Design Criteria for Ceramic Tile / Stone Installations

Noble Company
P.O. Box 350
Grand Haven, MI 49417-0350
Tel: 231-799-8000
Fax: 231-799-8850
Toll-Free: 800-878-5788
Email: richard@noblecompany.com
Web: www.noblecompany.com

Presented By: Richard Maurer
Noble Company
P.O. Box 350
Grand Haven, MI 49417-0350

Description: Provides an overview of the key design elements that are required for a successful ceramic tile/stone installation, including a discussion of the importance of properly designed crack isolation, waterproofing, and sound control membranes.

Learning Objectives

Upon completing this course, you will be able to:

- discuss the critical design elements relating to ceramic tile/stone installations that should be considered during the design and specification phases
- explain the importance of properly designed movement joints in reducing flooring failure
- state the various construction methods and materials used to facilitate a successful ceramic tile/stone installation, and
- explain how the features and characteristics of CPE (Chlorinated Polyethylene) composite sheet membranes in a flooring assembly contribute to the prevention of building movement failures.

Thermal and Structural Movement:

Design Considerations

Structural Movement

Buildings should be designed to withstand all types of movements.

Several conditions - such as natural light, temperature, dimensions, etc., contribute to potential movement and should be considered in the design stage.

This course begins with a discussion of these considerations, including:

- large span structures
- types of forces
- thermal movement
- post tension concrete
- larger tiles

Large Span Structures

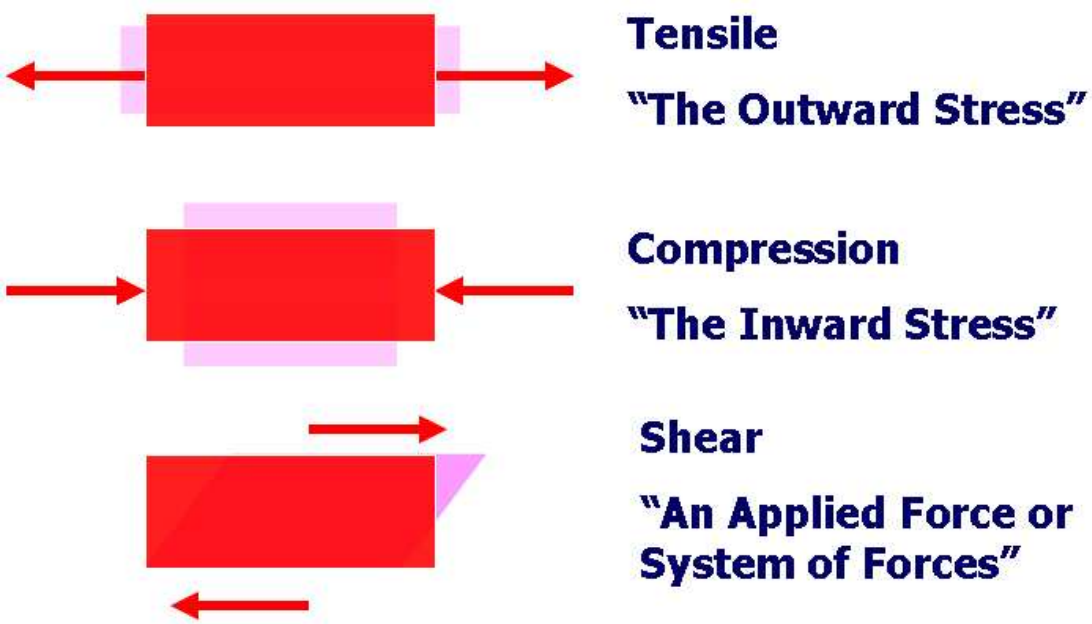
Many building are designed to address large amounts of movement.

Airports, for example, with very large spans, accommodate movements of several feet.

When designing large span structures, such as airports and shopping malls, it is critical to have proper design of the movement joints (covered in Section 2).

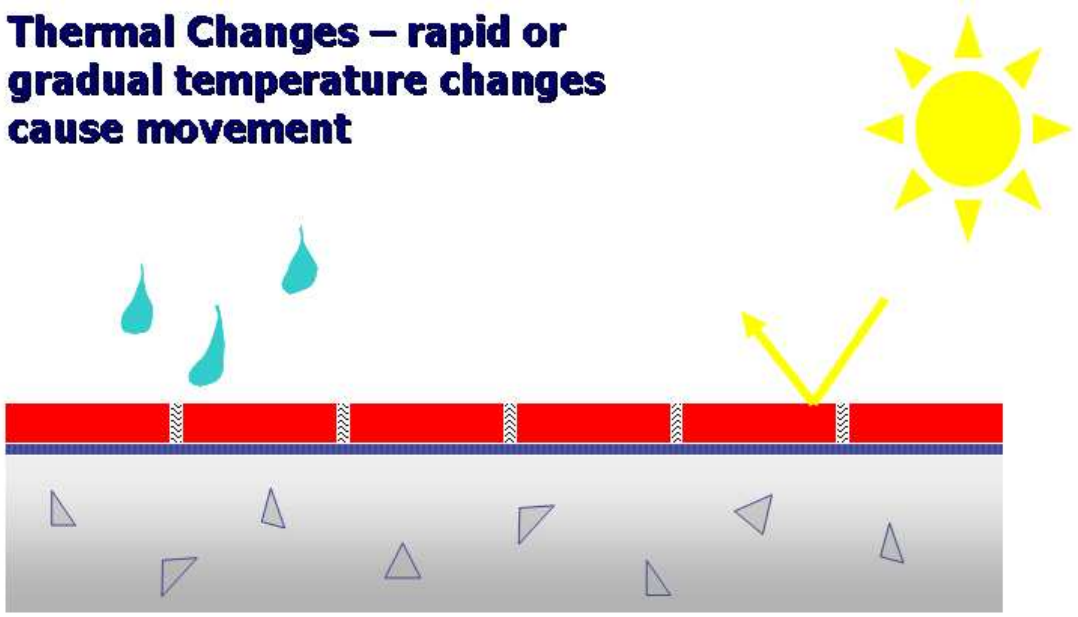
Types of Forces

Movement can result from outward stress (tensile), inward stress (compression), and applied force (shear).



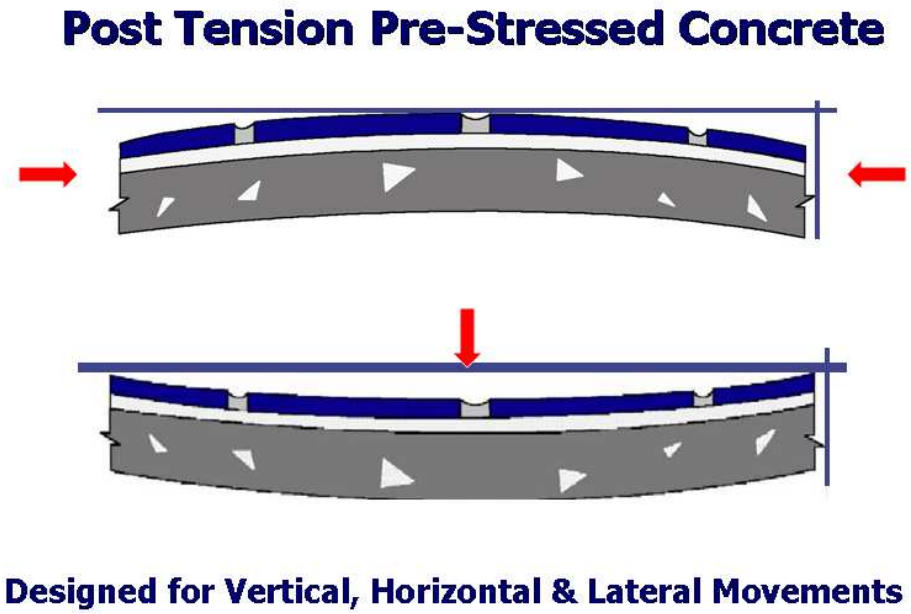
Thermal Movement

Movement can also result when flooring materials are subjected to temperature changes, such as freeze/thaw or thermal shock. Therefore, ambient conditions are a crucial element that require consideration in the design process.



Post Tension Concrete

Post tension concrete presents a unique challenge when installing ceramic and stone tile in that it is designed for vertical, horizontal, AND lateral movements.



Larger Tiles

Another consideration is tile size. Tiles have become larger over the years and the bigger the tile, the more it moves.

Additionally, the smaller the grout joint, the less the floor has the ability to “breathe.”

Together, these two conditions result in a problematic combination of internal stresses that need to be considered when writing an installation specification.

In most cases, a crack isolation membrane is recommended for a successful installation.

Movement Joints

Introduction

For the long term success of ceramic and stone tile installations, the use of membrane underlayments is recommended and proper design of movement joints is required.

The details and location of these joints are the responsibility of the architect.

Guidelines, which are helpful in setting up a good specification, are available in the TCNA (Tile Council of North America) Handbook and ANSI Standards.

Information pertaining to vertical and horizontal movement joints is available in TCNA detail EJ171.

"Because of limitless conditions and structural systems on which tile and stone can be installed, the architect or designer shall show locations and details of movement joints on project drawings." – TCNA

"Specifier shall specify and details movement joints and show locations." – ANSI 2005

Where to Use Movement Joints

Movement joints are required on all existing construction joints, control joints, and expansion joints in the structure or the substrate.

Additionally, movement joints are required:

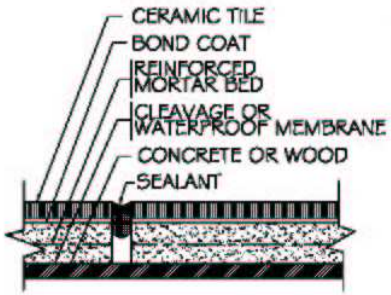
- where dissimilar substrates or materials meet, and
- where tiles or stones change plane.

Subsequent slides illustrate the various types of vertical and horizontal movement joints.

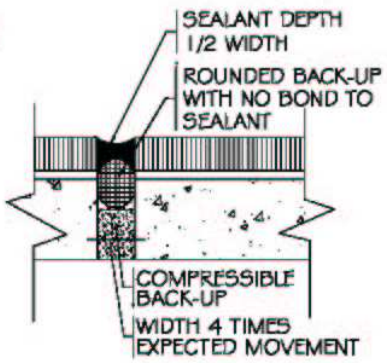
Shown is a large profile stone installed at the perimeter of a room. A movement joint is required where the floor meets the wall.

Movement Joints: Vertical and Horizontal

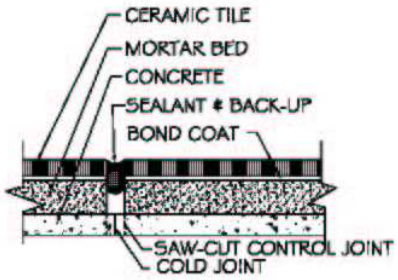
Expansion Joint



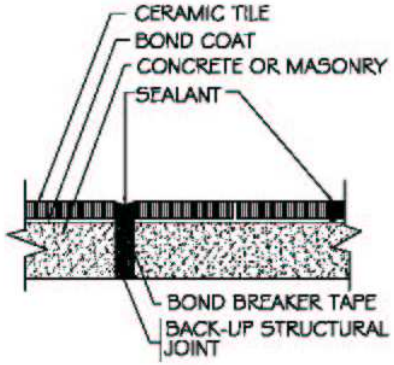
Expansion Joint



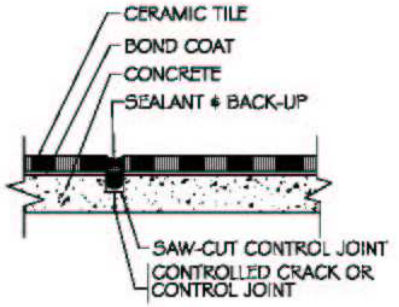
Construction Joint



Isolation/Expansion Joint



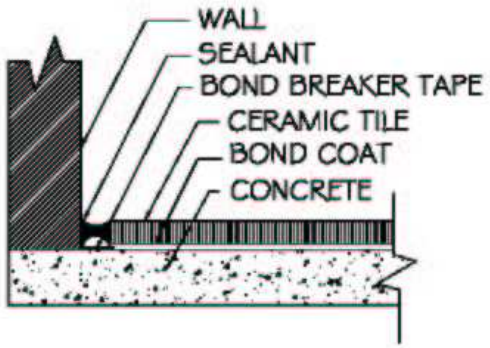
Contraction Joint



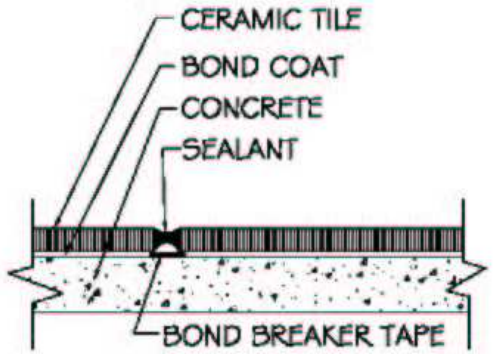
Movement Joints: Vertical and Horizontal cont'd…

Note the bond breaker tape in the details. In order to have a movement joint, you can only have two side adhesions; the tape permits the requisite movement.

Perimeter Joint



Generic Movement Joint



TCNA Recommendations

The TCNA recommendations concerning movement joints include:

- **Interior**
  A108.01-3.7.3
  20’ to 25’ on center

- **Interior:**
  Exposed to Direct Sunlight or Moisture
  A108.01-3.7.3.1
  8’ to 12’ in each direction
  Above ground concrete slab
  8’ to 12’ in each direction

- **Exterior**
  A108.01-3.7.2
  8’ to 12’ in each direction

Flooring Failure

Failure to comply with the aforementioned movement joint recommendations can cause or contribute to flooring failure.

This limestone floor failed as a result of a misplaced soft/control joint.

Construction Methods and Materials

Introduction

In the previous section, we discussed the proper design of movement joints to help prevent one of the most common contributors of flooring failure: building movement.

In this next section we address construction methods and materials that are used to facilitate a successful installation, beginning with the substrate.

Type of Substrate

The type and condition of the substrate is an important factor in the success of an installation. Although there are many types of substrates in the construction world, only a few are suitable for tile and stone installations (see below).

Wood

- Joists 16”-24” o.c. (Fig. A)

Concrete

- Slabs, thinset (Fig. B)
- Underlayment and thinset/mortar beds (Fig. C)
- Mortar beds with thinset/bonded tiles (Fig. D)

Fig. A

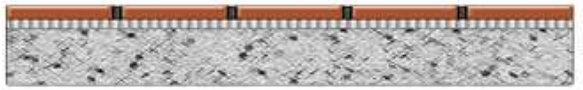


Fig. B

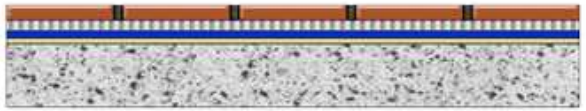


Fig. C

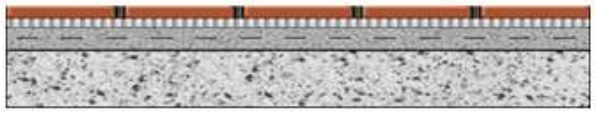


Fig. D

Condition of Substrate

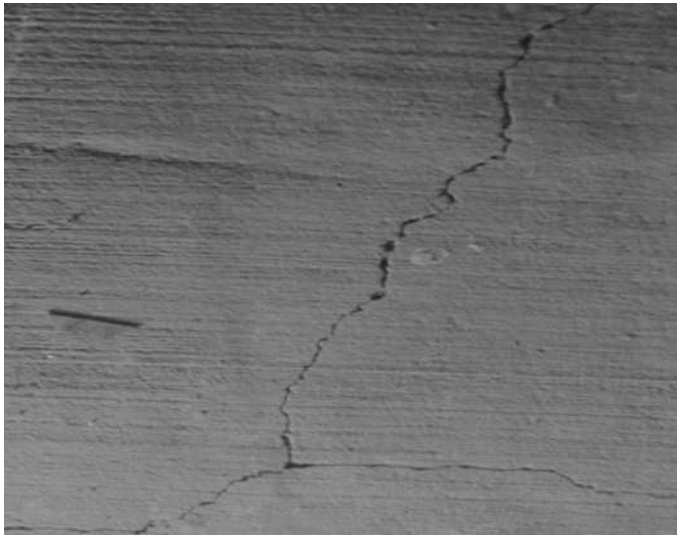
According to the ANSI Standard:

"*A proper substrate must be sound and conform to all building code requirements.*"

This means that the substrate should be structurally sound, and have sufficient compressive strength and structural strength to meet deflection criteria for the specific application.

In addition, the substrate must allow for bonding of tile.

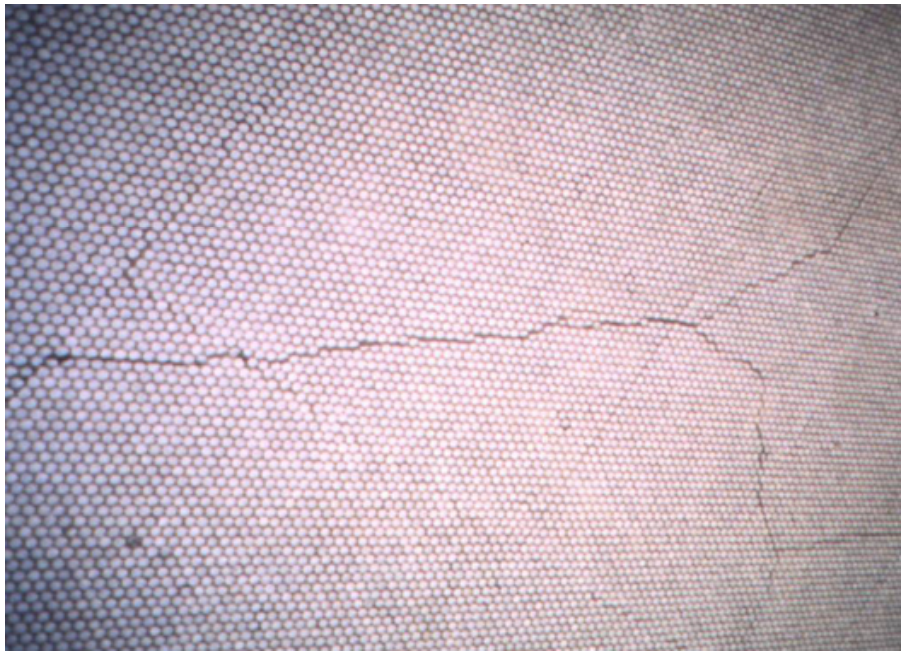
Note that concrete substrates should not include bond breakers and wood subfloors should not be treated.



Unacceptable Substrate

Condition of Substrate cont'd…

The damage that resulted from installing mosaic tiles over a cracked substrate is evidenced in the image below.



Condition of Substrate cont'd…

A proper substrate preparation is a crucial part of the installation process, otherwise repairs can be inconvenient and costly.

The causes for the failed floor at right could include:

- settling of structure
- expansion, shrinkage, compression, deflection
- natural veins and fissures in stone
- impact
- lack of sufficient coverage of thin-set mortar
- unsupported areas of tile under imposed loads
- improperly gapped and treated joints in plywood or backerboards
- high points in tile, edge wear with high impact traffic

The solution for this failed floor is full bedding of the tile, following correct substrate preparation.

Deflection

Since tile and stone are very rigid and do not accommodate excessive movement, deflection is an important aspect when designing with these materials. Stone is more sensitive to deflection than ceramic tile, which can be a concern when deciding flooring surfaces for certain applications.

The changes for deflection criteria for ceramic tile are included in the 2008 TCNA Handbook. Rather than L/360, the requirement reads as follows:

> "*Floor systems, over which tile will be installed using appropriate TCNA methods, shall be in conformance with the IRC for residential applications, the IBC for commerical applications, or applicable building codes.*"

Currently, according to the MIA (Marble Institute of America), the deflection criteria for marble is L/720.

An example of calculating deflection is presented on the following slide.

Deflection cont'd…

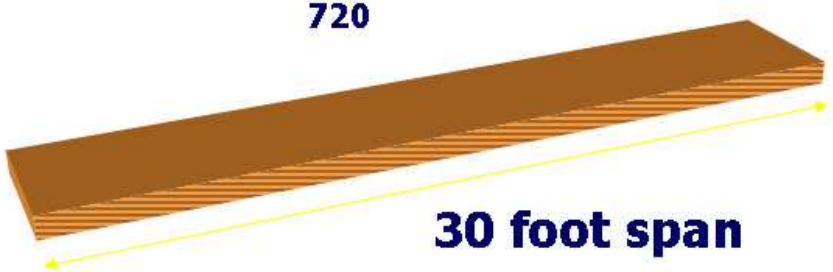
Using a 30' span as an example, the maximum allowable deflection is ½".

Deflection - L/720

(including live and dead loads)

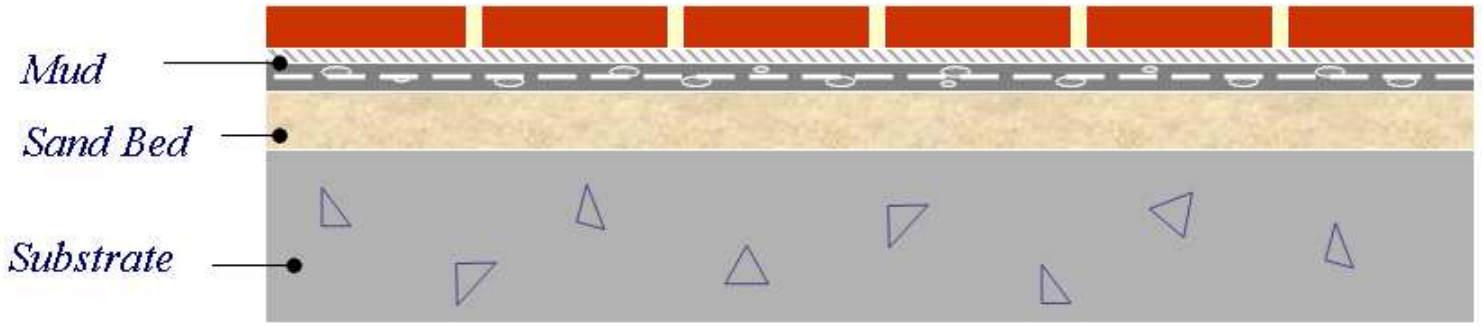
Example:

$$\textbf{30 ' span} \times 12" = \frac{360 \text{ inches}}{720} = 1/2" \text{ of deflection in 30 ft}$$



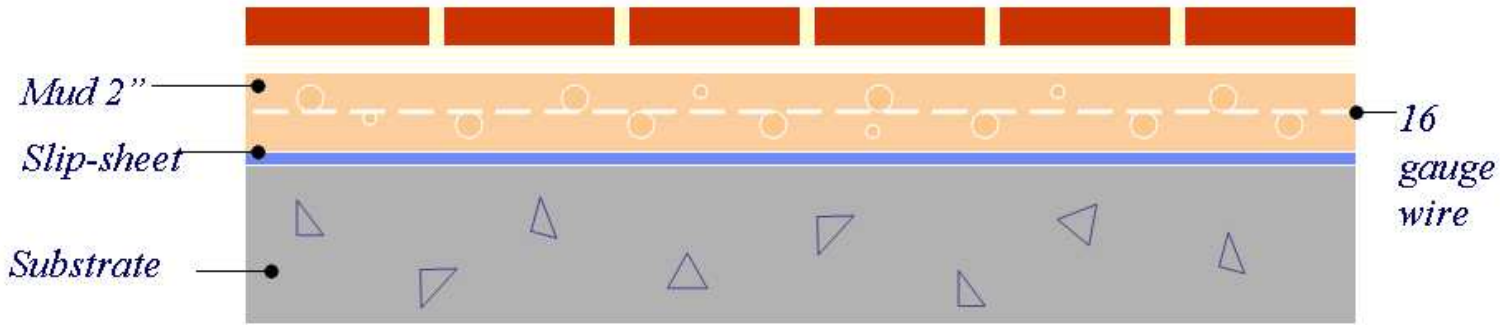
European Thick Bed Method (Indirect Bond)

Next for review is the history of installation methods used for ceramic tile and stone installations. Illustrated below is the old European technique where tiles were installed using the indirect bond thick bed method.



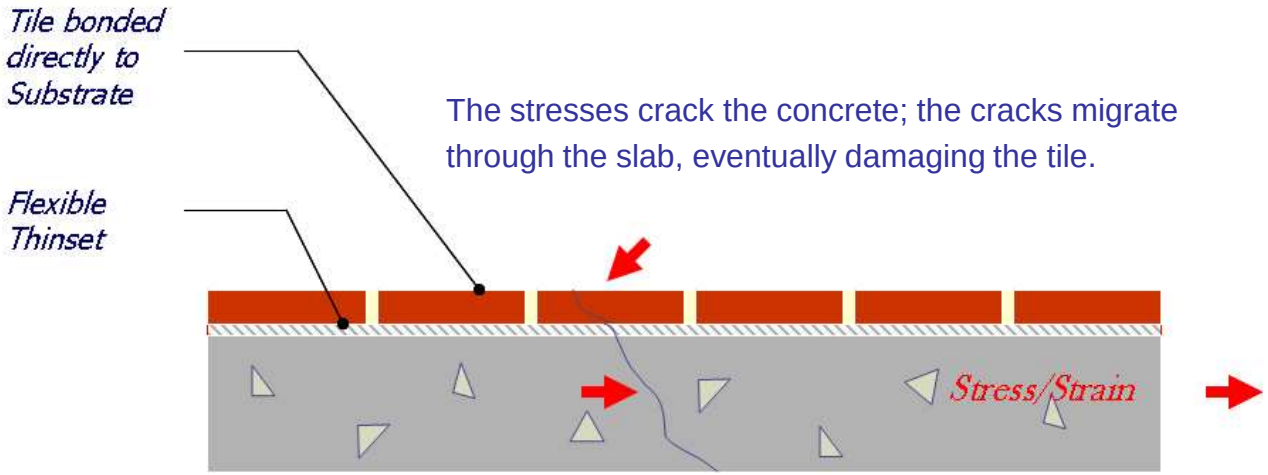
American Thick Bed Method (Indirect Bond)

Years later, the Americans created a newer indirect bond method that helped reduce the amount of cracks that appeared in the installations that led to floor failure.



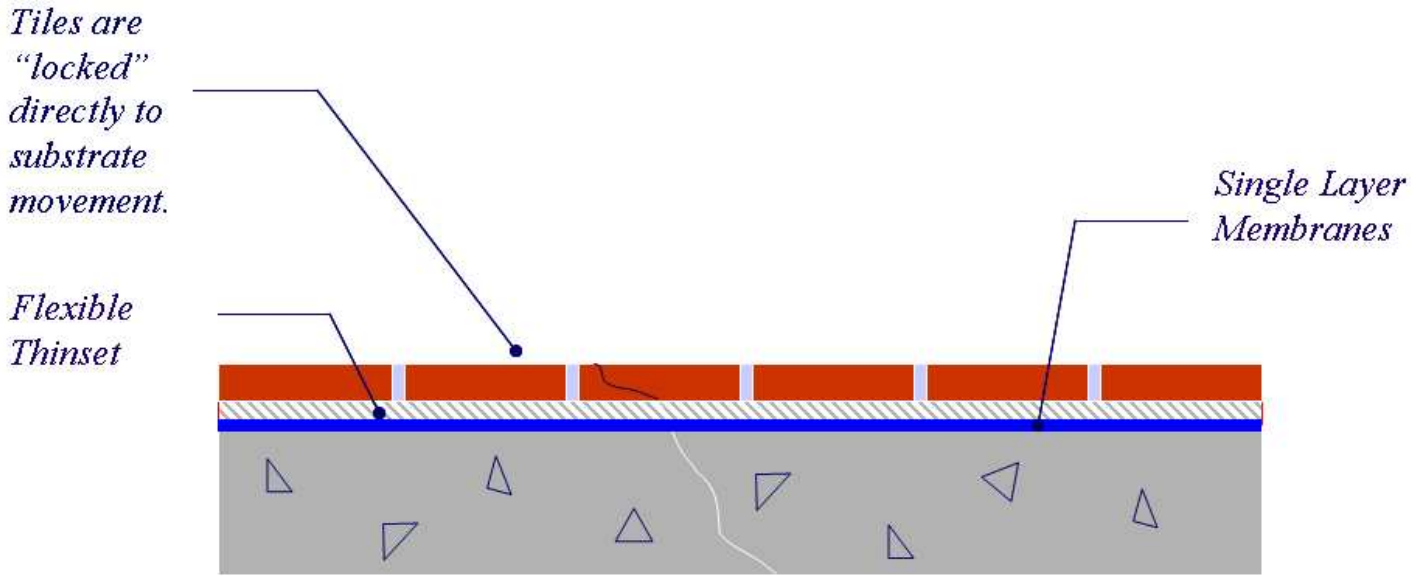
Thinset Method (Direct Bond)

In the 1960's, the arrival of thin set mortars meant tiles could be installed with only 3/8" of setting materials, eliminating the excess weight associated with the thick bed method. With small tiles, less than 8" square, this is sufficient, but as previously mentioned, the trend is larger tiles and using this method poses a major design problem: tiles are bonded directly to the substrate, and because there is no separation, the system can accommodate very limited movement (generally under .020").



Single Layer Membrane (Direct Bond)

To address this problem, single layer membranes were developed, offering an interface that supposedly allowed movement to occur, without disturbing the installation system. However, it didn't work because the tiles were "locked" to the substrate. Cracks that formed in the concrete could still migrate up through the setting system, eventually causing the tiles to crack and fail. This method has the highest risk of failure in dealing with building movement.



Types of Direct Bond Membranes

Neither thin set mortars or single layer membranes solved the problems that they were created to eliminate, but before we discuss solutions, it's helpful to have an understanding of the types of direct bond membranes that are available in the industry.

There are four basic types of direct bond membranes:

1. fluid applied
2. trowel applied
3. integral additives
4. sheet applied

Fluid applied membranes involve the on-site application of a waterproofing liquid often with an imbedded reinforcing fabric that forms a seamless, continuous waterproof membrane. The reinforcing fabric and waterproofing liquid are specially formulated to be compatible and allow direct bonding of ceramic tile or stone.

Types of Fluid and Trowel Applied Membranes

Trowel applied direct bond membranes consist of either a polymer modified cementitious material or a thick, viscous liquid that is applied with a trowel to form a seamless membrane.

Fluid applied and trowel applied membranes are available in two formulas:

- **Latex**
  This type of membrane system usually consists of a polyester reinforcing fabric with a brush or roller application of a proprietary liquid latex. The fabric provides some degree of mechanical key to improve tile adhesion and the latex formulation is compatible with thin set adhesives that are used to install tile.

- **Modified Bitumen**
  This type of membrane is typically a less expensive version of the 100% latex formulation described above.

Integral Additives / Sheet Applied Direct Bond Membranes

- **Integral Additives**

  This type of direct bond waterproofing (also referred to as capillary waterproofing or crystallization) is not typically used for waterproofing ceramic and tile stone installations. While this method categorically belongs in the family of direct bond waterproofing, it is not a membrane in the physical sense, but rather it is an internal chemical reaction in concrete that forms a barrier to water when applied to the surface or directly to the concrete mix.

- **Sheet Applied**

  As the name implies, this type of membrane involves a specially surfaced, prefabricated waterproof sheet that is seamed together on-site with adhesive and installed with either a proprietary adhesive, or a standard latex cement adhesive mortar. The textured fabric, which is fused to the surface of the membrane, along with the configuration of the sheet itself, gives these membranes the unique quality of allowing direct bonding of ceramic tile or stone.

Types of Sheet Applied Direct Bond Membranes

There are several types of sheet applied direct bond membranes.

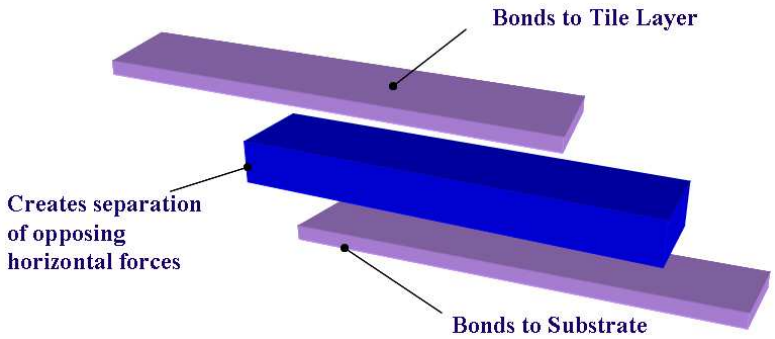
- Chlorinated Polyethylene (CPE) is a non-plasticized elastomer that remains flexible for the life of the membrane
- Polyvinyl Chloride (PVC) formulations may rely on plasticizers for flexibility, which can off-gas and can lead to a brittle membrane over time (similar to PVC flashing)
- Polymer Modified Bitumen sheet membranes should be checked for compatibility with tile adhesive
- Composite Sheet Membranes (see next section)

Composite Sheet Membranes

Introduction

Composite sheet membranes were developed as a solution to the aforementioned problems that plague thin set mortar and single layer membrane systems.

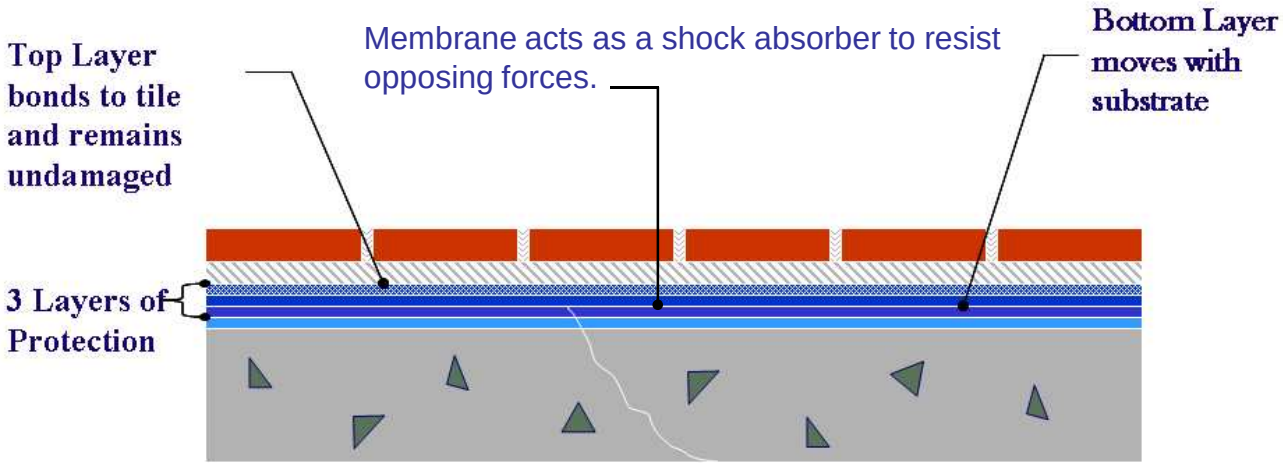
Comprised of a core material, like chlorinated polyethylene (CPE), sandwiched between outer layers of spun bond polyester, composite sheet membranes boast the following characteristics:



- support internal movement and stresses
- resistant to effect from extreme temperature change
- allows for bonding the membrane to a vertical or horizontal substrate and for tile to be bonded to the membrane

Chlorinated Polyethylene (CPE)

Because CPE is amorphous, it creates a flexible middle layer that separates the top layer of the composite sheet membrane from the bottom layer, creating a forgiving interface. Furthermore, it is extremely chemical resistant, works in a wide range of temperatures, and has the lowest perm rating of any product tested in the waterproofing industry.

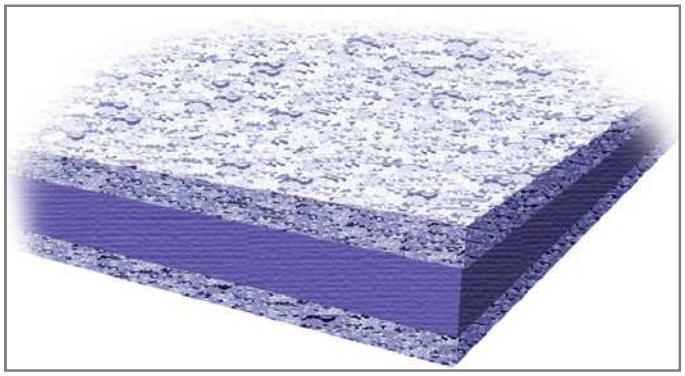


Features of Composite Sheet Membrane

A flexible adhesive is used to bond the membrane to the substrate.

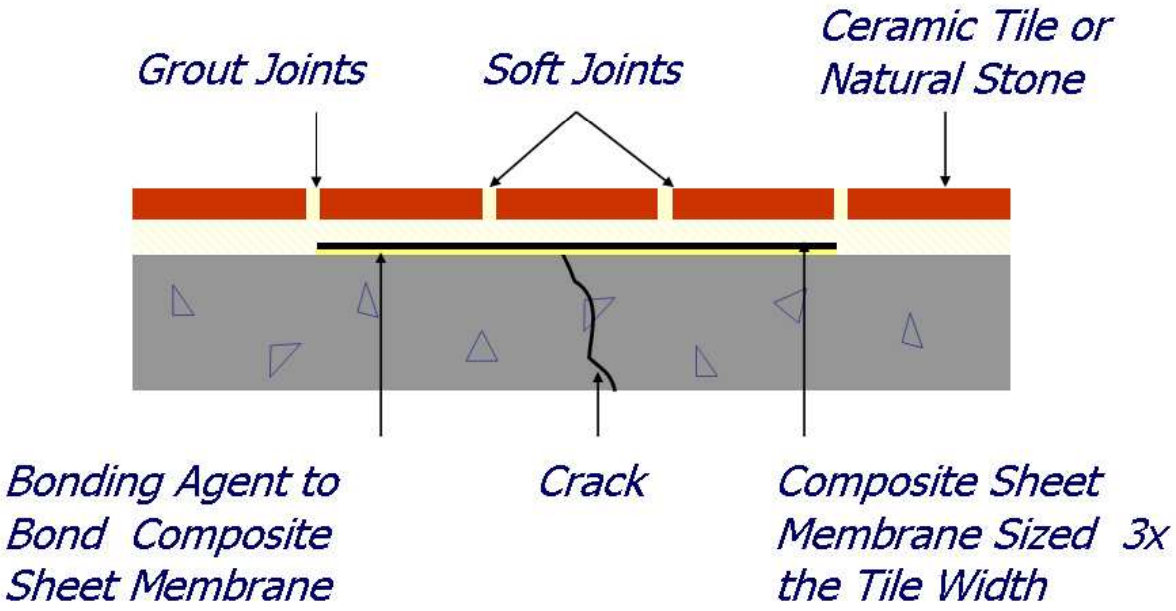
Tiles are installed with a flexible thin set mortar.

Note that indirect bond of composite sheet membranes made with CPE perform far better in terms of preventing building movement failures than other single layer membranes and flexible thin sets.



Crack Isolation Detail

Composite sheet membranes are designed to accept movement without disturbing the integrity of the tile installation, and may be used to bridge control joints, as well as existing cracks and/or potential cracks. Note that the composite sheet size should equal three times the width of the tile, according to industry standards. A typical crack isolation detail is illustrated below.



Crack Isolation Detail cont'd…

The TCNA Handbook includes a section on crack isolation with two details:

1. F125 for partial coverage
2. F125A for full coverage

ANSI A118.12 is the crack isolation standard. It includes a section for performance measurement which is called "System Crack Resistance". There are two levels of performance.

1. Standard performance requires that the membrane bridge movement > 1/16", and
2. High performance requires that the membrane bridge movement > 1/8".

Case Study: Galleria Mall, Henderson, NV

A completely inferior substrate led to total floor failure in the Galleria Mall, Henderson, NV (top image).

To solve the problem, the tile was removed and the substrate was repaired and cleaned.

Next, a self-leveling underlayment was used, followed by the installation of a crack isolation membrane that was applied over the entire area.

Once the movement joints were properly designed, new ceramic tiles were installed (bottom image).

Case Study: Galleria Mall, Henderson, NV cont'd…

The result: this project earned the Spectrum Award, the ceramic tile industry's highest award of distinction.

Waterproofing

Introduction

In this section of the course we present a discussion on ASTM D 1079 Standard Definitions for Waterproofing, as well as the performance characteristics of direct bond waterproof membrane products.

Waterproofing is one of the most important, but least understood building components by both contractors and architects. This is evidenced in the interface claim statistics presented on the next slide.

Proper waterproofing design would have saved this installation.

Waterproofing Statistics

- **90% of all waterproofing problems involve 1% of the installation area.**
  Waterproofing products are relatively foolproof, but detailing and installation of the interface with other building components is critical. Waterproofing products are often not the source of water leak problems. Generally, leaks occur at drains, penetrations, and transitions with other materials as a result of poor design detailing and/or careless installations.
  (Source: Construction waterproofing handbook Michael T. Kubal)

- **77% of design professional liability insurance claim dollars paid involve water leakage and water damage.**
  (Source: Design Professional Insurance Company Study)

Waterproofing Applications

Architects can reduce the high probability of problems by making the investigation, analysis, and careful detailing of waterproofing a high priority.

Many architectural firms employ specification/technical staff who specialize and focus on waterproofing and roofing applications, as the range, type, and complexity of applications now requires dedicated understanding.

Waterproofing applications include:

- swimming pools and water parks
- spa's and fountains
- whirlpool tubs and hydrotherapy pools
- showers and steam rooms
- commercial kitchens
- buildings facades
- roof decks
- exterior plaza's and balconies

ASTM D 1079 Standard Definitions for Waterproofing

- **Waterproof**

  According to ASTM and ACI (American Concrete Institute) standard definitions, waterproofing is the treatment of a surface to prevent passage of water under hydrostatic pressure. In order for hydrostatic pressure to exist, the installation must be below the water table (or submerged in water). Ceramic tile or stone installations simply installed with a latex cement or epoxy adhesive can eventually leak after exposed to hydrostatic pressure.

- **Water Resistant**

  A material will not deteriorate or dissolve when exposed to water, although water may pass through the material. While most tile installation adhesives are water resistant, they will eventually absorb and allow transfer of water through the assembly, especially under hydrostatic pressure. Note: If not under pressure, and only subject to intermittent exposure to water, the installation may not leak.

ASTM D 1079 Standard Definitions for Waterproofing cont'd…

- **Damproof**

  Involves the treatment of a surface to prevent passage of water not subject to hydrostatic pressure. A damproof system is resistant to water vapor or minor amounts of moisture and acts as a backup system to primary waterproofing materials. The field of tile installations are damproof, but penetrations and other interfaces will likely leak, even if the installation is not subject to hydrostatic pressure.

- **Vapor Barrier**

  Prevents transmission of water vapor through a substrate.

- **Crack Suppression Membrane / Anti-Fracture Membrane**

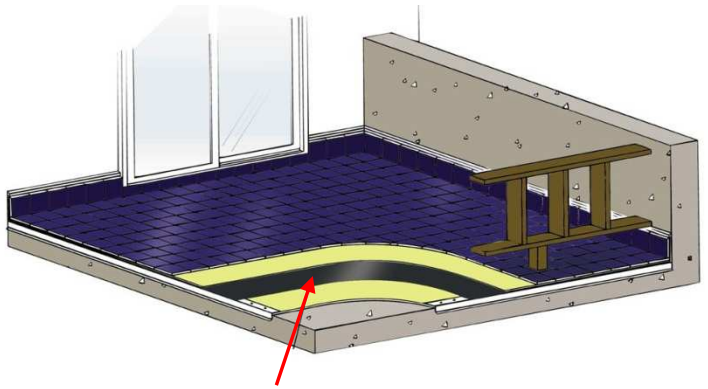
  These interchangeable terms relate to materials that bridge existing and potential future cracks [e.g. 3MM (1/8")] used as an insurance that future substrate cracking will not telegraph up through tile installation.

Crack Suppression Membrane

Providing waterproofing and protection from cracking, sheet membranes have some obvious advantages, including strength, continuity, and uniform thickness.

Membranes made with high-tech polymers, like chlorinated polyethylene, can provide extremely effective barriers to moisture and vapor.

Sheet membranes are easy to install and minimize workmanship variables, since sheets are manufactured in a controlled environment.



Crack Suppression Membrane

Crack Suppression Membrane cont'd…

Corners, which can be a problem with some liquid products, can be folded and formed without penetrating or terminating the membrane. Some sheet membrane manufacturers produce prefabricated corners for dams, or to protect against leaks where cut corners may be required.

Hotel Pool Application

This hotel pool is typical of many hotel pools where they are built on the upper level or roof level, over occupied space below. Such applications require positive waterproofing. The raised curb and flush gutter system is made possible due to a direct adhered waterproofing membrane.

ANSI A118.10

While some bonded waterproof membrane products have been on the market for over 25 years, the ANSI standard for bonded, load bearing waterproofing membranes for tile installations was approved in 1993. The standard is ANSI A118.10. This standard includes testing for the following properties:

- micro-organism resistance
- breaking strength [ASTM D 752, 170 psi (1.17 Mpa) transverse and longitudinal]
- seam strength [ASTM D 751, 8 lbs/inch (0.06 Mpa/25 mm) of width]
- dimensional stability (ASTM D 1204, 0.7% length change - 15° to 158° F)

ANSI A118.10 – 1993 cont'd…

- **Waterproof capabilities (ASTM D 4068)**
  Testing involves 48-hour exposure to hydrostatic pressure with no leakage. Note that the results of this test are misleading, as certain products may not allow any water leakage within a 48-hour test period, but may leak under prolonged exposure.

- **Adhesion Strength Tests (ANSI A 118.10 Re-affirmed 2005)**
  These tests measure the adhesion strength performance of the membrane within a typical ceramic tile assembly. The 7-day test is important, in that it measures the bond strength of the assembly when it is first exposed to moisture. Failure can easily occur in smaller applications within the first 7 days. Most critical is the 100-day test, as it measures the effect of prolonged exposure to moisture and, to some degree, alkaline conditions. Shear Strength to Mortar Samples [all tests require min. 50 psi (0.35 Mpa) shear bond strength]
  - 7 day (dry and water immersion)
  - 28 day (dry)
  - 100 day (water immersion)

Building Codes

Codes vary by location, but most current building codes, such as BOCA (Building Officials and Code Administrators), UBC (Uniform Building Code), and the ICC (International Code Council) require a minimum of 50 psi (0.35 Mpa) shear bond strength for adhered tile or stone veneer assemblies, including the waterproof membrane.

ANSI 118.1 Dry-Set Mortar standard requires 7, 28, and 100-day shear bond strength of 50 psi (0.35 Mpa).

ANSI 118.10 Direct Bond Membranes and ANSI 118.4 Latex-Fortified Mortars are formulated to meet this minimum requirement.

ANSI 118.13 Installation of Waterproofing Membranes for Tile and Dimensional Stone was revised in 2005.

Waterproofing Application

IAPMO / State and Local Codes

While many direct bond waterproof membranes meet the minimum physical requirements of ANSI 118.10, certain applications may require additional approval by evaluation organizations, such as IAPMO (International Association of Plumbing and Mechanical Officials) or IPC (International Plumbing Code), which is part of the ICC (International Code Council).

Shower pan receptor waterproofing is commonly regulated by these types of local and regulatory agencies. It is important to ensure that the waterproofing product that is selected will be approved by a plumbing inspector. If there is any doubt, check with the local plumbing code authority.

Plaza deck waterproofing may require compliance with roof covering product code requirements, as well as regulatory agency approval by FM (Factory Mutual) for wind uplift resistance and fire resistance.

Flood Testing

Note that some codes require a flood test for commercial projects, such as the one pictured below.

Sound Reduction Membranes

Introduction

Sound waves, if not properly considered, can turn an otherwise beautiful architectural space into an uninhabitable one.

Some manufacturers offer sound reduction membranes. These acoustical underlayments can reduce impact noise. Many can be used over common substrates, including concrete, wood subfloors, radiant heat, and primed gypsum underlayment.

Following is a review of terminology, followed by a discussion of the standards relating to sound rated floors.

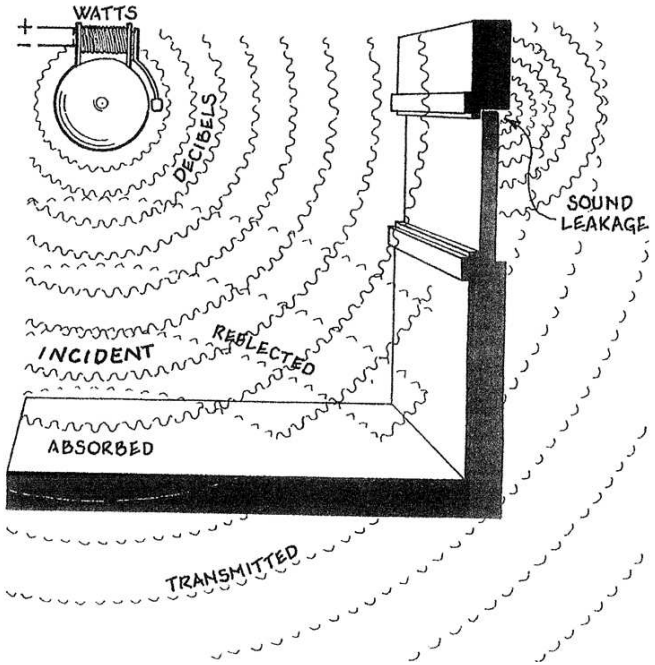
Definitions

- **Sound** - a vibration in an elastic medium; such oscillations are subtle, unpredictable and can vary in characteristics (e.g., fast/slow, hard/soft).

- **Absorbed** – to retain wholly that which is taken in, without reflection or transmission.

- **Incident** –when a sound strikes a surface, it is either absorbed or reflected.

- **Sound Leakage** – refers to any tiny opening, such as an uncaulked seam between a duct or wall, that can allow sound to pass through.



Standard for Bonded, Sound Reduction Membranes

ANSI A118.13, Standard for Bonded Sound Reduction Membranes for thin-0set tile installations..

Emphasis is on reporting performance, using information from acoustical test reports, including ASTM E2179 and ICC (Impact Insulation Class) testing.

In order to be a sound reduction membrane, product must have a ASTM E2179 Delta Value of 10 or more. The standard also includes point load requirements and most of the requirements in the crack isolation standard (ANSI A118.12 and ASTM C627)

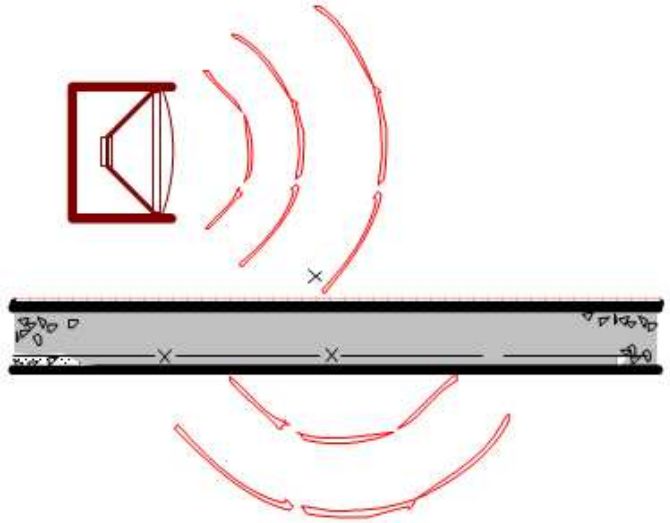
Testing: STC

Sound Transmission Class (STC) is a single-number rating derived from laboratory measurement of sound transmission loss.

STC describes the sound insulating properties in the 100-4kHz frequency range, primarily for assessing airborne sounds, such as speech, through a structure.

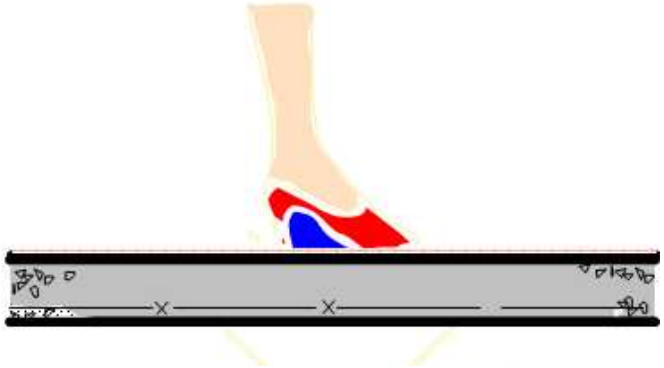
It is calculated in accordance with ASTM E 413, “Classification for Rating Sound Insulation.”

Typically, the minimum code requirement for STC is 50 (higher numbers indicate better performance). The scale is logarithmic so small changes can be significant.



Testing: IIC

Impact Insulation Class (IIC) is a single-number rating derived from one-third octave band values of impact noise levels measured through a floor/ceiling system, using a standard tapping machine.



The IIC rating describes the insulating properties of a floor/ceiling assembly for impact (like footfall) noise. Code requirements are generally IIC = 50.

The scale is logarithmic and higher numbers indicate better performance.

Testing

Impact Noise Rating (INR) test was largely replaced by IIC in North America. However, it is still referenced in some literature in Europe and used in some areas of the USA. An INR of 0 equals IIC of 51. Higher numbers indicate better performance.

ASTM E2179 was introduced in 2003. It is titled “The Standard Test Method for Laboratory Measurement of the Effectiveness of Floor Coverings in Reducing Impact Sound Transmission Through Concrete Floors”.

The test measures the effectiveness of a topping, which includes the flooring surface and sound reducing underlayment. The test requires performing IIC test on a bare, concrete substrate and then adding a sound reduction membrane and flooring surface and retesting. Results for both are compared at each of 21 frequencies and a change (or delta) is calculated. Although it has no performance criteria, this test can provide an estimate of the IIC rating when a specific sound reduction membrane and flooring surface are added to the substrate.

Sound Reduction Membranes

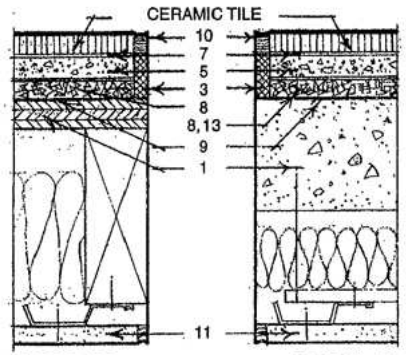
Pictured on the next slide is an excerpt from the 1998 TCA Handbook, a useful resource that indicates not only the IIC and STC results for a variety of details, but also lists the products used in the examples. Note that the scales for IIC and STC are only 20 points, ranging from 45 to 65.

FLOORS

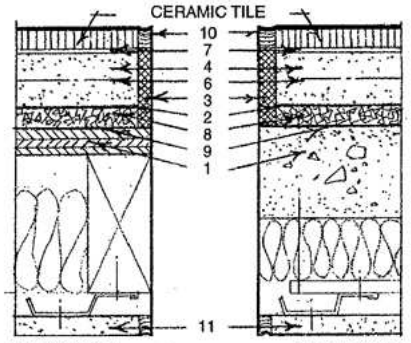
SOUND-RATED
Wood and Concrete Subfloors

Cement Mortar, Dry-Set Mortar or Latex-Portland Cement Mortar **RF900-98**

All specifications for ceramic tile installations must conform to local building codes, ordinances, trade practices and climatic conditions.



RF911-98 RF912-98



RF913-98 RF914-98

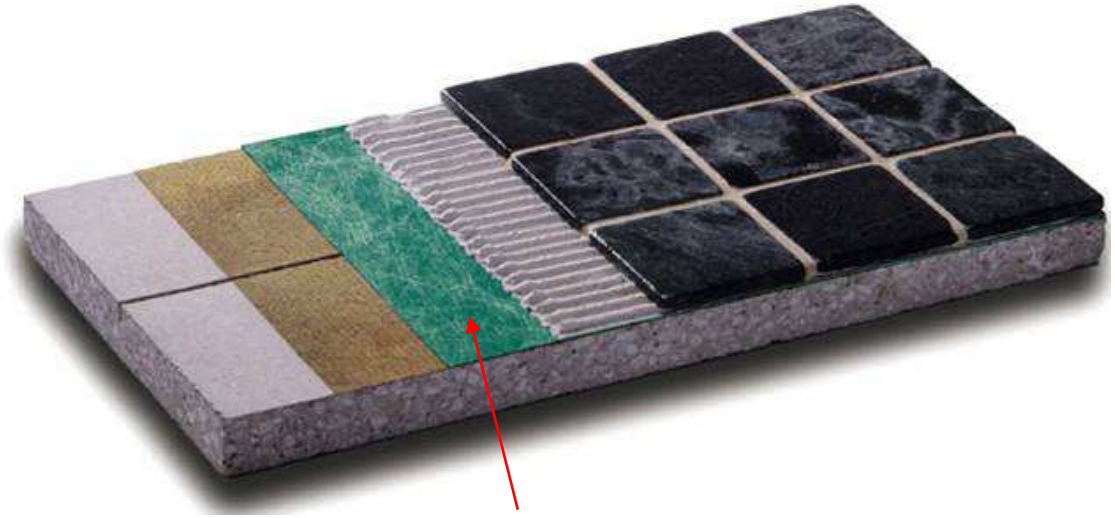
When comparing STC values or IIC values, a higher value indicates less sound transmission.

Method	Sound Transmission Class (STC)	Impact Insulation Class (IIC)	Total Thickness Above Subfloor (excluding tile)	Tile Installation
RF911	≥62	≥58	7/8"	F-144
RF912 (8)	≥59	≥52	7/8"	F-144
RF912 (13)	≥60	≥65	1-1/8"	F-144
RF913	≥60	≥55	1-3/4"	F-111
RF914	≥61	≥62	1-3/4"	F-111
RF915	≥61	≥54	1-5/8"	F-111
RF916 (12)	≥60	≥58	1-5/8"	F-111
RF916 (13)	≥60	≥59	1-7/8"	F-111
RF916 (14)	≥60	≥59	1-1/2"	F-111
RF917 (8)	≥59	≥52	7/8"	F-144
RF917 (13)	≥59	≥59	1-1/8"	F-144
RF918 (8)	≥60	≥54	1-3/4"	F-111
RF918 (13)	≥59	≥52	2"	F-111
RF918 (14)	≥56	≥50	1-5/8"	F-111
RF919	≥59	≥62	1/8"	F-122

Sound Reduction Membranes

Sound insulation can be improved by using various sound insulating underlayments, such as composite sheet membranes.

Some acousticians say that an increase of 10 IIC points is equal to a 90% decrease in the sound pressure level, which translates to a reduction of approximately 50% in noise levels.



Sound Isolation Composite Sheet Membrane

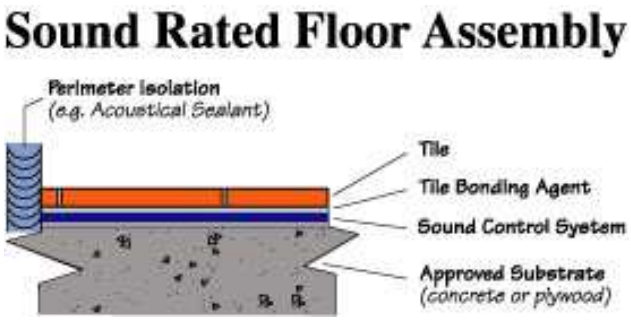
Sound Rated Sealant

A tile floor must be isolated from the wall and floor.

If the cavity is not deep, an acoustical sealant can be used as indicated in the detail.

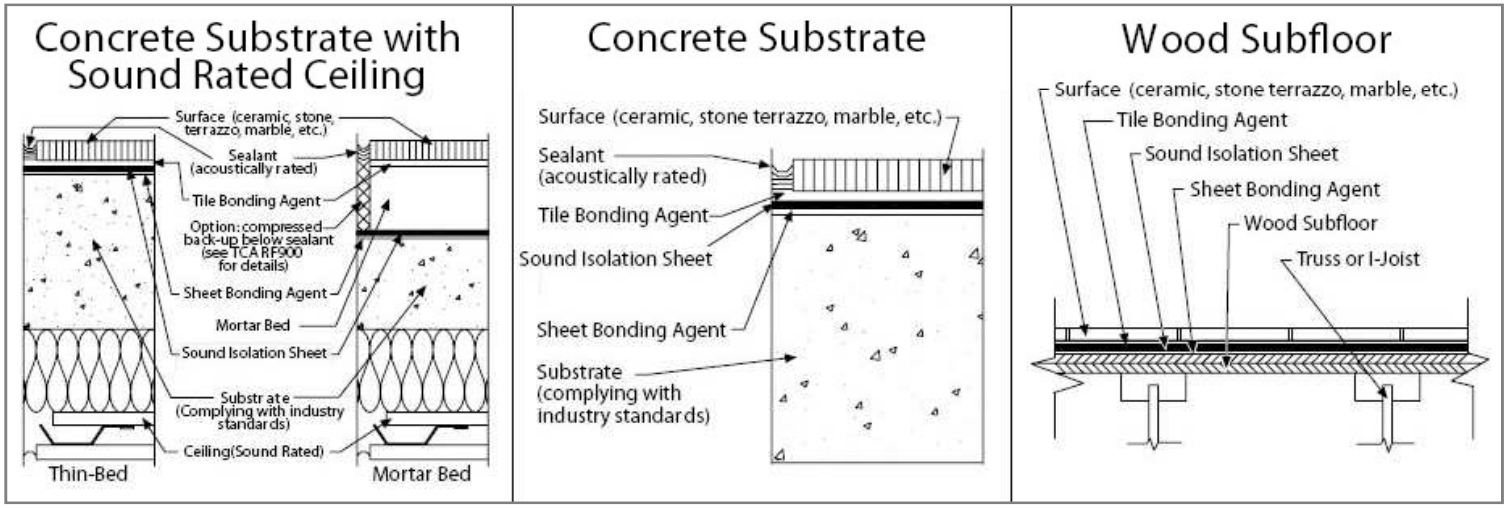
Deeper cavities require different remedy. For example, a compressible backer rod may be used to fill a cavity. The isolation material could be covered with acoustical sealant.

The floor should be isolated from building elements whereever the flooring product (or bonding agents, like mortar) contacts a hard surface.



Sound Rated Sealant cont'd…

The sealant is used to keep the cavity from becoming filled and allowing contact between the hard surface flooring and building elements, such as studs, columns, etc. If the hard surface is in contact with the wall (or other items in the floor) it can create noise which can be transmitted to the floor below. That noise is referred to as "flanking noise."



Conclusion

This presentation reviewed some of the common problems that can occur in ceramic tile/stone installations as a result of failing to plan properly for building movement, crack isolation, waterproofing, and sound isolation.

As well, key design factors, standards, and testing related to the ceramic stone/tile industry were discussed in an effort to improve and facilitate the specification process.

Lastly, the course addressed the numerous benefits of using CPE composite sheet membranes when designing with ceramic tile/stone.

References

- The Tile Council of North America (TCNA)
  http://www.tileusa.com/ Accessed on July 30, 2008

- International Code Council (ICC)
  http://www.iccsafe.org/ Accessed on July 30, 2008

- American National Standards Institute (ANSI)
  http://www.ansi.org/ Accessed on July 30, 2008