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2019

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TCNA HANDBOOK



**FOR CERAMIC, GLASS, AND
STONE TILE INSTALLATION**

The Tile Council of North America (TCNA) is a trade association representing North American manufacturers of ceramic tile, tile installation materials, tile equipment, raw materials, and other tile-related products. Established in 1945 as the Tile Council of America (TCA), the Tile Council has a leadership role in facilitating the development of North American and international industry quality standards to benefit tile consumers. Additionally, the Tile Council regularly conducts independent research and product testing, works with regulatory, trade, and other government agencies, offers professional training, and publishes installation guidelines, tile standards, economic reports, and promotional literature.

Our member companies help sustain the publication of this document and other technical literature — look for the “Member of Tile Council of North America” logo on their products.

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Cover: The Nebraska State Capitol interior vestibule (exterior, inset). The theme of the vestibule is “Gifts of Nature to Man on the Plains,” with agricultural products of Nebraska depicted in the mosaic tile dome. Bertram Grosvenor Goodhue, architect; Lee Lawrie, sculptor; Hildreth Meiere, tile and mosaic designer; and Hartley B. Alexander, thematic consultant for inscription and symbolism. Photo by Art Whitton, artwhitton.com.

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TCNA HANDBOOK



FOR CERAMIC, GLASS, AND
STONE TILE INSTALLATION

2019

| Release Date January 2019
| Tile Council of North America

2019 TCNA HANDBOOK FOR CERAMIC, GLASS, AND STONE TILE INSTALLATION

The Tile Council of North America (TCNA) provides the *TCNA Handbook for Ceramic, Glass, and Stone Tile Installation* as a guide, not a product, to assist in clarifying and standardizing installation specifications for tile. Each installation method requires a properly designed, constructed, and prepared substructure using materials and construction techniques that meet nationally recognized material and construction standards.

The quick reference details cover most installation methods and conditions. However, some installation methods and materials are not recognized and may not be suitable in some geographical areas because of local trade practices, climatic conditions, or construction methods. Therefore, while the goal of the Conference for the *TCNA Handbook* is to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons. All specifications for tile installations must conform to local building codes, ordinances, and trade standards and practices.

The information presented herein represents a consensus of the national and regional organizations and individuals who serve on the Handbook Committee. The Committee considers revisions on a regular basis to present architects and specification writers with current, accurate recommendations.

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TECHNICAL CHANGES TO THE 2019 *TCNA HANDBOOK*

Changes to the *TCNA Handbook* are made at the discretion of TCNA Handbook Committee members serving on the committee when such changes are balloted; note that any given revision may or may not have been supported by any individual committee member. See the following page for committee roster as of September 2018.

Technical changes made to this 2019 edition of the *TCNA Handbook* are listed in the order in which they appear, with any global changes to standard (repeated) language listed according to the first appearance of the revised language. Editorial changes and clarifications are not listed.

Revised: Breaking Strength, Bond Strength, Crazing, Thermal Shock section, within the “Ceramic Tile Selection Guide”

Revised: Where relevant, “GLASS TILE” was added to the CAD drawings (editorial change)

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2019 | PRODUCT SELECTION GUIDES

CERAMIC TILE SELECTION GUIDE

[For natural stone tile, see “Natural Stone Tile Selection and Installation Guide”; for glass tile, see “Glass Tile Selection and Installation Guide.”]

Ceramic Tile Types

Ceramic tiles suitable for *TCNA Handbook* installation methods are those that meet the specifications outlined in ANSI A137.1 *American National Standard Specifications for Ceramic Tile*. ANSI A137.1 contains performance and aesthetic criteria for the five major types of ceramic tiles: porcelain, pressed floor, mosaic, quarry, and glazed wall tiles.

Porcelain tiles are ceramic tiles for floor and wall applications with a water absorption of 0.5% or less per the ASTM C373 test method and that are generally made by the pressed or extruded method. This category does not include materials with very little or no crystallinity, such as glass tiles. Tiles specifically warranted as porcelain by a manufacturer, and independently tested and confirmed to comply with this water absorption requirement, may be certified by the Porcelain Tile Certification Agency (PTCA).

Pressed floor tiles are ceramic tiles made by pressing, having a facial area equal to or greater than 9 square inches, and although specified by manufacturers as appropriate for floors, are also suitable for use on walls.

Ceramic mosaic tiles are tiles for floor and wall applications having a facial area less than 9 square inches, which are typically mounted on sheets or strips.

Quarry tiles are ceramic tiles for floor and wall applications made by the extrusion process from natural clay or shale.

Glazed wall tiles are nonvitreous ceramic tiles intended for interior use, and are not required nor expected to withstand excessive impact or exposure to freeze/thaw cycling. Tiles in this category are not intended for use on floors.

Water Absorption

Water absorption per the ASTM C373 test method is the determinative factor for whether a tile is considered to be impervious (absorption $\leq 0.5\%$), vitreous ($0.5\% < \text{absorption} \leq 3.0\%$), semivitreous ($3.0\% < \text{absorption} \leq 7.0\%$), or nonvitreous ($7.0\% < \text{absorption} \leq 20.0\%$).

- Porcelain tiles in compliance with ANSI A137.1 are impervious. Due to their low water absorption, bonding materials specifically appropriate for porcelain tiles are recommended.

- Pressed floor tiles in compliance with ANSI A137.1 may be vitreous, semivitreous, or nonvitreous.
- Mosaic tiles in compliance with ANSI A137.1 may be impervious, vitreous, semivitreous, or nonvitreous.
- Quarry tiles in compliance with ANSI A137.1 may be impervious, vitreous, or semivitreous with an absorption value up to 5.0%.
- Glazed wall tiles in compliance with ANSI A137.1 are nonvitreous.

Grade, Sampling, and Labeling

Grade: Standard grade tiles (also referenced as first grade) shall be in compliance with all testing criteria set forth in ANSI A137.1. Second grade tiles (marked as such by the tile manufacturer) shall be in compliance with all testing criteria set forth in ANSI A137.1, except that the evaluation for facial defects shall be performed from a distance of 10' instead of 3'.

Sampling: Evaluation of a shipment is made based on random sampling and acceptance numbers per ANSI/ASQ Z1.4-2003 (Normal Sampling Plan, Level 2) with an AQL of 2.5%. Table 2 in ANSI A137.1 provides the number of allowable defective tiles per sample with acceptance criteria applied separately for each characteristic under test.

Labeling: All tiles in compliance with ANSI A137.1 shall be shipped in sealed packages with the claim of grade, type of tile, producer identification, and country of origin clearly indicated.

Aesthetic Classifications

Tiles may vary in color, texture, or appearance according to the manufacturer's design for that particular tile series or product line. The following designations classify the range of such variation.

V0 tiles are very uniform in appearance and smooth in texture. When measured by a colorimetric spectrophotometer, they have an overall color difference (delta E) of less than 3 Judds.

V1 tiles have a generally uniform appearance with minimal production run differences among pieces. Some color differences can be observed.

V2 tiles are similarly colored with variations in texture and/or pattern, which are clearly distinguishable.

V3 tiles are moderately variant, and although the colors and/or textures present on a single piece are indicative of the colors and/or textures on another, the amount of colors and/or textures on each piece may vary significantly. It is recommended that the range be viewed before selection and that a mock layout be made.

V4 tiles are substantially variant with random color and/or texture differences from tile to tile, where one tile may have totally different colors and/or textures from another. Because a final installation with V4 tiles will be unique, it is recommended that the range be viewed before selection and that a mock layout be made.

Although checking the range of color and texture for V3 and V4 tiles is specifically recommended, all of the categories above have some range and should be checked and generally installed from several boxes in random fashion to avoid aesthetic issues.

Abrasion Resistance

ANSI A137.1 specifies two test methods for determining abrasion resistance, one for unglazed tiles and the other for glazed tiles.

Unglazed tiles are tested for deep abrasion resistance by test method ASTM C1243, in which tiles are quantitatively evaluated for material loss after being subjected to an abrasive disk. For an unglazed tile, the total material loss from abrasion must be below a specified maximum. The maximum value depends on whether the tile was pressed or extruded and its water absorption category: impervious, vitreous, semivitreous, or nonvitreous.

Glazed tiles are tested for visible abrasion resistance by test method ASTM C1027 in which the tiles are qualitatively evaluated and categorized based on visually noticeable changes in gloss or color following increasing cycles of abrasion. Although many products are tested per this methodology, it should be noted that the following limitations are referenced in ASTM C1027:

- Certain irregular surfaces may not be evaluated properly by the test method because of wear patterns that will occur on the high spots of the tile.
- The procedure does not make provisions for the apparent difference in abrasion values between light and dark colored glazed tiles.
- The procedure does not optimally evaluate loss of gloss with abrasion.

Although a complete explanation of these qualifiers requires an in-depth understanding of the method, it is sufficient to note that with the evolution of more sophisticated glazes, and the increased durability of such, it has been observed that the test method does not appropriately characterize the real world performance of some glazed tiles, especially glazed porcelain. Where information is desired regarding the wear characteristics of such tiles, it is recommended that the manufacturer be contacted directly.

Dimensional Consistency

Tiles in compliance with ANSI A137.1 shall meet the specified criteria for facial dimensions, thickness, warpage, and wedging. Facial dimension criteria specify the maximum allowable variation in size and deviation from the manufacturer-specified nominal size. Thickness criteria specify the acceptable range of thickness variation. Warpage criteria establish allowable deviation from planarity of a tile's surface, and wedging criteria define the allowable extent tiles can be out-of-square.

Tiles may be rectified (mechanically finished along their edges to achieve more precise facial dimensions), calibrated (sorted to meet a specified caliber range), or "natural" (packaged directly after manufacturing with no rectification or sorting). Depending on the type of tile, dimensional criteria may be given for one, two, or all three categories as detailed in A137.1 Tables 6–10.

See "Grout Joint Size, Layouts, and Patterns" for related information.

Breaking Strength, Bond Strength, Crazing, Thermal Shock

Tiles in compliance with ANSI A137.1 shall have an average breaking strength equal to or greater than 275 lbf for porcelain and quarry tile, 250 lbf for pressed floor and mosaic tiles, and 125 lbf for glazed wall tiles.

When tested per ASTM C482, they shall exhibit a bond strength of at least 50 psi and demonstrate no evidence of crazing when tested per ASTM C424 and no evidence of thermal shock when tested per ASTM C484.

Freeze/Thaw Cycling

When tiles will be used in an environment subject to freeze/thaw cycling, testing per ASTM C1026 can be required to evaluate their potential performance under such conditions.

Coefficient of Friction and the DCOF AcuTest®

Coefficient of friction (COF) is the measurement of a tile's frictional resistance, closely related to traction and slipperiness. The method for measuring the COF of ceramic tile floors changed in 2012, after years of research and with the approval of the accredited national consensus body (ASC A108) responsible for ANSI A137.1, the *American National Standard Specifications for Ceramic Tile*. Previously, COF was determined per the ASTM C1028 method from a measurement of static friction, which is the frictional resistance one pushes against when starting in motion. The new method, known as the **DCOF AcuTest**,* measures dynamic friction, which is the frictional resistance one pushes against when already in motion. For both static coefficient of friction (SCOF) and dynamic coefficient of friction (DCOF), a slip occurs when pushing off with more force than the surface can resist.

In addition to mandating the switch from SCOF to DCOF, the standard now requires a minimum wet **DCOF AcuTest** value of 0.42 for ceramic tiles for level interior spaces expected to be walked upon when wet. According to the standard, tiles with a wet **DCOF AcuTest** value of less than 0.42 are only suitable for floor areas that will be kept dry. Polished tiles generally fall into this category.

Previously, there was no required value in ANSI A137.1 for wet floors (static or dynamic), although a minimum value of 0.6 wet SCOF, measured by ASTM C1028, was commonly specified for ceramic tile in commercial spaces for many years. The new required value stems from extensive research in Europe and at TCNA. Researchers at the University of Wuppertal in Germany studied human

subjects walking on force plates to find the relationship between the tangential force and the vertical force needed for reliable traction (this relationship defines the coefficient of friction and has been widely studied in the US and in Europe). They then considered many different slippery conditions, different ways people could move on a surface, and accident statistics over many years to recommend to the German national insurance body a minimum wet DCOF value of 0.42 for flooring.¹

In various studies at TCNA, including a study of over 300 tile surfaces,² TCNA researchers found that 0.60 wet SCOF could be correlated on average with 0.38 wet DCOF.

Considering both the TCNA research and the years of research in Europe, the ANSI A108 Accredited Standards Committee decided to include an additional measure of safety over the widely used ASTM C1028 wet SCOF value of 0.60. They revised ANSI A137.1 to include a threshold minimum wet **DCOF AcuTest** value of 0.42 for level interior spaces expected to be walked upon when wet.

Not all tiles, though, with a wet **DCOF AcuTest** value equal to or greater than 0.42 are suitable for all level interior spaces. The specifier shall determine tiles appropriate for specific project conditions, considering by way of example, but not in limitation, type of use, traffic, drainage, how the tiles are profiled or structured, expected contaminants, expected maintenance, expected wear, and manufacturers' guidelines and recommendations.

Refer to Section 6.2.2.1.10 of ANSI A137.1 for further explanation and detail.

* DCOF AcuTest is the industry designation for the test procedure contained in ANSI A137.1 Section 9.6, which has been extensively researched, allows for in-situ field measurements, and is in use at tile manufacturing facilities. It was so named to distinguish it from other DCOF measurements using different instruments and/or protocols.

¹ The German research considered was extensive and can be found in the following publications: (1) Boenig, Stefan. Experimental Investigation to Determine the Standardized Limits of the Coefficient of Friction When Walking (Archive Number D468), University of Wuppertal Department of Safety Technology, 1996. (2) Skiba, Reinald. (1988). Sicherheitsgrenzwerte zur Vermeidung des Ausgleitens auf Fuessboeden, Zeitschrift fuer Arbeitswissenschaft (Journal of Occupational Science),

42, 47-51. (3) BGI/GUV-I 8687, 2011, "Bewertung der Rutschgefahr unter Betriebsbedingungen," German National Institute for Social Accident Insurance (DGUV). (4) Sebal, Jens. (2009). System oriented concept for testing and assessment of the slip resistance of safety, protective and occupational footwear. Berlin: Pro BUSINESS GmbH.

² While the 300 surfaces chosen were selected to represent a wide spectrum of tile surfaces, no claim is made or offered that this represented the entire spectrum of available tile surfaces nor can any inference be made regarding any individual tile surface. ASTM C1028 SCOF measurements and DCOF AcuTest® measurements cannot be directly compared or correlated on a per tile basis as different sensors, test conditions, and measurement physics are employed.

Stain and Chemical Resistance

While stain and chemical resistance are not required, ceramic tiles generally perform very well in these categories. Testing for stain resistance is performed per ASTM C1378 and testing for chemical resistance is performed per ASTM C650. Depending on the number of stains or chemicals that affect the surface, the tiles are classified from A (no effect) to E, where 4 or more stains or chemicals affected the tile.

Trim Units

Trim units are specified in ANSI A137.1, including line drawings and nomenclature for the 50 most common types.

Mounted Tile

Mounted tile is assembled into units or sheets by suitable material to facilitate handling and installation. Mounted tile assemblies shall have sufficient exposure to bonding surfaces of the tile body to allow for 80% coverage of the bond mortar in dry areas and 95% in wet areas. Tile manufacturers must specify whether their assemblies are suitable for installation in swimming pools, on exteriors, and in other wet areas. Paper back-mounted mosaics are not recommended in wet areas.

Back-mounted and edge-mounted tile assemblies may have perforated paper, fiber mesh, resin, polyurethane, or other bonding material on the back or edges of each tile, which becomes an integral part of the tile installation. Clear film-faced tile is assembled with clear plastic adhesive film on the face, which is removed after final set has occurred. Paper-faced tile has paper applied to the face of the tile with water-soluble adhesives, which should be removed during the installation process by wetting and removing the paper, followed by adjusting the tile prior to its final set.

Specialty Tile

Specialty tiles are designed to meet special physical requirements or to have special appearance characteristics. They are not required to meet all requirements of ANSI A137.1. Consult the manufacturer's specifications. They are sometimes manufactured to create an architectural effect toward the casual. These tiles vary in size, one tile from the other. Variations in plane may be expected. Larger tiles will usually require greater variations in joint width. For each specialty tile being chosen, review installation guidelines supplied by manufacturer/distributor of specialty tiles and/or adhesive manufacturer. Specialty tiles include, but are not limited to, tiles made from nonceramic materials.

GLASS TILE SELECTION AND INSTALLATION GUIDE

TCNA Handbook installation methods that can be used for installing glass tile have glass tile listed in the Materials section of the method. Suitable glass tiles are those that meet the specifications outlined in ANSI A137.2 *American National Standard Specifications for Glass Tile*.

Glass Tile Types

Based on temperature of formation, there are three types of glass tile: cast, fused, and low-temperature-coated. Each type is further categorized, based on size, as: large format, mosaic, or miniature mosaic. Fused and low-temperature-coated glass tiles with any edge longer than 24" and cast glass tiles with any edge longer than 12" are defined as glass panels and are not covered by A137.2 or this *Handbook*.

Cast glass tiles are formed in a liquid state at 1600°F or higher. Many cast glass tiles are wavy and slightly textured, with inherent folds, bubbles, and creases. These unique characteristics are achieved through the casting process.

Fused glass tiles are typically made from sheet glass units that are altered through heat between 1023°F and 1599°F. During manufacturing, different materials and glazes are fused to the sheet glass units, usually in multiple stages, to create a variety of colors and patterns. Fused glass tiles can be smooth, textured, uniform, or nonuniform.

Low-temperature-coated glass tiles are made from sheet glass units that are altered through heat at temperatures less than 1022°F. Typically, these alterations involve heat transference of coatings to the back of transparent sheet glass units. These coatings can contain wide varieties of colors and patterns.

Aesthetic Properties and Considerations

Dimensional Requirements

Glass tiles must meet the criteria for facial dimensions, thickness, warpage, and wedging found in A137.2 Tables 5–7. Facial dimension criteria specify the maximum allowable variation in size and deviation from the manufacturer-specified nominal size. Thickness criteria specify the acceptable range of thickness variation. Warpage criteria establish allowable deviation from planarity of a tile's surface, and wedging criteria define the allowable amount that tiles can be out-of-square.

Glass tiles may be classified by the manufacturer as standard or natural. For the purposes of specifying glass tile, standard glass tiles are those that are manufactured to meet specific sizing tolerances, and natural glass tiles are those that are manufactured with inherent variation

and thus not held to specific sizing tolerances. (The term natural, when used to reference a type of glass tile, is not associated with sustainability criteria.)

Aesthetic Classes

Glass tiles may vary in color, texture, or appearance according to the manufacturer's design for a particular tile series or product line. The tile manufacturer uses aesthetic classes V0–V4 to indicate the amount of variation that will be present in the tile. Although checking the range of color and texture for V3 and V4 tiles is specifically recommended, all categories have some range and should be checked and generally installed from several boxes in random fashion to avoid aesthetic issues.

V0 tiles are very uniform in appearance and smooth in texture. They can be measured for small color differences, and conform to manufacturer-reported limits.

V1 tiles have a generally uniform appearance with minimal production run differences among pieces. Some color differences can be observed.

V2 tiles are similarly colored with variations in texture and/or pattern, which are clearly distinguishable.

V3 tiles are moderately variant, and although the colors and/or textures present on a single piece are indicative of the colors and/or textures on another, the amount of colors and/or textures on each piece may vary significantly. It is recommended that the range be viewed before selection and that a mock layout be made.

V4 tiles are substantially variant with random color and/or texture differences from tile to tile, where one tile may have totally different colors and/or textures from another. Because a final installation with V4 tiles will be unique, it is recommended that the range be viewed before selection and that a mock layout be made.

Translucence and Opacity

Opaque glass tiles are defined in ANSI A137.2 as those with an opacity percentage greater than or equal to 95 when tested per section 7.5. Translucent glass tiles are defined as those with an opacity percentage less than 95.

With translucent glass tiles, setting material color consistency and full mortar coverage are essential; white mortar is commonly recommended. Avoid using setting materials from different production batches and check for bag-to-bag color consistency. To achieve uniform coverage on the back of translucent glass tile, back-buttering and/or flattening the trowel ridges is recommended. Regardless of

installation technique, mesh backing on translucent tiles may be visible after installation.

Bonding translucent glass tiles directly to membranes or other impervious surfaces is not recommended because any moisture trapped between the tile and membrane would be visible. Membranes should be placed behind or below the tile setting substrate where translucent glass tile will be installed. Select only opaque glass tile if the tile will be bonded to a membrane.

For translucent, shaped pieces (v-cap, quarter round, crown caps, etc.), follow manufacturer recommendations on back-buttering and whether (and how) to fill the cavity. Excess setting material can shrink and cause cracking or ghosting, a slight visible separation of the mortar from the glass tile.

When grouting translucent glass tile, grout joints must be filled uniformly and consistently, as spaces and voids can be visible.

Determination of Aesthetic Defects

Because of the difference in appearance of each glass tile type, resulting from the different methods of manufacture, ANSI A137.2 outlines separate aesthetic criteria for each glass tile type with regard to aesthetic defects. The casting process produces inherent and unique appearance characteristics, such as bubbles below the tile surface, which are not considered defects, as they do not affect the integrity of the tile. In fact, cast glass tiles are typically selected when a less-uniform appearance is desired. At the same time, a bubble at the surface of the tile could leave a chipped or sharp edge and is considered a defect. Fused and low-temperature-coated glass tiles generally have a more uniform appearance and thus, different criteria for determining aesthetic defects. See ANSI A137.2 Section 7 for evaluation procedure and criteria for determining aesthetic defects.

Performance Requirements

Abrasion resistance: Glass tiles are tested for abrasion resistance per ASTM C1027 and categorized based on changes in gloss or color following increasing cycles of abrasion. Visible abrasion classifications range from 0, for tiles not recommended for use on floors, to V, for tiles that can withstand heavy commercial wear. Generally, glass tile is less resistant to abrasion than ceramic tile; select glass tile suitable for expected traffic.

Freeze/thaw cycling resistance: Glass tiles must pass freeze/thaw cycling resistance testing per ASTM C1026.

Crazing: Glass tiles must pass ASTM C424 test for crazing.

Thermal shock resistance: Glass tiles (except those intended for dry interior wall applications) must pass thermal shock cycling when tested per ANSI A137.2 Section 7.9. Glass tile is more sensitive than ceramic tile to thermal shock, and may not be suitable for applications where an instantaneous temperature change of more than 100°F is likely. Consult glass tile manufacturer/distributor for specific written recommendations.

Thermal expansion: Thermal expansion is addressed in A137.2 on an “as reported” basis. Glass tile expands more, when heated, than ceramic tile. Consult manufacturer for minimum distance of the tile from direct heat sources (fireplaces, stoves, etc.).

Static coefficient of friction: When static coefficient of friction (SCOF) data are required for a specific project, testing shall conform to ASTM C1028. However, because area of use and maintenance by the owner of installed tile directly affect coefficient of friction, the SCOF of the manufactured product shall be as agreed upon by manufacturer and purchaser. Water, especially standing water, oil, grease, etc., create slippery conditions. Floor applications with exposure to these elements require extra maintenance and caution in product selection.

Stain and chemical resistance: While stain and chemical resistance are only required on an “as reported” basis in A137.2, glass tiles are generally resistant to a wide range of common chemicals and staining agents. Testing for stain resistance is performed per ASTM C1378 and testing for chemical resistance is performed per ASTM C650. Depending on the number of stains or chemicals that affect the surface, the tiles are classified from A (no effect) to E, where 4 or more stains or chemicals affected the tile. Consult manufacturer for specific chemical exposure recommendations, such as those used in pools and fountains, as applicable.

Breaking strength/modulus of rupture/compressive strength: Since differently sized tiles respond to loading in different ways, ANSI A137.2 assesses glass tile strength through different test methods for each size category. Large format glass tiles must meet modulus of rupture (MOR) criteria; mosaic glass tiles must meet point load criteria; and miniature mosaic glass tiles must meet compressive strength criteria.

Bond strength: Glass tiles must facilitate bond strength greater than or equal to 150 psi when tested in a dry condition and 100 psi when tested in a submerged condition.

Mounting: Glass tiles are generally sold and installed as mounted assemblies, and whether they are back-mounted or face-mounted is important. Some tiles with re-emulsifiable glues and/or insufficient contact area between the tile backing and mortar, can delaminate in submerged applications. It is recommended that glass tiles intended for submerged applications be face-mounted to prevent problems stemming from improper coverage or backing material failure. For back-mounted and edge-mounted products, manufacturers must clearly state for which areas their mounted tiles are suitable.

Grade, Sampling, and Labeling

Standard grade (or first grade) glass tiles must conform to all testing criteria set forth in ANSI A137.2. Conformance of a shipment is based on sampling and acceptance numbers per ANSI/ASQ Z1.4-2003 (Normal Sampling Plan, Level 2) with an AQL of 2.5%. Table 1 in ANSI A137.2 provides the number of allowable defective tiles per sample, with acceptance criteria applied separately for each characteristic under test. Glass tiles in conformance with ANSI A137.2 must be shipped in sealed packages with the claim of grade, tile type, producer identification, and country of origin clearly marked.

Installation Considerations

Substrates

Although the substrates recommended for glass tile installations are similar to ceramic tile installations, extra attention should be given to substrate stability, rigidity, and preparation. Substrates should be sufficiently flat to allow uniform coverage and avoid excessive mortar thickness. Glass tile should not be installed on single-float (one coat) mortar bed walls framed with wood or metal, and glass tile should never be bonded directly to wood substrates. For above-ground slabs, reinforced mortar beds may be required, especially for large-format glass tile. Some manufacturers require mortar bed substrates be cured a minimum of 7 days prior to glass tile installation.

Glass tile is generally more vulnerable to crack propagation than ceramic tile. Where opacity allows (see Translucence and Opacity) the glass tile manufacturer may recommend use of an ANSI A118.12 crack isolation membrane for large format glass tiles.

Setting Materials

Mortars specifically formulated or recommended for glass tile must be used. Some glass tile manufacturers require use of a specific mortar. When installed over an impervious substrate, setting materials may take longer to cure.

Some low-temperature-coated glass tiles are not intended for installation with cementitious materials, as cement mortar alkalinity may deteriorate the low-temperature-applied tile backing and cause delamination, particularly in wet or humid environments. Tiles that cannot be installed with cementitious mortars do not meet ANSI A137.2 and are not covered by this *Handbook*.

Grouting

Grout recommendations for glass tile vary based on aesthetics and joint size. While some glass tile manufacturers specify unsanded grout to prevent scratching, others require sanded grout. Because glass tile is impervious, additional setting time may be necessary to allow the grout to firm prior to cleaning. Manufacturer recommendations vary with regard to whether or not the use of epoxy grout is acceptable.

Movement Joints

Because glass tile expands more than ceramic tile, more movement accommodation is necessary. Also consult tile manufacturer for minimum distance from a direct heat source (fireplace, stove, etc.).

NATURAL STONE TILE SELECTION AND INSTALLATION GUIDE

This guide addresses natural stone tiles that are adhered to a substrate. Natural stone tile, also called dimension stone, is stone that has been harvested from its in-situ position in the Earth and cut and machined into tiles without altering the natural fabric of the material. Dimension stone tile has a nominal thickness of less than 3/4" (19 mm) and does not have any facial dimension greater than 2' (610 mm). Agglomerates and other engineered products do not meet this definition and therefore are excluded. Natural stone tiles that meet the definition but not the dimensional requirements are also excluded.

Stone tiles are generally supplied in a gauged, or calibrated, thickness, which generally has a tolerance of $\pm 1/32$ " (± 0.8 mm) in thickness. Tolerances on face sizes will generally be $\pm 1/16$ " (± 1.5 mm), with some tiles available in tighter tolerances.

General

The success of any stone installation requires consideration of the stone's specific properties and how they affect its use as a building material. When dealing with most other construction products, a different color material is only different visually, whereas in natural stones a change in color is a change to a different species of stone with different behavior and performance. This is because every stone is comprised of a variety of minerals that give the stone its behavior and performance in addition to its appearance. The mode of formation, or genesis, of a stone also can be a factor.

Stones, referred to as "rocks" by Earth scientists, are formed by three different methods. Sedimentary rocks are formed by clasts, or particles that settle and are then cemented together by another agent. Limestone, sandstone, travertine, and onyx are examples of sedimentary rock. Metamorphic stones are those that have undergone a change in composition resulting from intense heat and pressure, typically, a crystallization or recrystallization of the original rock fabric. Marble, slate, serpentine, quartzite, gneiss, and soapstone are examples of metamorphic rocks or stones. Igneous stones are formed by solidification, by cooling of molten or semimolten material. Igneous materials can be intrusive, meaning they cooled below the Earth's surface, or extrusive, meaning they cooled above ground. Granite and basalt are examples of igneous rocks or stones.

Of equal importance to the method of formation is the primary chemical makeup of the stone—they are either calcareous or siliceous. Calcareous rocks, such as marble, travertine, and limestone, are made up primarily of calcium

carbonate mineralogy. Because calcium carbonate, or the calcite crystal, can be attacked by relatively mild acids, such stones are predictably vulnerable in acidic environments.

Siliceous rocks are made up primarily of silicates, such as quartz and feldspar. Quartz-based sandstone and granite are examples of siliceous rocks.

	Sedimentary	Metamorphic	Igneous
Calcareous	Onyx Travertine Limestone	Marble	
Siliceous	Sandstone	Slate Serpentine Quartzite Soapstone	Granite

Some generalizations can be made from the table above. Moving from left to right, from sedimentary to igneous, the stone will be more dense and thus have higher abrasion resistance and lower absorption. Moving from top to bottom in the table, from calcareous to siliceous, the chemical resistance of the material, particularly resistance to acids, will increase. For more information on the geology of the various dimension stone types, refer to the *Dimension Stone Design Manual* published by the Natural Stone Institute (NSI).

Applicable Standards

Dimension stone products are governed by the following ASTM standards, test methods, and guides. Some of these were drafted for standardization of anchored veneer applications and do not wholly apply to tile and/or adhered systems.

ASTM C97	Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
ASTM C99	Test Method for Modulus of Rupture of Dimension Stone
ASTM C119	Terminology Relating to Dimension Stone
ASTM C170	Test Method for Compressive Strength of Dimension Stone

ASTM C503	Specification for Marble Dimension Stone
ASTM C568	Specification for Limestone Dimension Stone
ASTM C615	Specification for Granite Dimension Stone
ASTM C616	Specification for Quartz-Based Dimension Stone
ASTM C629	Specification for Slate Dimension Stone
ASTM C880	Test Method for Flexural Strength of Dimension Stone
ASTM C1201	Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
ASTM C1353	Test Method Using the Taber Abraser for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic
ASTM C1354	Test Method for Strength of Individual Stone Anchorages in Dimension Stone
ASTM C1496	Standard Guide for Assessment and Maintenance of Exterior Dimension Stone Masonry Walls and Façades
ASTM C1515	Standard Guide for Cleaning of Exterior Dimension Stone, Vertical and Horizontal Surfaces, New or Existing
ASTM C1526	Specification for Serpentine Dimension Stone
ASTM C1527	Specification for Travertine Dimension Stone
ASTM C1528	Standard Guide for Selection of Dimension Stone

References for Further Reading

Dimension Stone Design Manual, published by the Natural Stone Institute (NSI)

ANSI American National Standard Specifications for the Installation of Ceramic Tile, published by the Tile Council of North America (TCNA)

NTCA Reference Manual, published by the National Tile Contractors Association (NTCA)

Considerations When Selecting Natural Stone Tile

Water-Sensitivity

Many green-colored marbles and serpentines warp, or curl, when exposed to water or a water-based adhesive such as a cementitious mortar. To avoid having stones warp from the moisture in such setting materials, an epoxy adhesive bond coat, which does not contain water, may be required. Because some green marbles and serpentines do not warp, or only mildly exhibit this behavior, research is encouraged on the particular stone species selected. Some can be successfully installed with water-based portland cement mortars. For stones that are mildly water-sensitive, consider mixing the mortar with reduced water volumes as allowed by the mortar manufacturer or wetting the exposed surface of the tiles after installation to provide balanced saturation levels on both surfaces. There are a few stones other than green marbles or serpentines that will warp with unbalanced water exposures, so research is encouraged on any particular stone with which one has no direct experience.

Fiberglass Mesh Reinforced Stone

Many stone products have a mesh reinforcement adhered to the back surface of the tile. The adhesive used to attach the mesh is not standardized, but is commonly an epoxy or polyester-based adhesive that portland cement mortars will not reliably bond to. Such reinforced stone tiles require epoxy bonding mortar.

Filled Voids in Travertine

Travertine typically has voids, or holes, which are commonly filled at the fabrication site with cementitious or resinous filler. Travertine can be supplied in a vein cut, where the slab is sawn perpendicular to the bedding planes to expose the veined character, or in a fleuri cut, also called crosscut, where the slab is sawn parallel to the bedding planes to yield a random, flowery appearance. Particularly for fleuri cut tiles, many voids can exist just below the finished surface, concealed only by a slight shell of stone material. This concealment prevents detection and filling of the voids in the factory. Once in service, a concentrated load or point load will fracture the thin shell of stone, exposing the void below. High-heeled shoes and wheeled carts are examples of common causes of this occurrence, and maintenance to fill voids as they appear over time will be required when such stones are used.

Pinholes in Marble

On a much smaller scale than the voids found in travertine, many marbles have pinholes visible in the face of the material. Frequency can be as high as 100 or more per

square foot. This is not considered a defect, but rather a natural characteristic of the material. Proper sampling is required to be aware of these occurrences prior to commencing with installation.

Viewing/Inspection Distance

As products of nature, dimension stones will have inherent characteristics that may be considered objectionable to some viewers. Inspection of the material should be done at reasonable distances, similar to how the material is viewed by building occupants. It is recommended that samples, range samples, mockups, and finished work be viewed for inspection at a distance of 6½' from a position normal (perpendicular) to the stone face, and with natural lighting. Lighting of reduced angles of incidence, for instance downwashed lights, can accentuate lippage and warpage that is within industry tolerances. Such lighting should be turned off for inspection purposes. See also "Flatness and Lippage."

Variation of Abrasion Resistance in Patterned Floors

When two or more stone species are used together in a floor pattern, it is possible to have different rates of wear when the materials have different resistance to abrasion. If any of the materials have an abrasion resistance less than 20.0 when tested per ASTM C241 or C1353, the difference between the abrasion resistance of any two stones being used together should not differ in abrasion resistance by more than 5.0.

Acid Sensitivity

Stones resistant to acid are required where acid exposure is likely. Most notably, calcium carbonate and calcite-based stones will react to relatively mild acids like lemon juice, vinegar, and cut tomatoes. The result is not a stain, which could be removed, but an etching of the stone surface, which cannot be removed without refinishing the stone. Acid attack of polished stones will usually manifest itself as a dull spot within the surrounding glossy surface.

Anisotropy

An anisotropic material is one that has different physical or visual properties in different directions. Most stones, particularly sedimentary stones, have some degree of anisotropy. Therefore, it is common that they will have a strong axis and a weak axis. Attention must be paid to this feature, particularly when reviewing test results, to ensure that the direction tested is the same as the direction used.

Delamination

"Rift" is the direction along which a stone is most easily split, and many stone varieties have pronounced bedding planes, along which a predetermined rift exists. Bedding planes can be a region of weakness, and some stones, particularly sandstones and some slates, will spall or delaminate along bedding plane boundaries after installation. Delamination is when a portion of the stone separates from the rest of the stone—typically the surface dislodges from the bottom, which remains bonded in place. Differential mineral expansion due to weathering and thermal cycles accelerate this occurrence, and freeze/thaw cycling is an additional factor. Additionally, floor traffic can cause spalling and delamination. Delamination is not related to any failure in adhesive; and research is required to verify the adequacy of stones with bedding planes for the intended application.

Shading and Variation

As products of nature, dimension stone will have inherent variation in color, shade, and character, including markings and veining, throughout any given lot of material. Variations from piece to piece are characteristic of the material and acceptable. Because of this variation, several pieces should be supplied as a sample, and because the material from a quarry can change over time, ensure samples are current before they are specified. Depending on the stone, it may be impossible for samples to represent all possible variations in color and character. Variations can be greater than or less than what is expressed by the sample pieces. The range of stones actually supplied should be reviewed and accepted prior to their installation. Dry laying pieces before installation helps ensure a pleasing blend of the tiles prior to permanently installing them, but is not always feasible, nor is doing so required unless specified in writing by the project superintendent or owner.

For viewing and installation, it is recommended that the material be blended from multiple packaging units to distribute the variation throughout the project and to avoid a blocking effect, where an area of one shade is distinctly bordered or surrounded by a different shade. For larger projects, it may not be feasible to view pieces from the full lot being supplied for the project. The project superintendent shall coordinate with the tile contractor to determine initial and subsequent viewing and acceptance procedures. As the owner's representative on the jobsite, the superintendent is responsible for checking the installation as it progresses and identifying shading issues immediately. If the superintendent does not initiate such

procedures, the contractor is responsible for blending tiles, but not for future issues arising over shade differences or individual stone pieces supplied. Distributors and suppliers typically will not address issues of shade variation and acceptability after installation.

Ensure adequate quantities are ordered, including requirements for waste, breakage, and attic stock. While some stone deposits are uniform through hundreds of feet of depth times vast lateral distances, there are also quarries where the inter-block, and even intra-block variability are so great that a given lot of material cannot be matched one month later.

Soundness of Marbles

Marbles are classified according to soundness based on the level of repair or reinforcement commonly required to facilitate their use. The soundness classifications A, B, C, and D are in descending order of soundness and ascending order of reinforcement and/or repair requirements. These classifications have no bearing on the commercial value of the stone. The lesser soundness classifications of C and D include many of the aesthetically prized, decorative marbles. However, these stones typically have too much repair or reinforcement to be used in wet or exterior areas. For more information about marble soundness, refer to the MIA's *Dimension Stone Design Manual*.

Efflorescence

Efflorescence results from migration of soluble salts originating from soils or masonry. These salts are carried to the surface where the water evaporates, leaving a white residue. Natural stones are not generally the source of efflorescence; however, they can sometimes provide efficient paths for the migration. In some high-porosity or open-veined stone varieties, efflorescence can travel through the stone tile in addition to traveling through the grout joint. Cleaning the salt deposit is generally easy and mechanical methods such as brushing are usually effective, but this only removes the symptom. The efflorescence will reoccur unless the source (water infiltration) can be eliminated.

Water Spots

Differing water chemistries may spot a given stone, which is generally most visible on dark, polished stones. This deposit will be on the surface of the stone, and can normally be removed mechanically by buffing with #000 steel wool, but in some cases requires buffing with a polishing powder.

Stone Finishes

A variety of standard stone finishes are available as well as some proprietary finishes. Only textured finishes are

recommended for outdoor or wet area applications, for pedestrian safety. While the texture enhances the safety aspect of the walking surface, it may complicate the maintenance by requiring brushes for cleaning, as soft mops may snag by some of the sharper profile finishes. For more information on stone finishes, refer to ASTM C119 Standard Nomenclature for Dimension Stone and the MIA's *Dimension Stone Design Manual*.

Iron Staining

Some stones, slates in particular, contain soluble iron that can cause "bleeding" if installed in a wet area. The use of a sealer will not prevent this from occurring. Yellowing of light-colored marbles may also be due to iron oxide.

Mohs Scale of Relative Hardness

The Mohs scale of relative hardness is based on 10 minerals. Mohs scale is one of relative hardness, not absolute hardness, meaning it is not linear. By example, orthoclase is harder than apatite, which is harder than fluorite, which is harder than calcite. However, orthoclase is not twice as hard as calcite even though 3 doubled is 6. For perspective, a human fingernail would be about 2.5 on the Mohs scale, gold and silver would be 2.5 to 3, a copper penny would be about 3.5, an iron nail would be about 4, window glass would be about 5.5, and aluminum oxide abrasive would be about 8.

Mohs Scale of Relative Hardness	
Hardness	Mineral
1	Talc or Mica
2	Gypsum
3	Calcite
4	Fluorite
5	Apatite
6	Orthoclase
7	Quartz
8	Topaz
9	Corundum
10	Diamond

Considerations When Selecting Installation Materials

Staining

Light-colored marbles and nearly all onyx and limestone must be installed with white mortars due to their susceptibility to staining from the grey portland cement components in grey bonding mortars.

Although silicone itself does not stain natural stone, silicone sealants can contain plasticizers that can wick into the stone and stain it. This is more problematic for higher-porosity stones, but can occur in dense stones as well. Some silicone manufacturers keep a database of projects where their sealants have been used with various species of stones so compatibility can be verified. In the absence of an exemplar project to view, compatibility can be verified via accelerated laboratory testing.

The use of dyes in grouts, epoxies, polyesters, and any other joint fillers should always be tested to verify that the dyes will not leach into the stone, causing a “picture frame” stain. This is most common when using materials of contrasting color, although dyes of matching color can also cause staining.

Sanded and Unsanded Grout

The sand in sanded grout is generally harder than any of the calcium-carbonate-based stones, such as limestone, travertine, marbles, and onyx. Masking the stone surface or the use of unsanded grout should be considered to avoid scratching the surface finish. This is particularly true of these stones when polished. If unsanded grout is required, the grout joint must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

Impregnators

It is a common, although not universal, practice to treat natural stone installations with impregnating repellants, often referred to as sealers, although this is a misnomer. The products typically used on natural stones are not truly sealers, in that they are formulated to allow the transmission of vapor, which maintains the breathability of the stone. The use of some impregnators with a particular stone species may create an undesirable color alteration, typically darkening. There are also products marketed as “color enhancers,” which are intentionally formulated to darken colors and accentuate natural veining and character of the stone.

SETTING MATERIALS SELECTION GUIDE

Note

Specifications in this *Handbook* for the materials used to adhere ceramic, glass, and stone tile have been developed according to the requirements and procedures of two standards-setting bodies: the American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). These standards were developed with differing criteria and do not correlate with each other; they cannot be cross-referenced or used interchangeably. Both sets of standards are in widespread and common use in North America. Accordingly, each installation method in this *Handbook* provides setting material specifications according to both sets of standards where applicable. For complete material properties and requirements, refer to the applicable ANSI or ISO standard or "Appendix A."

Introduction

The following are the most widely used materials for setting ceramic, glass, and natural stone tiles. Each possesses specific qualities that make it suitable for installing tile over certain backings or under a given set of conditions.

The conventional portland cement mortar method, including the one coat method, is the only recognized thick-bed method. All others are thin-bed methods and are covered by existing trade jurisdictional decisions of record. Dry-set mortars and latex-portland cement mortars can be used in lieu of neat cement as a $\frac{1}{16}$ "-thick bond coat to bond ceramic, glass, and natural stone tiles to a portland cement mortar bed that is still workable. They can also be used on a cured portland cement mortar bed (minimum $\frac{3}{32}$ " thickness after tile is embedded) according to ANSI A108.1B.

A neat cement bond coat can be used only when the portland cement mortar is still workable (A108.1A). Absorptive ceramic and stone tiles must be soaked before setting on a mortar bed that is still workable when using a neat portland cement bond coat. Under normal job conditions, a minimum of 20 hours cure at 70°F is adequate, but longer mortar bed cures of up to 10 days are desirable. When epoxy mortars, epoxy adhesives, furan, or organic adhesives are used, the mortar bed must be dry.

To ensure practical and satisfactory installations, the cement mortar bed to receive the tile, whether left workable or allowed to harden, is to be applied by the tile contractor who must establish all the finished dimensions at the time this bed is applied.

Noncement setting materials such as epoxies and furans offer properties not possible with cement-based mortar

(e.g., chemical resistance, quick setting times). However, special skills on the part of the tile setter may be required.

Neat Cement and Portland Cement Mortar

Portland cement mortar is a mixture of portland cement and sand, roughly in proportions of 1:5 for floors, and of portland cement, sand, and lime, in proportions of 1:5:½ to 1:7:1 for walls.

Portland cement mortar is suitable for most surfaces and ordinary types of installation. A mortar bed, up to 2" in thickness, facilitates accurate slopes or planes in the finished tilework on floors and walls.

The mortar bed can be modified with the inclusion of a latex/redispersible polymer per the manufacturer's directions as part or all of the liquid portion of the mixture to enhance certain performance properties.

There are two equivalent methods recognized for installing ceramic, glass, and natural stone tiles with a portland cement mortar bed on walls, ceilings, and floors. They are: the method covered by ANSI A108.1A, which requires that the tile be set on a mortar bed that is still workable; and the method covered by ANSI A108.1B, which requires that the tile be set on a cured mortar bed with dry-set or latex/polymer modified portland cement mortar. Absorptive ceramic and stone tiles must be soaked before setting on a mortar bed that is still workable when using a neat portland cement bond coat.

Portland cement mortars can be bonded to concrete floors, backed with membranes and reinforced with wire mesh or metal lath, or applied on metal lath over open studding on walls. They are structurally strong, are not affected by prolonged contact with water, and can be used to plumb and square surfaces installed by others.

Suitable backings when properly prepared are: brick or cement masonry, concrete, wood or steel stud frame, rough wood floors, plywood floors, foam insulation board, gypsum board, and gypsum plaster. The one coat method may be used over masonry, plaster, or other solid backing that provides firm anchorage for metal lath.

Complete installation and material specifications are contained in ANSI A108.1A, A108.1B, and A108.1C. These mortars are not characterized by ISO criteria.

Dry-Set Mortar

Dry-set mortar is a mixture of portland cement with sand and additives imparting water retentivity that is used as a bond coat for setting tile.

Dry-set mortar is suitable for thin-bed installations of ceramic and natural stone tiles over a variety of surfaces. It is used in one layer nominally between $\frac{3}{32}$ " and $\frac{1}{4}$ " after tiles are embedded, has excellent water and impact resistance, is water-cleanable, nonflammable, good for exterior work, and does not require soaking of tile.

Dry-set mortar is available as a factory-sanded mortar to which only water need be added. Cured dry-set mortar is not affected by prolonged contact with water, but does not form a water barrier. It is not intended to be used in truing or leveling the work of others.

Suitable backings, when properly prepared, include plumb and true masonry, concrete, gypsum board, cement backer board, fiber-cement backer board, cementitious coated foam backer board, cured portland cement mortar beds, brick, ceramic tile, and dimension stone. Consult membrane and setting material manufacturer for use over uncoupling membranes, waterproof membranes, and crack isolation membranes.

Complete installation and material specifications are contained in ANSI A108.5 and ANSI A118.1. For applicable ISO material specifications, see ISO C criteria.

Latex/Polymer Modified Portland Cement Mortar

Latex/polymer modified portland cement mortar is a mixture of portland cement, sand, and special latex/polymer additive that is used as a bond coat for setting tile.

The uses of latex/polymer modified portland cement mortar are similar to those of dry-set mortar. Latex/polymer additives for use in thin-bed portland cement mortars are designed to improve adhesion, reduce water absorption, and provide greater bond strength and resistance to shock and impact. These additives allow some latitude in time, working conditions, and temperatures. Therefore, latex/polymer modified portland cement mortar is required for the installation of porcelain tile.

When latex/polymer modified portland cement mortar is used to install ceramic, glass, and natural stone tiles in an area that may not thoroughly dry out in use (e.g., swimming pools and gang showers, etc.) or where initial drying is inhibited (between tile and impervious substrates), it is recommended that the completed installation be allowed to dry out thoroughly before exposure to water. This drying period can range from 14 to more than 60 days depending upon the temperature and humidity and other climatic conditions, and whether the installation is interior or exterior. Consult setting material manufacturer for minimum set times before grouting tile or allowing traffic, water exposure, or submersion.

When installing 8" × 8" or larger impervious tile over a waterproof or crack isolation membrane, or other impervious substrate, longer curing times may be required. Cure times may also be extended with narrow grout joints and when high performance grouts such as those meeting ANSI A118.3, A118.5, and A118.7 are used. When one or more of these conditions exists, delaying grouting will allow better evaporation of excess moisture.

When longer cure times are required on floors, extend the amount of time before allowing traffic on the floor.

A rapid-setting latex/polymer modified cement mortar may need to be specified for faster curing. Consult manufacturer for recommendations and requirements. Because polymers vary considerably, the directions of the latex/polymer mortar manufacturer must be followed explicitly.

Not all latex/polymer modified portland cement mortars are suitable for wet areas. Consult manufacturer for suitability for intermittent and submerged applications.

Complete installation and material specifications are contained in, respectively, ANSI A108.5 and A108.12 installation standards and ANSI A118.4, A118.11, and A118.15 material standards. For applicable ISO material specifications, see ISO C criteria.

Exterior Glue Plywood (EGP) Latex Portland Cement Mortar

EGP mortar is a latex/polymer modified portland cement mortar specifically for bonding ceramic, glass, and natural stone tiles to exterior glue plywood. When added in latex form, the polymer is added as a replacement for part or all of the gauging water in accordance with the manufacturer's instructions.

Complete installation and material specifications are contained in ANSI A108.12 and ANSI A118.11. For applicable ISO material specifications, see ISO C, P criteria.

Dry Set Mortar for Large and Heavy Tile (LHT Mortar), formerly *Medium Bed Mortar*

LHT mortar (formerly medium bed mortar) is a thin-set bonding mortar for ceramic and stone tile, formulated by the manufacturer so as to minimize slump and facilitate a thicker bond coat as compared with a bonding mortar that is not labeled as dry set mortar for large and heavy tile, or LHT mortar (formerly medium bed mortar). It is intended to be used as a bond coat $\frac{3}{32}$ " thick (nominal) to $\frac{1}{2}$ " thick (nominal) after the tile is embedded. LHT mortar (formerly medium bed mortar) is declared as such by its manufacturer based on its characteristics; there are no ANSI or ISO standards specific to this type of mortar.

Rather, LHT mortar (formerly medium bed mortar) must meet the requirements of an existing ANSI mortar standard (A118.1, A118.4, A118.11, or A118.15) or ISO mortar standard (C1 or C2).

The characteristics of LHT mortar (formerly medium bed mortar) make it useful for setting heavy tiles (generally, tiles that are 5 pounds/square foot or heavier) and tiles with ungauged thickness. It is also useful and commonly used for setting large tiles (tiles with at least one side greater than 15" long) because, when setting such tiles, larger trowels are used and needed to apply enough bonding mortar to achieve mortar coverage requirements. For large tiles, a thicker bond coat is often required to achieve mortar coverage requirements if there is warpage in the tile, which necessitates additional bonding mortar to eliminate voids under the tile where the tile's curvature creates a larger space between tile and substrate, typically in the center of the tile. Refer to ANSI A137.1 for allowable warpage for ceramic tile.

NOTE TO SPECIFIER: LHT mortar (formerly medium bed mortar) is not intended for truing or leveling substrates or the work of others. Where substrate variation exceeds allowances, LHT mortar (formerly medium bed mortar) cannot be used to remedy such, because the application would exceed the limitations of the mortar. LHT mortar (formerly medium bed mortar) is intended to be used to install tile per ANSI A108.5, the installation standard for installing tile by the thin-bed method. Accordingly, LHT mortar (formerly medium bed mortar) is a product, not an installation method. Project plans and specifications that call for or refer to setting tile by a "medium bed method" or "large and heavy method" or that call for the use of bonding mortar to level, flatten, or fill substrates or to create slopes or transitions between finish floor heights do not conform to tile industry standards or norms.

Epoxy Mortar

Epoxy mortar is a mortar system designed for chemical resistance employing epoxy resin and epoxy hardener portions. Epoxy mortar is suitable for thin-bed installations of ceramic and natural stone tiles where chemical resistance of floors, high bond strength, and high impact resistance are important considerations. High-temperature-resistant formulas are also available. Acceptable substrates, when properly prepared, include concrete, wood and plywood, steel plate, ceramic tile, and stone tile. Application is made in one thin layer. Pot life, adhesion, water-cleanability before cure, and chemical resistance vary with manufacturer. Epoxy grout is also available. See "Grout Selection Guide."

Complete installation and material specifications are contained in ANSI A108.6 and ANSI A118.3. For applicable ISO material specifications, see ISO R criteria.

Modified Epoxy Emulsion Mortar

Modified epoxy emulsion mortar is a mortar system employing emulsified epoxy resin and hardener with portland cement and silica sand. Modified epoxy emulsion mortars are formulated for thin-bed installations of ceramic and natural stone tiles on floors and walls, interior and exterior. Their features include high bond strength, ease of application, little or no shrinkage, and economical epoxy application. They are not designed for chemical resistance.

Recommended uses include residential floors over substrates such as cementitious backer units and concrete. Where complete and firm support under the tiles is mandatory, 95% coverage is required. This material is recommended by most manufacturers as a bond coat or setting material. Some also recommend it for grouting.

Complete installation and material specifications are contained in ANSI A108.9 and ANSI A118.8. For applicable ISO material specifications, see ISO R criteria.

Furan Resin Mortar

Furan resin mortar is a mortar system designed for chemical resistance consisting of furan resin and furan hardener portions. Furan mortar is suitable for thin-bed installations of ceramic tile where chemical resistance of floors is an important consideration. Acceptable subfloors, when properly prepared, include concrete, wood and plywood, steel plate, and ceramic tile. They are typically not used in the installation of glass or stone tiles. Furan grout is also available. See "Grout Selection Guide."

Complete installation and material specifications are contained in ANSI A108.8 and ANSI A118.5. For applicable ISO material specifications, see ISO R criteria.

Epoxy Adhesive

Epoxy adhesive is an adhesive system employing epoxy resin and epoxy hardener portions. Epoxy adhesive is formulated for thin-bed installations of ceramic and stone tile on floors, walls, and counters. It is designed primarily for high bond strength and ease of application and not for optimum chemical resistance. However, its chemical and solvent resistance tends to be better than that of organic adhesives.

Complete installation and material specifications are contained in ANSI A108.4 and ANSI A118.3. For applicable ISO material specifications, see ISO R criteria.

Spot-Bonding Epoxy

Spot-bonding epoxy is a multi-component high-strength epoxy adhesive designed for spot-bonding ceramic tile and stone.

Refer to ANSI A118.3. For applicable ISO material specifications, see ISO R criteria.

Organic Adhesive

Organic adhesive is a prepared organic material for interior use only, ready to use with no further addition of liquid or powder, which cures or sets by evaporation. Organic adhesives are suitable for setting ceramic tile on floors, walls, and countertops, where surfaces are appropriate and properly prepared in accordance with adhesive manufacturer's directions. Adhesives are applied in one thin layer with a trowel, first using the flat edge for continuous coverage and then the notched edge for uniform thickness. Where leveling or truing is required, an underlayment is used.

Adhesives are not suitable for swimming pools, exteriors, or areas exposed to temperatures exceeding 140°F. They supply some flexibility to the tile facing. Bond strength varies greatly among the numerous brands available. Solvents in some adhesives are irritating to some persons, and some adhesives are flammable.

Complete installation and material specifications are contained in ANSI A108.4 and ANSI A136.1. For applicable ISO material specifications, see ISO D criteria.

GROUT SELECTION GUIDE

Note

Specifications in this *Handbook* for the materials used to grout ceramic, glass, and stone tile have been developed according to the requirements and procedures of two standards-setting bodies: The American National Standards Institute (ANSI) and the International Organization for Standardization (ISO). These standards were developed with differing criteria and do not correlate with each other; they cannot be cross-referenced or used interchangeably. Both sets of standards are in widespread and common use in North America. Accordingly, each installation method in this *Handbook* provides grouting material specifications according to both sets of standards where applicable. For complete material properties and requirements, refer to the applicable ANSI or ISO standard or “Appendix A.”

Introduction

Grouting materials for ceramic, glass, and stone tiles are available in many forms to meet the requirements of the different kinds of tile and types of exposures. Portland cement is the base for most grouts and is modified to provide specific qualities such as whiteness, mildew resistance, uniformity, hardness, flexibility, and water retentivity. Non-cement-based grouts such as epoxies, furans, and premixed polymer resin grouts offer properties not possible with cement grouts. However, special skills and precautions on the part of the tile setter may be required.

Sand-Portland Cement Grout

An on-the-job mixture of 1 part portland cement to 1 part fine, graded, clean sand (ASTM C144) is used for joints up to $\frac{1}{8}$ " in width; 1:2 for joints up to $\frac{1}{2}$ " in width; and 1:3 for joints wider than $\frac{1}{2}$ ". Up to $\frac{1}{5}$ part lime may be added.

Sand-portland cement grout can be used with ceramic mosaic tiles, quarry tiles, pressed floor tiles, porcelain tiles, some glass tiles, and some stone tiles on floors and walls. Damp curing is necessary. On stone tiles and glass tiles, make sure the surface will not be scratched by the sand in the grout; unsanded grout may be required. Unsanded grout is commonly used with polished calcium carbonate-based stones (see “Natural Stone Tile Selection and Installation Guide”). Some glass tile manufacturers require unsanded grout to prevent scratching on smooth glass tile surfaces (see “Glass Tile Selection and Installation Guide”).

Complete installation and material specifications are contained in ANSI A108.10. This type of grout is not characterized by ISO criteria.

Standard Cement Grout

Standard Unsanded Cement Grout: A factory-prepared mixture of cement, fine aggregate, and other ingredients to produce a water-resistant, dense, uniformly-colored material meant for joints $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

Standard Sanded Cement Grout: A factory-prepared mixture of cement, graded sand, and other ingredients to produce a water-resistant, dense, uniformly-colored material meant for joints $\frac{1}{8}$ " in width or greater.

Grouts in this category are suitable for grouting walls and floors subject to ordinary use. On stone and glass tiles, make sure the surface will not be scratched by sand in the grout; unsanded grout may be required. Unsanded grout is commonly used with polished calcium carbonate-based stones (see “Natural Stone Tile Selection and Installation Guide.”) Some glass tile manufacturers require unsanded grout to prevent scratching on smooth glass tile surfaces (see “Glass Tile Selection and Installation Guide”).

Complete installation and material specifications are contained in ANSI A108.10 and A118.6. For applicable ISO material specifications, see ISO CG criteria.

High Performance Tile Grout

High Performance Unsanded Tile Grout: A factory-prepared mixture of cement and other ingredients, including a redispersible latex/polymer powder, to which only water is added at the jobsite, or a liquid latex admixture. When added in a latex form, it is added as a replacement for part or all of the mixing water. These grouts are designed for installation in joints $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

High Performance Sanded Tile Grout: A factory-prepared mixture of cement, sand, and other ingredients, including a redispersible latex/polymer powder, to which only water is added at the jobsite, or a liquid latex admixture. When added in a latex form it is added as a replacement for part or all of the mixing water. These grouts are designed for installation in joints $\frac{1}{8}$ " in width or greater. The maximum allowable joint width is designated by the grout manufacturer.

Grouts in this category provide improved characteristics such as increased bond strengths, flexural strengths, and lower water absorption to resist frost damage. On stone and glass tiles, make sure the surface will not be scratched by sand in the grout; unsanded grout may be required. Unsanded grout is commonly used with polished calcium carbonate-based stones (see “Natural Stone Tile Selection and Installation Guide”). Some

glass tile manufacturers require unsanded grout to prevent scratching on smooth glass tile surfaces (see “Glass Tile Selection and Installation Guide”).

Complete installation and material specifications are contained in ANSI A108.10 and A118.7. For applicable ISO material specifications, see ISO CG criteria.

Grout Color Selection

Selection of a grout color that contrasts with the tile will emphasize the grout joint and correspondingly any variations in tile size and position. Selection of a similar or complementary grout color will de-emphasize such variations.

When a similar color grout is used, it is often more difficult to see the haze left after the initial grout cleaning and extra care must be taken to remove all haze.

Stain Resistance and Color Consistency of Cementitious Grouts

Color consistency and stain resistance vary depending on several factors: water absorption of the tile (with lower absorption generally producing a lighter shade), grout color chosen, whether polymer or water is used, amount of water used in mixing and cleaning, degree of curing before cleaning, grout compaction, joint depth, joint finishing, humidity, and many other parameters. In-field color can vary significantly from factory-prepared color samples, and many grouts are darker when wet.

While there is currently no industry standard to evaluate color consistency or stain resistance of cementitious grouts, there are grout formulations and/or admixtures available that allow for improved color consistency. Similarly, there are grout formulations, and/or admixtures, and/or sealers that allow for improved stain resistance by reducing the extent or severity of staining. Not all stains are affected similarly; consult grout manufacturers for application suitability and maintenance recommendations.

Regardless of the grout used and whether or not a sealer was applied, tile and grout can generally be cleaned by sweeping first and rinsing with water. In cases where excess dirt cannot be removed, use an alkaline or pH-neutral cleaner at the lowest effective concentration and rinse thoroughly to eliminate residue. Do not use oil-based cleaners, which are difficult to remove and entrap dirt.

Epoxy Grout

Epoxy grout is a grout system employing epoxy resin and hardener portions, often containing coarse silica filler, especially formulated for industrial and commercial

installations where chemical resistance is important. These grouts also provide high bond strength, impact resistance, and improved stain resistance. High-temperature, chemical-resistant formulas are also available. Chemical and stain resistance can vary between epoxies; consult grout manufacturers for application suitability, including exterior UV exposure and maintenance recommendations.

Complete installation and material specifications are contained in ANSI A108.6 and A118.3. For applicable ISO material specifications, see ISO RG criteria.

Epoxy Emulsion Grout

Epoxy emulsion grout is a grout system employing epoxy resin and hardener portions, both of which contain additional water to form an emulsion. The coarse silica filler portion also contains portland cement. These grouts are not designed for chemical resistance nor designed to meet ANSI A108.6 or ANSI A118.3.

Complete installation and material specifications are contained in ANSI A108.9 and A118.8. For applicable ISO material specifications, see ISO RG criteria.

Furan Resin Grout

Furan resin grout is a grout system consisting of furan resin and hardener portions. Furan grout is used in industrial and commercial areas requiring chemical resistance. Use of this grout requires waxed tiles, special installation skills, and additional safety precautions when compared to all other grouts. Architects should select the type of furan grout applicable to the specified chemical and temperature exposure. This grout is not used with stone or glass tiles.

Complete installation and material specifications are contained in ANSI A108.8 and ANSI A118.5. For applicable ISO material specifications, see ISO RG criteria.

Premixed Polymer Resin Grout

Premixed polymer resin grout is a one-part liquid ready-to-use grout that requires no mixing with water. These grouts may contain various types of water-based polymer including acrylics or urethanes and fillers that may be sanded or unsanded. The appropriateness of these grouts for commercial, water-exposed, and exterior applications varies widely; review and follow manufacturer recommendations before use.

There are no product or installation standards for this type of grout.

BACKER BOARD SELECTION GUIDE

Cement Backer Board

A backer board designed for use on floors, walls, and ceilings in wet or dry areas, this board is applied directly to wood or metal wall studs or over wood subfloors—referred to in ANSI as cementitious backer units (CBU). Ceramic tile can be bonded to it with dry-set, latex/polymer modified portland cement mortar, or epoxy by following the backer board manufacturer's instructions. It can also be used for glass and stone installations. Complete interior installation and material specifications are contained in ANSI A108.11 and ANSI A118.9 or ASTM C1325.

Coated Glass Mat Water-Resistant Gypsum Backer Board

A backer board conforming to ASTM C1178. Designed for use on floors, walls, and ceilings in wet or dry areas, this board is applied directly to wood or metal wall studs or over wood subfloors. Ceramic tile can be bonded to it with latex/polymer modified portland cement mortar or epoxy by following the backer board manufacturer's instructions. It can also be used for glass and stone installations.

Glass Mat Water-Resistant Gypsum Backer Board

A backer board conforming to ASTM C1658. Designed for use on walls and ceilings in dry areas, this board is applied directly to wood or metal studs and ceiling framing. Ceramic tile can be bonded to it with dry-set, latex/polymer modified portland cement mortar, organic adhesive, or epoxy by following the manufacturer's instructions. It can also be used for glass and stone installations.

Fiber-Cement Backer Board

A dispersed fiber-reinforced cement backer board designed for use on floors, walls, and ceilings in wet or dry areas, this board is applied directly to wood or metal wall studs or over wood subfloors. Ceramic tile can be bonded to it with latex/polymer modified portland cement mortar, organic adhesive, or epoxy by following the backer board manufacturer's instructions. It can also be used for glass and stone installations. General interior installation and material specifications are contained in ANSI A108.11 and ASTM C1288. Consult the manufacturer's written literature for specific application details.

Fiber-Reinforced Water-Resistant Gypsum Backer Board

A backer board conforming to ASTM C1278. Designed for use on floors, walls, and ceilings in dry or wet areas, this board is applied directly to wood or metal wall studs or over wood subfloors. Ceramic tile can be bonded to it with latex/polymer modified portland cement mortar, organic adhesive, or epoxy by following the backer board manufacturer's instructions. It can also be used for glass and stone installations.

Cementitious Coated Extruded Foam Backer Board

A waterproof backer board constructed from extruded polystyrene and coated with a cementitious coating, designed as a substrate for ceramic tile and stone in wet and dry areas. Designed for use on floors, walls, and ceilings in dry or wet areas, this board is applied directly to wood or metal wall studs or over wood subfloors. Ceramic tile can be bonded to it with dry-set, latex/polymer modified portland cement mortar, or epoxy by following the backer board manufacturer's instructions. It can also be used for glass and stone installations. Material specifications are contained in ASTM C578 and ASTM D4068.

Direct Bond to Wood or Gypsum Wall Board—Caution

Wood-based panels such as particle board, composite panels (veneer faces bonded to reconstituted wood cores), nonveneer panels (wafer board, oriented strand board (OSB), and other similar boards), lauan plywood, and softwood plywood expand and contract with changes in moisture content and are not recommended as backing materials for direct bonding of ceramic tile. Plywood manufactured with fully waterproof adhesive and with an exposure durability rating of Exposure 1 or Exterior may be used on residential horizontal surfaces when installed in accordance with ANSI specifications for the installation of ceramic tile (A108.01).

Gypsum wall board, including water-resistant gypsum backing board, may not be used as a backing for direct application of tile in intermittent wet or wet areas.

MEMBRANE SELECTION GUIDE

Membrane Types

Cleavage Membranes

A cleavage membrane is a thin layer of material within a tile assembly that is loose laid (floating) or mechanically attached but not bonded. Cleavage membranes are incorporated below the mortar setting bed in a thick-bed tile installation when the backing or substrate surface can be damaged by water, is not continuous, is cracked, or is dimensionally unstable. The cleavage membrane separates the backing surface from the mortar setting bed and tile allowing the mortar setting bed to be unbonded and free floating, and thereby not subject to the instability of the backing surface, preventing reflective cracking. When a cleavage membrane is incorporated, the setting bed is required to be reinforced with lath or wire.

Cleavage membranes are always materials that are moisture resistant. Cleavage membranes do not necessarily form an impermeable membrane that will hold water, but are intended to provide other materials some protection from moisture and vapor. Typical cleavage membranes include roofing felt, reinforced asphalt paper, asphalt laminated paper, polyethylene sheeting, chlorinated polyethylene (CPE) sheeting, polyvinyl chloride (PVC) membrane, or high-solids cold-liquid-applied membrane. ANSI A108.02-3.8 provides the specific requirements for these various materials. Some of these same materials can be used as a vapor retarder membrane. See Vapor Retarder Membranes.

Vapor Retarder Membranes

No material can completely eliminate water vapor transmission. However, the transmission of vapor can be reduced through the use of a vapor retarder membrane. These membranes are used in wet areas, placed behind mortar bed walls and some types of backer board to retard moisture and vapor transmission into the wall cavity. Examples of vapor retarder membranes include: roofing felt, reinforced asphalt paper, asphalt laminated paper, polyethylene sheeting, chlorinated polyethylene (CPE) sheeting, and polyvinyl chloride (PVC) membrane.

Waterproof Membranes

In addition to built-up membranes, single-ply membranes, and nonmetallic and lead or copper waterproofing, there are also waterproof membranes (ANSI A118.10) available for use with both vertical and horizontal thin-bed and thick-bed installations of tile, which may be installed by tile trades.

Among these are single- or multi-component membranes applied in liquid/paste form, which cure into continuous membranes and membranes applied in flexible sheet form. Some of these membranes have integral reinforcing fabrics for tensile strength and minor crack-bridging properties. Others are designed to be used as a combination waterproofing and setting material for the tile.

Depending upon the type of waterproofing membrane, manufacturers may require that tile products be installed on a reinforced portland cement mortar bed applied over the membrane; directly on the membrane with dry-set or latex/polymer modified portland cement mortar; or bonded to the membrane using a troweled application of the waterproofing membrane product.

Low Perm Waterproof Membranes

No material can completely eliminate water vapor transmission. However, the transmission of vapor can be reduced through the use of a low perm waterproof membrane. Low perm waterproof membranes are waterproof membranes (ANSI A118.10) with a water vapor permeance of less than 0.5 perms when tested per ASTM E96 Standard Test Methods for Water Vapor Transmission of Materials, Procedure E (desiccant method at 100°F) and 90% relative humidity. Not all waterproof membranes meeting ANSI A118.10 are low perm waterproof membranes.

Crack Isolation Membranes

Crack isolation membranes (ANSI A118.12) for thin-bed ceramic, glass, and stone installations act to isolate the tile from minor in-plane substrate cracking. Membranes covered by this definition are bonded to a variety of manufacturer-approved substrates covered by ANSI specifications. In some cases, the trowel-applied products can be used as the adhesive for the tile. Other products within the scope of this category are allowed to cure or are applied as sheet goods and are then used as the substrate for the tile.

Uncoupling Membranes

An uncoupling membrane is a plastic membrane system geometrically configured to provide air space between the tile and the substrate to allow independent movement between the two and limit the transfer of stresses. These membranes are not characterized by ANSI or ISO standards. The uncoupling membrane must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3. Consult the manufacturer's written literature for specific application details.

Bonded Sound Reduction Membranes

Bonded sound reduction membranes are intended to reduce floor-to-floor impact insulation class (IIC) sound. The higher the IIC or delta value, the less transmission of impact noise that is allowed by the membrane. Bonded sound reduction membranes must reduce impact noise (increase IIC) by at least 10 IIC points when tested to ASTM E2179, in accordance with ANSI A118.13. The Uniform Building Code requires a minimum IIC of 50 for sound reduction membranes, and local building codes may require even more stringent minimum acceptable IIC values.

Bonded sound reduction membranes may be trowel applied, sheet, or composite membranes that are bonded to a suitable substrate so that tile can be bonded directly to the membrane.

Material specifications are contained in ANSI A118.13.

Considerations When Using Membranes

Membranes installed properly can produce hollow-sounding tiles. This is not indicative of loss of bond without concomitant installation issues.

Where membranes are used, mortar cure times may be extended. See “Setting Material Selection Guide.”

Membranes and/or membrane adhesives and primers may be sensitive to naturally occurring moisture and alkalinity when used over cement and gypsum-based substrates. Consult manufacturer for acceptable limits of moisture and alkalinity.

ADDITIONAL PRODUCTS USED IN TILE INSTALLATIONS

Exterior Ceramic Tile Panels

To reduce construction time, these prefabricated, lightweight, custom-built panels are shipped to the construction site and attached to the building by welding or mechanical fasteners.

Panel size, shape, and thickness are determined by building design. Size, spacing, and gauge of the steel stud framework are also dependent on design but may be related to the climatic conditions of the building location.

Manufacturers of tile, mortars, and backing materials and regional contractor associations can supply guide specifications for panel construction. However, the ceramic tile installation is usually done in accordance with W201 (from the membrane out) or W244E (bonding directly to solid backing attached to the studs). Tile to be installed per ANSI specifications.

Integrated Bonding Flange

An integrated bonding flange is designed to provide a large contact area at the top of the drain assembly, which will allow ample surface adhesion to thin, load bearing, bondable waterproof membranes. Drain assemblies of this type are constructed in such a way that the waterproof membrane is bonded to the top of the substrate rather than below it. All drains must comply with local code.

Profiles

Floor profiles, wall profiles, transition profiles, cove profiles, and preformed joint profiles may be incorporated into a tile installation where suitable. Profiles are available in various materials, finishes, colors, and heights. Select the correct material considering traffic and environmental conditions (water exposure, chemical exposure, etc.) and the correct height considering the tile thickness and setting bed thickness.

These products are not characterized by ASTM, ANSI, or ISO product standards. Consult manufacturer for all performance and installation criteria.

Reduced Thickness Porcelain Tiles

Reduced thickness porcelain tiles, or thin tiles, are now in the marketplace with properties different from traditional ceramic tiles. Several manufacturing technologies exist, producing tiles in traditional sizes up to tiles, or “panels,” as large as 5 feet by 10 feet and less than ¼" thick (nominally).

Depending on the thickness, while typically meeting ISO 13006 modulus of rupture requirements (one measurement of strength), many of these thinner tiles do not meet ANSI A137.1 breaking strength requirements and require handling and installation that take the lower breaking strength into consideration. Not all manufacturers recommend their tiles for all substrates. Check with the manufacturer for recommended applications, and whether flooring applications are supported.

Some reduced thickness tiles employ reinforcement on the back changing the physical properties of the tiles, adding impact resistance, raising the breaking strength (although in this category, the breaking strength after reinforcement can still be below the ANSI A137.1 threshold), and reducing crack propagation. There are a variety of technologies employed and such reinforcement requires additional consideration when selecting appropriate setting materials.

In general, specialized tools, equipment, thin-bed mortar, and training are required for the successful installation of reduced thickness tiles. With larger tiles, flattening the substrate before installation may be required as stringent substrate and installation requirements apply, especially in flooring applications. Special care may be required to achieve sufficient mortar contact between the tile and substrate, especially near the grout joints.

These products are not characterized by ASTM, ANSI or ISO product performance or installation standards. Consult manufacturer for all substrate, performance and installation criteria. Some manufacturers may require the use of pre-qualified installers.

Structural Ribbed Self-Supporting Boards (SRSB)

Structural ribbed self-supporting boards (SRSB) are a pultruded, lightweight board manufactured of a composite dovetailed rib system, integrated and adhered to a fiberglass backing. The boards are engineered to be structural and are attached directly to the wood or steel joist system of an exterior deck or balcony. By eliminating the wood deck boards or a plywood substrate, the deck and the tiled surface are no longer subject to wood swelling and shrinking due to humidity and moisture. The dovetailed cavities are filled with mortar to establish the tile substrate. A waterproof membrane conforming to ANSI A118.10 is required for all installations subject to freeze/thaw conditions.

These products are not characterized by ASTM, ANSI, or ISO product standards. Consult manufacturer for all performance and installation criteria.

Thresholds

By acting as a transitional piece between two different finished floor levels, thresholds permit the use of the conventional mortar method in rooms where it would not otherwise be possible. They also can be used with thin-bed methods.

Ventilated Rainscreen Exterior Wall Systems

Tiles up to 1¼" thick, up to 4' x 4' (and larger) in size, have the strength and characteristics necessary to be used as mechanically anchored exterior wall cladding, similar to traditional mechanically anchored natural stone panels. As an engineered product, tile can be manufactured to have consistent physical characteristics with many color, texture, and surface finish choices. These tiles are well suited for ventilated, back-drained rainscreen wall systems, a relatively new type of exterior wall cladding with functional, environmental, and aesthetic benefits.

These systems, often referred to as ventilated tile façades, consist of tiles attached to a structural aluminum framework attached to a primary back-up wall, creating an open air cavity between the primary wall and the tiles. The tiles form a secondary wall cladding, and the joints between the tiles are left open to induce air circulation within the cavity, allowing for continuous insulation and efficient heat, moisture, and acoustic dissipation. The open cavity creates convection in the insulating air chamber between the tile cladding and the primary wall, effectively insulating the primary wall. The ventilated cavity also minimizes thermal bridging, moisture condensation, and the inefficiencies of traditional internal wall insulation. The backs of the tiles can be reinforced with mesh to reduce accidental breakage, and tiles can also be easily removed and replaced, facilitating access to and maintenance of internal wall components.

Ventilated rainscreen tile wall systems can reduce building energy consumption substantially, reduce damaging water infiltration and condensation, and reduce material and installation costs by use of prefabricated high strength, lightweight components.

GREEN BUILDING STANDARDS AND GREEN PRODUCT SELECTION GUIDE

Environmentally sustainable buildings have many different attributes, and there are many options to consider when “building green.” While most green building projects target certification or compliance with green building standards or rating systems, others are initiated for tax incentives, operational cost savings, or solely in the spirit of following environmentally responsible building practices.

Product selection is a major component in green building. Products can impact the environment in different ways, and it is important to understand the variety of contributions by all products. The sustainability of a product involves much more than recycled material content, energy efficiency, or any other single attribute. Multi-attribute sustainability, including environmental and social impacts, and whether the environmental information is transparently reported should be considered when evaluating a product’s true sustainability. Additionally, how products combine into installed product systems is important. For green building projects, use the installation guidelines in this *Handbook* with products meeting the Green Squared® standard to achieve durable long-lasting assemblies that are truly sustainable. Publicly available North American industry-wide EPDs (environmental product declarations) for tile, mortar, and grout can also be reviewed to obtain in-depth data on the environmental impacts of tile assemblies throughout their life cycle.

Specifying Conforming Sustainable Tile Products

Green Squared, the Multi-Attribute Product Sustainability Standard: The tile industry considered a host of sustainability criteria in creating the wide-ranging, multi-attribute product sustainability standard, ANSI A138.1. This standard establishes requisite and elective criteria for sustainable tiles and installation materials, including social and environmental criteria, and is the first multi-attribute product sustainability standard to encompass a full range of products within an industry. These criteria establish a consistent approach to the evaluation and determination of product sustainability, and are in accordance with North American green building practices, expectations, and leading initiatives. Tiles and installation materials in conformance with ANSI A138.1 should be specified for green building projects.

Green Squared Certification: TCNA developed the Green Squared certification program as a way for specifiers and consumers to easily determine which products meet ANSI A138.1. If a tile or installation

material is labeled with the Green Squared Certified® mark, it means that it meets ANSI A138.1, as certified by one of three credible and widely recognized certification bodies. The use of Green Squared Certified products helps earn and/or directly contributes toward points in several green building codes, standards and rating systems, including the National Green Building Standard (ICC 700), Leadership in Energy and Environmental Design (LEED), the International Green Construction Code (IgCC), Standard for the Design of High-Performance Green Buildings (ASHRAE 189.1), and Green Globes for New Construction.

For additional information on Green Squared, see “Tile: The Natural Choice” published by Tile Council and visit www.GreenSquaredCertified.com.

Using Publicly Available Data to Understand the Environmental Impacts of Products Being Specified

An EPD (environmental product declaration) provides a comprehensive overview of how a product impacts the environment—specifically with regard to global warming, abiotic resource depletion, acidification, smog formation, eutrophication, and ozone depletion. The primary intent of an EPD is transparency, and while developed within a standardized reporting framework, the EPD itself does not indicate conformance to any particular environmental performance threshold(s). Just as nutrition labels inform with respect to food choices, an EPD informs with respect to sustainability.

For tile and related installation materials industry-wide EPDs are publicly available for North American-made ceramic tile, for North American-made cement mortar for tile installation, and for North American-made cement grout for tile installation. Additionally, product-specific (proprietary) EPDs are available.

Combined use of EPDs for tile, mortar, and grout provides specifiers and design professionals data needed to evaluate and understand the environmental footprint of a full assembly. Additionally, using products with proprietary or industry-wide EPDs can directly contribute toward points in LEED, Green Globes, ASHRAE 189.1, and IgCC. Because most green building standards, codes, and rating systems provide incremental credit for each product with an EPD, using tile can contribute three times as much when applicable mortar and grout is also used.

Each of the North American industry-wide EPDs is independently certified by UL Environment and provides

60-year environmental impacts, per square meter of installed product, based on “cradle-to-grave” life cycle data provided by major North American manufacturing companies. For additional information see “Tile: The Natural Choice” published by Tile Council and visit www.TCNAtile.com to download copies of the EPDs.

Additional Green Tile and Installation Material Considerations

Recycled Content: Tile and installation material manufacturers offer wide varieties of products with pre- and post-consumer recycled content. Recycled content in tile products can contribute to overall building recycled content, and can help achieve compliance with the recycled content criteria in LEED, ICC 700, Green Globes, ASHRAE 189.1, and IgCC. Consult with manufacturers to ensure that materials labeled as having recycled content meet project-specific requirements. Often, green building projects require that recycled content fits the following ISO and FTC definitions:

- **Post-consumer material:** Waste material generated by households or by commercial, industrial, and institutional facilities in their role as end-users of the product, which can no longer be used for its intended purpose.
- **Pre-consumer material:** Material diverted from the waste stream during the manufacturing process. Reutilization of materials is excluded (i.e., rework, regrind, or scrap generated in a process and capable of being reclaimed within the same process that generated it).

Additionally, high levels of responsibly recovered waste, including dust, powder, unfired scrap and water, are commonly reincorporated into the manufacturing process. Such materials, when reincorporated into the same processes that created them, are not typically considered pre-consumer recycled content by ISO and FTC definitions. However, waste reclamation is a vital component to minimizing waste and maximizing resources, and it is becoming more widely acknowledged in green building. In fact, many factories are so efficient at this they are effectively closed-loop facilities, reducing waste to zero and fully utilizing all inputs.

Regional Availability: Tile products manufactured with indigenous raw materials and within close proximity of building sites can help reduce overall energy consumption and air pollution. For contributing points to LEED, ICC 700, Green Globes, ASHRAE 189.1, and IgCC projects, manufacturers can provide the necessary paperwork regarding production locations, quantities of indigenous raw materials, and modes of product/raw material transportation.

Indoor Air Quality: Building materials with few or no volatile organic compounds (VOCs) are necessary for good indoor air quality. Ceramic and porcelain tiles have zero VOCs (because they are manufactured at high temperatures) and easily meet the product emission requirements established by the California Department of Public Health (commonly referred to as California Section 01350). Indication of such compliance for ceramic tile is not required for LEED, ICC 700, Green Globes, ASHRAE 189.1 or IgCC projects, as tile is exempted from VOC emission testing. Low VOC tile adhesives and other installation materials in compliance with California public health requirements or SCAQMD Rule 1168 can also contribute to LEED, ICC 700, Green Globes, ASHRAE 189.1, and IgCC projects.

Exterior Contribution: Light-colored tiles for site hardscaping, as opposed to traditional paving materials, can lower a site’s heat absorption, or heat island effect. Using tile this way can contribute toward compliance in LEED, ICC 700, Green Globes, ASHRAE 189.1 and IgCC projects when tile products have a solar reflective index (SRI) of 29 or greater. Manufacturers should be contacted for more information on such products.

Cleaning and Maintenance: The use of tile generally eliminates the need for harsh cleaning chemicals and their environmental burdens. Tile and grout manufacturers should be contacted to provide cleaning and maintenance recommendations for products used in green building projects. When sealers are used, consult with sealer manufacturers to confirm compliance with the VOC criteria in California public health requirements or SCAQMD Rule 1168 for products being utilized in LEED, ICC 700, Green Globes, ASHRAE 189.1, or IgCC projects.

Cleanliness and Sterility: Inherently, ceramic tiles are inhospitable to dust mites, mold, germs and bacteria and are therefore desirable for people with allergies or asthma. Additionally, some tiles and installation materials have innovative components that inhibit microbial growth. Although antimicrobial tile products are fairly new to the tile industry, the use of such products is expected to grow.

Durability: The durability of tile products is a main reason for the overall inherent sustainability of tile installations. When building green, it is important to use products that meet or exceed the industry durability criteria referenced in the Green Squared standard.

Life Cycle Performance: The inherent durability and long life of tile installations lower their overall environmental impact. Most commonly, life cycle assessments (LCAs) are performed in accordance with ISO 14040 and ISO 14044. LCAs are the basis for EPDs, which are standardized

under ISO 14025 and ISO 21930. Products that have undergone such evaluation are eligible for contribution to LEED, ICC 700, Green Globes, ASHRAE 189.1, and IgCC projects. Furthermore, various green building standardization efforts are bringing more attention to the subject of life cycle evaluation, especially as it pertains to building and material service life and performance.

Energy Reduction: Tile finishes can contribute to the energy efficiency of a building in many ways. By their nature, tile products have exceptional thermal mass which allows them to store and release heat. In the summer, tiled surfaces capture and store heat from interior environments without significantly changing temperature, keeping interiors cool during the hottest parts of the day. Similarly, during the winter, tiled surfaces radiate heat back to an interior environment when the ambient temperature is below the temperature of the tile. Additionally, there are several innovative technologies, including radiant heating systems, ventilated façades, and photovoltaic products, which can help improve energy efficiency to lower a building's energy footprint, reduce operational costs, and help meet energy reduction targets in LEED, ICC 700, Green Globes, ASHRAE 189.1, and IgCC projects.

Innovation: Manufacturers of tile and installation materials continue to create new products that lower energy usage, reduce material consumption, improve human health, and lower other environmental burdens. The use of new products with innovative environmental technologies can contribute toward innovation credits in LEED if approved by their respective project authorities.

Common Green Building Standards and Rating Systems

The most common green building standards and rating systems are described in this section. While there are several others—some consensus-based and some written exclusively for certification by various third-party entities—many of them have product selection criteria similar to that of the most commonly used green standards and rating systems.

LEED (Leadership in Energy and Environmental Design): LEED is a suite of green building rating systems developed by the U.S. Green Building Council (USGBC) that allows builders, owners, and tenants to evaluate the impact of their design on energy and environmental issues. LEED certification of a project can be earned based on points received for choices made during the design, construction, and operation of a new or existing building or major renovation.

ICC 700: Through the American National Standards Institute (ANSI) consensus process, and based on initiatives of the National Association of Home Builders (NAHB), the International Code Council (ICC) published the National Green Building Standard (ICC 700), a voluntary green building standard dedicated to residential construction. Similar to LEED and CHPS, points are awarded for choices made during the design, construction, and operational phases of a project.

Green Globes: Green Globes is a rating system and certification program by the Green Building Initiative (GBI) and the Canadian Building Owners and Managers Association to provide an alternative to LEED for building environmental design and management. New or existing buildings can be submitted for assessment, and points are awarded toward four different levels of certification, from “One Globes” to “Four Globes.”

IgCC (International Green Construction Code): IgCC was created by the International Code Council (ICC) in partnership with the American Institute of Architects (AIA); ASTM International; the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE); the United States Green Building Council (USGBC); and the Illuminating Engineering Society (IES). IgCC is designed to complement ICC's existing family of I-Codes. Like the other I-Codes, the IgCC requires adoption by governing jurisdictions before becoming law. The IgCC provides a regulatory environmental framework for new and existing commercial buildings, and is written in enforceable model code language.

ASHRAE 189.1: An ANSI-accredited standard, ASHRAE 189.1 provides minimum requirements for designing, building, and operating high-performance green buildings; it is recognized by IgCC as an alternative compliance path, and like IgCC, is considered a “model code” that provides regulatory framework for adoption by governing jurisdictions.

2019 | FIELD AND INSTALLATION REQUIREMENTS

SUBSTRATE REQUIREMENTS

Maximum Allowable Deflection for Floor Systems and Substrates

Floor systems, whether wood framed or concrete, over which the tile will be installed using the appropriate TCNA method, according to the “Floor Tiling Installation Guide,” shall be in conformance with the International Residential Code (IRC) for residential applications, the International Building Code (IBC) for commercial applications, or applicable building codes. For ceramic tile installations maximum allowable floor member live load and concentrated load deflection for framed floor systems shall not exceed $L/360$, where “L” is the clear span length of the supporting member per applicable building code. For natural stone tile installations, maximum allowable floor member live load and concentrated load deflection for wood framed floor systems shall not exceed $L/720$, where “L” is the clear span length of the supporting member, per applicable building code.

The owner should communicate in writing to the project design professional and general contractor the intended uses of the tile installation, including in-service loads or information to allow a project design professional to calculate such. Project design professional and general contractor must make necessary allowances for the expected live load, concentrated loads, impact loads, and dead loads, including maximum allowable loads during construction and maintenance. When concentrated loads such as scissor lifts, pallet jacks, automobiles, forklifts, etc., will be utilized on a tile or stone floor, the project design professional shall include their use in the determination of the appropriate substrate. For the weight of the tile and setting bed (contribution to dead load), see Typical Weight of Tile Installation in the method being specified.

The tile contractor shall not be responsible for problems resulting from any structural subfloor installation not compliant with applicable building codes, unless structural subfloor was designed and installed by tile contractor, nor for problems from overloading. As tile is a finish applied to and relying upon the underlying structure, an inadequate substructure can cause a tile failure. In many cases, problems in the substructure may not be obvious, and the tile contractor cannot be expected to discover such and tile contractor shall not be responsible for designing flooring assembly, unless specifically engaged to do so in writing. Tile contractor cannot determine possibility of an overloaded condition.

In addition to deflection considerations, above-ground installations are inherently more susceptible to vibration. Consult grout, mortar, and membrane manufacturers to determine appropriate installation materials for above-ground installations. Crack isolation or uncoupling membranes and higher quality setting materials can increase the performance capabilities of above-ground applications. However, these upgraded materials cannot mitigate structural deficiencies including floors not meeting code requirements and/or overloading or other abuse of the installation in excess of design parameters.

Natural Stone Tile Installations on Post-Tensioned Concrete

Because dynamic movements of post-tensioned slabs have proven problematic for directly adhered natural stone, F111 is the only method of installing natural stone tile over post-tensioned slabs, on-ground or above-ground.

Proper Spacing for Wood Subflooring and Wood Underlayments

Plywood subflooring, OSB subflooring, and plywood underlayment shall be installed with proper spacing between the sheets (typically $\frac{1}{8}$," except if specified otherwise by the wood manufacturer). If the subfloor or underlayment is installed without proper spacing, this condition cannot be corrected by the tile installer. It is the responsibility of the project owner (or owner's subflooring or underlayment installer) to ensure proper spacing is used as failure to do so may not be obvious, and the tile installer cannot be expected to discover such. If expansion takes place in wood subflooring or underlayment installed without proper spacing, the tile installation could fail.

Natural Stone Tile Installations Over Wood Substrates

Two layers of structural wood panels are required on floors to receive stone tile when backer board will be used as the tile substrate. The MIA prohibits installation of stone tile over single-layer wood floor systems under backer board because of the discontinuity of the system at seams between the subfloor panels. If an unbonded mortar bed will be installed as the tile substrate, a single layer of wood subflooring is permitted.

Natural Stone Tile Installation Over Frame Construction

Strongbacks, bridging, or other load-sharing members may be required within a wood framed system to reduce differential deflection between adjacent framing members; project design professional is responsible for determining the necessity of such. Without the use of such load-sharing members, deflection may differ significantly between adjoining members. Accordingly, for framed construction, an L/720 requirement has been specified (see Maximum Allowable Deflection for Floor Systems and Substrates) while an L/360 requirement can be accepted for concrete/masonry substrates.

Moisture-Affected Materials—Caution

The performance of a properly installed ceramic tile installation is dependent upon the durability and dimensional stability of the substrate. Some substrate materials used in wet areas are subject to deterioration from moisture penetration. (Reference ANSI A108.01-2.4.) Therefore, while the goal of the conference for the *TCNA Handbook* is to produce accurate guidelines, they should be used only with the independent approval of technically qualified persons.

Substrate Tolerances

To facilitate a tile installation that will meet ANSI finish flatness requirements or a stone installation that will meet MIA finish flatness requirements (see “Flatness and Lippage”), the installation substrate must meet the following flatness tolerances per ANSI A108.02 and MIA’s DSDM.

Substrate Tolerances for Mortar Bed Methods and Self-Leveling Methods

For thick-bed (mortar bed) ceramic and stone tile installations and self-leveling methods: maximum allowable variation in the substrate prior to the installation of the mortar bed or self-leveling material— $\frac{1}{4}$ " in 10' from the required plane.

Substrate Tolerances for Thin-Bed Methods

For thin-bed ceramic tile installations when a cementitious bonding material will be used, including mortar for large and heavy tile (formerly medium bed mortar): maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is

$\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length or longer, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. For modular substrate units, such as plywood panels or adjacent concrete masonry units, adjacent edges cannot exceed $\frac{1}{32}$ " difference in height.

For thin-bed ceramic tile installations when an organic adhesive or epoxy adhesive will be used: maximum allowable variation in the tile substrate is $\frac{1}{16}$ " in 3' from the required plane with no abrupt irregularities greater than $\frac{1}{32}$ ".

Thin-bed stone tile installations: maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane.

Project specifications shall include a specific and separate requirement to bring the substrate into compliance if a thin-bed method is specified but substrate does not meet the flatness requirements.

See also: Disparity Between Concrete Flatness Tolerances Based on F-Numbers and the 10-Foot Straightedge Method and Substrate Tolerances and Large Tile.

Substrate Tolerances and Large Tile

As tile size increases, the negative effect of substrate irregularities is compounded. If specifying a thin-bed method, project specifications should include a separate specification and requirement (such as a pourable underlayment) to bring the substrate into compliance if the substrate does not meet the required flatness tolerance. Alternatively, when specifying tile with any edge longer than 15" consider specifying a recessed installation substrate and a mortar bed (thick-set) method to produce a tile substrate that meets the more stringent flatness requirement for large format tiles. There is no “medium bed installation method” that can be used to flatten the substrate while installing the tile, as mortar (including LHT mortar) is not intended for truing or leveling substrates or the work of others.

See also: Disparity Between Concrete Flatness Tolerances Based on F-Numbers and the 10-Foot Straight-edge Method and Dry Set Mortar For Large and Heavy Tile (LHT Mortar), Formerly *Medium Bed Mortar*.

Substrate Tolerance When More Stringent Finish Tolerance is Desired

Should the architect/designer require a more stringent finish tolerance (e.g., $\frac{1}{8}$ " in 10'), the substrate specification must reflect that tolerance, or the tile specification must include a specific and separate requirement to bring the substrate into compliance with the desired tolerance.

Disparity Between Concrete Flatness Tolerances Based on F-Numbers and the 10-Foot Straightedge Method

Division 3 project specifications typically require concrete substrates to comply with floor flatness (F_F) tolerances based on the ASTM E1155 Standard Test Method to Determine Floor Flatness and Floor Levelness Numbers. A floor's F_F value reflects the aggregate of many measurements and is an indication of the overall flatness of the concrete at the time of measurement. A specified overall flatness SO_{F_F} of 20 is considered "conventional," while an SO_{F_F} of 35 is considered "flat." To establish if the concrete substrate meets the specified F_F the ASTM E1155 test is performed.

By contrast, Division 9 project specifications typically incorporate ANSI A108.02 criteria and as such require areas to receive tile to meet flatness tolerances based on measurements taken with a 10-foot straightedge, where the tolerance is measured as a gap between the straightedge and the floor, e.g., $\frac{1}{4}$ " in 10'. Unlike an F_F number, where results are aggregated, straightedge measurements are used individually, and each area exhibiting a gap greater than the allowed tolerance is out of compliance with the required substrate flatness.

Because an F_F value is derived from many measurements, concrete that meets a specified F_F of 35 will typically have areas that do not meet the required flatness tolerance for tile. This is particularly true when larger tiles will be installed because of the tighter tolerance that applies—the maximum allowable variation for any areas where tiles with at least one edge 15" in length or longer will be installed is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. For tiles with all edges shorter than 15" the maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. If these tolerances as specified in ANSI A108.02 are not met, the tile contractor cannot provide an installation that complies with tile industry tolerances for flatness and lippage without additional effort and compensation for first bringing the substrate into compliance.

In addition to the lack of correlation between the two methods for measuring concrete flatness, there are other provisions of the ASTM E1155 method that are problematic in consideration of the flatness requirements for tile. The method requires measurements be taken within 72 hours of concrete placement, before concrete curling and shrinkage resulting from the curing process has culminated. While the concrete may meet the tolerance at the time of measurement, the flatness can change significantly afterward, generally becoming less flat, not more. Additionally, no measurements are taken at construction, isolation, or control joints; at column block-outs; or within 2 feet of the perimeter of the slab; these are typically the areas with the greatest amount of variation due to curling.

Therefore, a concrete substrate that meets specified Division 3 F_F criteria will likely not be suitably flat to receive tile as defined in ANSI A108.02 and Division 9. Accordingly, a separate specification and requirement is often necessary to bring the substrate into tolerance for tile, with the amount of substrate flattening required dependent on how close the concrete is to meeting the A108.02 flatness criteria at the time of tile installation.

Including a separate requirement helps avoid change orders. If such substrate preparation is not separately and specifically required and included in bid proposals, the tile contractor assumes a suitably flat substrate will be provided. Industry standards for tile finish flatness and lippage do not apply if the project owner does not provide a substrate that meets required ANSI A108.02 substrate flatness tolerances and chooses not to correct substrate flatness issues. See also: Substrate Tolerances and Large Tile.

Substrate Flatness Tolerance and Framed Wall Construction

In framed wall construction, where framing supports or straps are needed for mounted fixtures (grab bars, mirrors, towel dispensers, etc.), such must be located between studs. When supports or straps are installed over studs, the thickness of the supports and the fasteners used to attach them will cause flatness or plumb deviations, and studs must be shimmed out by the framing contractor sufficiently to compensate for the thickness of the supports and anchors.

Alternately, project specifications can include a separate requirement for the tile contractor to bring out-of-tolerance walls into tolerance. However such is not included unless clearly and additionally specified and included in bid proposals. Industry requirements for tile finish flatness and

lippage do not apply if the project owner does not provide a substrate that meets minimum flatness requirements and chooses not to correct substrate flatness issues. See also: Substrate Tolerances and Large Tile.

Maximum Allowable Deflection for Framed Walls

Walls intended for ceramic tile and stone installations shall meet applicable building code requirements.

“Equivalent Gauge” Steel Framing for Drywall (Commonly Referred to as “EQ” Drywall Studs)

For tile and stone installations on cementitious backer board fastened to steel studs, American National Standard Specifications for the Interior Installation of Cementitious Backer Units (A108.11) call for 20 gauge structural steel studs. Similar criteria are used for gypsum board and other backer units in tile and stone applications. According to steel stud industry standards, 20 gauge structural (load-bearing) steel studs have a minimum base metal thickness of 0.0329" and 20 gauge drywall (nonstructural, non-load-bearing wall) studs have a minimum base metal thickness of 0.0296". Some gypsum board and backer board manufacturers require the use of 20 gauge structural studs for tile and stone installations as specified by ANSI A108.11, while others allow the use of 20 gauge drywall studs.

On interior walls with a tile or stone finish, gypsum board and backer board manufacturers commonly do not support the use of steel studs with less than 0.0296" base metal thickness. This includes the use of “equivalent gauge” steel drywall framing, also known as “EQ” drywall studs, typically marketed and engineered for interior drywall applications where painted drywall is the intended finished surface.

Although referred to as “equivalent,” the base metal thickness for “EQ” drywall studs is 0.019" to 0.024" (approximately two-thirds the thickness of 20 gauge structural and 20 gauge drywall studs.) Use of “EQ” drywall studs in tile or stone applications can lead to problems with wall deflection and overall flatness, screw spin-out and stripping of the framing, torsional effects, stud flange bending, and stud warpage.

If considering “EQ” drywall studs for use in a tile or stone installation, work with a project engineer, structural engineer, and/or design professional to ensure that appropriate testing and engineering analysis has been performed to confirm the suitability of the “EQ” drywall studs for the specific application, and confirm with backer

board manufacturer. If such an installation is pursued, consider increased stud frequency, additional bracing, lighter weight tiling products, counter balancing, and/or use of special fasteners. Additionally, consider performing a small system mockup prior to board installation to evaluate that the fastening tools are properly adjusted such that fasteners are installed in a manner to avoid fastener spin out and overdriving, yet snug enough to remove gaps between connected parts. See *Specifications for the Application and Finishing of Gypsum Panel Products*, published by the Gypsum Association, for stud thickness criteria for abuse-resistant and impact-resistant gypsum panels, as the inherent density and weight of such products present similar challenges to those of tile and stone walls.

As tile is a finish applied to and relying upon the underlying structure, an inadequate substructure can cause a tile failure. In many cases, problems in the substructure may not be obvious, and the tile contractor cannot be expected to discover such. Accordingly, the installing tile contractor shall not be responsible for problems resulting from any structural installation not compliant with applicable building codes or not sufficient for the intended use or application.

LIGHTING AND TILE INSTALLATIONS

Use of wall-washer and cove-type lighting, where the lights are located either at the wall/ceiling interface or mounted directly on the wall, are popular techniques for producing dramatic room lighting effects. However, when proper backing surfaces, installation materials and methods, and location of light sources are not carefully coordinated these lighting techniques produce shadows and undesirable effects with ceramic tiles, particularly when light strikes the tile surface at a low or nearly flat angle (i.e., nearly parallel to the tile surface.) Similar shadows can be created from natural light from windows and doors side-lighting interior walls and floors, and when light shines at a low angle on exterior walls and floors, as commonly occurs in the early morning and evening.

Because such low angle lighting highlights and exaggerates normal and acceptable inconsistencies in tile and tilework, the shadow-producing light is often referred to as “critical light” or “critical lighting.” Some of the allowable and acceptable characteristics of tile and tilework that can be highlighted or exaggerated by critical lighting include:

- Die release lines on the edges of tiles
- Difference in appearance between a factory edge of a tile versus an edge that has been field-cut by scoring, grinding, or wet cutting
- Allowable warpage in the tile (see ANSI A137.1 for definition and allowances)
- Allowable lippage (see ANSI A108.02 for definition and allowances)
- Allowable variation in height between field tile and trim pieces and/or accent tiles, whether such are or are not part of the same tile line

In addition, critical lighting can worsen the appearance of tilework that does not meet the finish flatness and lippage tolerances set forth in ANSI A108.02, which is considered acceptable tile workmanship under certain specified conditions:

- Tiled floors sloping to drains (see ANSI A108.02)
- When the project owner does not provide a substrate that meets required flatness tolerances for tile nor contract the tile contractor to correct substrate flatness defects (see ANSI A108.01 and Disparity Between Concrete Flatness Tolerances Based on F-Numbers and the 10-Foot Straightedge Method in this *Handbook*)

To minimize the undesirable effects of critical lighting:

- Place lighting such that it will decrease or eliminate the undesirable effects of critical lighting, and install permanent lights prior to tile installation to provide the installer the maximum opportunity to reduce undesirable shadows.
- Reduce the amount of inherent or allowable lippage by ensuring substrates meet required flatness tolerances for ceramic tile, for example by: specifying a mortar bed, pourable underlayment, or other tile substrate that facilitates a flat tile installation; including adequate allowance in the tile specification for substrate preparation; and specifying the trade responsible for required alterations to a substrate that does not meet flatness tolerances for tile.
- Reduce the amount of inherent or allowable lippage by specifying tile with minimal warpage, such as rectified tile per ANSI A137.1.
- Minimize the effect of lippage due to warpage by specifying wider grout joints, cushioned or beveled edge tile, and tile sizes and patterns that minimize lippage due to warpage, for example avoid offset or brick-joint patterns or specify a maximum 25% or 33% offset (see ANSI A108.02).

MORTAR APPLICATION AND COVERAGE

Mortar Coverage for Ceramic Tile

Average contact area for dry areas is 80% and for wet areas is 95%. Mortar coverage is to be evenly distributed to support edges and corners.

It is not possible or practical to achieve 100% coverage consistently and such should not be specified.

Mortar Coverage for Natural Stone Tile

Mortar coverage must be sufficient to prevent cracks in the stone resulting from voids in the setting bed. In dry and wet areas, the minimum coverage is 95% with no voids exceeding 2 square inches and no voids within 2" of tile corners. All corners and edges of the stone tiles must be fully supported, and back-parging, or back-buttering, is recommended in all areas. Coating the back of the tile, however, does not constitute coverage, which is the area where the mortar makes contact with the tile and the substrate.

It is not possible or practical to achieve 100% coverage consistently and such should not be specified.

Directional Troweling

To ensure proper coverage of the bonding surface of 8" x 8" and larger tiles and to provide full support of edges and corners, select a notched trowel sized to facilitate the proper coverage. Key the mortar into the substrate with the flat side of the trowel. Comb with the notched side of the trowel in one direction. Firmly press tiles into the mortar and move them perpendicularly across the ridges forward and back to flatten the ridges and fill the valleys. This method can produce maximum coverage, with the corners and edges fully supported, without back-buttering or beat-in. Periodically remove and check a tile to ensure proper coverage is being attained.

Excessive or Nonuniform Depth of Mortar

Many stone varieties, particularly the softer marbles, limestones, and travertines, are extremely vulnerable to nonuniform shrinkage of cement mortar. Uneven mortar shrinkage during curing can produce a fine but visible crack in the stone. This is also true for larger glass tiles. To avoid this, the mortar must be applied in uniform thickness, and within the minimum and maximum thickness allowed by the manufacturer. Substrate preparation, or flattening, is required if the substrate does not meet the substrate tolerances. Mortar bed and self-leveling

methods may be a good choice when larger glass tiles or such stones have been selected.

High-Porosity Stone Tile

Installing high-porosity stones in hot, dry climates may require that the stone be presoaked prior to installation to prevent the stone from wicking excessive amounts of water out of the mortar and inhibiting hydration of the cement needed for bonding. Alternately, rapid-setting mortar can be used.

FLATNESS AND LIPPAGE

Flatness for Ceramic and Stone Tile Installations

The finish flatness requirement for ceramic tile installations is $\frac{1}{4}$ " in 10' from the required plane according to ANSI A108.02. The finish flatness requirement for stone tile installations is $\frac{1}{8}$ " in 10' from the required plane according to MIA.

Lippage in Natural Stone Tile Installations

Lippage is a condition where one edge of a tile is higher than an adjacent tile, giving the finished surface an uneven appearance. Lippage in stone tile flooring is accentuated from what would be perceived in a ceramic tile installation for several reasons. First, natural stones tend to be installed with tighter joints, particularly because some stones require narrower joints to allow for the use of unsanded grout. Second, natural stones typically have slight or no chamfer at their edges. Third, many natural stones have a high-gloss, polished finish.

Industry standards limit lippage between adjacent units of smooth-finished natural stone flooring to $\frac{1}{32}$ ". When this is not achieved, there is the option of grinding the stone tiles in place to eliminate the lippage. This work must be done by skilled, experienced technicians, with care taken to avoid a wavy-looking finished floor. In some cases, installing contractors plan to grind the finished floor regardless of the lippage amount, usually per the requirement of the client. Lippage should still be minimized to the extent possible during installation to avoid extremely thin stone sections after grinding.

Lippage in Ceramic Tile Installations

Lippage is a condition where one edge of a tile is higher than an adjacent tile, giving the finished surface an uneven appearance. Lippage is inherent in all ceramic installation methods and may also be unavoidable due to the tile tolerances, in accordance with ANSI A137.1.

The following is excerpted from ANSI A108.02—2017, Section 4.3.7:

4.3.7 Lippage—guidelines, explanation, and caution: Lippage refers to differences in elevation between edges of adjacent tile modules. These differences or perception thereof are influenced by many factors such as:

A) The allowable thickness variation of the tile modules when judged in accordance with manufacturing standards.

B) The allowable warpage of the tile modules.

C) The spacing or separation of each tile module, which would influence a gradual or abrupt change in elevation.

D) Angle of natural or manufactured light accentuating otherwise acceptable variance in modules.

E) Highly reflective surfaces of tile modules accentuating otherwise acceptable variance in modules.

The following chart is a guideline for identifying acceptable lippage—in addition to the inherent warpage of tile manufactured in accordance with ANSI A137.1—for typical installations of tile:

Tile Type	Tile Size (in.)	Joint Width (in.)	Allowable Lippage (in.)
Glazed Wall/Mosaics	1 × 1 to 6 × 6	$\frac{1}{16}$ to $\frac{1}{8}$	$\frac{1}{32}$
Quarry	6 × 6 to 8 × 8	$\frac{1}{4}$ or greater	$\frac{1}{16}$
Pressed Floor and Porcelain Tiles	All	$\frac{1}{16}$ to less than $\frac{1}{4}$	$\frac{1}{32}$
Pressed Floor and Porcelain Tiles	All	$\frac{1}{4}$ or greater	$\frac{1}{16}$

CAUTION—This chart does not apply to tiled floors sloping to drains. Lippage will be present when using tiles 6 in. × 6 in. and larger over interior and exterior conical surfaces sloped to drains. The larger the tile unit surface area, the greater the lippage. Cutting the individual units can reduce the amount of lippage but may not eliminate lippage. Using smaller units in sloping areas will reduce lippage.

End of Excerpt

GROUT JOINT SIZE, LAYOUTS, AND PATTERNS

Minimum Grout Joint Width

The minimum required joint width for ceramic tile and natural stone tile is $\frac{1}{16}$ " Setting ceramic or stone without a grout joint of at least $\frac{1}{16}$ " often referred to as a butt joint, does not provide sufficient accommodation for dynamic building movement, differential thermal expansion, or allowable variation in fabrication or manufacturing.

ANSI Grout Joint and Offset Pattern Requirements for Ceramic Tile Installations

The following criteria are excerpted from ANSI A108.02—2017, Section 4.3.8 regarding grout joint size, particularly in relation to the tile size, dimensional precision, and offset pattern:

4.3.8 Grout joint size: To accommodate the range in facial dimensions of the tile supplied for a specific project, the actual grout joint size may, of necessity, vary from the grout joint size specified. The actual grout joint size shall be at least three times the actual variation of facial dimensions of the tile supplied. Example: for tile having a total variation of $\frac{1}{16}$ in. in facial dimensions, a minimum of $\frac{3}{16}$ in. grout joint shall be used. Nominal centerline of all joints shall be straight with due allowances for hand-molded or rustic tiles. In no circumstance shall the grout joint be less than $\frac{1}{16}$ in.

4.3.8.1 Running bond/brick joint patterns: For running bond/brick joint patterns utilizing tiles (square or rectangular) with any side greater than 15 in., the grout joint shall be, on average, a minimum of $\frac{1}{8}$ in. wide for rectified tiles and, on average, a minimum of $\frac{3}{16}$ in. wide for calibrated (non-rectified) tiles. The grout joint width shall be increased over the minimum requirement by the amount of edge warpage on the longest edge of the actual tiles being installed. For example, for a rectified tile exhibiting $\frac{1}{32}$ in. edge warpage on the longest edge, the minimum grout joint for a running bond/brick joint pattern will be $\frac{1}{8}$ in. + $\frac{1}{32}$ in. or $\frac{5}{32}$ in., on average. Of necessity, in any installation, some grout joints will be less and some more than the average minimum dimension to accommodate the specific tiles being installed.

4.3.8.2 Running bond/brick joint and any offset pattern: For running bond/brick joint and any offset patterns (i.e. non-continuous grout joints) utilizing tiles (square and/or rectangular) where the side being offset is greater than 15 in. (nominal dimension), the offset pattern will be a maximum of 33% unless otherwise specified by the tile manufacturer. If an offset greater than 33% is specified, specifier and owner must approve mock-up and lippage.

End of Excerpt

Tile Layout Considerations

Basic provisions for tile layout are given in ANSI A108.02 Section 4.3, however such may not be practical or applicable under the following conditions:

- The size and configuration of the room and the size of the tile make it impossible to center the layout in all aspects or avoid cut tiles less than $\frac{1}{2}$ tile.
- The tile layout is continuous, flowing into multiple spaces, making it impossible to center the layout in all aspects or avoid cut tiles less than $\frac{1}{2}$ tile.
- The overall layout and/or aesthetics are improved by laying out the tiles such that the layout is not centered in all aspects and/or not all cut tiles are at least $\frac{1}{2}$ tile, for example to place a full tile or larger cut tile, or decorative element, in a high visibility location.
- Tile waste can be dramatically reduced using a layout that is not centered in all aspects and/or does not have any cut tiles less than $\frac{1}{2}$ tile.

The layout preferences of the design professional should be well defined for each space prior to bidding. If a layout is not provided by the design professional prior to bidding, the tile contractor may, of necessity, determine the layout based on the space, tiles, and pattern specified.

System Modularity

Nominal sizes only provide a general idea of tile size (see ANSI A137.1) and cannot be relied upon as an indicator of size compatibility or pattern compatibility with other tiles having the same nominal size, including for tiles from the same tile line. Grout joint sizing for patterns can only be determined based on actual tiles ready for installation.

Per ANSI A137.1 system modularity is defined as follows: “tiles of various nominal dimensions are sized so that they may be installed together in patterns with a common specified grout joint width.” System modularity is not a required or standardized tile property, although various trade names exist for common modular patterns (pinwheel, ashlar, hopscotch, etc.) While tiles manufactured to be installed in a modular pattern will have both the pattern and suggested grout joint width provided by the manufacturer, the specified grout joint width may not be appropriate for the site conditions or the size variations in the actual tiles supplied for installation. Adjusting the grout joint width may be required to accommodate the actual tiles, and, because of site conditions and size variations in the tiles, some grout joints will be wider than others. This is a necessary fact of the overall modular layout.

Similarly, when the design professional creates a modular pattern using tiles that are not specifically manufactured for a pattern, some grout joints will of necessity be wider than others. Verifying system modularity and specifying the achievable grout joint for the pattern and actual tiles to be installed is the responsibility of the design professional.

If grout joint alignment from floor to wall is desired (i.e., carrying grout joints continuously from a floor onto adjoining walls), the design professional must confirm suitability of such based on actual tiles to be installed. If grout joint alignment cannot be accommodated with the actual tiles, the tile contractor may, by necessity, reasonably adjust the pattern, for example by “breaking the joint” at the floor/wall interface. Tiles should not be field-cut to size to accomplish modular patterns or to align grout joints, as field-cut edges will be dissimilar from factory edges and cannot be held to the same squareness tolerance.

FINISHED TILEWORK

Protecting New Tilework

To avoid damage to finished tilework, schedule floor installations to begin only after all structural work, building enclosure, and overhead finishing work, such as ceilings, painting, mechanical, and electrical work, are completed. Keep all traffic off finished tile floors until they have fully cured. Builder shall provide up to ¾"-thick plywood or OSB protection over nonstaining kraft paper to protect floors after installation materials have cured. Covering the floor with polyethylene or plywood in direct contact with the floor may adversely affect the curing process of grout and latex/polymer modified portland cement mortar.

Maintenance

All tile installations (especially exterior installations, which include the movement joint sealant) require periodic inspection and maintenance by the owner. Consult material manufacturers and maintenance product manufacturers for recommended procedures.

Visual Inspection of Tilework

All components of a tile installation, including but not limited to the substrate, the tile, the installation materials, and the workmanship have tolerances, allowances, and industry best practices that govern the determination of acceptable work and the visual and aesthetic appearance of the finished installation. All of these factors shall be taken into consideration when compiling punch lists or deficiency lists.

When visually inspecting finished ceramic, stone, and glass tile installations, do so without magnification under the permanent intended lighting (artificial and/or natural) and without the use of additional lighting such as flashlights, spot lights, or temporary lights. View the installation 36" from walls and 60" or normal standing height from floors. Recognizing the hand-built aspect of tile installations, any aesthetic concerns not visible at these distances (but apparent at closer distances) are acceptable under industry best practices.

Refer to the following industry-recognized publications and standards for details on tolerances and allowances in tile and tilework:

- **Finished flatness:** Allowances are provided in ANSI A108.02; see also "Substrate Requirements" and "Flatness and Lippage" in this *Handbook*.
- **Allowable tile warpage, wedging, and facial dimensions:** Allowances are provided in ANSI A137.1 and ANSI A137.2.
- **Effects of lighting on installation appearance:** See "Lighting and Tile Installations" in this *Handbook*.
- **Workmanship, cutting, and fitting:** Allowances are provided in ANSI A108.02.
- **Tile layout, system modularity:** See "Grout Joint Size, Layouts, and Patterns" in this *Handbook*.
- **Grout joint size:** Minimum size and related allowances are provided in ANSI A108.02; see also "Grout Joint Size, Layouts, and Patterns" in this *Handbook*.
- **Shade variation in ceramic tile:** Allowances and related information are provided in ANSI A137.1; see also "Ceramic Tile Selection Guide" in this *Handbook*.
- **Shade variation in natural stone tile:** Provisions are given in the *Dimension Stone Design Manual* published by MIA; see also "Natural Stone Tile Selection and Installation Guide" in this *Handbook*.
- **Facial and structural defects in glass tile:** Allowances and related information are provided in ANSI A137.2; see also "Glass Tile Selection and Installation Guide" in this *Handbook*.
- **Mortar coverage:** Allowances are provided in ANSI A108.02; see also "Mortar Application and Coverage" in this *Handbook*.
- **Hollow-sounding tile:** See "Membrane Selection Guide" in this *Handbook*.
- **Lippage:** Allowances are provided in ANSI A108.02; see also "Substrate Requirements" and "Flatness and Lippage" in this *Handbook*.

ACCESSIBILITY

When ceramic tile is used as the flooring surface, design professionals should consider the following, based on ANSI A108.01 and A108.02, where accessibility is a primary consideration.

Changes in Level

Changes in level up to $\frac{1}{4}$ " may be vertical and without edge treatment. Changes in level between $\frac{1}{4}$ " and $\frac{1}{2}$ " shall be beveled with a slope no greater than 1:2. Changes in level greater than $\frac{1}{2}$ " shall be accomplished by means of a ramp. The maximum slope of a ramp in new construction shall be no greater than 1:12. Ramps where space limitations prohibit this may have slopes and rises as follows: a slope between 1:10 and 1:12 is allowed for a maximum rise of 6", and a slope between 1:8 and 1:10 is allowed for a maximum rise of 3". A slope steeper than 1:8 is not allowed.

Flatness and Lippage

With regard to flatness, the amount of substrate variation generally is reflected in the finished tile installation. For any application, a tiled floor should comply with the flatness requirements in ANSI A108.02: no variations exceeding $\frac{1}{4}$ " in 10' from the required plane. Conformance to this standard requires that substrates conform to the following: For tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. For modular substrate units, such as plywood panels, adjacent edges cannot exceed $\frac{1}{32}$ " difference in height. Additionally, the effect from irregularities in the substrate increases as the tile size increases. A substrate tolerance of $\frac{1}{8}$ " in 10' may be required.

Because the flatness of wood and concrete substrates can change over time, it is recommended that the designer make provisions for evaluating substrate flatness just before installation of the tile. Project specifications should make clear which trade is responsible for the required alterations if the subfloor is found not to be in compliance with the flatness requirements. Alternately, the designer may choose to specify a mortar bed method or a pourable underlayment installed by the tile contractor to ensure substrate flatness sufficient to facilitate a flat tile installation.

Lippage is most significantly influenced by substrate flatness and tile warpage. Allowable lippage is calculated by adding the actual warpage of the tile supplied, plus either $\frac{1}{32}$ " or $\frac{1}{16}$ " based on tile type and size and grout joint width (see "Flatness and Lippage"). Specifying wider grout joints allows for more gradual changes. To minimize lippage due to warpage, specify tile that meets the dimensional requirements for rectified tile according to ANSI A137.1, and use a larger grout joint. Some patterns, such as a 50% offset (brick-joint) pattern, accentuate the effects of warpage and result in more lippage than other patterns would. Cushioned or beveled-edge tiles can minimize the effects of lippage.

In addition to taking measures to ensure a flat substrate, designers should consult with the tile manufacturer to discuss grout joint size and tile and pattern selections that will minimize issues relating to flatness and lippage. See also "Grout Joint Size, Layouts, and Patterns."

WET AREAS GUIDELINES

The installation methods in this *Handbook* are rated for water exposure suitability—these ratings are listed under the Environmental Exposure Classifications subhead within each method as well as in the Environmental Exposure Classifications chart. However, this rating system cannot predict the actual amount of water any installation will be exposed to, nor compensate for water exposure exceeding the method's rating.

The design professional must choose an installation method suitable for the amount of water the installation will be subjected to; damage can result from water exposure exceeding the method's Environmental Exposure Classifications rating. Where the use of a waterproof membrane is optional, the rating assumes the optional membrane will not be used. If use of a waterproof membrane is intended in these applications, to provide a more water-resistant installation, it must be clearly specified.

When selecting a method, in addition to the use of the tiled area, consider maintenance practices that will be employed. For example, commercial restrooms and locker rooms typically do not require waterproofing in order to be suitable for their intended uses and normal maintenance; typically these are limited water exposure (Res2/Com2) applications. However, if such areas are to be hosed down or otherwise saturated, specify a wet area (Res3/Com3) method. Wet area installation methods typically incorporate waterproofing to contain and evacuate water and to protect building materials. The two general categories of waterproof installation methods are:

- Use of an unbonded water-containment membrane (referenced in this *Handbook* as an unbonded shower pan membrane).
- Use of a bonded waterproof membrane meeting ANSI A118.10.

A shower pan membrane is a loose laid, or unbonded, liner that is placed below a mortar bed, with the mortar bed receiving the tile. Acceptable shower pan membrane materials are listed in ANSI A108.01 Section 3.6 and include plastics such as polyvinyl chloride (PVC) and chlorinated polyethylene (CPE), metals such as lead and copper, and hot-mop systems, which employ layers of asphalt or coal-tar saturated roofing felt. Shower pan membranes connect into drains at the clamping ring level. Refer to B414, B415, B420, B426, B431, and F121 for shower pan membrane assemblies.

Bonded waterproof membranes can be sheet materials, or roll-on or trowel-on materials that dry/cure to form a

waterproof membrane. These membranes also connect to drains, either at the clamping ring level, or just below the tile when an integrated bonding flange is used. Because these membranes can be bonded to various substrates, and tile is bonded to the membrane, they allow for thin-bed tile installation. Refer to B421 and B422 for bonded waterproof membrane assembly specifications.

Both systems manage water. The following are the essential requirements and considerations for designing wet areas.

Incorporation of a Drain/Slope to Drain

To fully evacuate water, shower pan membranes and bonded waterproof membranes must slope to and connect with a drain. Plumbing code typically requires membranes to be sloped a minimum of $\frac{1}{4}$ " per foot and extend at least 3" above the height of the curb or threshold. Account for the perimeter floor height required to form adequate slopes. Membranes must be installed over other horizontal surfaces in wet areas subject to deterioration, like shower seats. They must be sloped and configured so as to direct water to the membrane connected to the drain.

Open Weep Holes

The weep holes of clamping drains enable water to pass from the membrane into the plumbing system. Crushed stone or tile or other positive weep protectors placed around/over weep holes prevent their blockage.

Membrane Connection with Drain or Integrated Bonding Flange

To form a watertight seal, membranes must have adequate contact with the clamping ring of the drain or with the bonding area of an integrated bonding flange.

Membrane Cuts and Penetrations

Membranes must be protected to prevent punctures resulting from traffic on the membrane before the mortar bed is installed (for shower pan membranes) or before the tile is installed (for bonded waterproof membranes). For punctures that do occur, the membrane must be replaced or repaired according to the membrane manufacturer's directions for repairs. Ensure the integrity of any repairs by water testing the repaired membrane.

Backer board cannot be fastened to studs lower than 3" above the finished curb height, nor fastened to the top or the inside of a curb. Backer board on shower seats must be topically waterproofed due to the use of fasteners.

In-Corners, Out-Corners, and Seams

Shower pan membrane in-corners should be folded not cut. For out-corners, such as where the shower curb meets the jamb, membrane manufacturers typically offer preformed out-corners to better enable wrapping of the membrane at the curb/jamb interface. For sheet-type bonded waterproof membranes applied topically, pre-made in-corners and out-corners enable waterproofing of corners without excessive material thickness that would result from folding. Sheet membranes in large areas are seamed, bonded, or otherwise welded together to form a continuous membrane.

Liquid-Applied and Trowel-Applied Bonded Waterproof Membranes

These membrane types are manufactured in the field by the installer who applies the waterproofing material. These products require a minimum wet film thickness and have specified cure/dry time requirements. Many membranes of this variety incorporate a mesh that is embedded in the wet material during installation. Mesh may be required over the entire surface to be waterproofed or only in corners and/or joints.

Configuration of Shower Receptor Components

When a shower pan membrane system is employed, some backer board types must be installed with the board held out of the mortar bed due to the saturation that occurs below this level. Vapor retarder membranes fastened to studs must weather-lap the shower pan membrane or flange of the tub or prefabricated shower receptor.

Whether a shower pan membrane or a bonded waterproof membrane system is used, the membrane must completely wrap the curb, and the jamb must be waterproofed to its outside edge a minimum of 3" above the curb. Curb and jamb waterproofing must be seamed together without breach to form a continuous barrier.

Performing a Water Test

Where complete waterproofing is required such as in showers, water testing of the membrane, by the installing contractor, is recommended and may be required by applicable plumbing code.

FLOOR TILING INSTALLATION GUIDE

Performance Level Requirement Guide and Selection Table

Based on results from ASTM Test Method C627 Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson Type Floor Tester, all methods are material dependent—performance rating should not exceed rating of weakest component—consult each material manufacturer for individual component rating. Tests to determine performance levels utilized representative products meeting recognized industry standards.

Consideration must also be given to wear properties of surface of tile selected, tile size, and coefficient of friction. Unglazed standard grade tile will give satisfactory wear or abrasion resistance in installations listed. Glazed tile or soft-body, decorative, unglazed tile should have the manufacturer's approval for intended use. Color, pattern, surface texture, and glaze hardness must be considered in determining tile acceptability on a particular floor.

Those methods also applicable to stone tile installation will carry a similar rating when stone tiles with adequate compressive strength, flexural strength, and resistance to abrasion are used.

SERVICE REQUIREMENTS	INSTALLATION SUBSTRATE					
Find required performance level and choose installation method that meets or exceeds it. Performance results are based on ceramic tile meeting ANSI A137.1 or tile designated by tile manufacturer.	CONCRETE			WOOD		
EXTRA HEAVY Extra heavy and high-impact use in food plants, dairies, breweries, and kitchens. Requires quarry tile, packing house tile, or tile designated by tile manufacturer. (Passes ASTM C627 cycles 1 through 14.)	F101 F102 F111 F112 F113 F113A	F114 F115 F115A F116E F128 ^e F131	F132 F133 F134 F205 F205A RH117			
HEAVY Shopping malls, stores, commercial kitchens, work areas, laboratories, auto showrooms and service areas, shipping/receiving, and exterior decks. (Passes ASTM C627 cycles 1 through 12).	F103 F121	F103B ^f	F104			
MODERATE Normal commercial and light institutional use in public space of restaurants and hospitals. (Passes ASTM C627 cycles 1 through 10.)	F122 F200A RH111 RH112A RH116	F122A RH110 RH111A RH115 RH116A	F200 RH110A RH112 RH115A			
LIGHT Light commercial use in office space, reception areas, kitchens, and bathrooms. (Passes ASTM C627 cycles 1 through 6.)	F128 ^e			F105 F143 ^d F150 ^d F175 RH122 RH135 ^{b,c}	F141 F144 ^{b,c} F160 F180 RH123 RH141	F145 F146 F170 F250 ^d RH130 ^d
RESIDENTIAL Kitchens, bathrooms, and foyers. (Passes ASTM C627 cycles 1 through 3.)	F116O TR711 ^a	F135	F136	F142 F147 F150 ^d F155 RH130 ^d	F143 ^d F148 F151 F185 RH135 ^{b,c}	F144 ^{b,c} F149 F152 F250 ^d RH140

- a. Tile bonded to existing resilient flooring with epoxy adhesive.
- b. Minimum 7/16"-thick cement backer board or minimum 1/4"-thick fiber-cement backer board tested.
- c. Minimum 1/4"-thick cement backer board can be used for residential applications over minimum 1 1/2"-thick subfloor; minimum 1/4"-thick cement backer board can be used for light commercial applications over minimum 2 3/32"-thick subfloor.
- d. Requires minimum 1 1/2" exterior glue plywood underlayment for light rating; 1 3/32" exterior glue plywood underlayment may be used for residential rating.
- e. Rated light for mosaic tile and extra heavy for 12" x 12" and larger porcelain tiles.
- f. Not all drainage mat systems will receive heavy rating. Consult drainage mat manufacturer.

ENVIRONMENTAL EXPOSURE CLASSIFICATIONS

The end user significantly affects the amount of water and vapor an installation will be exposed to. Examples provided below and the classifications assigned to the individual methods are guidelines only and are not meant to be all inclusive. Base installation method selection on actual exposure levels, and consult with product manufacturers and their specifications. In methods where inclusion of a waterproof membrane is optional, the design professional must clearly specify that a membrane is desired. Optional membranes are not included unless clearly specified.

Res1 (Residential Dry): Tile surfaces that will not be exposed to moisture or liquid, except for cleaning purposes. Includes areas adjacent to R2 areas. Examples: Floors in rooms with no direct access to the outdoors and no wet utility function, such as living rooms, dining rooms, and bedrooms; dry area ceilings, soffits, decorative/accent walls, fireplaces, some backsplashes and some wainscots.

Res2 (Residential Limited Water Exposure): Tile surfaces that are subjected to moisture or liquids but do not become soaked or saturated due to the system design or time exposure. If waterproofing is desired, it must be clearly specified. Includes areas adjacent to R3 areas. Examples: Floors in bathrooms, kitchens, mudrooms, laundry, and foyers, where water exposure is limited and/or water is removed; some backsplashes, some wainscots, some countertops.

Res3 (Residential Wet): Tile surfaces that are soaked, saturated, or regularly and frequently subjected to moisture or liquids. Examples: Shower floors; floors and other horizontal surfaces where water is not removed or drained, such as some countertops; tub walls, shower walls, and enclosed pool area walls.

Res4 (Residential High Humidity, Heavy Moisture Exposure): Tile surfaces that are subject to continuous high humidity or heavy moisture exposure. Examples: Intermittent-use steam shower walls, ceilings, and floors.

Res5 (Residential High Temperature $\geq 125^{\circ}\text{F}$): Tile surfaces frequently subjected to water or vapor equal to or greater than 125°F . Examples: Furnace and boiler areas.

Res6 (Residential Exterior): Tile surfaces exposed to exterior conditions. When designing such installations, consider local climate and conditions including temperature and temperature fluctuations, humidity and humidity fluctuations, and freeze/thaw cycling. If waterproofing is desired, it must be clearly specified. Examples: Exterior walls, balconies, decks.

Res7 (Residential Submerged): Tile surfaces exposed

to continuous water submersion in interior or exterior conditions. Examples: Swimming pools, water features, and fountains.

Com1 (Commercial Dry): Tile surfaces that will not be exposed to moisture or liquid, except for cleaning purposes. Commercial cleaning and maintenance practices typically generate greater water exposure than residential practices. Includes areas adjacent to C2 areas. Examples: Floors in areas with no direct access to the outdoors and no wet utility function, such as hallways; dry area ceilings; soffits; decorative/accent walls; corridor walls.

Com2 (Commercial Limited Water Exposure): Tile surfaces that are subjected to moisture or liquids but do not become soaked or saturated due to the system design or time exposure. If waterproofing is desired, it must be clearly specified. Includes areas adjacent to C3 areas. Examples: Floors in bathrooms and locker rooms; some backsplashes and other walls, such as bathroom walls and wainscots where water exposure is limited and/or water is removed.

Com3 (Commercial Wet): Tile surfaces that are soaked, saturated, or regularly and frequently subjected to moisture or liquids. Includes areas adjacent to C4 areas. Examples: Tub walls, shower walls and floors, enclosed pool areas, natatoriums, gang showers, and some commercial kitchen floors and walls.

Com4 (Commercial High Humidity, Heavy Moisture Exposure): Tile surfaces that are subject to continuous high humidity or heavy moisture exposure, especially in enclosed areas. Examples: Continuous use steam shower/steam room walls and ceilings.

Com5 (Commercial High Temperature $\geq 125^{\circ}\text{F}$): Tile surfaces that are frequently subjected to water or vapor equal to or greater than 125°F . Examples: Commercial saunas, furnace and boiler areas, and some commercial kitchen floors and walls.

Com6 (Commercial Exterior): Tile surfaces exposed to exterior conditions. When designing such installations, consider local climate and conditions including temperature and temperature fluctuations, humidity and humidity fluctuations, and freeze/thaw cycling. If waterproofing is desired, it must be clearly specified. Examples: Exterior walls, balconies, decks.

Com7 (Commercial Submerged): Tile surfaces exposed to continuous water submersion in interior or exterior conditions. Examples: Swimming pools, water features, and fountains.

	Installation Method	Method Type T = Tile S = Stone	Residential (Res)							Commercial (Com)						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7
FLOORS	F101	T, S							•							•
	F102	T, S							•							•
	F103	T, S							•							•
	F103B	T, S							•							•
	F104	T, S							•							•
	F105	T, S							•							•
	F111	T, S	•	•	•			•			•	•	•			•
	F112	T, S	•	•	•			•			•	•	•			•
	F113	T, S	•	•	•			•			•	•	•			•
	F113A	T, S	•	•	•			•			•	•	•			•
	F114	T	•	•	•	•	•				•	•	•	•	•	
	F115	T	•	•	•	•	•				•	•	•	•	•	
	F115A	T	•	•	•	•	•				•	•	•	•	•	
	F116E	T	•	•	•	•	•				•	•	•	•	•	
	F116O	T	•													
	F121	T, S	•	•	•			•			•	•	•			•
	F122	T, S	•	•	•			•			•	•	•			•
	F122A	T, S	•	•	•			•			•	•	•			•
	F128	T	•	•	•	•	•				•	•	•	•	•	
	F131	T	•	•	•	•	•				•	•	•	•	•	
	F132	T	•	•	•	•	•				•	•	•	•	•	
	F133	T	•	•	•	•	•				•	•	•	•	•	
	F134	T	•	•	•	•	•				•	•	•	•	•	
	F135	T	•													
	F136	T	•													
	F141	T, S	•	•								•	•			
	F142	T	•													
	F143	T	•	•								•	•			
	F144	T	•	•								•	•			
	F145	T	•	•								•	•			
	F146	T	•	•								•	•			
	F147	T	•	•												
F148	T	•	•													
F149	T	•														
F150	T	•									•					
F151	T	•	•													
F152	T	•	•													
F155	T	•														
F160	T	•									•					

ENVIRONMENTAL EXPOSURE CLASSIFICATIONS

	Installation Method	Method Type T = Tile S = Stone	Residential (Res)							Commercial (Com)						
			1	2	3	4	5	6	7	1	2	3	4	5	6	7
FLOORS	F170	T	•	•							•	•				
	F175	T	•	•							•	•				
	F180	T	•								•					
	F185	T	•	•												
	F200	T, S	•								•					
	F200A	T, S	•								•					
	F205	T, S	•								•					
	F205A	T, S	•								•					
	F250	S	•	•							•	•				
	RH110	T, S	•	•	•		•				•	•	•		•	
	RH110A	T, S	•	•	•		•				•	•	•		•	
	RH111	T, S	•								•					
	RH111A	T, S	•								•					
	RH112	T, S	•								•					
	RH112A	T, S	•								•					
	RH115	T	•	•							•	•				
	RH115A	T	•	•							•	•				
	RH116	T, S	•								•					
	RH116A	T, S	•								•					
	RH117	T, S	•	•	•		•				•	•	•		•	
	RH122	T	•								•					
	RH123	T	•								•					
	RH130	T	•								•					
	RH135	T	•	•							•	•				
RH140	T	•								•						
RH141	T, S	•	•							•	•					
WALLS	W201	T, S							•							•
	W202E	T, S							•							•
	W202I	T, S	•	•	•		•			•	•	•		•		
	W211	T, S	•	•	•		•			•	•	•		•		
	W215	T, S	•							•						
	W221	T, S	•	•	•		•			•	•	•		•		
	W222	T, S	•	•			•			•	•			•		
	W223	T	•	•						•	•					
	W231/W241	T, S	•	•			•			•	•			•		
	W242	T	•							•						
	W243	T, S	•							•						
	W244C	T, S	•	•			•			•	•			•		
	W244E	T, S							•							•

	Installation Method	Method Type T = Tile S = Stone	Residential (Res)							Commercial (Com)							
			1	2	3	4	5	6	7	1	2	3	4	5	6	7	
WALLS	W244F	T, S	•	•			•				•	•			•		
	W245	T, S	•	•							•	•					
	W246	T, S	•	•							•	•					
	W247	T, S	•	•							•	•					
	W248	T, S	•								•						
	W260	T, S	•								•						
BATHTUBS AND SHOWERS	B411	T, S	•	•	•		•				•	•	•		•		
	B412	T, S	•	•	•		•				•	•	•		•		
	B413	T, S	•								•						
	B414	T, S	•	•	•		•				•	•	•		•		
	B415	T, S	•	•	•		•				•	•	•		•		
	B419	T, S	•	•	•						•	•	•				
	B420	T, S	•	•	•						•	•	•				
	B421	T, S	•	•	•						•	•					
	B421C	T	•	•	•						•	•					
	B422	T, S	•	•	•						•	•					
	B422C	T	•	•	•						•	•					
	B425	T, S	•	•	•						•	•	•				
	B426	T, S	•	•	•						•	•	•				
	B430	T, S	•	•	•						•	•					
	B431	T, S	•	•	•						•	•					
	B440	T, S	•	•	•		•				•	•	•		•		
	B441	T, S	•	•	•		•				•	•	•		•		
	SR613	T					•								•		
SR614	T					•											
CEILINGS	C311	T, S	•	•	•		•				•	•	•		•		
	C312	T, S	•								•						
	C315	T, S	•	•	•						•	•					
COUNTERTOPS	C511	T	•	•							•	•					
	C512	T	•	•							•	•					
	C513	T	•	•							•	•					
POOLS & WATER FEATURES	P601MB	T			•	•		•	•				•	•		•	•
	P601TB	T			•	•		•	•				•	•		•	•
	P602	T			•	•		•	•				•	•		•	•

USING THE *TCNA HANDBOOK* FOR SPECIFICATION WRITING

The *TCNA Handbook* is not a specification. The quick-reference details provide a means of simplifying and standardizing installation specifications for ceramic, glass, and stone tile. In addition to referencing *Handbook* methods, architects and specifiers should specify tile and installation materials, including specific locations of movement joints on drawings. Use American National Standards Institute (ANSI) standards for developing specifications. Specifications shall conform to applicable building codes, ordinances, trade standards and practices, and climatic conditions. Use of materials and methods not specifically designated by the architect, will, of necessity, be determined by the tile contractor.

General

Select an installation method for the given backing or substrate with the appropriate Environmental Exposure Classification, and for floors, having the required Service Rating.

Special installation procedures or proprietary installation methods or materials should be specified in accordance with manufacturer recommendations.

Product selection guides are provided to aid in the selection of the individual components of an installation: tile (ceramic, glass, stone), setting materials, grout, backer boards, and membranes. The “Field and Installation Requirements” section outlines many of the important conditions and considerations that must be provided for when specifying and installing tile.

Components of an Installation Method

Drawing: *Handbook* illustrations show the necessary components of the given tile installation method, including the installation substrate. Glass tile can be substituted for ceramic tile in the assembly if glass tile is listed as an option under Materials.

The illustrations are intentionally not to scale in order for each material and its location within the assembly to be clearly visible. Consult manufacturers for the actual dimensions of any material.

Recommended Uses: Provides typical areas or applications for the installation method.

Service Rating: Provided for floor methods only. Indicates the expected level of use (service rating) based on Robinson Floor Test (ASTM C627) results.

Environmental Exposure Classifications: Indicates the conditions in which the installation is generally expected to perform.

Typical Weight of Tile Installation: Provided for floor methods only. Indicates estimated weight the tile installation contributes to the dead load.

Limitations: Provides special considerations and restrictions.

Membrane Options: Lists the possible membrane types that can be optionally specified.

Note: For methods that require use of a membrane, this section lists the types of membranes that may be used when there is more than one option. For methods in which use of a membrane is optional, this section lists the possible membrane choices that could be specified, if use of a membrane is desired. In both cases, the job specification must clearly indicate which, if any, membrane is to be used. If using a membrane is optional, the contractor is not required to install a membrane unless it is clearly specified to do so. If using a membrane is required, the tile contractor may choose any listed membrane option in the absence of a clear specification.

Requirements: Lists important conditions and considerations.

Materials: Lists tile and installation material options that can be used and the minimum criteria the materials must meet such as ANSI, ISO, or ASTM specifications.

Note: This section lists minimum required criteria for the listed materials. If upgraded materials are desired, the job specification must clearly indicate such. When more than one type of material is listed, for example cementitious grout and epoxy grout, the job specification must clearly indicate which material is desired. If such an indication is not included, the tile contractor by necessity may choose any listed material option.

Preparation by Other Trades: Indicates the materials and/or preparation work required of other trades preceding the work of the tile contractor. ANSI A108.01 and A108.02 provide particular specifications for related trades regarding preparation for tilework.

Preparation by Tile Trade: Indicates the materials, preparations, or other requirements typically expected of the tile contractor.

Preparation by Backer Board Installers: Indicates the materials, preparations, or other requirements expected of the contractor that installs the backer board.

Movement Joint: Refers user to EJ171 movement joint guidelines.

Installation Specifications: Lists applicable ANSI

installation specifications.

Notes: Lists additional considerations that may be important in the specification or installation of the tile and installation materials for the given method.

Design Considerations When Specifying Tile

Numerous tile industry standards, guidelines, and best practices exist, which define parameters for acceptable tilework, many of which are impacted by the tiles and designs selected. Through familiarity with tile industry standards and best practices, building design professionals can factor such parameters into selection and design decisions to specify products, patterns, and installation details that will produce the desired end result.

When variation from existing standards and guidelines is desired, such must be clearly defined prior to bidding and installation and noted within project specifications as a variance from industry standards. Such variances are discouraged because they will not always be possible to meet, with the given materials and job conditions. In such cases, established tile industry ANSI standards and industry guidelines apply.

The following are the commonly referenced industry standards, guidelines, and best practices that pertain to finished tilework and serve as the defining criteria for evaluating quality of installation and workmanship unless project specifications define otherwise:

Base/cove alternatives: Appropriate trim shapes and details must be specified by the design professional or left to the discretion of the tile contractor. All details in this *Handbook* are stylized cross-sectional drawings of typical installations and are not intended to show specific treatments of the transition between vertical and horizontal tile surfaces.

Finished flatness: Tolerances for finish flatness are provided in ANSI A108.02; see also “Substrate Requirements” and “Flatness and Lippage” in this *Handbook*.

Grout joint size: Tolerances for grout joint size are provided in ANSI A108.02; see also “Grout Joint Size, Layouts, and Patterns” in this *Handbook*.

Tile layout: Workmanship with regard to layout is addressed in ANSI A108.02; see also “Grout Joint Size, Layouts, and Patterns” in this *Handbook*.

Tile patterns and modularity: See “Grout Joint Size, Layouts, and Patterns” in this *Handbook*.

Mortar coverage: Required mortar coverage is provided

in ANSI A108.02; see also “Mortar Application and Coverage” in this *Handbook*.

Effect of lighting on tilework: Natural and artificial light can dramatically affect the appearance of a tile installation; see “Lighting and Tile Installations” in this *Handbook*.

Lippage: Allowances are provided in ANSI A108.02; see also ANSI A137.1 for allowable tile warpage.

Tile warpage, wedging, and facial dimensions: Allowances are provided in ANSI A137.1.

Shade variation in ceramic tile: Allowances and related information are provided in ANSI A137.1; see also “Ceramic Tile Selection Guide” in this *Handbook*.

Shade variation in natural stone tile: Provisions are given in the Dimension Stone Design Manual published by MIA; see also Shading and Variation section within the “Natural Stone Tile Selection and Installation Guide,” in this *Handbook*.

Facial and structural defects in glass tile: Allowances and related information are provided in ANSI A137.2.

ANSI Installation Specifications

- A108.01** General Requirements: Subsurfaces and Preparations by Other Trades
- A108.02** General Requirements: Materials, Environmental, and Workmanship
- A108.1A** Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar
- A108.1B** Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar
- A108.1C** Contractor’s Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar
- A108.4** Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive
- A108.5** Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar

- A108.6 Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy
- A108.8 Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout
- A108.9 Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/Grout
- A108.10 Installation of Grout in Tilework
- A108.11 Interior Installation of Cementitious Backer Units
- A108.12 Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar
- A108.13 Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone
- A108.14 Installation of Paper-Faced Glass Mosaic Tile
- A108.15 Alternative Method: Installation of Paper-Faced Mounted Glass Mosaic Tile
- A108.16 Installation of Paper-Faced, Back-Mounted, or Clear Film Face-Mounted Glass Mosaic Tile
- A108.17 Installation of Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone

Mockups

In addition to tile industry standards and guidelines, design professionals can utilize mock ups, especially in-situ mock-ups, to see the specified products and designs executed under the given job conditions.

INSTALLER AND CONTRACTOR QUALIFICATIONS GUIDE

General

A home or any building today is one of the few things still made entirely “by hand” and every aspect of a tile installation relies on the tile contracting company and its installers. How good the finished installation looks, how well it performs, and how long it lasts are in their hands. It is for this reason that the Handbook Committee and the Tile Council of North America strongly recommend using installers who have demonstrated their commitment to their craft and taken the time to stay current with the latest materials and methods. Because tile is a permanent finish, the lowest bid should not be the driving factor, but rather who is the most qualified to perform the scope of the work specified.

Requiring a portfolio and references reflecting the installer’s/contractor’s experience, along with a bid or estimate, is a good way to ensure work of similar size, scope, and complexity has been completed. Pools, exterior facades, mortar beds, shower pans, steam showers, etc., require different skills. Matching installer ability to the project at hand requires close evaluation of their experience, training, state licensing (where applicable), and certifications/credentials (where applicable). The Ceramic Tile Education Foundation (CTEF) provides a Contractor Questionnaire that can be used to aid in evaluating and comparing contractors (www.tilecareer.com).

Various programs administered by associations, nonprofit educational organizations, unions, and private companies serve the tile industry by providing education, hands-on training, and evaluation of the skills and competency of installers and contractors. It is important to distinguish between the many programs available:

- Classroom and/or online knowledge training
- Hands-on installation skills training
- Evaluation/certification of contractor qualifications
- Evaluation/certification of knowledge
- Evaluation/certification of hands-on skills

As with all programs, the rigor and credibility of the program must also be considered.

The following nonprofit programs are well-established and recognized by the Handbook Committee (listed alphabetically):

Advanced Certifications for Tile Installers (ACT): ACT is an evaluation and certification program for tile installers in advanced, specific skills areas: large format tile installation and substrate preparation, mudwork for

walls, mudwork for floors, shower receptor (waterproof shower pan membrane, mortar bed, mortar curb) installation, membrane applications, and grouting. To pass an ACT test module, an installer must demonstrate hands-on proficiency and specific knowledge. Only installers who have already passed the Certified Tile Installer (CTI) test or those who are recognized by the U.S. Department of Labor as Journeyman Tile Layers may register for ACT testing. ACT tests were developed collaboratively by product manufacturers and industry associations including the Ceramic Tile Education Foundation (CTEF), Tile Contractors Association of America (TCAA), International Union of Bricklayers and Allied Craftworkers (IUBAC), International Masonry Institute (IMI), National Tile Contractors Association (NTCA), and Tile Council of North America (TCNA). Certification testing is administered by CTEF and IMI. For more information see www.tilecertifications.com. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Ceramic Tile Education Foundation (CTEF) Certified Tile Installer Program: CTEF tests hands-on installation skills and knowledge. Installers must achieve the minimum required score on both tests to earn the “CTEF Certified Tile Installer” designation. Contractors that employ CTEF Certified Tile Installers are listed on the CTEF website. See www.tilecareer.com for more information. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

International Masonry Institute (IMI) Contractor College Program: IMI conducts professional and technical courses for union masonry and tile contractors, which lead to certification in installation and project supervision. See www.imiweb.org for more information. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Journeyman Tile Layer Apprenticeship Programs: Installers recognized by the U.S. Department of Labor (DOL) as Journeyman Tile Layers are required to fulfill and document several years of training and on-the-job experience as apprentices to become Journeymen. The majority of these setters earn their Journeyman status through registered apprenticeship programs that are jointly-trusted by union and management trustees, although some non-union tile contractors administer their own DOL-recognized apprenticeship programs and employ journeyman tile layers. Contractors that employ union Journeyman Tile Setters can be found through the union locals that list their signatory contractors, primarily

the Bricklayer and Allied Craftworkers (BAC) and the United Brotherhood of Carpenters (UBC). See www.bacweb.org and www.carpenters.org for more information. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Natural Stone Institute (NSI) Accreditation for Natural Stone Tile Installation Contractors: The Natural Stone Institute is an internationally recognized trade association that operates an industry accreditation program for natural stone tile installation contractors. NSI Accredited companies are required to: have been in business for at least three years and have completed at least 200 projects in that timeframe, agree to a code of ethics, and have passed the NSI Accreditation exam. NSI Accredited companies are evaluated and tested with regard to best practices in installation and safety. Visit www.naturalstoneinstitute.org/gettheseal for more information.

National Tile Contractors Association (NTCA) Five Star Contractor Program: NTCA is a tile contractors association, with membership open to all tile contractors. Their Five Star program is a peer review program to recognize NTCA members who have demonstrated a track record of providing successful installations. Earning the Five Star designation requires recommendations from customers, suppliers, and peers as well as participation in continuing education, training, and safety programs. See www.tile-assn.com for more information. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Tile Contractors' Association of America (TCAA) Trowel of Excellence Program: TCAA is a contractors association for BAC signatory contractors. Its Trowel of Excellence program is a peer review program to recognize TCAA members who have demonstrated a track record of providing successful installations. Earning the Trowel of Excellence designation requires letters of reference, submittal of a detailed project description and photos, employee participation in educational programming, and proof of financial responsibility. See www.tcaainc.org for more information. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Other Programs: The Handbook Committee recognizes many qualified tile installers and contractors can be found that have not participated in the programs listed above. They are encouraged to do so, in order that consumers may more easily identify them. Similarly, the Handbook Committee recognizes there are useful training and evaluation programs for contractors and installers not listed in

this guide, such as consumer-review-based rating systems, programs offered by for-profit educational firms, and government-based programs. See also: Sample Language for Including Installer and Contractor Qualifications in Specifications.

Sample Language for Including Installer and Contractor Qualifications in Specifications

Where inclusion of installer and contractor qualifications in project specifications is desired, include the qualifications under a quality assurance section and require proof of qualifications under a submittals section. The language below may be used for the purpose of including such requirements.

Qualifications/Quality Assurance

Installing contractor is [a five-star member of the National Tile Contractors Association] [and] [or] [a Trowel of Excellence member of the Tile Contractors' Association of America].

Installing contractor's foreman or superintendent for the Project holds the International Masonry Institute's Foreman Certification¹

Installing contractor employs [Ceramic Tile Education Foundation Certified Installers] [and] [or] [installers recognized by the U.S. Department of Labor as Journeyman Tile Layers].

Individual installer(s) working for installing contractor are certified through Advanced Certifications for Tile Installers (ACT) for installation of <Insert one or more ACT certification requirements>: [Large Format Tile and Substrate Preparation] [and] [or] [Membranes] [and] [or] [Mud (Mortar Bed) Floors] [and] [or] [Mud (Mortar) Walls] [and] [or] [Shower Receptors] [and] [or] [Grouts].

Installer meets the requirements of a program identified and approved by the architect with the criteria for such program similar to or exceeding [Advanced Certifications for Tile Installers (ACT) for installation of Large Format Tile and Substrate Preparation] [and] [or] [Advanced Certifications for Tile Installers (ACT) for installation of Membranes] [and] [or] [Advanced Certifications for Tile Installers (ACT) for installation of Mud (Mortar

¹ The International Masonry Institute's Foreman Certification is available only to members of the International Union of Bricklayers and Allied Craftworkers; accordingly, only IUBAC signatory contractors can meet this requirement.

Bed) Floors] [and] [or] [Advanced Certifications for Tile Installers (ACT) for installation of Mud (Mortar Walls] [and] [or] [Advanced Certifications for Tile Installers (ACT) for installation of Shower Receptors] [and] [or] [Advanced Certifications for Tile Installers (ACT) for installation of Grout] [and] [or] [Ceramic Tile Education Foundation (CTEF) Certified Tile Installer Program] [and] [or] [International Masonry Institute (IMI) Contractor College Program] [and] [or] [Department of Labor recognized Journeyman Tile Layer Apprenticeship Programs].

Installing contractor meets the requirements of a program identified and approved by the architect with the criteria for such program similar to or exceeding [National Tile Contractors Association (NTCA) Five Star Contractor Program] [and] [or] [Tile Contractors' Association of America (TCAA) Trowel of Excellence Program].

Submittals

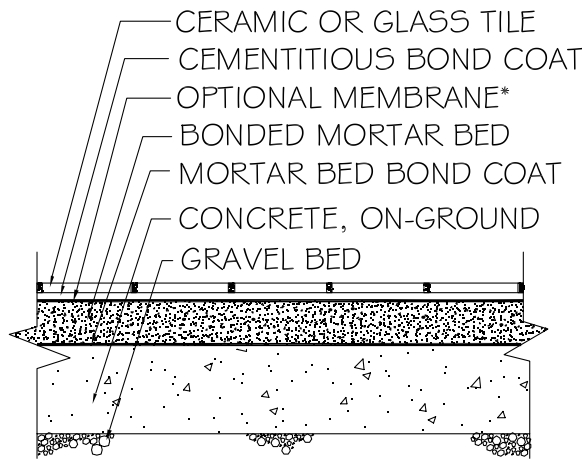
Submit certificates and other qualification data for Installer(s).

Submit certificates and other qualification data for Installing Contractor(s).

2019 | CERAMIC AND GLASS TILE INSTALLATION METHODS

F101-19

- On-Ground Concrete
- Bonded Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior slab-on-ground construction where no bending stresses occur and positive drainage below slab is provided, for example, floors, decks, or patios.
- For areas where leveling, flattening, or contouring of finish floor height is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 15 pounds/square foot with 3/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and reduce the need for below-slab drainage. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Seal edges of mortar bed with a trowelable membrane/sealant when water intrusion is expected.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Mortar bed thickness—3/4" minimum to 2" maximum.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gravel bed or other means of drainage below slab.
- Slope slab for complete drainage.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scuffing is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

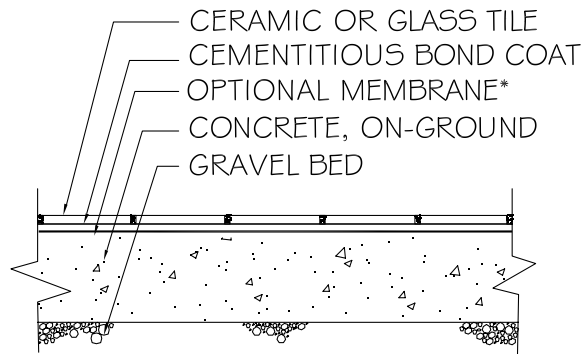
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- If a waterproof membrane is not used, positive drainage below slab must be provided.

F102-19

- On-Ground Concrete
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior slab-on-ground construction where no bending stresses occur, positive drainage below the slab is provided, and thin-bed installation of tile is desired, for example, floors, decks, or patios.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and reduce the need for below-slab drainage. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F125-full). See F125 for more information.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gravel bed or other means of drainage below slab.
- Slope slab for complete drainage.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

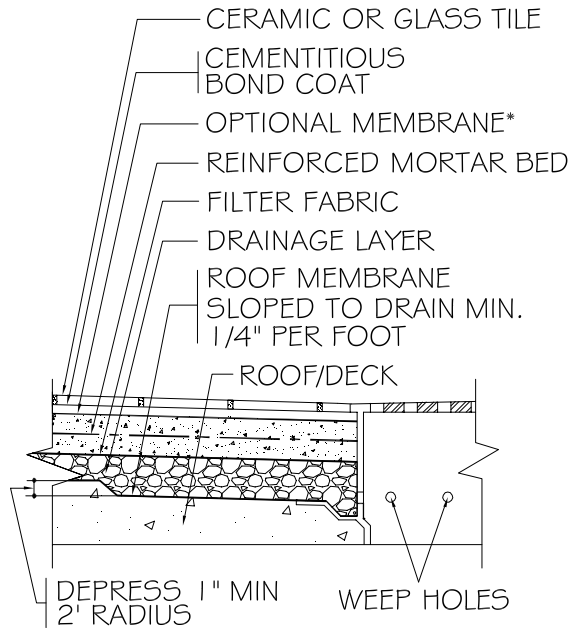
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- If a waterproof membrane is not used, positive drainage below slab must be provided.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.

F103-19

- **Roof Deck or Balcony**
- **Drainage Layer**
- **Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior roofs or decks of concrete, steel, or wood where a waterproof roof membrane is used and sloped minimum 1/4" per foot to a drain.

Service Rating

- Heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 31 pounds/square foot with 1 1/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw

cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- Protect weep holes to prevent blockage.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Mortar bed thickness—1/4" minimum to 2" maximum.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.

- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed and reinforcing—ANSI A108.1A.
- Drainage layer—minimum 1" thick bed of crushed stone (½" maximum size).
- Filter fabric—burlap or closely woven cheesecloth.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Roof drains and membrane by other trades—provide complete drainage at roof membrane level by use of weep holes as shown or other methods. Flat deck with poor or no drainage will not perform well.
- Maximum allowable variation in the roof/deck—¼" in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- Movement joints should not go through the gravel bed; they should extend only to the bottom of the setting bed.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

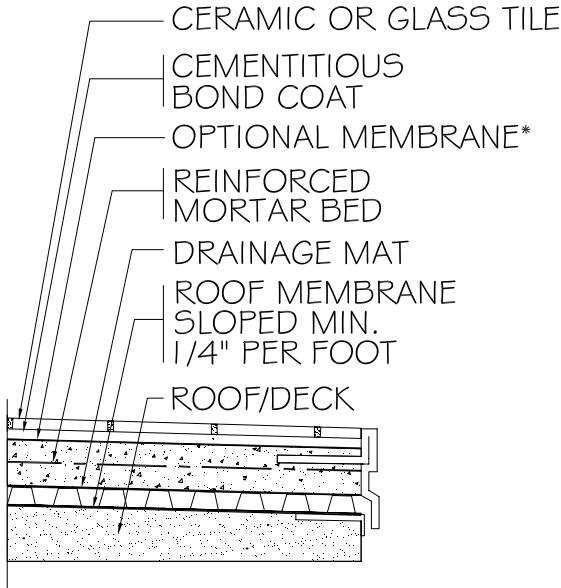
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F103B-19

- **Roof Deck or Balcony**
- **Drainage Mat**
- **Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior roofs or decks of concrete, steel, or wood where a waterproof roof membrane is used and sloped minimum 1/4" per foot.

Service Rating

- Consult drainage mat manufacturer.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 21 pounds/square foot with 1 1/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Mortar bed thickness— 1/4" minimum to 2" maximum.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:

- Must be recommended by manufacturer for above-ground use.
- When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
- When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed and reinforcing—ANSI A108.1A.
- Drainage mat—recommended by manufacturer for intended use or application.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Roof membrane must be sloped and provide complete protection from moisture. Tile over flat deck with poor or no drainage will not perform well.
- Maximum allowable variation in the roof/deck— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

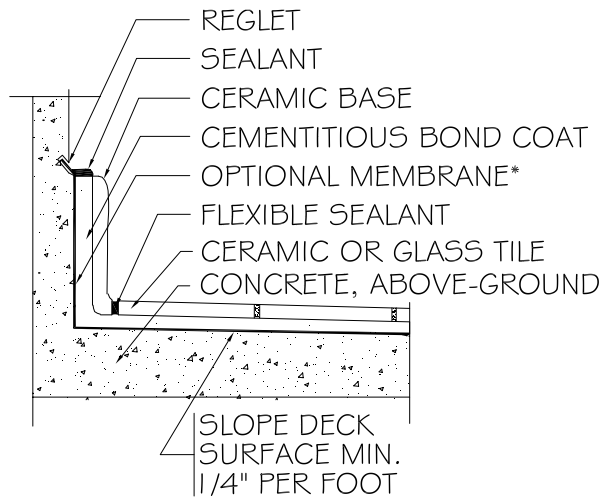
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Drainage mat—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F104-19

- **Roof Deck or Balcony**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.

Recommended Uses

- For exterior balconies or decks of concrete over unoccupied space where waterproof roof membrane is not used, where slab is sloped minimum $\frac{1}{4}$ " per foot, and where thin-bed installation of tile is desired.

Service Rating

- Heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate

if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.

- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F125-full). See F125 for more information.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Slope slab minimum $\frac{1}{4}$ " per foot. Flat deck with poor or no drainage will not perform well.
- Slab to have steel trowel finish with no curing compounds used. When used, mechanical scarification is necessary.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

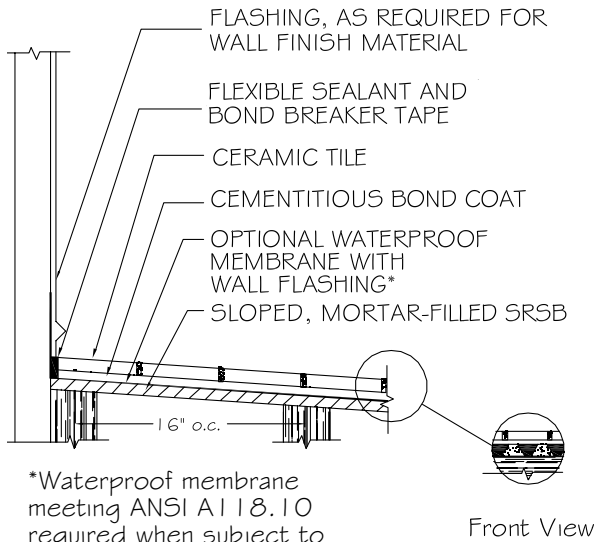
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

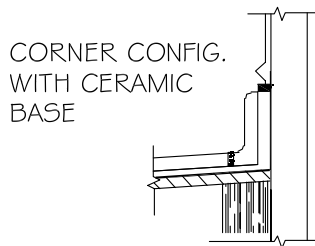
- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F105-19

- **Roof Deck or Balcony**
- **Structural Ribbed Self-Supporting Boards (SRSB) Filled with Portland Cement Mortar**
- **Ceramic Tile**



*Waterproof membrane meeting ANSI A118.10 required when subject to freeze/thaw cycling. See Membrane Options.



Recommended Uses

- For residential balconies and decks over unoccupied space, constructed of a joist system sloped min. 1/4" per foot.

Service Rating

- Light.

Environmental Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate (mortar-filled SRSB). See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- 12" x 12" and larger tile only.

- Maximum joist spacing 16" on center.
- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) is required for installations that will be exposed to freeze/thaw cycling. When used, membrane flashing is required.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Mortar bed thickness—screed fill channels of SRSB boards flush to top of ribs and allow to cure 24 hours.

Preparation by SRSB Installers

- The ends of SRSB must be fully supported. Cantilevering is not permitted.
- Do not extend movement joints through SRSB boards.
- Fasteners—1 5/8" pan head screws, non-corrosive and non-oxidizing.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.7 or better or ISO CG2 or better.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.

- When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
- When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Waterproof membrane, when used—ANSI A118.10.
- Waterproof membrane flashing, when used—per applicable building codes.
- Mortar bed—ANSI A108.1A.
- Structural ribbed self-supporting boards—recommended by manufacturer for intended use or application and meeting the following requirements:
 - Water absorption < 3% when tested per ASTM D570.
 - Passes 300 cycles when tested per ASTM C67, Section 9.
 - Flexural strength $\geq 2,600$ psf when tested per ASTM D790.
 - Direct screw withdrawal resistance (using SRSB manufacturer's recommended fastener) ≥ 250 psf when tested per ASTM D1037, Section 16.
 - Passes Robinson Floor Test (ASTM C627) cycles 1-10 when tested with standard 12" \times 12" ANSI A137.1 porcelain tile, ANSI A118.6 grout, and ANSI A118.4 mortar; and joists spaced 16" o.c.
 - Passes Robinson Floor Test (ASTM C627) cycles 1-10 when tested with standard 12" \times 12" ANSI A137.1 porcelain tile, ANSI A118.6 grout, and ANSI A118.4 mortar; joists spaced 16" o.c.; and modified to accommodate a 14' suspended floor assembly.
 - Receives flame spread and smoke development indices of 0-0-0-0 when the assembly is exposed to fire, when tested per ASTM E84.
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the joist system— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane.
- Slope joist system min. $\frac{1}{4}$ " per foot. Flat deck with poor or no drainage will not perform well.

Movement Joint (architect must specify type of joint and show location and details on drawing)

- Movement joints—mandatory according to EJ171. For above-ground installations additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Mortar bed—ANSI A108.1B.
- SRSB—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- State and local building codes for exterior deck construction, membrane requirements, and membrane flashing requirements vary; check applicable codes for requirements.
- SRSB are structural panels. Specifier to ensure compliance with building codes and expected load. Consult with SRSB manufacturer for design criteria.
- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.

Materials for Green/Sustainable Design

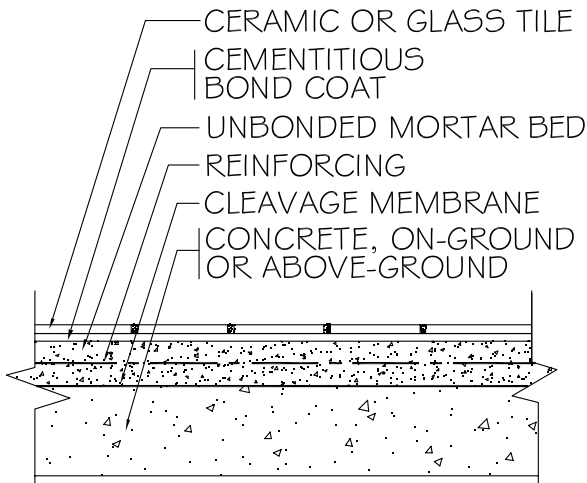
- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- For decks with 8 foot and longer joists, cross bracing may be needed between joists to prevent racking. Consult SRSB manufacturer.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also "Substrate Requirements."

F111-19

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed
- Ceramic Tile, Glass Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction.
- For isolating the tile installation from the concrete substrate.
- For areas where leveling, flattening, or contouring of finish floor height is required, such as commercial kitchens and gang showers.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For concrete substrates that are cracked or present bonding issues.
- For areas with in-slab hydronic tubing.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to staining and/or chemical attack, see also F114, F132, and F134.

Typical Weight of Tile Installation

- 21 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide" and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.

- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - ANSI A118.15 or better or ISO C2S1 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate with steel trowel finish.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

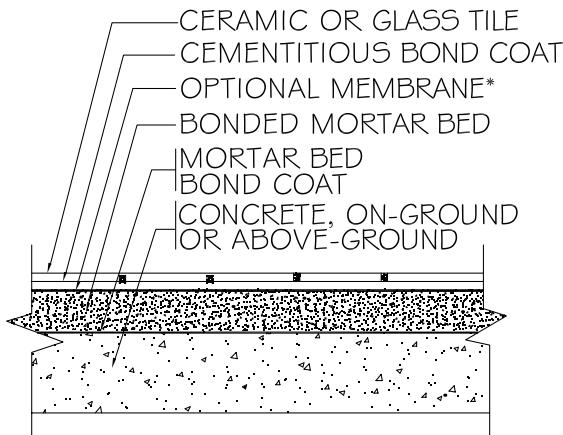
- Tile—ANSI A108.1A, .1B, or .1C.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.
- For waterproof application when using a mortar bed, see F121 or F112.
- For hydronic tubing on top of the slab when using a mortar bed, see RH117.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F112-19

- On-Ground or Above-Ground Concrete
- Bonded Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and for above-ground structural slabs where tile installation is 100 square feet or less.
- For areas where leveling, flattening, or contouring of finish floor height is required, such as commercial kitchens and gang showers.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For areas with in-slab hydronic tubing.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to staining and/or chemical attack, see also F114, F132, and F134.

Typical Weight of Tile Installation

- 15 pounds/square foot with 3/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B"

for assumptions, included materials, and their individual weights.

Limitations

- Not for use over above-ground structural slabs or other floors subject to movement and/or deflection except where tile installation is 100 square feet or less. See Notes.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayment, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Mortar bed thickness—3/4" minimum to 2" maximum.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy, or oily films including curing compounds.
- Mortar beds in excess of 2" thick shall be detailed by architect.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate

deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

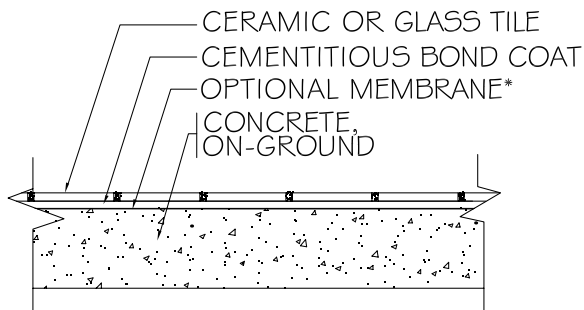
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Above-ground—not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- For hydronic tubing on top of the slab when using a mortar bed, see RH117.
- For waterproofing below mortar bed (unbonded), see F121.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F113-19

- On-Ground Concrete
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and thin-bed installation of tile is desired.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to staining and/or chemical attack, see also F115, F131, and F133.

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F113A.

Membrane Options

- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane

manufacturer for recommendations and requirements.

- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Uncoupling membrane, when used—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

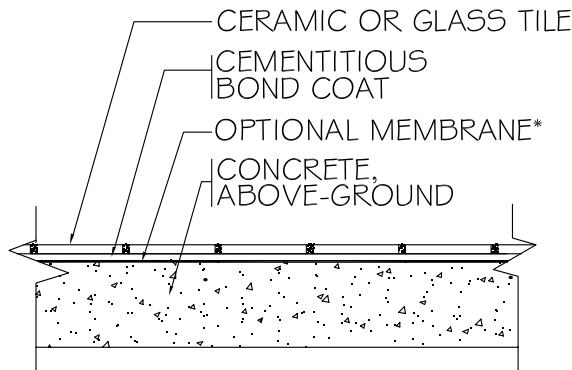
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application where thin-bed installation is desired, see F122.
- For electric radiant in-floor heat application, where thin-bed installation is desired, see RH115.
- For in-slab hydronic tubing, see RH110.
- For young concrete, see F128.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F113A-19

- Above-Ground Concrete
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs and other floors subject to movement and/or deflection where thin-bed installation of tile is desired.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to staining and/or chemical attack, see also F115A, F131, and F133.

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial)

or for protection against future in-plane cracking (F125-full). See F125 for more information.

- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.

- Crack isolation membrane, when used—A118.12.
- Uncoupling membrane, when used—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.

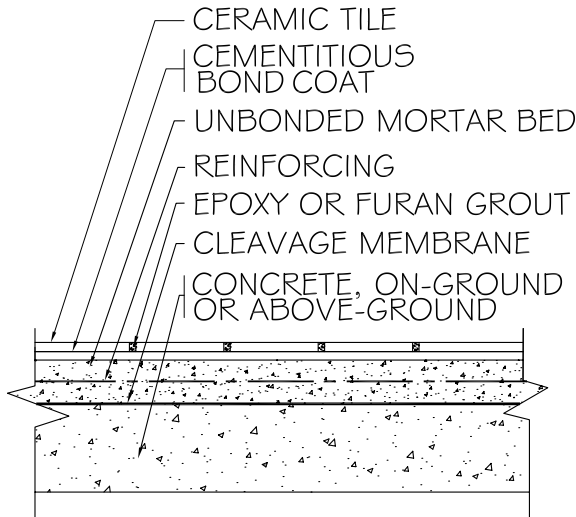
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—A108.17.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- For waterproof application where thin-bed installation is desired, see F122A.
- For electric radiant in-floor heat application, where thin-bed installation is desired, see RH115A.
- For in-slab hydronic tubing, see RH110A.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F114-19

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed
- Ceramic Tile
- Epoxy or Furan Grout



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where good stain resistance and mild chemical resistance are preferred, for example, in commercial dining areas, dark rooms, public toilets, public foyers, etc.
- For areas where leveling, flattening, or contouring of finish floor height is required, such as commercial kitchens and gang showers, where good stain resistance and mild chemical resistance are preferred.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern and good stain resistance and mild chemical resistance are preferred.
- For concrete substrates that are cracked or present bonding issues and good stain resistance and mild chemical resistance are preferred.
- For areas with in-slab hydronic tubing where good stain resistance and mild chemical resistance are preferred.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical resistance, see also F132 and F134.

Typical Weight of Tile Installation

- 21 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Not for severe chemical resistance such as may be needed in commercial kitchens, dairies, breweries, and food processing plants. See Environmental Exposure Classifications in this method.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High-temperature-resistant formulas are available.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also "Product Selection Guides."
- Tile surface must be waxed before grouting when furan resin grout is used.
- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Joints must be clean and completely filled with epoxy or furan. Partial filling with sand or mortar is unacceptable.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Epoxy or furan grout—ANSI A118.3, A118.5 or ISO RG.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.

- ANSI A118.15 or better or ISO C2S1 or better.
- Mortar bed, reinforcing, and cleavage membrane—A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate with steel trowel finish.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

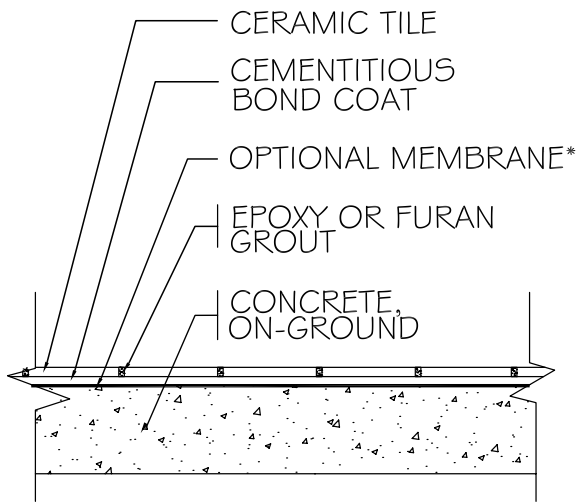
- Tile—ANSI A108.1B.
- Epoxy grout—ANSI A108.6.
- Furan grout—ANSI A108.8
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.
- For hydronic tubing on top of the slab when using a mortar bed, see RH117.
- For waterproof application when using a mortar bed, see F121 or F112.

F115-19

- On-Ground Concrete
- Ceramic Tile
- Epoxy or Furan Grout



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur, thin-bed installation of tile is desired, and good stain resistance and mild chemical resistance are preferred, for example, in commercial dining areas, dark rooms, public toilets, public foyers, etc.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical resistance, see also F131 and F133.

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical resistance such as may be needed in commercial kitchens, dairies, breweries, and food processing plants. See Environmental Exposure Classifications in this method.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High-temperature-resistant formulas are available.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F115A.

Membrane Options

- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also “Product Selection Guides.”
- Tile surface must be waxed before grouting when furan resin grout is used.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Joints must be clean and completely filled with epoxy or furan. Partial filling with sand or mortar is unacceptable.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Epoxy or furan grout—ANSI A118.3, A118.5, or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.*

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

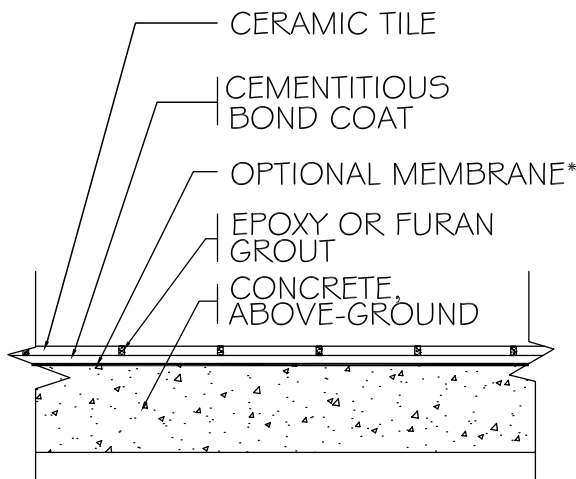
- Tile—ANSI A108.5.
- Epoxy grout—ANSI A108.6.
- Furan grout—ANSI A108.8.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application where thin-bed installation is desired, see F122.

F115A-19

- Above-Ground Concrete
- Ceramic Tile
- Epoxy or Furan Grout



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where thin-bed installation of tile is desired and good stain resistance and mild chemical resistance are preferred, for example, in commercial dining areas, dark rooms, public toilets, public foyers, etc.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical resistance, see also F131 and F133.

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical resistance such as may be needed in commercial kitchens, dairies, breweries, and food processing plants. See Environmental Exposure Classifications in this method.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High-temperature-resistant formulas are available.

Membrane Options

- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also “Product Selection Guides.”
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Tile surfaces must be waxed before grouting when furan resin grout is used.
- Joints must be clean and completely filled with epoxy or furan. Partial filling with sand or mortar is unacceptable.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Epoxy or furan grout—ANSI A118.3, A118.5, or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $1/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $1/4$ " in 10' from the required plane, with no more than $1/16$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $1/8$ " in 10' from the required plane, with no more than $1/16$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

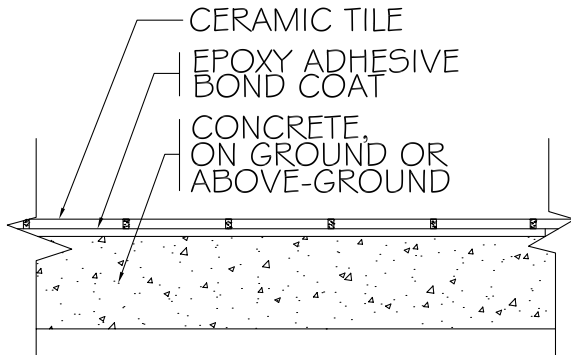
- Tile—ANSI A108.5.
- Epoxy grout—ANSI A108.6.
- Furan grout—ANSI A108.8
- Crack isolation membrane—A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- For waterproof application where thin-bed installation is desired, see F122A.

F116E-19

- On-Ground or Above-Ground Concrete
- Epoxy Adhesive
- Ceramic Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where thin-bed installation of tile is desired and high bond strength and/or high impact strength is desired.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to staining and/or chemical attack, see also F131 and F133.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy or furan grout, when used—ANSI A118.3, A118.5, or ISO RG.
- Epoxy adhesive—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{16}$ " in 3' with no abrupt irregularities greater than $\frac{1}{32}$ ".

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

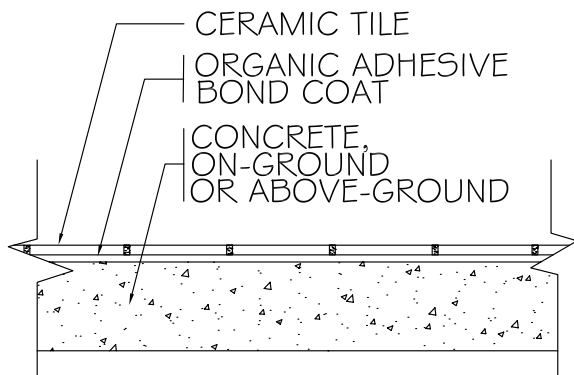
- Tile—ANSI A108.4.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Furan grout—ANSI A108.8.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the subfloor from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, subfloor flattening may be required.
- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- For waterproof application where thin-bed installation is desired, see F122 and F122A.

F1160-19

- On-Ground or Above-Ground Concrete
- Organic Adhesive
- Ceramic Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where thin-bed installation of tile is desired in residential dry areas with light traffic and will not be subjected to high impact, wheel loads, or point loads.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Will not withstand high impact, wheel loads, or point loads.
- Not for below-ground installations.
- Not for use where moisture vapor transmission exceeds recommendation of organic adhesive manufacturer.
- Not for areas exposed to temperatures exceeding 140°F.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Requirements

- Consult the adhesive manufacturer for maximum moisture vapor transmission limitations prior to tile setting.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Organic adhesive bond coat—ANSI A136.1 Type I or ISO D2. For above-ground use, must also be recommended by manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.

- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{16}$ " in 3' with no abrupt irregularities greater than $\frac{1}{32}$ ".

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

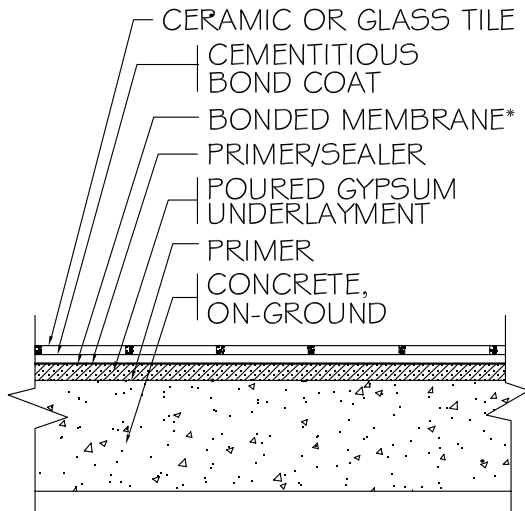
- Tile—ANSI A108.4.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the subfloor from the required plane. Organic adhesive thickness must be thin and uniform; therefore, subfloor flattening may be required.
- Above-ground—not all organic adhesives and grouts are suitable for above-ground installations. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.

F200-19

- On-Ground Concrete
- Poured Gypsum Underlayment
- Bonded Membrane
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS REQUIRED.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and with a poured gypsum underlayment.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 12 pounds/square foot with $\frac{3}{4}$ " poured gypsum. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installation.

- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F200A.
- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of gypsum underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When an uncoupling membrane is used, check with membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

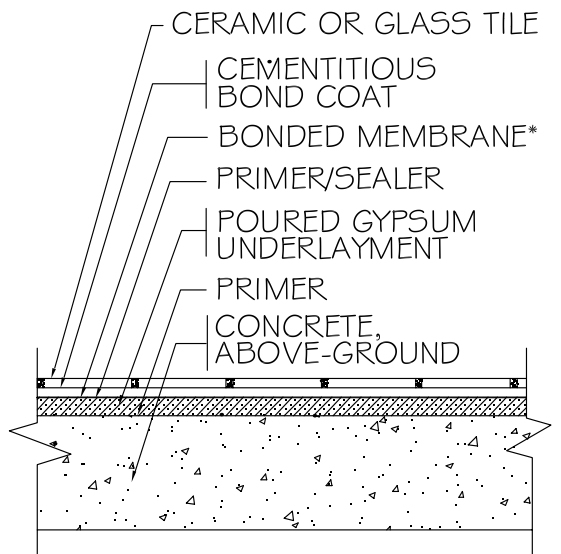
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer's directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F200A-19

- Above-Ground Concrete
- Poured Gypsum Underlayment
- Bonded Membrane
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs with a poured gypsum underlayment.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 12 pounds/square foot with $\frac{3}{4}$ " poured gypsum. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout

designated by tile and grout manufacturers.

- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

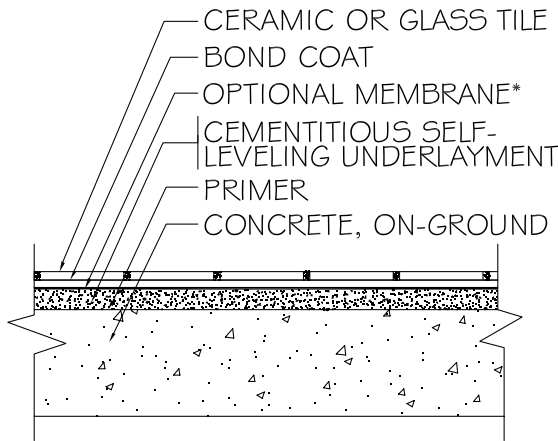
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F205-19

- On-Ground Concrete
- Cementitious Self-Leveling Underlayment
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 11 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.

- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F205A.
- Not for below-ground installation.

Membrane Options

- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass

Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no

more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

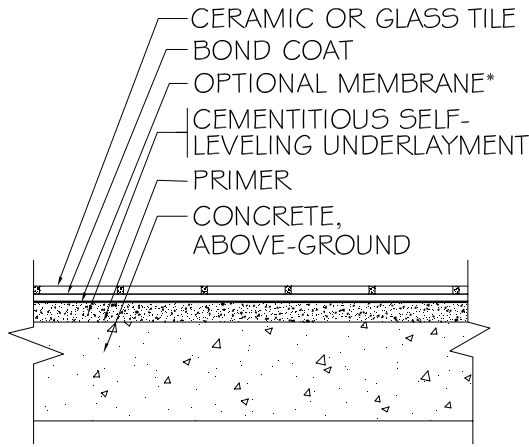
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F205A-19

- Above-Ground Concrete
- Cementitious Self-Leveling Underlayment
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs and other floors subject to movement and/or deflection where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 11 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.

- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

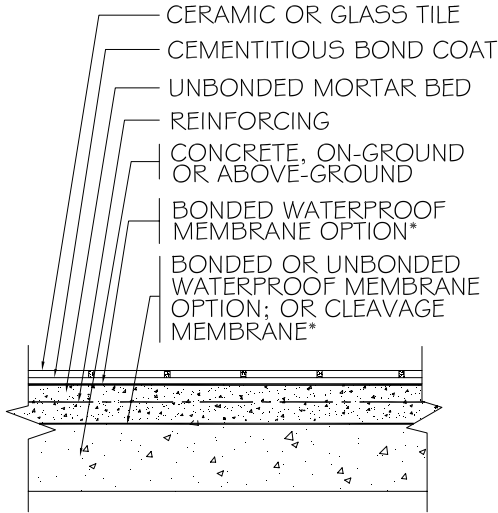
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F121-19

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed
- Waterproof Membrane
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where a waterproof floor is required.
- For areas where leveling, flattening, or contouring of finish floor height is required, such as commercial kitchens and gang showers, and a waterproof floor is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern, and a waterproof floor is required.
- For concrete substrates that are cracked or present bonding issues and a waterproof floor is required.

Service Rating

- Heavy. Consult membrane manufacturer to verify.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to staining and/or chemical attack, see also F114, F132, and F134.

Typical Weight of Tile Installation

- 21 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical exposure. See Environmental Exposure Classifications in this method.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane and a cleavage membrane are required.
- If a bonded waterproof membrane (ANSI A118.10) is used, it may be placed above or below the mortar bed. If a shower pan membrane (ASTM D4551 or D4068) is used, it must be placed below the mortar bed.
- The waterproof membrane can also function as the cleavage membrane if loose laid (not bonded to concrete) below the mortar bed. Check with membrane manufacturer if membrane may be loose laid.
- If waterproof membrane is bonded to the top of the mortar bed, a cleavage membrane must be placed below the mortar bed.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and***

intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When waterproof membrane is placed below mortar bed—ANSI A118.1 or better or ISO C1 or better.
 - When waterproof membrane is placed above mortar bed—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When waterproof membrane is placed below mortar bed—ANSI A118.15 or better or ISO C2S1 or better.
 - When waterproof membrane is placed above mortar bed—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.
- Waterproof membrane, when used—ANSI A118.10.
- Shower pan membrane, when used—ASTM D4551 or D4068.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate, with steel trowel finish.
- Slope subfloor $\frac{1}{4}$ " per foot to drain.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

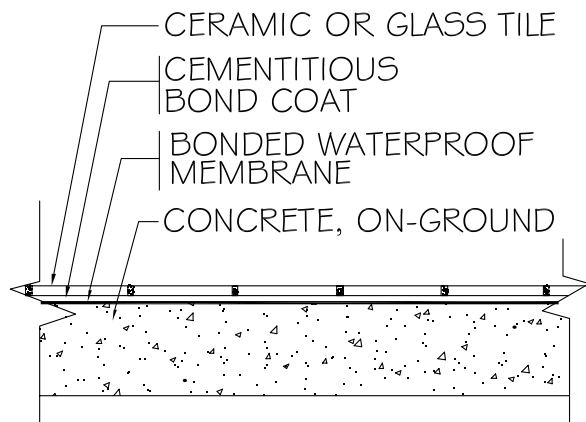
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used on top of the mortar bed.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13 or manufacturer’s directions. Comply with applicable plumbing and building codes.
- Shower pan membrane—manufacturer’s directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For hydronic tubing on top of the slab when using a mortar bed, see RH117.
- See shower receptor details B414, B421, and B422 for drain connections.
- For a waterproof application, but with a bonded mortar bed, see F112.
- Above-ground—not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F122-19

- On-Ground Concrete
- Waterproof Membrane
- Ceramic Tile, Glass Tile



Recommended Uses

- For slab-on-ground construction where no bending stresses occur, where thin-bed installation of tile is desired, and a waterproof floor is required.

Service Rating

- Moderate. Consult membrane manufacturer to verify.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to staining and/or chemical attack, see also F115, F131, and F133.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical exposure. See Environmental Exposure Classifications in this method.
- Not for use over above-ground structural slabs and

other floors subject to movement and/or deflection. See F122A.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel finish free of curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Slope subfloor $\frac{1}{4}$ " per foot to drain.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

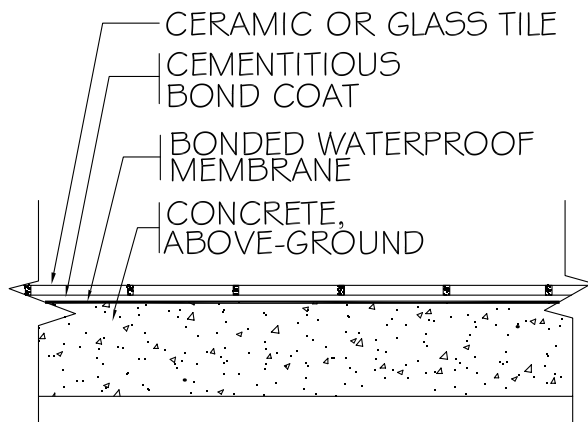
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13 or manufacturer's directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- See shower receptor details B421 and B422 for drain connections.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.

F122A-19

- Above-Ground Concrete
- Waterproof Membrane
- Ceramic Tile, Glass Tile



Recommended Uses

- For above-ground structural slabs and other floors subject to movement and/or deflection where thin-bed installation of tile is desired and a waterproof floor is required.

Service Rating

- Moderate. Consult membrane manufacturer to verify.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to staining and/or chemical attack, see also F115A, F131, and F133.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

- Not for severe chemical exposure. See Environmental Exposure Classifications in this method.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10.

Materials for Green/Sustainable Design

- See Green Building Standards and Green Product Selection Guide and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel finish free of curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.
- Slope subfloor 1/4" per foot to drain.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

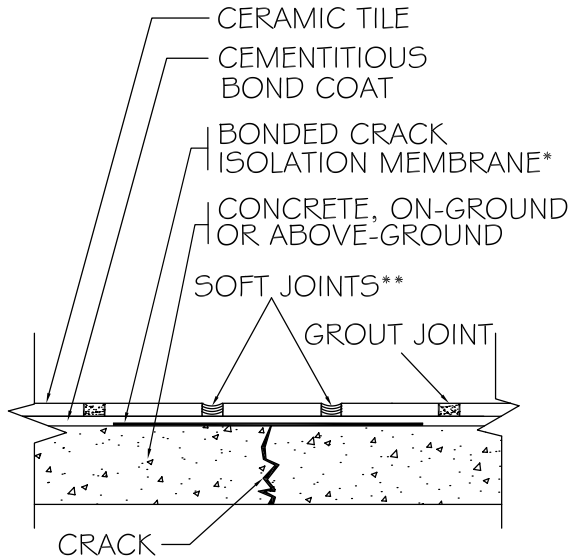
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13 or manufacturer’s directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- See shower receptor details B421 and B422 for drain connections.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F125-Partial-19

- On- or Above-Ground Concrete
- Crack Isolation Membrane (Partial Coverage)
- Ceramic Tile

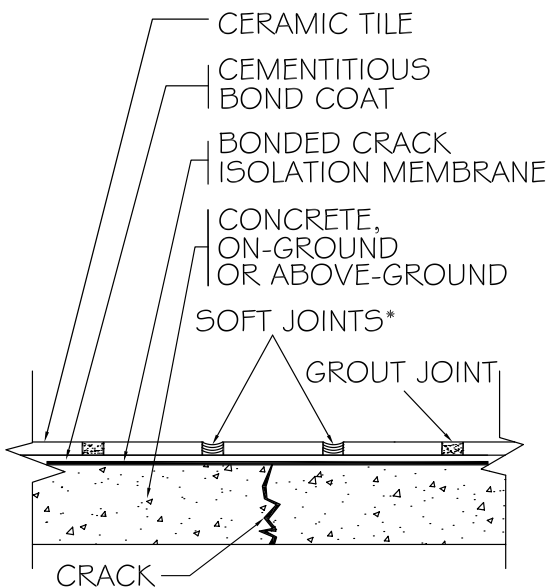


*CONSULT MANUFACTURER FOR MEMBRANE WIDTH

**ONE OR TWO SOFT JOINTS MAY BE REQUIRED (CONSULT MANUFACTURER)

F125-Full-19

- On- or Above-Ground Concrete
- Crack Isolation Membrane (Full Coverage)
- Ceramic Tile



*ONE OR TWO SOFT JOINTS MAY BE REQUIRED (CONSULT MANUFACTURER)

Recommended Uses

- For use in conjunction with other concrete substrate installation methods.
- For slab-on-ground construction and above-ground structural slabs where thin-bed installation of tile is desired and crack isolation is required to treat existing in-plane cracks (F125-Partial).
- For slab-on-ground construction and above-ground structural slabs where thin-bed installation of tile is desired and protection against future in-plane cracking is desired, full-coverage is recommended and must be additionally specified (F125-Full).

Service Rating

- Different crack isolation membranes will produce different service ratings when tested per ASTM C627. Consult membrane manufacturer to verify service rating.

Environmental Exposure Classifications

- Refer to appropriate installation method.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- May not always be 100% effective in preventing reflective cracking.
- For lateral (in-plane) movement only.
- Standard performance membranes can accommodate >1/16" in-plane movement. Consult manufacturer for membrane performance rating.
- High performance membranes can accommodate >1/8" in-plane movement. Consult manufacturer for membrane performance rating.
- Not for cracking associated with deflection of above-ground installations.

Requirements

- For existing cracks, soft joints may be required adjacent to cracks per manufacturer’s instructions.
- Specifier to identify areas of coverage (partial or full). Unless full coverage is clearly specified, installing contractor’s responsibility is limited to partial coverage.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical

exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options. Unless full coverage of crack isolation membrane is clearly specified, installing contractor’s responsibility is limited to partial coverage.**
- Refer to appropriate installation method.
- Sealant—ASTM C920.
- Crack isolation membrane—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Refer to appropriate installation method.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge

15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.

Installation Specifications

- Refer to appropriate installation method.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Movement Joint (architect must specify type of joint and show location and details on drawings)

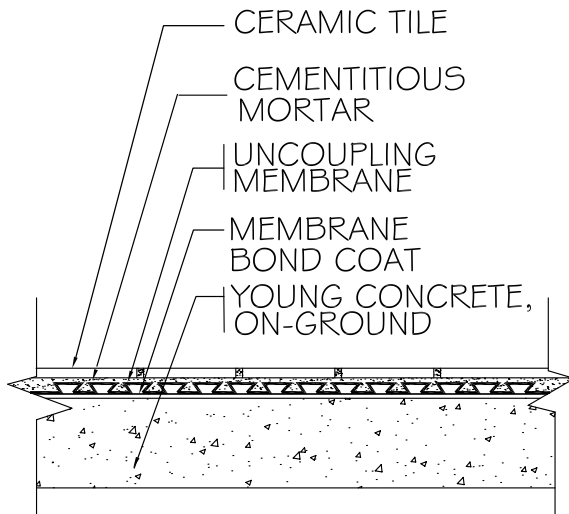
- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Notes

- Tiles that do not meet the breaking strength requirement of ANSI A137.1, such as Saltillo tiles, can be subject to breakage from strain induced by membrane movement or deflection over softer, compressible membrane material. Consult membrane and tile manufacturers for suitability. Testing per ANSI A118.12, modified by conducting the test using the actual tile can be performed to evaluate its performance under test as compared with the tile meeting ANSI A137.1 specified by the test.

F128-19

- On-Ground Young Concrete
- Uncoupling Membrane
- Ceramic Tile



Recommended Uses

- For tiling over young concrete on slab-on-ground construction where no bending stresses occur.

Service Rating

- Light commercial with 2" × 2" and larger tiles.
- Extra heavy with 12" × 12" and larger porcelain tiles.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection.

Requirements

- Slab to be free of waxy or oily films and curing compounds.
- No standing water on slab during uncoupling membrane installation.

- Concrete must be cured sufficiently to support tile installation traffic as determined by the project design professional, construction manager, or general contractor.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious mortar—as recommended by membrane manufacturer.
- Uncoupling membrane—recommended by manufacturer for use on young concrete; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.
- Slope, when required, to be in subfloor.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

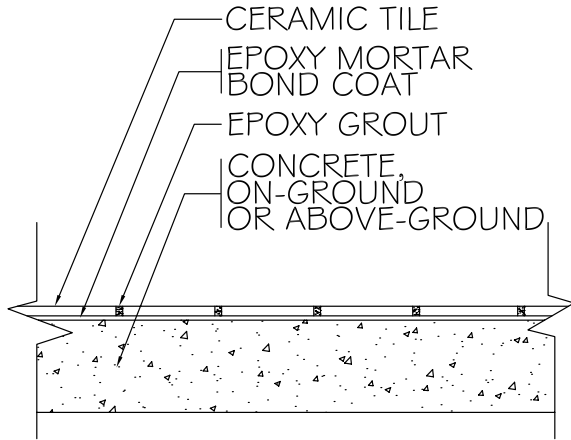
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Uncoupling membrane—follow manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Keep traffic off finished tile floors until fully cured.

F131-19

- On-Ground or Above-Ground Concrete
- Epoxy Mortar
- Ceramic Tile
- Epoxy Grout



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where thin-bed installation of tile is desired and resistance to moderate chemical exposure and severe cleaning methods is desired, for example, in commercial kitchens, dairies, breweries, food processing plants, etc.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical and heat resistance, see also F133.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical exposure or extreme heat. See Environmental Exposure Classifications in this method.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High-temperature-resistant formulas are available.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also “Product Selection Guides.”

- Subfloor carefully finished to proper elevation and slope. See Notes.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Joints must be clean and completely filled with epoxy. Partial filling with sand is unacceptable.
- Consult grout manufacturer for special precautions when chemical exposure is severe or at prolonged temperatures above 140°F.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Epoxy grout—ANSI A118.3 or ISO RG. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy grout certified by manufacturer for intended use.
- Epoxy mortar—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy mortar certified by manufacturer for intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated

loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

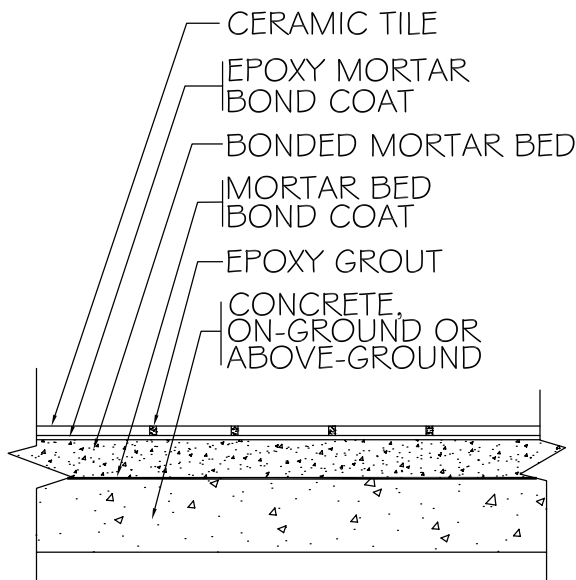
- Tile and grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As tile size increases, there is less tolerance for variation in the subfloor from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, subfloor flattening may be required.
- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.

F132-19

- On-Ground or Above-Ground Concrete
- Bonded Mortar Bed
- Epoxy Mortar
- Ceramic Tile
- Epoxy Grout



Recommended Uses

- For slab-on-ground construction and for above-ground structural slabs where tile installation is 100 square feet or less, where resistance to moderate chemical exposure and severe cleaning methods is desired, for example commercial kitchens, dairies, breweries, food processing plants, etc.
- For areas where leveling, flattening, or contouring of finish floor height is required, such as commercial kitchens and gang showers, and resistance to moderate chemical exposure and severe cleaning methods is desired.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern and resistance to moderate chemical exposure and severe cleaning methods is desired.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical and heat resistance, see also F134.

Typical Weight of Tile Installation

- 15 pounds/square foot with $\frac{3}{4}$ " mortar bed. Add 3 pounds/square foot for each additional $\frac{1}{4}$ " of mortar bed.

- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for severe chemical exposures or extreme heat. See Environmental Exposure Classifications in this method.
- Not for use over above-ground structural slabs or other floors subject to movement and/or deflection except where tile installation is 100 square feet or less. See Notes.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High-temperature-resistant formulas are available.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also "Product Selection Guides."
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Joints must be clean and completely filled with epoxy. Partial filling with sand is unacceptable.
- Consult grout manufacturer for special precautions when chemical exposure is severe or at prolonged temperatures above 140°F.
- Mortar bed thickness— $\frac{3}{4}$ " minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by architect.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Epoxy grout—ANSI A118.3 or ISO RG. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy grout certified by manufacturer for intended use.
- Epoxy mortar—ANSI A118.3 or ISO R1 or better.

For above-ground use, must also be recommended by manufacturer. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy mortar certified by manufacturer for intended use.

- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

- Tile and grout—ANSI A108.6.
- Mortar bed—ANSI A108.1B.
- Movement Joints—EJ171 and ASTM C1193.

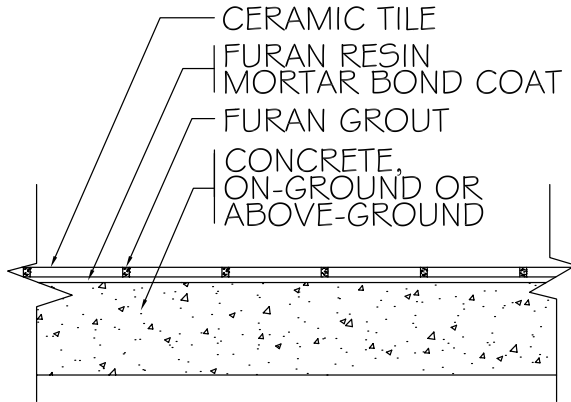
Notes

- An unbonded mortar bed, per F114, may be specified and is preferred over above-ground structural slabs and other floors subject to movement and deflection. Modify by specifying epoxy mortar and grout as shown here for chemical resistance.

- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.

F133-19

- On-Ground or Above-Ground Concrete
- Furan Resin Mortar
- Ceramic Tile (Waxed)
- Furan Grout



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where thin-bed installation of tile is desired and moderate resistance to chemical exposure and severe cleaning methods is preferred, for example, in commercial kitchens, dairies, breweries, food processing plants, etc.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.
- For increased chemical and heat resistance, see also F134.

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Specify tile and grout suitable for stain and/or chemical exposure. Consult product manufacturers. See also “Product Selection Guides.”
- Subfloor carefully finished to proper elevation. See Notes.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.

- Tile surface must be waxed before grouting with furan resin.
- Joints must be clean and completely filled with furan. Partial filling with sand is unacceptable.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Furan grout—ANSI A118.5.
- Furan mortar bond coat—ANSI A118.5. For above-ground use, must also be recommended by manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no

more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

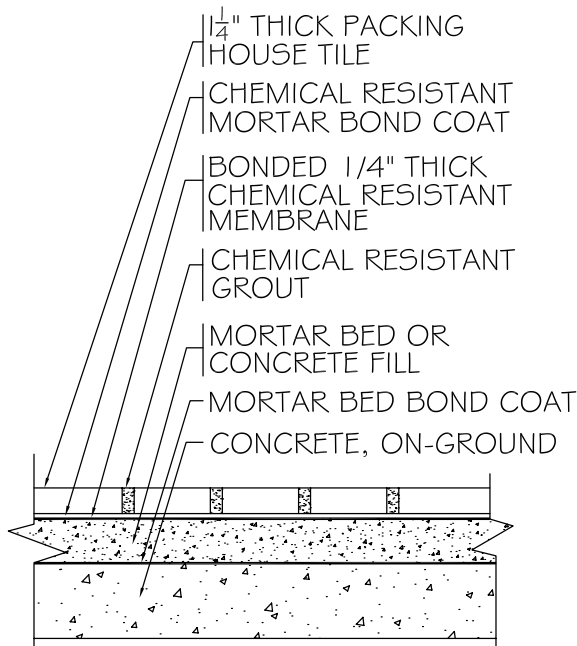
- Tile and grout—ANSI A108.8.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the subfloor from the required plane. Furan adhesive thickness must be a thin and uniform bond coat; therefore, subfloor flattening may be required.
- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.

F134-19

- Concrete
- Bonded Mortar Bed
- Chemical-Resistant Membrane
- Chemical-Resistant Mortar
- Packing House Tile
- Chemical-Resistant Grout



Recommended Use

- For setting 1 1/4"-thick packing house tiles in areas of continuous or severe chemical exposure, where special protection against leakage or damage to concrete subfloor is required.

Service Rating

- Extra heavy.

Environmental Exposure Classifications

- Res1, 2, 3, 4, 5; Com1, 2, 3, 4, 5.

Typical Weight of Tile Installation

- 26 pounds/square foot with 3/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Requirements

- Requires chemical-resistant membrane.
- Structurally sound subfloor, carefully finished to proper elevation and slope.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1 and recommended by manufacturer.
- Epoxy or furan grout—ANSI A118.3, A118.5, or ISO RG.
- Epoxy or furan mortar bond coat—ANSI A118.3, A118.5, or ISO R1 or better.
- Chemical-resistant membrane—recommended by membrane manufacturer for intended use.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum variation in the concrete fill or mortar bed 1/4" in 10' from the required plane.
- Chemical-resistant membrane may be installed by other trades separate from tilework.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- None in subfloor beneath continuous membrane unless special installation method is designed to accommodate them.

Installation Specifications

- Tile—ANSI A108.5.
- Epoxy grout and/or bond coat—ANSI A108.6.
- Furan grout and/or bond coat—ANSI A108.8.
- Mortar bed—ANSI A108.B.
- Membrane—manufacturer's directions.

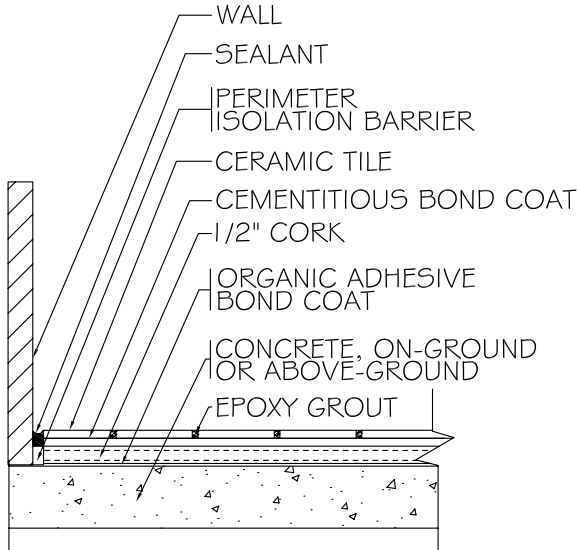
- Movement Joints—EJ171 and ASTM C1193.

Notes

- The entire floor system is usually installed by a specialty ceramic tile flooring contractor and should be so specified.
- Joints must be clean and completely filled with epoxy or furan. Partial filling with sand or mortar is unacceptable.
- Consult resin manufacturer for special precautions when chemical exposure is severe or at high temperature.

F135-19

- On-Ground or Above-Ground Concrete
- 1/2" Cork Underlayment
- Ceramic Tile
- Epoxy Grout



Recommended Uses

- For on-ground and above-ground structural slabs in residential dry areas where a cork underlayment is desired.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1.

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- For 8" x 8" and larger floor tiles only.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Minimum 6"-thick concrete subfloor.
- Slab to be well cured, dimensionally stable, free of cracks, waxy or oily films, and curing compounds.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Epoxy grout—ANSI A118.3 or ISO RG.
- Cementitious bond coat (on ground):
 - ANSI A118.4 or better or ISO C2S1 or better.
- Cementitious bond coat (above-ground):
 - Must be recommended by manufacturer for above-ground use.
 - ANSI A118.15 or better or ISO C2S1 or better.
- Cork—1/2"-thick (+/- .010") underlayment sheets consisting of a mix of pure cork granules combined with a polyurethane binder, having a density of between 11.8 and 13.6 pounds/cubic foot.
- Organic adhesive bond coat (for cork underlayment)—ANSI A136.1 Type I or ISO D2.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab—steel trowel or comparable level of finish.
- Slope, when required, to be in the subfloor.
- Maximum allowable variation in the installation substrate (concrete)—for tiles with all edges shorter than

15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

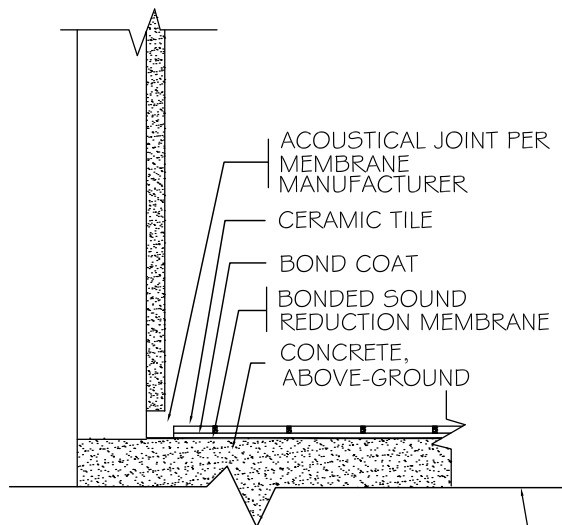
- Tile—ANSI A108.5.
- Epoxy grout—ANSI A108.6.
- Cork—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all mortars and grouts are suitable for above-ground installations. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.

F136-19

- Above-Ground Concrete
- Bonded Sound Reduction Membrane
- Ceramic Tile



DRAWING DEPICTS TILE INSTALLATION ONLY. THICKNESS OF CONCRETE AND WHETHER SUSPENDED CEILING IS USED ARE NOT SHOWN. SOUND REDUCTION WILL BE DRAMATICALLY HIGHER WHEN A SUSPENDED CEILING IS USED.

Recommended Uses

- For above-ground structural slabs and other floors subject to movement and/or deflection where thin-bed installation of tile is desired and reduction of sound transference to area below the tile installation is desired.

Service Rating

- Different sound reduction membranes will produce different service ratings when tested per ASTM C627. Consult membrane manufacturer to verify service rating with tile and installation materials that will be used.

Environmental Exposure Classifications

- Res1.
- May be suitable for Res2, Com1, and/or Com2. Consult membrane manufacturer.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Acoustical joints are required at the perimeter of the floor area being treated and at all penetrations and retaining surfaces to minimize flanking. Proper installation at the wall trim/flooring interface is critical. Observe membrane manufacturer’s acoustical joint or perimeter isolation joint details.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Sound reduction membranes meeting ANSI A118.13 must meet a minimum laboratory Δ IIC rating of 10 when tested per ASTM E2179. When installed in the field, the membrane may yield higher or lower sound reduction. Field installation variables such as slab thickness; slab density and porosity; ceiling heights and assemblies; floor penetrations; tile type and size; adhesive type; grout type and joint width; room size; atmospheric pressure; framing member type and arrangement; fastener locations; and other factors affect field impact (FIIC) sound transmission measurements. Design professional is responsible for ensuring system components are specified and designed to achieve the desired FIIC sound reduction. A suspended ceiling should be specified for greatest sound reduction.
- Sound reduction membranes that meet ANSI A118.13 must meet a minimum laboratory Δ IIC rating of 10 when tested per ASTM E2179. A higher Δ IIC rating may be required to produce a code compliant installation.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Bond coat (for tile)—use manufacturer-recommended material.
- Bond coat (for membrane)—use manufacturer-recommended material.
- Sound reduction membrane—ANSI A118.13.
- Sealant, when used—ASTM C919 and recommended by membrane manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel finish free of curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- Perimeter joints must be properly located and left open or filled per membrane manufacturer’s instructions.

Installation Specifications

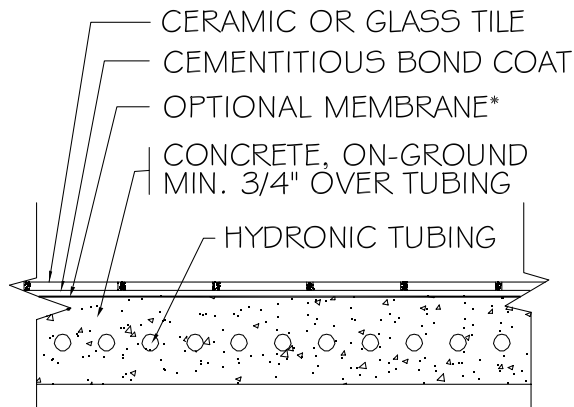
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Sound reduction membrane—manufacturer’s directions.
- Acoustical Sealant, when used—ASTM C919-08.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- In addition to being tested per ANSI A118.13 and meeting all requirements of that standard for sound reduction membranes, sound reduction membranes may be additionally tested using exact or more similar materials and assemblies to those that will be used in the field. Such testing may provide a more accurate indication of actual sound reduction and service rating that could be expected.
- Consult individual manufacturers for specific instructions, application, performance levels, and limitations concerning their materials. Follow the individual manufacturer’s written instructions precisely.
- See “Sound Rated Floors Guide” for more information.
- The tile contractor is not responsible for the design or testing of the sound reduction system.

RH110-19

- **On-Ground Concrete Encapsulating Hydronic Tubing**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur, thin-bed installation of tile is desired, and hydronic tubing is encapsulated within the slab.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for use on above-ground structural slabs and other floors subject to movement and/or deflection. See RH110A.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a crack isolation membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.
- Portland cement concrete poured minimum $\frac{3}{4}$ " over top of hydronic tubing.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

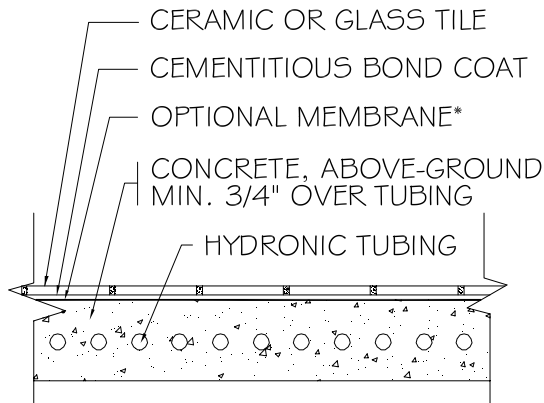
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—A108.10.
- Epoxy grout—A108.6.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application, see F122.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH110A-19

- Above-Ground Concrete Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where thin-bed installation of tile is desired and hydronic tubing is encapsulated within the slab.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 5 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a crack isolation membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.

- When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.
- Portland cement concrete poured minimum $\frac{3}{4}$ " over top of hydronic tubing.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

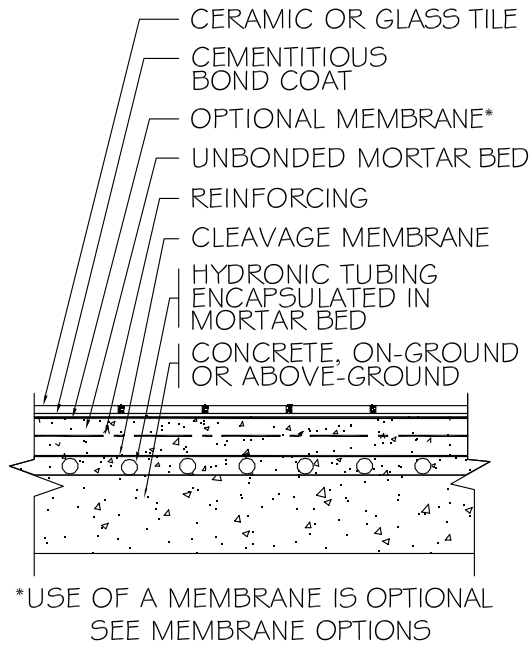
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—A108.10.
- Epoxy grout—A108.6.
- Crack isolation membrane—A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- For waterproof application, see F122A.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH117-19

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where hydronic tubing will be placed over the slab.
- For areas where leveling, flattening, or contouring of finish floor height is required where hydronic tubing will be placed over the slab.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern, and where hydronic tubing will be placed over the slab.
- For concrete substrates that are cracked or present bonding issues and hydronic tubing will be placed over the slab.

Service Rating

- Extra heavy.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 30 pounds/square foot with 1¼" mortar bed over hydronic tubing. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Screed fill flush to top of radiant tubing before placing cleavage membrane and mortar bed.
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout***

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat (on ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product

sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate with steel trowel finish.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)—1/4" in 10' from the required plane.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

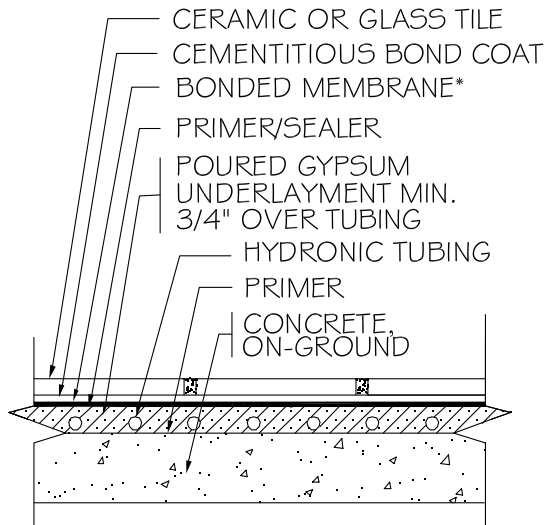
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane or epoxy grout to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—A108.10.
- Epoxy grout—A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof Membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For in-slab hydronic tubing, see F111.
- Above-ground—not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH111-19

- On-Ground Concrete
- Poured Gypsum Underlayment Encapsulating Hydronic Tubing
- Bonded Membrane
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and with a poured gypsum underlayment encapsulating hydronic tubing.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 19 pounds/square foot with $\frac{3}{4}$ " poured gypsum over hydronic tubing. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installation.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH111A.
- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of gypsum underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.

- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is $\frac{3}{4}$ " above hydronic tubing.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Radiant tubing by others.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472

modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

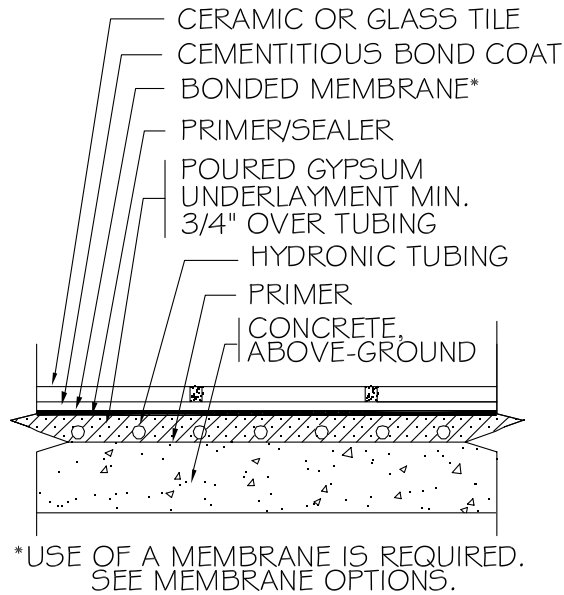
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer's directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH111A-19

- Above-Ground Concrete
- Poured Gypsum Underlayment Encapsulating Hydronic Tubing
- Bonded Membrane
- Ceramic Tile, Glass Tile



Recommended Uses

- For above-ground structural slabs with a poured gypsum underlayment encapsulating hydronic tubing.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 19 pounds/square foot with $\frac{3}{4}$ " poured gypsum over hydronic tubing. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of underlayment prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.

- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to be well cured, dimensionally stable, and free of unremediated structural cracks, waxy or oily films, and curing compounds.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is 1/4" in 10' from the required plane, with no

more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.

- Radiant tubing by others.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 3/4" above hydronic tubing.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

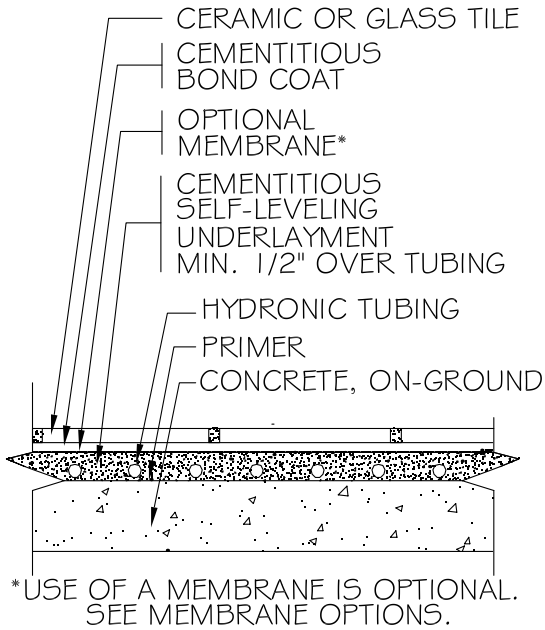
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer's directions.
- RH117 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH112-19

- On-Ground Concrete
- Cementitious Self-Leveling Underlayment Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



Recommended Uses

- For slab-on-ground construction where no bending stresses occur and where hydronic tubing will be placed on the slab.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 19 pounds/square foot with 1/2" cementitious self-leveling underlayment over hydronic tubing. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installations.
- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH112A.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 1/2" above hydronic tubing.
- Surfaces must be prepared and primed according to manufacturer’s instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have fine broom finish with no curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

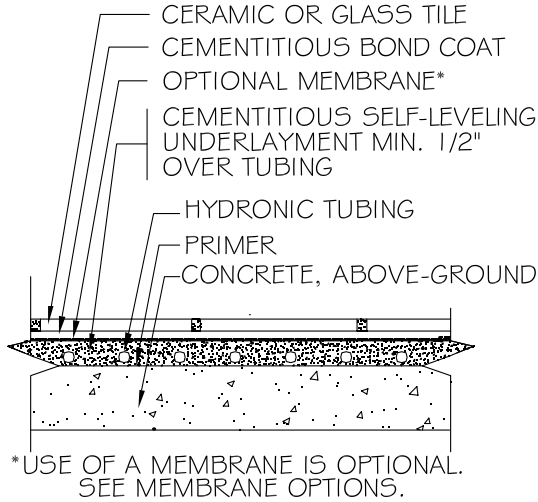
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH112A-19

- Above-Ground Concrete
- Cementitious Self-Leveling Underlayment Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



Recommended Uses

- For above-ground structural slabs where hydronic tubing will be placed on the slab.

Service Rating

- Moderate.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 19 pounds/square foot with 1/2" cementitious self-leveling underlayment over hydronic tubing. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 1/2" above hydronic tubing.
- Surfaces must be prepared and primed according to the manufacturer’s instructions.
- Proper curing/drying of underlayment prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout***

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have fine broom finish with no curing compounds used. When used, mechanical scarification is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

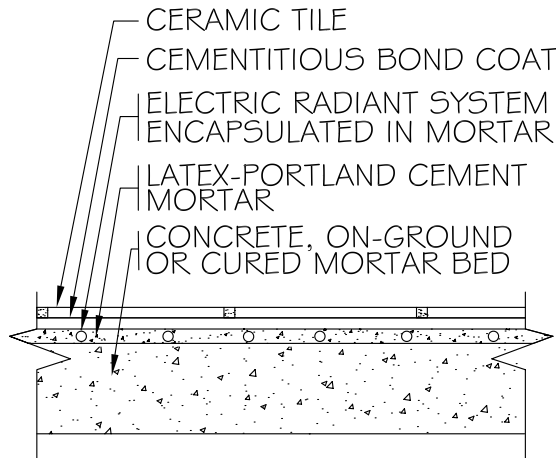
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- RH117 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH115-19

- On-Ground Concrete
- Electric Radiant Heat System Encapsulated in Portland Cement Mortar
- Ceramic Tile



USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and electric radiant in-floor heat is desired.
- For snow and ice melting applications, as determined by heat system manufacturer.

Service Rating

- Moderate.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for exterior applications when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection. Consult heat system manufacturer.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for use over above-ground structural slabs and

other floors subject to movement and/or deflection. See RH115A.

Membrane Options

- Consult heat system manufacturer and setting material manufacturer for requirements and options.
- If a membrane is used, follow manufacturer’s instructions for membrane type, installation, placement, and setting materials required.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Electric radiant system should not be installed over building expansion joints.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used on top of mortar-encapsulated radiant system—ANSI A118.15 or better or ISO C2S1 or better.
 - When a membrane is used on top of mortar-encapsulated radiant system—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)—for tiles with all edges shorter than

15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

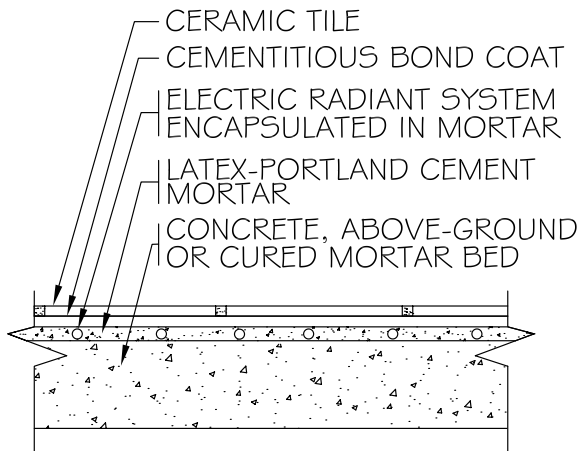
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Bond coat thickness and application varies, consult heat system manufacturer for recommendations.
- If latex-portland cement mortar is to be applied over $\frac{3}{16}$ " in thickness, consult setting material manufacturer for additional installation instructions.

RH115A-19

- Above-Ground Concrete
- Electric Radiant Heat System
Encapsulated in Portland Cement Mortar
- Ceramic Tile



USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where electric radiant in-floor heat is desired.
- For snow and ice melting applications, as determined by heat system manufacturer.

Service Rating

- Moderate.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for exterior applications when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing and material selection. Consult heat system manufacturer.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- Consult heat system manufacturer and setting material manufacturer for requirements and options.
- If a membrane is used, follow manufacturer’s instructions for membrane type, installation, placement, and setting materials required.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Electric radiant system should not be installed over building expansion joints.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used on top of mortar-encapsulated radiant system—ANSI A118.15 or better or ISO C2S1 or better.
 - When a membrane is used on top of mortar-encapsulated radiant system—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate

deflection under live load not to exceed $1/360$. See also "Substrate Requirements."

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)—for tiles with all edges shorter than 15"; maximum allowable variation is $1/4$ " in 10' from the required plane, with no more than $1/16$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $1/8$ " in 10' from the required plane, with no more than $1/16$ " variation in 24" when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

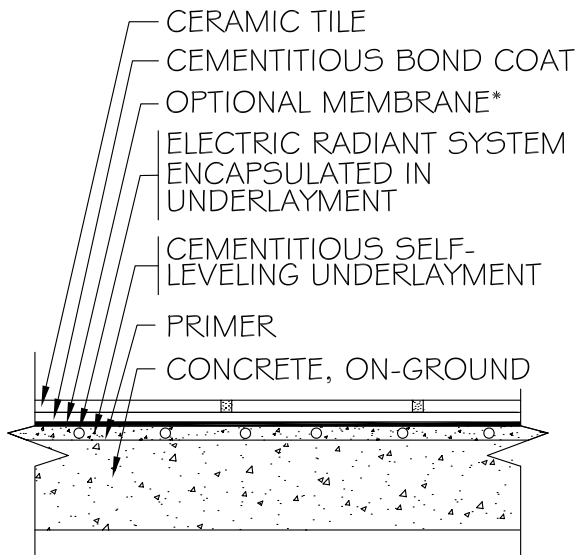
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Bond coat thickness and application varies, consult heat system manufacturer for recommendations.
- If latex-portland cement mortar is to be applied over $3/16$ " in thickness, consult setting material manufacturer for additional installation instructions.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.

RH116-19

- On-Ground Concrete
- Electric Radiant Heat System Encapsulated in Cementitious Self-Leveling Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and where floor leveling and electric radiant in-floor heat are desired.

Service Rating

- Moderate.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 11 pounds/square foot with ½" cementitious self-leveling underlayment. Add 2¾ pounds/square foot for each additional ¼" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installations.

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH116A.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Electric radiant system should not be installed over building expansion joints.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout***

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

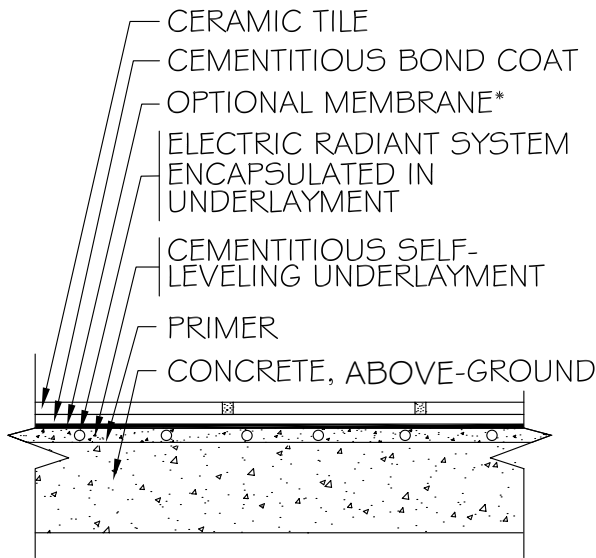
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer's directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer's directions.

RH116A-19

- Above-Ground Concrete
- Electric Radiant Heat System Encapsulated in Cementitious Self-Leveling Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where floor leveling and electric radiant in-floor heat are desired.

Service Rating

- Moderate.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 11 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Electric radiant system should not be installed over building expansion joints.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

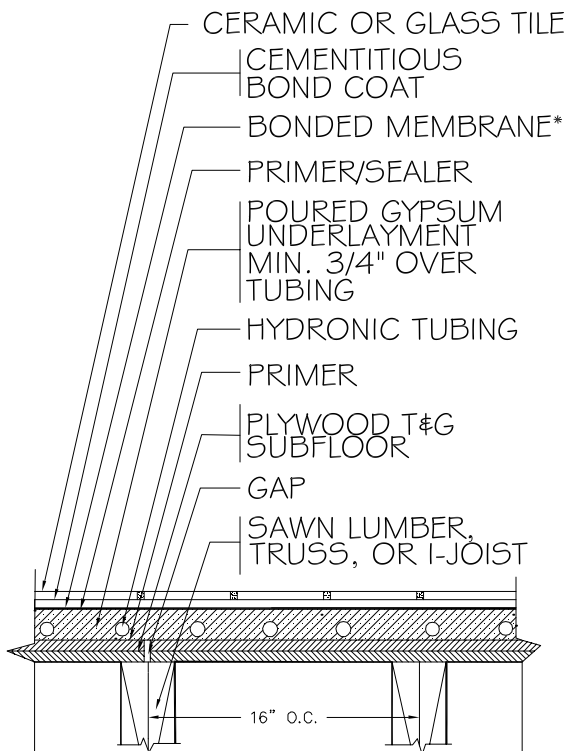
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer's directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer's directions.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.

RH122-19

- Joists max. 16" o.c./Plywood Subfloor
- Poured Gypsum Underlayment Encapsulating Hydronic Tubing
- Bonded Membrane
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates with a poured gypsum underlayment encapsulating hydronic tubing.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 19 pounds/square foot with 3/4" poured gypsum over

hydronic tubing. Add 2¼ pounds/square foot for each additional ¼" of poured gypsum.

- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of underlayment prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.

- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 3/4" above hydronic tubing.

- Exterior grade plywood subfloor to be clean and free of dirt, dust, paint, and oily film.
- Face grain of plywood shall run perpendicular to joists.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Subfloor—minimum 23/32" tongue and groove exterior glue plywood.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.
- Some manufacturers of poured gypsum underlayments require use of plastic lath. Follow manufacturer’s recommendations for installation and use of the lath.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

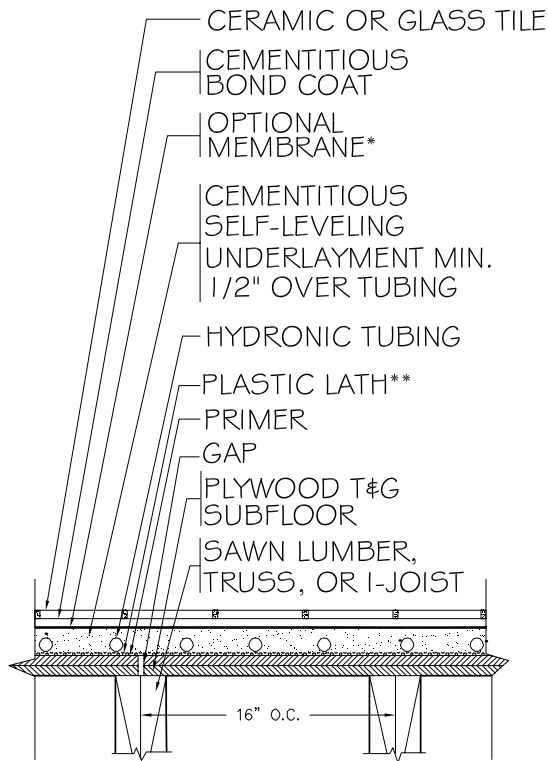
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH123-19

- Joists max. 16" o.c./Plywood Subfloor
- Cementitious Self-Leveling Underlayment Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

** IF NECESSARY, PLASTIC LATH MAY BE INSTALLED ON TOP OF HYDRONIC TUBING. CONTACT MANUFACTURER FOR DIRECTIONS.

Recommended Uses

- For wood substrates where hydronic tubing will be placed.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 19 pounds/square foot with 1/2" cementitious self-leveling underlayment over hydronic tubing. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 1/2" above hydronic tubing.
- Plywood subfloor to be clean and free of dirt, dust, paint, and oily film.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Use plastic lath designed for this purpose, nailed or stapled in accordance with the underlayment manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the

IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $2\frac{3}{32}$ " tongue and groove exterior glue plywood.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

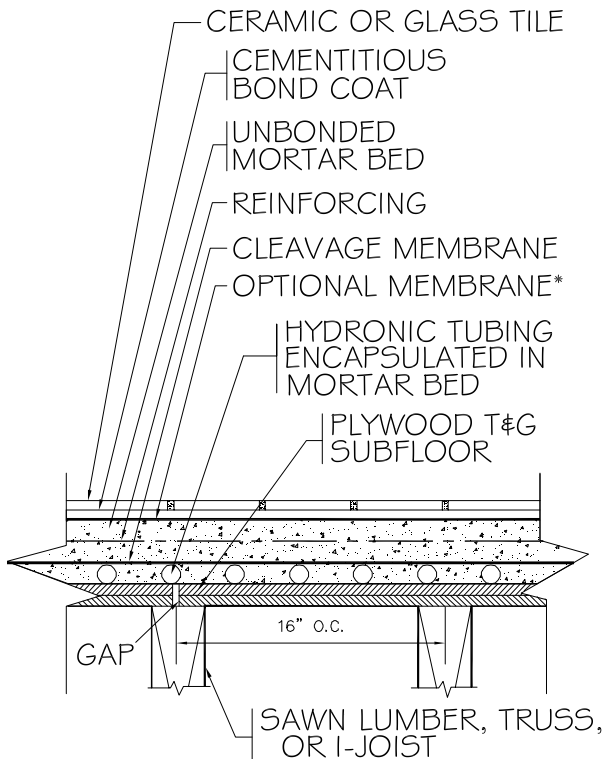
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH141-19

- Joists max. 16" o.c./Plywood Subfloor
- Unbonded Mortar Bed Encapsulating Hydronic Tubing
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For floor leveling or flattening, especially where multiple finish floor heights must be accommodated or slopes are required and where hydronic tubing will be placed.
- For installations that must be at least 1½" thick (nominal, including tile) and where hydronic tubing will be placed.
- For isolating the tile installation from the floor framing where hydronic tubing will be placed.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.

- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 30 pounds/square foot with 1¼" mortar bed over hydronic tubing. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlaments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Screed fill flush to top of hydronic tubing before placing a cleavage membrane and reinforced mortar bed.
- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a membrane is not used on top of the mortar bed—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used on top of the mortar bed—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used on top of the mortar bed—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in

conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $\frac{1}{32}$ " tongue and groove plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.
- Depressing subfloor between joists on ledger strips permissible in residential use.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

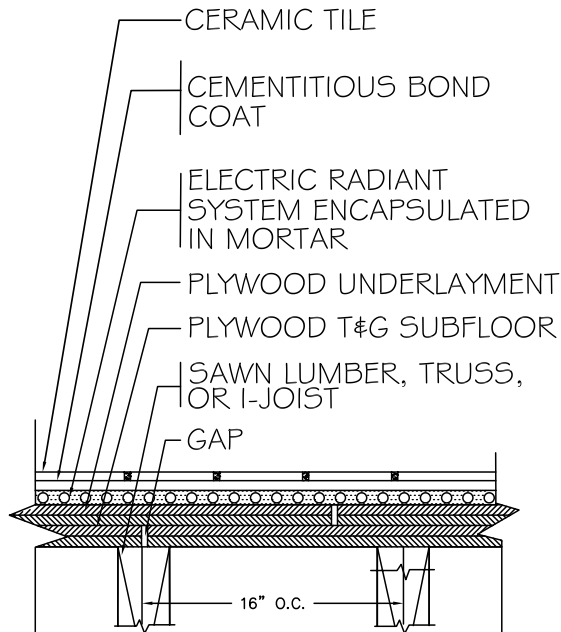
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—A108.17.
- Waterproof membrane—A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

RH130-19

- Joists max. 16" o.c./Plywood Subfloor
- Plywood Underlayment
- Electric Radiant Heat System Encapsulated in Mortar
- Ceramic Tile



USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates in dry areas where electric radiant in-floor heat is desired.

Service Rating

- Residential with minimum $1\frac{5}{32}$ "-thick plywood underlayment.
- Light commercial with minimum $1\frac{9}{32}$ "-thick plywood underlayment.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- Consult heat system manufacturer and setting material manufacturer for requirements and options.
- If a membrane is used, follow manufacturer's instructions for membrane type, installation, placement, and setting materials required.

Requirements

- Plywood underlayment—clean and free of dirt, dust, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer's recommendations.
- Electric radiant system should not be installed over building expansion joints.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - Mortar for encapsulating electric radiant system—ANSI A118.11 or ISO C2S1P1.
 - Mortar for bonding tile, when a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - Mortar for bonding tile, when a membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications,

the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Plywood subfloor—minimum $1\frac{1}{32}$ " exterior-glue tongue and groove plywood.
- Plywood underlayment—minimum $1\frac{5}{32}$ " exterior glue plywood with $\frac{1}{8}$ " gaps between sheets. See also Service Rating.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

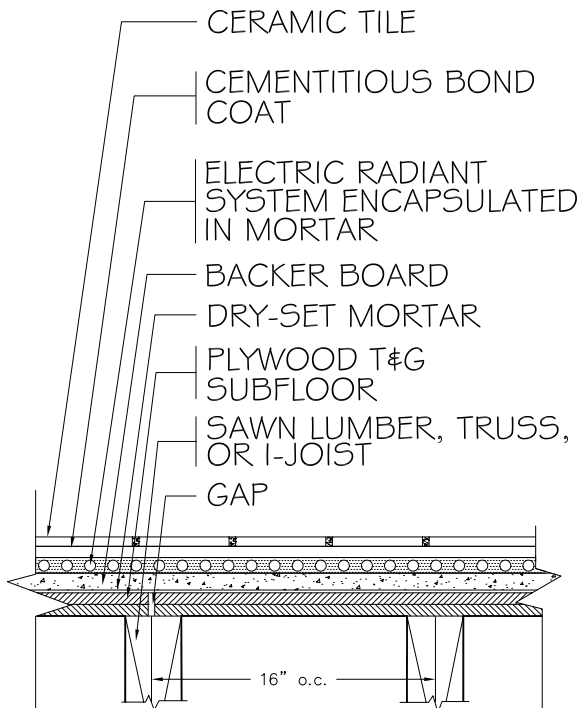
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Bond coat thickness and application varies, consult floor warming manufacturer for recommendations.
- If latex-portland cement mortar is to be applied over $\frac{3}{16}$ " in thickness, consult setting material manufacturer for additional installation instructions.
- Underlayment fasteners should not penetrate joists below.

RH135-19

- Joists max. 16" o.c./Plywood Subfloor
- Backer Board
- Electric Radiant Heat System Encapsulated in Mortar
- Ceramic Tile



USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where electric radiant in-floor heat and water resistance are desired.

Service Rating

- Residential with minimum $1\frac{9}{32}$ "-thick plywood subfloor.
- Light commercial with minimum $2\frac{3}{32}$ "-thick plywood subfloor.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 8 pounds/square foot if $\frac{1}{4}$ " or $\frac{1}{2}$ " cementitious coated foam backer board used.

- 9 pounds/square foot if $\frac{1}{4}$ " fiber-reinforced water-resistant gypsum or $\frac{1}{4}$ " coated glass mat water-resistant gypsum backer board used.
- 10 pounds/square foot if $\frac{1}{4}$ " cement backer board, $\frac{1}{4}$ " or $\frac{7}{16}$ " fiber cement backer board, $\frac{1}{2}$ " coated glass mat water-resistant gypsum backer board, or $\frac{3}{8}$ " fiber-reinforced water-resistant gypsum backer board used.
- 11 pounds/square foot if $\frac{1}{2}$ " fiber-reinforced water-resistant gypsum backer board used.
- 12 pounds/square foot if $\frac{1}{2}$ " cement backer board used.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- Consult heat system manufacturer and setting material manufacturer for requirements and options.
- If a membrane is used, follow manufacturer's instructions for membrane type, installation, placement, required cure time based on backer board type, and setting materials required.

Requirements

- Treat joints between backer units per manufacturer's directions.
- Surface of backer units—clean and free of dirt, dust, or oily film.
- Electric radiant system should not be installed over building expansion joints.
- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Fasten backer units with corrosion-resistant fasteners per manufacturer's directions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.

- When a membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325.
- Cementitious-coated foam backer board, when used—ASTM C578 (minimum Type VI).
- Coated-glass mat water-resistant gypsum backer board, when used—ASTM C1178.
- Fiber-cement backer board, when used—ASTM C1288.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood. See also Service Rating.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

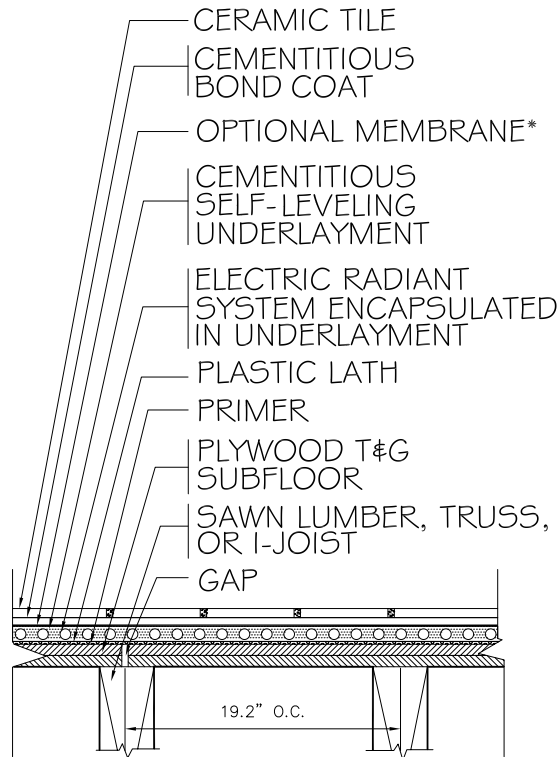
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Backer board—ANSI A108.11 or manufacturer’s directions.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Bond coat thickness and application varies, consult floor warming manufacturer for recommendations.
- If latex-portland cement mortar is to be applied over $\frac{3}{16}$ " in thickness, consult setting material manufacturer for additional installation instructions.

RH140-19

- Joists max. 19.2" o.c./Plywood Subfloor
- Electric Radiant Heat System Encapsulated in Cementitious Self-Leveling Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where joists are spaced 19.2" o.c. or less and electric radiant in-floor heat is desired.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 11 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.

- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 19.2" on center.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood subfloor—clean and free of dirt, dust, paint, and oily film.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Use plastic lath designed for this purpose, nailed or stapled in accordance with the underlayment manufacturer's instructions.
- Self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with electric radiant systems.
- Proper curing/drying of underlayments prior to the application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Electric radiant system should not be installed over building expansion joints.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout*

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Waterproof membrane, when used—ANSI A118.10.
- Crack isolation membrane, when used—ANSI A118.12.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $2\frac{3}{32}$ " tongue and groove exterior-glue plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

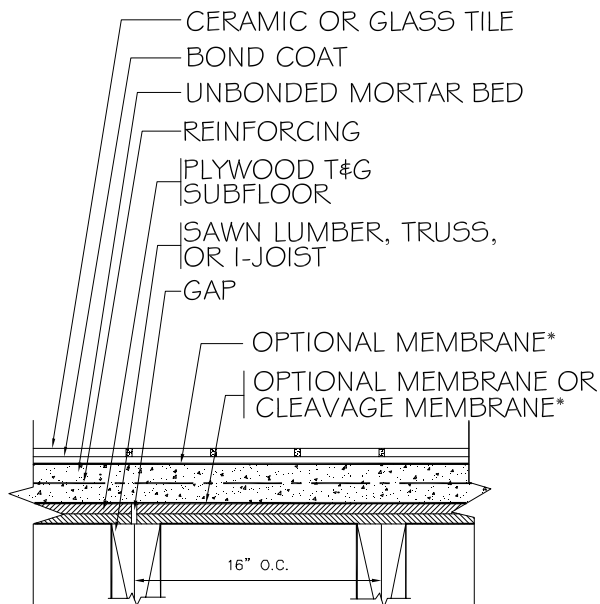
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Electric radiant systems—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.

F141-19

- Joists max. 16" o.c./Plywood Subfloor
- Unbonded Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where leveling, flattening, or contouring of finish floor height is required, such as when finishing to adjacent floors or where slopes are required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 21 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A cleavage membrane is required.
- If a bonded waterproof membrane (ANSI A118.10) is used, it may be placed above or below the mortar bed. If a shower pan membrane (ASTM D4551 or D4068) is used, it must be placed below the mortar bed.
- The waterproof membrane can also function as the cleavage membrane if loose laid (not bonded to concrete) below the mortar bed. Check with membrane manufacturer if membrane may be loose laid.
- If waterproof membrane is bonded to the top of the mortar bed, a cleavage membrane must be placed below the mortar bed.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and***

intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable

building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{1}{32}$ " tongue and groove exterior glue plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.
- Depressing subfloor between joists on ledger strips permissible in residential use.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

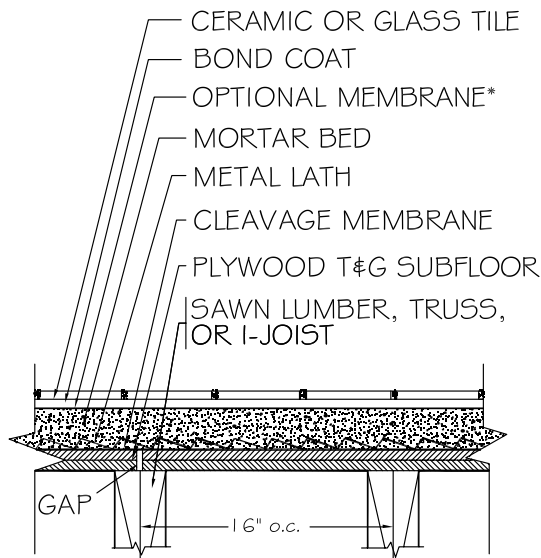
- Tile—ANSI A108.1A, 1B, or .1C. A108.1B required if membrane or epoxy grout or bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For hydronic heat application, see RH141.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For thinner mortar bed, see F145.

F145-19

- Joists max. 16" o.c./Plywood Subfloor
- Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where leveling, flattening, or contouring of finish floor height is required, such as when finishing to adjacent floors or where slopes are required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 15 pounds/square foot with $\frac{3}{4}$ " mortar bed. Add 3 pounds/square foot for each additional $\frac{1}{4}$ " of mortar bed.
- Does not include weight of substrate. See "Appendix B"

for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Expanded metal lath—minimum 2.5 pounds/square yard nailed or stapled to subfloor over a cleavage membrane.
- Mortar bed thickness— $\frac{3}{4}$ " minimum to $1\frac{1}{2}$ " maximum.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $\frac{23}{32}$ " tongue and groove exterior glue plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

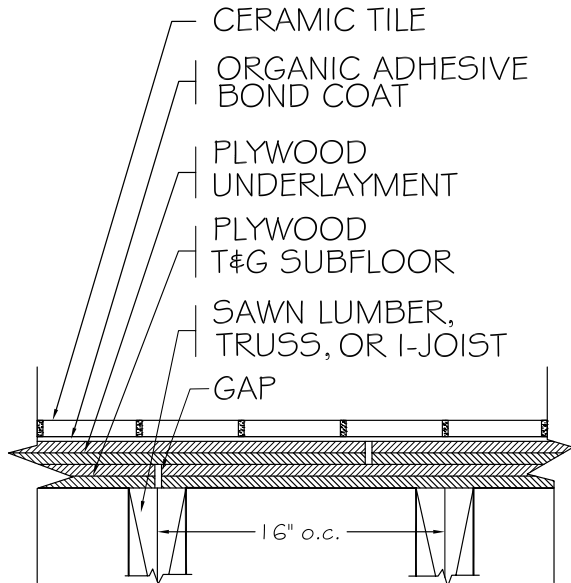
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane or epoxy grout or bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For thicker mortar bed, see F141.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F142-19

- Joists max. 16" o.c./Plywood Subfloor
- Plywood Underlayment
- Organic Adhesive
- Ceramic Tile



Recommended Uses

- For wood substrates in residential dry areas that will not be subjected to high impact, wheel loads, or point loads.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.
- Will not withstand high impact, wheel loads, or point loads.
- Not for areas exposed to temperatures exceeding 140°F.
- Maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Organic adhesive bond coat—ANSI A136.1 Type I or ISO D2.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Subfloor—minimum $\frac{1}{32}$ " tongue and groove exterior glue plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.
- Underlayment— $\frac{1}{32}$ " minimum exterior glue plywood with $\frac{1}{8}$ " gap between sheets.

- Maximum allowable variation in the tile substrate— $\frac{1}{16}$ " in 3'. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.
- Offset end and edge joints of the underlayment panels by at least 2" from the joints of subfloor panels; they should not coincide with framing below.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Joints—mandatory according to EJ171.

Installation Specifications

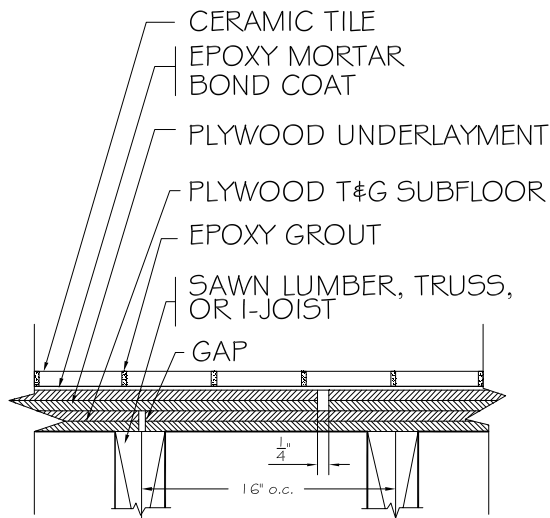
- Tile—ANSI A108.4.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the subfloor from the required plane. Organic adhesive thickness must be thin and uniform; therefore, subfloor flattening may be required.
- Underlayment fasteners should not penetrate joists below.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption.

F143-19

- Joists max. 16" o.c./Plywood Subfloor
- Plywood Underlayment
- Epoxy Mortar
- Ceramic Tile
- Epoxy Grout



Recommended Uses

- For wood substrates where increased resistance to traffic and/or loading, water, chemicals, and/or aggressive cleaning practices are desired.

Service Rating

- Residential with minimum $1\frac{5}{32}$ "-thick plywood underlayment.
- Light commercial with minimum $1\frac{9}{32}$ "-thick plywood underlayment.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.
- Not for severe chemical exposure or extreme heat.
- Extreme heat or improper steam cleaning will soften epoxy grouts and wash them out of joints. High temperature resistant formulas are available.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer's recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Epoxy grout—ANSI A118.3 or ISO RG. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy grout certified by manufacturer for intended use.
- Epoxy mortar—ANSI A118.3 or ISO R1 or better. For tilework exposed to prolonged high temperatures, use high-temperature, chemical-resistant epoxy mortar certified by manufacturer for intended use.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also "Substrate Requirements."

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " tongue and groove plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.
- Underlayment—minimum $1\frac{5}{32}$ " exterior glue plywood with $\frac{1}{4}$ " gap between sheets. See also Service Rating.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

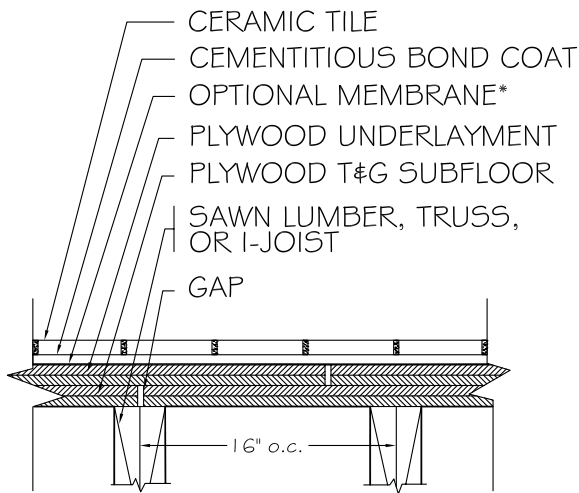
- Epoxy mortar/grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Specify tile suitable for expected chemical exposure.
- As tile size increases, there is less tolerance for variation in the subfloor from the required plane. Epoxy mortar thickness must be thin and uniform; therefore, subfloor flattening may be required.
- Underlayment fasteners should not penetrate joists below.

F150-19

- Joists max. 16" o.c./Plywood Subfloor
- Plywood Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates in dry areas where increased resistance to traffic and loading is desired.

Service Rating

- Residential with minimum $1\frac{5}{32}$ "-thick plywood underlayment.
- Light commercial with minimum $1\frac{9}{32}$ "-thick plywood underlayment.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to

prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.11 or better or ISO C2S1P1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer (mortar for bonding tile to membrane).
- When a waterproof membrane is used, follow membrane manufacturer's directions for bonding membrane to plywood underlayment.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard*

Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Underlayment—minimum $1\frac{5}{32}$ " exterior glue plywood with $\frac{1}{8}$ " gap between sheets. See also Service Rating.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

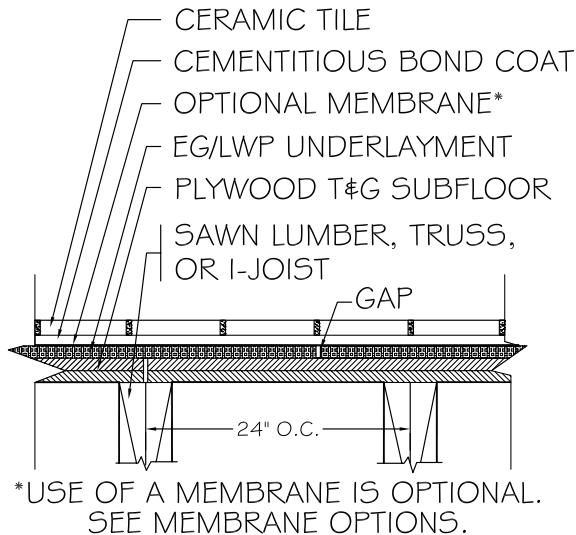
- Tile—ANSI A108.12.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.

F160-19

- Joists max. 24" o.c./Plywood Subfloor
- Exterior Glue/Laminated Wood Panel (EG/LWP) Underlayment
- Ceramic Tile



Recommended Uses

- For wood substrates in dry areas where joists are spaced 24" on center or less.

Service Rating

- Light commercial.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 8" x 8" and larger tile only.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls

and building materials. Base flashing should be used for maximum effectiveness.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer's recommendations.
- Fasten underlayment with screws every 6" in the field and every 4" along the perimeter. Do not staple.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.11 or better or ISO C2S1P1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer (mortar for bonding tile to membrane).
- When a waterproof membrane is used, follow membrane manufacturer's directions for bonding membrane to EG/LWP underlayment.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard*

Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and EG/LWP underlayment shall run perpendicular to joists.
- Subfloor—minimum $\frac{23}{32}$ " tongue and groove exterior glue plywood with $\frac{1}{8}$ " gap between sheets.
- Underlayment—minimum $\frac{3}{8}$ " exterior-glue laminated birch wood panel with a minimum of 7 plies.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

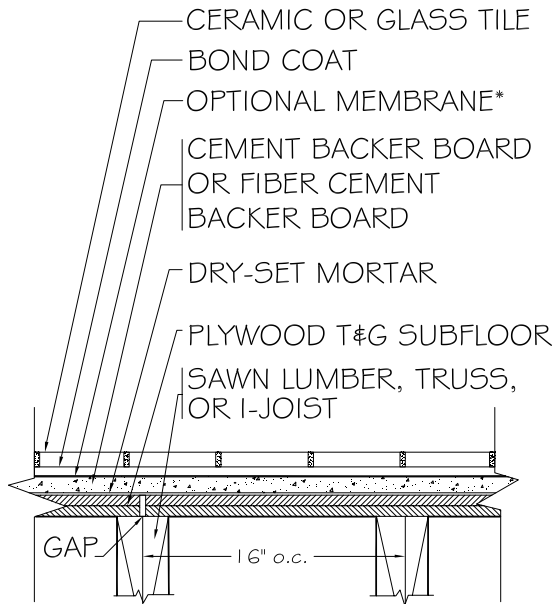
- Tile—ANSI A108.12 or .5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.

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- Joists max. 16" o.c./Plywood Subfloor
- Cement Backer Board or Fiber-Cement Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where water-resistance is desired.

Service Rating

- Residential with minimum $\frac{19}{32}$ "-thick subfloor and minimum $\frac{1}{4}$ "-thick cement backer board.
- Light commercial with minimum $\frac{19}{32}$ "-thick subfloor and minimum $\frac{7}{16}$ "-thick cement backer board or $\frac{1}{4}$ "-thick fiber cement backer board.
- Light commercial with minimum $\frac{23}{32}$ "-thick subfloor and minimum $\frac{1}{4}$ "-thick cement backer board.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure.

For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 8 pounds/square foot if $\frac{1}{4}$ " cement backer board or $\frac{1}{4}$ " fiber-cement backer board used.
- 9 pounds/square foot if $\frac{7}{16}$ " fiber-cement backer board used.
- 10 pounds/square foot if $\frac{1}{2}$ " cement backer board used.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Surface of units—clean and free of dirt, dust, paint, and oily film.

Preparation by Backer Board Installers

- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Fasten backer units with corrosion-resistant fasteners per manufacturer's directions.
- Leave $\frac{1}{8}$ " perimeter movement gap and $\frac{1}{8}$ " gap between sheets. Fill joints between sheets solid and tape with portland cement mortar and 2" alkali-resistant glass fiber mesh tape. Do not fill perimeter joint.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325. See Service Rating for minimum thickness.
- Fiber cement backer board, when used—ASTM C1288. See Service Rating for minimum thickness.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets. See also Service Rating.
- Maximum variation in the plywood surface— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane. Adjacent edges of plywood sheets—maximum $\frac{1}{32}$ " above or below each other.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

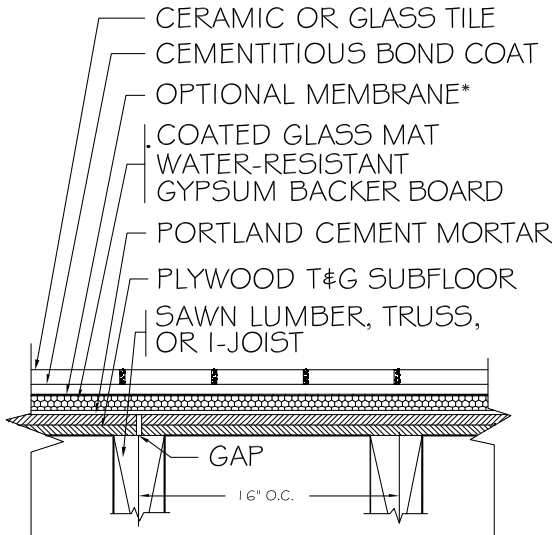
- Tile—ANSI A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Backer board—ANSI A108.11 or manufacturer's directions.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

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- Joists max. 16" o.c./Plywood Subfloor
- Coated Glass Mat Water-Resistant Gypsum Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where water-resistance is desired.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 8 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion through seams, corners,

fasteners, and other penetrations to protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness. Follow backer board and membrane manufacturer’s waterproofing requirements.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Set tile on positive side of moisture barrier coating.
- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Fasten backer units with corrosion-resistant fasteners per manufacturer’s directions.
- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Coated glass mat water-resistant gypsum backer board—ASTM C1178.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Waterproof membrane, when used—A118.10.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications,

the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $1/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum variation in the plywood surface— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane. Adjacent edges of plywood sheets—maximum $\frac{1}{32}$ " above or below each other.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

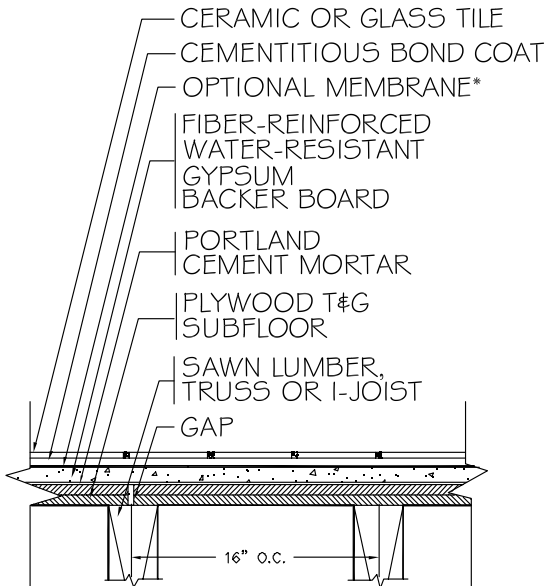
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

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- Joists max. 16" o.c./Plywood Subfloor
- Fiber-Reinforced Water-Resistant Gypsum Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where water-resistance is desired.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 8 pounds/square foot if 1/4" or 3/8" fiber-reinforced water-resistant gypsum backer board used.
- 9 pounds/square foot if 1/2" fiber-reinforced water-resistant gypsum backer board used.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Caulk or seal penetrations and abutments to dissimilar materials.
- Surface of units—clean and free of dirt, dust, paint, and oily film.

Preparation by Backer Board Installers

- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Fasten backer units with corrosion-resistant fasteners per manufacturer's directions.
- Leave 1/8" perimeter movement gap and 1/8" gap between sheets. Fill joints between sheets solid and tape with portland cement mortar and 2" alkali-resistant glass fiber mesh tape. Do not fill perimeter joint.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.
- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and**

intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Waterproof membrane, when used—A118.10.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated

loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum variation in plywood surface— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane. Adjacent edges of plywood sheets—maximum $\frac{1}{32}$ " above or below each other.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

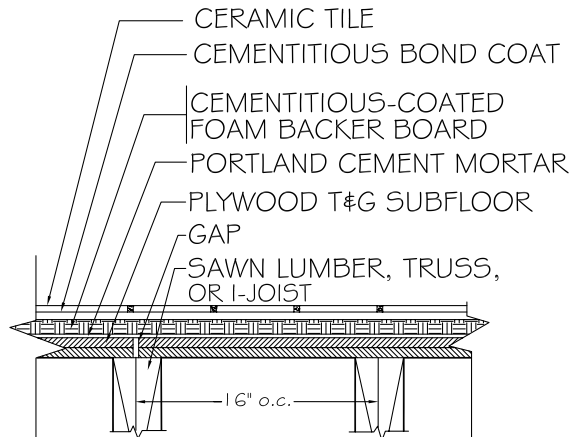
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F175-19

- Joists max. 16" o.c./Plywood Subfloor
- Cementitious-Coated Extruded Foam Backer Board
- Ceramic Tile



Recommended Uses

- For wood substrates where water-resistance is desired.

Service Rating

- Light commercial.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure when backer board manufacturer's waterproofing instructions are followed.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.
- 8" x 8" and larger tile only.

Requirements

- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Specifier shall indicate if complete waterproofing is required, including if/how to connect to drain assembly, if base flashing is required, and treatment at other termination points.

Preparation by Backer Board Installers

- Fasten backer board with board manufacturer's recommended fasteners.
- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed, and over fastener heads, per backer board manufacturer's instructions.
- Joints may be taped with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material in dry areas.
- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Cementitious-coated extruded foam backer board—ASTM C578.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape, when used.
- Flexible sealant—must be recommended by backer board manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum variation in plywood surface— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane. Adjacent edges of plywood sheets—maximum $\frac{1}{32}$ " above or below each other.

Movement Joint (architect must specify type of joint and show location and details on drawings)

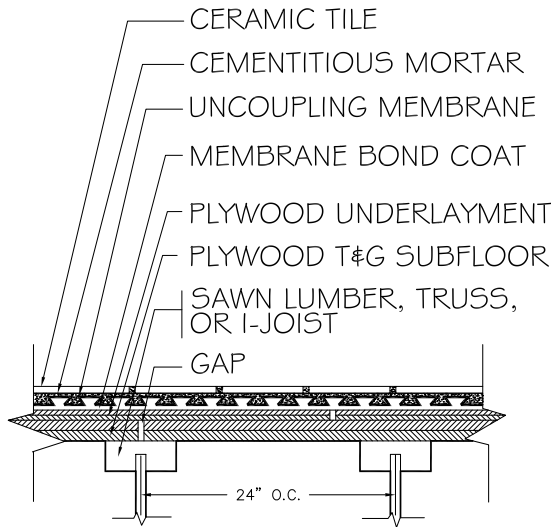
- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

F147-19

- Joists max. 24" o.c./Plywood Subfloor
- Plywood Underlayment
- Uncoupling Membrane
- Ceramic Tile



Recommended Uses

- For wood substrates where joists are spaced 24" on center or less and water resistance and uncoupling are desired.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1, 2.
- May be suitable for increased water exposure when membrane manufacturer’s waterproofing instructions are followed. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 4" x 4" and larger tile only.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious mortar—as recommended by membrane manufacturer.
- Uncoupling membrane—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Trusses or I-joists with minimum 2¼" top flange (1½" top flange permissible with 8" × 8" and larger tile); cross-bracing recommended.
- Subfloor—minimum 2³/₃₂" tongue and groove exterior glue plywood with ⅛" gap between sheets.
- Underlayment—minimum 3³/₈" exterior glue plywood with ⅛" gap between sheets.
- Maximum allowable variation in the installation substrate (plywood underlayment)—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than 1¹/₁₆" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than 1¹/₁₆" variation in 24" when measured from the high points in the surface.
- Vapor barrier on crawl space floors according to building code.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

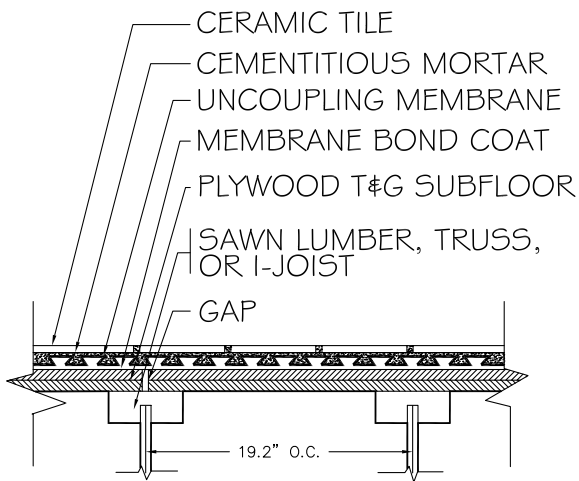
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.
- Seal seams between membrane sheets per membrane manufacturer's instructions to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

F148-19

- Joists max. 19.2" o.c./Plywood Subfloor
- Uncoupling Membrane
- Ceramic Tile



Recommended Uses

- For wood substrates where joists are spaced 19.2" on center or less and water resistance and uncoupling are desired.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1, 2.
- May be suitable for increased water exposure when membrane manufacturer's waterproofing instructions are followed. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 6 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 19.2" on center.
- 3" x 3" and larger tile only.

Requirements

- Plywood subfloor—clean and free of dirt, dust, paint, and oily film.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious mortar—as recommended by membrane manufacturer.
- Uncoupling membrane—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum 2³/₃₂" tongue and groove exterior glue plywood with 1/8" gap between sheets.
- Maximum allowable variation in the installation substrate (plywood underlayment)—for tiles with all edges

shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

- Vapor barrier on crawl space floors according to building code.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

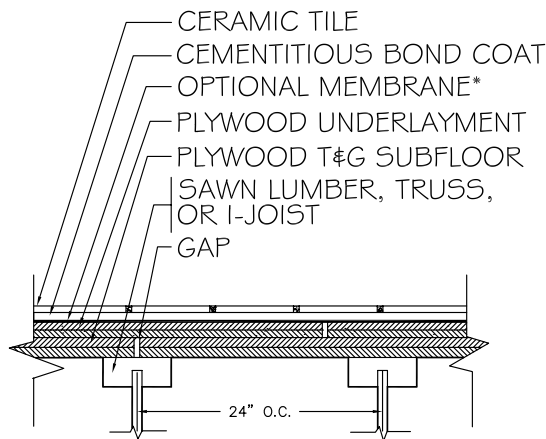
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Seal seams between membrane sheets per membrane manufacturer's instructions to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

F149-19

- Joists max. 24" o.c./Plywood Subfloor
- Plywood Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates in dry areas where joist spacing is 24" on center or less.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 8" x 8" and larger tile only.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between plywood underlayment sheets to be treated per setting material manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.11 or better or ISO C2S1P2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer (mortar for bonding tile to membrane).
 - When a waterproof membrane is used, follow membrane manufacturer's directions for bonding membrane to plywood underlayment.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Trusses or I-joists with minimum $1\frac{1}{2}$ " top flange or sawn lumber joists; cross bracing recommended.
- Subfloor—minimum $2\frac{3}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Underlayment—minimum $1\frac{9}{32}$ " exterior glue plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

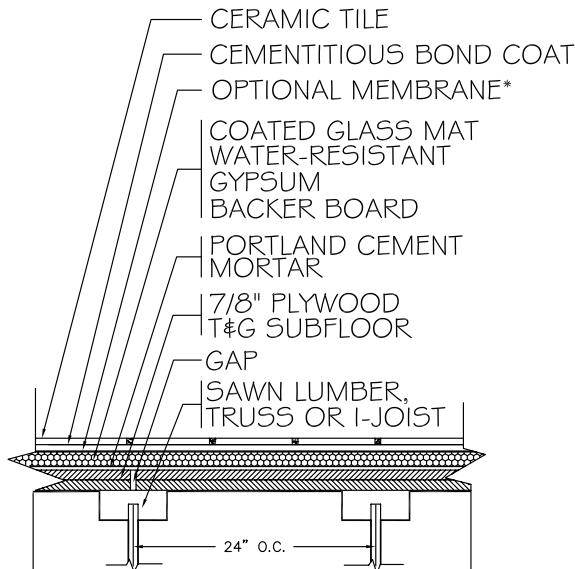
- Tile—ANSI A108.12 or .5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.

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- Joists max. 24" o.c./Plywood Subfloor
- Coated Glass Mat Water-Resistant Gypsum Backer Board
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where joists are 24" on center or less and water resistance is desired.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 8 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 8" x 8" and larger tile only.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion through seams, corners, fasteners, and other penetrations to protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness. Follow backer board and membrane manufacturer's waterproofing requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayment, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Surfaces of units—clean and free of dirt, dust, paint, and oily film.
- Set tiles on positive side of moisture barrier coating.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is 1/8" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Fasten backer units with corrosion-resistant fasteners per manufacturer's directions.
- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the

same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Coated glass mat water-resistant gypsum backer board—ASTM C1178.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Waterproof membrane, when used—A118.10.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated

loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $\frac{7}{8}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum variation in the plywood surface— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane. Adjacent edges of plywood sheets—maximum $\frac{1}{32}$ " above or below each other.
- Install tongue and groove plywood according to manufacturer's installation instructions for tiled floors.

Movement Joint (architect must specify type of joint and show location and details on drawings)

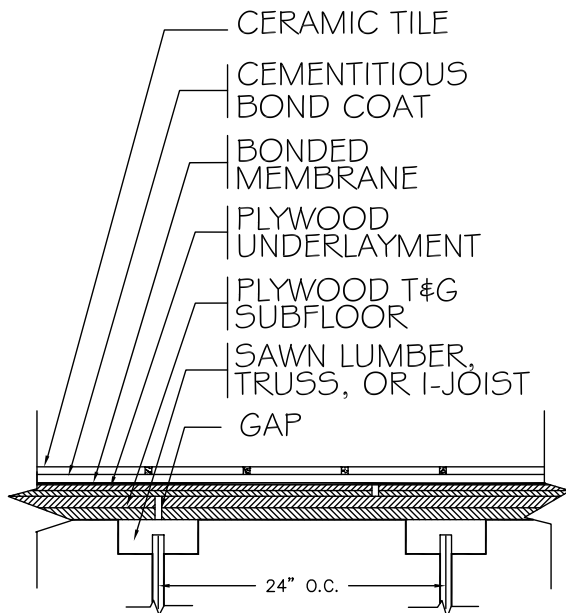
- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Coated glass mat water-resistant gypsum backer board—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

F152-19

- Joists max. 24" o.c./Plywood Subfloor
- Plywood Underlayment
- Bonded Membrane
- Ceramic Tile



Recommended Uses

- For wood substrates where joists are spaced 24" on center or less and a water-resistant or waterproof floor is desired.

Service Rating

- Residential. Consult membrane manufacturer to verify.

Environmental Exposure Classifications

- Res1, 2.
- May be suitable for increased water exposure when membrane meets ANSI A118.10 and manufacturer's waterproofing instructions are followed. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 4" x 4" and larger tile only.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Consult membrane manufacturer to verify membrane meets residential service rating when tested per ASTM C627 with joists spaced 24" on center and with actual tile selected.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Seal seams between membrane sheets per membrane manufacturer's instructions to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat (for bonding tile to membrane)—ANSI A118.4 or better or ISO C2S1 or better.
- Membrane—recommended by manufacturer.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed 1/360. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall

specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Trusses or I-joists with minimum 2¼" top flange (1½" top flange permissible with 8" × 8" and larger tile); cross-bracing recommended.
- Subfloor—minimum 2³/₃₂" tongue and groove exterior glue plywood with ⅛" gap between sheets.
- Underlayment—minimum ⅜" exterior glue plywood with ⅛" gap between sheets.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than 1/16" variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed 1/32" difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

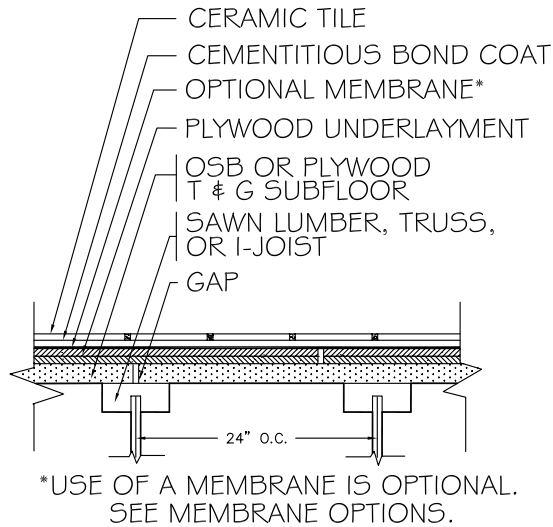
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.
- Not all membranes are recommended for this application. Consult membrane manufacturer.

F155-19

- Joists max. 24" o.c./Plywood or OSB Subfloor
- Plywood Underlayment
- Ceramic Tile



Recommended Uses

- For wood substrates in dry areas where joist spacing is 24" on center or less.

Service Rating

- Residential.

Environmental Exposure Classifications

- Res1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 24" on center.
- 8" x 8" and larger tile only.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls

and building materials. Base flashing should be used for maximum effectiveness.

- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Plywood underlayment—clean and free of dirt, dust, paint, and oily film.
- Gaps between underlayment sheets to be treated per setting material manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.11 or better or ISO C2S1P2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer (mortar for bonding tile to membrane).
- When a waterproof membrane is used, follow membrane manufacturer's directions for bonding membrane to plywood underlayment.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Strength axis of OSB subfloor and face grain of plywood underlayment shall run perpendicular to joists.
- Trusses or I-joists with minimum $1\frac{1}{2}$ " top flange or sawn lumber joists; cross bracing recommended.
- Subfloor—minimum $2\frac{3}{32}$ " tongue and groove OSB or plywood with $\frac{1}{8}$ " gap between sheets.
- Underlayment—minimum $1\frac{9}{32}$ " exterior glue plywood with $\frac{1}{8}$ " gap between sheets.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

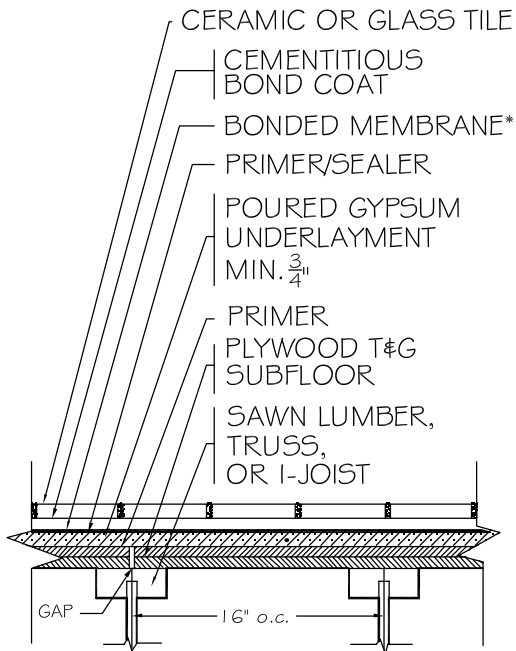
- Tile—ANSI A108.12 or .5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.

F180-19

- Joists max. 16" o.c./Plywood Subfloor
- Poured Gypsum Underlayment
- Bonded Membrane
- Ceramic Tile, Glass Tile



* USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates with a poured gypsum underlayment.

Service Rating

- Light commercial.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2) with waterproof membrane. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 12 pounds/square foot with 3/4" poured gypsum. Add 2 1/4 pounds/square foot for each additional 1/4" of poured gypsum.
- Does not include weight of substrate. See "Appendix B"

for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When an uncoupling membrane is used, check with membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live load and concentrated load deflection shall not exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from

the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

- Face grain of plywood shall run perpendicular to joists.
- Exterior grade plywood subfloor to be clean and free of dirt, dust, paint, and oily film.
- Some manufacturers of poured gypsum underlayments require use of plastic lath. Follow manufacturer's recommendations for installation and use of the lath.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Subfloor—minimum $\frac{23}{32}$ " tongue and groove exterior glue plywood.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

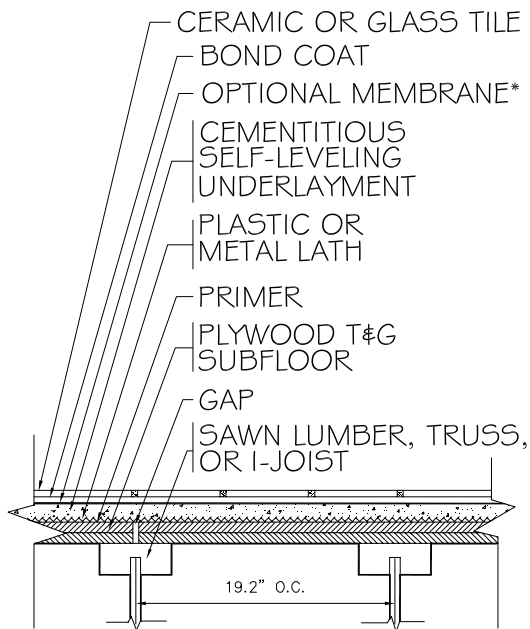
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer's directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

F185-19

- Joists max. 19.2" o.c./Plywood Subfloor
- Cementitious Self-Leveling Underlayment
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where joists are spaced 19.2" on center or less and floor flatness is critical, such as when tiles with an edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Residential.
- When glass tile is used, service rating may be lower.

Environmental Exposure Classifications

- Res1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 11 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.

- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 19.2" on center.
- When glass tile is used, maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Plywood subfloor to be clean and free of dirt, dust, paint, and oily film.
- Surfaces must be prepared and primed according to the underlayment manufacturer's instructions.
- Use lath designed for this purpose, nailed or stapled in accordance with the underlayment manufacturer's instructions.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Proper curing/drying of underlayments prior to the application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and***

intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for service rating and environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable floor member live

load and concentrated load deflection shall not exceed 1/360. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood shall run perpendicular to joists.
- Plywood subfloor—minimum ²³/₃₂" tongue and groove exterior glue plywood with ¹/₈" gap between sheets.
- Maximum allowable variation in the installation substrate (plywood)—¹/₄" in 10' from the required plane.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¹/₄" in 10' from the required plane, with no more than ¹/₁₆" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ¹/₈" in 10' from the required plane, with no more than ¹/₁₆" variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

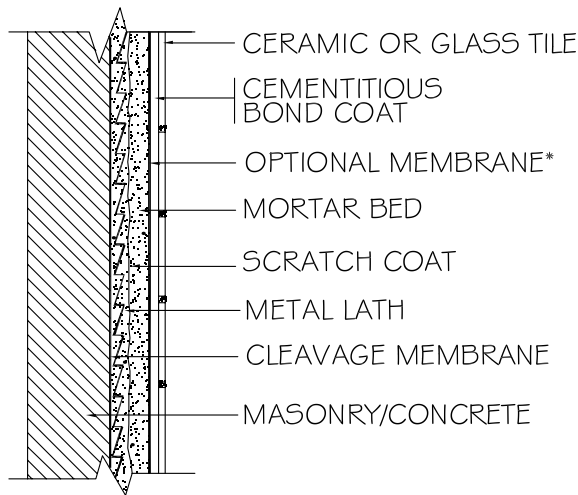
- Tile—ANSI A108.5 or A108.6.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W201-19

- **Masonry or Concrete**
- **Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior walls of masonry or concrete where flattening or truing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.
- For isolating the tile installation from the substrate.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Cut lath at all movement joints.
- Mortar bed thickness— $\frac{3}{4}$ " minimum to $1\frac{1}{2}$ " maximum.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete/masonry)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

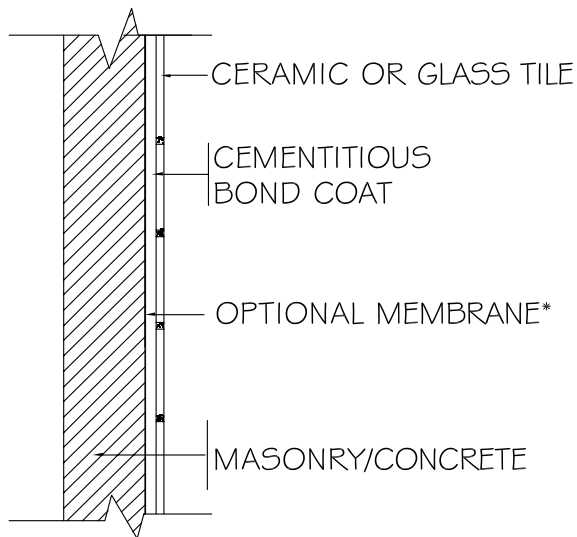
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see “Additional Products Used in Tile Installations.”
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- For interior mortar bed applications, see W211, W221, W222, W231/241, B411, B414, SR613, and R612.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W202E-19

- **Masonry or Concrete**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For clean, sound exterior walls of masonry or concrete where thin-bed installation of tile is desired.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.
- Not for cracked or coated surfaces.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is 1/4" in 10' from the required plane, with no more than 1/16" variation in 12" when measured from

the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints mandatory—according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

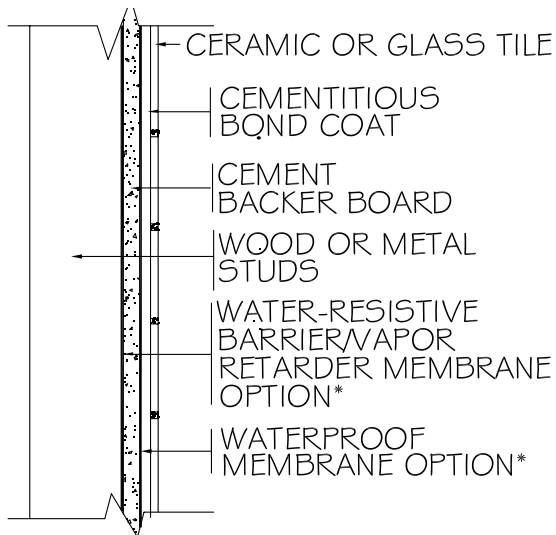
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see "Additional Products Used in Tile Installations."
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- For interior thin-bed applications over masonry or concrete, see W202I and W223.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.

W244E-19

- Wood or Metal Studs
- Cement Backer Board
- Ceramic Tile, Glass Tile



* USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior walls over wood or metal studs.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.
- Maximum stud spacing 16" on center.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- If waterproof membrane is applied over cement board, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Water-resistive barrier or waterproof membrane required, per building code. See Membrane Options.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅓" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅓" in 10' from the required plane, with no more than ⅓" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅓" spacing filled solid and taped with latex-portland cement mortar and 4" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 4" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Cementitious bond coat:
 - When a waterproof membrane is not used on face of cement backer board—ANSI A118.15 or better or ISO C2S1 or better.

- When a waterproof membrane is used on face of cement backer board—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type A).
- Fasteners—noncorrosive and nonoxidizing.
- Hot-dipped fasteners meeting ASTM F2329-05 required in wet areas.
- 4" alkali-resistant glass fiber mesh tape.
- Water-resistive barrier/vapor retarder membrane, when used—per building code.
- Waterproof membrane, when used—ANSI A118.10.
- Metal studs—ASTM C645.
- For interior applications, see W244C, B412, B415, and SR614.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0–4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

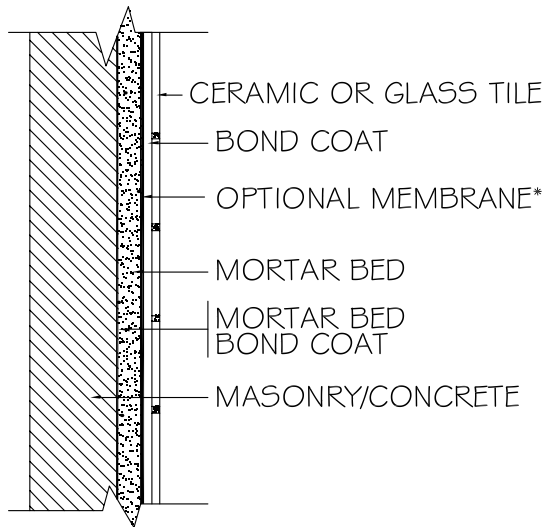
- Cement backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see “Additional Products Used in Tile Installations.”
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.

W211-19

- **Masonry or Concrete**
- **Bonded Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For clean, sound interior walls of masonry or concrete where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Not for cracked or coated surfaces.
- Exterior—where installation will be subjected to freeze/thaw cycles, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete

waterproofing is required, including base flashing and treatment at other termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum. Scratch coat required if mortar bed will exceed $\frac{3}{4}$ ".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.

- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete/masonry)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

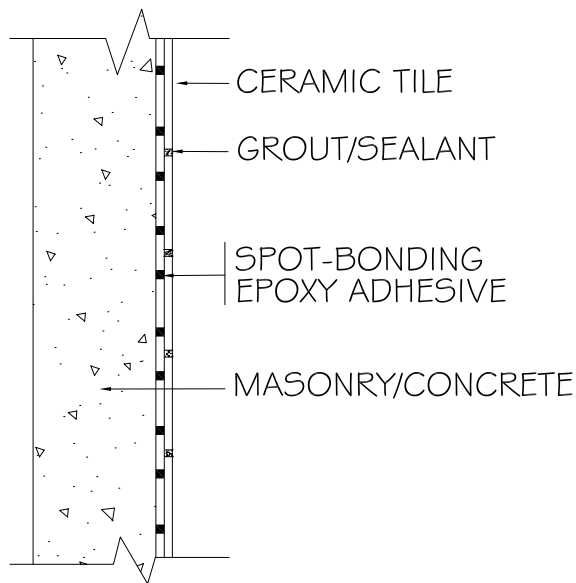
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane or epoxy bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W215-19

- **Masonry or Concrete**
- **Spot-Bonding Epoxy**
- **Ceramic Tile**



Recommended Uses

- For clean, sound interior walls of masonry or concrete where large format tiles are specified.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Will not withstand impact.
- Not for cracked or coated surfaces.

Requirements

- Epoxy must be recommended by the manufacturer for spot-bonding.
- Follow epoxy manufacturer’s coverage requirements.
- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated,**

optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Sealant, when used as grout—ASTM C920.
- Spot bonding epoxy adhesive—epoxy recommended by manufacturer for spot bonding.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.*

Preparation by Other Trades

- Maximum allowable variation in the tile substrate— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

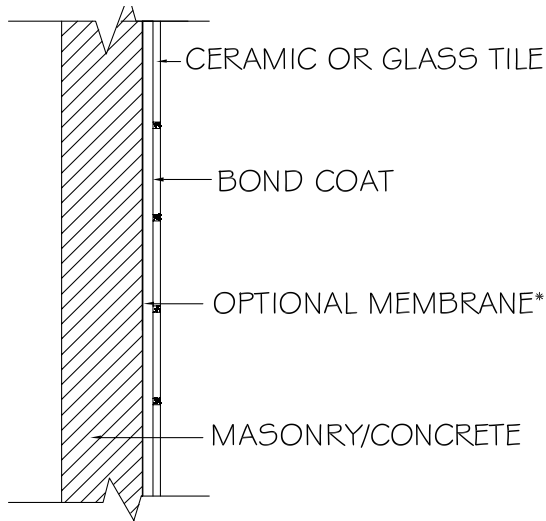
- Movement joints—mandatory according to EJ171.

Installation Specifications

- Tile—epoxy manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Sealant—follow sealant and epoxy manufacturer’s instructions for using sealant as grout.
- Movement Joints—EJ171 and ASTM C1193.

W202I-19

- **Masonry or Concrete**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of masonry or concrete where thin-bed installation of tile is desired.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for cracked or coated surfaces.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints mandatory—according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

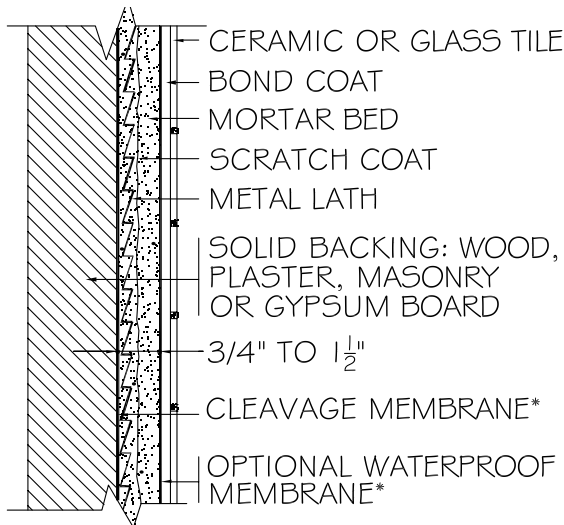
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For exterior application, see W202E.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.

W221-19

- **Solid Backing**
- **Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of masonry, plaster, or other solid backing where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.

Environmental Exposure Classifications

- With masonry backing—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With gypsum board or plaster backing—Res1, 2; Com1, 2.
- With wood backing—Res1; Com1.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- When backing is gypsum board, not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- If a waterproof membrane (A118.10) is not specified and backing material is moisture sensitive, cleavage membrane must be used behind mortar bed in wet areas.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3 1/2".
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3 1/2" for residential applications or 3 3/8" for commercial applications.
- Solid backing must provide firm anchorage for metal lath.
- Mortar bed thickness—3/4" minimum to 1 1/2" maximum.
- Cut lath at all movement joints.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (solid backing)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

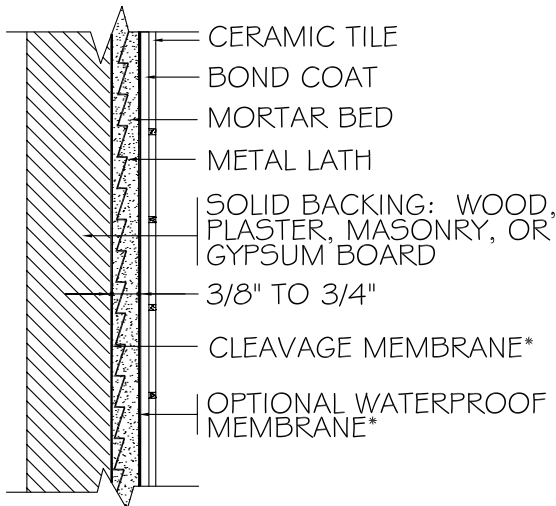
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- If lath cannot be attached directly to backing, use furring strips. See W231/W241.

W222-19

- Solid Backing
- Mortar Bed (One Coat Method)
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of masonry, plaster, or other solid backing where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.

Environmental Exposure Classifications

- With masonry backing—Res1, 2, 5; Com1, 2, 5.
- With gypsum board or plaster backing—Res1, 2; Com1, 2.
- With wood backing—Res1; Com1.
- For Res3 and Com3, see B440 and B441.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- When backing is gypsum board, not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- If a waterproof membrane (A118.10) is not specified and backing material is moisture sensitive, cleavage membrane must be used behind mortar bed in wet areas.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Solid backing must provide firm anchorage for metal lath.
- Mortar bed thickness—⅜" minimum to ¾" maximum.
- Cut lath at all movement joints.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.

- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (solid backing)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

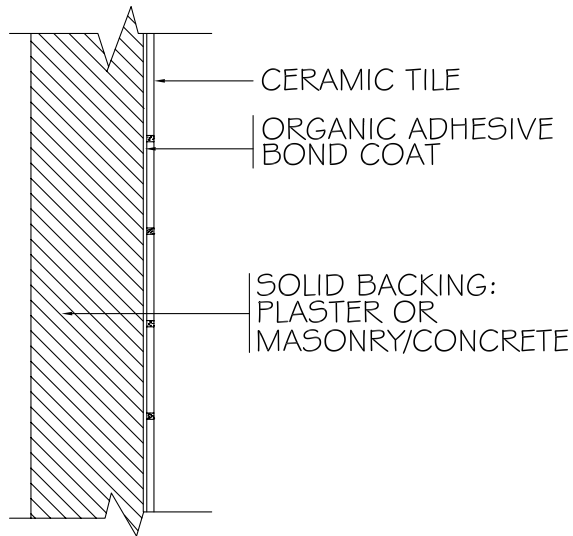
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- If lath cannot be attached directly to backing, use furring strips. See W231/W241.
- For thicker mortar bed, see W221.
- For mortar bed directly over wood or metal studs, see W231/W241.
- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.

W223-19

- Concrete, Masonry, or Plaster
- Organic Adhesive
- Ceramic Tile



Recommended Uses

- For interior walls of concrete, masonry, plaster, or other backers.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.
- Not for areas exposed to temperatures exceeding 140°F.

Requirements

- Masonry or concrete—well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Masonry or concrete—may require bush-hammering or sandblasting to facilitate bonding.
- Wood studs—dry and well-braced, minimum depth 3½".
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Organic adhesive bond coat—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ISO D1 and A136.1 Type II are suitable for dry areas only (Res1; Com1).
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate— $\frac{1}{16}$ " in 3' with no abrupt irregularities greater than $\frac{1}{32}$ ".

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

- Tile—ANSI A108.4.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

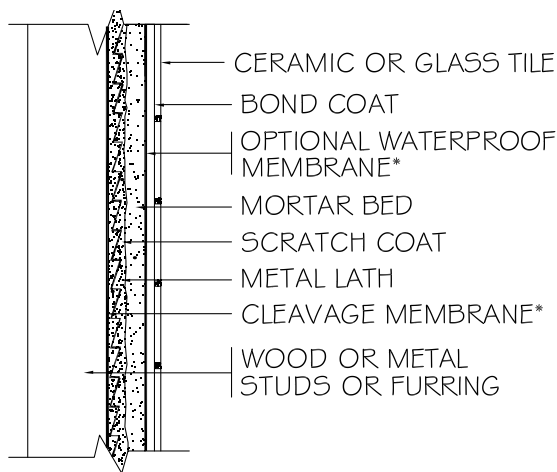
Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- For bonding tile to gypsum board with organic adhesive, see W242.
- For bonding tile to cement backer board with organic adhesive, see W244C.
- For bonding tile to fiber-cement backer board with organic adhesive, see W244.

- For bonding tile to fiber-reinforced water-resistant gypsum backer board with organic adhesive, see W247.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.

W231/W241-19

- Wood or Metal Studs
- Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls framed of wood or metal where flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- Res 1, 2, 5; Com1, 2, 5.
- For Res3 and Com3, see B411 and B414.
- For Res4 and Com4, see SR614.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete

waterproofing is required, including base flashing and treatment at other termination points.

- If a waterproof membrane is applied over the mortar bed, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1½" maximum.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will

- impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Water-resistive barrier/vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

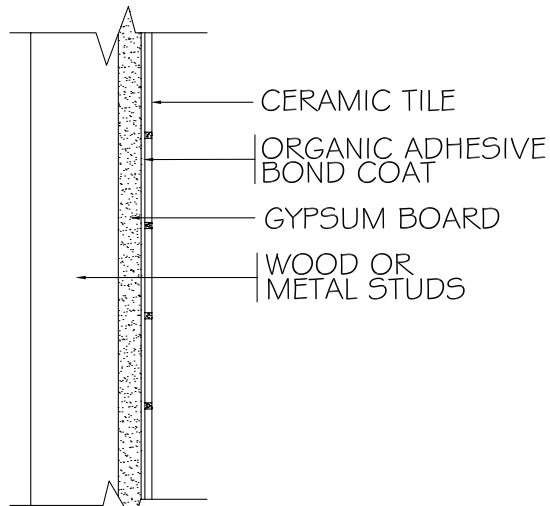
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W242-19

- Wood or Metal Studs
- Gypsum Board
- Organic Adhesive
- Ceramic Tile



Recommended Uses

- For interior walls in dry areas where gypsum board is the tile backer.
- For fire-resistant, sound-insulated, ceramic tiled walls. See RW800 for fire and sound ratings. (Fire-resistance and sound-insulation ratings calculated on partitions before tiling.)

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Not for areas exposed to temperatures exceeding 125°F.
- Maximum stud spacing 16" on center.
- Maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Organic adhesive bond coat—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ANSI A136.1 Type II and ISO D1 are suitable for dry areas only (Res1; Com1).
- Gypsum board—ASTM C1396/C1396M. Minimum ½" thick for single layer applications.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gypsum board, single or double layer, to be installed per GA-216.
- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Maximum allowable variation in the tile substrate— $\frac{1}{16}$ " in 3' with no abrupt irregularities greater than $\frac{1}{32}$ ".
- Corners, door jambs, etc., must be plumb within $\frac{1}{8}$ " in 8'.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

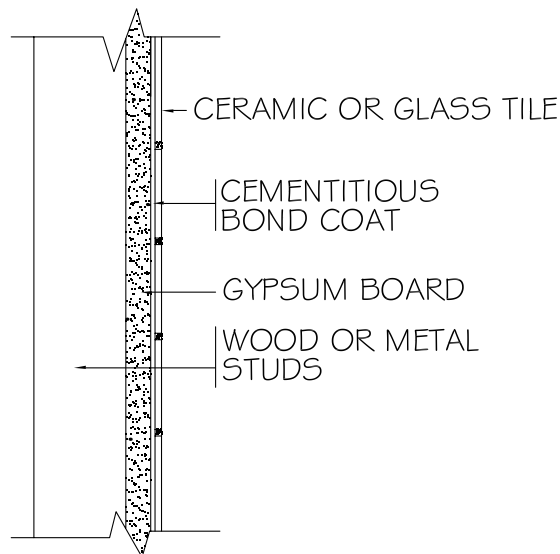
- Gypsum board—GA-216.
- Tile—ANSI A108.4.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrates.
- Dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.

W243-19

- Wood or Metal Studs
- Gypsum Board
- Cementitious Bond Coat
- Ceramic Tile, Glass Tile



Recommended Uses

- For interior walls in dry areas where gypsum board is the tile backer.
- For fire-resistant, sound-insulated, ceramic tiled walls. See RW800 for fire and sound ratings. (Fire-resistance and sound-insulation ratings calculated on partitions before tiling.)

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for areas exposed to temperatures exceeding 125°F.
- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly*

specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Gypsum board—ASTM C1396/C1396M. Minimum ½" thick for single layer applications.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gypsum board, single or double layer, to be installed per GA-216.
- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

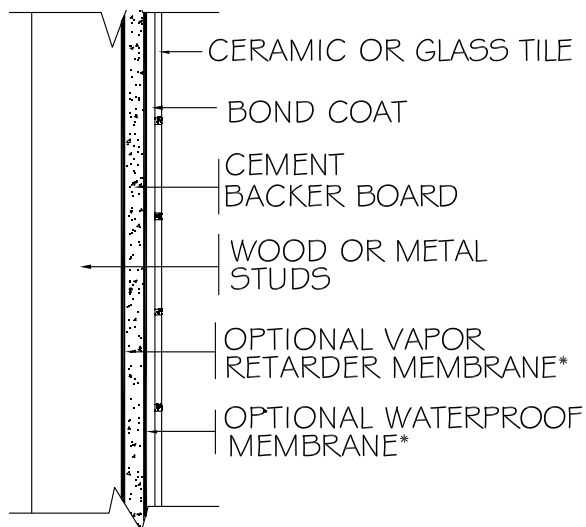
- Gypsum board—GA-216.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W244C-19

- Wood or Metal Studs
- Cement Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- With cementitious or epoxy bond coat—Res1, 2, 5; Com1, 2, 5.
- With organic adhesive bond coat—Res1, 2; Com1, 2.
- For Res3 and Com3, see B412 and B415.
- For Res4 and Com4, see SR614.
- For Res6 and Com6, see W244E.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- When organic adhesive is used—not for areas exposed to temperatures exceeding 140°F.
- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) may be specified to prevent

moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass

Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ISO D1 and ANSI A136.1 Type II are suitable for dry areas only (Res1; Com1)
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type B).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

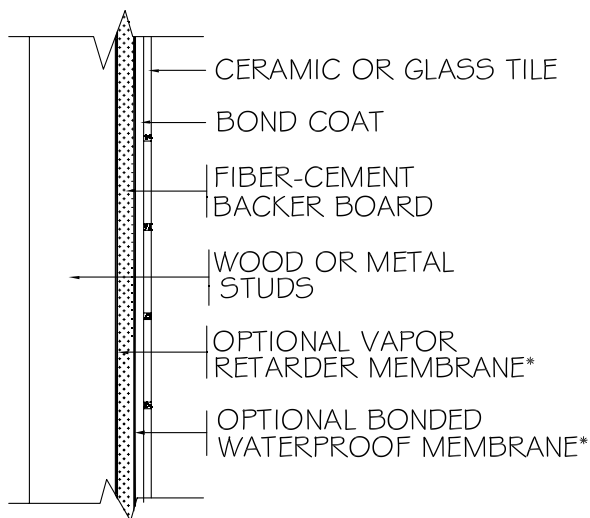
- Cement backer board—ANSI A108.11.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive or epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive or epoxy bond coat is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W244F-19

- Wood or Metal Studs
- Fiber-Cement Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- With cementitious or epoxy bond coat—Res1, 2, 5; Com1, 2, 5.
- With organic adhesive bond coat—Res1, 2; Com1, 2.
- For Res3 and Com3, see B412 and B415.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- When organic adhesive is used—not for areas exposed to temperatures exceeding 140°F.
- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) may be specified to prevent moisture intrusion and protect adjacent building

materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅙" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅙" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile

manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ISO D1 and ANSI A136.1 Type II are suitable for dry areas only (Res1; Com1).
- Waterproof membrane, when used—ANSI A118.10.
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Fiber cement backer board—ASTM C1288.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

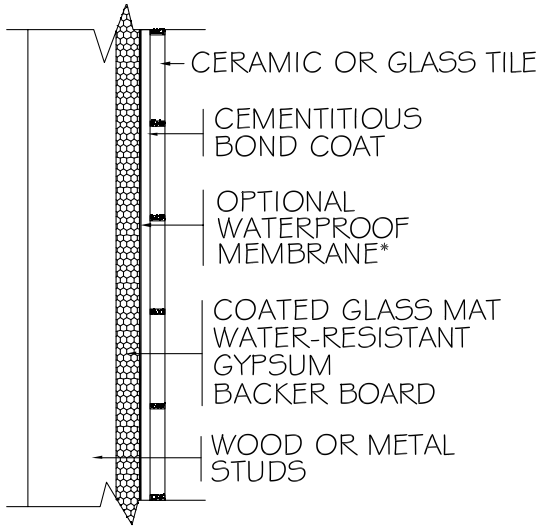
- Fiber cement backer board—manufacturer’s directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive or epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive or epoxy bond coat is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W245-19

- Wood or Metal Studs
- Coated Glass Mat Water-Resistant Gypsum Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3 and Com3, see B419 and B420.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect adjacent building materials. Follow backer board and membrane manufacturer’s waterproofing requirements. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

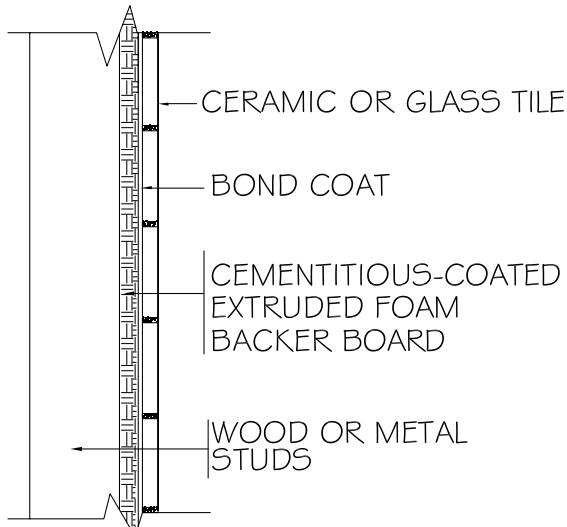
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W246-19

- Wood or Metal Studs
- Cementitious-Coated Extruded Foam Backer Board
- Ceramic Tile, Glass Tile



Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3 and Com3, see B425 and B426.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Requirements

- When glass tile is used, consult glass tile manufacturer for recommendations over sealant (when used).
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer’s recommended fasteners.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable

variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.

- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed, and over fastener heads, per backer board manufacturer’s instructions.
- Joints may be taped with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material in dry areas.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.

- Cementitious-coated extruded foam backer board—ASTM C578.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape, when used.
- Flexible sealant—must be recommended by backer board manufacturer.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

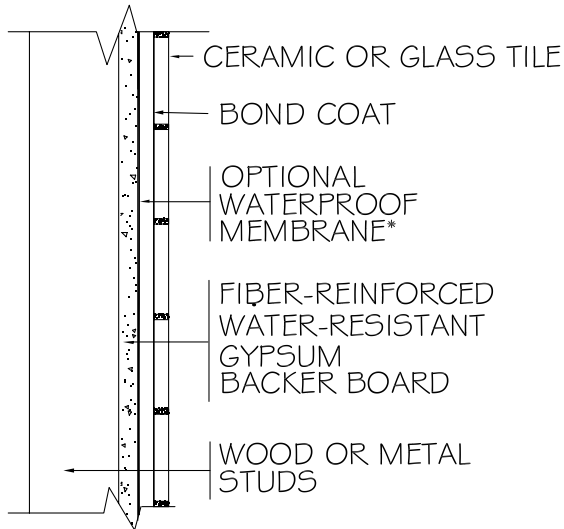
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W247-19

- Wood or Metal Studs
- Fiber-Reinforced Water-Resistant Gypsum Backer Board
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3, see B430 and B431.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.
- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for

applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations and abutments to dissimilar materials.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO

CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.

- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ISO D1 and ANSI A136.1 Type II are suitable for dry areas only (Res1; Com1).
- Waterproof membrane, when used—ANSI A118.10.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.
- Flexible sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—manufacturer’s directions.

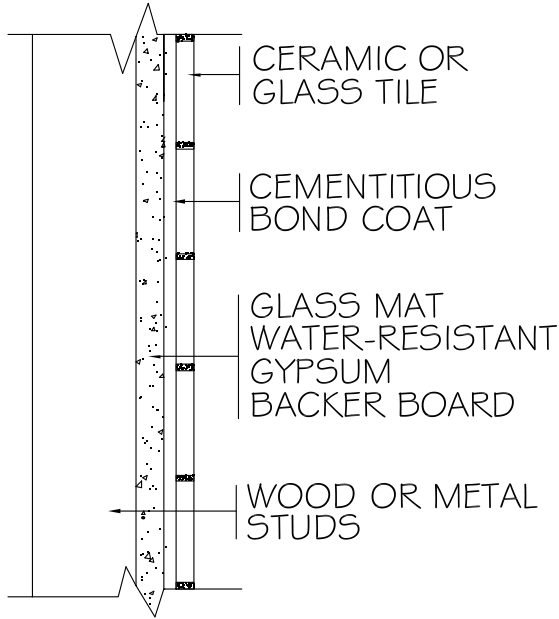
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W248-19

- Wood or Metal Studs
- Glass Mat Water-Resistant Gypsum Backer Board
- Ceramic Tile, Glass Tile



Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable

variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.

- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and skim coat with cementitious bonding material.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Glass mat, water-resistant gypsum backer board—ASTM C1658.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

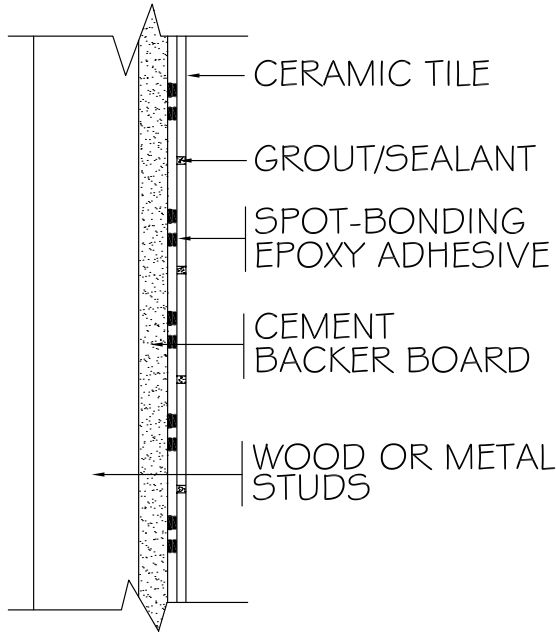
- Glass mat water-resistant gypsum backer board—manufacturer's directions.
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.
- Glass tile—manufacturer's directions.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

W260-19

- Wood or Metal Studs
- Cement Backer Board
- Spot-Bonding Epoxy
- Ceramic Tile



Recommended Uses

- For interior walls where cement backer board is the tile backer and large format tiles are specified.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- Installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Will not withstand impact.
- Maximum stud spacing 16" on center.

Requirements

- Epoxy must be recommended by the manufacturer for spot-bonding.
- Follow epoxy manufacturer’s coverage requirements.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—¼" in 10' from the required plane.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Sealant, when used as grout—ASTM C920.
- Spot bonding epoxy adhesive—epoxy recommended by manufacturer for spot bonding.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type B).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Cementitious mortar (for taping joints)—ANSI A118.4 or better or ISO C2 or better.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

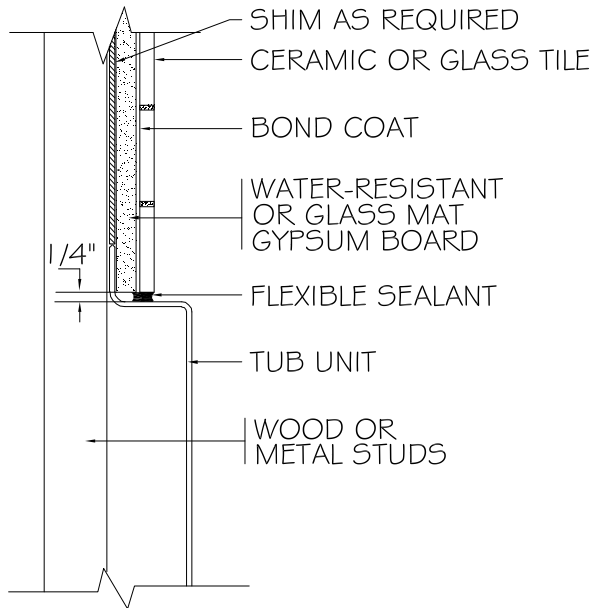
- Movement joints—mandatory according to EJ171.

Installation Specifications

- Cement backer board—ANSI A108.11.
- Tile—epoxy manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Sealant—sealant and epoxy manufacturer's directions for using sealant as grout.
- Movement Joints—EJ171 and ASTM C1193.

B413-19

- **Bathtub Walls (No Showerhead)**
- **Gypsum Board or Glass Mat Gypsum Board**
- **Ceramic Tile, Glass Tile**



Recommended Uses

- For tub enclosures without a shower head where gypsum board or glass mat water-resistant gypsum backer board is the tile backer.
- For fire-resistant, sound-insulated, ceramic tiled walls. See RW800 for fire and sound ratings. (Fire-resistance and sound-insulation ratings calculated on partitions before tiling.)

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for areas exposed to temperatures exceeding 125°F.
- Maximum stud spacing 16" on center.
- When organic adhesive is used, maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.
 - ANSI A136.1 Type II and ISO D1 are suitable for dry areas only (Res1; Com1).
- Gypsum board, when used—ASTM C1396/C1396M. Minimum ½" thick for single layer applications.
- Glass mat water-resistant gypsum backer board, when used—ASTM C1658.
- Metal studs—ASTM C645.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable

variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.

- All openings cut in backing board for plumbing and all cut joints between adjoining pieces—seal with adhesive or other materials recommended by manufacturer of backing board.
- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Apply backing board horizontally with the factory paperbound edge spaced a minimum of $\frac{1}{4}$ " above the lip of the tub.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

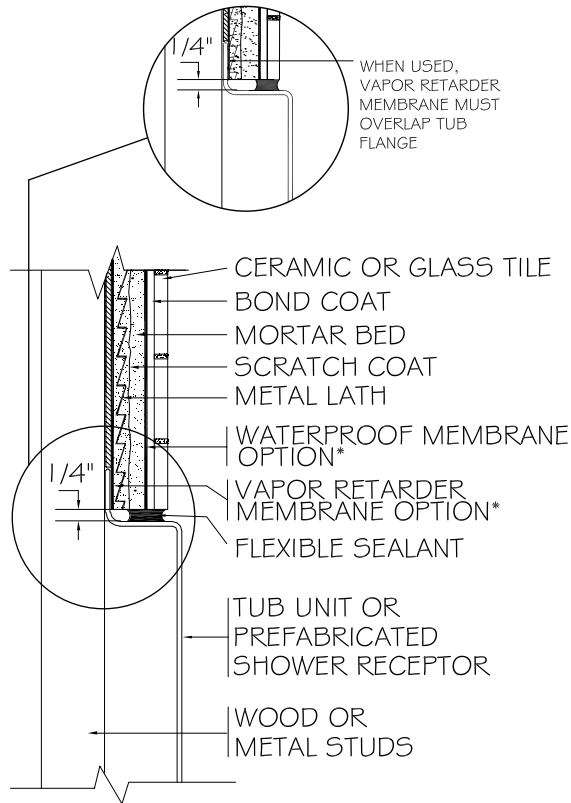
- Gypsum board—GA-216.
- Glass mat water-resistant gypsum backer board—manufacturer's directions.
- Tile—ANSI A108.4 or A108.5
- Glass Tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.

B411-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Mortar Bed**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC. MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors, where flattening or trueing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For showers that do not have a prefabricated receptor, see B414.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For Res4 and Com4, see SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical

attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides"

Limitations

- Maximum mortar bed thickness—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- If a waterproof membrane is applied over the mortar bed, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Membrane behind mortar bed, when used, must lap over face of flange of tub or prefabricated shower receptor.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1" maximum (metal studs) or 1½" maximum (wood studs).

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.

- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed bathtubs—not to exceed ½" more than total length of tub.
- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

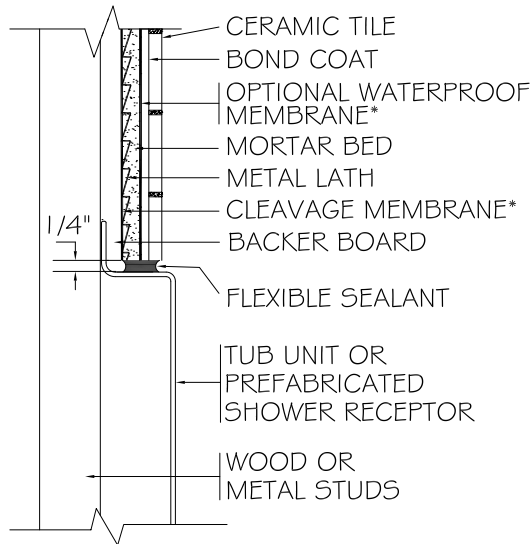
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

B440-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Backer Board**
- **Mortar Bed (One Coat Method)**
- **Ceramic Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors, where minor flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For showers that do not have a prefabricated receptor, see B441.

Environmental Exposure Classifications

- With cement backer board or fiber cement backer board—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With coated glass mat water-resistant gypsum backer board or cementitious-coated extruded foam backer board—Res1, 2, 3; Com1, 2, 3.
- With fiber-reinforced water-resistant gypsum backer board—Res 1, 2, 3; Com 1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure.

For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides"

Limitations

- Maximum mortar bed thickness— $\frac{3}{4}$ "
- Maximum stud spacing 16" on center.
- When coated glass mat water-resistant gypsum backer board or fiber-reinforced water-resistant gypsum backer board is used—not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A cleavage membrane is required. A waterproof membrane (A118.10) may also be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Cleavage membrane must lap over face of flange of tub or prefabricated shower receptor.
- Wood studs—dry and well-braced, minimum depth $3\frac{1}{2}$ "
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth $3\frac{1}{2}$ " for residential applications or $3\frac{5}{8}$ " for commercial applications.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum.
- Backer board must provide firm anchorage for metal lath.
- Cut lath at all movement joints.

Preparation by Backer Board Installers

- Maximum allowable variation in the backer board— $\frac{1}{8}$ " in 10' from the required plane.
- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, and taping of joints and corners.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.

- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Coated glass mat, water-resistant gypsum backer board, when used—ASTM C1178.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed bathtubs—not to exceed ½" more than total length of tub.
- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.
- Fire and sound ratings—extend gypsum board required

for ratings down to the floor behind the tub so that construction will be the same as the tested assembly. Backer board may be part of, or installed over, the rated assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

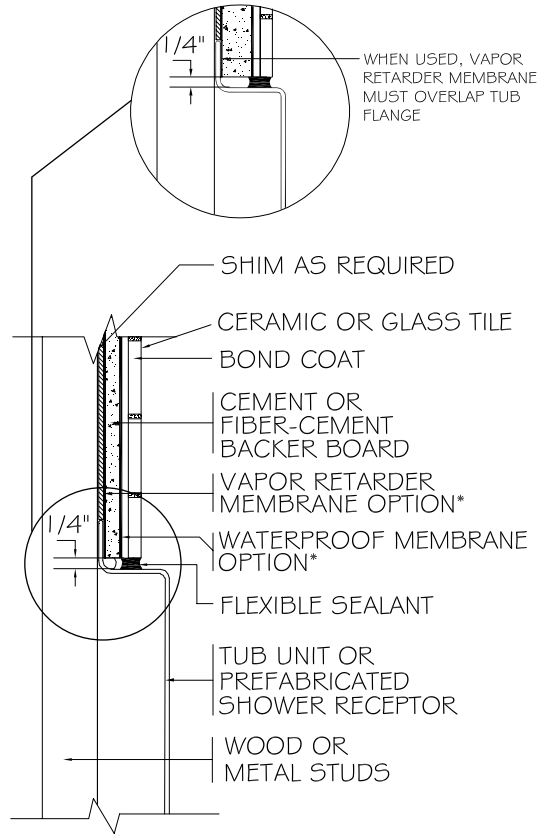
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer’s directions.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When coated glass mat water-resistant gypsum backer board is used, do not install a vapor barrier behind the backer board.
- If lath cannot be attached directly to backing, use furring strips. See B411.
- For thicker mortar bed, see B411.
- For mortar bed directly over wood or metal studs, see B411.

B412-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Cement Backer Board or Fiber-Cement Backer Board**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B415.

Environmental Exposure Classifications

- With cementitious or epoxy bond coat—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With organic adhesive bond coat—Res1, 2, 3; Com1, 2.
- For Res4 and Com4, see SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- When organic adhesive is used—not for areas exposed to temperatures exceeding 140°F.
- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Membrane behind backer board, when used, must lap over face of flange of tub or prefabricated shower receptor.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come

together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 Type I or ISO D2.
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub—not to exceed ½" more than length of tub.
- Bathtub—install level and support with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for ratings down to the floor behind the tub so that construction will be the same as the tested assembly. Backer board may be part of, or installed over, the rated assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

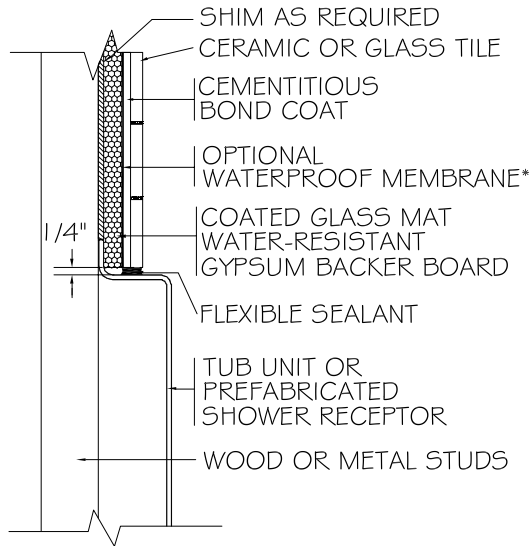
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer's directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive or epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive or epoxy bond coat is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

B419-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Coated Glass Mat Water-Resistant Gypsum Backer Board**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B420.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified

to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect adjacent building materials. Follow backer board and membrane manufacturer’s waterproofing requirements. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅓" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅓" variation in 24" when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.

- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub not to exceed ½" more than length of tub.
- Bathtub—install level and supported with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for rating down to the floor behind the tub so that construction will be the same as the tested assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

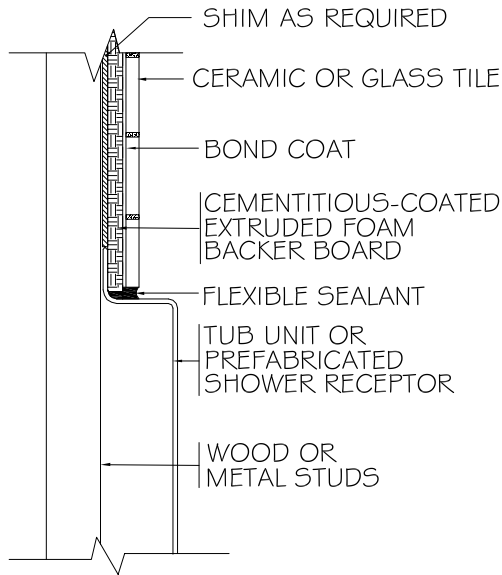
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Do not install a vapor barrier behind the tile backer board.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

B425-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Cementitious-Coated Extruded Foam Backer Board**
- **Ceramic Tile, Glass Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B426.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Requirements

- When glass tile is used, consult glass tile manufacturer for recommendations over sealant (when used).

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer’s recommended fasteners.
- All openings cut in backer board for plumbing and all cut joints between adjoining pieces—seal as recommended by backer board manufacturer.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed and over fastener heads per backer board manufacturer’s instructions.
- Apply backer board tight to lip of tub and seal to tub with manufacturer-recommended sealant.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.

- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cementitious-coated extruded foam backer board—ASTM C578.
- Fasteners—noncorrosive and nonoxidizing.
- Flexible sealant—must be recommended by backer board manufacturer.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Bathtub—install level and support with metal hangers or on wood framing members.
- Opening for recessed tub not to exceed ½" more than length of tub.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

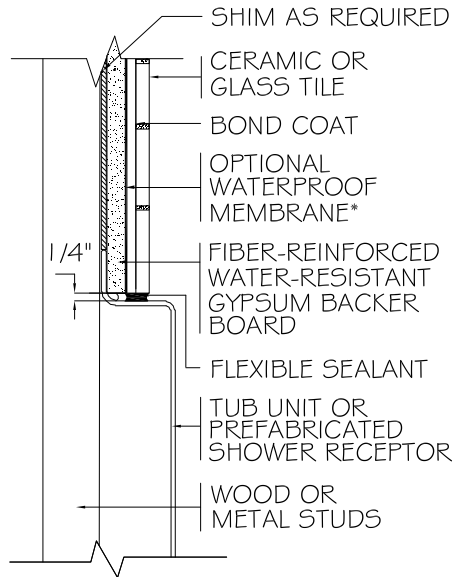
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface

sloped toward drain. Where present, waterproofing also must be sloped.

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

B430-19

- **Bathtub or Shower with Prefabricated Receptor**
- **Fiber-Reinforced Water-Resistant Gypsum Backer Board**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B431.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.
- When organic adhesive is used—maximum tile size

8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations and abutments to dissimilar materials.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅓" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅓" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and***

intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 Type I or ISO D2.
- Waterproof membrane, when used—ANSI A118.10.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub not to exceed ½" more than the tub length.
- Bathtub—install level and supported with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for rating down to the floor behind the tub so that construction will be the same as the tested assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

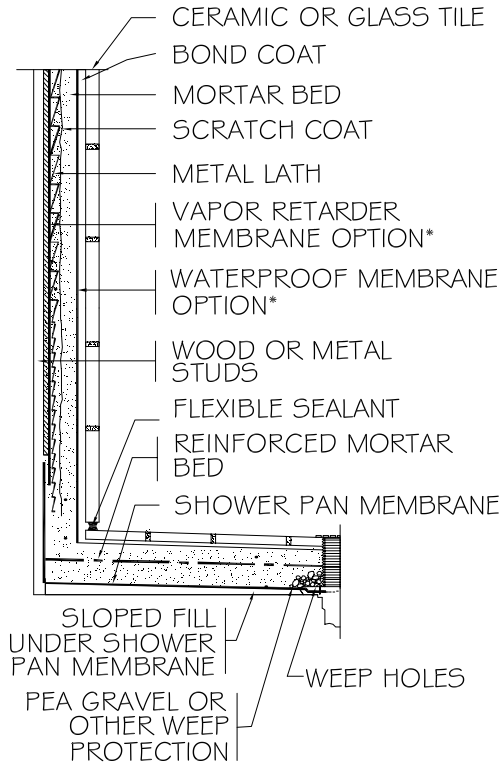
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

B414-19

- **Wood or Metal Studs**
- **Mortar Bed Walls**
- **Mortar Bed Floor**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

WALL MEMBRANE LAPS OVER SHOWER PAN.

Recommended Uses

- For showers that do not have prefabricated receptors.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For Res4 and Com4, see SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure.

For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides"

Limitations

- Maximum mortar bed thickness (walls)—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- If a waterproof membrane is applied over the mortar bed walls, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1" maximum (metal studs) or 1½" maximum (wood studs)
- Membrane behind mortar bed, when used, must lap over shower pan membrane.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification

recommendations. Not all glass tiles are suitable.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

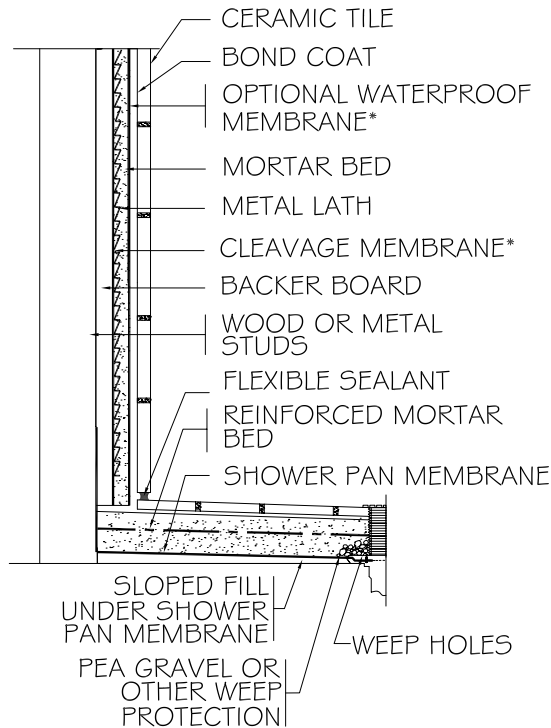
- Shower pan membrane—ANSI A108.01-3.6.
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved pre-formed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B441-19

- **Wood or Metal Studs**
- **Backer Board**
- **Mortar Bed Walls (One Coat Method)**
- **Mortar Bed Floor**
- **Ceramic Tile**



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

CLEAVAGE MEMBRANE LAPS OVER SHOWER PAN.

Recommended Uses

- For showers that do not have prefabricated receptors, where minor flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- With cement backer board or fiber cement backer board—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With coated glass mat water-resistant gypsum backer board or cementitious-coated extruded foam backer board—Res1, 2, 3; Com1, 2, 3.

- With fiber-reinforced water-resistant gypsum backer board—Res 1, 2, 3; Com 1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness (walls)— $\frac{3}{4}$ "
- Maximum stud spacing 16" on center.
- When coated glass mat water-resistant gypsum backer board or fiber-reinforced water-resistant gypsum backer board is used—not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A cleavage membrane is required. A waterproof membrane (A118.10) may also be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Cleavage membrane must lap over shower pan membrane.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum.
- Backer board must provide firm anchorage for metal lath.
- Cut lath at all movement joints.
- Slope shower pan membrane $\frac{1}{4}$ " per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.

Preparation by Backer Board Installers

- Maximum allowable variation in the backer board— $\frac{1}{8}$ " in 10' from the required plane.
- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, taping of joints and corners, and special instructions for wet areas.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated,**

optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Coated glass mat, water-resistant gypsum backer board, when used—ASTM C1178.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

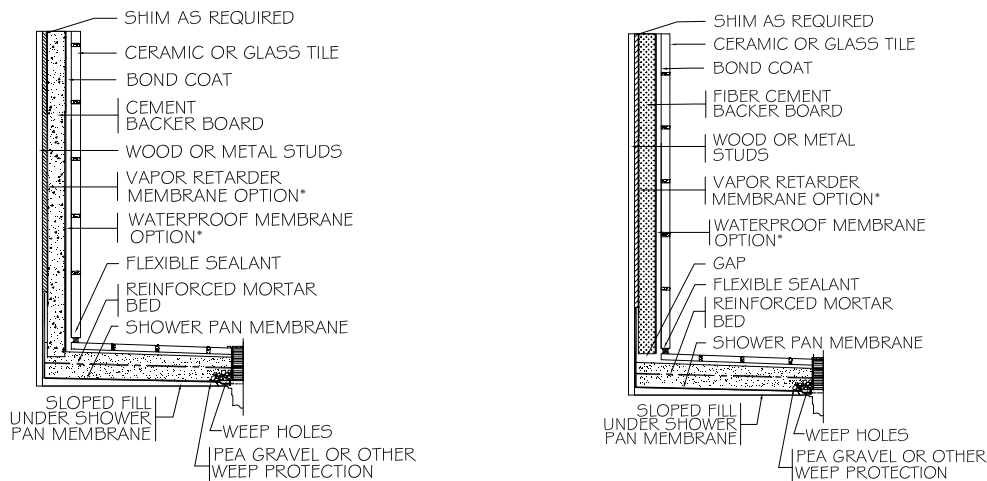
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer’s directions.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.
- Shower pan membrane—ANSI A108.01-3.6.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When coated glass mat water-resistant gypsum backer board is used, do not install a vapor barrier behind the backer board.
- If lath cannot be attached directly to backing, use furring strips. See B414.
- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- For thicker mortar bed, see B414.
- For mortar bed directly over wood or metal studs, see B414.
- For curbless shower receptor, see B421C and B422C.

B415-19

- Wood or Metal Studs
- Cement Backer Board or Fiber-Cement Backer Board Walls
- Mortar Bed Floor
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS. SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- With cementitious or epoxy bond coat—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With organic adhesive bond coat—Res1, 2, 3; Com1, 2.
- For Res4 and Com4, see SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- When organic adhesive is used—not for areas exposed to temperatures exceeding 140°F.
- When organic adhesive is used—maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.
- Organic adhesive may be used on walls only; do not use on floor or curb.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam,

high-temperature and/or chemical exposure, or exterior use.

- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Membrane behind backer board, when used, must lap over shower pan membrane.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.

- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used (walls only)—ANSI A136.1 Type I or ISO D2.
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber-cement backer board, when used—ASTM C1288.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

- Shower pan membrane—local building code.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

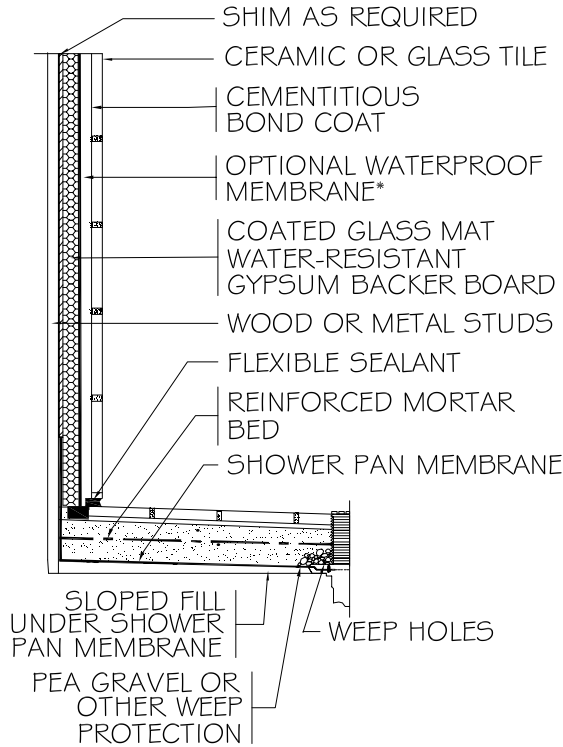
- Shower pan membrane—ANSI A108.01-3.6.
- Fiber-cement backer board—manufacturer's directions.
- Cement backer board—ANSI A108.11.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive or epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive or epoxy bond coat is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B420-19

- Wood or Metal Studs
- Coated Glass Mat Water-Resistant Gypsum Backer Board Walls
- Mortar Bed Floor
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE ON WALLS IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified for walls to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect adjacent building materials. Follow backer board and membrane manufacturer’s waterproofing requirements. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.

- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.
- Shower pan membrane—local building code.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

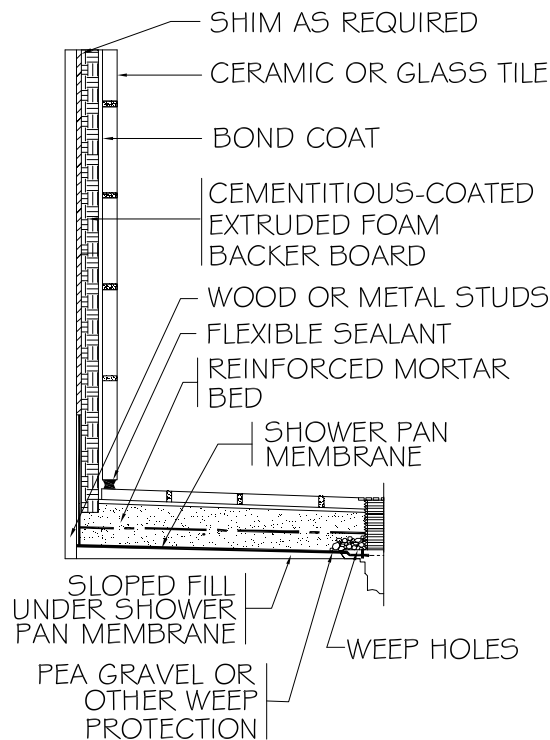
- Shower pan membrane—ANSI A108.01-3.6.
- Coated glass mat water-resistant gypsum backer board—manufacturer's directions.
- Tile—A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Do not install a vapor barrier behind the tile backer board.
- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B426-19

- Wood or Metal Studs
- Cementitious-Coated Extruded Foam Backer Board Walls
- Mortar Bed Floor
- Ceramic Tile, Glass Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. For greater resistance to chemical exposure, also specify an epoxy bonding material. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum stud spacing 16" on center.

Requirements

- When glass tile is used, consult glass tile manufacturer for recommendations over sealant (when used).
- Wood studs—dry and well-braced, minimum depth 3½".
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer's recommended fasteners.
- All openings cut in backer board for plumbing and all cut joints between adjoining pieces—seal as recommended by backer board manufacturer.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅓" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅓" in 10' from the required plane, with no more than ⅓" variation in 24" when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed and over fastener heads per backer board manufacturer's instructions.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Cementitious-coated extruded foam backer board—ASTM C578.
- Fasteners—noncorrosive and nonoxidizing.
- Flexible sealant—must be recommended by backer board manufacturer.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Apply blocking between studs to support the shower pan membrane.
- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

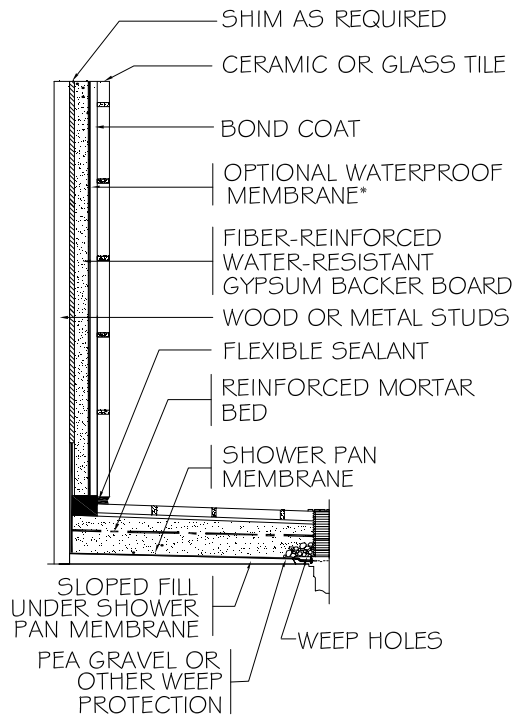
- Shower pan membrane—ANSI A108.01-3.6.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Glass tile—manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved pre-formed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B431-19

- Wood or Metal Studs
- Fiber-Reinforced Water-Resistant Gypsum Backer Board Walls
- Mortar Bed Floor
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE ON WALLS IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.
- Organic adhesive may be used on walls only; do not use on floor or curb.

Membrane Options

- A waterproof membrane (A118.10) may be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Caulk or seal penetrations and abutments to dissimilar materials.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and

stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used (walls only)—ANSI A136.1 Type I or ISO D2.
- Waterproof membrane, when used—ANSI A118.10.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Apply blocking between the studs to support the shower pan membrane.
- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0–4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

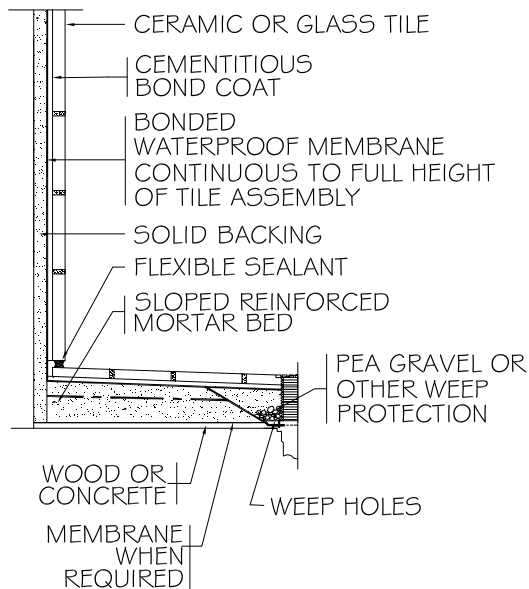
- Shower pan membrane—ANSI A108.01-3.6.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer's directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrate.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B421-19

- **Solid Backing**
- **Bonded Waterproof Membrane**
- **Ceramic Tile, Glass Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have a prefabricated receptor, where topical waterproofing of floors and walls is desired.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2
- May be suitable for Com3, Res5, and Com5 as determined by membrane and backing material manufacturers.
- For Res4 and Com4, see SR613 and SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- When glass tile is used, consult glass tile manufacturer

for tile suitability over non-absorptive surface.

- Bonded waterproof membrane must be continuous, including at changes in plane. Follow membrane manufacturer's requirements for corners, seaming, and overlap.
- Waterproof membrane must extend to full height of tile assembly.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Refer to appropriate wall method for applicable requirements based on type of backing used.
- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane manufacturer's instructions for connecting membrane to drain.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

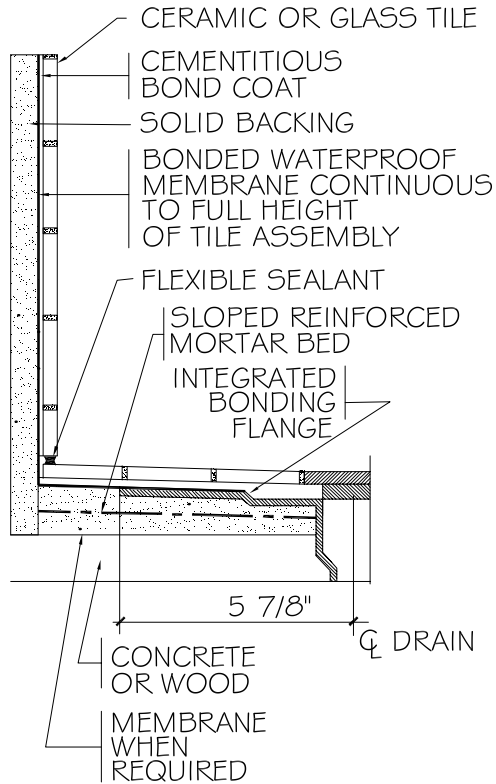
- Waterproof membrane—ANSI A108.13.
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B422-19

- Solid Backing
- Bonded Waterproof Membrane
- Integrated Bonding Flange
- Ceramic Tile, Glass Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have a prefabricated receptor, where topical waterproofing of floors and walls is desired.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- May be suitable for Com3, Res5, and Com5 as determined by membrane and backing material manufacturers.
- For Res4 and Com4, see SR613 and SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure.

Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.
- Bonded waterproof membrane must be continuous, including at changes in plane. Follow membrane manufacturer’s requirements for corners, seaming, and overlap.
- Waterproof membrane must extend to full height of tile assembly.
- Refer to appropriate wall method for applicable requirements based on type of backing used.
- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane and integrated bonding flange manufacturers’ instructions for connecting membrane to integrated bonding flange.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

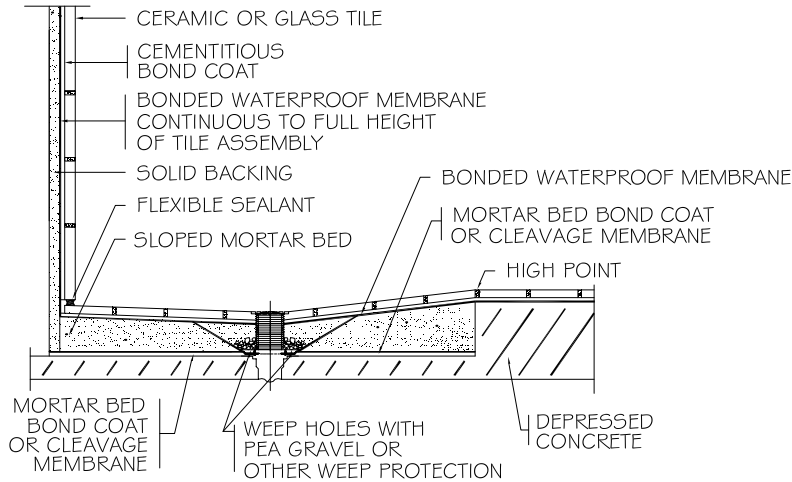
- Waterproof membrane—ANSI A108.13.
- Tile—ANSI 108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- For curbless shower receptor, see B421C and B422C.

B421C-19

- **Solid Backing (wall)**
- **Concrete Substrate (floor)**
- **Bonded Waterproof Membrane**
- **Ceramic Tile, Glass Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATION SECTION.

FOR MORTAR BEDS OVER 65 S.F., WIRE REINFORCING IS REQUIRED.

Recommended Uses

- For construction of a shower without a curb.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2
- May be suitable for Com3, Res5, and Com5 as determined by membrane and backing material manufacturers.
- For Res4 and Com4, see SR613 and SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Facilitates construction of a curbless shower without adding floor height at restroom entryway, but does not inherently comply with Americans with Disabilities Act (ADA) Standards for Accessible Design. Follow ADA where ADA compliance is required or desired.
- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.
- Bonded waterproof membrane must be continuous,

- including at changes in plane. Follow membrane manufacturer’s requirements for corners, seaming, and overlap.
- Waterproof membrane inside shower area must extend to full height of tile assembly. Also, the floor and wall waterproofing must continue outside the immediate shower area one foot beyond the high point of the floor, but not beyond the tiled area. Additional waterproofing of floor and/or walls outside the shower area may be needed to effectively contain and evacuate shower water and splash water and to protect building materials. When additional waterproofing of floor and/or walls outside the shower area is desired or required, the building design professional must specify all areas to be waterproofed and indicate membrane termination points.
- A secondary drain may be required outside the immediate shower area to facilitate evacuation of shower water and splash water that is not contained in the shower area due to curbless design. When required or desired, building design professional must specify type and location of secondary drain.
- High point of the floor must be outside the shower area, i.e., beyond shower door or curtain, to facilitate evacuation of shower water and splash water that is not contained in the shower area due to curbless design. Location of the high point of the floor is especially critical when secondary drain is not included outside the shower area.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Refer to appropriate wall method for applicable requirements based on type of backing used.

- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane manufacturer's instructions for connecting membrane to drain.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Depressed slab by others. Depressed area must extend beyond shower area to facilitate a finished floor installation that effectively evacuates shower water and splash water, which are often difficult to contain within a curbless shower.
- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

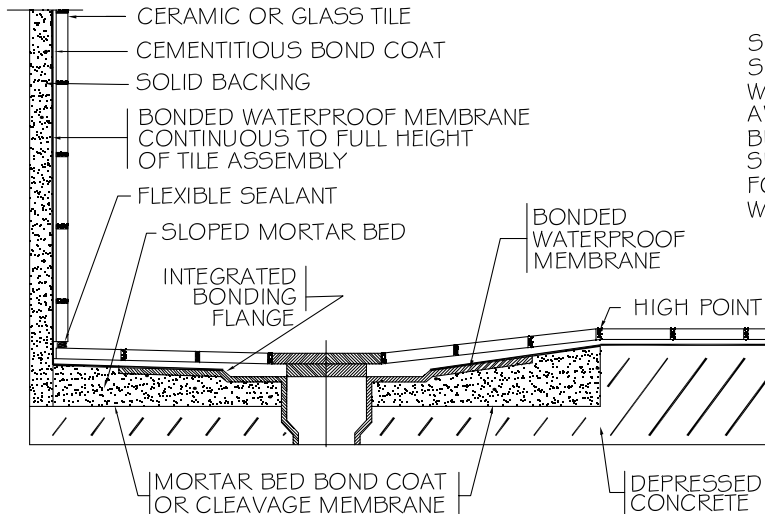
- Waterproof membrane—ANSI A108.13.
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- Follow applicable plumbing and building codes.

B422C-19

- **Solid Backing (wall)**
- **Concrete Substrate (floor)**
- **Bonded Waterproof Membrane**
- **Ceramic Tile, Glass Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION. FOR MORTAR BEDS OVER 65 S.F., WIRE REINFORCING IS REQUIRED.

Recommended Uses

- For construction of a shower without a curb.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2
- May be suitable for Com3, Res5, and Com5 as determined by membrane and backing material manufacturers.
- For Res4 and Com4, see SR613 and SR614.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Facilitates construction of a curbless shower without adding floor height at restroom entryway, but does not inherently comply with Americans with Disabilities Act (ADA) Standards for Accessible Design. Follow ADA where ADA compliance is required or desired.
- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- When glass tile is used, consult glass tile manufacturer for tile suitability over non-absorptive surface.
- Bonded waterproof membrane must be continuous, including at changes in plane. Follow membrane manufacturer’s requirements for corners, seaming, and overlap.
- Waterproof membrane inside shower area must extend to full height of tile assembly. Also, the floor and wall waterproofing must continue outside the immediate shower area one foot beyond the high point of the floor, but not beyond the tiled area. Additional waterproofing of floor and/or walls outside the shower area may be needed to effectively contain and evacuate shower water and splash water and to protect building materials. When additional waterproofing of floor and/or walls outside the shower area is desired or required, the building design professional must specify all areas to be waterproofed and indicate membrane termination points.
- A secondary drain may be required outside the immediate shower area to facilitate evacuation of shower water and splash water that is not contained in the shower area due to curbless design. When required or desired, building design professional must specify type and location of secondary drain.
- High point of the floor must be outside the shower area, i.e., beyond shower door or curtain, to facilitate evacuation

of shower water and splash water that is not contained in the shower area due to curbless design. Location of the high point of the floor is especially critical when secondary drain is not included outside the shower area.

- Refer to appropriate wall method for applicable requirements based on type of backing used.
- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane and integrated bonding flange manufacturer's instructions for connecting membrane to integrated bonding flange.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Depressed slab by others. Depressed area must extend

beyond shower area to facilitate a finished floor installation that effectively evacuates shower water and splash water, which are often difficult to contain within a curbless shower.

- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

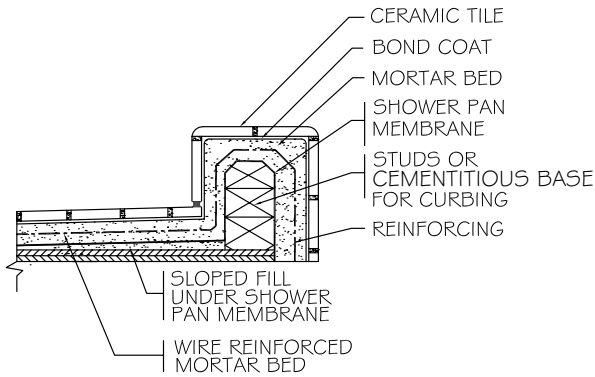
Installation Specifications

- Waterproof membrane—ANSI A108.13.
- Tile—ANSI A108.5.
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

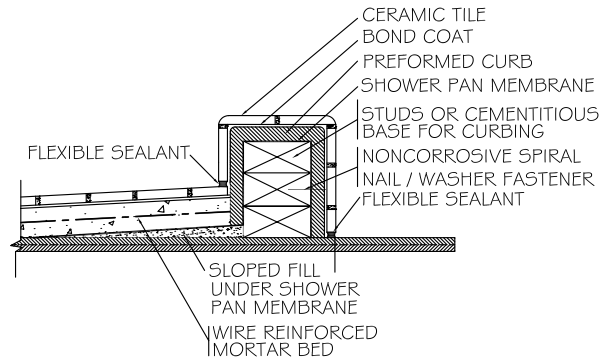
Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.
- Follow applicable plumbing and building codes.

Mortar Curb*

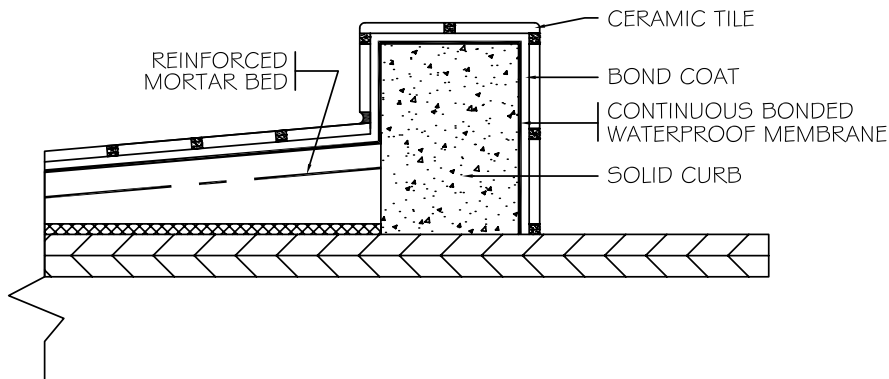


Preformed Curb*

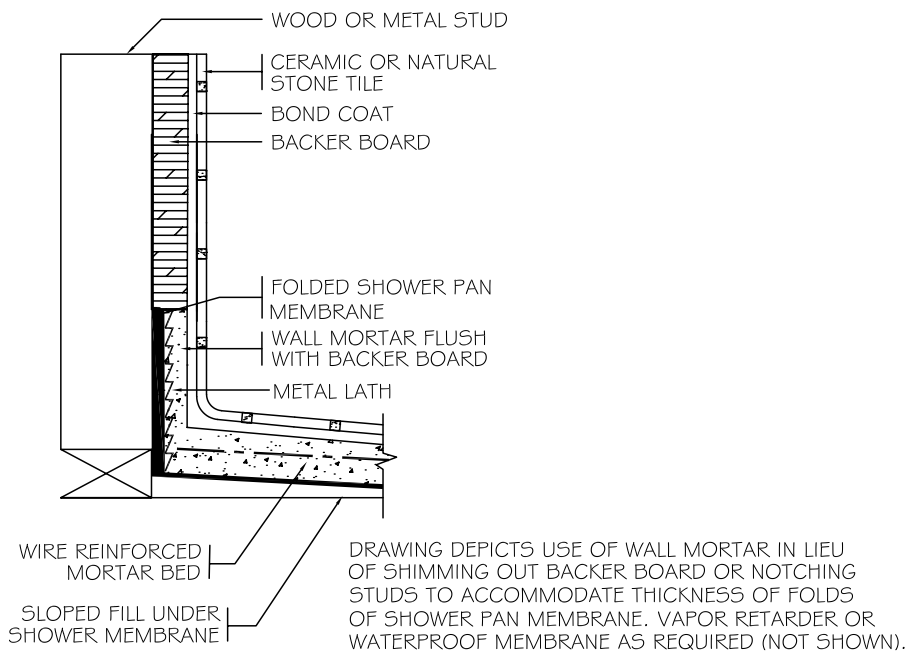


*NOTE: Construct curb such that membrane on top of curb (shower pan membrane or bonded waterproof membrane) is sloped toward drain.

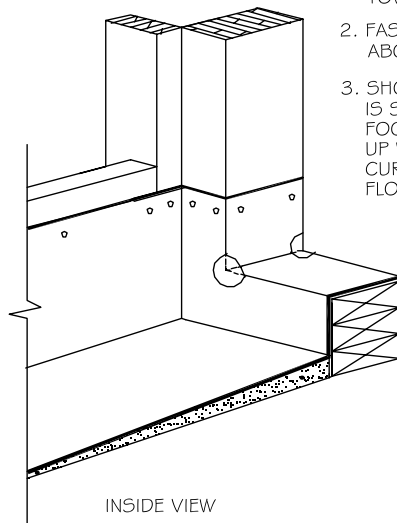
Solid Curb*



Alternate Receptor Base

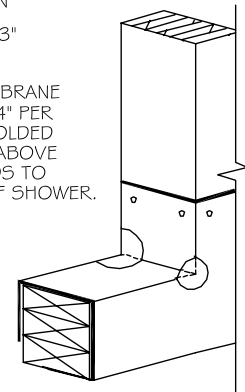


Shower Pan Membrane at Curb/Jamb

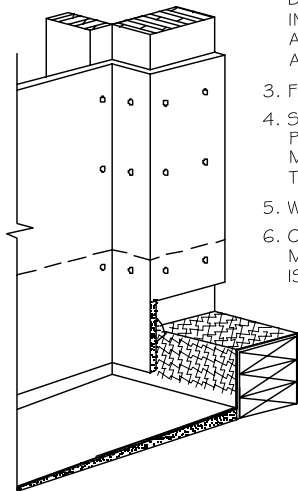


INSIDE VIEW

1. CONSTRUCT CURB SUCH THAT WATERPROOF MEMBRANE ON TOP SIDE OF CURB IS SLOPED TOWARD THE DRAIN
2. FASTENERS - MIN. 3" ABOVE CURB
3. SHOWER PAN MEMBRANE IS SLOPED MIN. 1/4" PER FOOT TO DRAIN, FOLDED UP WALLS MIN. 3" ABOVE CURB, AND EXTENDS TO FLOOR OUTSIDE OF SHOWER.



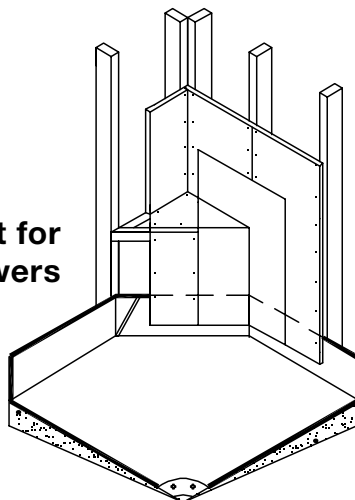
OUTSIDE VIEW



1. SPACE, TAPE, SEAL, ETC., BACKER BOARD PER MANUFACTURER'S REQUIREMENTS, INCLUDING FOR BOTTOM EDGE OF BOARD.
2. BECAUSE OF VARYING REQUIREMENTS, VAPOR RETARDER BEHIND BACKER BOARD NOT SHOWN. INCLUDE AND INSTALL VAPOR RETARDER WHEN AND AS REQUIRED BY BUILDING CODE AND BACKER BOARD MANUFACTURER.
3. FASTENERS - MIN. 3" ABOVE CURB
4. SHOWER PAN MEMBRANE IS SLOPED 1/4" PER FOOT TO DRAIN, FOLDED UP WALLS MIN. 3" ABOVE CURB, AND EXTENDS TO FLOOR OUTSIDE OF SHOWER.
5. WIRE MESH FOR CURB - PER ANSI
6. CONSTRUCT CURB SUCH THAT WATERPROOF MEMBRANE ON TOP SIDE OF CURB IS SLOPED TOWARD THE DRAIN.

Backer Board Installation Over Shower Pan Membrane

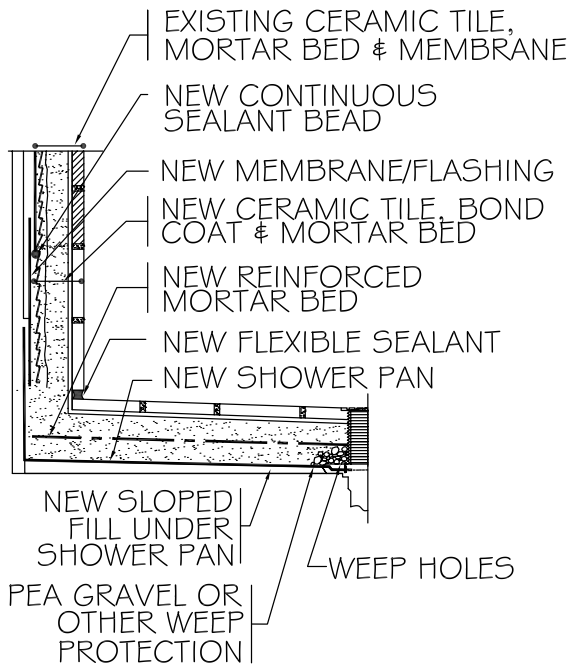
Typical Shower Seat for Backer Board Showers



1. CONSTRUCT SHOWER SEAT SUCH THAT BONDED WATERPROOF MEMBRANE ON BACKER BOARD ON TOP SIDE OF SHOWER SEAT IS SLOPED MIN. 1/4" PER FOOT TO DRAIN, AND EXTEND BONDED WATERPROOF MEMBRANE BEYOND SEAT/WALL INTERSECTION, AND BELOW TOP EDGE OF SHOWER PAN MEMBRANE.
2. SHOWER PAN MEMBRANE IS SLOPED MIN. 1/4" PER FOOT TO DRAIN AND FOLDED UP WALLS.
3. SPACE, TAPE, SEAL, ETC., BACKER BOARD PER MANUFACTURER'S REQUIREMENTS, INCLUDING FOR BOTTOM EDGE OF BOARD.
4. BECAUSE OF VARYING REQUIREMENTS, VAPOR RETARDER BEHIND BACKER BOARD NOT SHOWN. INCLUDE AND INSTALL VAPOR RETARDER WHEN AND AS REQUIRED BY BUILDING CODE AND BACKER BOARD MANUFACTURER.

TR418-19

- **Mortar Bed Walls**
- **Mortar Bed Floor**



Recommended Uses

- For use where old shower pan has failed.

Requirements

- Remove existing shower receptor, shower pan, and wall tile, as required, to install new shower pan.
- Replace any damaged wall and floor substrate materials.
- New shower pan—slope ¼" per foot to weep holes in drain.
- New shower pan to turn up wall a minimum of 3" above curb (6" above floor in showers without curbs).
- New wall membrane/flashings (ANSI A108.02-3.8) placed behind existing wall membrane, out over new shower pan, and fastened to studs.
- Place continuous bead of sealant on existing wall mortar with new wall mortar brought up tight against it.

Materials for Green/Sustainable Design

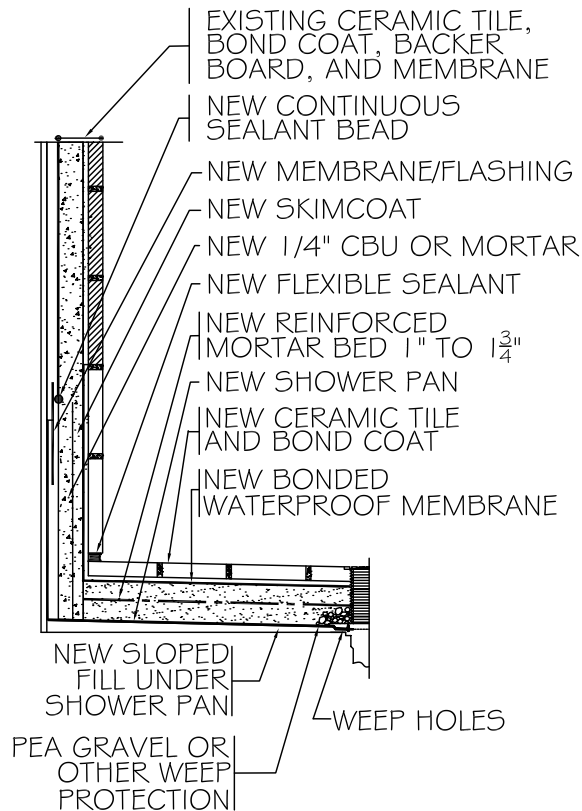
- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Notes

- See B414 for complete specifications.

TR420-19

- Backer Board Walls
- Mortar Bed Floor



Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials

Notes

- See B415, B420, B426, or B431 for complete specifications based on wall backing type.

Recommended Uses

- For use where old shower pan has failed.

Requirements

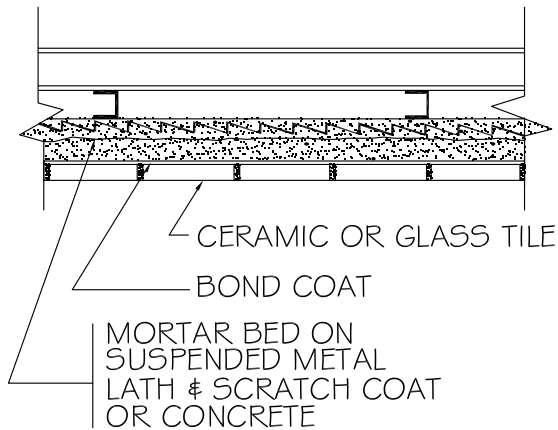
- Remove existing shower receptor, shower pan, and wall tile, as required, to install new shower pan.
- Replace any damaged wall and floor substrate materials.
- New shower pan—slope 1/4" per foot to weep holes in drain.
- New shower pan to turn up wall a minimum of 3" above curb (6" above floor in showers without curbs).
- New wall membrane/flashing (ANSI A108.02-3.8) placed behind existing wall membrane, out over new shower pan, and fastened to studs.
- Place continuous bead of sealant on existing wall substrate material with new wall substrate material brought up tight against it.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard*

C311-19

- Mortar Bed
- Ceramic Tile, Glass Tile



Recommended Uses

- For ceilings where trueing is required.
- For areas where substrate flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For Res4 and Com4, see SR613.

Limitations

- Maximum joist spacing 16" on center.

Requirements

- Suspended ceiling systems must be capable of supporting weight of mortar bed and tile.
- Concrete to be well cured, dimensionally stable, and free of cracks, waxy, or oily films.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.

- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

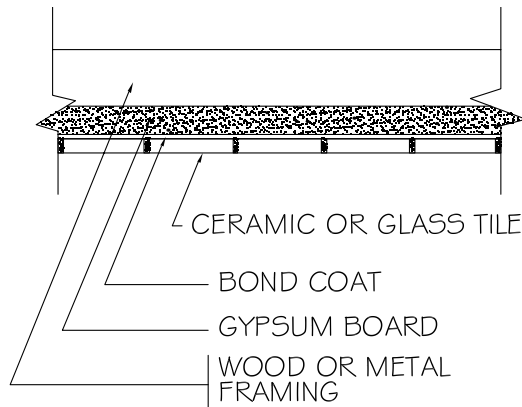
- Tile—ANSI A108.1A, .1B, or .1C.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

C312-19

- Gypsum Board
- Ceramic Tile, Glass Tile



Recommended Uses

- For ceilings in dry areas where gypsum board is the tile backer.

Environmental Exposure Classifications

- Res1; Com1.

Limitations

- The weight of overlaid unsupported insulation shall not exceed 1.3 psf for ½"-thick gypsum board with framing spacing 24" o.c., or 2.2 psf for ½"-thick gypsum board with framing spacing 16" o.c. or ⅝"-thick gypsum board with framing spacing 24" o.c.
- Not for areas exposed to temperatures exceeding 125°F.
- When organic adhesive is used—maximum tile size 8" × 8" unless organic adhesive manufacturer allows larger tile size. See Notes.
- Ceiling framing, furring, or blocking shall not exceed 12" o.c. for ½"-thick water-resistant gypsum backing board and 16" o.c. for ⅝"-thick water-resistant gypsum backing board.

Requirements

- Surface—free of coatings, oil, and wax.
- Ceiling framing must be capable of supporting the weight of backing and tile.
- Minimum thickness of gypsum board—½".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅙" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅙" variation in 24" when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Gypsum board—GA-216.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—manufacturer’s directions.

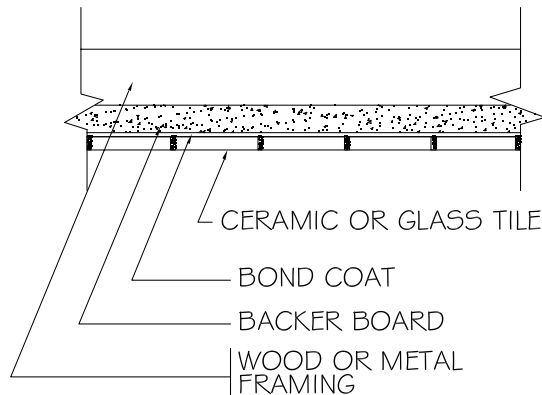
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrates.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

C315-19

- Backer Board
- Ceramic Tile, Glass Tile

**Recommended Uses**

- For ceilings in dry or wet areas.

Environmental Exposure Classifications

- With cementitious bond coat—Res1, 2, 3; Com1, 2.
- With organic adhesive—Res1, 2; Com1, 2.
- For Res4, see SR614.

Limitations

- The weight of the tile shall not exceed 5 psf for ½"-thick backer board with framing spacing 24" o.c., or 6 psf for ½"-thick backer board with framing spacing 16" o.c.
- When organic adhesive is used—not for areas exposed to temperatures exceeding 140°F.
- When organic adhesive is used—maximum tile size 8" x 8" unless organic adhesive manufacturer allows larger tile size. See Notes.
- When backer board is coated glass mat gypsum backer board or fiber-reinforced gypsum backer board, not for areas exposed to temperatures exceeding 125°F.

Requirements

- Surface—free of coatings, oil, and wax.
- Ceiling framing must be capable of supporting the weight of backer board and tile.
- Minimum thickness of backer board—½"
- Fasten backer board as recommended by the manufacturer.
- For glass tile over coated glass mat water-resistant gypsum backer board, consult glass tile manufacturer for tile suitability over non-absorptive surface.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15," maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅓" variation in 12" when measured from the

high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅓" in 10' from the required plane, with no more than ⅓" variation in 24" when measured from the high points in the surface.

- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, and taping of joints and corners.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also "Glass Tile Selection and Installation Guide," and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When cement backer board, fiber-cement backer board, or cementitious-coated extruded foam backer board is used—ANSI A118.1 or better or ISO C1 or better.
 - When coated glass mat water-resistant gypsum or fiber-reinforced water-resistant gypsum backer board is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Organic adhesive bond coat, when used—ANSI A136.1 (Type I or II) or ISO D1 or better.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325.
- Fiber-cement backer board, when used—ASTM C1288.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Coated glass mat water-resistant gypsum backer board, when used—ASTM C1178.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).

- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

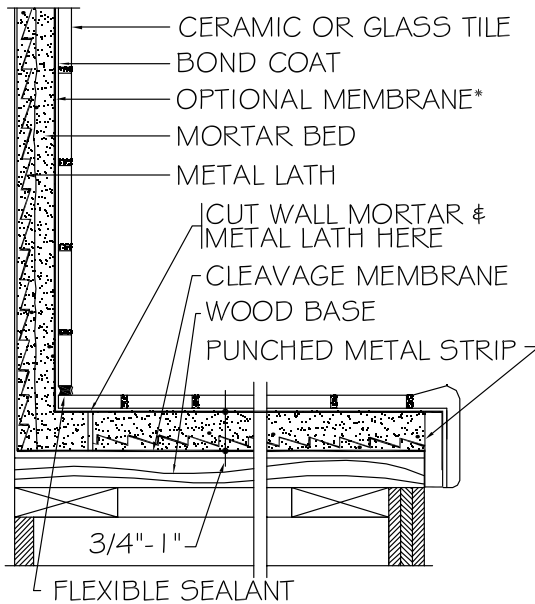
- Backer board—ANSI A108.11 or manufacturer’s directions.
- Tile—ANSI A108.4 or A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Organic adhesive thickness must be thin and uniform; therefore, substrate flattening may be required when organic adhesive is used.
- Do not use organic adhesives to bond tile to a membrane or other impervious substrates.
- Extended dry time may be required for larger tiles and tiles with low water absorption when organic adhesive is used.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

C511-19

- Plywood Base
- Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- On countertops, drainboards, lavatory tops, etc.
- Preferred method where sink or lavatory is to be recessed.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Requirements

- Set the bottom edge of the countertop trim the proper

distance above the finish floor material to allow clearance for dishwashers, compactors, etc.

- Protect wood substrate with cleavage membrane (ANSI A108.02-3.8).
- Cut lath off at corner as shown.

Materials

• **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***

- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Mortar bed, lath, and cleavage membrane—ANSI A108.1A.
- Flexible sealant—ASTM C920 or proper sealant for food preparation areas. Follow sealant manufacturer’s instructions.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.*

Preparation by Other Trades

- Wood base—1" x 6" boards with 1/4" gap between boards or 3/4" exterior glue plywood with dot and dash saw cuts

6" to 8" on center through the length of the plywood board to prevent warping.

- Where overhangs or cantilever counters are used, adequate support must be provided to prevent movement.

Installation Specifications

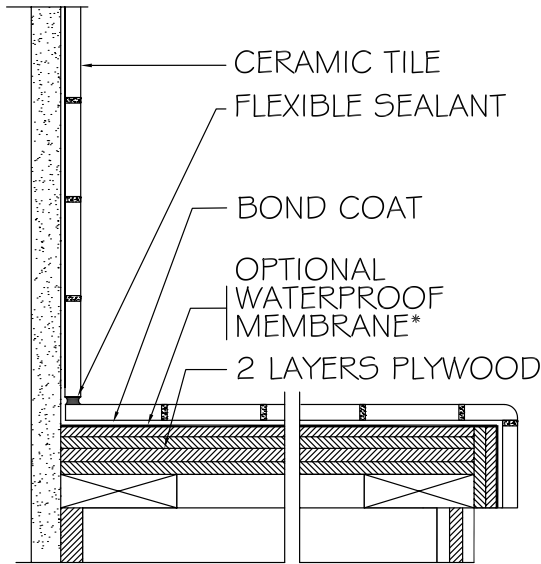
- Tile—ANSI A108.1A, .1B, or .1C. A108.1B required if membrane to be used.
- Glass tile—ANSI A108.14, .15, .16, or manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Use tile recommended by manufacturer for countertop applications.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.
- A punched metal strip attached to the front edge of the cabinet is used in some geographical areas as a screed and support for the countertop trim. It is filled with wall mortar.

C512-19

- Plywood Base
- Plywood Underlayment
- Ceramic Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- On countertops where thin-bed installation is desired.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure.
- Protect plywood from exposure to water and high humidity.
- Use a waterproof membrane (ANSI A118.10) to seal edge and bottom of plywood overhang at face of counter and all other plywood surfaces and edges that will be exposed to water or moisture, especially around automatic dishwashers.

Requirements

- Double plywood layer—clean and free of dirt, dust, and oily film.
- Gaps between plywood sheets to be treated per setting material manufacturer’s recommendations.
- Set the bottom edge of the countertop trim the proper distance above the finish floor material to allow clearance for dishwashers, compactors, etc.
- When tile is set with epoxy, completely fill gap between sheets of plywood with epoxy.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Ceramic tile—ANSI A137.1.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.11 or better or ISO C2S1P1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer (mortar for bonding tile to membrane).
- When a waterproof membrane is used, follow membrane manufacturer’s directions for bonding membrane to plywood underlayment.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better.
- Flexible sealant—ASTM C920 or proper sealant for food preparation areas. Follow sealant manufacturer’s instructions.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- When tile is set with epoxy, leave $\frac{1}{4}$ " gap between sheets of plywood. Apply batten to underside of sheets to cover gap.
- Wood base—1" x 6" boards with $\frac{1}{4}$ " gap between boards or $\frac{3}{4}$ " exterior glue plywood with dot and dash saw cuts 6" to 8" on center through the length of the plywood board to prevent warping.
- Where overhangs or cantilever counters are used, adequate support must be provided to prevent movement.
- Bottom layer— $\frac{1}{32}$ " exterior glue plywood.
- Underlayment— $\frac{1}{32}$ " exterior glue plywood.

Installation Specifications

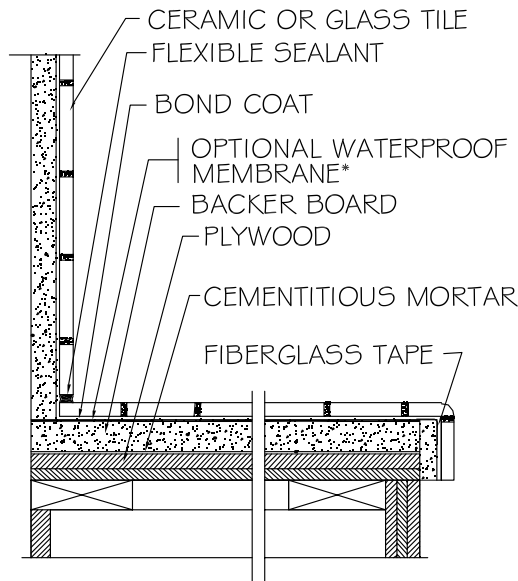
- Tile—ANSI A108.12.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Use tile recommended by manufacturer for countertop applications.

C513-19

- **Plywood Base**
- **Backer Board**
- **Ceramic Tile, Glass Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- Preferred thin-set mortar method where self-rimming sinks and lavatories are desired on countertops, drainboards, lavatory tops, etc.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”
- For installations that may be exposed to mild chemical attack, specify epoxy grout and tile suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.
- When coated glass mat water-resistant gypsum backer board is used—some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Set the bottom edge of countertop trim the proper distance above the finish floor material to allow clearance for dishwashers and compactors.
- For glass tile over coated glass mat water-resistant gypsum backer board, consult glass tile manufacturer for tile suitability over non-absorptive surface.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is ¼" in 10' from the required plane, with no more than ⅛" variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is ⅛" in 10' from the required plane, with no more than ⅛" variation in 24" when measured from the high points in the surface.
- Follow backer board manufacturer’s directions for installation, including orientation and spacing of boards, required fasteners, and taping of joints and corners.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1.
- Glass tile, when used—ANSI A137.2; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - When cement backer board, fiber cement backer board, or cementitious-coated extruded foam backer board is used—ANSI A118.1 or better or ISO C1 or better.
 - When coated glass mat water-resistant gypsum or fiber-reinforced water-resistant gypsum backer board is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When porcelain tile is used—ANSI A118.4 or better or ISO C2 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.

- Flexible sealant—ASTM C920 or proper sealant for food preparation areas. Follow sealant manufacturer's instructions.
- Nails—1¼" galvanized roofing type preferably screw shank, or other corrosion-resistant fasteners, applied 6" on center.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Provide support on overhangs or cantilever counters to prevent movement.
- Maximum allowable variation in plywood surface— $\frac{1}{8}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane.
- Install plywood base flat and level.
- $\frac{23}{32}$ " exterior glue plywood base.

Installation Specifications

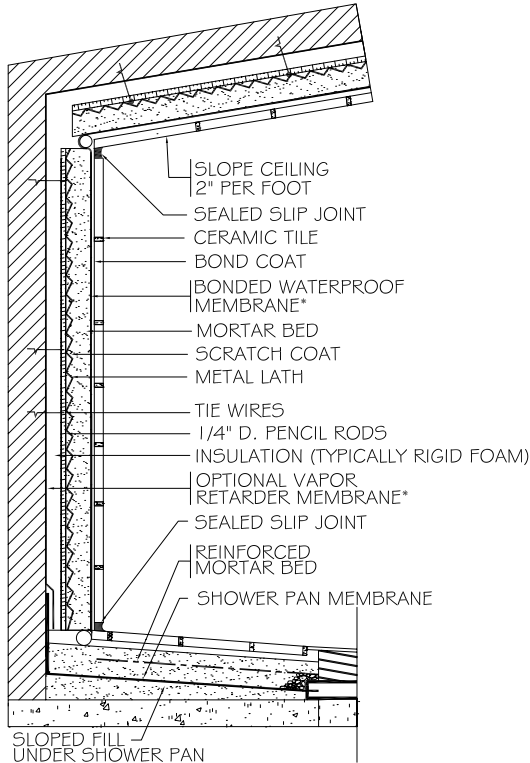
- Backer board—ANSI A108.11 or manufacturer's directions.
- Tile—ANSI A108.5.
- Glass tile—ANSI A108.15, .16, or manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Use tile recommended by manufacturer for countertop applications.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.

SR613-19

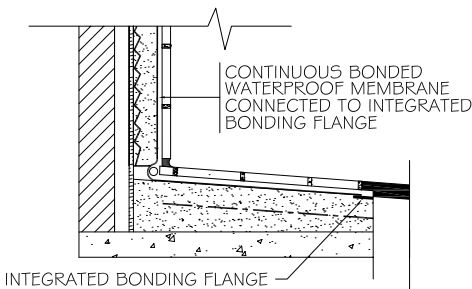
- **Masonry or Concrete**
- **Mortar Bed Walls**
- **Mortar Bed Floor**
- **Ceramic Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY DETAILED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

*FOR CONTINUOUS USE STEAM SHOWERS:
IF BONDED WATERPROOF MEMBRANE HAS A WATER VAPOR PERMEANCE GREATER THAN 0.5 PERMS, A SECONDARY VAPOR RETARDER MEMBRANE IS REQUIRED. SEE REQUIREMENTS. WHEN USED, VAPOR RETARDER MEMBRANE MUST OVERLAP INTO SHOWER PAN MEMBRANE.

CONFIGURATION OF BASE WITH INTEGRATED BONDING FLANGE



Recommended Uses

- For steam showers and steam rooms where the substrate is concrete or masonry.

Environmental Exposure Classifications

- Res4; Com4.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also Notes and “Product Selection Guides.”

Limitations

- Duration of use as a steam room or steam shower as determined by membrane manufacturer; lower membrane water vapor permeance decreases water vapor transmission.

Requirements

- Steam rooms are highly specialized applications. Design and installation are critical to avoid damage to adjoining materials from vapor migration. Design criteria must include consideration of necessary insulation and temperature and humidity differential.
- Use a tile contractor knowledgeable in steam room installation and experienced with the materials specified.
- Bonded waterproof membrane (sheet, liquid, and trowel-on) must be continuous and must adequately limit vapor transmission into adjacent spaces and building materials, according to intended duration of use as a steam room or steam shower.
- Steam showers designed for continuous use applications should specify a low perm waterproof membrane (a waterproof membrane meeting ANSI A118.10 and with a water vapor permeance rating of 0.5 perms or less when tested per ASTM E96 Procedure E, tested at 90% relative humidity). When a waterproof membrane with a water vapor permeance rating greater than 0.5 perms is specified, a vapor retarder behind the wall assembly is required, and vapor retarder must have a water vapor permeance rating of 0.1 perm or less when tested per ASTM E96 Procedure A, tested at 50% relative humidity. Consult waterproof membrane manufacturer for water vapor permeance rating and vapor retarder requirements.
- Specifier shall indicate how waterproofing and vapor retarding is to be achieved, including details for membrane penetrations such as penetrations for plumbing, lighting fixtures, tie wires, etc. Specifier shall also indicate where and how to waterproof curbs and jambs and where membrane terminates. Area outside steam shower door is a wet area and should be treated accordingly.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature and/or chemical exposure.
- Some waterproof membrane manufacturers require use of a vapor retarder membrane in addition to the waterproof membrane. Consult membrane manufacturer for requirements. When used, vapor retarder membrane must weather lap itself and lap into the shower pan membrane.

- If vapor retarder membrane is required, integrated bonding flange cannot be used.
- Follow waterproof membrane manufacturers' directions for interface between drain and membrane(s).
- Design professional to specify adequate insulation on walls and ceilings to reduce condensation. Consult insulation manufacturer for application suitability.
- Seal all membrane penetrations with appropriate sealant according to membrane manufacturer's requirements.
- Specify slip joints at changes in plane, such as where walls and ceiling meet.
- Slope ceiling minimum 2" per foot to avoid condensate dripping onto occupants; sloping ceiling from center can minimize rundown on walls.
- Masonry/concrete must provide firm anchorage for metal lath.
- Attach four equally spaced tie wires through the insulation. Attach ¼" diameter steel pencil rods vertically over the insulation. Attach metal lath to pencil rods on walls and ceilings.
- Mortar bed thickness—¾" minimum to 1½" maximum.
- Cut lath at all slip joints.
- Slope shower pan membrane minimum ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes. (Does not apply if integrated bonding flange is used.)

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—A137.1 and recommended by manufacturer for use in steam rooms.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.15 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Waterproof membrane—ANSI A118.10 and recommended by membrane manufacturer for use in specific application. For continuous use applications, see Requirements for water vapor permeance.

- Shower pan membrane—ANSI A118.10, ASTM D4068, or D4551 and meeting applicable building code.
- Mortar bed and reinforcing—ANSI A108.1A
- Vapor retarder membrane, when used—recommended by manufacturer for use in specific application.
- Flexible mildew-resistant sealant—ASTM C920 and recommended by manufacturer for use in steam showers.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete/masonry)—¼" in 10' from the required plane.

Movement Joint (architect must show type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- Slip joints at changes in plane, such as where walls and ceiling meet.

Installation Specifications

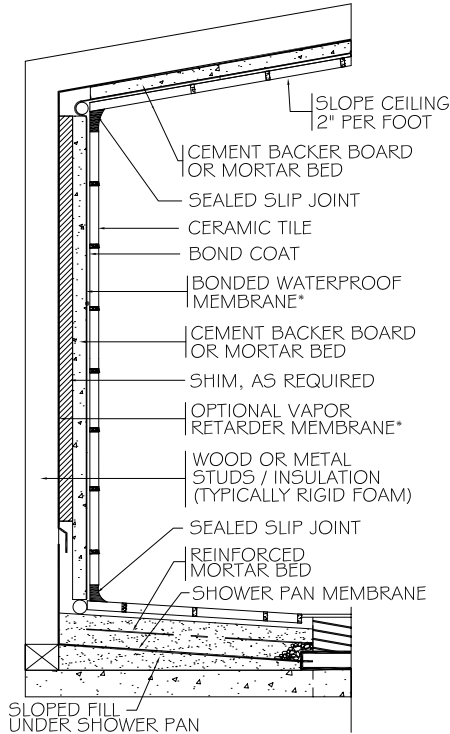
- Shower pan membrane—ANSI A108.01-3.6.
- Mortar bed and reinforcing—ANSI A108.1A, .1B, and .1C.
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane and slip joint—ANSI A108.13 and membrane manufacturer's slip joint directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Use of softened water in steam showers and steam rooms helps reduce grout and tile staining due to iron and/or hard water. Such stains may require harsh chemicals for removal. Select products suitable for water type and maintenance practices that will be used.
- Standard grouts will need to be periodically maintained over the life of the steam shower.
- Steam unit design must take into consideration the affect of moisture vapor transmission (MVT) on opposite side of steam unit walls. MVT can cause efflorescence and can affect paints and other adhered finishes.

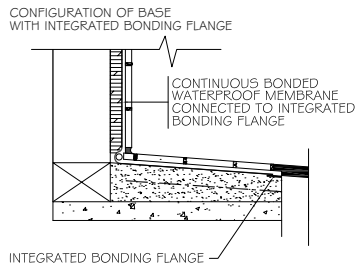
SR614-19

- Wood or Metal Studs
- Mortar Bed or Cement Backer Board Walls
- Mortar Bed Floor
- Ceramic Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY DETAILED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

*FOR CONTINUOUS USE STEAM SHOWERS: IF BONDED WATERPROOF MEMBRANE HAS A WATER VAPOR PERMEANCE GREATER THAN 0.5 PERMS, A SECONDARY VAPOR RETARDER MEMBRANE IS REQUIRED. SEE REQUIREMENTS. WHEN USED, VAPOR RETARDER MEMBRANE MUST OVERLAP INTO SHOWER PAN MEMBRANE.



Recommended Uses

- For steam showers and steam rooms framed with wood or metal studs. Specify mortar bed walls option when wall flatness is critical, such as when tiles with any edge longer than 15" are specified.

Environmental Exposure Classifications

- Res4.

- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also Notes and "Product Selection Guides."

Limitations

- Duration of use as a steam shower or steam room as determined by membrane and cement backer board (when used) manufacturers; lower membrane water vapor permeance decreases water vapor transmission.
- Maximum stud spacing 16" on center.

Requirements

- Steam rooms are highly specialized applications. Design and installation are critical to avoid damage to adjoining materials from vapor migration. Design criteria must include consideration of necessary insulation and temperature and humidity differential.
- Use a tile contractor knowledgeable in steam applications and experienced with the materials specified.
- Bonded waterproof membrane (sheet, liquid, and trowel-on) must be continuous and must adequately limit vapor transmission into adjacent spaces and building materials, according to intended duration of use as a steam shower.
- Steam showers designed for continuous use applications should specify a low perm waterproof membrane (a waterproof membrane meeting ANSI A118.10 and with a water vapor permeance rating of 0.5 perms or less when tested per ASTM E96 Procedure E, tested at 90% relative humidity). When a waterproof membrane with a water vapor permeance rating greater than 0.5 perms is specified, a vapor retarder behind the wall assembly is required, and vapor retarder must have a water vapor permeance rating of 0.1 perm or less when tested per ASTM E96 Procedure A, tested at 50% relative humidity. Consult waterproof membrane manufacturer for water vapor permeance rating and vapor retarder requirements.
- Specifier shall indicate how waterproofing and vapor retarding is to be achieved, including details for membrane penetrations such as penetrations for plumbing, lighting fixtures, fasteners, etc. Specifier shall also indicate where and how to waterproof curbs and jambs and where membrane terminates. Area outside steam shower door is a wet area and should be treated accordingly.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature and/or chemical exposure.
- Some waterproof membrane manufacturers require use of a vapor retarder membrane in addition to the waterproof membrane. Consult membrane manufacturer for requirements. When used, vapor retarder membrane must weather lap itself and lap into the shower pan membrane.
- If vapor retarder membrane is required, integrated bonding flange cannot be used.
- Follow waterproof membrane manufacturers' directions for interface between drain and membrane(s).
- Design professional to specify adequate insulation on walls and ceilings to reduce condensation. Consult insulation manufacturer for application suitability.
- Seal all membrane penetrations with appropriate sealant according to membrane manufacturer's requirements.
- Specify slip joints at change in plane, such as where walls and ceiling meet.

- Slope ceiling minimum 2" per foot to avoid condensate dripping onto occupants; sloping ceiling from center can minimize rundown on walls.
- When mortar bed walls, studs must provide firm anchorage for metal lath.
- When mortar bed walls, mortar bed wall thickness— $\frac{3}{4}$ " minimum to 1 $\frac{1}{2}$ " maximum.
- When mortar bed walls, cut lath at all slip joints.
- Slope shower pan membrane minimum $\frac{1}{4}$ " per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes. (Does not apply if integrated bonding flange is used.)
- Wood studs, when used—dry and well braced, minimum depth 3 $\frac{1}{2}$ ".
- Metals studs, when used—well-braced; 20 gauge (0.033") or heavier; minimum depth 3 $\frac{1}{2}$ " for residential applications or 3 $\frac{5}{8}$ " for commercial applications.

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 12" when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{4}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- Horizontal joints— $\frac{1}{8}$ " spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1 and recommended by manufacturer for use in steam showers.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better.
- Epoxy grout, when used—ANSI A118.3 or ISO RG.
- Cementitious bond coat:
 - ANSI A118.15 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type A).
- Fasteners—noncorrosive and nonoxidizing.
- Hot dipped fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Waterproof membrane—ANSI A118.10 and recommended by membrane manufacturer for use in specific application. For continuous use applications, see Requirements for water vapor permeance.
- Vapor retarder membrane, when used—recommended by manufacturer for use in specific application.
- Metal studs, when used—ASTM C645.
- Shower pan membrane—ANSI A118.10, ASTM D4068, or D4551 and meeting applicable building code.
- Mortar bed and reinforcing—ANSI A108.1A.
- Flexible mildew-resistant sealant—ASTM C920 and recommended by manufacturer for use in steam showers.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must show type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.
- Slip joints at changes in plane, such as where walls and ceiling meet.

Installation Specifications

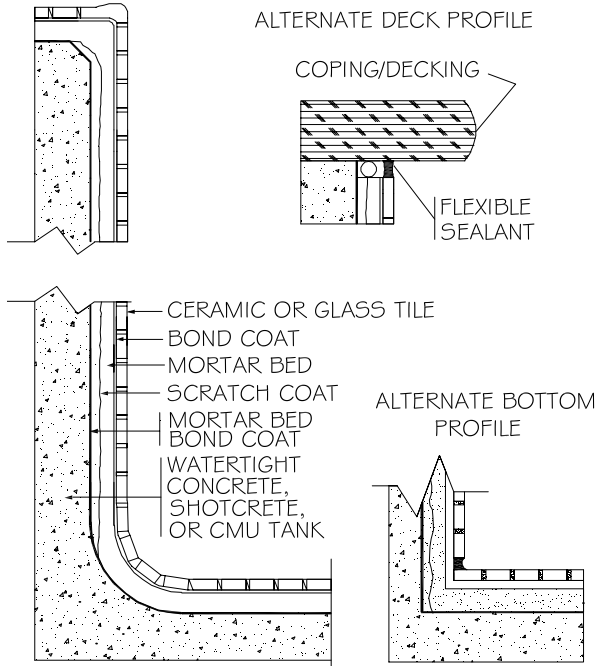
- Shower pan membrane—ANSI A108.01-3.6.
- Mortar bed and reinforcing—ANSI A108.1A, .1B, and .1C.
- Tile—ANSI A108.5.
- Cementitious grout—A108.10.
- Epoxy grout—A108.6.
- Waterproof membrane and slip joint—ANSI A108.13 and membrane manufacturer's slip joint directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Use of softened water in steam showers and steam rooms helps reduce grout and tile staining due to iron and/or hard water. Such stains may require harsh chemicals for removal. Select products suitable for water type and maintenance practices that will be used.
- Standard grouts will need to be periodically maintained over the life of the steam shower.
- Steam unit design must take into consideration the affect of moisture vapor transmission (MVT) on opposite side of steam unit walls. MVT can cause efflorescence and can affect paints and other adhered finishes.

P601MB-19

- **Watertight Concrete, Shotcrete, or CMU Pool Tank**
- **Bonded Mortar Bed**
- **Ceramic Tile, Glass Tile**



Recommended Uses

- For interior and exterior pools and water features with watertight tanks constructed of reinforced concrete, shotcrete, CMU, etc.
- For commercial, public, and competition pools.

Environmental Exposure Classifications

- Res3, 4, 6, 7; Com3, 4, 6, 7.

Requirements

- Pool tank must be watertight.
- Cement mortar bed nominal thickness—walls 3/4", floors 1 1/4". Walls exceeding 3/4" require a cured scratch coat.
- Cure cement mortar beds a minimum of 7 days prior to application of tile.
- Tile bond coat coverage—minimum 95% contact with tile and substrate.
- Pool tank surface must be free of grease, oil, wax, curing compounds, or other bond inhibiting coatings; pressure wash/mechanically scarify if necessary.
- Specify deck profile required, based on pool type/use.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout**

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.1 should be recommended in writing by the manufacturer for use in pools and water features.
- Glass tile, when used—ANSI A137.2 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.2 should be recommended in writing by the manufacturer for use in pools and water features; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Blue, green, and red grouts may not be suitable for submerged applications; consult manufacturer for application suitability. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG. Epoxy grout may be affected by UV exposure; consult manufacturer for application suitability.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.15 or better or ISO C2S1 or better.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R2 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Portland cement—ASTM C150 Type I.
- Sand—ASTM C144.
- Lime—ASTM C206 Type S or ASTM C207 Type S.
- Water—potable.
- Mortar bed (pool bottom)—1 part portland cement, 4 parts damp sand by volume.
- Scratch coat and mortar bed (pool walls and gutter)—1 part portland cement, 1/2 part lime, and 4 parts dry sand or 5 parts damp sand; or 1 part portland cement, 3 parts dry sand or 4 parts damp sand.

- Metal lath, when used (for gooseneck gutter)—3.4 pounds galvanized diamond mesh tied to reinforcing rods.
- Flexible Sealant—ASTM C920 and suitable for pool applications. Consult manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- When applicable, based on the soil report, pool tank must be engineered and constructed to support the tile installation and meet the requirements of the ANSI/APSP Pool and Spa Standards 1–5 and applicable building codes.
- Pool tank to be finished with medium-rough bush-hammer finish or with aggregate exposed.
- Deviations from dimensions, contours, or slopes in concrete, shotcrete, or CMU tank must not exceed ½" or encroach on the required minimum thickness of the mortar bed and tilework in order to provide exact dimensional requirements in length and width and specified tolerances.
- For pools and water features completely covered with tile, a water fill test (performed by pool contractor) is required.
- Defects in the tank (i.e., active water leaks, cracks, unsound concrete, shotcrete, CMU) must be repaired prior to the commencement of tilework.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Directly over any joints in the concrete tank (EJ171A or EJ171E).
- In tilework on 8' to 12' centers (EJ171F).
- Perimeter joint between the tile assembly and coping/decking (EJ171I).
- Perimeter joint at all changes in plane and at all restraining abutments (EJ171G).
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Tile—ANSI A108.1A, .1B, or .1C (with cementitious bond coat) or A108.6 (with epoxy bond coat).
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.

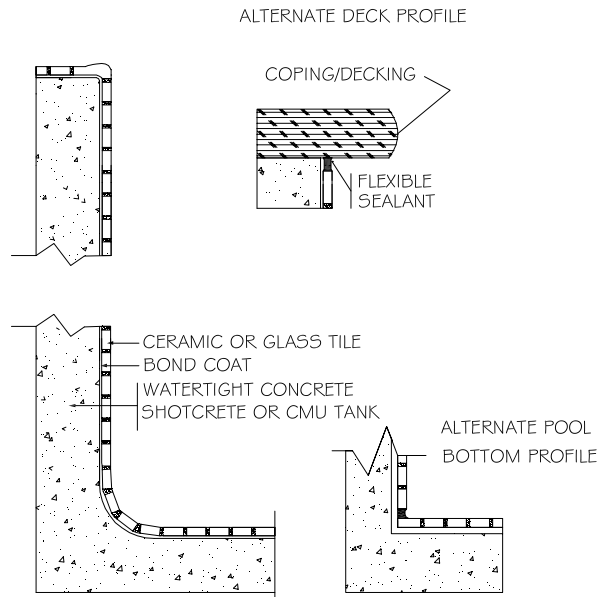
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some tile, glazes, backings, and mounting systems are not suitable for exterior or submerged applications.
- Not all epoxy may be used in exterior applications. Consult manufacturer for epoxy bond coat and epoxy grout suitability.
- Not all bonding mortars are suitable for exterior or submerged use.
- Mortar bed performance may be improved by the use of modified mortar; consult manufacturer for recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- Pool water chemistry and balance will impact the appearance and performance/serviceability of the tile and installation materials. It should be monitored/maintained by a pool maintenance professional. Refer to ANSI APSP-5 for residential or APSP-11 for water quality in public pools and spas for pool start-up and maintenance guidelines.
- Consult setting material and grout manufacturers for minimum cure times prior to submersion. Proper cure time prior to submersion is necessary.
- Pool may need to be protected from direct sunlight, excessive heat, wind, precipitation, and freezing during substrate preparation, installation, and curing.

P601TB-19

- **Watertight Concrete, Shotcrete, or CMU Pool Tank**
- **Ceramic Tile, Glass Tile**



Recommended Uses

- For interior and exterior pools and water features with watertight tanks constructed of reinforced concrete, shotcrete, or CMU, etc., where thin-bed installation of tile is desired.

Environmental Exposure Classifications

- Res3, 4, 6, 7; Com3, 4, 6, 7.

Limitations

- Not for competition pools or other pools or water features with strict dimensional criteria; specify P601MB for such applications.
- Shotcrete tanks typically do not meet required substrate tolerances for thin-bed tile installation.

Requirements

- Pool tank must be watertight.
- Pool tank must meet 1/8" in 10' and 1/16" in 1' finish tolerance and have a concrete surface profile (CSP) of 3 or better. When these tolerances cannot be met, specify P601MB.
- Tile bond coat coverage—minimum 95% contact with tile and substrate.
- Pool tank surface must be free of grease, oil, wax, curing compounds, or other bond inhibiting coatings; pressure wash/mechanically scarify if necessary.
- Specify deck profile required, based on pool type/use.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Ceramic tile—ANSI A137.1 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.1 should be recommended in writing by the manufacturer for use in pools and water features.
- Glass tile, when used—ANSI A137.2 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.2 should be recommended in writing by the manufacturer for use in pools and water features; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Blue, green, and red grouts may not be suitable for submerged applications; consult manufacturer for application suitability. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG. Epoxy grout may be affected by UV exposure; consult manufacturer for application suitability.

• Cementitious bond coat:

- ANSI A118.15 or better or ISO C2S1 or better.
- When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R2 or better.
- When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Flexible Sealant—ASTM C920 and suitable for pool applications. Consult manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- When applicable, based on the soil report, concrete tank must be engineered and constructed to support the tile installation and meet the requirements of the ANSI/APSP Pool and Spa Standards 1–5 and applicable building codes.
- Maximum allowable substrate variation—for tiles with all edges shorter than 15", maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " in 1' from the required plane, when measured from the high points in the surface. For tiles with at least one edge 15" in length, maximum allowable variation is $\frac{1}{8}$ " in 10' from the required plane, with no more than $\frac{1}{16}$ " variation in 24" when measured from the high points in the surface.
- For pools and water features completely covered with tile, a water fill test (performed by pool contractor) is required.
- Defects in the tank (i.e., active water leaks, cracks, unsound concrete, shotcrete, CMU) must be repaired prior to the commencement of tilework.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Directly over any joints in the concrete tank (EJ171A or EJ171E).
- In tilework on 8' to 12' centers (EJ171F).
- Perimeter joint between the tile assembly and coping/decking (EJ171I).
- Perimeter joint at all changes in plane and at all restraining abutments (EJ171G).
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

- Tile—ANSI A108.5 (with cementitious bond coat) or A108.6 (with epoxy bond coat).
- Glass tile—manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Movement Joints—EJ171 and ASTM C1193.

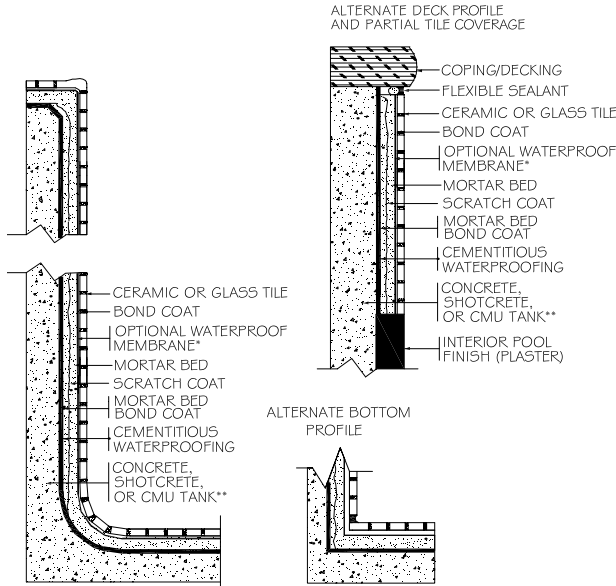
Notes

- Some tile, glazes, backings, and mounting systems are not suitable for exterior or submerged applications.

- Not all epoxy may be used in exterior applications. Consult manufacturer for epoxy bond coat and epoxy grout suitability.
- Not all bonding mortars are suitable for exterior or submerged use.
- When glass tile is used, see "Glass Tile Selection and Installation Guide," and consult manufacturer for recommendations and requirements.
- Pool water chemistry and balance will impact the appearance and performance/serviceability of the tile and installation materials. It should be monitored/maintained by a pool maintenance professional. Refer to ANSI APSP-5 for residential or APSP-11 for water quality in public pools and spas for pool start-up and maintenance guidelines.
- Consult setting material and grout manufacturers for minimum cure times prior to submersion. Proper cure time prior to submersion is necessary.
- Pool may need to be protected from direct sunlight, excessive heat, wind, precipitation, and freezing during substrate preparation, installation, and curing.

P602-19

- Concrete, Shotcrete, or CMU Pool Tank
- Cementitious Waterproofing
- Bonded Mortar Bed
- Ceramic Tile, Glass Tile



*USE OF AN A118.10 WATERPROOF MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

**MAY BE TREATED WITH A PENETRATING COLLOIDAL SILICATE PRIOR TO APPLICATION OF CEMENTITIOUS WATERPROOFING. SEE PREPARATION BY OTHER TRADES.

Recommended Uses

- For interior and exterior pools and water features with tanks constructed of reinforced concrete, shotcrete—wet mix, shotcrete—dry mix, CMU, etc., that are not watertight.

Environmental Exposure Classifications

- Res3, 4, 6, 7; Com3, 4, 6, 7.

Requirements

- Pool tank and water feature construction must be reinforced concrete, shotcrete, CMU, etc.
- Cement mortar bed nominal thickness—walls 3/4", floors 1 1/4". Walls exceeding 3/4" require a cured scratch coat.
- Cure cement mortar beds a minimum of 7 days prior to application of tile or bonded waterproof membrane (A118.10).
- Tile bond coat coverage—minimum 95% contact with tile and substrate.
- Pool tank surface must be free of grease, oil, wax, curing compounds, or other bond inhibiting coatings; pressure wash/mechanically scarify if necessary.
- Specify deck profile required, based on pool type/use.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Ceramic tile—ANSI A137.1 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.1 should be recommended in writing by the manufacturer for use in pools and water features.
- Glass tile, when used—ANSI A137.2 and recommended in writing by manufacturer for use in pools and water features. Tile not covered by A137.2 should be recommended in writing by the manufacturer for use in pools and water features; see also “Glass Tile Selection and Installation Guide,” and consult tile manufacturer for environmental exposure classification recommendations. Not all glass tiles are suitable.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Blue, green, and red grouts may not be suitable for submerged applications; consult manufacturer for application suitability. When glass tile is used, specify grout designated by tile and grout manufacturers.
- Epoxy grout, when used—ANSI A118.3 or ISO RG. Epoxy grout may be affected by UV exposure; consult manufacturer for application suitability.
- Cementitious bond coat:
 - When a waterproof membrane is not used on the face of the mortar bed—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used on the face of the mortar bed—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When glass tile is used, specify mortar designated by tile and mortar manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R2 or better.
 - When glass tile is used, specify epoxy bond coat designated by tile and bond coat manufacturers. Bond coat color will impact the final appearance of translucent glass tile. Specifier shall confirm bond coat color is acceptable.
- Waterproof membrane on top of the mortar bed, when used—ANSI A118.10.
- Walls—cement mortar bed/scratch coat 1 part portland cement (ASTM C150) to 4 parts damp sand (ASTM C144) by volume.
- Floors—cement mortar bed 1 part portland cement (ASTM C150) to 4 to 5 parts damp sand (ASTM C144) by volume mixed with water to a consistency and workability to allow maximum compaction during tamping (ANSI A108.1A-2.2.2).
- Mortar bed bond coat—latex-portland cement mortar meeting ANSI A118.4 or better or ISO C2S1 or better.
- Cementitious waterproofing—recommended by

manufacturer for use in positive and negative hydrostatic pressure applications and swimming pools. Must be able to support the weight of the bonded mortar bed and tile assembly; consult manufacturer for application suitability.

- Flexible Sealant—ASTM C920 and suitable for pool applications. Consult manufacturer.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Membrane Options

- A waterproof membrane (A118.10) may be specified for use over the mortar bed, which may be beneficial in freeze-thaw climates or when additional resistance to positive hydrostatic pressure is required.
- Confirm membrane suitability for specified application with manufacturer. Not all membranes are suitable for exterior use, submersion, high-temperature, chemical exposure, or partial coverage applications such as waterlines.
- When glass tile is used, consult glass tile manufacturer for membrane options and recommendations.

Preparation by Other Trades

- Deviations from dimensions, contours, or slopes in concrete, shotcrete, or CMU tank must not exceed ½" or encroach on the required minimum thickness of the mortar bed and tilework in order to provide exact dimensional requirements in length and width and specified tolerances.
- When applicable, based on the soil report, concrete tank must be engineered and constructed to support the tile installation and meet the requirements of the ANSI/APSP Pool and Spa Standards 1–5 and applicable building codes.
- Concrete tank to be finished per cementitious waterproofing manufacturer’s requirements.
- Concrete tank to be made watertight with cementitious waterproofing.
- A penetrating colloidal silicate may be applied to the pool tank prior to application of cementitious waterproofing to densify the tank and reduce the migration of water soluble mineral compounds (efflorescence). Consult penetrating colloidal silicate manufacturer for recommendations. When used, confirm compatibility with cementitious waterproofing manufacturer.
- For pools and water features completely covered with tile, a water fill test (performed by the waterproofing contractor) after the cementitious waterproofing has been applied and cured per manufacturer’s directions is required.
- Defects in the tank (i.e., active water leaks, cracks, unsound concrete, shotcrete, CMU, etc.) must be repaired prior to the commencement of tilework.

Movement Joint (architect must show type of joint and show location and details on drawings)

- Directly over any joints in the concrete tank (EJ171A or EJ171E).
- In tilework on 8' to 12' centers (EJ171F).
- Perimeter joint between the tile assembly and coping/decking (EJ171I).
- Perimeter joint at all changes in plane and at all restraining abutments (EJ171G).
- When glass tile is used, adhere to more frequent placement recommendations within the ranges listed in EJ171.

Installation Specifications

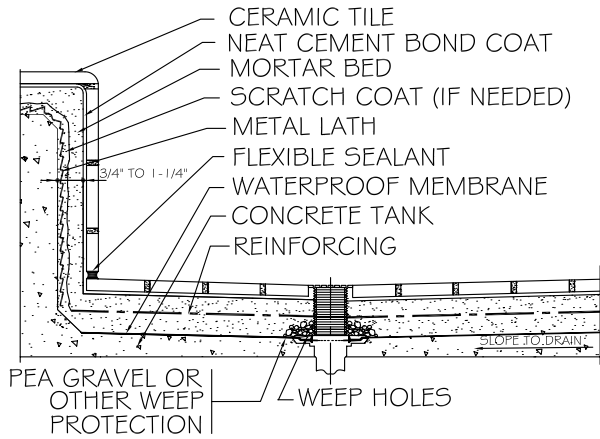
- Tile—ANSI A108.5 (with cementitious bond coat) or A108.6 (with epoxy bond coat).
- Glass tile—ANSI A108.14, .15, .16, or manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Epoxy grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Cementitious waterproofing—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.
- Penetrating Colloidal Silicate—manufacturer’s directions.

Notes

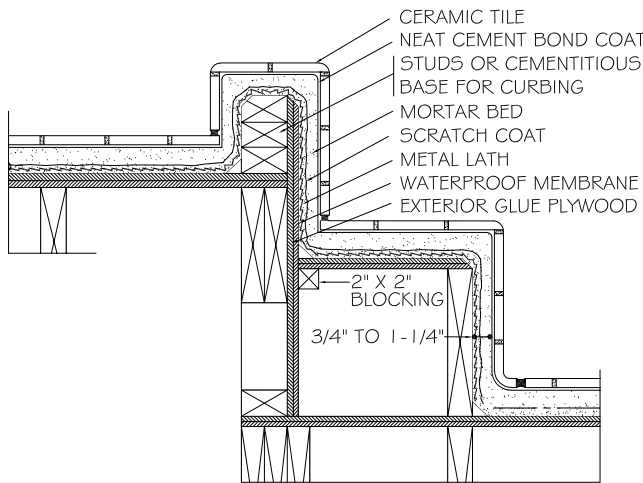
- Some tile, glazes, backings, and mounting systems are not suitable for exterior or submerged applications.
- Not all epoxy may be used in exterior applications. Consult manufacturer for epoxy bond coat and epoxy grout suitability.
- Not all bonding mortars are suitable for exterior or submerged use.
- In freeze-thaw climates, additional waterproofing consideration may be required to prevent cement mortar bed moisture intrusion.
- Mortar bed performance may be improved by the use of modified mortar; consult manufacturer for recommendations.
- When glass tile is used, see “Glass Tile Selection and Installation Guide,” and consult manufacturer for recommendations and requirements.
- Pool water chemistry and balance will impact the appearance and performance/serviceability of the tile and installation materials. It should be monitored/maintained by a pool maintenance professional. Refer to ANSI APSP-5 for residential or APSP-11 for water quality in public pools and spas for pool start-up and maintenance guidelines.
- Consult setting material and grout manufacturers for minimum cure times prior to submersion. Proper cure time prior to submersion is necessary.
- Pool may need to be protected from direct sunlight, excessive heat, wind, precipitation, and freezing during substrate preparation, installation, and curing.

B417-19

- Concrete Tank
- Mortar Bed

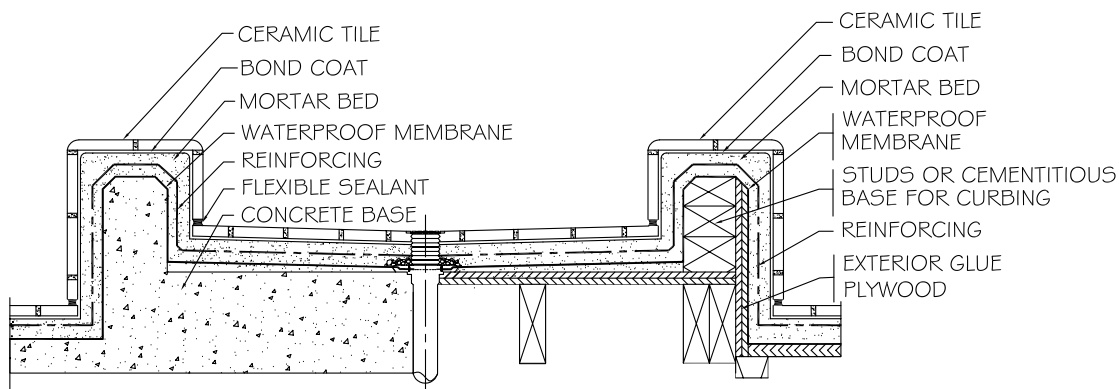


- Wood Form
- Mortar Bed



- Concrete Curb
- Mortar Bed

- Wood Curb
- Mortar Bed



NOTE: This detail reflects both concrete and wood substrates. Specify one or the other.

Requirements

- Waterproof membrane—slope membrane 1/4" per foot to weep holes in drain.
- Wood framing, when used, should be pressure treated and designed to resist deflection and movement.

Preparation by Other Trades

- Test tank, membrane, and drainage fittings for leaks before starting tilework.

Materials for Green/Sustainable Design

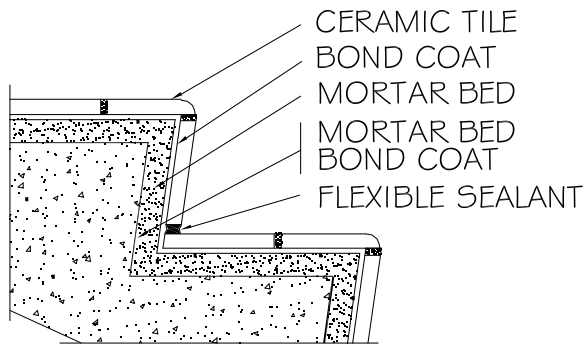
- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Installation Methods

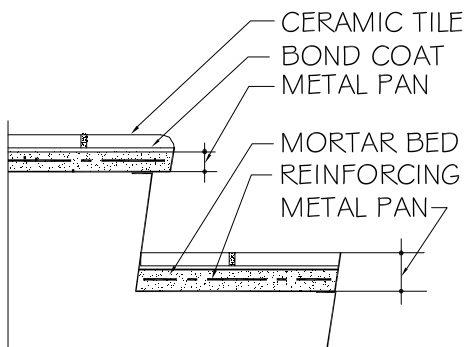
- Attach metal lath only above water line.
- Floor—follow F121.
- Walls—follow W221.

Installation Specifications

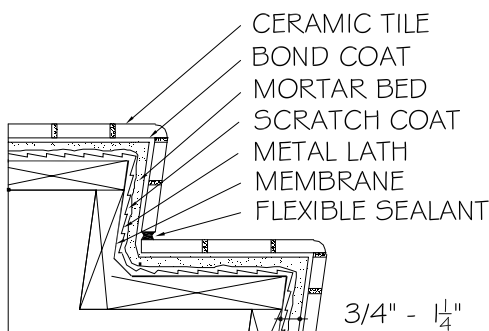
- Tile—ANSI A108.1A.
- Grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

S151-17**• Concrete Stairs**

- Concrete to be finished with medium-rough bush-hammer finish and be free of cracks, waxy or oily films, and curing compounds.

• Metal Stairs

- Reinforcing mesh mandatory. Attach to metal by tack welds or other means.
- Metal stair riser may be tiled. Cut mortar bed and reinforcing at juncture of tread and riser.

• Wood Stairs

- Waterproof membrane for exterior and wet area installations; cleavage membrane for interiors.

Design Considerations—all stairs

- Use cove tile at junction of riser and tread for easy maintenance. Quarry or paver tile cove can be set horizontally or vertically to facilitate layout.
- Finished step nosings are available in specially shaped quarry and paver tile pieces.
- Use full radius ceramic mosaic bullnose tile for nosings.
- Slip-resistant tile should be specified on stair treads.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

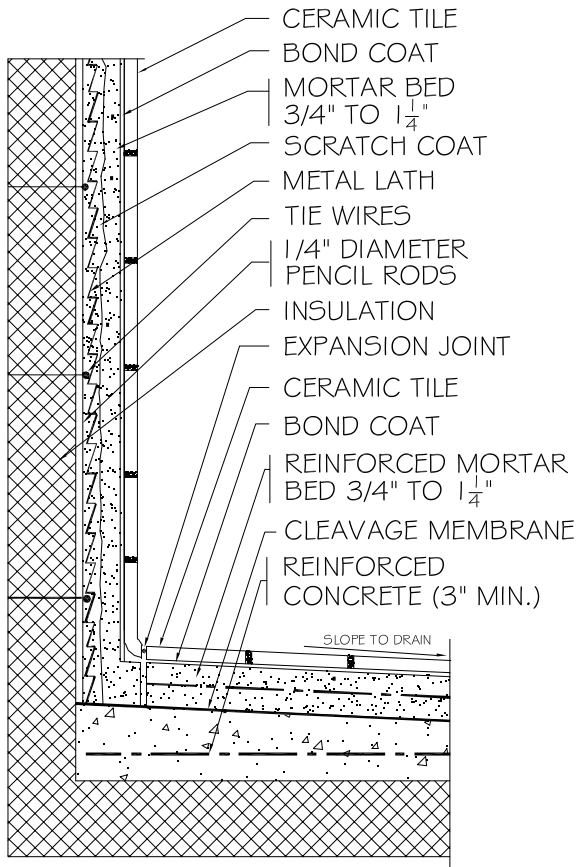
Installation Specifications

- Metal stairs—See F111. Membrane not required.
- Concrete stairs—See F112; risers see W211.
- Wood stairs—See F141; risers see W231.
- Movement Joints—EJ171 and ASTM C1193.

R612-19

- Mortar Bed Walls
- Mortar Bed Floor
- Ceramic Tile

- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

**Requirements**

- Use tile designated as frost proof by the manufacturer in all rooms subject to freezing temperatures.
- Provide reinforced concrete slab over floor insulation to resist wheel load of hand and mechanical trucks. (3" minimum; 4" or more for forklift trucks.)

Material and Tile Installation

- Attach four equally spaced tie wires to the supporting members and through the insulation. Attach 1/4" D steel pencil rods vertically over the insulation.
- Attach metal lath to pencil rods and follow W222, or install on a mortar bed meeting the requirements of W241.
- Floors and movement joints may be installed in accordance to F112, F113, or F131.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.

TR711-19**• Tile Over Other Surfacing
Materials/Walls and Floors**

Ceramic tile may be considered as a surfacing material over existing wall finishes such as paint, cold glazes (sprayed on plastic), plastic laminates, and steel plate, or existing floor surfacing such as epoxy coatings, paint, vinyl or asphalt tile, seamless flooring,* exposed concrete† and steel plate. Ideally, existing finishes should be completely removed so that the tilework can be placed on the substructure following *Handbook* methods. However,

because this is not always practical, the following is intended as a general guide for renovation with ceramic tile. In all cases, consult the setting material manufacturer before starting the work. Consideration should be given to covering the existing surface with a more suitable base. For example: badly cracked or irregular walls should be overlaid with firmly attached gypsum board or backer board to provide a sound tile-setting base.

TR711-19**• with Organic Adhesive, Interiors Only****Suitable Backings**

- Smooth walls of all types including plaster, gypsum board, cement backer board, and masonry.
- Smooth floors of all types including wood, concrete, and terrazzo in residences or areas of equivalent residential performance requirements. Deflection not to exceed 1/360.
- New gypsum board nailed and/or adhesively applied over existing walls.
- Plastic laminate countertops and walls.

Requirements

- Backing surface must be sound, clean, and dry.
- Abrupt irregularities, such as trowel marks, ridges, and grains, shall be less than 1/32" above adjacent area.

Preparation

- Roughen surfaces which are glossy, painted, or which have loose surface material by sanding or scarifying.*
- Surface material must be removed if not compatible with adhesive.

- Use primer when recommended by the adhesive manufacturer for particular backings.
- Clean thoroughly to remove all oil, dirt, and dust.
- Apply underlayment as needed according to manufacturer's directions.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Installation Specifications

- Tile—ANSI A108.4.
- Grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

*WARNING: Do not sand existing resilient flooring. Certain older resilient floor coverings, including sheet vinyl floor covering and vinyl tile, may contain asbestos fibers that are not readily identifiable. Inhalation of asbestos dust may cause serious bodily harm. Smoking greatly increases any such risk of serious bodily harm.

CAUTION: Mechanical or chemical abrasion of tile can release fine particles which could cause harm if inhaled or

ingested. Mineral analysis of the tile and glaze should be performed before performing any operation. Appropriate safety equipment should be worn at all times.

†Special installation precautions are necessary when installing tile using a thin-bed method over old concrete floors in bakeries, kitchens, and meat-processing areas. Fats and greases penetrate into concrete floors and cannot be completely neutralized. Note preparation sections included in renovation methods.

TR711-19

- **with Cementitious Bond Coat, Interior and Exterior**

Suitable Backings

- Prepared portland cement plaster, concrete, concrete masonry, structural clay tile, or brick.
- Backer board applied over existing walls or floors.
- New gypsum board applied over properly furred existing wall in dry areas. Use water-resistant gypsum backer board in wet areas.

Requirements

- The backing surface must be sound, clean, and dry.

Preparation

- Roughen concrete or masonry walls and floors which are glossy, painted, or effloresced, or which have loose surface material. This should be accomplished by sandblasting, chipping, or scarifying.
- Clean thoroughly to remove all sealers, coatings, oil, dirt, and dust to expose masonry surface.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Installation Specifications

- Tile—ANSI A108.5.
- Grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

TR711-19

- **with Tile-Setting Epoxy Mortar, Epoxy Adhesive, or Modified Epoxy Emulsion Mortar**

Suitable Backings

- Generally all sound wall and floor finishes.
- Especially valuable for setting tile floors over non-masonry surfaces where moderate performance level is required.
- Suitable for speedy installation where downtime must be kept to a minimum.

Requirements

- Backing surface must be sound, clean, and dry.

Preparation

- Roughen surfaces which are glossy, painted, or effloresced, or which have loose surface material, by sanding or scarifying.*
- Clean thoroughly to remove all waxes, oil, dirt, and dust.
- With epoxy adhesives, use primer when recommended by the manufacturer as proper for the particular backing.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Installation Specifications

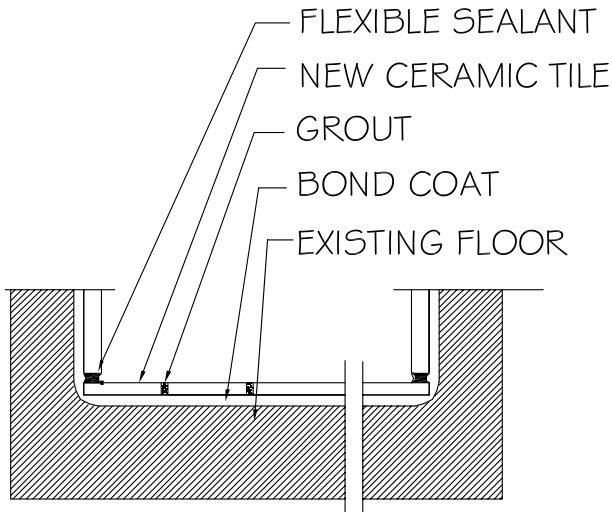
- Tile-setting epoxy mortar and epoxy adhesive—ANSI A108.6.
- Modified epoxy emulsion mortar—ANSI A108.9.
- Epoxy formulations vary with respect to chemical resistance and use on vertical surfaces. Consult manufacturer’s specifications.
- Grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

*WARNING: Do not sand existing resilient flooring. Certain older resilient floor coverings, including sheet vinyl floor covering and vinyl tile, may contain asbestos fibers that are not readily identifiable. Inhalation of asbestos dust may cause serious bodily harm. Smoking greatly increases any such risk of serious bodily harm.

CAUTION: Mechanical or chemical abrasion of tile can release fine particles which could cause harm if inhaled or ingested. Mineral analysis of the tile and glaze should be performed before performing any operation. Appropriate safety equipment should be worn at all times.

TR712-19

• Tile Over Tile Interior Floors



Recommended Uses

- For alteration of ceramic-tiled areas where modernization or a change of design is desired in residences, motels and hotels, restaurants, public rest rooms, malls, etc.
- Also applicable to smooth floors of terrazzo, stone, slate, etc.

Requirements

- Existing installation must be sound, well-bonded, and without structural cracks.
- When possible, remove floor-mounted plumbing and heating fixtures before beginning work.
- Threshold required to adjust between adjacent floors; see TR611.

Preparation

- Remove soap scum, wax, coatings, oil, etc., from existing tile surfaces. Mechanical abrasion with a Carborundum disk followed by a clear water wash is recommended. Other cleaning methods involve use of soapless detergents, commercial tile cleaners, and, in special cases, solvents or acids. Solvents and acids should be used with care and only when necessary because of their hazardous nature. (Appropriate safety equipment should be worn at all times.)
- Installation must be thoroughly rinsed and dry before setting the new tile.

Materials, Grouting, Movement Joints, and Installation Specifications

- Epoxy mortar installation—ANSI A108.6.
- Dry-set mortar or latex-portland cement mortar installation—ANSI A108.5.
- Organic adhesive installation—ANSI A108.4 and

follow manufacturer’s directions.

- Require current certification from adhesive manufacturer that adhesive conforms with ANSI A136.1.
- Grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Materials for Green/Sustainable Design

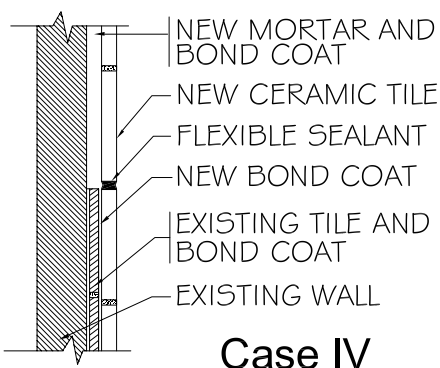
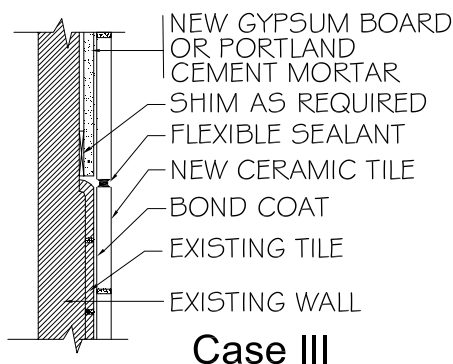
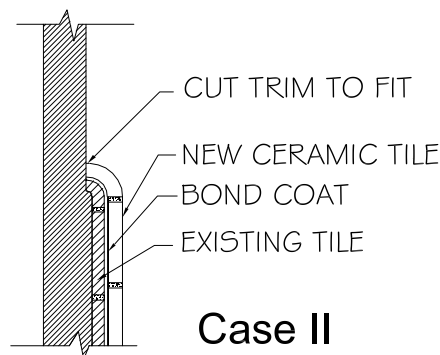
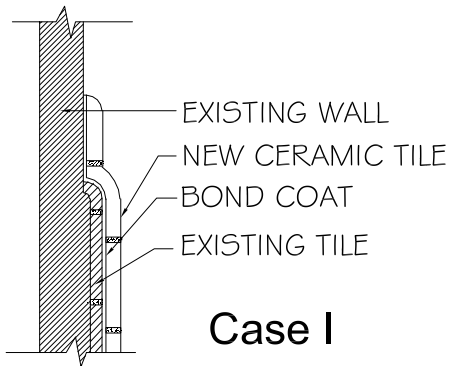
- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Notes

- Use the “Floor Tiling Installation Guide” to select adequate installation method.
- If existing installation is not structurally sound, F111 and F141 may be applicable.

TR713-19

• Tile Over Tile Interior Walls



Recommended Uses

- For alteration of ceramic-tiled areas where modernization or a change of design is desired in residences, motels and hotels, malls, restaurants, public rest rooms, etc.
- Also applicable to smooth walls of marble, stone, slate, etc.

Requirements

- Existing installation must be sound, well-bonded, and without major structural cracks.

Materials, Grouting, Movement Joints, and Installation Specifications

- For organic adhesive installation, see W223.
- For dry-set or latex-portland cement mortar installation, see W202.
- For epoxy adhesive installation, refer to manufacturer's literature.
- Movement Joints—EJ171 and ASTM C1193.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation

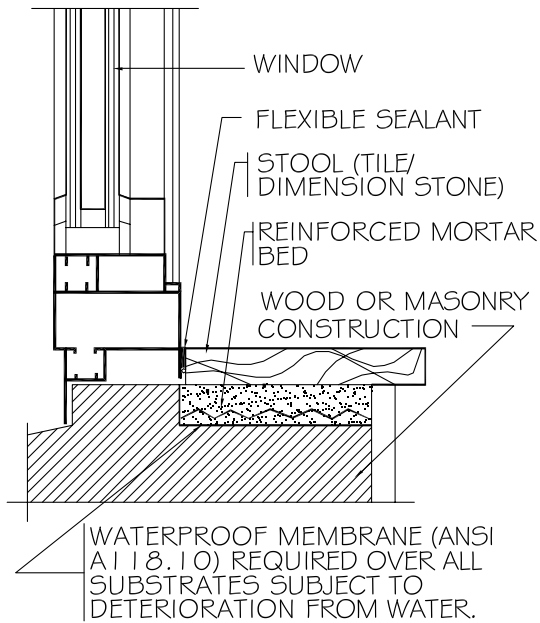
- Remove soap scum, wax, coatings, oil, etc., from existing tile surfaces. Mechanical abrasion with a Carborundum disk followed by a clear water wash is recommended. Other cleaning methods involve use of soapless detergents, commercial tile cleaners, and, in special cases, solvents or acids. Solvents and acids should be used with care and only when necessary because of their hazardous nature.
- Installation must be thoroughly rinsed and dry before setting the new tile.
- CASE I—prepare wall above tile to receive trim tile as shown.
- CASE II—cut trim tile to fit over existing trim.
- CASES III and IV—apply new gypsum board above existing wainscot tile to prepare for full wall tiling.

Notes

- Use portland cement mortar or backer board in tub enclosures and shower stalls.
- In wet areas, the application of water-resistant gypsum backer board over any base which creates a vapor barrier, such as old tile or paint, will lead to failure unless such barrier is vented.
- If installation is not structurally sound, W221 and W222 may be applicable.

WS610-19

• Window Stool

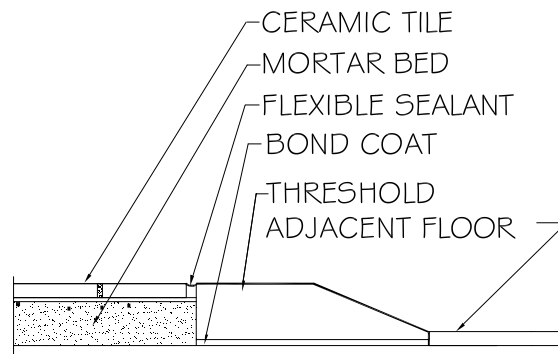


Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

TR611-19

• Threshold



Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Notes

- Thresholds adjust levels between adjacent floors. Commercial and residential thresholds and window stools are available in tile, marble, stone, slate, etc., and can be made in virtually any size and shape to fit special conditions.
- Use 95% coverage of bonding material between threshold and floor or window stool and substrate.

RW800-19**• Fire and Sound Ratings for Wall Assemblies**

WALL METHOD	RW 811	RW 812	RW 813	RW 814	RW 815	RW 816	RW 817	RW 818	RW 819	RW 820	RW 821	RW 822	RW 823	RW 824	RW 825
Fire Resistance Rating ASTM E119 (hours)	2	2	1	1	1	1	2	2	1	1	2	2	1	-	2
Field Sound Transmission Class (FSTC) ASTM E336, E413					51	53	50	52	61	60					
Sound Transmission Class (STC) ASTM E90, E413															$\frac{48}{52^{(14)}}$

Recommended Uses

- Wood stud load bearing—RW813, RW814.
- Wood stud load bearing chase wall—RW817, RW818.
- Metal stud non load bearing— $3\frac{5}{8}$ " stud width: RW811, RW812, RW815, RW816, RW823, and RW825.
- Metal stud non load bearing— $2\frac{1}{2}$ " stud width: RW824.
- Metal stud non load bearing chase wall—RW819, RW820, RW821, and RW822.

Limitations

- Stud spacing not to exceed 16" o.c.
- $\frac{3}{32}$ " minimum bond coat thickness.
- Cement backer board—maximum screw or nail spacing, 8" o.c.
- Gypsum board—maximum screw or nail spacing, 8" o.c. at edges and 12" o.c. in field for face layer; 24" o.c. for base layer.

Design Requirements (Test Reports)

- Underwriters Laboratory Inc. (ULI)
- United States Gypsum (USG)
- Warnock Hersey International (WHI)
- National Gypsum (NG)
- RW811, RW812—ULI 443 and 443 alt.
- RW813, RW814—ULI U329 and U329 alt.
- RW815, RW816—ULI 442 and 442 alt. (Fire Resistance). USG 840321 and 840313 (Sound Transmission).
- RW817, RW818—WHI 495-0505 and 495-0508 (Fire Resistance). USG 840523 and 840516 (Sound Transmission).
- RW819, RW820—ULI 445 and 445 alt. (Fire Resistance). USG 840524 and 840515 (Sound Transmission).
- RW821, RW822—ULI 444 and 444 alt.
- RW823—WHI-694-0189.
- RW824—NG C3086 and C3087.
- RW825—WHI-694-0400.11.

Preparation by Other Trades

- Gypsum board face layer joints must be taped and finished with minimum of two coats of joint compound. Finish fastener heads.
- Offset studs on each side of chase walls.

Preparation by Backer Board Installers

- Closely fit horizontal and vertical joints and corners without touching, leaving a maximum space of $\frac{1}{8}$ ".
- Embed 2"-wide glass fiber mesh tape in a skim coat of the setting material over joints and corners.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Tile Installation

- RW823—any method over solid backing.
- RW824—see W222.
- RW825—see W244C.
- All others—see W223, W244C, or W244F.

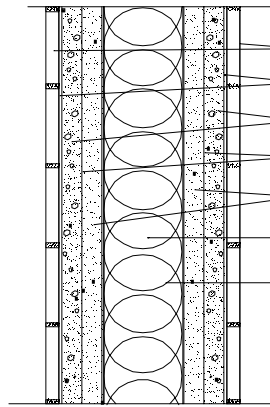
Materials (Refer to Details)

- (1) Glazed ceramic wall tile—ANSI A137.1.
- (2) Cementitious bond coat—latex-portland cement mortar ANSI A118.4 or organic adhesive ANSI A136.1, Type 1.
- (3) Cementitious bond coat—dry-set mortar ANSI A118.1.
- (4) ½"-thick cement backer board—certified by manufacturer as suitable for intended use.
- (5) 7/16"-thick cement backer board—certified by manufacturer as suitable for intended use.
- (6) Metal studs—25 gauge, 3 5/8" × 1 1/4" ASTM C645. Floor and ceiling tracks, 3 3/8" × 1 1/4."
- (7) Metal studs—25 gauge, 2 1/2" ASTM C645. Floor and ceiling tracks, 2 1/2" × 1 1/4."
- (8) Metal studs—20 gauge, 3 5/8" ASTM C645. Floor and ceiling tracks, 3 5/8" × 1 1/4."
- (9) Wood studs—3 1/2" × 1 1/2". Floor and ceiling plates 3 1/2" × 1 1/2"
- (10) Mineral fiber insulation—3" minimum thickness.
- (11) Mineral fiber insulation—3 1/2" thick.
- (12) Mineral fiber insulation—3 5/8" × 6" blanket, 2.5 pounds/cubic foot.
- (13) Mineral fiber insulation—1 1/2" minimum thickness.
- (14) Mineral fiber insulation—2" thick. Required for STC rating of 53.
- (15) Gypsum board—5/8" thick, Type X, ASTM C1396/C1396M.
- (16) Cross brace—1/2" × 12" × chase width gypsum panel spaced 48" o.c. horizontally and vertically.
- (17) 4 mil. polyethylene film (when required as moisture barrier).
- (18) Metal lath—self-furring, galvanized or painted, expanded metal lath, 3.4 pounds/square yard.
- (19) Mortar bed—1 part portland cement, 1 part lime, 6 parts sand.
- (20) 13/32"-thick fiber-cement backer board—certified by the manufacturer as suitable for the intended use.
- Standard tile grout.
- 2" glass fiber mesh tape.
- Screws—1 1/4" Type S; 1 5/8" screw for double layer gypsum board.
- Nails—1 1/2" galvanized roofing for cement backer board; 1 3/8" ring shank for gypsum wall board; 1 5/8" nail for double layer gypsum board.

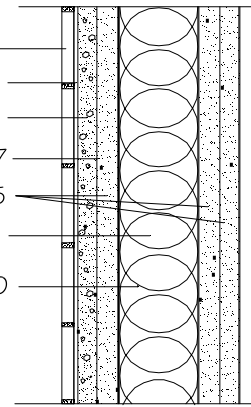
Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

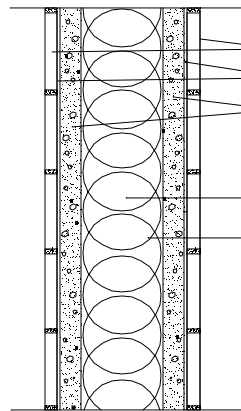
RW811-19



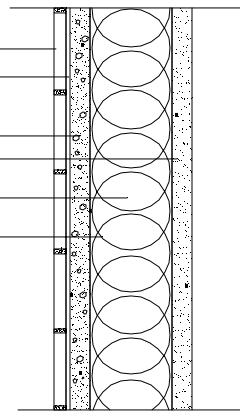
RW812-19



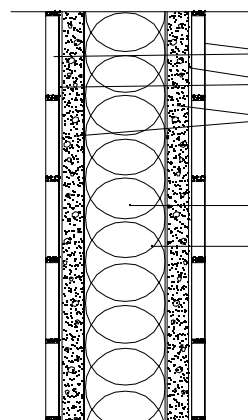
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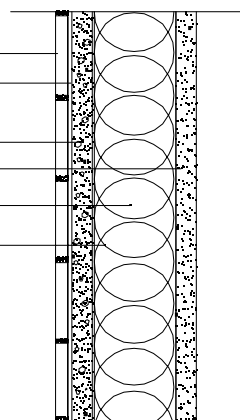
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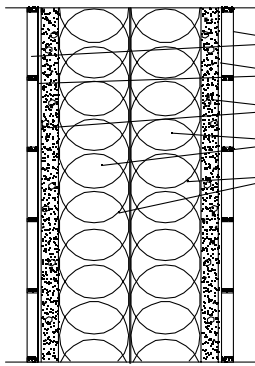
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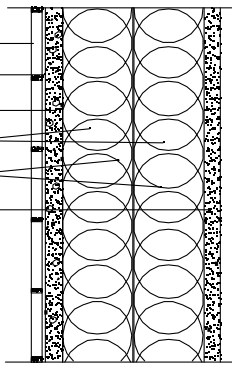
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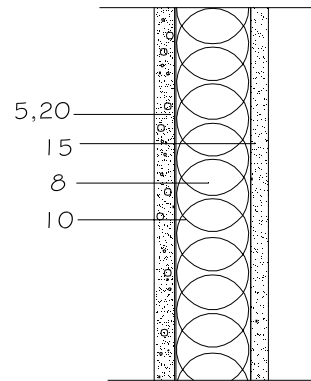
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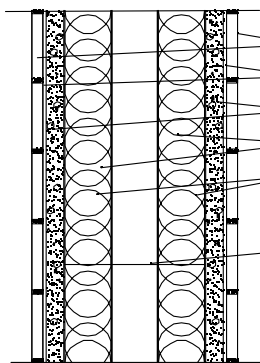
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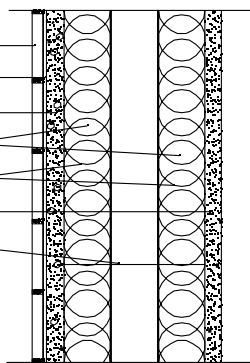
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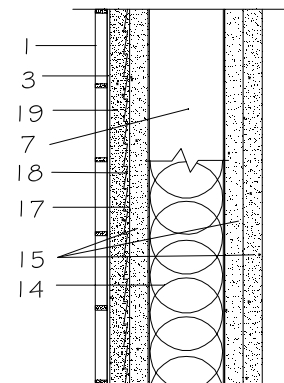
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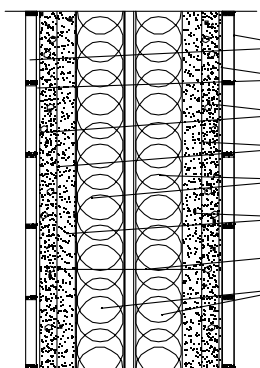
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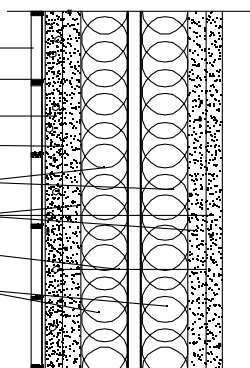
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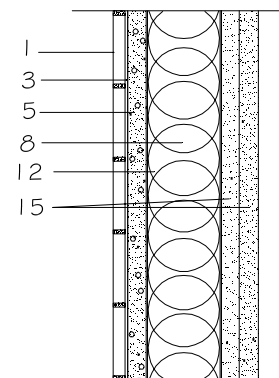
RW821-19



RW822-19



RW825-19



NOTES

- Fire side—both sides of all methods are classified as the fire side except RW824, which is sound-rated only.
- See Materials on page 292 for key.

SOUND RATED FLOORS GUIDE

What is Sound Control?

There are two types of ratings used for sound control: STC (Sound Transmission Class), which is airborne sound, such as speaking, music, etc., and IIC (Impact Insulation Class), which is sound from people walking, moving chairs, dropping objects, etc. Flanking is the transmission of sound through joints, penetrations, or structural components in the assembly. Presenting the greatest challenge for the STC component of sound control is high-frequency sound energy, such as that which is produced by a blow-horn or a whistle. The greatest challenge for sound control in regard to IIC is low-frequency sound energy, such as that which occurs when a basketball is dropped on the floor.

STC Ratings

The term STC refers to the single figure of evaluation used to quantify the transmission of airborne sound through building elements, such as walls or floor systems. These types of sounds would be the equivalent of voices, radio, or television in the context of a multi-family building. The term STC translates to Sound Transmission Class and is measured and stated in accordance with ASTM Standard number C634 and tested via the test methodology of ASTM Test Methods E90, E336, and E596. When done in an accredited test laboratory, these values are stated as an exact number to the right of the initials STC. When done in the field, using ASTM Method E336, the values are designated by the initials FSTC to the left of the numeric value. STC values are in a large part influenced by the solid mass of the structure, but are also dependent on isolation and resilience within the structure.

IIC Ratings

The term IIC refers to the statistical measurement standards used to quantify the transmission of impact sound energy through a floor/ceiling assembly system. These types of sounds would be the equivalent of foot traffic, dropped articles, or furniture moving in the context of a multi-family building. The term IIC translates to Impact Isolation Class and is measured and stated in accordance with ASTM Standard numbers C634 and E989 and tested via the test methodology of ASTM Test Method E492. In addition, a new test protocol for concrete subfloors has been introduced under ASTM E2179. When done in an accredited test laboratory, these values are stated as an exact number to the right of

the initials IIC. When done in the field, using ASTM Method E1007, the values are designated by the initials FIIC to the left of the numeric value.

IIC values are not heavily influenced by the presence of solid mass in the structure. IIC values are usually dependent on the presence of a resilient material somewhere in the assembly to isolate and absorb the sonic energy created by impacts.

STC and IIC Ratings and Building Codes

In multi-family construction, in most jurisdictions, there are minimum IIC and STC values that the floor/ceiling assembly must achieve in order to meet the building code standards. Most common are the ICC/BOCA U.B.C. Uniform Building Code and International Building Code (IBC), which call for a minimum 50 IIC and 50 STC value. The higher the IIC or STC, the better the sound attenuation, with 50 considered the minimum for multi-family dwellings. Some states, municipalities, and counties have different building code standards, but the U.B.C. and I.B.C. codes are by far the most common. Consult your local Building Department for the exact code standards applicable in your area.

In addition to the building code standards, some condominium developers and condo homeowners associations have their own minimum standards written into their Covenants, Conditions, and Restrictions (CC&R's), which are often more stringent than the building code in that given jurisdiction. It is wise to consult your condo association in regard to their CC&R standards for the required IIC and STC values before installing hard surface flooring materials in your unit or project.

Challenges

A number of different materials are promoted and used for sound control in floors. Each material is only one component of a complete system in which each component is an essential part of the total assembly. Elimination of any component of the assembly can seriously deplete the sound rating desired. Most of the data available to the market relates to tests of floor/ceiling systems that are comprised of concrete slabs with gypsum wallboard hung on resilient furring channels (suspended or sound-rated ceiling system) with a layer of mineral wool or fiberglass insulation in the cavity. Unfortunately, most of the construction detail in the field does not have this type of ceiling treatment.

In addition, in 2003 a new test protocol for concrete subfloors has been introduced under ASTM E2179. When done in an accredited test laboratory, these values are stated as an exact number to the right of the initials IIC and actually give a separate IIC contribution value number of the product assembly by itself. This number provides an excellent way to evaluate different products and to determine if additional key components (e.g., a suspended or sound-rated ceiling assembly) are needed. Products that have only Field Test reports (FIIC) and no laboratory testing should be considered with caution. Field tests are project specific; comparing different field tests done in different buildings is not an accurate way to make a proper assessment of product performance.

Many materials that are promoted for sound control in hard surface flooring may not be suitable for direct bond tile and stone installations as they are too compressible, and do not provide proper structural support for these installations. In many cases, it is necessary to use additional reinforcing materials, such as mortar beds, poured in place overlays, backer boards, epoxy mortars and grouts, thicker tiles, and other methods to provide a structurally sound installation. It is recommended that all products/systems to be used for sound control be subjected to ASTM C627, commonly referred to as the Robinson Floor Test, and that such products/systems meet a minimum “Residential Rating.” All components of the test assembly should be divulged to determine that the product in question is able to achieve the performance rating desired, for the given installation design and the same or similar materials should be used for the sound testing. In particular the size, thickness and type of the tile; the type of mortar and type of grout should be consistent.

ANSI A118.13

In 2010 a new standard was created for “Bonded Sound Reduction Membranes for Thin-set Ceramic Tile Installation.” This standard addresses relatively thin bonded membranes for substrates that are approved by the manufacturer and are covered by ANSI Specifications. This standard was created specifically for ceramic tile but can be used for Dimension Stone. It should be recognized that stone tile can be relatively fragile and may be susceptible to damage when placed on sound reduction materials, which are almost always resilient or compressible by nature.

This standard applies to trowel applied, liquid, and flexible sheet membranes used for sound attenuation that are bonded to the substrate.

Key aspects of this standard:

- Fungus and microorganism resistance
- Shear strength of membrane bonded to ceramic tile with cement mortar
- ASTM C627 Robinson Floor Test minimum “Residential Rating”
- ASTM E2179 “Sound Transmission Reduction testing” Δ IIC rating of 10 or greater

Concrete Slab Subfloors

Concrete slabs come in a variety of thicknesses and compositions (e.g., hollow core, post-tensioned, prestressed). The most commonly cited are 6" and 8" concrete slabs with or without a suspended ceiling assembly. Test results for these two thicknesses vary when comparing field tests versus laboratory tests. The field tests result in a much higher range of values than those conducted in the labs. Table 1 demonstrates the wide range of numbers, particularly those within the field reports. If a suspended ceiling assembly is not possible, the most effective method to establish an improved IIC rating is to install a “floating” floor system. This can be done by utilizing a layer of some type of acoustically rated resilient material, followed by a layer of lightweight concrete, mortar bed, or gypsum concrete (typically 3/4" or more, depending on material), onto which the tile or stone is installed.

Wood Joist Floors

For aesthetics and design purposes, wood frame construction will normally have a gypsum wallboard ceiling assembly. To achieve a solid base of sound control, the use of resilient metal channels supporting the gypsum wallboard and sound-absorbing insulating batts in the cavity is recommended. An assembly of this nature with a single layer subfloor has an approximate IIC rating of 45. Adhering a tile or stone surface will actually lower the IIC to around 40. The reason for this is that the hard surface increases noise levels at the higher frequencies, thereby reducing the overall IIC rating. If the subfloor thickness is doubled and the ceiling wallboard panels are doubled as well, the net effect will increase the STC rating, as well as the IIC rating.

Key Points to Remember

- It is not good practice to select materials or systems based solely on field tests. Lab tests are a more accurate model for predicting performance in a range of different construction types; field tests are accurate only for the site where the tests were performed.

- If field tests are being conducted, require both before and after installation testing.
- Testing labs should be NVLAP certified and meet the criteria established in ASTM guidelines E548, E597, and in ASTM Standard E717.
- Sound abatement materials are often quite resilient, so a Robinson Floor Test (ASTM C627) is strongly recommended.
- The size, thickness, and type of tile as well as the type of mortar and grout used in the Robinson Floor Test should be the same/similar as that shown for the sound control testing conducted in the lab or field.
- If a suspended sound rated ceiling is not being used, then a relatively thick assembly on top of the slab may be required (e.g. full mortar bed) to achieve a 50 IIC

Table 1

Concrete Slab Thickness	No Sound Rated Ceiling	Sound Rated Suspended Ceiling*	In Lab IIC**	In Field IIC
6"	X		26 to 30	24 to 32
8"	X		28 to 32	25 to 35
6"		X	45 to 52	33 to 48
8"		X	48 to 55	38 to 52

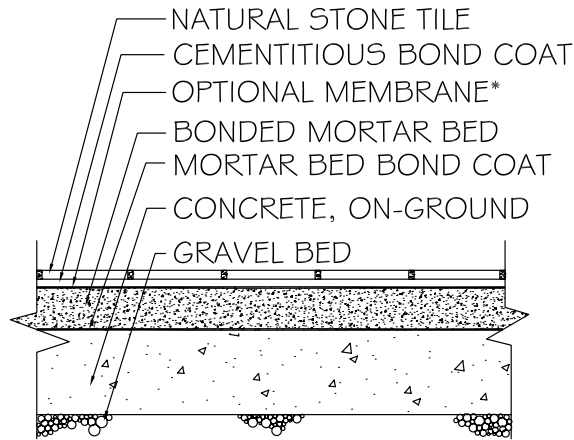
*Suspended Sound Rated ceiling composed of: 7" plenum, 3" of insulation, resilient channels, 5/8" Type X gypsum wallboard panels.

**Tests were conducted in several different labs. Hence, the range of values for each slab thickness shows the variance between labs, not a variance in the test results within a single lab.

2019 | NATURAL STONE TILE INSTALLATION METHODS

F101-19 STONE

- On-Ground Concrete
- Bonded Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior slab-on-ground construction where no bending stresses occur and positive drainage below slab is provided, for example, floors, decks, or patios.
- For areas where leveling, flattening, or contouring of finish floor height is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 17 pounds/square foot with $\frac{3}{4}$ " mortar bed. Add 3 pounds/square foot for each additional $\frac{1}{4}$ " of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square

feet or less. Consult stone supplier and installation materials manufacturers.

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and reduce the need for below-slab drainage. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Seal edges of mortar bed with a trowelable membrane/sealant when water intrusion is expected.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Mortar bed thickness— $\frac{3}{4}$ " minimum to 2" maximum.
- Minimum grout joint width— $\frac{1}{16}$ ".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gravel bed or other means of drainage below slab.
- Slope slab for complete drainage.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

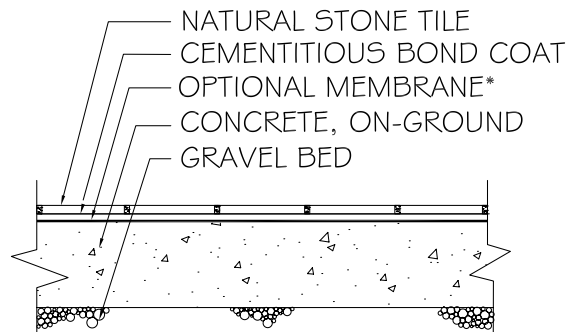
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- If a waterproof membrane is not used, positive drainage below slab must be provided.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F102-19 STONE

- On-Ground Concrete
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior slab-on-ground construction where no bending stresses occur, positive drainage below the slab is provided, and thin-bed installation of tile is desired, for example, floors, decks, or patios.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and reduce the need for below-slab drainage. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.

- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F125-full). See F125 Stone for more information.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gravel bed or other means of drainage below slab.
- Slope slab for complete drainage.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

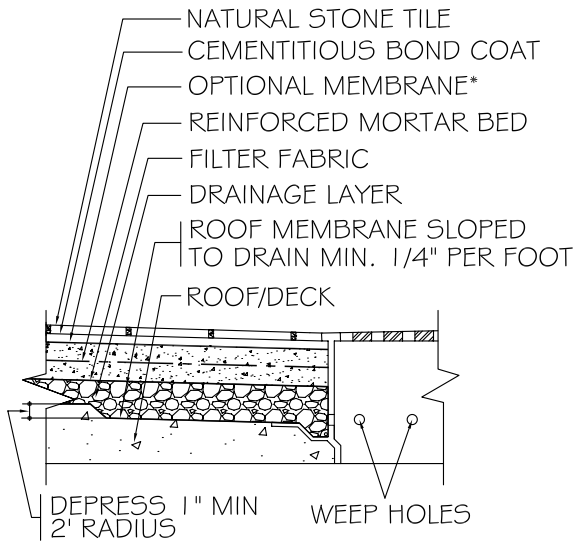
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- If a waterproof membrane is not used, positive drainage below slab must be provided.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**F103-19
STONE**

- Roof Deck or Balcony
- Drainage Layer
- Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior roofs or decks of concrete, steel, or wood where a waterproof roof membrane is used and sloped minimum 1/4" per foot to a drain.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 33 pounds/square foot with 1 1/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- Protect weepholes to prevent blockage.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Mortar bed thickness—1 1/4" minimum to 2" maximum.
- Minimum grout joint width—1/16".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.

- When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
- When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed and reinforcing—ANSI A108.1A.
- Drainage layer—minimum 1"-thick bed of crushed stone ($\frac{1}{2}$ " maximum size).
- Filter fabric—burlap or closely woven cheesecloth.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Roof drains and membrane by other trades—provide complete drainage at roof membrane level by use of weep holes as shown or other methods. Flat deck with poor or no drainage will not perform well.
- Maximum allowable variation in the roof/deck— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.
- Movement joints should not go through the gravel bed; they should extend only to the bottom of the setting bed.

Installation Specifications

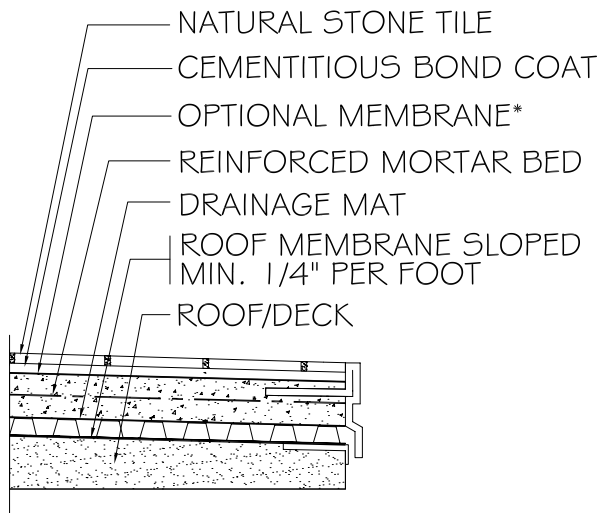
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F103B-19 STONE

- Roof Deck or Balcony
- Drainage Mat
- Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior roofs or decks of concrete, steel, or wood where a waterproof roof membrane is used and sloped minimum $\frac{1}{4}$ " per foot.
- For areas where ungauged stone will be used.

Service Rating

- Consult drainage mat manufacturer.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 23 pounds/square foot with $\frac{1}{4}$ " mortar bed. Add 3 pounds/square foot for each additional $\frac{1}{4}$ " of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.
- Requires additional consideration by design professional to accommodate movement and/or deflection.

Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- When bond coat is portland cement paste, cover completed tilework and allow to cure.
- Mortar bed thickness— $\frac{1}{4}$ " minimum to 2" maximum.
- Minimum grout joint width— $\frac{1}{16}$ ".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable; For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI

A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed and reinforcing—ANSI A108.1A.
- Drainage mat—recommended by manufacturer for intended use or application.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Roof membrane must be sloped and provide complete protection from moisture. Flat deck with poor or no drainage will not perform well.
- Maximum allowable variation in the roof/deck— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.

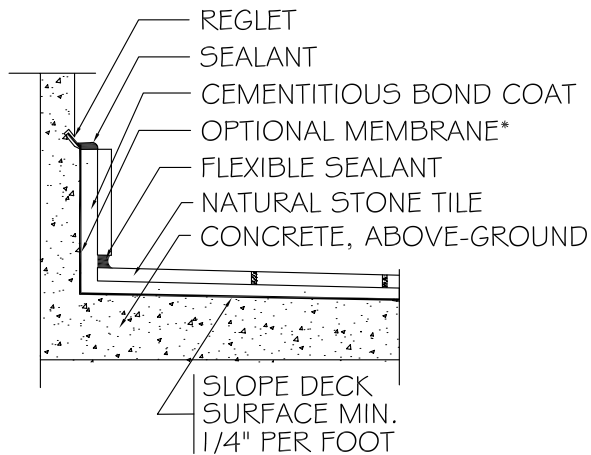
- Drainage mat—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F104-19 STONE

- Roof Deck or Balcony
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior balconies or decks of concrete over unoccupied space where waterproof roof membrane is not used, where slab is sloped minimum $\frac{1}{4}$ " per foot, and where thin-bed installation of tile is desired.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.
- Requires additional consideration by design professional

to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F125-full). See F125 Stone for more information.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$ ".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.15 or better or ISO C2S1 or better.

- When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Slope slab minimum $\frac{1}{4}$ " per foot. Flat deck with poor or no drainage will not perform well.
- Slab to have steel trowel finish with no curing compounds used. When used, mechanical scarification is necessary.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

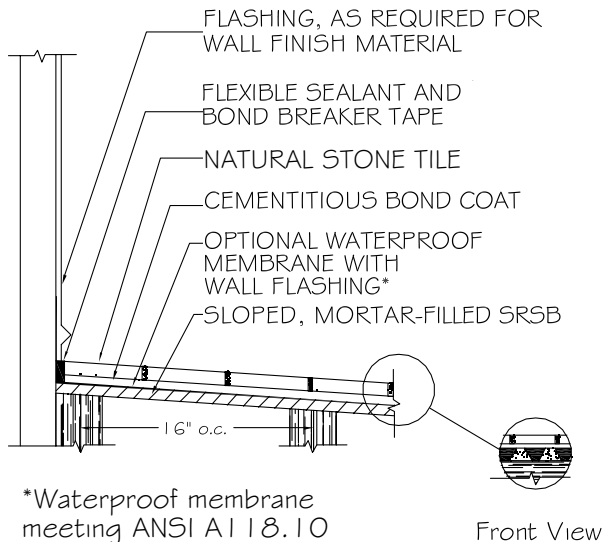
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

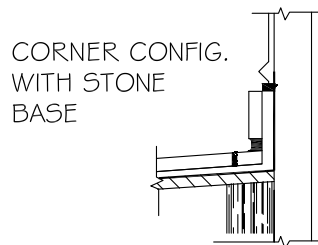
- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F105-19 STONE

- Roof Deck or Balcony
- Structural Ribbed Self-Supporting Boards (SRSB) Filled with Portland Cement Mortar
- Natural Stone Tile



*Waterproof membrane meeting ANSI A118.10 required when subject to freeze/thaw cycling. See Membrane Options.



Recommended Uses

- For residential balconies and decks over unoccupied space, constructed of a joist system sloped min. ¼" per foot.

Service Rating

- Light, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Classifications

- Res6; Com6.
- For installations that may be exposed to staining, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate (mortar-filled SRSB). See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- 12" × 12" and larger tile only.
- Maximum joist spacing 12" on center.
- Where the installation will be subjected to freeze-thaw cycles, snow and ice accumulation, and/or snow melting chemicals, degradation can occur over time.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) is required for installations that will be exposed to freeze/thaw cycling. When used, membrane flashing is required.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Minimum grout joint width—¼"
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Mortar bed thickness—screed fill channels of SRSB boards flush to top of ribs and allow to cure 24 hours.

Preparation by SRSB Installers

- The ends of SRSB must be fully supported. Cantilevering is not permitted.
- Do not extend movement joints through SRSB boards.
- Fasteners—1⅝" pan head screws, non-corrosive and non-oxidizing.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.

- Cementitious grout—ANSI A118.7 or better or ISO CG2 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.15 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Waterproof membrane flashing, when used—per applicable building codes.
- Mortar bed—ANSI A108.1A.
- Structural ribbed self-supporting boards—recommended by manufacturer for intended use or application and meeting the following requirements:
 - Water absorption < 3% when tested per ASTM D570.
 - Passes 300 cycles when tested per ASTM C67, Section 9.
 - Flexural strength $\geq 2,600$ psf when tested per ASTM D790.
 - Direct screw withdrawal resistance (using SRSB manufacturer's recommended fastener) ≥ 250 psf when tested per ASTM D1037, Section 16.
 - Passes Robinson Floor Test (ASTM C627) cycles 1-10 when tested with standard 12" \times 12" ANSI A137.1 porcelain tile, ANSI A118.6 grout, and ANSI A118.4 mortar; and joists spaced 16" o.c.
 - Passes Robinson Floor Test (ASTM C627) cycles 1-10 when tested with standard 12" \times 12" ANSI A137.1 porcelain tile, ANSI A118.6 grout, and ANSI A118.4 mortar; joists spaced 16" o.c.; and modified to accommodate a 14' suspended floor assembly.
 - Receives flame spread and smoke development indices of 0-0-0 when the assembly is exposed to fire, when tested per ASTM E84.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/720$. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the joist system— $\frac{1}{4}$ " in 10' and $\frac{1}{16}$ " in 1' from the required plane.
- Slope joist system min. $\frac{1}{4}$ " per foot. Flat deck with poor or no drainage will not perform well.

Movement Joint (architect must specify type of joint and show location and details on drawing)

- Movement joints—mandatory according to EJ171. For above-ground installations additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.5
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Mortar bed—ANSI A108.1B
- SRSB—manufacturer's directions
- Movement Joints—EJ171 and ASTM C1193.

Notes

- State and local building codes for exterior deck construction, membrane requirements, and membrane flashing requirements vary; check applicable codes for requirements.
- SRSB are structural panels. Specifier to ensure compliance with building codes and expected load. Consult with SRSB manufacturer for design criteria.
- Not all bonding mortars are suitable for exterior use.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- Some substrate materials used in wet areas are subject to deterioration from moisture. See ANSI A108.01-2.4.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

Materials for Green/Sustainable Design

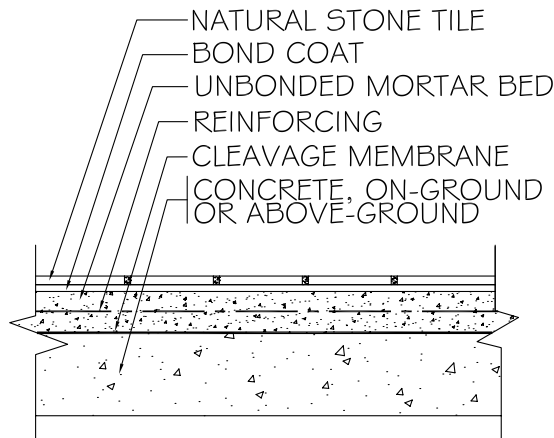
- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying tile and installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- For decks with 8 foot and longer joists, cross bracing may be needed between joists to prevent racking. Consult SRSB manufacturer.

F111-19 STONE

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction.
- For isolating the tile installation from the concrete substrate.
- For areas where leveling, flattening, or contouring of finish floor height is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For concrete substrates that are cracked or present bonding issues.
- For areas with in-slab hydronic tubing.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 23 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.

- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Minimum grout joint width—¼₁₆."
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Cementitious bond coat (above ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - ANSI A118.15 or better or ISO C2S1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.

- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

- For hydronic tubing on top of the slab when using a mortar bed, see RH117 Stone.
- Above-ground—not all mortars and grouts are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be 1/16" to 1/8" wide (nominal).

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate with steel trowel finish.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)—1/4" in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

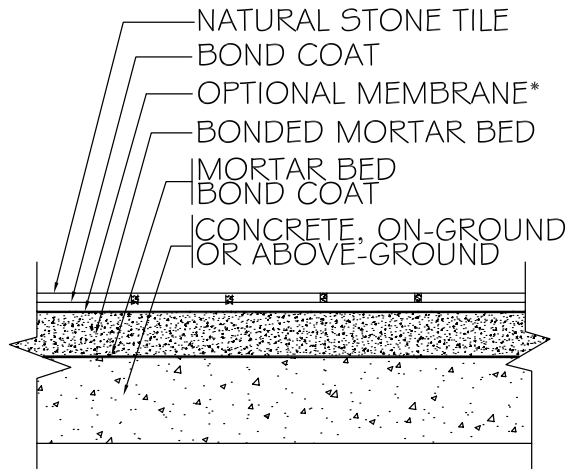
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application when using a mortar bed, see F121 Stone or F112 Stone.

**F112-19
STONE**

- On-Ground or Above-Ground Concrete
- Bonded Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and for above-ground structural slabs where tile installation is 100 square feet or less.
- For areas where leveling, flattening, or contouring of finish floor height is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For areas with in-slab hydronic tubing.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 17 pounds/square foot with 3/4" mortar bed. Add 3 pounds/square foot for each additional 1/4" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use over above-ground structural slabs or other floors subject to movement and/or deflection except where tile installation is 100 square feet or less. See Notes.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Mortar bed thickness—3/4" minimum to 2" maximum.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy, or oily films including curing compounds.
- Mortar beds in excess of 2" thick shall be detailed by architect.
- Minimum grout joint width—1/16."
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.

- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Cementitious bond coat (above ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

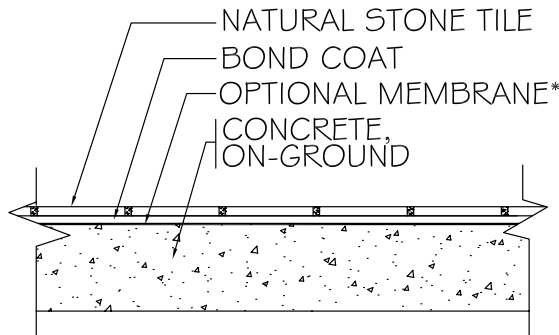
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Above-ground—not all mortars, grouts and membranes are suitable for above-ground use. Check manufacturer recommendations.
- For hydronic tubing on top of the slab when using a mortar bed, see RH117 Stone.
- For waterproofing below mortar bed (unbonded), see F121 Stone.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**F113-19
STONE**

- On-Ground Concrete
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and thin-bed installation of tile is desired.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F113A Stone.

Membrane Options

- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection

against future in-plane cracking (F-125 full). See F125 Stone for more information.

- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$ ”.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Uncoupling membrane, when used—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

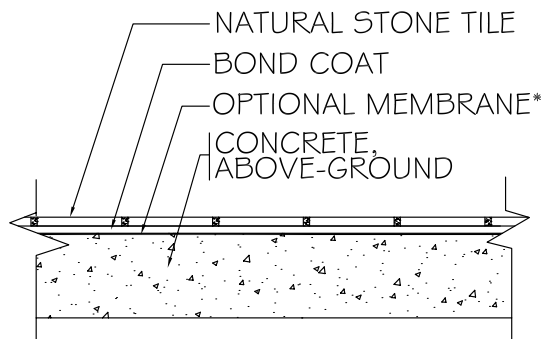
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application where thin-bed installation is desired, see F122 Stone.
- For in-slab hydronic tubing, see RH110 Stone.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F113A-19 STONE

- Above-Ground Concrete
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where thin-bed installation of tile is desired.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be specified to treat existing in-plane cracks (F125-partial) or

for protection against future in-plane cracking (F125-full). See F125 Stone for more information.

- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$ ”.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”

- Crack isolation membrane, when used—A118.12.
- Uncoupling membrane, when used—recommended by manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—A108.17.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

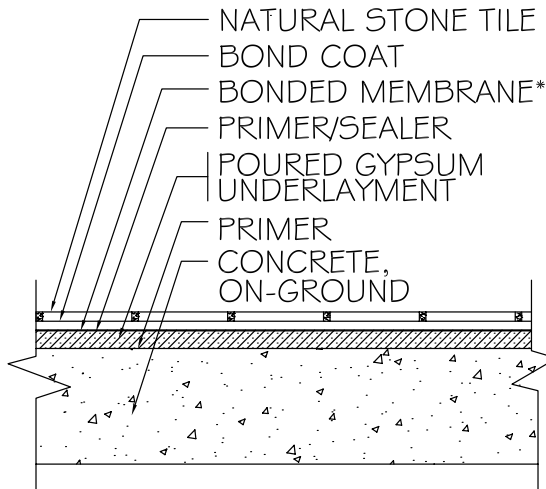
Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.

- For waterproof application where thin-bed installation is desired, see F122A Stone.
- For in-slab hydronic tubing, see RH110A Stone.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F200-19 STONE

- On-Ground Concrete
- Poured Gypsum Underlayment
- Bonded Membrane
- Natural Stone Tile



*USE OF A MEMBRANE IS REQUIRED.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and with a poured gypsum underlayment.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 14 pounds/square foot with $\frac{3}{4}$ " poured gypsum. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.

- Not for below-ground installation.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F200A Stone.
- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2, Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Proper curing/drying of gypsum underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Minimum grout joint width— $\frac{1}{16}$ "

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or

- ISO C1 is recommended by membrane manufacturer.
- When an uncoupling membrane is used, check with membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

- Tile—ANSI A108.5 or A108.6.

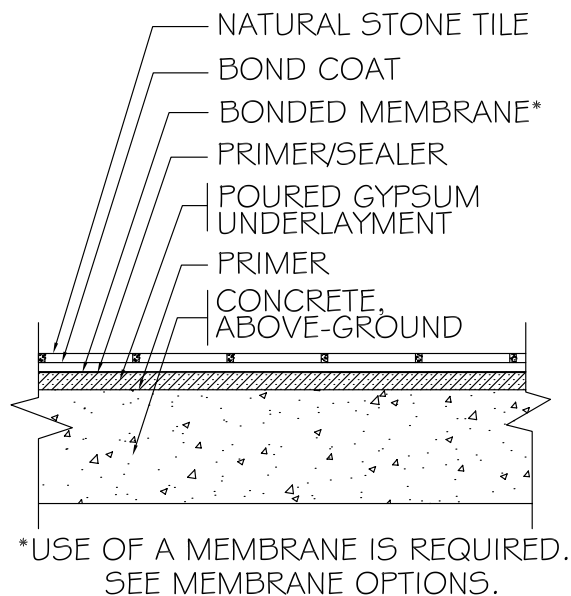
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F200A-19 STONE

- Above-Ground Concrete
- Poured Gypsum Underlayment
- Bonded Membrane
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs with a poured gypsum underlayment.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 14 pounds/square foot with $\frac{3}{4}$ " poured gypsum. Add $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square

feet or less. Consult stone supplier and installation materials manufacturers.

- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2, Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Minimum grout joint width— $\frac{1}{16}$ ".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.

- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed 1/360. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.

- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

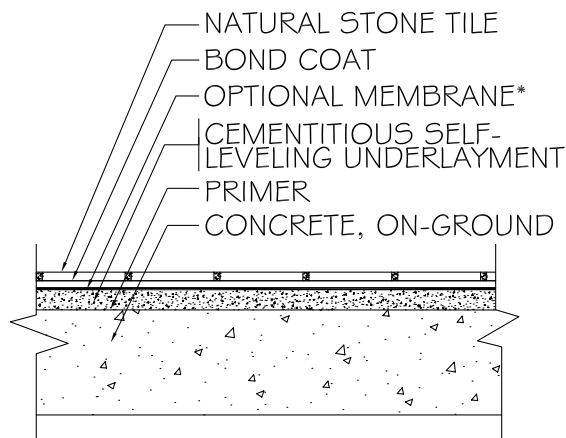
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F205-19 STONE

- On-Ground Concrete
- Cementitious Self-Leveling Underlayment
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 13 pounds/square foot with ½" cementitious self-leveling underlayment. Add 2¾ pounds/square foot for each additional ¼" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.

- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F205A Stone.
- Not for below-ground installation.

Membrane Options

- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 Stone for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Minimum grout joint width—¼"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Cementitious self-leveling underlayment—manufacturer’s directions.

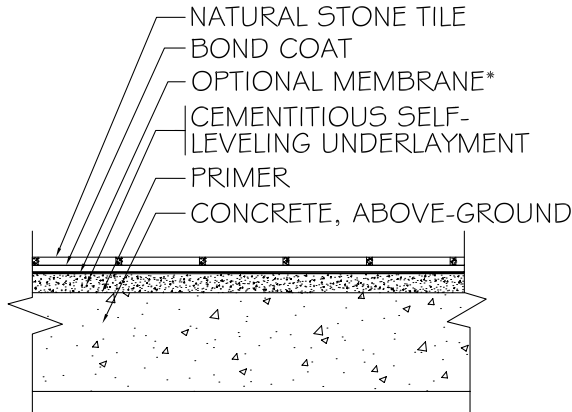
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**F205A-19
STONE**

- Above-Ground Concrete
- Cementitious Self-Leveling Underlayment
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 13 pounds/square foot with 1/2" cementitious self-leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.
- Requires additional consideration by design professional

to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 Stone for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Minimum grout joint width—1/16".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

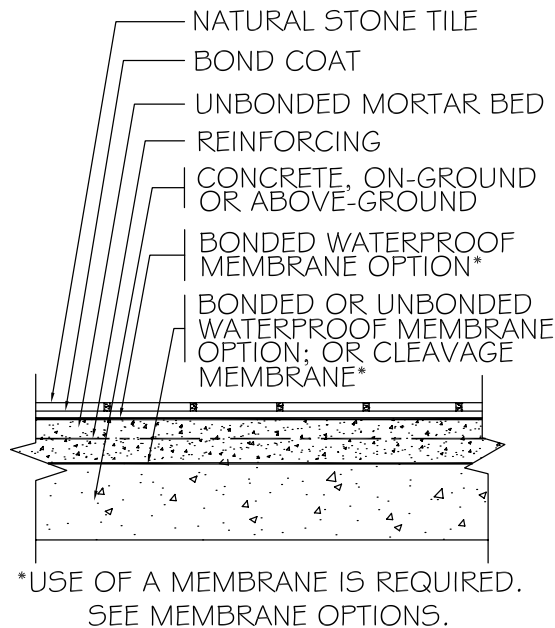
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F121-19 STONE

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed
- Waterproof Membrane
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where a waterproof floor is required.
- For areas where leveling, flattening, or contouring of finish floor height is required and a waterproof floor is required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern, and a waterproof floor is required.
- For concrete substrates that are cracked or present bonding issues and a waterproof floor is required.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used. Consult membrane manufacturer to verify.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 23 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A waterproof membrane and a cleavage membrane are required.
- If a bonded waterproof membrane (ANSI A118.10) is used, it may be placed above or below the mortar bed. If a shower pan membrane (ASTM D4551 or D4068) is used, it must be placed below the mortar bed.
- The waterproof membrane can also function as the cleavage membrane if loose laid (not bonded to concrete) below the mortar bed. Check with membrane manufacturer if membrane may be loose laid.
- If waterproof membrane is bonded to the top of the mortar bed, a cleavage membrane must be placed below the mortar bed.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Reinforcing mesh mandatory.
- Minimum grout joint width—1/16".
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance**

specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When waterproof membrane is placed below mortar bed—ANSI A118.1 or better or ISO C1 or better.
 - When waterproof membrane is placed above mortar bed—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When waterproof membrane is placed below mortar bed—ANSI A118.15 or better or ISO C2S1 or better.
 - When waterproof membrane is placed above mortar bed—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.
- Waterproof membrane, when used—ANSI A118.10.
- Shower pan membrane, when used—ASTM D4551 or D4068.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard*

Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate, with steel trowel finish.
- Slope subfloor $\frac{1}{4}$ " per foot to drain.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $1/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

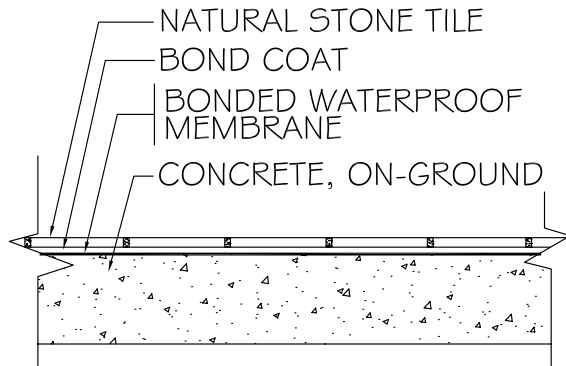
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane to be used on top of the mortar bed and/or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13 or manufacturer’s directions. Comply with applicable plumbing and building codes.
- Shower pan membrane—manufacturer’s directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For hydronic tubing on top of the slab when using a mortar bed, see RH117 Stone.
- See shower receptor details in stone methods B414, B421, and B422 for drain connections.
- For a waterproof application, but with a bonded mortar bed, see F112 Stone.
- Above-ground—not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F122-19 STONE

- On-Ground Concrete
- Waterproof Membrane
- Natural Stone Tile



Recommended Uses

- For slab-on-ground construction where no bending stresses occur, where thin-bed installation of tile is desired, and a waterproof floor is required.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used. Consult membrane manufacturer to verify.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 8 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See F122A Stone.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Minimum grout joint width— $\frac{1}{16}$ ”.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel finish free of curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Slope subfloor $\frac{1}{4}$ " per foot to drain.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

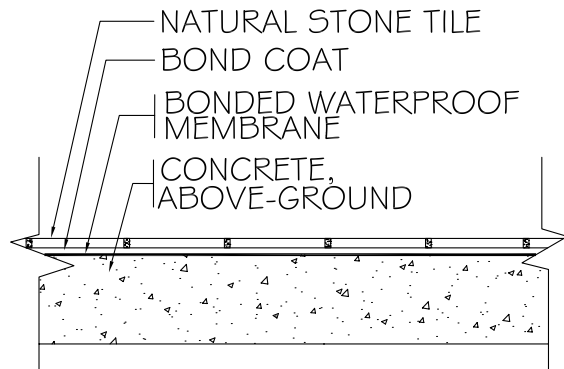
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13 or manufacturer's directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- See shower receptor details B421 Stone and B422 Stone for drain connections.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F122A-19 STONE

- Above-Ground Concrete
- Waterproof Membrane
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs where thin-bed installation of tile is desired and a waterproof floor is required.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used. Consult membrane manufacturer to verify.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 8 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Minimum grout joint width— $\frac{1}{16}$ ”.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and

suppliers for product sustainability and contribution to green building design.

- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $1/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel finish free of curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the tile substrate— $1/8$ " in 10' from the required plane when measured from the high points in the surface.
- Slope subfloor $1/4$ " per foot to drain.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13 or manufacturer’s directions. Comply with applicable plumbing and building codes.
- Movement Joints—EJ171 and ASTM C1193.

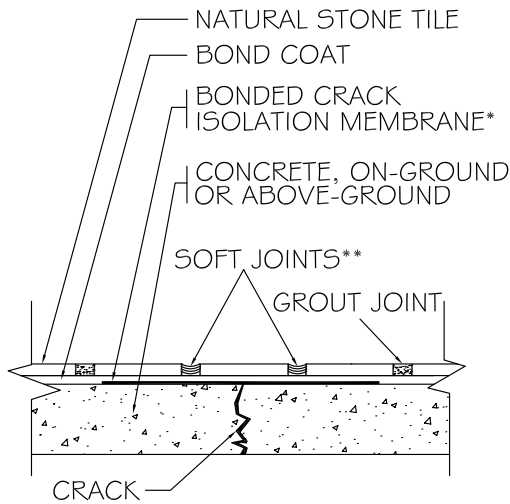
Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- See shower receptor details B421 and B422 for drain connections.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.

- When unsanded grout is used, grout joint width must be $1/16$ " to $1/8$ " wide (nominal).

**F125-Partial-19
STONE**

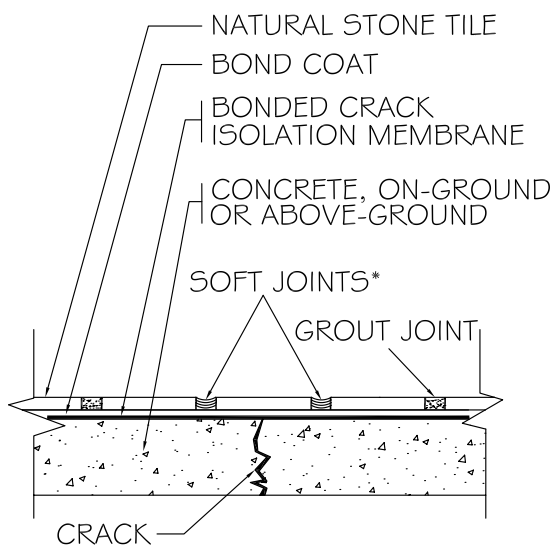
- On- or Above-Ground Concrete
- Crack Isolation Membrane (Partial Coverage)
- Natural Stone Tile



*CONSULT MANUFACTURER FOR MEMBRANE WIDTH
 **ONE OR TWO SOFT JOINTS MAY BE REQUIRED (CONSULT MANUFACTURER)

**F125-Full-19
STONE**

- On- or Above-Ground Concrete
- Crack Isolation Membrane (Full Coverage)
- Natural Stone Tile



*ONE OR TWO SOFT JOINTS MAY BE REQUIRED (CONSULT MANUFACTURER)

Recommended Uses

- For use in conjunction with other concrete substrate installation methods.
- For slab-on-ground construction and above-ground structural slabs where thin-bed installation of tile is desired and crack isolation is required to treat existing in-plane cracks (F125-partial).
- For slab-on-ground construction and above-ground structural slabs where thin-bed installation of tile is desired and protection against future in-plane cracking is desired, full-coverage is recommended and must be additionally specified (F125-full).

Service Rating

- Different crack isolation membranes will produce different service ratings when tested per ASTM C627. Consult membrane manufacturer to verify service rating.

Environmental Exposure Classifications

- Refer to appropriate installation method.

Typical Weight of Tile Installation

- 8 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.
- May not always be 100% effective in preventing reflective cracking.
- For lateral (in-plane) movement only.
- Standard performance membranes can accommodate $\geq 1/16$ " in-plane movement. Consult manufacturer for membrane performance rating.
- High performance membranes can accommodate $\geq 1/8$ " in-plane movement. Consult manufacturer for membrane performance rating.
- Not for cracking associated with deflection of above-ground installations.

Requirements

- For existing cracks, soft joints may be required adjacent to cracks per manufacturer’s instructions.
- Specifier to identify areas of coverage (partial or full). Unless full coverage is clearly specified, installing contractor’s responsibility is limited to partial coverage.

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- Minimum grout joint width— $\frac{1}{16}$ "
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options. Unless full coverage of crack isolation membrane is clearly specified, installing contractor's responsibility is limited to partial coverage.***
- Refer to appropriate installation method.
- Sealant—ASTM C920.
- Crack isolation membrane—ANSI A118.12.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Refer to appropriate installation method.
- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $1/360$. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the

high points in the surface.

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

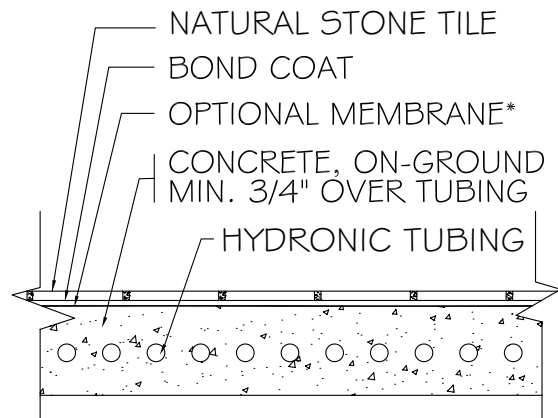
- Refer to appropriate installation method.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Stone tiles with reduced flexural strength, or natural planes of separation within the stone fabric may be vulnerable to breakage either due to elongation strain of the membrane or deflection over softer, compressible membrane materials. Consult membrane manufacturer and stone supplier for suitability. Testing per ANSI A118.12, modified by conducting the test using the actual stone tile can be performed to evaluate its performance under test as compared with the ceramic tile meeting ANSI A137.1 specified by the test.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

RH110-19 STONE

- On-Ground Concrete Encapsulating Hydronic Tubing
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur, thin-bed installation of tile is desired, and hydronic tubing is encapsulated within the slab.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Not for use on above-ground structural slabs and other floors subject to movement and/or deflection. See RH110A Stone.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 Stone for more information.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$ ”.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a crack isolation membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and

suppliers for product sustainability and contribution to green building design.

- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Radiant tubing by others.
- Portland cement concrete poured minimum $\frac{3}{4}$ " over top of hydronic tubing.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

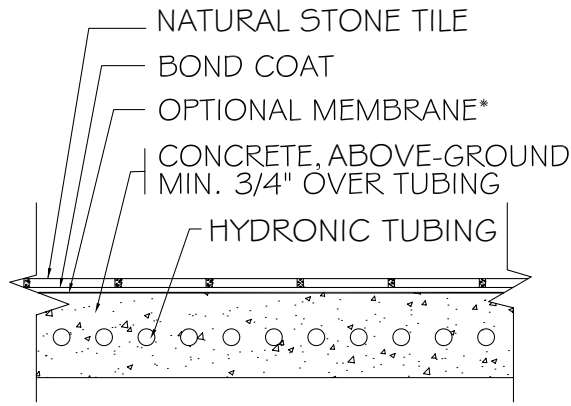
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For waterproof application, see F122 Stone.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

RH110A-19 STONE

- Above-Ground Concrete Encapsulating Hydronic Tubing
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where thin-bed installation of tile is desired and hydronic tubing is encapsulated within the slab.

Service Rating

- Moderate, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 7 pounds/square foot.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not recommended for use with some stones on post-tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturers.
- Requires additional consideration by design professional to accommodate movement and/or deflection.

Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-partial) or for protection against future in-plane cracking (F-125 full). See F125 Stone for more information.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Minimum grout joint width— $\frac{1}{16}$ ".
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a crack isolation membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.

- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. Must also be recommended by manufacturer for above-ground use. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have steel trowel and fine broom finish free of curing compounds. When used, mechanical scarifying is necessary.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Radiant tubing by others.
- Portland cement concrete poured minimum $\frac{3}{4}$ " over top of hydronic tubing.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—A108.17.
- Movement Joints—EJ171 and ASTM C1193.

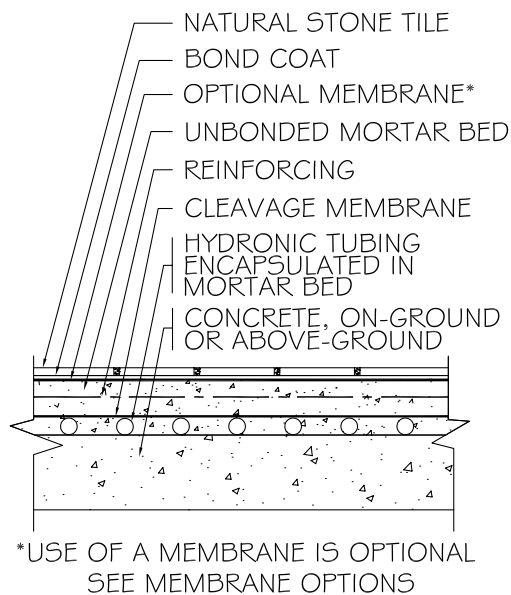
Notes

- F111 is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.

- Not all mortars, grouts, and membranes are suitable for above-ground installations. Check manufacturer recommendations.
- For waterproof application, see F122A Stone.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

RH117-19 STONE

- On-Ground or Above-Ground Concrete
- Unbonded Mortar Bed Encapsulating Hydronic Tubing
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs and for slab-on-ground construction where hydronic tubing will be placed over the slab.
- For areas where leveling, flattening, or contouring of finish floor height is required where hydronic tubing will be placed over the slab.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern, and where hydronic tubing will be placed over the slab.
- For concrete substrates that are cracked or present bonding issues and hydronic tubing will be placed over the slab.
- For areas where ungauged stone will be used.

Service Rating

- Heavy, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 32 pounds/square foot with 1¼" mortar bed over hydronic tubing. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Above-ground structural slabs and other floors subject to movement and/or deflection—requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion. Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayment, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Screed fill flush to top of radiant tubing before placing cleavage membrane and mortar bed.
- Minimum grout joint width—1/16".
- Above-ground—above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat (on-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Cementitious bond coat (above-ground)—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. For above-ground use, must also be recommended by manufacturer. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard*

Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Where slab is depressed to accommodate mortar bed thickness, slab depression to be accurate with steel trowel finish.
- Slope, when required, to be in subfloor.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

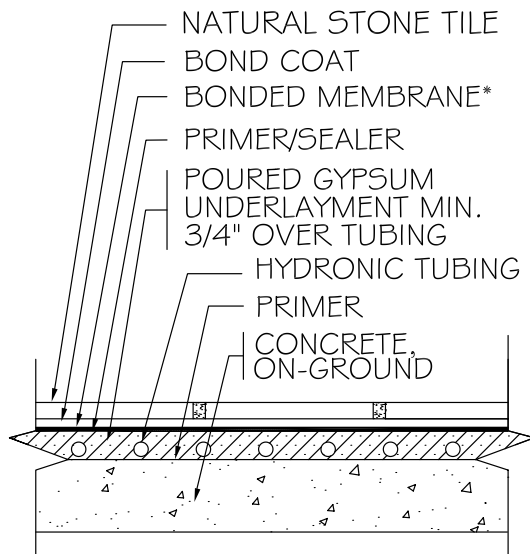
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For in-slab hydronic tubing, see F111 Stone.
- Above-ground—not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

RH111-19 STONE

- On-Ground Concrete
- Poured Gypsum Underlayment Encapsulating Hydronic Tubing
- Bonded Membrane
- Natural Stone Tile



*USE OF A MEMBRANE IS REQUIRED.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For slab-on-ground construction where no bending stresses occur and with a poured gypsum underlayment encapsulating hydronic tubing.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 21 pounds/square foot with 3/4" poured gypsum over hydronic tubing. Add 2 1/4 pounds/square foot for each additional 1/4" of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installation.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH111A Stone.
- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Proper curing/drying of gypsum underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Minimum grout joint width—1/16."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included*. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx or similar.

- Cementitious bond coat:
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is $\frac{3}{4}$ " above hydronic tubing.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Radiant tubing by others.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of

ASTM C627 for the anticipated service level designated by the specifier or intended use.

- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

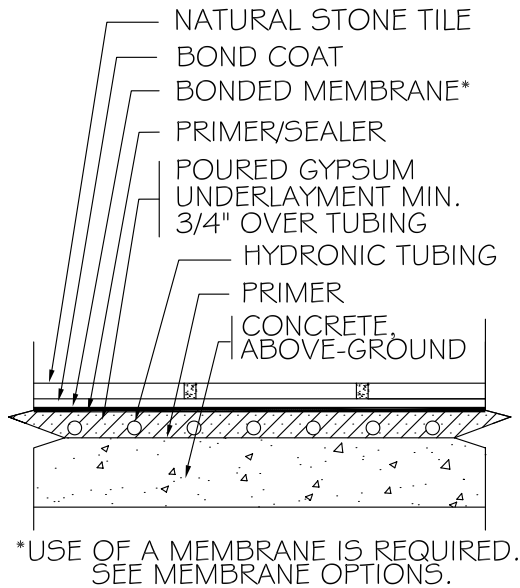
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**RH111A-19
STONE**

- Above-Ground Concrete
- Poured Gypsum Underlayment Encapsulating Hydronic Tubing
- Bonded Membrane
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs with a poured gypsum underlayment encapsulating hydronic tubing.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for limited water exposure areas (Res2; Com2). See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 21 pounds/square foot with 3/4" poured gypsum over hydronic tubing. Add 2 1/4 pounds/square foot for each additional 1/4" of poured gypsum.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting

materials with improved bond strength and deformability are required.

- Not for use where moisture vapor transmission rate exceeds gypsum underlayment manufacturer’s limitations.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- Requires use of crack isolation (A118.12) and/or waterproof (A118.10) and/or uncoupling membrane.
- Membrane must meet ANSI A118.10 for limited water exposure areas (Res2; Com2). Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Proper curing/drying of underlayment prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Minimum grout joint width—1/16."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.

- When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- When an uncoupling membrane is used, check with membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $l/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to be well cured, dimensionally stable, and free of unremediated structural cracks, waxy or oily films, and curing compounds.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Radiant tubing by others.

- Poured gypsum underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is $\frac{3}{4}$ " above hydronic tubing.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Poured gypsum underlayment—minimum compressive strength of 2000 psi when tested per ASTM C472 modified and meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.
- Poured gypsum underlayment—installed only by a manufacturer-approved applicator in accordance with manufacturer’s recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

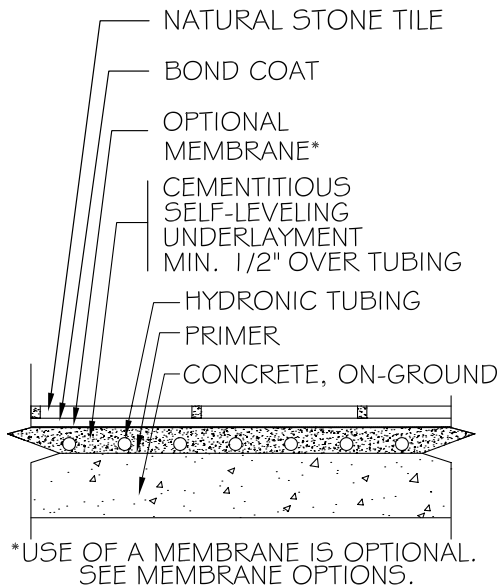
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the membrane. Follow manufacturer’s directions.
- RH117 Stone is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

RH112-19 STONE

- On-Ground Concrete
- Cementitious Self-Leveling Underlayment Encapsulating Hydronic Tubing
- Natural Stone Tile



Recommended Uses

- For slab-on-ground construction where no bending stresses occur and where hydronic tubing will be placed on the slab.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 21 pounds/square foot with 1/2" cementitious self-leveling underlayment over hydronic tubing. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installations.

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer's limitations.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH112A Stone.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-Partial Stone) or for protection against future in-plane cracking (F-125 Full Stone). See F125 Stone for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 1/2" above hydronic tubing.
- Surfaces must be prepared and primed according to manufacturer's instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.

- Minimum grout joint width— $\frac{1}{16}$ "

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile*

Installation Materials.

Preparation by Other Trades

- Slab to have fine broom finish with no curing compounds. When used, mechanical scarification is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

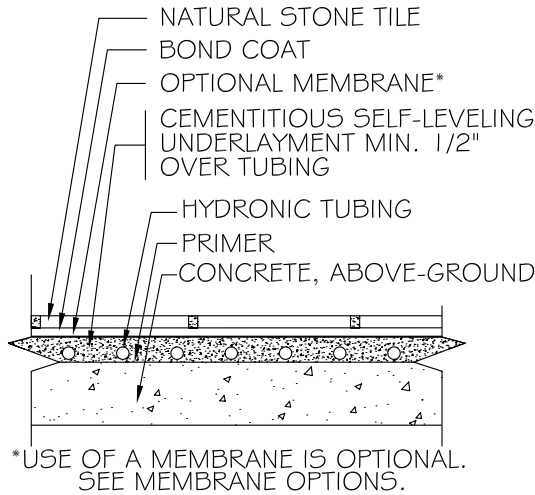
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**RH112A-19
STONE**

- Above-Ground Concrete
- Cementitious Self-Leveling Underlayment Encapsulating Hydronic Tubing
- Natural Stone Tile



Recommended Uses

- For above-ground structural slabs where hydronic tubing will be placed on the slab.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 21 pounds/square foot with 1/2" cementitious self-leveling underlayment over hydronic tubing. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting materials with improved bond strength and deformability are required.

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-Partial Stone) or for protection against future in-plane cracking (F-125 Full Stone). See F125 Stone for more information.
- An uncoupling membrane may be specified to accommodate subfloor movement. Check with membrane manufacturer for recommendations and requirements.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations when used with floor warming systems. Minimum thickness is 1/2" above hydronic tubing.
- Surfaces must be prepared and primed according to the manufacturer’s instructions.
- Proper curing/drying of underlayment prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Minimum grout joint width—1/16."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - When an uncoupling membrane is used, check with membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Uncoupling membrane, when used—recommended by uncoupling membrane manufacturer; must achieve 50 psi or greater shear bond strength in 7 days per the test method in ANSI A118.12 Section 5.1.3.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate deflection under live load not to exceed $1/360$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have fine broom finish with no curing compounds used. When used, mechanical scarification is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $1/4$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $1/8$ " in 10' from the required plane when measured from the high points in the surface.
- Radiant tubing by others.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

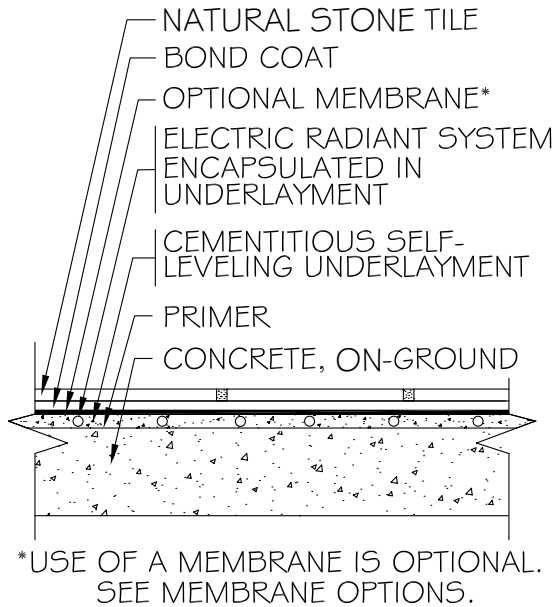
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Uncoupling membrane—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- RH117 Stone is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $1/16$ " to $1/8$ " wide (nominal).

**RH116-19
STONE**

- On-Ground Concrete
- Electric Radiant Heat System Encapsulated in Cementitious Self-Leveling Underlayment
- Natural Stone Tile



Recommended Uses

- For slab-on-ground construction where no bending stresses occur and where floor leveling and electric radiant in-floor heat are desired.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 13 pounds/square foot with ½" cementitious self-leveling underlayment. Add 2¾ pounds/square foot for each additional ¼" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Not for below-ground installations.
- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.
- Not for use over above-ground structural slabs and other floors subject to movement and/or deflection. See RH116A Stone.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-Partial Stone) or for protection against future in-plane cracking (F-125 Full Stone). See F125 Stone for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to manufacturer’s instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Electric radiant system should not be installed over building expansion joints.

- Minimum grout joint width— $\frac{1}{16}$ "

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.

- Maximum allowable variation in the installation substrate (concrete)— $\frac{1}{4}$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

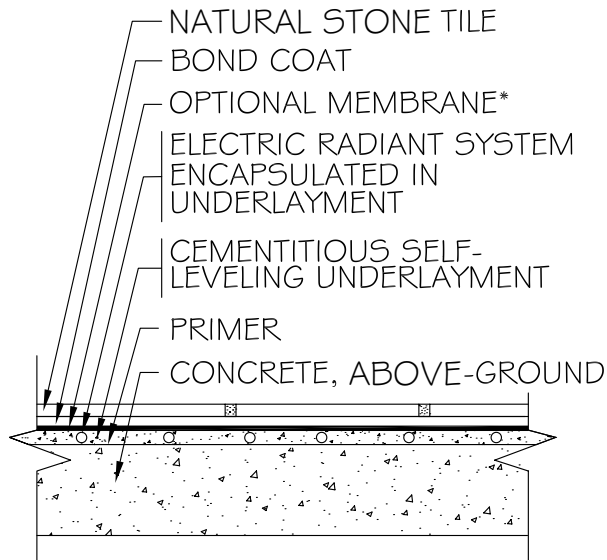
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer’s directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/dry time of installation before radiant heat system is activated.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer’s directions.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**RH116A-19
STONE**

- Above-Ground Concrete
- Electric Radiant Heat System Encapsulated in Cementitious Self-Leveling Underlayment
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For above-ground structural slabs where floor leveling and electric radiant in-floor heat are desired.

Service Rating

- Moderate when stone with adequate compressive strength, flexural strength and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1; Com1.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Typical Weight of Tile Installation

- 13 pounds/square foot with 1/2" cementitious self leveling underlayment. Add 2 3/4 pounds/square foot for each additional 1/4" of underlayment.
- Does not include weight of substrate. See “Appendix B” for assumptions, included materials, and their individual weights.

Limitations

- Requires additional consideration by design professional to accommodate movement and/or deflection. Setting

materials with improved bond strength and deformability are required.

- Not for use where moisture vapor transmission rate exceeds underlayment manufacturer’s limitations.
- Not recommended for use with some stones on post tensioned concrete unless tile installation is 100 square feet or less. Consult stone supplier and installation materials manufacturer.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be required for areas exposed to moisture. Consult underlayment manufacturer for requirements.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A crack isolation membrane may be specified to treat existing in-plane cracks (F125-Partial Stone) or for protection against future in-plane cracking (F-125 Full Stone). See F125 Stone for more information.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Consult the manufacturer for maximum moisture vapor transmission limitations prior to application of underlayment.
- Slab to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Cementitious self-leveling underlayment thickness and application varies, consult the manufacturer for specific recommendations.
- Surfaces must be prepared and primed according to the underlayment manufacturer’s instructions.
- Proper curing/drying of underlayments prior to application of tile is critical for proper performance. Consult the underlayment manufacturer for specific instructions.
- Electric radiant system should not be installed over building expansion joints.
- Above-ground installations are inherently more susceptible to vibration and deflection. Grout and mortar manufacturers to warrant product suitability.
- Minimum grout joint width—1/16."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—See “Natural Stone Tile Selection and Installation Guide” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semi-soft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - Must be recommended by manufacturer for above-ground use.
 - When a membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.
- Self-leveling underlayment—meeting performance requirements of ASTM C627 for the anticipated service level designated by the specifier or intended use.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes. Maximum allowable substrate

deflection under live load not to exceed $1/360$. See also “Substrate Requirements.”

- When concentrated loads (scissor lifts, pallet jacks, automobiles, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Slab to have a fine broom finish with no curing compounds used. When used, mechanical scarifying is necessary.
- Maximum allowable variation in the installation substrate (concrete)— $1/4$ " in 10' from the required plane.
- Maximum allowable variation in the tile substrate— $1/8$ " in 10' from the required plane when measured from the high points in the surface.
- Electrician or qualified contractor to wire electric radiant system to power source.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171. For above-ground installations, additional movement joints are required.

Installation Specifications

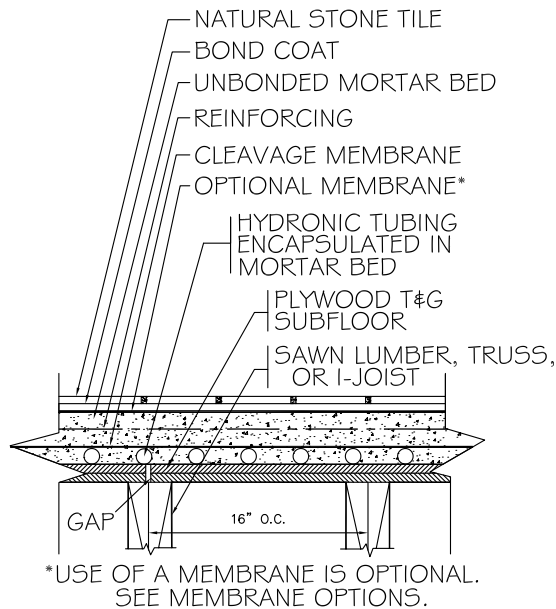
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Cementitious self-leveling underlayment—manufacturer's directions.
- Crack isolation membrane—ANSI A108.17.
- Waterproof membrane—ANSI A108.13.
- Electric radiant system—UL (US) 1693; UL (CAN/CSA) C22.2 #217; NEC Article 424.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Consult underlayment manufacturer for minimum cure/ dry time of installation before radiant heat system is activated.
- RH117 Stone is preferred over above-ground structural slabs and other floors subject to movement and/or deflection.
- Some manufacturers require special primers prior to the application of the setting materials or membrane. Follow manufacturer's directions.
- Not all mortars, grouts, and membranes are suitable for above-ground use. Check manufacturer recommendations.
- When unsanded grout is used, grout joint width must be $1/16$ " to $1/8$ " wide (nominal).

**RH141-19
STONE**

- Joists max. 16" o.c./ Plywood Subfloor
- Unbonded Mortar Bed Encapsulating Hydronic Tubing
- Natural Stone Tile



Recommended Uses

- For floor leveling or flattening, especially where multiple finish floor heights must be accommodated or slopes are required and where hydronic tubing will be placed.
- For installations that must be at least 1½" thick (nominal, including tile) and where hydronic tubing will be placed.
- For isolating the tile installation from the floor framing where hydronic tubing will be placed.
- For areas where ungauged stone will be used.

Service Rating

- Light commercial, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 32 pounds/square foot with 1¼" mortar bed over hydronic tubing. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A crack isolation membrane (A118.12) may be required. Check with heat system and setting material manufacturers.
- Crack isolation membrane may also provide waterproofing. Consult membrane manufacturer.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Screed fill flush to top of hydronic tubing before placing a cleavage membrane and reinforced mortar bed.
- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Minimum grout joint width—1/16"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a membrane is not used on top of the mortar bed—ANSI A118.15 or better or ISO C2S1 or better.
 - When a crack isolation membrane is used on top of the mortar bed—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used on top of the mortar bed—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.
- Crack isolation membrane, when used—ANSI A118.12.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes and maximum allowable floor member live load and concentrated load deflection shall not exceed $l/720$. See also “Substrate Requirements.”
- When concentrated loads (scissor lifts, pallet jacks, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.

- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{1}{32}$ " tongue and groove plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.
- Depressing subfloor between joists on ledger strips permissible in residential use.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

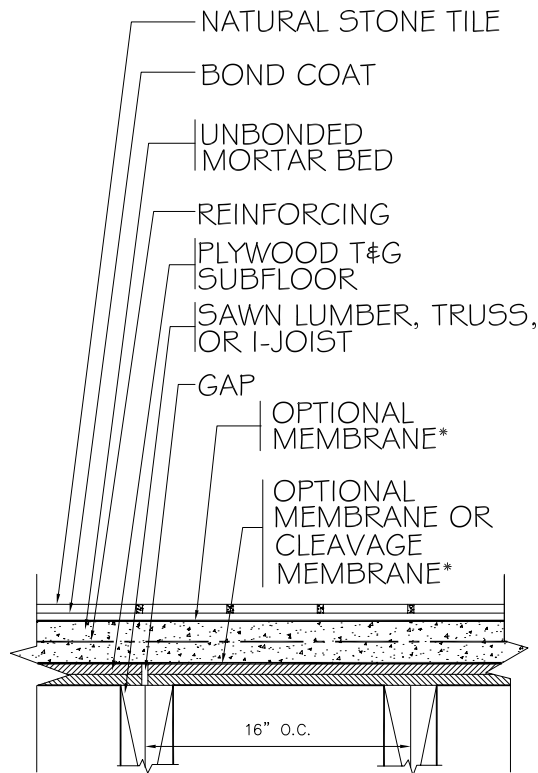
- Tile—ANSI A108.1A,.1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Crack isolation membrane—A108.17.
- Waterproof membrane—A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**F141-19
STONE**

- Joists max. 16" o.c./ Plywood Subfloor
- Unbonded Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where leveling, flattening, or contouring of finish floor height is required, such as when finishing to adjacent floors or where slopes are required.
- For areas where floor flatness is critical, such as when tiles with any edge longer than 15" are specified or where accessibility is a concern.
- For areas where ungauged stone will be used.

Service Rating

- Light commercial, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- May be suitable for exterior applications in areas not subject to freeze/thaw cycling when appropriate precautions are taken, including expansion joint placement, proper slope, waterproofing, and material selection.

- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 23 pounds/square foot with 1¼" mortar bed. Add 3 pounds/square foot for each additional ¼" of mortar bed.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent walls and building materials. Base flashing should be used for maximum effectiveness.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- A cleavage membrane is required.
- If a bonded waterproof membrane (ANSI A118.10) is used, it may be placed above or below the mortar bed. If a shower pan membrane (ASTM D4551 or D4068) is used, it must be placed below the mortar bed.
- The waterproof membrane can also function as the cleavage membrane if loose laid (not bonded to plywood) below the mortar bed. Check with membrane manufacturer if membrane may be loose laid.
- If waterproof membrane is bonded to the top of the mortar bed, a cleavage membrane must be placed below the mortar bed.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.

Requirements

- Reinforcing mesh mandatory.
- Mortar bed thickness—1¼" minimum to 2" maximum.
- Mortar beds in excess of 2" thick shall be detailed by the architect.
- Minimum grout joint width—¼"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout**

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, reinforcing, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and subfloor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes and maximum allowable floor member live load and concentrated load deflection shall not exceed $l/720$. See also “Substrate Requirements.”
- Face grain of plywood shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " tongue and groove exterior glue plywood with $\frac{1}{8}$ " gap between sheets or 1" nominal boards.

- Depressing subfloor between joists on ledger strips permissible in residential use.
- Maximum allowable variation in the installation substrate (plywood)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

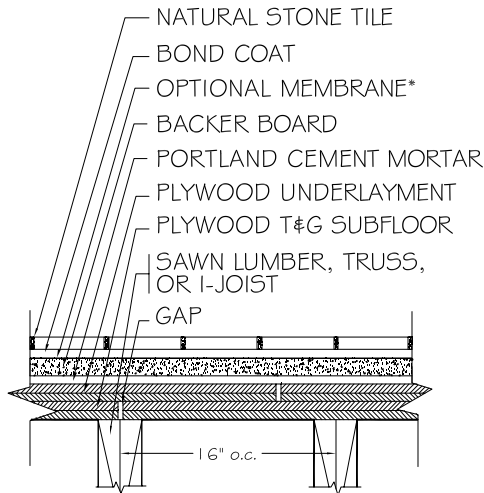
- Tile—ANSI A108.1A,.1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For hydronic heat application, see RH141 Stone.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

F250-19 STONE

- Joists max. 16" o.c./Plywood Subfloor
- Plywood Underlayment
- Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For wood substrates where thin-bed installation is desired.

Service Rating

- Residential with minimum $1\frac{5}{32}$ "-thick plywood underlayment, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.
- Light commercial with minimum $1\frac{9}{32}$ "-thick plywood underlayment, when stone with adequate compressive strength, flexural strength, and resistance to abrasion is used.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- May be suitable for increased water exposure. See Membrane Options.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Typical Weight of Tile Installation

- 10 pounds/square foot with $\frac{1}{4}$ " or $\frac{1}{2}$ " cementitious coated extruded foam backer board over $1\frac{5}{32}$ " or $1\frac{9}{32}$ " plywood underlayment.
- 11 pounds/square foot with $\frac{1}{4}$ " or $\frac{1}{2}$ " coated glass mat water-resistant gypsum backer board over $1\frac{5}{32}$ " plywood underlayment; or with $\frac{1}{4}$ " board over $1\frac{9}{32}$ " plywood underlayment.
- 11 pounds/square foot with $\frac{1}{4}$ " cement backer board over $1\frac{5}{32}$ " plywood underlayment.

- 11 pounds/square foot with $\frac{1}{4}$ " or $\frac{3}{8}$ " fiber-reinforced water-resistant gypsum backer board over $1\frac{5}{32}$ " plywood underlayment; or with $\frac{1}{4}$ " board over $1\frac{9}{32}$ " plywood underlayment.
- 11 pounds/square foot with $\frac{1}{4}$ " fiber-cement backer board over $1\frac{5}{32}$ " plywood underlayment.
- 12 pounds/square foot with $\frac{1}{4}$ " or $\frac{7}{16}$ " fiber-cement backer board over $1\frac{9}{32}$ " plywood underlayment; or with $\frac{7}{16}$ " board over $1\frac{5}{32}$ " plywood underlayment.
- 12 pounds/square foot with $\frac{1}{4}$ " cement backer board over $1\frac{9}{32}$ " plywood underlayment.
- 12 pounds/square foot with $\frac{1}{2}$ " coated glass mat water-resistant gypsum backer board over $1\frac{9}{32}$ " plywood underlayment.
- 12 pounds/square foot with $\frac{3}{8}$ " fiber-reinforced, water-resistant gypsum backer board over $1\frac{9}{32}$ " plywood underlayment; or with $\frac{1}{2}$ " board over $1\frac{5}{32}$ " plywood underlayment.
- 13 pounds/square foot with $\frac{1}{2}$ " cement backer board over $1\frac{5}{32}$ " plywood underlayment.
- 13 pounds/square foot with $\frac{1}{2}$ " fiber-reinforced, water-resistant gypsum backer board over $1\frac{9}{32}$ " plywood underlayment.
- 14 pounds/square foot with $\frac{1}{2}$ " cement backer board over $1\frac{9}{32}$ " plywood underlayment.
- Does not include weight of substrate. See "Appendix B" for assumptions, included materials, and their individual weights.

Limitations

- Maximum joist spacing 16" on center.
- 8" x 8" or larger tile required when cementitious coated extruded foam backer board used.

Membrane Options

- Membrane options are available according to type of backer board used. See ceramic tile methods F144, F146, F170, and F175 for options.
- Specifier shall indicate if complete waterproofing is required, including if/how membrane connects to drain assembly, if base flashing is required, and treatment at other termination points.
- Check with membrane manufacturers for suitability for applicable conditions, as not all membranes are suitable for steam, high temperature, and/or chemical exposure, exterior use, use over above-ground structural slabs, use over pourable underlayments, use with radiant heat, or use over concrete with excessive moisture vapor transmission and/or alkalinity. Membrane may also affect service rating.
- When coated glass mat water-resistant gypsum backer board is used—some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- See ceramic tile methods F144, F146, F170, or F175 for requirements based on backer board type.
- Minimum grout joint width— $\frac{1}{16}$ ".

Preparation by Backer Board Installers

- Use a sufficient amount of portland cement mortar under the backer board to establish a supporting plane and eliminate voids.
- Installation of backer board varies according to type of backer board used. See ceramic tile methods F144, F146, F170, and F175.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Stagger backer board end and edge joints so as not to coincide with joints in subfloor. Stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Backer board—cement backer board meeting ANSI A118.9 or ASTM C1325, fiber-cement backer board meeting ASTM C1288, coated glass mat water-resistant gypsum backer board meeting ASTM C1178, fiber-reinforced water-resistant gypsum backer board meeting ASTM C1278 Section 6, or cementitious-coated extruded foam backer board meeting ASTM C578.
- Mortar under backer board—ANSI A118.1 or better or ISO C1 or better.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Floor systems, including the framing system and sub-floor panels, over which tile will be installed shall be in conformance with the IRC for residential applications, the IBC for commercial applications, or applicable building codes and maximum allowable floor member live load and concentrated load deflection shall not exceed $1/720$. See also "Substrate Requirements."
- When concentrated loads (scissor lifts, pallet jacks, forklifts, etc.) will be used on an above-ground tiled floor, the engineer and/or specifier shall specify a substrate to accommodate the concentrated loads. Owner/specifier is responsible for protecting the tilework from damage, including allowing sufficient time for installed materials to cure properly.
- Face grain of plywood subfloor and underlayment shall run perpendicular to joists.
- Subfloor—minimum $1\frac{9}{32}$ " exterior-glue tongue and groove plywood with $\frac{1}{8}$ " gap between sheets.
- Underlayment—minimum $1\frac{5}{32}$ " exterior glue plywood with $\frac{1}{4}$ " gap between sheets. See also Service Rating.
- Maximum allowable variation in the plywood underlayment— $\frac{1}{8}$ " in 10' from the required plane, when measured from the high points in the surface. Adjacent edges of plywood sheets not to exceed $\frac{1}{32}$ " difference in height.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

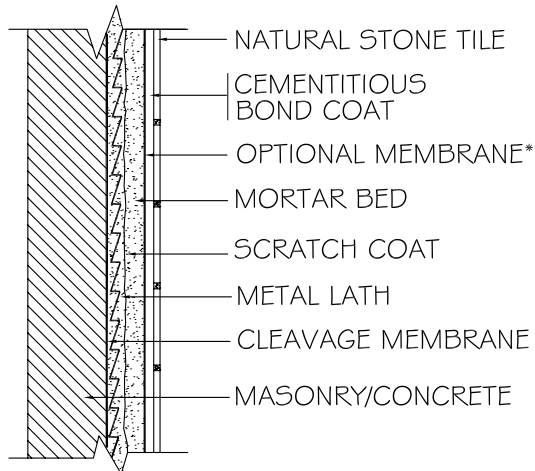
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Backer board—ANSI A108.11 or manufacturer's directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Underlayment fasteners should not penetrate joists below.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W201-19 STONE

- Masonry or Concrete
- Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior walls of masonry or concrete where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.
- For isolating the tile installation from the substrate.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for

applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Cut lath at all movement joints.
- Mortar bed thickness— $\frac{3}{4}$ " minimum to 1 $\frac{1}{2}$ " maximum.
- Minimum grout joint width— $\frac{1}{16}$ ".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete/masonry)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

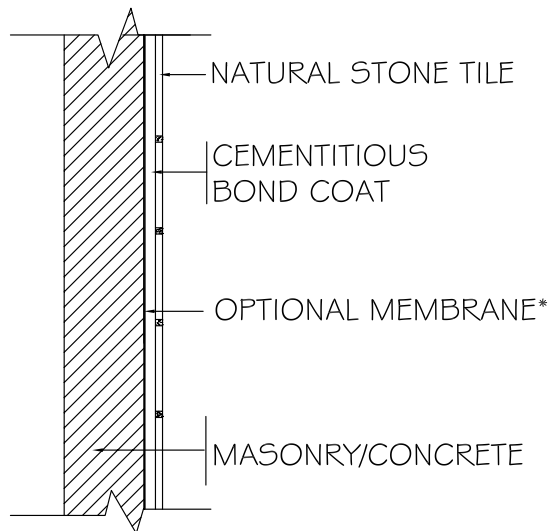
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see “Additional Products Used in Tile Installations.”
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- For interior mortar bed applications, see stone methods W211, W221, W222, W231/W241, B411, and B414.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W202E-19 STONE

- Masonry or Concrete
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For clean, sound exterior walls of masonry or concrete where thin-bed installation of tile is desired.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.
- Not for cracked or coated surfaces.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.
- Minimum grout joint width— $\frac{1}{16}$ ”

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ ” in 10’ from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints mandatory—according to EJ171.

Installation Specifications

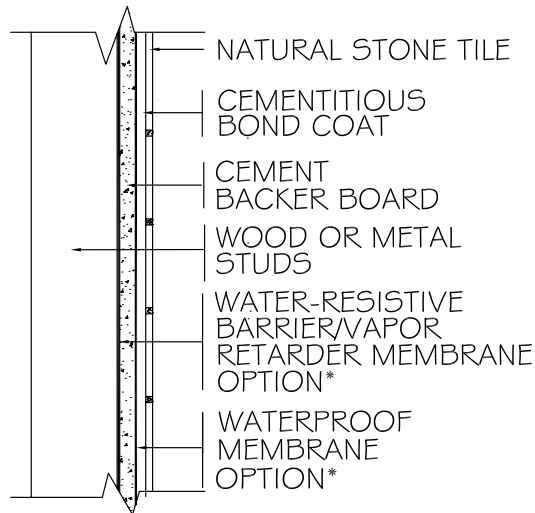
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see “Additional Products Used in Tile Installations.”
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- For interior thin-bed applications over masonry or concrete, see W202I Stone.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W244E-19 STONE

- Wood or Metal Studs
- Cement Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS REQUIRED.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For exterior walls over wood or metal studs.

Environmental Exposure Classifications

- Res6; Com6.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Where installation will be subjected to freeze/thaw cycles, degradation can occur over time.
- Maximum stud spacing 16" on center.

Membrane Options

- Check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.
- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- If waterproof membrane is applied over cement board, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Water-resistive barrier or waterproof membrane required, per building code. See Membrane Options.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 4" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 4" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used on face of cement backer board—ANSI A118.15 or better or ISO C2S1 or better.
 - When a waterproof membrane is used on face of cement backer board—ANSI A118.4 or better or ISO C2S1 or better, unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type A).
- Fasteners—noncorrosive and nonoxidizing.
- Hot-dipped fasteners meeting ASTM F2329-05 required in wet areas.
- 4" alkali-resistant glass fiber mesh tape.
- Water-resistive barrier/vapor retarder membrane, when used—per building code.
- Waterproof membrane, when used—ANSI A118.10.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

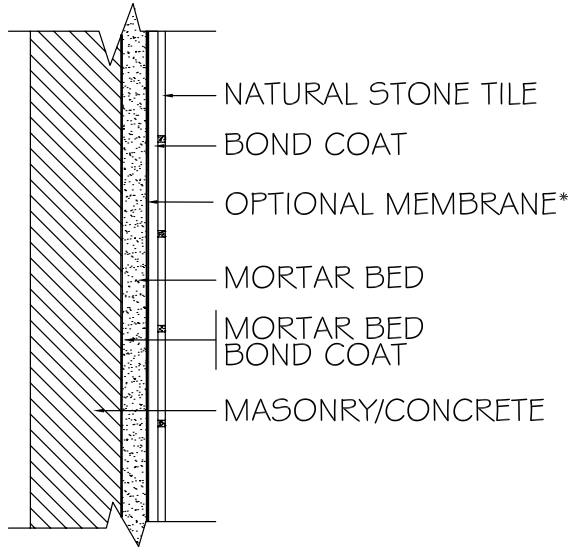
- Cement backer board—manufacturer’s directions.
- Tile—ANSI A108.5.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For prefabricated exterior panels, see “Additional Products Used in Tile Installations.”
- Not all bonding mortars are suitable for exterior use.
- Protection of installation may be required to prevent premature exposure of setting materials to moisture.
- For interior applications, see stone methods W244C, B412, and B415.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**W211-19
STONE**

- **Masonry or Concrete**
- **Bonded Mortar Bed**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For clean, sound interior walls of masonry or concrete where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Not for cracked or coated surfaces.
- Exterior—where installation will be subjected to freeze/thaw cycles, degradation can occur over time.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum. Scratch coat required if mortar bed will exceed $\frac{3}{4}$ ".
- Minimum grout joint width— $\frac{1}{16}$ ".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed—ANSI A108.1A.
- Mortar bed bond coat—portland cement slurry.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (concrete/masonry)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

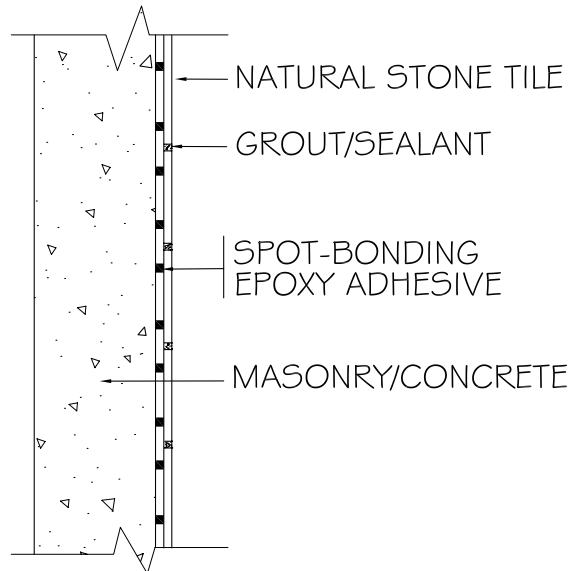
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W215-19 STONE

- Masonry or Concrete
- Spot-Bonding Epoxy
- Natural Stone Tile



Recommended Uses

- For clean, sound interior walls of masonry or concrete where large format tiles are specified.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Will not withstand impact.
- Not for cracked or coated surfaces.

Requirements

- Epoxy must be recommended by the manufacturer for spot-bonding.
- Follow epoxy manufacturer’s coverage requirements.
- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.
- Concrete may require bush-hammering or sandblasting to facilitate bonding.
- Minimum grout joint width— $\frac{1}{16}$ ”

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout**

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Sealant, when used as grout—ASTM C920.
- Spot bonding epoxy adhesive—epoxy recommended by manufacturer for spot bonding.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate— $\frac{1}{4}$ ” in 10’ from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

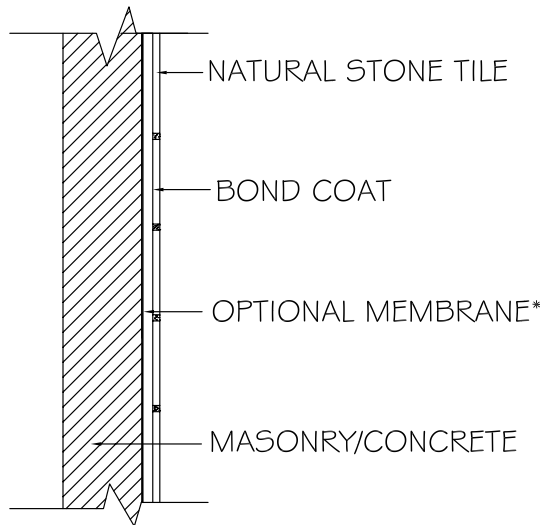
- Tile—epoxy manufacturer’s directions.
- Cementitious grout—ANSI A108.10.
- Sealant—follow sealant and epoxy manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ ” to $\frac{1}{8}$ ” wide (nominal).

**W2021-19
STONE**

- **Masonry or Concrete**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of masonry or concrete where thin-bed installation of tile is desired.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For Res6 and Com6, see W202E Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for cracked or coated surfaces.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Masonry or concrete to be well cured, dimensionally stable, and free of cracks, waxy or oily films, and curing compounds.

- Concrete may require bush-hammering or sandblasting to facilitate bonding.
- Minimum grout joint width— $\frac{1}{16}$."

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints mandatory—according to EJ171.

Installation Specifications

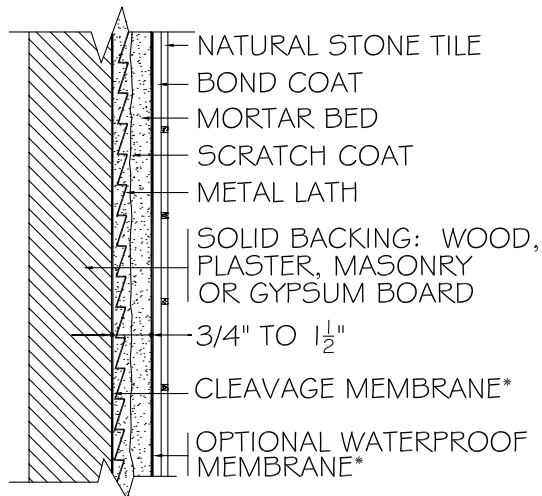
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- For exterior application, see W202E Stone.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W221-19 STONE

- Solid Backing
- Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of masonry, plaster, or other solid backing where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- With masonry backing—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With gypsum board or plaster backing—Res1, 2; Com1, 2.
- With wood backing—Res1; Com1.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- When backing is gypsum board, not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified

to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.

- If a waterproof membrane (A118.10) is not specified and backing material is moisture sensitive, cleavage membrane must be used behind mortar bed in wet areas.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½".
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Solid backing must provide firm anchorage for metal lath.
- Mortar bed thickness—¾" minimum to 1½" maximum.
- Cut lath at all movement joints.
- Minimum grout joint width—⅛".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.

- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (solid backing)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

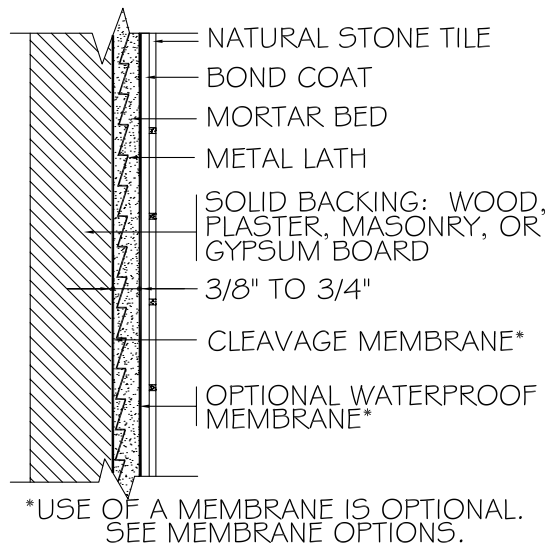
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- If lath cannot be attached directly to backing, use furring strips. See W231/W241 Stone.
- For thinner mortar bed, see W222 Stone.
- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W222-19 STONE

- Solid Backing
- Mortar Bed (One Coat Method)
- Natural Stone Tile



Recommended Uses

- For interior walls of masonry, plaster, or other solid backing where flattening or trueing of substrate is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For substrates that are cracked, coated, or present bonding issues.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- With masonry backing—Res1, 2, 5; Com1, 2, 5.
- With gypsum board or plaster backing—Res1, 2; Com1, 2.
- With wood backing—Res1; Com1.
- For Res3 and Com3, see B440 Stone and B441 Stone.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- When backing is gypsum board, not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- If a waterproof membrane (A118.10) is not specified and backing material is moisture sensitive, cleavage membrane must be used behind mortar bed in wet areas.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Solid backing must provide firm anchorage for metal lath.
- Mortar bed thickness—⅜" minimum to ¾" maximum.
- Cut lath at all movement joints.
- Minimum grout joint width—⅛"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate (solid backing)— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

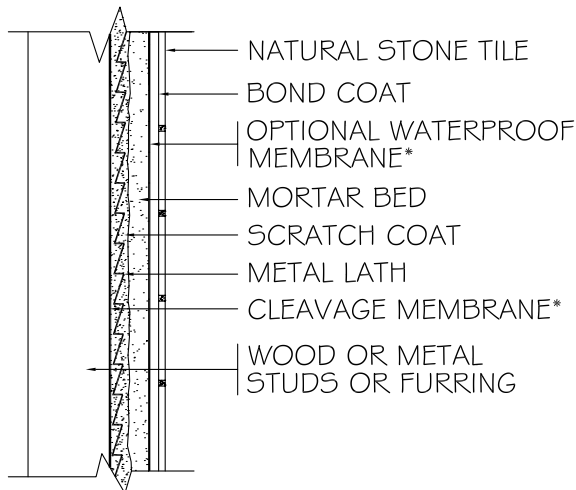
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- If lath cannot be attached directly to backing, use furring strips. See W231/W241 Stone.
- For thicker mortar bed, see W221 Stone.
- For mortar bed directly over wood or metal studs, see W231/W241 Stone.
- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W231/W241-19 STONE

- Wood or Metal Studs
- Mortar Bed
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls of wood or metal framing where flattening or trueing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- Res 1, 2, 5; Com1, 2, 5.
- For Res3 and Com3, see B411 Stone and B414 Stone.
- May be suitable for exterior applications when appropriate precautions are taken, including flashing, expansion joint placement, waterproofing, and material selection. See Notes.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.

- If a waterproof membrane is applied over the mortar bed, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Exterior—check building code—water-resistive barrier, waterproof membrane, or vapor retarder membrane may be required.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1½" maximum.
- Minimum grout joint width—¼"

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Water-resistive barrier/vapor retarder membrane, when used—ANSI A108.02-3.8.

- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

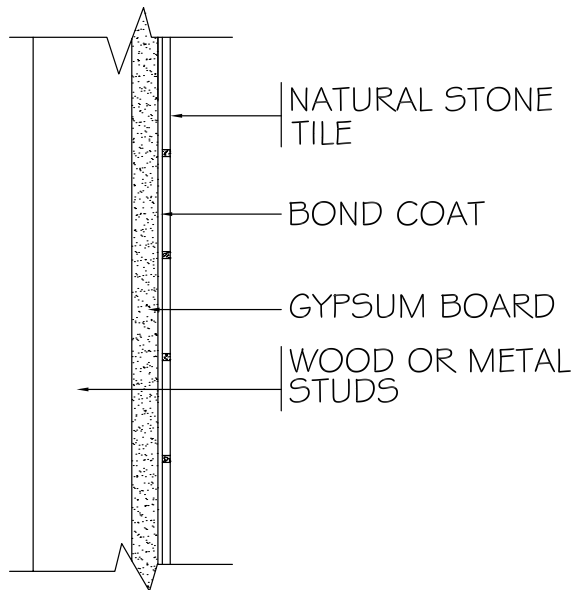
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar/grout—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Exterior—not all bonding mortars are suitable for exterior use.
- Exterior—protection of installation may be required to prevent premature exposure of setting materials to moisture.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W243-19 STONE

- Wood or Metal Studs
- Gypsum Board
- Natural Stone Tile



Recommended Uses

- For interior walls in dry areas where gypsum board is the tile backer.
- For fire-resistant, sound-insulated, ceramic tiled walls. See RW800 for fire and sound ratings. (Fire-resistance and sound-insulation ratings calculated on partitions before tiling.)

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for areas exposed to temperatures exceeding 125°F.
- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Minimum grout joint width—¼"

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated,*

optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Gypsum board—ASTM C1396/C1396M. Minimum ½" thick for single layer applications.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gypsum board, single or double layer, to be installed per GA-216.
- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

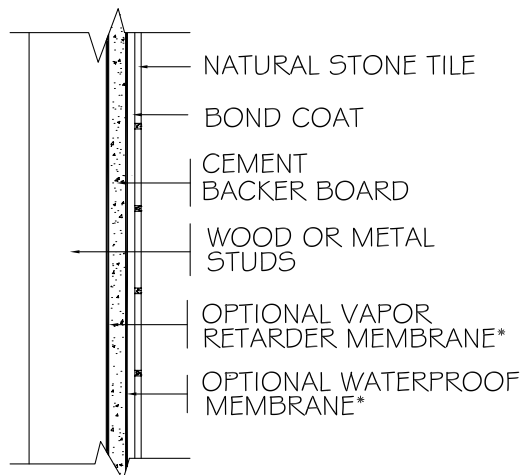
- Gypsum board—GA-216.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W244C-19 STONE

- Wood or Metal Studs
- Cement Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2, 5; Com1, 2, 5.
- For Res3 and Com3, see B412 Stone and B415 Stone.
- For Res6 and Com6, see W244E Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Vapor retarder membrane, when used—ANSI A108.02-3.8.

- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type B).
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

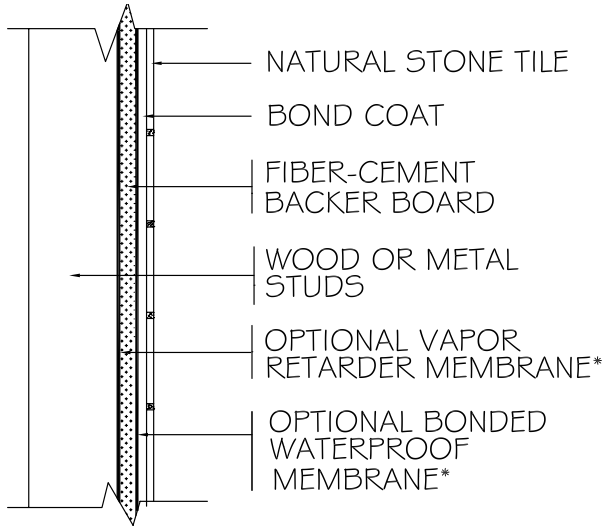
- Cement backer board—ANSI A108.11.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**W244F-19
STONE**

- Wood or Metal Studs
- Fiber-Cement Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2, 5; Com1, 2, 5.
- For Res3 and Com3, see B412 Stone and B415 Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Vapor retarder membrane, when used—ANSI A108.02-3.8.

- Waterproof membrane, when used—ANSI A118.10.
- Fiber cement backer board—ASTM C1288.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

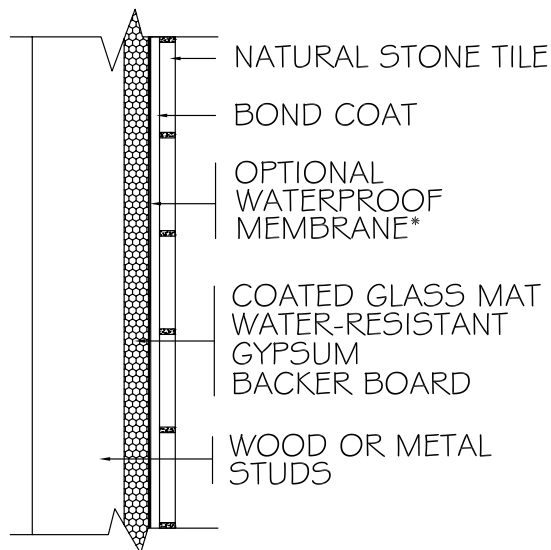
- Fiber cement backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W245-19 STONE

- Wood or Metal Studs
- Coated Glass Mat Water-Resistant Gypsum Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3 and Com3, see B419 Stone and B420 Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect adjacent building materials. Follow backer board and membrane manufacturer’s waterproofing requirements. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.

- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

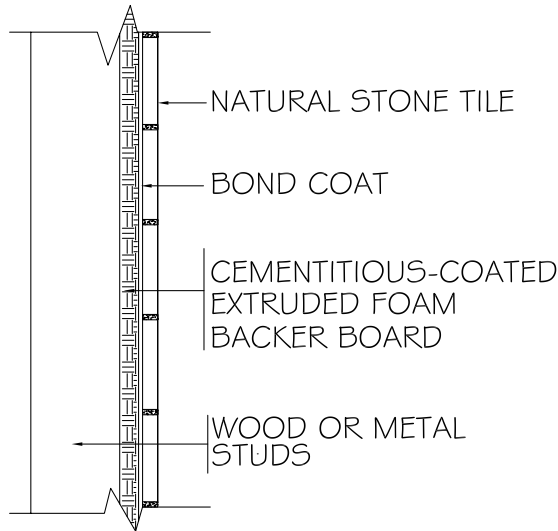
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**W246-19
STONE**

- Wood or Metal Studs
- Cementitious-Coated Extruded Foam Backer Board
- Natural Stone Tile



Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3 and Com3, see B425 Stone and B426 Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer’s recommended fasteners.
- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in

panel joints as panels are being installed, and over fastener heads, per backer board manufacturer’s instructions.

- Joints may be taped with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material in dry areas.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

• **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Cementitious-coated extruded foam backer board—ASTM C578.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape, when used.
- Flexible sealant—must be recommended by backer board manufacturer.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

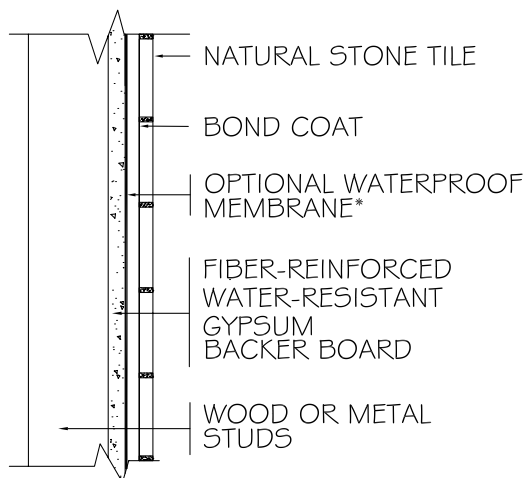
- Cementitious-coated extruded foam backer board—manufacturer's directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

W247-19 STONE

- Wood or Metal Studs
- Fiber-Reinforced Water-Resistant Gypsum Backer Board
- Natural Stone Tile



*USE OF A MEMBRANE IS OPTIONAL.
SEE MEMBRANE OPTIONS.

Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1, 2; Com1, 2.
- For Res3, see B430 Stone and B431 Stone.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including base flashing and treatment at other termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.

- Caulk or seal penetrations and abutments to dissimilar materials.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.

- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Metal studs—ASTM C645.
- Flexible sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0–4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

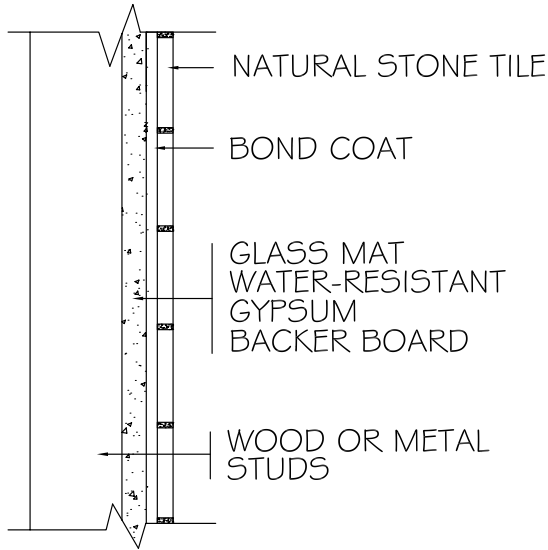
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**W248-19
STONE**

- Wood or Metal Studs
- Glass Mat Water-Resistant Gypsum Backer Board
- Natural Stone Tile



Recommended Uses

- For interior walls over wood or metal studs.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.

- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and skim coat with cementitious bonding material.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Glass mat, water-resistant gypsum backer board—ASTM C1658.
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

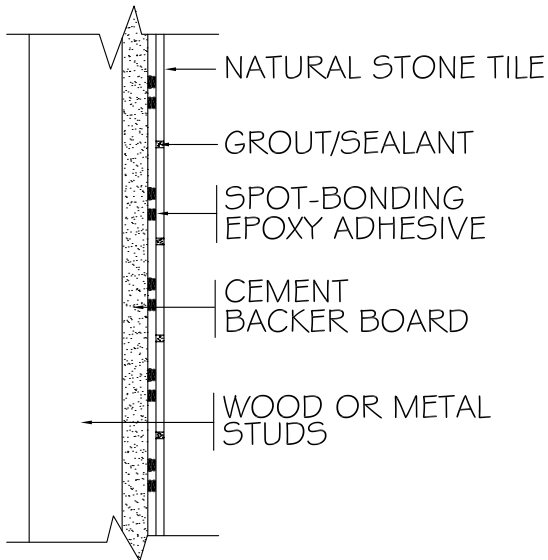
- Glass mat water-resistant gypsum backer board—manufacturer's directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**W260-19
STONE**

- Wood or Metal Studs
- Cement Backer Board
- Spot-Bonding Epoxy
- Natural Stone Tile



Recommended Uses

- For interior walls where cement backer board is the tile backer and large format tiles are specified.

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Will not withstand impact.
- Maximum stud spacing 16" on center.

Requirements

- Epoxy must be recommended by the manufacturer for spot-bonding.
- Follow epoxy manufacturer’s coverage requirements.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—¼" in 10' from the required plane.

- Horizontal joints—¼" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Sealant, when used as grout—ASTM C920.
- Spot bonding epoxy adhesive—epoxy recommended by manufacturer for spot bonding.
- Cement backer board—ANSI A118.9 or ASTM C1325 (Type B).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Cementitious mortar (for taping joints)—ANSI A118.4 or better or ISO C2 or better.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

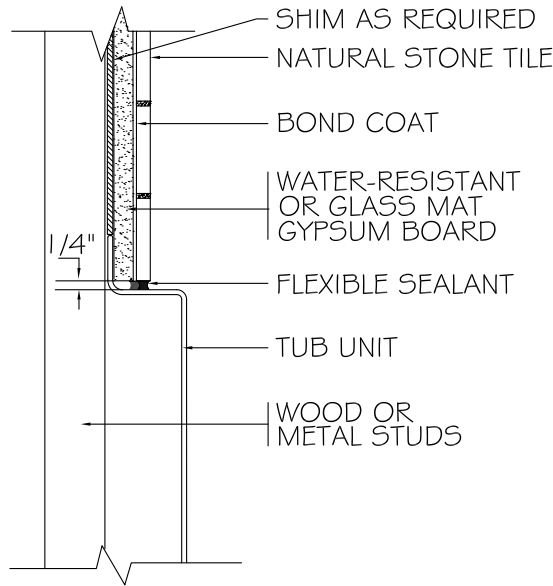
- Cement backer board—ANSI A108.11.
- Tile—epoxy manufacturer's directions.
- Cementitious grout—ANSI A108.10.
- Sealant—sealant and epoxy manufacturer's instructions for using sealant as grout.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**B413-19
STONE**

- **Bathtub Walls (No Showerhead)**
- **Gypsum Board or Glass Mat Gypsum Board**
- **Natural Stone Tile**



Recommended Uses

- For tub enclosures without a shower head where gypsum board or glass mat water-resistant gypsum backer board is the tile backer.
- For fire-resistant, sound-insulated, ceramic tiled walls. See RW800 for fire and sound ratings. (Fire-resistance and sound-insulation ratings calculated on partitions before tiling.)

Environmental Exposure Classifications

- Res1; Com1.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Not for areas exposed to temperatures exceeding 125°F.
- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅞" for commercial applications.
- Minimum grout joint width—¼"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly**

specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Gypsum board, when used—ASTM C1396/C1396M. Minimum ½" thick for single layer applications.
- Glass mat water-resistant gypsum backer board, when used—ASTM C1658.
- Metal studs—ASTM C645.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.
- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- All openings cut in backing board for plumbing and all cut joints between adjoining pieces—seal with adhesive or other materials recommended by manufacturer of backing board.
- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Apply water-resistant gypsum backing board horizontally with the factory paperbound edge spaced a minimum of ¼" above the lip of the tub.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

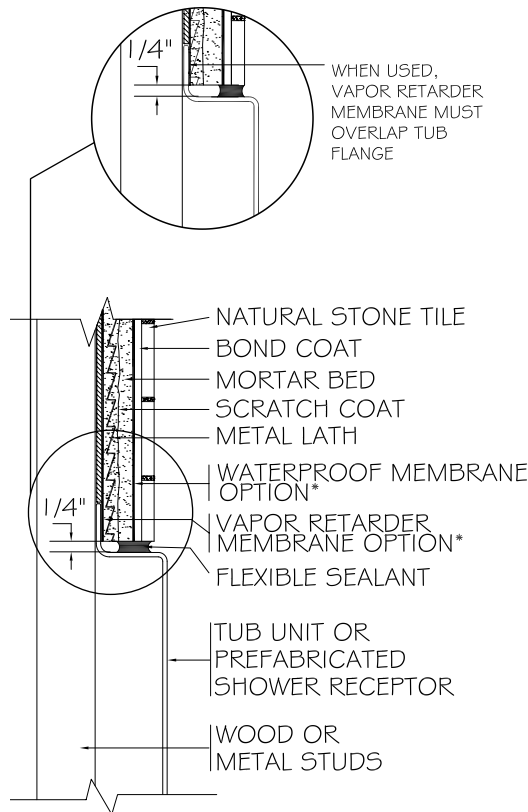
- Gypsum board—GA-216.
- Glass mat water-resistant gypsum backer board—manufacturer's directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**B411-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Mortar Bed**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors, where flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.
- For showers that do not have a prefabricated receptor, see B414 Stone.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- If a waterproof membrane is applied over the mortar bed, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, when used, or exterior use.

Requirements

- Membrane behind mortar bed, when used, must lap over face of flange of tub or prefabricated shower receptor.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1½" maximum.
- Minimum grout joint width—⅛"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI

A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Metal studs—ASTM C645.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed bathtubs—not to exceed ½" more than total length of tub.
- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Epoxy mortar—ANSI A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

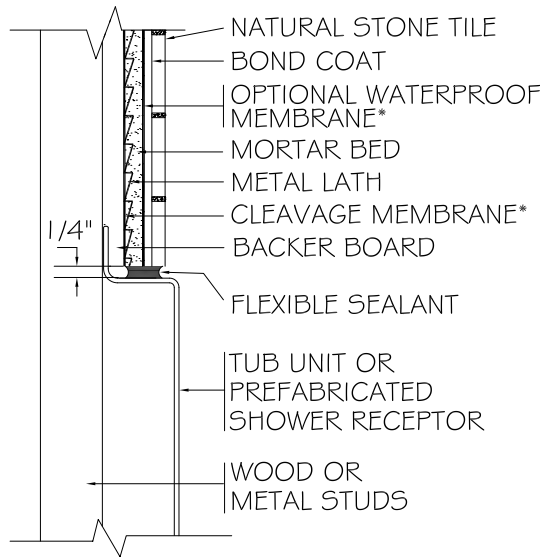
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface

sloped toward drain. Where present, waterproofing also must be sloped.

- When unsanded grout is used, grout joint width must be ¼" to ⅛" wide (nominal).

**B440-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Backer Board**
- **Mortar Bed (One Coat Method)**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors, where minor flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where unglazed stone will be used.
- For showers that do not have a prefabricated receptor, see B441 Stone.

Environmental Exposure Classifications

- With cement backer board or fiber cement backer board—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With coated glass mat water-resistant gypsum backer board or cementitious-coated extruded foam backer board—Res1, 2, 3; Com1, 2, 3.
- With fiber-reinforced water-resistant gypsum backer board—Res 1, 2, 3; Com 1, 2.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness— $\frac{3}{4}$ "
- Maximum stud spacing 16" on center.
- When coated glass mat water-resistant gypsum backer board or fiber-reinforced water-resistant gypsum backer board is used—not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A cleavage membrane is required. A waterproof membrane (A118.10) may also be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Cleavage membrane must lap over face of flange of tub or prefabricated shower receptor.
- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum.
- Backer board must provide firm anchorage for metal lath.
- Cut lath at all movement joints.
- Minimum grout joint width— $\frac{1}{16}$ ".

Preparation by Backer Board Installers

- Maximum allowable variation in backer board— $\frac{1}{8}$ " in 10' from the required plane.
- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, and taping of joints and corners.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.

- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Coated glass mat, water-resistant gypsum backer board, when used—ASTM C1178.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0–4.3.
- Opening for recessed bathtubs—not to exceed ½" more than total length of tub.
- Bathtub—install level and support with metal hangers or on end grain wood blocks.
- Fireproofing behind tub when required.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

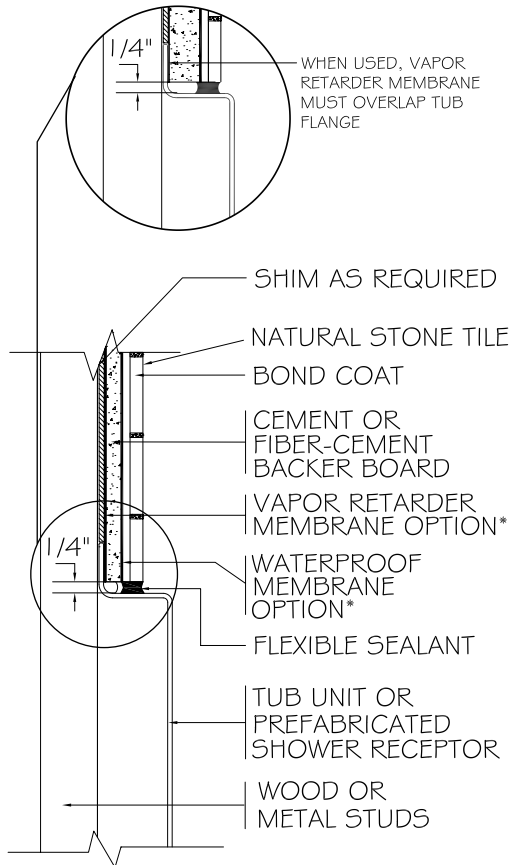
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer’s directions.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When coated glass mat water-resistant gypsum backer board is used, do not install a vapor barrier behind the backer board.
- When unsanded grout is used, grout joint width must be ¼" to ⅜" wide (nominal).
- If lath cannot be attached directly to backing, use furring strips. See B411 Stone.
- For thicker mortar bed, see B411 Stone.
- For mortar bed directly over wood or metal studs, see B411 Stone.

**B412-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Cement Backer Board or Fiber-Cement Backer Board**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC. MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B415 Stone.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Membrane behind backer unit, when used, must lap over face of flange of tub or prefabricated shower receptor.
- Minimum grout joint width—1/16"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—1/8" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—1/8" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub—not to exceed ½" more than length of tub.
- Bathtub—install level and support with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for ratings down to the floor behind the tub so that construction will be the same as the tested assembly. Backer board may be part of, or installed over, the rated assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

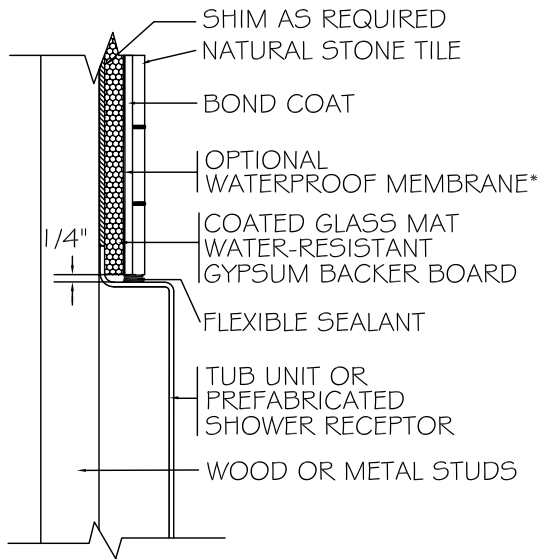
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be ¼" to ⅛" wide (nominal).

**B419-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Coated Glass Mat Water-Resistant Gypsum Backer Board**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B420 Stone.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified for walls to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect

adjacent building materials. Follow backer board and membrane manufacturer’s waterproofing requirements. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.

- When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub not to exceed ½" more than length of tub.
- Bath tub—install level and supported with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for rating down to the floor behind the tub so that construction will be the same as the tested assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

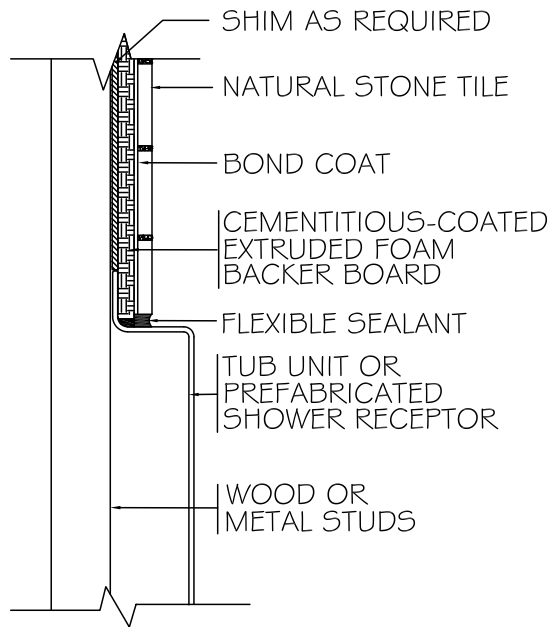
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Do not install a vapor barrier behind the tile backer board.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be ¼" to ⅛" wide (nominal).

**B425-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Cementitious-Coated Extruded Foam Backer Board**
- **Natural Stone Tile**



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B426 Stone.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer’s recommended fasteners.
- All openings cut in backer board for plumbing and all cut joints between adjoining pieces—seal with waterproofing as recommended by backer board manufacturer.
- Maximum allowable variation in the tile substrate—¼" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed and over fastener heads per backer board manufacturer’s instructions.
- Apply backer board tight to lip of tub and seal to tub with manufacturer-recommended sealant.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer’s recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Cementitious-coated extruded foam backer board—ASTM C578.
- Fasteners—noncorrosive and nonoxidizing.
- Flexible sealant—must be recommended by backer board manufacturer.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Bathtub—install level and support with metal hangers or on wood framing members.
- Opening for recessed tub not to exceed ½" more than length of tub.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

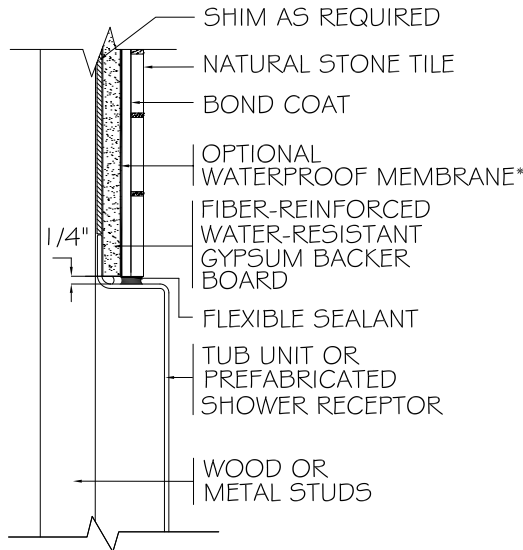
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be ¼" to ⅛" wide (nominal).

**B430-19
STONE**

- **Bathtub or Shower with Prefabricated Receptor**
- **Fiber-Reinforced Water-Resistant Gypsum Backer Board**
- **Natural Stone Tile**



*USE OF A MEMBRANE IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For tub enclosures or showers with prefabricated receptors.
- For showers that do not have a prefabricated receptor, see B431 Stone.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations and abutments to dissimilar materials.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.

- Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Opening for recessed tub not to exceed $\frac{1}{2}$ " more than the tub length.
- Bathtub—install level and supported with metal hangers or on wood framing members.
- Fire and sound ratings—extend gypsum board required for rating down to the floor behind the tub so that construction will be the same as the tested assembly.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

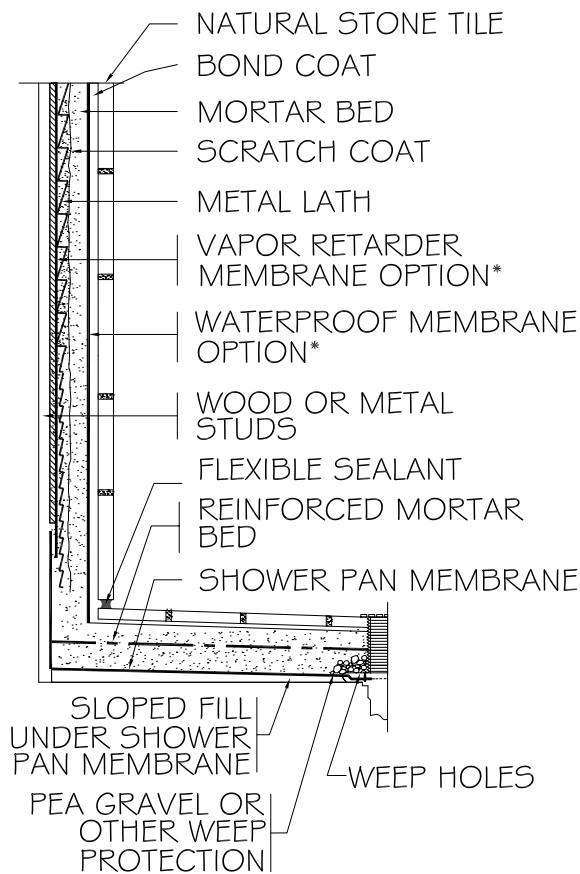
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.

B414-19 STONE

- Wood or Metal Studs
- Mortar Bed Walls
- Mortar Bed Floor
- Natural Stone Tile



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining and/or

chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness (walls)—1" for metal studs, 1½" for wood studs.
- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- If a waterproof membrane is applied over the mortar bed walls, membrane over framing members may not be required.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, when used, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Mortar bed thickness—¾" minimum to 1" maximum (metal studs) or 1½" maximum (wood studs).
- Membrane behind mortar bed, when used, must lap over shower pan membrane.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Minimum grout joint width—⅛"

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included.* If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1

or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.

- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

- Shower pan membrane—ANSI A108.01-3.6.
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.

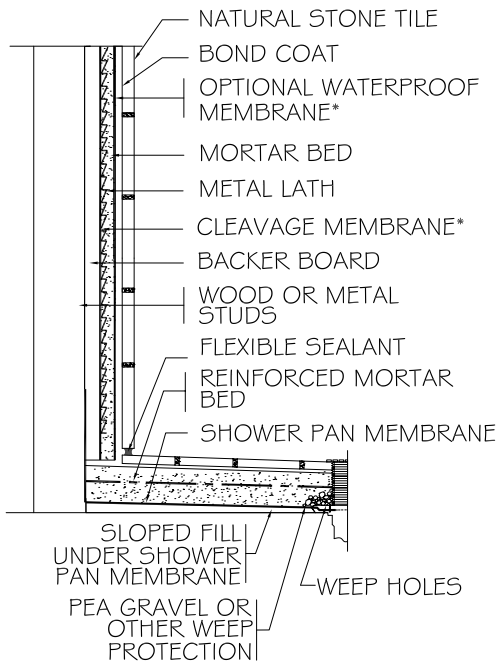
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved pre-formed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

B441-19 STONE

- Wood or Metal Studs
- Backer Board
- Mortar Bed Walls (One Coat Method)
- Mortar Bed Floor
- Natural Stone Tile



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS. SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

CLEAVAGE MEMBRANE LAPS OVER SHOWER PAN.

Recommended Uses

- For showers that do not have prefabricated receptors, where minor flattening or truing of walls is required.
- For areas where wall flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- With cement backer board or fiber cement backer board—Res1, 2, 3, 5; Com1, 2, 3, 5.
- With coated glass mat water-resistant gypsum backer board or cementitious-coated extruded foam backer board—Res1, 2, 3; Com1, 2, 3.
- With fiber-reinforced water-resistant gypsum backer board—Res 1, 2, 3; Com 1, 2.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for

exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum mortar bed thickness (walls)— $\frac{3}{4}$ "
- Maximum stud spacing 16" on center.
- When coated glass mat water-resistant gypsum backer board or fiber-reinforced water-resistant gypsum backer board is used—not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A cleavage membrane is required. A waterproof membrane (A118.10) may also be specified to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Cleavage membrane must lap over shower pan membrane.
- Wood studs—dry and well-braced, minimum depth $3\frac{1}{2}$ "
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth $3\frac{1}{2}$ " for residential applications or $3\frac{5}{8}$ " for commercial applications.
- Mortar bed thickness— $\frac{3}{8}$ " minimum to $\frac{3}{4}$ " maximum.
- Backer board must provide firm anchorage for metal lath.
- Cut lath at all movement joints.
- Slope shower pan membrane $\frac{1}{4}$ " per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Minimum grout joint width— $\frac{1}{16}$ ".

Preparation by Backer Board Installers

- Maximum allowable variation in the backer board— $\frac{1}{8}$ " in 10' from the required plane.
- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, taping of joints and corners, and special instructions for wet areas.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.***

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.
- Coated glass mat, water-resistant gypsum backer board, when used—ASTM C1178.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

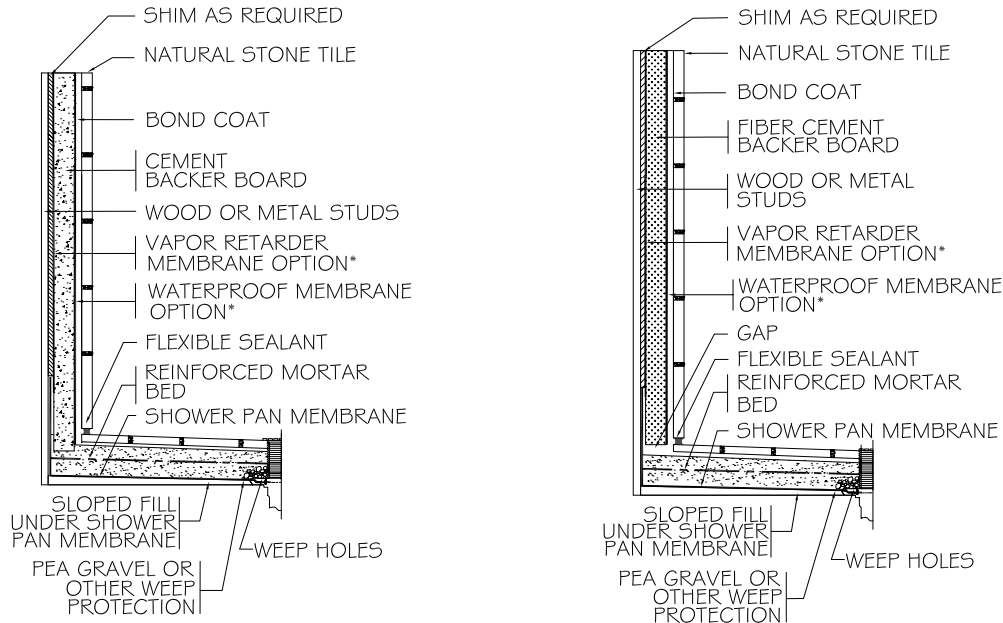
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if waterproof membrane or epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Epoxy mortar—ANSI A108.6.
- Waterproof membrane—ANSI A108.13.
- Cement backer board—ANSI A108.11.
- Fiber cement backer board—manufacturer’s directions.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Movement Joints—EJ171 and ASTM C1193.
- Shower pan membrane—ANSI A108.01-3.6.

Notes

- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When coated glass mat water-resistant gypsum backer board is used, do not install a vapor barrier behind the backer board.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).
- If lath cannot be attached directly to backing, use furring strips. See B414 Stone.
- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved pre-formed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- For thicker mortar bed, see B414 Stone.
- For mortar bed directly over wood or metal studs, see B414 Stone.

**B415-19
STONE**

- Wood or Metal Studs
- Cement Backer Board or Fiber Cement Backer Board Walls
- Mortar Bed Floor
- Natural Stone Tile



*USE OF A MEMBRANE ON WALLS IS REQUIRED. SEE MEMBRANE OPTIONS. SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Maximum stud spacing 16" on center.

Membrane Options

- A waterproof membrane (A118.10) or vapor retarder membrane (A108.02-3.8) must be specified for walls to prevent moisture intrusion and protect adjacent-building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Surface of units—clean and free of dirt, dust, paint, and oily film.
- Membrane behind backer unit, when used, must lap over shower pan membrane.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Minimum grout joint width—1/16"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints— $\frac{1}{8}$ " spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.1 or better or ISO C1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Vapor retarder membrane, when used—ANSI A108.02-3.8.
- Waterproof membrane, when used—ANSI A118.10.
- Cement backer board, when used—ANSI A118.9 or ASTM C1325 (Type B).
- Fiber cement backer board, when used—ASTM C1288.

- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.
- Shower pan membrane—local building code.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan membrane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

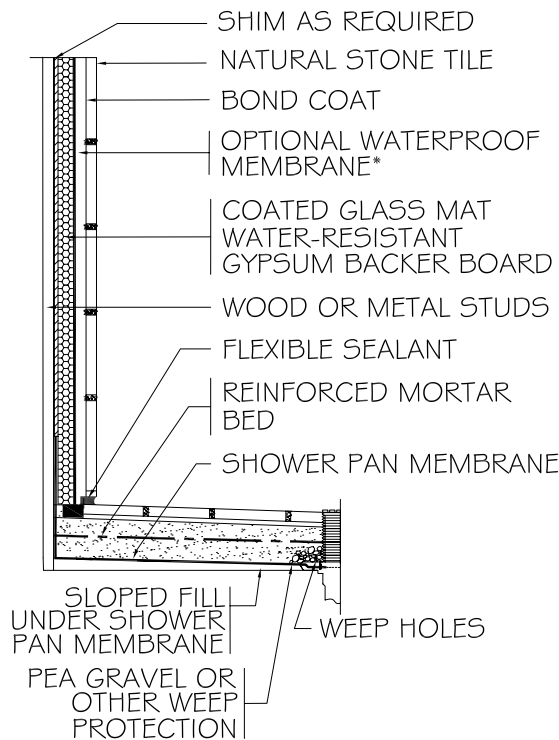
- Shower pan membrane—ANSI A108.01-3.6.
- Fiber cement backer board—manufacturer's directions.
- Cement backer board—ANSI A108.11.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

B420-19 STONE

- Wood or Metal Studs
- Coated Glass Mat Water-Resistant Gypsum Backer Board Walls
- Mortar Bed Floor
- Natural Stone Tile



*USE OF A MEMBRANE ON WALLS IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified for walls to prevent moisture intrusion through seams, corners, fasteners, and other penetrations and to protect adjacent building materials. Follow backer board and membrane manufacturer's waterproofing requirements. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.
- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.
- Some liquid-applied waterproof membranes will require extended cure time. Consult membrane manufacturer.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Caulk or seal penetrations, corners, and abutments to dissimilar materials with flexible sealant.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges closely to eliminate gaps between panels, including in corners.
- Tape seams and corners with 2" alkali-resistant glass fiber mesh tape and cementitious bonding material, and skim coat over fastener heads, unless waterproofing has been applied.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated,*

optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2S1 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Coated glass mat, water-resistant gypsum backer board—ASTM C1178.
- Fasteners—noncorrosive and nonoxidizing.
- Fasteners meeting ASTM F2329-05 required in wet areas.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Metal studs—ASTM C645.
- Shower pan membrane—local building code.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.
- Apply blocking between the studs to support the shower pan.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

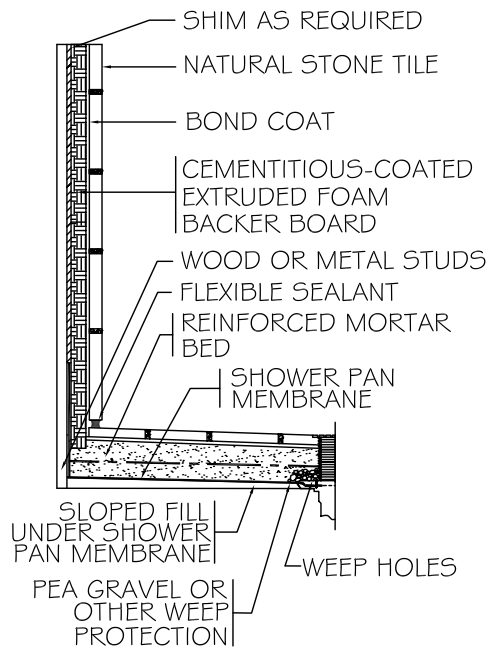
- Shower pan membrane—ANSI A108.01-3.6.
- Coated glass mat water-resistant gypsum backer board—manufacturer’s directions.
- Tile—A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be 1/16" to 1/8" wide (nominal).

B426-19 STONE

- Wood or Metal Studs
- Cementitious-Coated Extruded Foam Backer Board Walls
- Mortar Bed Floor
- Natural Stone Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2, 3.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum stud spacing 16" on center.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3"

above shower curb (6" above floor in showers without curbs).

- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Minimum grout joint width—¼"

Preparation by Backer Board Installers

- Fasten backer board to studs with board manufacturer's recommended fasteners.
- All openings cut in backer board for plumbing and all cut joints between adjoining pieces—seal with waterproofing as recommended by backer board manufacturer.
- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Fit ends and edges tightly together, including in corners. Apply a bead of manufacturer-recommended sealant in panel joints as panels are being installed and over fastener heads per backer board manufacturer's instructions.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Cementitious-coated extruded foam backer board—ASTM C578.

- Fasteners—noncorrosive and nonoxidizing.
- Flexible sealant—must be recommended by backer board manufacturer.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Apply blocking between studs to support the shower pan membrane.
- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

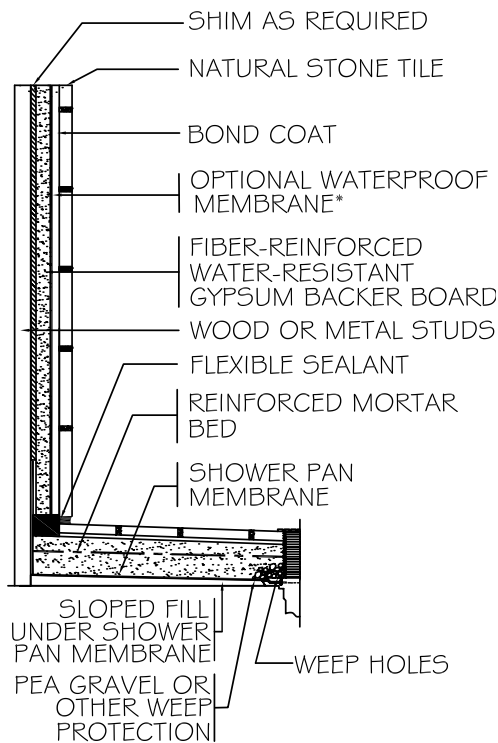
- Shower pan membrane—ANSI A108.01-3.6.
- Cementitious-coated extruded foam backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

B431-19 STONE

- Wood or Metal Studs
- Fiber-Reinforced Water-Resistant Gypsum Backer Board Walls
- Mortar Bed Floor
- Natural Stone Tile



*USE OF A MEMBRANE ON WALLS IS OPTIONAL. SEE MEMBRANE OPTIONS.

SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have prefabricated receptors.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum stud spacing 16" on center.
- Not for areas exposed to temperatures exceeding 125°F.

Membrane Options

- A waterproof membrane (A118.10) may be specified

for walls to prevent moisture intrusion and protect adjacent building materials. Specifier shall indicate if complete waterproofing of walls is required, including treatment at termination points.

- Check with membrane manufacturer for suitability for applicable conditions, as not all membranes are suitable for steam, high-temperature and/or chemical exposure, or exterior use.

Requirements

- Wood studs—dry and well-braced, minimum depth 3½"
- Metal studs—well-braced; 20 gauge (0.033") or heavier; minimum depth 3½" for residential applications or 3⅝" for commercial applications.
- Slope shower pan membrane ¼" per foot to weep holes in drain.
- Turn shower pan membrane up walls a minimum of 3" above shower curb (6" above floor in showers without curbs).
- Fur out studs above shower pan membrane or notch-out studs behind the shower pan membrane so folds/corners of shower pan membrane do not cause backer board to bow inward, or use Alternate Receptor Base Method.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Caulk or seal penetrations and abutments to dissimilar materials.
- Minimum grout joint width—⅛"

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Horizontal joints—⅛" spacing filled solid and taped with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Vertical joints—fill any space and tape with latex-portland cement mortar and 2" alkali-resistant glass fiber mesh tape.
- Corners—leave space between backer units. Tape joints using skim coat of latex-portland cement mortar, but do not fill.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout**

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When a waterproof membrane is not used—ANSI A118.4 or better or ISO C2 or better.
 - When a waterproof membrane is used—ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane, when used—ANSI A118.10.
- Fiber-reinforced water-resistant gypsum backer board—ASTM C1278 (Paragraph 6.1).
- Fasteners—noncorrosive and nonoxidizing.
- 2" alkali-resistant glass fiber mesh tape.
- Flexible mildew-resistant sealant—ASTM C920.
- Shower pan membrane—local building code.
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Apply blocking between the studs to support the shower pan membrane.
- Wall framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory in accordance with EJ171.

Installation Specifications

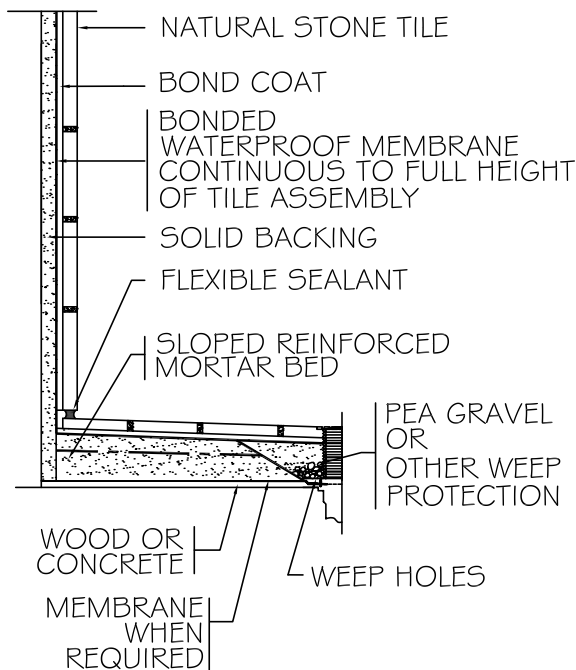
- Shower pan membrane—ANSI A108.01-3.6.
- Fiber-reinforced water-resistant gypsum backer board—manufacturer’s directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Waterproof membrane—ANSI A108.13.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- Test shower pan membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- A sloped portland cement mortar fill or approved preformed slope may be used under shower pan membrane when subfloor is not sloped to drain.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be 1/16" to 1/8" wide (nominal).

B421-19 STONE

- Solid Backing
- Bonded Waterproof Membrane
- Natural Stone Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have a prefabricated receptor, where topical waterproofing of floors and walls is desired.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.
- May be suitable for Com3 as determined by membrane and backing material manufacturers.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- Bonded waterproof membrane must be continuous, including at changes in plane. Follow membrane manufacturer’s requirements for corners, seaming, and overlap.
- Waterproof membrane must extend to full height of tile assembly.
- Surround drain with pea gravel or other weep protection to prevent mortar from blocking weep holes.
- Refer to appropriate wall method for applicable requirements based on type of backing used.
- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane manufacturer’s instructions for connecting membrane to drain.
- Minimum grout joint width— $\frac{1}{16}$ ".

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

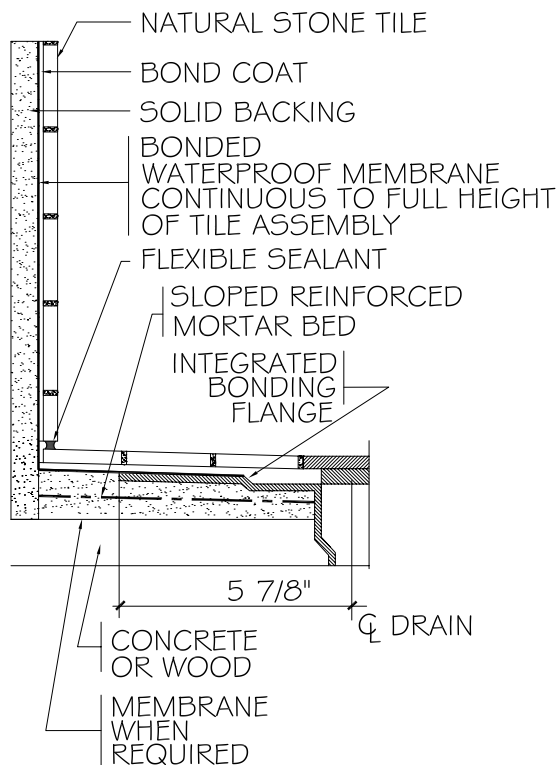
- Waterproof membrane—ANSI A108.13.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

B422-19 STONE

- Solid Backing
- Bonded Waterproof Membrane
- Integrated Bonding Flange
- Natural Stone Tile



SHOWER RECEPTORS, CURBS, SEATS, ETC., MUST BE PROPERLY WATERPROOFED AND INSTALLED TO AVOID WATER DAMAGE TO ADJACENT BUILDING MATERIALS. SEE COMMON SHOWER CONFIGURATIONS SECTION.

Recommended Uses

- For showers that do not have a prefabricated receptor, where topical waterproofing of floors and walls is desired.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2
- May be suitable for Com3 as determined by membrane and backing material manufacturers.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also “Product Selection Guides.”

Limitations

- Refer to appropriate wall method for applicable limitations based on type of backing used—W201, W202E, W202I, W211, W221, W222, W231/W241, W243, W244C, W244E, W244F, W245, W246, and W247.

Requirements

- Bonded waterproof membrane must be continuous, including at changes in plane. Follow membrane manufacturer’s requirements for corners, seaming, and overlap.
- Waterproof membrane must extend to full height of tile assembly.
- Refer to appropriate wall method for applicable requirements based on type of backing used.
- Slope mortar bed $\frac{1}{4}$ " per foot toward drain and follow membrane and integrated bonding flange manufacturers’ instructions for connecting membrane to integrated bonding flange.
- Minimum grout joint width— $\frac{1}{16}$ ".

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.*
- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.4 or better or ISO C2S1 or better unless ANSI A118.1 or ISO C1 is recommended by membrane manufacturer.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”
- Waterproof membrane—ANSI A118.10 and recommended by manufacturer of membrane for use over backing type in intended application.
- Flexible mildew-resistant sealant—ASTM C920.

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades/Backer Board Installers

- Refer to appropriate wall method for applicable preparations by other trades and backer board installers.
- Maximum allowable variation in the tile substrate— $\frac{1}{8}$ " in 10' from the required plane when measured from the high points in the surface.
- Center backer board end or edge joints on framing and stagger joints in adjacent rows so four corners do not come together within the same plane. Space panel ends and edges in accordance with manufacturer's recommendations.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

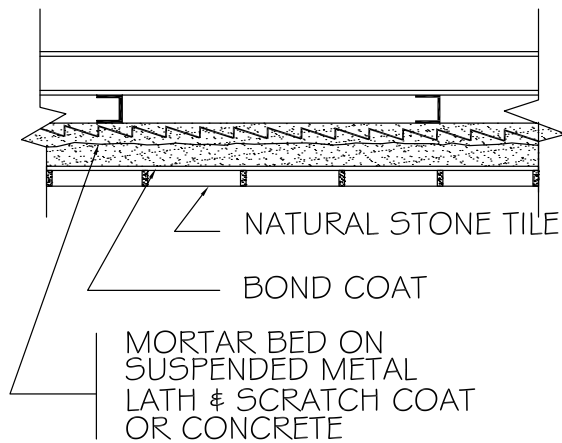
- Waterproof membrane—ANSI A108.13.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- Test shower pan membrane/waterproof membrane and drainage fitting for leaks before commencing tilework.
- Materials adversely affected by moisture in areas immediately adjacent to showers, tubs, and roman tubs should be properly protected.
- All horizontal surfaces, for example shower seats, sills, curbs, etc., must slope towards drain or other surface sloped toward drain. Where present, waterproofing also must be sloped.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

**C311-19
STONE**

- Mortar Bed
- Natural Stone Tile



Recommended Uses

- For ceilings where trueing is required.
- For areas where substrate flatness is critical, such as when tiles with any edge longer than 15" are specified.
- For areas where ungauged stone will be used.

Environmental Exposure Classifications

- Res1, 2, 3, 5; Com1, 2, 3, 5.
- For installations that may be exposed to staining and/or chemical attack, specify tile and grout suitable for exposure. Consult product manufacturers; see also "Product Selection Guides."

Limitations

- Maximum joist spacing 16" on center.

Requirements

- Suspended ceiling systems must be capable of supporting weight of mortar bed and tile.
- Concrete to be well cured, dimensionally stable, and free of cracks, waxy, or oily films.
- Minimum grout joint width— $\frac{1}{16}$ "

Materials

- Multiple options exist for membranes, mortars, grouts, and other materials and *must be clearly specified* to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.
- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.

- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat—portland cement paste on a mortar bed that is still workable. For a cured mortar bed, follow recommendations below to select appropriate bonding mortar:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Mortar bed, metal lath, and cleavage membrane—ANSI A108.1A.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Maximum allowable variation in the installation substrate— $\frac{1}{4}$ " in 10' from the required plane.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

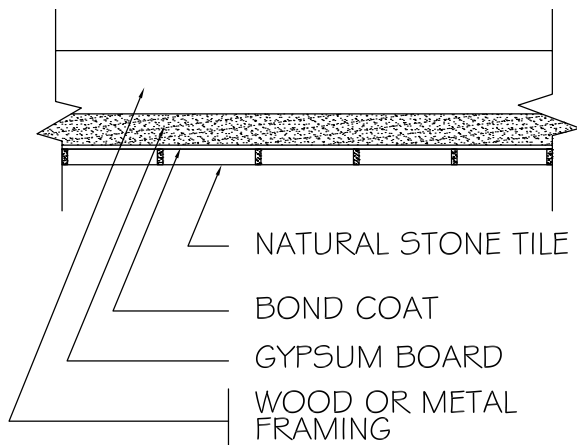
- Tile—ANSI A108.1A, .1B, or .1C. Ungauged stone may require installation per ANSI A108.1A. Material with minimal variation may be allowed per A108.1B with LHT mortar. A108.1B required if epoxy bond coat to be used.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

C312-19 STONE

- Gypsum Board
- Natural Stone Tile



Recommended Uses

- For ceilings in dry areas where gypsum board is the tile backer.

Environmental Exposure Classifications

- Res1; Com1.

Limitations

- The weight of overlaid unsupported insulation shall not exceed 1.3 psf for ½"-thick gypsum board with framing spacing 24" o.c. or 2.2 psf for ½"-thick gypsum board with framing spacing 16" o.c. or ⅝"-thick gypsum board with framing spacing 24" o.c.
- Not for areas exposed to temperatures exceeding 125°F.
- Ceiling framing, furring, or blocking shall not exceed 12" o.c. for ½"-thick water-resistant gypsum backing board and 16" o.c. for ⅝"-thick water-resistant gypsum backing board.

Requirements

- Surface—free of coatings, oil, and wax.
- Ceiling framing must be capable of supporting the weight of backing and tile.
- Minimum thickness of gypsum board—½".
- Minimum grout joint width—⅓/16".

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.**

- Natural stone tile—see “Natural Stone Tile Selection and Installation Guide,” and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - ANSI A118.1 or better or ISO C1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the “Natural Stone Tile Selection and Installation Guide.”

Materials for Green/Sustainable Design

- See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Gypsum board face layer joints—treated with tape and joint compound, bedding coat only (no finish coats). Nail heads, one coat only.
- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

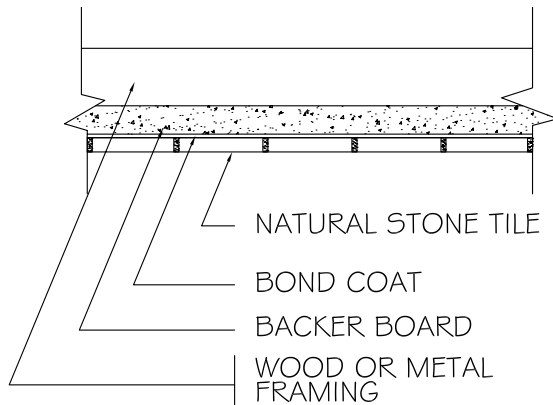
- Gypsum board—GA-216.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be ⅓/16" to ⅛" wide (nominal).

C315-19 STONE

- Backer Board
- Natural Stone Tile



Recommended Uses

- For ceilings in dry or wet areas.

Environmental Exposure Classifications

- Res1, 2, 3; Com1, 2.

Limitations

- The weight of the tile shall not exceed 5 psf for ½"-thick backer board with framing spacing 24" o.c., or 6 psf for ½"-thick backer board with framing spacing 16" o.c.
- When backer board is coated glass mat gypsum backer board or fiber-reinforced gypsum backer board, not for areas exposed to temperatures exceeding 125°F.

Requirements

- Surface—free of coatings, oil, and wax.
- Ceiling framing must be capable of supporting the weight of backer board and tile.
- Minimum thickness of backer board—½".
- Fasten backer board as recommended by the manufacturer.
- Minimum grout joint width—¼".

Preparation by Backer Board Installers

- Maximum allowable variation in the tile substrate—⅛" in 10' from the required plane when measured from the high points in the surface.
- Follow backer board manufacturer's directions for installation, including orientation and spacing of boards, required fasteners, and taping of joints and corners.

Materials

- **Multiple options exist for membranes, mortars, grouts, and other materials and must be clearly specified to be included. If not specifically indicated, optional materials are not included and mortar/grout**

choice defaults to minimum performance specification indicated. Consider each system component and intended use to determine minimum requirements and to specify options.

- Natural stone tile—see "Natural Stone Tile Selection and Installation Guide," and consult supplier for application suitability.
- Cementitious grout—ANSI A118.6 or better or ISO CG1 or better. Consider unsanded grout for soft or semisoft stones such as limestone, travertine, marble, onyx, or similar.
- Cementitious bond coat:
 - When cement backer board, fiber cement backer board, or cementitious-coated extruded foam backer board is used—ANSI A118.1 or better or ISO C1 or better.
 - When coated glass mat water-resistant gypsum or fiber-reinforced water-resistant gypsum backer board is used—ANSI A118.4 or better or ISO C2S1 or better.
 - Use white for light-colored marble, limestone, and other stones where staining or darkening from grey setting materials is possible.
- Epoxy bond coat, when used—ANSI A118.3 or ISO R1 or better. See Water Sensitivity and Fiberglass Mesh Reinforced Stone in the "Natural Stone Tile Selection and Installation Guide."
- Cement backer board, when used—ANSI A118.9 or ASTM C1325.
- Fiber cement backer board, when used—ASTM C1288.
- Cementitious-coated extruded foam backer board, when used—ASTM C578.
- Coated glass mat water-resistant gypsum backer board, when used—ASTM C1178.
- Fiber-reinforced water-resistant gypsum backer board, when used—ASTM C1278 (Paragraph 6.1).
- Metal studs—ASTM C645.

Materials for Green/Sustainable Design

- See "Green Building Standards and Green Product Selection Guide" and consult manufacturers and suppliers for product sustainability and contribution to green building design.
- Consider specifying installation materials that meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Preparation by Other Trades

- Framing shall meet the general framing requirements of ANSI A108.11-4.0-4.3.

Movement Joint (architect must specify type of joint and show location and details on drawings)

- Movement joints—mandatory according to EJ171.

Installation Specifications

- Backer board—ANSI A108.11 or manufacturer's directions.
- Tile—ANSI A108.5 or A108.6.
- Cementitious grout—ANSI A108.10.
- Movement Joints—EJ171 and ASTM C1193.

Notes

- As the tile size increases, there is less tolerance for variation in the substrate from the required plane. Epoxy bond coat thickness must be thin and uniform; therefore, substrate flattening may be required when epoxy bond coat is used.
- When unsanded grout is used, grout joint width must be $\frac{1}{16}$ " to $\frac{1}{8}$ " wide (nominal).

2019 | MOVEMENT JOINTS

EJ171 MOVEMENT JOINT GUIDELINES FOR CERAMIC, GLASS, AND STONE

Perimeter and field movement joints within a tile installation are essential and required. This section provides general recommendations and guidelines, including the means by which movement joints in substrates are carried through and incorporated into tile installations.

Because of the limitless conditions and structural systems on which tile can be installed, the design professional or engineer shall show the specific locations and details of movement joints on project drawings. Preparation of openings left by the tile contractor and installation of backup strip and sealant should be specified in the Caulking and Sealant section of the job specification.

Location and Frequency of Joints

Interior—maximum of 25' in each direction.

Exterior—8' to 12' in each direction. More frequent joint placement may be required depending on materials and environmental conditions.

Interior tilework exposed to direct sunlight (heat) or moisture—maximum of 12' in each direction.

Above-ground concrete slab substrate—maximum of 12' in each direction.

Perimeter Joints—movement joints are required where tilework abuts restraining surfaces such as perimeter walls, dissimilar floor finishes, curbs, columns, pipes, ceilings, and where changes occur in backing materials, but not at drain strainers.

Change of plane, exterior—movement joints required at all inside and outside corners.

Change of plane, interior—movement joints required at all inside corners.

All expansion, control, construction, cold, saw-cut, isolation, contraction, and seismic joints in the structure should continue through the tilework, including such joints at vertical surfaces.

If a proprietary crack isolation membrane is specified over a saw cut joint to relocate a movement joint, contrary to EJ171, the tile contractor is not responsible for cracking in grout joints or tile over the saw cut, provided the tile, membrane, and other materials were installed correctly. This includes curling and/or deformation of the concrete occurring after installation of the membrane.

Joint Width

The following recommendations do not consider frequency and width for substrates subject to deflection, shrinkage, and expansion. All example calculations only consider the thermal linear expansion of the tile. All other considerations are specifically excluded and must be estimated by the design professional or engineer.

Exterior

Width shall be a minimum $\frac{3}{8}$ " for joints 8' on center and minimum $\frac{1}{2}$ " for joints 12' on center. Minimum widths must be increased $\frac{1}{16}$ " for each 15°F tile surface temperature change greater than 100°F between summer high and winter low. For example, for a 115°F temperature change, add $\frac{1}{16}$ " to the minimum joint width; for a 130°F change, add $\frac{1}{8}$ ".

Interior

Perimeter joints at perimeter walls—not less than $\frac{1}{4}$ " and commonly covered by tile trim, cove base, or shoe molding.

Perimeter joints, other than perimeter walls—preferred not less than $\frac{1}{4}$ " but never less than $\frac{1}{8}$ ".

Change of plane—same as grout joint but never less than $\frac{1}{8}$ ".

Dry Interior Generic Movement Joints Not Exposed to Direct Sunlight

Formula for Calculating

To calculate the approximate minimum movement joint width (sealant joint) for dry interior generic movement joints not exposed to direct sunlight considering (with respect to expected movement) only linear thermal expansion of the tile, use the formula:

$$W_M = \frac{(L \times \Delta T \times \alpha)}{\left(\frac{S}{100}\right)}$$

W_M Sealant joint width required for movement

L Total linear dimension between movement joints expressed in inches (in.)

ΔT Change in temperature expressed in degrees Celsius (°C)

α Coefficient of linear thermal expansion expressed in inches per inch per degree Celsius (in./in.°C)

S Sealant movement rating or class per ASTM C920

Note: Calculation does not consider concrete shrinkage from curing and other forms of substrate shrinkage or expansion.

Sample calculation for approximate minimum required movement joint width when:

coefficient of linear thermal expansion of the tile (α):
 7×10^{-6} in./in.°C

total linear dimension between movement joints (L):
 240" (every 20')

change in temperature (ΔT):
 27.8°C (10°C to 37.8°C, or 50°F to 100°F)

sealant movement rating or class (S):
 25

$$W_M = \frac{(240 \text{ in.} \times 27.8^\circ\text{C} \times 0.000007 \text{ in./in.}^\circ\text{C})}{(25/100)} = 0.1868 \text{ in. (approximately } \frac{3}{16} \text{")}$$

Using the formula, in the above sample calculation, $\frac{3}{16}$ " movement joints are needed every 20'.

EJ171 TABLE 1: Pre-calculated approximate minimum required movement joint widths for dry interior generic movement joints not exposed to direct sunlight, based (with respect to movement) only on linear thermal expansion of the tile and various options for joint frequency, assuming a class 25 sealant and minimum and maximum temperatures of 50°F (10°C) and 100°F (37.8°C), respectively.

Tile's Coefficient of Linear Thermal Expansion (α)	Frequency of Joints				
	8' (96")	12' (144")	16' (192")	20' (240")	25' (300")
3×10^{-6}	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "
4×10^{-6}	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{3}{16}$ "
5×10^{-6}	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{3}{16}$ "
6×10^{-6}	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{3}{16}$ "	$\frac{1}{4}$ "
7×10^{-6}	$\frac{1}{8}$ "	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{3}{16}$ "	$\frac{1}{4}$ "
8×10^{-6}	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{3}{16}$ "	$\frac{1}{4}$ "	$\frac{5}{16}$ "
9×10^{-6}	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{1}{4}$ "	$\frac{1}{4}$ "	$\frac{5}{16}$ "
10×10^{-6}	$\frac{1}{8}$ "	$\frac{3}{16}$ "	$\frac{1}{4}$ "	$\frac{5}{16}$ "	$\frac{3}{8}$ "

In practical application, dry interior movement joints not exposed to direct sunlight shall be no less than as shown in Table 1 and in no case shall the movement joints be less than $\frac{1}{8}$ " wide.

Consult tile manufacturer for coefficient of linear thermal expansion in ambient temperature range of the installation.

Note: Some glass tiles and some stone tiles have a coefficient of linear thermal expansion greater than 10 and as high as 22 for some stones.

Design professional or engineer should also refer to ASTM C1193 "Standard Guide for the Use of Joint Sealants" and ASTM C1472 "Standard Guide for Calculating

Movement and Other Effects When Establishing Sealant Joint Width" to determine the appropriate movement joint width when considering parameters other than linear thermal expansion.

Caution: These guidelines and calculations do not consider concrete shrinkage from curing and other forms of substrate shrinkage or expansion.

Interior Generic Movement Joints Subject to Direct Sunlight or Moisture

Quarry Tile—same as grout joint, but not less than $\frac{1}{4}$ "

All other tile—preferred $\frac{1}{4}$ " but never less than $\frac{1}{8}$ "

Joint Width Over Other Trades' Substrate Joints

Joints in tile and setting materials shall never be less than the width of the saw-cut control joint width.

Joints through tilework directly over structural joints must never be narrower than the structural joint.

Joint Depth

Exterior

For joints $\frac{1}{2}$ " wide or less— $\frac{1}{4}$ "

For joints greater than $\frac{1}{2}$ " wide—joint depth shall be determined by a ratio of 2:1 (width/depth).

For joints greater than 1" wide—joint shall not exceed $\frac{1}{2}$ "

Interior

Preferred not less than $\frac{1}{4}$ " nor greater than $\frac{3}{8}$ " (width/depth ratio not applied for static joint)

Materials

Backup strip shall be a flexible and compressible type of closed-cell foam polyethylene, butyl rubber, or open cell and closed cell polyurethane, rounded at surface to contact sealant, as shown in details, and as recommended by sealant manufacturers. It must fit neatly into the joint without compacting and to such a height to allow a sealant depth of $\frac{1}{2}$ the width of the joint. Sealant must not bond to the backup material.

Suitable sealants include silicone, urethane, and polysulfide. Sealants are available in both single- and multi-component formulations. Either formulation is generally suitable for movement joints in tilework. Single-component sealants are furnished in prepacked cartridges or other forms requiring no jobsite mixing. Multi-component sealants require jobsite mixing, but cure faster than single-component counterparts, making them advantageous for traffic areas.

Urethane sealants are recommended for exterior vertical tile surfaces and both exterior and interior horizontal tile surfaces, including tiled traffic areas. Because of their abrasion and penetration resistance, urethane sealants are recommended for movement joints in tiled traffic areas.

Silicone sealants may be used on both exterior and interior vertical tile surfaces. Single-component, mildew-resistant silicone sealants are formulated with fungicide for sealing interior joints in ceramic tile showers and around tubs, sinks and plumbing fixtures.

Sealants in traffic areas require a Shore A hardness of 25 or greater.

Use sealants complying with ASTM C920, which designates sealants according to type, grade, class, and uses. The following are suitable for use in tilework:

- Type S—single-component sealant.
- Type M—multi-component sealant.
- Grade P—sealants for joints on horizontal surfaces.
- Grade NS—non-sagging sealants for joints in vertical surfaces.
- Class 25—sealants that can withstand an increase and decrease of $\pm 25\%$ of joint width.
- Use T—sealants for pedestrian and vehicle traffic exposure.
- Use NT—sealants for non-traffic exposures.
- Uses M and G—sealants that will remain adhered to mortar (M) and glass (G).

The performance requirements of some applications such as exterior swimming pools, dairies, food plants, etc., may exceed the minimum requirements of these sealant specifications. Therefore, follow recommendations of experienced manufacturers as to specific sealants suitable in the job environment. In some severe environments, a program for regular maintenance of sealant in joints may be required.

Silicone sealants contain plasticizers that may stain some natural stones. See “Natural Stone Tile Selection and Installation Guide.”

Manufactured/preformed joint profiles are available. Consult manufacturer.

Materials for Green/Sustainable Design

See “Green Building Standards and Green Product Selection Guide” and consult manufacturers and suppliers for product sustainability and contribution to green building design.

Consider specifying tile and installation materials that

meet ANSI A138.1, the *American National Standard Specifications for Sustainable Ceramic Tiles, Glass Tiles, and Tile Installation Materials*.

Installation

Install movement joints per ASTM C1193 Standard Guide for Use of Joint Sealants.

Tile edges to which the sealant will bond must be clean and dry.

Some sealants require edge priming. Consult manufacturer's specifications. If required, care must be taken to keep primer off tile faces.

To ensure that location of joints in tilework align with existing joints in substrate, joints in tilework should be constructed during installation of mortar beds and/or tile, rather than saw-cutting joints after installation.

Keep movement joint cavities open and free of dirt, debris, grout, mortar, and setting materials.

Set compressible backup strip when mortar is placed or utilize removable wood strip to provide space for backup after mortar has cured.

Install sealant after tilework and grout are dry. Follow sealant manufacturer's recommendations.

Movement Joint Types in Concrete

Construction/cold joint—The surface where two successive placements of concrete meet, across which it may be desirable to achieve bond and through which reinforcement may be continuous. A cold joint becomes a weakened joint that, upon movement, will crack, permitting leakage or buckling and cracking of a tile floor set over the slab. Such joints should be shown on architectural drawings.

Contraction/control joint—Formed, sawed, or tooled groove in a concrete structure to create a weakened plane and regulate the location of cracking resulting from the dimensional change of different parts of the structure. Also referred to as “saw-cut joint.”

Expansion joint—(1) A separation provided between adjoining parts of a structure to allow movement where expansion is likely to exceed contraction; (2) a separation between pavement slabs on grade, filled with a compressible filler material; (3) an isolation joint intended to allow independent movement between adjoining parts.

Isolation joint—A separation between adjoining parts of a concrete structure, usually a vertical plane, at a designated location such as to interfere least with

performance of the structure, yet such as to allow relative movement in three directions and avoid formation of cracks elsewhere in the concrete and through which all or part of the bonded reinforcement is interrupted.

Some large slabs on-grade are poured monolithically, then later saw-cut at intervals, providing control/contraction joints to allow for cracking at these weakened points.

Movement Joint Types, Other

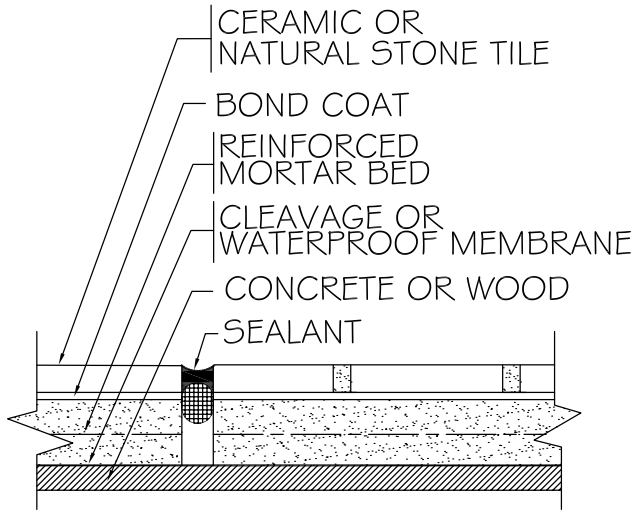
Acoustical Joint—A non-drying, non-hardening, rubber-like seal at the perimeter and at all penetrations and retaining surfaces of a floor installation in which a bonded sound reduction membrane is used for sound reduction. The primary function of an acoustical joint is to minimize flanking, the transmission of sound through joints, penetrations, or structural components in the assembly.

Wall Tile Movement Joints in Framed Wall Assemblies

Location and frequency of movement joints shall be determined by the design professional or engineer, including the design of the joint itself with framing, sheathing, and backer board considerations. Consult backer board manufacturer for specific recommendations. Design details must be specified before the wall is assembled as movement accommodation cannot be retroactively added.

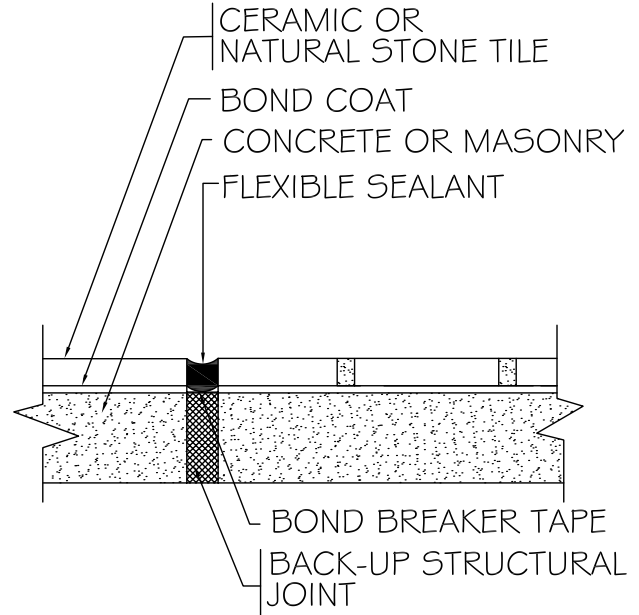
EJ171C-19

• Expansion Joint



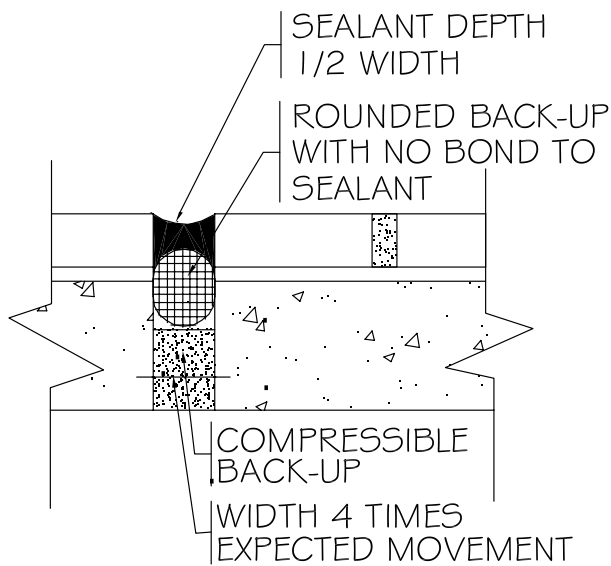
EJ171D-19

• Isolation/Expansion Joint



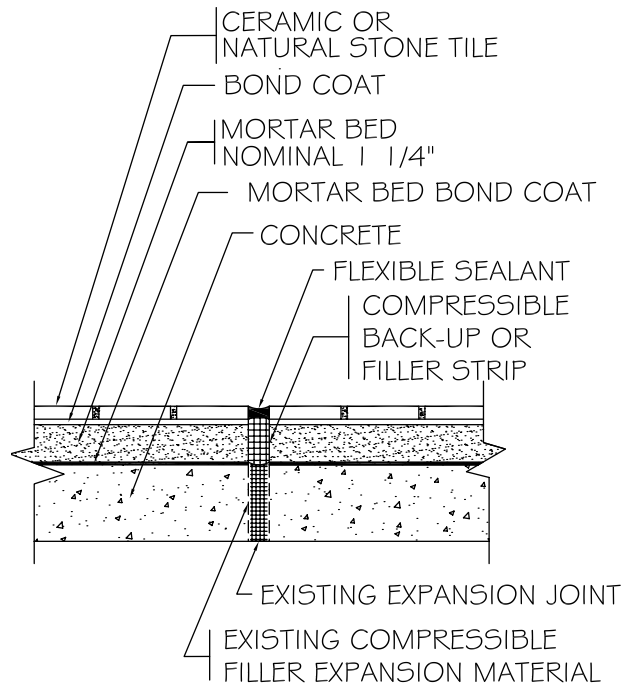
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• Expansion Joint



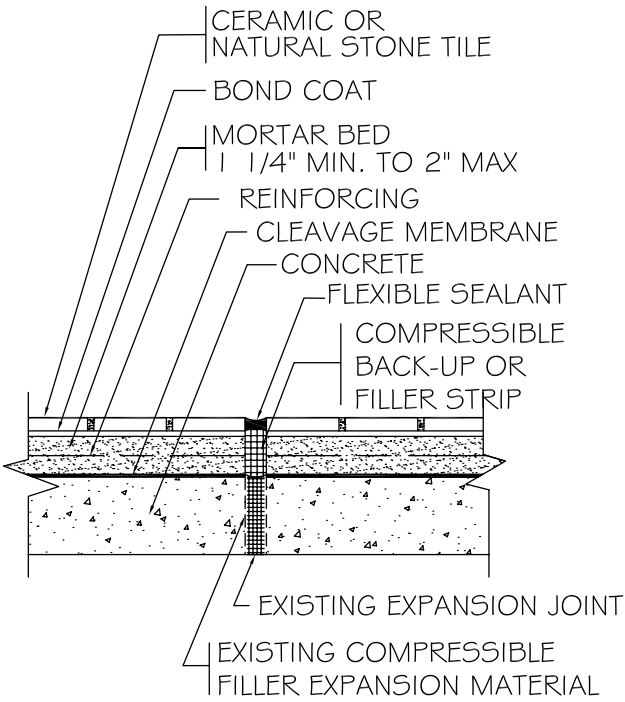
EJ171E-19

• Expansion Joint, Cement Mortar, Bonded



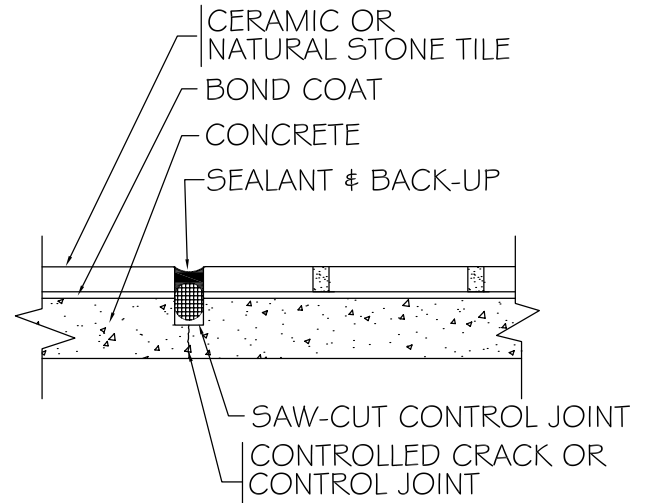
EJ171H-19

- Expansion Joint, Cement Mortar, Cleavage Membrane



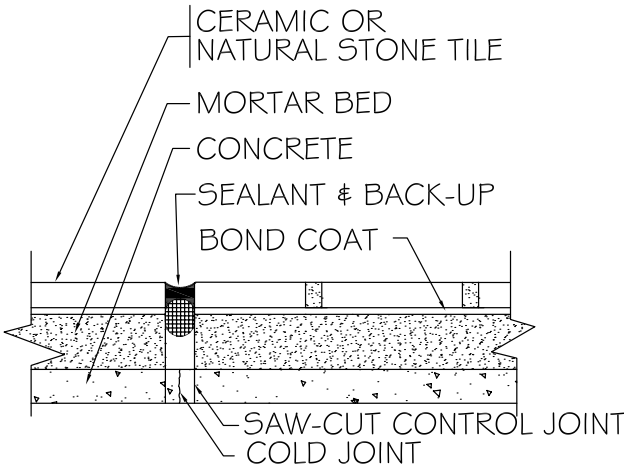
EJ171B-19

- Contraction Joint



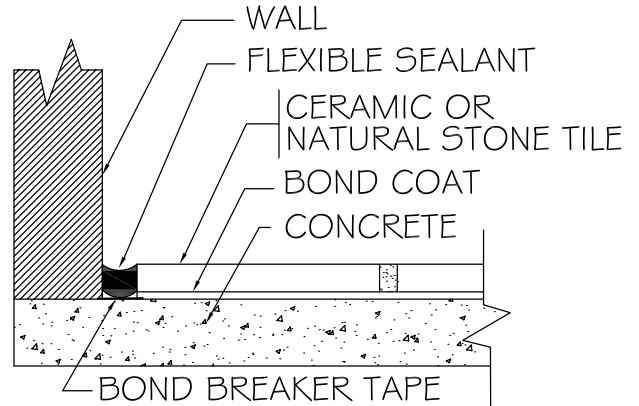
EJ171A-19

- Construction Joint



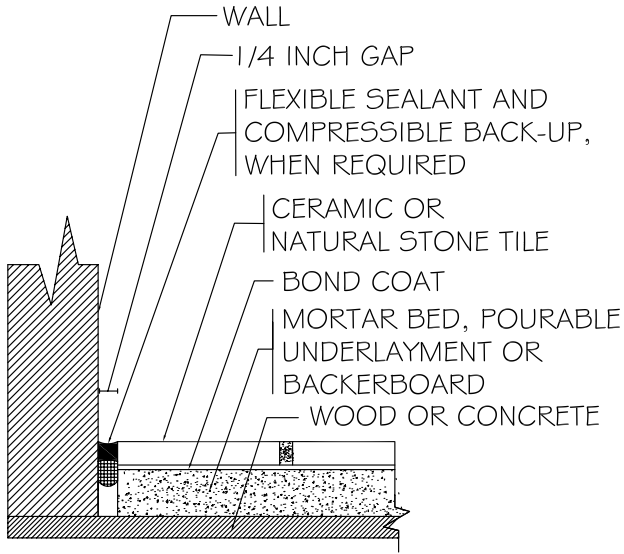
EJ171G-19

- Perimeter Joint



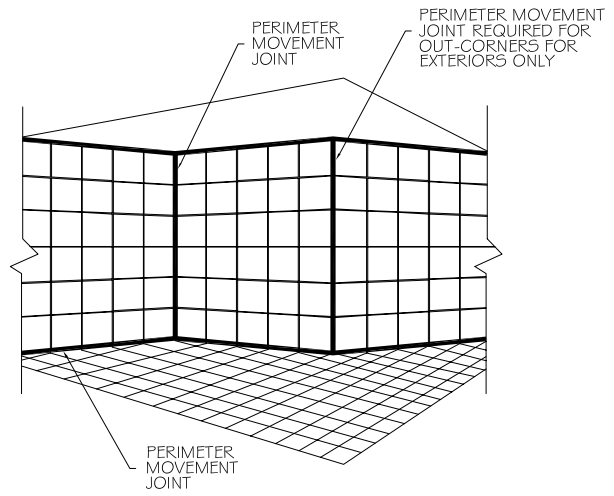
EJ171I-19

• **Perimeter Joint**



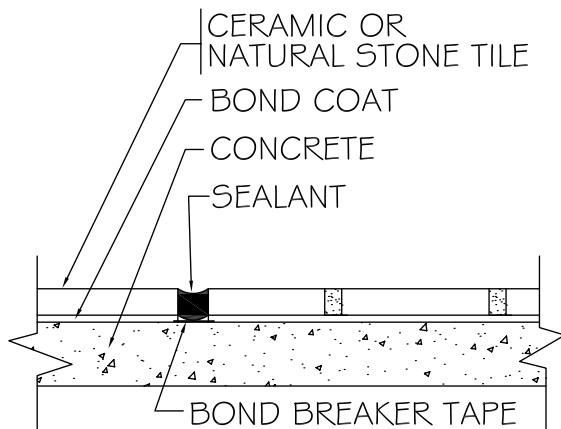
EJ171J-19

• **Perimeter Movement Joint**



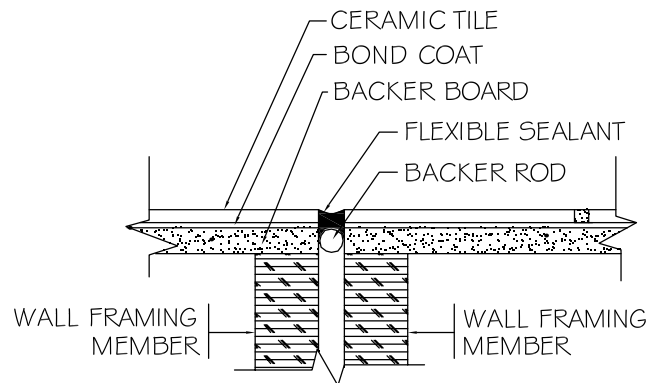
EJ171F-19

• **Generic Movement Joint**



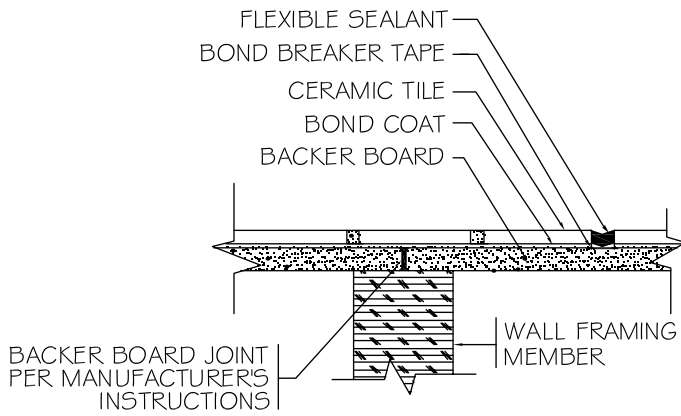
EJ171K-19

• **Movement Joint in Tile and Backerboard**



EJ171L-19

Generic Movement Joint with Backerboard



2019 | APPENDICES

APPENDIX A. ISO 13007 STANDARDS FOR ADHESIVES AND GROUTS

ISO installation material standards for mortars, adhesives, and grouts are more fully described in the following standards:

- 13007-1 Ceramic Tiles—Grouts and adhesives—Part 1: Terms, definitions, and specifications for adhesives
- 13007-2 Ceramic Tiles—Grouts and adhesives—Part 2: Test methods for adhesives
- 13007-3 Ceramic Tiles—Grouts and adhesives—Part 3: Terms, definitions and specifications for grouts
- 13007-4 Ceramic Tiles—Grouts and adhesives—Part 4: Test methods for grouts

Where ANSI installation material standards refer to “mortars,” ISO installation material standards refer to such mortars as either adhesives or mortar adhesives.

ISO adhesive and grout classifications are designated using letters to identify chemical make-up and optional properties. Numbers are used to identify performance levels.

ISO Performance Requirements for Adhesives

C—Cementitious Mortars

- C1:** Normal—Tensile bond strength of ≥ 72.5 psi (≥ 0.5 N/mm²) when tested per ISO 13007 curing parameters, including water immersion, heat aging, and freeze-thaw cycling. Twenty-eight-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi) after 20 minutes open time.
- C2:** Improved—Tensile bond strength of ≥ 145 psi (≥ 1 N/mm²) when tested per ISO 13007 curing parameters, including water immersion, heat aging, and freeze-thaw cycling. Twenty-eight-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi) after 20 minutes open time.

Note: A Tensile Bond Test quantifies the amount of vertical force required to pull a tile or stone from a given substrate after a prescribed period of time. This test can be performed both in the lab and at the jobsite.

D—Dispersion Adhesives (Mastics)

- D1:** Normal—Shear adhesion strength of ≥ 145 psi (≥ 1 N/mm²) when tested per ISO 13007 curing parameters, including heat aging. Twenty-eight-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi) after 20 minutes open time.
- D2:** Improved—D1 performance plus additional shear adhesion strength of ≥ 72.5 psi (0.5 N/mm²) after

21-day air cure and 7-day water immersion; also shear adhesion strength of ≥ 145 psi (1 N/mm²) at elevated temperatures.

R—Reaction Resin Adhesives (epoxy or polyurethane)

- R1:** Normal—Shear adhesion strength of ≥ 290 psi (2 N/mm²) when tested per ISO 13007 curing parameters, including water immersion. Twenty-eight-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi) after 20 minutes open time.
- R2:** Improved—R1 performance plus additional shear adhesion strength of ≥ 290 psi (2 N/mm²) after thermal shock testing.

ISO Optional Performance Characteristics for Adhesives

F—Fast-Setting/Fast-Drying

- F:** Fast-setting (cementitious) with a minimum tensile bond strength of ≥ 72.5 psi (0.5 N/mm²) achieved within 24 hours. Twenty-eight-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi) after 10 minutes open time.
- F:** Fast-drying (D2 dispersion adhesive/mastic) with a minimum shear bond strength of ≥ 72.5 psi (0.5 N/mm²) after 7-day air cure and 7-day water immersion; also shear adhesion strength of ≥ 145 psi (1 N/mm²) at elevated temperatures.

E—Extended Open Time

- E:** “Extended open time” extends the open time in which a tile can be laid into the adhesive without loss of minimum bond strength. This would extend the “Open Time” of a C1 or C2, D1 or D2 adhesive from 20 minutes to 30 minutes for a 28-day tensile adhesion bond strength ≥ 0.5 N/mm² (72.5 psi).

T—Thixotropic [Non-Slip/Non-Sag]

- T:** Slip resistant adhesives must not allow a specified test tile sample applied on a vertical surface to slip more than 0.0197" (0.5 mm).

S—Deformability

Transverse deformation is the ability of the mortar to accommodate movement between the tile and the substrate.

- S1:** Normal—Deformability ≥ 0.1 " (2.5 mm) and < 0.2 " (5 mm).
- S2:** Improved—Deformability ≥ 0.2 " (5 mm).

P–Plywood Adhesion Bond Strength

P1: Normal—Tensile adhesion bond strength of ≥ 72.5 psi (0.5 N/mm²) after 28-day cure

P2: Improved—Tensile adhesion bond strength of ≥ 145 psi (1 N/mm²) after 28-day cure

ISO Performance Requirements for Cementitious Grouts**CG–Cementitious Grouts****CG1:** Normal

Abrasion resistance < 0.12 in³ (2000 mm³)

Flexural strength under standard conditions > 362.5 psi (2.5 N/mm²)

Flexural strength after freeze-thaw cycles > 362.5 psi (2.5 N/mm²)

Compressive strength under standard conditions > 2176 psi (15 N/mm²)

Compressive strength after freeze-thaw cycles > 2176 psi (15 N/mm²)

Shrinkage < 3 mm/m

Water absorption after 30 min < 5 g

Water absorption after 240 min < 10 g

CG2: Improved

Meets CG1 criteria with either improved abrasion resistance, reduced water absorption or both as given below.

ISO Optional Performance Characteristics for Cementitious Grouts**A–Abrasion Resistance**

A: High abrasion resistance ≤ 0.06 cubic inch (1000 mm³).

W–Water Absorption

W: Reduced water absorption after 30 min ≤ 2 g; reduced water absorption after 240 min ≤ 5 g

F–Fast Setting (CG1 or CG2)

F: Fast-setting with compressive strength in ≤ 24 hours under standard conditions > 2176 psi (15 N/mm²)

ISO Performance Requirements for Reaction Resin Grouts**RG–Reaction Resin Grouts**

Abrasion resistance ≤ 0.015 cubic inch (250 mm³)

Flexural strength under standard conditions ≥ 4351 psi (30 N/mm²)

Compressive strength under standard conditions ≥ 6527 psi (45 N/mm²)

Shrinkage ≤ 1.5 mm/m

Water absorption after 240 min < 0.1 g

Note: An RG grout will always have higher performance characteristics than the best CG2AW grout in addition to higher chemical resistance to a wider variety of chemicals. Always check with the grout manufacturer for chemical resistance to a specific chemical.

Code			C–Cementitious Mortars
Type	Class	Optional Characteristics	
C	1	—	Cementitious mortar with normal tensile bond strength <ul style="list-style-type: none"> • Tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) when tested per 13007 curing parameters • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 20 minutes open time
C	2	—	Cementitious mortar with improved tensile bond strength <ul style="list-style-type: none"> • Tensile adhesion bond strength of $\geq 1 \text{ N/mm}^2$ (145 psi) when tested per 13007 curing parameters • Baseline “C1” open time characteristics
C	1 or 2	E	Cementitious mortar with extended open time <ul style="list-style-type: none"> • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 30 minutes open time
C	1 or 2	F	Cementitious mortar, fast-setting <ul style="list-style-type: none"> • 24-hour tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 10 minutes open time
C	1 or 2	T	Cementitious mortar with slip resistance <ul style="list-style-type: none"> • Will not allow a tile applied on a vertical surface to slip more than 0.5 mm (.0196")
C	1 or 2	S1	Cementitious mortar with normal deformability <ul style="list-style-type: none"> • Deformability $\geq 2.5 \text{ mm}$ (0.1") and $< 5 \text{ mm}$ (0.2") when tested per 13007
C	1 or 2	S2	Cementitious mortar with improved deformability <ul style="list-style-type: none"> • Deformability $\geq 5 \text{ mm}$ (0.2") when tested per 13007
C	1 or 2	P1	Cementitious mortar with normal adhesion to EGP (exterior glue plywood) <ul style="list-style-type: none"> • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi)
C	1 or 2	P2	Cementitious mortar with improved adhesion to EGP (exterior glue plywood) <ul style="list-style-type: none"> • 28-day tensile adhesion bond strength of $\geq 1 \text{ N/mm}^2$ (145 psi) • Note: It is recommended with EGP installations over 16" O.C. that the “S2” code also be specified in addition to the “P2” code.

Code			D–Dispersion (Mastic) Adhesives
Type	Class	Optional Characteristics	
D	1	—	Dispersion (Mastic) adhesive with normal shear bond adhesion strength <ul style="list-style-type: none"> • Shear adhesion bond strength of $\geq 1 \text{ N/mm}^2$ (145 psi) when tested per 13007 curing parameters • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 20 minutes open time
D	2	—	Dispersion (Mastic) adhesive with improved shear bond adhesion strength <ul style="list-style-type: none"> • Shear adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 21-day air cure, 7-day water immersion • Shear adhesion bond strength of $\geq 1 \text{ N/mm}^2$ (145 psi) at elevated temperatures • Baseline “D1” open time and adhesion strength characteristics for all other curing parameters
D	1 or 2	T	Dispersion (Mastic) adhesive with slip resistance <ul style="list-style-type: none"> • Will not allow a tile applied on a vertical surface to slip more than 0.5 mm (.0196")
D	2	F or A	Dispersion (Mastic) adhesive, fast (accelerated)-drying <ul style="list-style-type: none"> • Shear adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 7-day air cure, 7-day water immersion • Shear adhesion bond strength of $\geq 1 \text{ N/mm}^2$ (145 psi) at elevated temperatures
D	1 or 2	E	Dispersion (Mastic) adhesive with extended open time <ul style="list-style-type: none"> • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 30 minutes open time

Code			R—Reaction Resin (Epoxy or Urethane) Adhesives
Type	Class	Optional Characteristics	
R	1	—	Reaction resin (epoxy or urethane) adhesive <ul style="list-style-type: none"> • Shear adhesion bond strength of $\geq 2 \text{ N/mm}^2$ (290 psi) when tested per 13007 curing parameters • 28-day tensile adhesion bond strength of $\geq 0.5 \text{ N/mm}^2$ (72.5 psi) after 20 minutes open time
R	2	—	Reaction resin (epoxy or urethane) adhesive <ul style="list-style-type: none"> • Shear adhesion bond strength of $\geq 2 \text{ N/mm}^2$ (290 psi) after high temperature thermal shock • Baseline “R1” open time and adhesion strength characteristics for all other curing parameters
R	1 or 2	T	Reaction resin (epoxy or urethane) adhesive with slip resistance <ul style="list-style-type: none"> • Will not allow a tile applied on a vertical surface to slip more than 0.5 mm (.0196")

Code			CG—Cementitious Grouts
Type	Class	Optional Characteristics	
CG	1	—	Normal cementitious grout <ul style="list-style-type: none"> • Abrasion resistance $< 2000 \text{ mm}^3$ (0.12 in³) • Flexural strength under standard conditions $> 2.5 \text{ N/mm}^2$ (362.5 psi) • Flexural strength after freeze-thaw cycles $> 2.5 \text{ N/mm}^2$ (362.5 psi) • Compressive strength under standard conditions $> 15 \text{ N/mm}^2$ (2176 psi) • Compressive strength after freeze-thaw cycles $> 15 \text{ N/mm}^2$ (2176 psi) • Shrinkage $< 3 \text{ mm/m}$ • Water absorption after 30 min $< 5 \text{ g}$ • Water absorption after 240 min $< 10 \text{ g}$
CG	2	A	Improved cementitious grout with high abrasion resistance <ul style="list-style-type: none"> • Baseline “CG1” characteristics • Abrasion resistance $< 1000 \text{ mm}^3$ (0.06 in³)
CG	2	W	Improved cementitious grout with reduced water absorption <ul style="list-style-type: none"> • Baseline “CG1” characteristics • 30 minute water absorption $< 2 \text{ g}$ • 240 minute water absorption $< 5 \text{ g}$
CG	1 or 2	F	Fast-setting cementitious grout <ul style="list-style-type: none"> • Baseline “CG1,” “CG2A,” or “CG2W” characteristics • 24-hour compressive strength under standard conditions $> 15 \text{ N/mm}^2$ (2176 psi)

Code			RG—Reaction Resin (Epoxy or Urethane) Grouts
Type	Class	Optional Characteristics	
RG	—	—	<ul style="list-style-type: none"> • Abrasion resistance $\leq 250 \text{ mm}^3$ (0.15 in³) • Flexural strength under standard conditions $\geq 30 \text{ N/mm}^2$ (4351 psi) • Compressive strength under standard conditions $\geq 45 \text{ N/mm}^2$ (6527 psi) • Shrinkage $\leq 1.5 \text{ mm/m}$ • Water absorption after 240 min $\leq 0.1 \text{ g}$

APPENDIX B. ESTIMATED WEIGHTS FOR FLOOR INSTALLATIONS

The estimated weight of each floor installation method is provided to aid the design professional in calculating the contribution of the tile installation to the total dead load. Loads from all fixed objects and materials are dead loads. Dead load is defined in the 2009 International Building Code (IBC) as “the weight of materials of construction incorporated into the building, including but not limited to walls, floors, roofs, ceilings, stairways, built-in partitions, finishes, cladding and other similarly incorporated architectural and structural items, and the weight of fixed service equipment, such as cranes, plumbing stacks and risers, electrical feeders, heating, ventilating and air-conditioning systems and fire sprinkler systems.”

The estimated weights are based on typical weights of the materials used in the installation methods. They include materials installed above the substrate, not the substrate itself.

For each flooring installation method, a typical weight per square foot is provided. Where material thickness can vary, the weight per relevant unit of measure is given. For the actual weight of any installation, the actual products used and thickness of application must be considered.

Typical weights for individual components used to calculate the estimated weights are provided in Tables 1–6.

General Assumptions

Tile: The estimated weights assume a $\frac{3}{8}$ "-thick ceramic tile weighing 4 pounds/square foot, except in F134, in which the weight of a $1\frac{1}{4}$ "-thick packing house tile was used.

Stone Tile: The estimated weights assume a weight of 6 pounds/square foot for stone tiles. Stone densities vary from about 120 pounds/cubic foot for high-porosity limestones to 200 pounds/cubic foot for the black, igneous rocks commonly sold as “granite.” Additionally, stone tile thicknesses are generally 10, 12, or 15 mm, giving a range of weight/square foot as shown in the table below.

Weight per ft. ² of Stone Tiles			
Stone Density (lbs./cu. ft.)	Stone Thickness		
	10 mm $\frac{13}{32}$ in.	12 mm $\frac{15}{32}$ in.	15 mm $\frac{19}{32}$ in.
120	3.9 lbs.	4.7 lbs.	5.9 lbs.
140	4.6 lbs.	5.5 lbs.	6.9 lbs.
160	5.2 lbs.	6.3 lbs.	7.9 lbs.
180	5.9 lbs.	7.1 lbs.	8.9 lbs.
200	6.6 lbs.	7.9 lbs.	9.8 lbs.

Mortar Bed Assumptions

The estimated weights assume a $\frac{3}{4}$ "-thick or $1\frac{1}{4}$ "-thick mortar bed, depending on the minimum thickness required by the method. Where hydronic tubes are encapsulated in the mortar bed, the estimated weight assumes a 2"-thick mortar bed ($\frac{3}{4}$ " of mortar to encapsulate the $\frac{5}{8}$ " O.D. tubing and $1\frac{1}{4}$ " of mortar over that.) Thicker mortar beds can be calculated for by adding 3 pounds/square foot for each additional $\frac{1}{4}$ " of mortar. Estimated weights assume use of the standard materials of a cured mortar bed followed by a thin-bed tile application. Metal lath (2.5 pounds/square yard), where applicable, adds 0.3 pounds/square foot, per manufacturer literature.

Mortar Bed Bond Coat: The weight of a $\frac{1}{16}$ "-thick cementitious bond coat was used for all bonded mortar bed methods.

Chemical-Resistant Membrane: The typical weight of a $\frac{1}{4}$ "-thick chemical-resistant membrane was used in the weight calculation for F134, and it is assumed that the membrane is self-adhering and proportional in weight to a typical crack isolation membrane.

Cleavage Membrane: Cleavage membrane weight was assumed to be insignificant and not factored into the estimated weights.

Cementitious Self-Leveling Underlayment Assumptions

The estimated weights assume a $\frac{1}{2}$ "-thick cementitious self-leveling layer, with or without electric radiant systems. For each method with hydronic tubes, the estimated weight assumes a $1\frac{1}{4}$ "-thick cementitious self-leveling layer ($\frac{3}{4}$ " of self-leveler to encapsulate $\frac{5}{8}$ " O.D. tubing and $\frac{1}{2}$ " of self-leveler over that). Thicker self-leveling application can be calculated for by adding $2\frac{3}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of self-leveler.

Metal/Plastic Lath: For methods in which use of metal or plastic lath is optional, metal lath is included in the estimated weights at 2.5 pounds/square yard, adding 0.3 pounds/square foot. The weight of plastic lath is assumed to be insignificant and is not factored into the estimated weights of installation methods that reference only plastic lath.

Membranes: The typical weight of a crack isolation membrane with a $\frac{1}{16}$ " cementitious bond coat is included in the estimated weights of all methods with hydronic tubing.

Primer: The weights of primers is assumed to be insignificant and is not factored into the estimated weights.

Poured Gypsum Assumptions

The estimated weights assume $\frac{3}{4}$ " of poured gypsum, whether over concrete or plywood. For methods with hydronic radiant heating tubes, the estimated weight assumes $1\frac{1}{2}$ " of poured gypsum ($\frac{3}{4}$ " of poured gypsum to encapsulate $\frac{5}{8}$ " O.D. tubing and $\frac{3}{4}$ " of poured gypsum over that). Thicker applications of poured gypsum can be calculated for by adding $2\frac{1}{4}$ pounds/square foot for each additional $\frac{1}{4}$ " of poured gypsum.

Crack Isolation Membranes: The typical weight of a crack isolation membrane with a $\frac{1}{16}$ " cementitious bond coat is included in the estimated weights of all poured gypsum methods.

Primer/Sealer: The weights of primers/sealers atop poured gypsum is assumed to be insignificant and is not factored into the estimated weights.

Backer Board and Wood Underlayment Panel Assumptions

The weight of a $\frac{1}{8}$ "-thick cementitious mortar bedding coat is included in the estimated weights of all backer board methods. For wood underlayment panel methods, the weight of a bedding coat is not included, nor is the weight of fasteners, which is assumed to be insignificant.

Cement Backer Board: A weight of 4 pounds/square foot is assumed for $\frac{1}{2}$ " cement backer board, and a weight of 2 pounds/square foot is assumed for $\frac{1}{4}$ " board, although some manufacturers list weights closer to 3 pounds/square foot and 1.5 pounds/square foot, respectively.

Other Backer Boards: Weights of other types of backer boards, including cementitious-coated extruded foam, coated glass mat water resistant gypsum, fiber-cement, and fiber-reinforced water-resistant gypsum were derived from weights listed in the product literature of various manufacturers.

Membrane Assumptions

A $\frac{1}{16}$ "-thick cementitious bond coat is used for all sheet applied, non-self-adhering membrane methods. Partial-coverage crack isolation membrane weights are assumed to be insignificant.

Table 1: Direct Bond Methods

Method	Weight (lbs. per sq. ft.)					
	Mortar Fill	Tile/Stone Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
F102/F102S		1¼	4	6	5	7
F104/F104S		1¼	4	6	5	7
F105/F105S		1¼	4	6	5	7
F113/F113S		1¼	4	6	5	7
F113A/F113AS		1¼	4	6	5	7
F115		1¼	4		5	
F115A		1¼	4		5	
F116E		1½	4		6	
F116O		¾	4		5	
F131		1½	4		6	
F133		1¼	4		5	
RH110/RH110S		1¼	4	6	5	7
RH110A/RH110AS		1¼	4	6	5	7
RH115	1¼	1¼	4		7	
RH115A	1¼	1¼	4		7	

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest ¼ pound. However, non-rounded values were used for all calculations.

Table 2: Mortar Bed Methods

Method	Weight (lbs. per sq. ft.)										
	Drainage Layer	Metal Lath	Mortar Bed Bond Coat	Wire	Mortar Bed	Membrane	Tile or Stone Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
F101/F101S: ¾" Mortar Bed			½		9		1¼	4	6	15	17
F103/F103S: 1¼" Mortar Bed	10½			¼	15		1¼	4	6	31	33
F103B/F103BS: 1¼" Mortar Bed	¼			¼	15		1¼	4	6	21	23
F111/F111S: 1¼" Mortar Bed				¼	15		1¼	4	6	21	23
F112/F112S: ¾" Mortar Bed			½		9		1¼	4	6	15	17
F114: 1¼" Mortar Bed				¼	15		1¼	4		21	
F121/F121S: 1¼" Mortar Bed				¼	15		1¼	4	6	21	23
F132: ¾" Mortar Bed			½		9		1½	4		15	
F134: ¾" Mortar Bed			½		9	1¼	1½	13		26	
RH117/RH117S: 1¼" Mortar Bed				¼	24		1¼	4	6	30	32
RH141/RH141S: 1¼" Mortar Bed				¼	24		1¼	4	6	30	32
F141/F141S: 1¼" Mortar Bed				¼	15		1¼	4	6	21	23
F145: ¾" Mortar Bed		¼			9		1¼	4		15	

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest ¼ pound. However, non-rounded values were used for all calculations.

Table 3: Cementitious Self-Leveling Underlayment (SLU) Methods

Method	Weight (lbs. per sq. ft.)								
	Metal Lath	SLU	Membrane Bond Coat	Membrane	Tile or Stone Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
F205/F205S: ½" SLU		5½			1¼	4	6	11	13
F205A/F205AS: ½" SLU		5½			1¼	4	6	11	13
RH112/RH112S: 1¼" SLU		13½	½	¼	1¼	4	6	19	21
RH112A/RH112AS: 1¼" SLU		13½	½	¼	1¼	4	6	19	21
RH116/RH116S: ½" SLU		5½			1¼	4	6	11	13
RH116A/RH116AS: ½" SLU		5½			1¼	4	6	11	13
RH123: 1¼" SLU		13½	½	¼	1¼	4		19	
RH140: ½" SLU		5½			1¼	4		11	
F185: ½" SLU	¼	5½			1¼	4		11	

Table 4: Poured Gypsum Methods

Method	Weight (lbs. per sq. ft.)								
	Gypsum	Membrane Bond Coat	Membrane	Tile Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)	
F200/F200S: ¾" Gypsum	6½	½	¼	1¼	4	6	12	14	
F200A/F200AS: ¾" Gypsum	6½	½	¼	1¼	4	6	12	14	
RH111/RH111S: 1½" Gypsum	13	½	¼	1¼	4	6	19	21	
RH111A/RH111AS: 1½" Gypsum	13	½	¼	1¼	4	6	19	21	
RH122: 1½" Gypsum	13	½	¼	1¼	4		19		
F180: ¾" Gypsum	6½	½	¼	1¼	4		12		

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest ¼ pound. However, non-rounded values were used for all calculations.

Table 5: Backer Board and Wood Underlayment Panel Methods

Method	Backer Board or Wood Underlayment	Weight (lbs. per sq. ft.)								
		Mortar Under Board	Plywood Underlayment	Backer Board	Radiant System Mortar	Tile Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
RH130	1 ⁵ / ₃₂ " Plywood		1 ¹ / ₂		1 ³ / ₄	1 ¹ / ₄	4		7	
RH130	1 ⁹ / ₃₂ " Plywood		1 ³ / ₄		1 ³ / ₄	1 ¹ / ₄	4		7	
RH135	1/4" CBU	1		2	1 ³ / ₄	1 ¹ / ₄	4		10	
RH135	1/2" CBU	1		4	1 ³ / ₄	1 ¹ / ₄	4		12	
RH135	1/4" Cementitious-Coated Foam	1		1/2	1 ³ / ₄	1 ¹ / ₄	4		8	
RH135	1/2" Cementitious-Coated Foam	1		1/2	1 ³ / ₄	1 ¹ / ₄	4		8	
RH135	1/4" Coated-Glass Mat Gypsum	1		1 ¹ / ₂	1 ³ / ₄	1 ¹ / ₄	4		9	
RH135	1/2" Coated-Glass Mat Gypsum	1		2	1 ³ / ₄	1 ¹ / ₄	4		10	
RH135	1/4" Fiber-Cement	1		2	1 ³ / ₄	1 ¹ / ₄	4		10	
RH135	7/16" Fiber-Cement	1		2 ¹ / ₂	1 ³ / ₄	1 ¹ / ₄	4		10	
RH135	1/4" Fiber Gypsum	1		1 ¹ / ₂	1 ³ / ₄	1 ¹ / ₄	4		9	
RH135	3/8" Fiber Gypsum	1		2	1 ³ / ₄	1 ¹ / ₄	4		10	
RH135	1/2" Fiber Gypsum	1		2 ³ / ₄	1 ³ / ₄	1 ¹ / ₄	4		11	
F142	1 ⁹ / ₃₂ " Plywood		1 ³ / ₄			3/4	4		7	
F143	1 ⁵ / ₃₂ " Plywood		1 ¹ / ₂			1 ¹ / ₂	4		7	
F143	1 ⁹ / ₃₂ " Plywood		1 ³ / ₄			1 ¹ / ₂	4		7	
F150	1 ⁵ / ₃₂ " Plywood		1 ¹ / ₂			1 ¹ / ₄	4		7	
F150	1 ⁹ / ₃₂ " Plywood		1 ³ / ₄			1 ¹ / ₄	4		7	
F160	3/8" EG/LWP		1 ¹ / ₂			1 ¹ / ₄	4		7	
F144	1/4" CBU	1		2		1 ¹ / ₄	4		8	
F144	1/2" CBU	1		4		1 ¹ / ₄	4		10	
F144	1/4" Fiber-Cement	1		2		1 ¹ / ₄	4		8	
F144	7/16" Fiber-Cement	1		2 ¹ / ₂		1 ¹ / ₄	4		9	
F146	1/4" Coated-Glass Mat Gypsum	1		1 ¹ / ₂		1 ¹ / ₄	4		8	
F146	1/2" Coated-Glass Mat Gypsum	1		2		1 ¹ / ₄	4		8	
F170	1/4" Fiber Gypsum	1		1 ¹ / ₂		1 ¹ / ₄	4		8	
F170	3/8" Fiber Gypsum	1		2		1 ¹ / ₄	4		8	
F170	1/2" Fiber Gypsum	1		2 ³ / ₄		1 ¹ / ₄	4		9	
F175	1/2" Cementitious-Coated Foam	1		1/2		1 ¹ / ₄	4		7	

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest 1/4 pound. However, non-rounded values were used for all calculations.

Table 5: Backer Board and Wood Underlayment Panel Methods (Continued)

Method	Backer Board or Wood Underlayment	Weight (lbs. per sq. ft.)								
		Mortar Under Board	Plywood Underlayment	Backer Board	Radiant System Mortar	Tile Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
F149	1/32" Plywood		1 3/4			1 1/4	4		7	
F151	1/4" Coated-Glass Mat Gypsum	1		1 1/2		1 1/4	4		8	
F151	1/2" Coated-Glass Mat Gypsum	1		2		1 1/4	4		8	
F155	1/32" Plywood		1 3/4			1 1/4	4		7	
F250S	15/32" Plywood, 1/4" CBU	1	1 1/2	2		1 1/4		6		11
F250S	19/32" Plywood, 1/4" CBU	1	1 3/4	2		1 1/4		6		12
F250S	15/32" Plywood, 1/2" CBU	1	1 1/2	4		1 1/4		6		13
F250S	19/32" Plywood, 1/2" CBU	1	1 3/4	4		1 1/4		6		14
F250S	15/32" Plywood, 1/4" Cementitious-Coated Foam	1	1 1/2	1/2		1 1/4		6		10
F250S	19/32" Plywood, 1/4" Cementitious-Coated Foam	1	1 3/4	1/2		1 1/4		6		10
F250S	15/32" Plywood, 1/2" Cementitious-Coated Foam	1	1 1/2	1/2		1 1/4		6		10
F250S	19/32" Plywood, 1/2" Cementitious-Coated Foam	1	1 3/4	1/2		1 1/4		6		10
F250S	15/32" Plywood, 1/4" Coated-Glass Mat Gypsum	1	1 1/2	1 1/2		1 1/4		6		11
F250S	19/32" Plywood, 1/4" Coated-Glass Mat Gypsum	1	1 3/4	1 1/2		1 1/4		6		11
F250S	15/32" Plywood, 1/2" Coated-Glass Mat Gypsum	1	1 1/2	2		1 1/4		6		11
F250S	19/32" Plywood, 1/2" Coated-Glass Mat Gypsum	1	1 3/4	2		1 1/4		6		12
F250S	15/32" Plywood, 1/4" Fiber-Cement	1	1 1/2	2		1 1/4		6		11
F250S	19/32" Plywood, 1/4" Fiber-Cement	1	1 3/4	2		1 1/4		6		12
F250S	15/32" Plywood, 7/16" Fiber-Cement	1	1 1/2	2 1/2		1 1/4		6		12
F250S	19/32" Plywood, 7/16" Fiber-Cement	1	1 3/4	2 1/2		1 1/4		6		12
F250S	15/32" Plywood, 1/4" Fiber Gypsum	1	1 1/2	1 1/2		1 1/4		6		11
F250S	19/32" Plywood, 1/4" Fiber Gypsum	1	1 3/4	1 1/2		1 1/4		6		11
F250S	15/32" Plywood, 3/8" Fiber Gypsum	1	1 1/2	2		1 1/4		6		11
F250S	19/32" Plywood, 3/8" Fiber Gypsum	1	1 3/4	2		1 1/4		6		12
F250S	15/32" Plywood, 1/2" Fiber Gypsum	1	1 1/2	2 3/4		1 1/4		6		12
F250S	19/32" Plywood, 1/2" Fiber Gypsum	1	1 3/4	2 3/4		1 1/4		6		13

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest 1/4 pound. However, non-rounded values were used for all calculations.

Table 6: Membrane and Cork Underlayment Methods

Method	Membrane Type	Weight (lbs. per sq. ft.)							
		Plywood	Membrane Bond Coat	Membrane	Tile or Stone Bond Coat	Ceramic Tile	Stone	Total Assembly* (Tile)	Total Assembly* (Stone)
F122/ F122S	Waterproofing		½	¼	1¼	4	6	6	8
F122A/ F122AS	Waterproofing		½	¼	1¼	4	6	6	8
F125/ F125S	Crack Isolation		½	¼	1¼	4	6	6	8
F128	Uncoupling		½	¼	1¾	4		6	
F135	½" Cork		¼	½	1¼	4		6	
F136	Bonded Sound Reduction		¼	½	1¼	4		6	
F147	Uncoupling	1	½	¼	1¾	4		7	
F148	Uncoupling		½	¼	1¾	4		6	
F152	Generic	1	½	¼	1¼	4		7	

*Note: For presentation purposes, total assembly weights are rounded to the nearest pound, and individual component weights are rounded to the nearest ¼ pound. However, non-rounded values were used for all calculations.

APPENDIX C. MATERIAL AND INSTALLATION SPECIFICATIONS, TEST METHODS, AND GUIDES REFERENCED IN THIS HANDBOOK

All standards and specifications are revised or updated periodically. The current status can be confirmed by writing the particular authority. For the latest edition of American National Standards ANSI A108, A118, A136.1, or A137.1, contact the Tile Council of North America at www.TCNAtile.com.

American Concrete Institute (ACI)

38800 Country Club Drive
Farmington Hills, MI 48331
www.concrete.org

ACI Specifications:

117-06 Specifications for Tolerances for Concrete Construction and Materials and Commentary

American National Standards Institute (ANSI)

1899 L Street, NW, 11th floor
Washington, DC 20036
www.ansi.org

ANSI Installation Specifications:

A108.01-2016	General Requirements: Subsurfaces and Preparations by Other Trades
A108.02-2016	General Requirements: Materials, Environmental, and Workmanship
A108.1A-2014	Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar
A108.1B-2010	Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar
A108.1C-2016	Contractors' Option: Installation of Ceramic Tile in the Wet-Set Method with Portland Cement Mortar or Installation of Ceramic Tile on a Cured Portland Cement Mortar Setting Bed with Dry-Set or Latex-Portland Cement Mortar
A108.4-2009	Installation of Ceramic Tile with Organic Adhesives or Water Cleanable Tile-Setting Epoxy Adhesive
A108.5-2010	Installation of Ceramic Tile with Dry-Set Portland Cement Mortar or Latex-Portland Cement Mortar
A108.6-2010	Installation of Ceramic Tile with Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy
A108.8-2010	Installation of Ceramic Tile with Chemical Resistant Furan Resin Mortar and Grout
A108.9-2010	Installation of Ceramic Tile with Modified Epoxy Emulsion Mortar/grout
A108.10-2010	Installation of Grout in Tilework
A108.11-2016	Interior Installation of Cementitious Backer Units
A108.12-2010	Installation of Ceramic Tile with EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar
A108.13-2016	Installation of Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone
A108.14-2010	Installation of Paper-Faced Glass Mosaic Tile
A108.15-2016	Alternative Method: Installation of Paper-Faced Mounted Glass Mosaic Tile
A108.16-2016	Installation of Paper-Faced, Back-Mounted, or Clear Film Face-Mounted Glass Mosaic Tile
A108.17-2016	Installation of Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone

ANSI Material Specifications:

A118.1-2018	Dry-Set Portland Cement Mortar
A118.3-2013	Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive
A118.4-2018	Latex-Portland Cement Mortar
A118.5-2016	Chemical Resistant Furan Mortars and Grouts for Tile Installation
A118.6-2016	Standard Cement Grouts for Tile Installation
A118.7-2016	High Performance Cement Grouts for Tile Installation
A118.8-2016	Modified Epoxy Emulsion Mortar/grout
A118.9-2016	Test Methods and Specifications for Cementitious Backer Units
A118.10-2014	Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
A118.11-2010	EGP (Exterior Glue Plywood) Latex-Portland Cement Mortar
A118.12-2014	Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation
A118.13-2014	Bonded Sound Reduction Membranes for Thin-Set Ceramic Tile Installation
A118.15-2018	Improved Modified Dry-Set Cement Mortar
A136.1-2013	Organic Adhesives for Installation of Ceramic Tile
A137.1-2017	Ceramic Tile
A137.2-2013	Glass Tile

American Society for Testing and Materials (ASTM)

100 Barr Harbor Drive
West Conshohocken, PA 19428

www.astm.org

ASTM Material Specifications/Test Methods:

A653/A653M-10	Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
A484-11/A484M-11	Standard Specification for General Requirements for Stainless Steel Bars, Billets, and Forgings
C97/C97M-09	Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
C99/C99M-09	Standard Test Method for Modulus of Rupture of Dimension Stone
C119-08e3	Standard Terminology Relating to Dimension Stone
C144-04	Standard Specification for Aggregate for Masonry Mortar
C150/C150M-11	Standard Specification for Portland Cement
C170/C170M-09	Standard Test Method for Compressive Strength of Dimension Stone
C206-03 (2009)	Standard Specification for Finishing Hydrated Lime
C207-06	Standard Specification for Hydrated Lime for Masonry Purposes
C241/C241M-09	Standard Test Method for Abrasion Resistance of Stone Subjected to Foot Traffic
C373-88 (2006)	Standard Test Method for Water Absorption, Bulk Density, Apparent Porosity, and Apparent Specific Gravity of Fired Whiteware Products
C424-93 (2006)	Standard Test Method for Craze Resistance of Fired Glazed Whitewares by Autoclave Treatment
C472 -99 (2009)	Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters and Gypsum Concrete
C482-02 (2009)	Standard Test Method for Bond Strength of Ceramic Tile to Portland Cement Paste
C484-99 (2009)	Standard Test Method for Thermal Shock Resistance of Glazed Ceramic Tile
C503/C503M-10	Standard Specification for Marble Dimension Stone
C568/C568M-10	Standard Specification for Limestone Dimension Stone
C578-10a	Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation
C615/C615M-11	Standard Specification for Granite Dimension Stone
C616/C616M-10	Specification for Quartz-Based Dimension Stone
C627-10	Standard Test Method for Evaluating Ceramic Floor Tile Installation Systems Using the Robinson-Type Floor Tester
C629/C629M-10	Standard Specification for Slate Dimension Stone
C634-11	Standard Terminology Relating to Building and Environmental Acoustics
C645-09a	Standard Specification for Nonstructural Steel Framing Members
C650-04 (2009)	Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
C880/C880M-09	Standard Test Method for Flexural Strength of Dimension Stone
C919-12	Standard Practice for Use of Sealants in Acoustical Applications
C920-11	Standard Practice for Elastomeric Joint Sealants
C1026-10	Standard Test Method for Measuring the Resistance of Ceramic Tile to Freeze-Thaw Cycling
C1027-09	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
C1028-07e1	Standard Test Method for Determining the Static Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method
C1178/C1178M-08	Standard Specification for Coated Glass Mat Water-Resistant Gypsum Backing Panel
C1193-11a	Standard Guide for Use of Joint Sealants
C1201/C1201M-09	Standard Test Method for Structural Performance of Exterior Dimension Stone Cladding Systems by Uniform Static Air Pressure Difference
C1243-93 (2009)	Standard Test Method for Relative Resistance to Deep Abrasive Wear of Unglazed Ceramic Tile by Rotating Disc
C1278/C1278M-07a	Standard Specification for Fiber-Reinforced Gypsum Panel
C1288-99 (2010)	Standard Specification for Discrete Non-Asbestos Fiber-Cement Interior Substrate Sheets
C1325-08b	Standard Specification for Non-Asbestos Fiber-Mat Reinforced Cementitious Backer Units
C1353-09	Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform, Double-Head Abraser
C1354/C1354M-09	Standard Test Method for Strength of Individual Stone Anchorages in Dimension Stone
C1378-04 (2009)	Standard Test Method for Determination of Resistance to Staining
C1396/C1396M-09a	Standard Specification for Gypsum Board
C1496-09	Standard Guide for Assessment and Maintenance of Exterior Dimension Stone Masonry Walls and Facades
C1515-09	Standard Guide for Cleaning of Exterior Dimension Stone, Vertical and Horizontal Surfaces, New or Existing
C1526-08	Standard Specification for Serpentine Dimension Stone
C1527/C1527M-11	Standard Specification for Travertine Dimension Stone
C1528-10	Standard Guide for Selection of Dimension Stone for Exterior Use
C1658/C1658M-06	Standard Specification for Glass Mat Gypsum Panels

ASTM Material Specifications/Test Methods (continued):

D4068-09	Standard Specification for Chlorinated Polyethylene (CPE) Sheeting for Concealed Water-Containment Membrane
D4551-96 (2001)	Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Flexible Concealed Water-Containment Membrane
D5260-04 (2010)	Standard Classification for Chemical Resistance of Poly (Vinyl Chloride) (PVC) Homopolymer and Copolymer Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds
E90-09	Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
E96/E96M-10	Standard Test Methods for Water Vapor Transmission of Materials
E119-11	Standard Test Methods for Fire Tests of Building Construction and Materials
E336-10	Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings
E413-10	Classification for Rating Sound Insulation
E492-09	Standard Test Method for Laboratory Measurement of Impact Sound Transmission Through Floor-Ceiling Assemblies Using the Tapping Machine
E548-94e1	Standard Guide for General Criteria Used for Evaluating Laboratory Competence
E596-96 (2009)	Standard Test Method for Laboratory Measurement of Noise Reduction of Sound-Isolating Enclosures
E597	Practice for Determining A Single-Number Rating of Airborne Sound Isolation for Use in Multiunit Building Specifications
E717	Standard Guide for Preparation of the Accreditation Annex of Acoustical Test Standards
E989-06	Standard Classification for Determination of Impact Insulation Class (IIC)
E1007-11	Standard Test Method for Field Measurement of Tapping Machine Impact Sound Transmission Through Floor-Ceiling Assemblies and Associated Support Structures
E1155-96 (2008)	Standard Test Method for Determining FF Floor Flatness and FL Floor Levelness Numbers
E2179-03 (2009)	Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors
F2329-05 (2011)	Standard Specification for Zinc Coating, Hot-Dip, Requirements for Application to Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners

The Association of Pool and Spa Professionals (APSP)

2111 Eisenhower Avenue
 Alexandria, VA 22314
www.apsp.org

APSP Specifications:

ANSI/NSPI-1 2003	American National Standard for Public Swimming Pools
ANSI/NSPI-2 1999	American National Standard for Public Spas
ANSI/NSPI-3 1999	American National Standard for Permanently Installed Residential Spas
ANSI/NSPI-4 2007	American National Standard for Above-ground/On-ground Residential Swimming Pools
ANSI/NSPI-5 2003	American National Standard for Residential In-ground Swimming Pools
ANSI/NSPI-11 2009	American National Standard for Water Quality for Public Pools and Spas

Gypsum Association

6525 Belcrest Road, Suite 480
 Hyattsville, MD 20782
www.gypsum.org

Gypsum Association Specifications:

GA-216-07	Application and Finishing of Gypsum Panel Products
GA-239-04	Water-Resistant Gypsum Backing Board for Ceramic Tile in Wet Areas

International Code Council (ICC)

500 New Jersey Avenue, NW, 6th Floor
Washington, DC 20001
www.iccsafe.org

ICC Specifications:

International Building Code (IBC)
International Residential Code (IRC)

International Organization for Standardization (ISO)

Chemin de Blandonnet 8
CP 401
1214 Vernier, Geneva
Switzerland
www.iso.org

ISO Material Specifications:

13006:1998	Ceramic tiles—Definitions, classification, characteristics and marking
13007-1:2010	Ceramic tiles—Grouts and adhesives—Part 1: Terms, definitions and specifications for adhesives
13007-2:2010	Ceramic Tiles—Grouts and adhesives—Part 2: Test methods for adhesives
13007-3:2010	Ceramic tiles—Grouts and adhesives—Part 3: Terms, definitions and specifications for grouts
13007-4:2010	Ceramic Tiles—Grouts and adhesives—Part 4: Test methods for grouts

Natural Stone Institute (NSI)

380 E. Lorain Street
Oberlin, OH 44074
www.naturalstoneinstitute.org

NSI Specifications:

Dimension Stone Design Manual

National Fire Protection Association (NFPA)

1 Batterymarch Park
Quincy, MA 02169
www.nfpa.org

NFPA Specifications:

NFPA99-2005 Standard for Health Care Facilities

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**Interior wall methods marked with an asterisk (*) may be suitable for exterior applications. Consult Environmental Exposure Classifications section in each method for details.*

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with Prefabricated Shower Receptor or Bathtub

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**Interior floor methods—including radiant heat methods—marked with an asterisk (*) may be suitable for exterior applications. Consult Environmental Exposure Classifications section in each method for details.*

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FLOORS, INTERIOR OVER ON-GROUND CONCRETE SUBSTRATE

Mortar Bed Methods

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FLOORS, INTERIOR OVER ON-GROUND CONCRETE SUBSTRATE, WITH RADIANT HEAT

with Electric Radiant Heat

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RADIANT HEAT, FLOORS WITH

See Floors, Interior over Above-Ground Concrete Substrate, with Radiant Heat; Floors, Interior over On-Ground Concrete Substrate, with Radiant Heat; Floors, Interior over Plywood Substrate (Joists max. 16" o.c.), with Radiant Heat; and Floors, Interior over plywood substrate (Joists max 19.2" o.c.), with Radiant Heat

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**Interior wall methods marked with an asterisk (*) may be suitable for exterior applications. Consult Environmental Exposure Classifications section in each method for details.*

WALLS, INTERIOR OVER MASONRY OR CONCRETE SUBSTRATE

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Fiandre USA

800-828-9074
www.granitifiandre.com

Florida Tile, Inc.

800-352-8453
www.floridatile.com

Interceramic

214-503-5500
www.interceramicusa.com

Iris US

800-323-9906
www.irisus.com

Ironrock

800-325-3945
www.ironrock.com

Jeffrey Court, Inc.

951-340-3383
www.jeffreycourt.com

Ken Mason Tile (also known as BCIA)

562-432-7574
www.kmt-bcia.com

Landmark Ceramics

931-325-5700
www.lcusa.com

Lamosa

52-81-80474000
www.lamosa.com

Marazzi

214-398-1411
www.marazzitile.com

Mediterranea LLC

305-718-5091
www.mediterranea-usa.com

Metropolitan Ceramics

800-325-3945
www.metroceramics.com

Milestone

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www.florimusa.com

Vitromex USA

800-848-4146
www.vitromex.com

Mohawk Ceramic

800-266-4295
www.mohawkflooring.com

Mosaicos Venecianos de Mexico, SA de CV

52-77-73296640
www.m-v-m.mx

Nitropiso

52-44-48320100
www.nitropiso.com.mx

Oceanside Glass & Tile

866-648-8222
www.glasstile.com

Porcelanite

52-55-52469912
www.porcelanite.com

Pratt & Larson Ceramics

503-231-9464
www.prattandlarson.com

Quarry Tile Company

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www.quarrytile.com

Ragno

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www.ragnousa.com

Seneca Tiles, Inc.

800-426-4335
www.senecatiles.com

Sonoma Tilemakers

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StonePeak Ceramics, Inc.

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www.stonepeakceramics.com

Summitville Tiles, Inc.

330-223-1511
www.summitville.com

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52-81-88816300

Colorobbia Mexico

52-81-80420050

Covia Corp.

800-243-9004

Ferro Mexicana

52-55-50907200

Grupo Industrial Trébol

52-81-81262380

Gruppo Pro Ceramic

52-81-81540810

IMERYS-North America Ceramics/K-T Clay

770-594-0660

Microban International, Ltd.

704-875-0806

Old Hickory Clay Company

270-247-3042

Precision H2O

800-425-2098

Sicer MX S de RL de CV

52-81-11120087

Silicatos Especiales

52-55-57559400

SITI-B&T Group S.p.A.

52-81-8372-9879

Spinks Clay Company-Lhoist North America

731-642-5414

Torreid Mexico

52-81-81545757

Vetriceramici de Mexico

52-81-40008400

Visoft USA LLC

404-509-5665

Zinc Nacional

52-81-83426861

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Allison Eden Studios

212-243-9944

American Bullnose Company

714-630-6042

American Restoration Tile, Inc.

501-455-1000

AMosaic

231-375-8037

Appomattox Tile Art Company

804-732-8810

Artfind Tile

330-264-7706

ARTO Brick & Tile

310-768-8500

B.A. Schmidt Arts & Enterprises, Inc.

847-432-5679

Brick House Tile Co. (dba Cider Press Tile)

603-357-2884

California Art Tile

858-689-9596

Casa Ceramica, Inc.

561-659-7909

Cercan Mosaic

905-851-7923

Chadwick's Surfaces International, Inc.

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Clay Decór, LLC

607-654-7428

Coatings By Sandberg

714-538-0888

CR Studio 4, Inc.

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Diamond Tech Tiles

800-937-9593

Dunis Studios
512-722-3637

Elon Tile & Stone
203-628-7179

Images in Tile USA, Inc.
(dba Bison Coating & Supply)
417-206-0252

Julian Glass Inc.
248-224-1963

Lowitz & Company
773-784-2628

M Squared Innovative Concepts, Inc.
253-383-5659

Malibu Ceramic Works
310-455-2485

McIntyre Tile Company, Inc.
707-433-8866

Mediterra Tile
877-325-5510

Mission Tile West
626-799-4595

MTM Wizard Enterprise LLC
323-756-8430

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StoneImpressions
858-274-3400

Syzygy Tileworks
575-388-5472

Terhokoski Tile
404-333-2385

Terra Firma, Ltd.
803-643-9399

Terra Green Ceramics, Inc.
765-935-4760

Tile Artisans Digital Imaging LLC
800-601-4199

Tile District, Inc.
310-489-6101

Tile Optima
571-224-5821

Toto USA, Inc.
770-282-8686

Trikeen Tileworks, Inc.
607-281-1120

Wakei & Company, Ltd.
805-577-1187

Whitehill Enterprises, LLC
417-483-0566

Woodchuck Creations
800-416-0082

ASSOCIATE INSTALLATION MEMBERS

ACG Materials

405-366-9500

AcoustiCORK/Amorim Cork Composites

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Alino, Ltd.

416-922-5466

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52-81-83369633

Aqua Mix

800-366-6877

ARDEX Americas

724-203-5000

Bexel Internacional

52-81-81300200

Blanke Corporation

800-787-5055

Boral

210-503-2634

Bostik, Inc.

800-726-7845

Calidra de Oriente, SA de CV

52-22-32753632

C-Cure

800-895-2874

CEMIX

866-GO-CEMIX

Chemstar

612-722-0079

Compotite Corporation

800-221-1056

Cortag Tools USA

305-777-2024

Creaprac

52-81-83389399

Crest

52-81-80475000

Custom Building Products

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Dependable, LLC

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Donnelly Distribution Raimondi USA

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Dural USA, Inc.

800-278-1956

DYNA Metro, Inc.

905-761-3309

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Fin Pan, Inc.

800-833-6444

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Lackmond Products, Inc.

770-919-2100

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800-243-4788

LATICRETE, SA de CV

52-81-83905005

Leggett & Platt Flooring Products

800-475-0010

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Mark E. Industries, Inc.

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Merkrete

866-516-0061

MP Global Products - SnapStone

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NAC Products, Inc.

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National Gypsum Company

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NIASA

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Panel Rey

52-81-83450055

Park Industries

800-328-2309

Pearl Abrasive Company

562-927-5561

Perdura

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Peygran Leveling System

416-841-1774

Pliteq Inc.

416-449-0049

Profilitec Corporation

855-290-9591

Proflex

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Protecto Wrap Company

800-759-9727

QEP Co., Inc.

866-435-8665

QT Sound Insulation

866-326-5712

Red Tools

52-55-55986500

Reilly Foam Corporation

561-842-8090

Roberts Consolidated Industries, Inc.

866-435-8665

Rubi Tools USA

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Schluter-Systems

800-472-4588

SGM, Inc. (Southern Grouts and Mortars)

800-641-9247

Siena Tile & Stone Installation Products

951-737-7447

Solutek

52-55-55525012

Sound Seal

413-789-1770

Superior Adhesives & Chemicals

763-202-5374

TEC

800-832-9002

TEXRITE

800-669-0115

TI-PROBOARD

800-833-6444

Tile Redi, Ltd.

800-232-6156

TileWare Products

828-322-9273

Trimaco, LLC

919-949-1141

Ultimate RB

503-472-4691

UNIBLOCK

52-81-82892100

United States Gypsum Company (USG)

800-USG-4YOU

U.S. Rubber Recycling, Inc.

909-825-1200

Wacker Polymers

610-336-2700

wedi Corporation

877-933-9334

**AFFILIATED EQUIPMENT
MANUFACTURERS**

Ferrari & Cigarini North America, SA de CV
52-81-83903970

SACMI de Mexico, SA de CV
52-81-87487200

System Norte America, SA de CV
1-800-288-1100

USA Digital, Inc.
615-547-6980

**AFFILIATED PRODUCT
MANUFACTURERS**

AlysEdwards Tile & Stone
714-917-6720

Artistic Tile
201-864-7000

Creative Metals
800-394-8145

GBI Tile + Stone
949-567-1880

Hirsch Glass Corp.
732-329-8988

International Wholesale Tile, LLC
772-223-5151

Lunada Bay Tile
310-257-1300

New Ravenna
757-442-3379

Questech Corporation
802-773-1228

Rainbow Inc.
931-552-7783

Refine Tile, LLC
270-265-3771

RFMS, Inc.
800-701-7367

Soho Studio Corp.
718-677-8453

Stonexchange, Inc.
305-513-9795

US Bullnosing, Inc.
954-567-0404

Vidrepur Internacional
55-55-930447



Why leave it to just anyone?

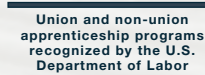
“Because tile is a permanent finish, the lowest bid should not be the driving factor, but rather who is the most qualified to perform the scope of the work specified.”

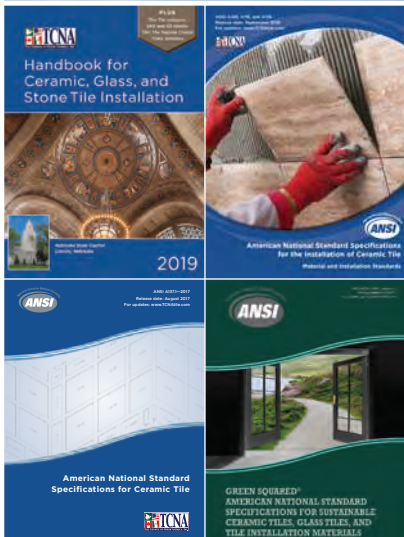
—TCNA Handbook

A home or any building today is one of the few things still made entirely “by hand” and every aspect of a tile installation relies on the tile contracting company and its installers. How good the finished installation looks, how well it performs, and how long it lasts are in their hands. After painstakingly choosing materials and specifying the performance requirements they must meet, it just doesn’t make sense to leave the rest to chance.

That’s why Tile Council of North America urges design professionals to include language in specifications to secure qualified contractors and installers. For boilerplate specification language, see the Installer and Contractor Qualifications Guide on page 48 in the *TCNA Handbook*, or visit TCNAtile.com/find-qualified.

Installer and Contractor Credentialing Programs recognized in the *TCNA Handbook*





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