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Why Are Movement Joints Needed in Tile And Stone Installtions?

TDS-1252

Why are movement joints needed in tile and stone applications?

The basic answer is that in the construction world everything moves. Therefore, accommodation for this movement is required to prevent materials from falling apart and causing destructive failure.

This principle is no different when it comes to ceramic tile and stone installations. Movement is a natural part of these installations and must be accounted for and accommodated. There have been many industry related articles written on this topic that can be consulted for additional information. In addition, the Australian Standard AS3958 and the Tile Council of North America (TCNA) Handbook for Ceramic, Glass, and Stone Tile Installation provides a very detailed explanation of the requirements and necessity for movement joint construction, design and placement. Consult AS3958 and the TCNA Handbook for Ceramic, Glass, and Stone Tile Installation detail EJ-171 for this vital information. Movement in tile systems are controlled by the construction of movement, expansion, contraction, perimeter and intermediate joints, amongst others, in the tile system.

Because of the limitless conditions and structural systems on which tile, glass, masonry veneer, and stone can be installed, it is the responsibility of the project's architect and engineer to show the specific locations and details of movement joints on project drawings. It is the Project Designer/Project Architect/Project Engineer's responsibility to detail and outline the requirements for each specific project. Design Professionals have available to them tables that outline the expansion rates (coefficient of expansion) of most building materials. They also know how much structures may shrink, or where the points of tension or compression are as slabs deflect. In their calculations, they can predict how much movement will take place on a given project over a specific substrate using a specific type of adhesive and installation method. As you can imagine, there are countless combinations. There is no way that an installer can know which combination is applicable before they walk onto a project.

Therefore, for best results; the "sizing" and "placement" of expansion / movement joints should be CALCULATED rather than assumed.

For instance, what is the "formula" for calculating the sizes and placement of joints for thermal expansion? In short, it is the tile coefficient of expansion X temperature range X distance between joints.

- The tile coefficient information should be available from the manufacturer or standard architectural references.
- The temperature range is the lowest anticipated ambient temperature to highest surface temperature that the project will experience.
- The distance between the joints is the only variable in the equation. This can be varied to achieve a joint of proper minimum and maximum width. Otherwise, if the planned distance between joints is fixed or if there is a minimum or maximum distance required, the joint width must be followed.

Note that the formula is not a simple one-dimensional calculation. There is also differential thermal movement of the underlying substrate, as well as moisture shrinkage/expansion, live loads (including seismic or wind) or dead loads, which may take precedence and determine minimum width of joints over thermal movement.

In the absence of a design professional, the Australian Standard AS3958 or the TCNA Handbook for Ceramic, Glass and Stone Tile Installation can be referenced guidence. suggestions outlined in detail EJ-171 in the TCNA Handbook for Ceramic, Glass, and Stone Tile Installation can be followed. It is interesting to note that the Stone Industry also points back to these details. The Marble Institute of America's (MIA) Design Manual references the TCNA Detail EJ-171 for expansion joint requirements in stone installations.

Some of the factors that affect the movement of tile installations are as follows. All of these factors cause the tile and stone installation to move. If this movement is not accommodated for, the resulting restraint and stress can cause failure, often manifesting as cracking grout or popped or delaminated tiles.

Physical Building Movement:

This can include the movement, vibration and deflection that an installation undergoes. This type of movement is the most common and can lead to failure if the proper measures are not implemented.

Shrinkage of Concrete:

Shrinkage of concrete occurs during the curing and hydration of concrete as moisture loss occurs. When this occurs, concrete naturally shrinks and shortens. In today's world of fast track construction, it has become normal to install tile and stone over newer concrete slabs that may not have experienced all the shrinkage that it will undergo. In many cases, you may see tiles tented up over new installations. The general reason for this is that the concrete has continued to shrink as it is curing whilst the tile installation has remained the same in size or grown in size. More frequent expansion joint placement, anticipating this movement, can allow for this type of movement and keep the tile installation in place.

Thermal Movement:

Thermal movement can include temperature fluctuations and changes in environmental temperature. This is easy to understand when it comes to exterior applications. However, in indoor applications, it is not even considered. Keep in mind that installations are subject to the cycling of cooling and heating systems that heat and cool the air. Moving air across an installation will cause the temperature to fluctuate and will cause the installation to move.

In addition, radiant heat flooring is gaining in popularity and can also affect and stress the installation. The creation of temperature difference on the surface of the installation and behind the installation can also create stresses that need accommodation. In exteriors, imagine an installation sitting in the sun. At times, these installations can reach temperatures of well over 60°. Then a quick rain shower comes by and douses the installation with cool rain. In this instance, the temperature can drop down to 21°C in a matter of seconds. This type of stress needs to be accommodated by expansion joints or loss of bond can occur. Also freezing and thawing can affect an installation.

Interior installations that have skylights or are surrounded by windows and glass doors may need to be treated as exterior applications. Expansion joint frequency and width should be increased in exterior and immersed applications due to more extreme conditions. In like manner, some interior applications can also see the same type of extreme conditions.

Moisture Expansion:

In some cases, the finish material used can take on moisture due to its porosity rate. Over time, this absorption of moisture can cause growth in the finish material. This growth can lead to loss of bond if periodic expansion joint placement is not available to accommodate this potential movement.

Encroachment of Dissimilar Building Materials:

Perimeter expansion joints are required on all installations to allow free movement at the perimeter of the installation. Generally, a perimeter movement joint is a minimum of 6mm in width. Dissimilar building materials can precipitate even faster rates of expansion and can encroach upon the tile and stone installation. It is good practice to place a soft movement joint at all changes of finish materials to accommodate this movement.

Changes of Plane:

Movement joints are also required at all changes of plane. For example, the corners and coves of an installation, or the transition between stair treads and risers. There is greater stress at these areas and they therefore require the use of a soft movement joint.

Treatment of Existing Movement Joints:

Existing movement joints can take several forms. They are as follows:
Dynamic Movement Joints – are joints in a substrate that are designed to take and absorb dynamic movement
Contraction Control Joints – are joints that are sawn into green concrete to help control shrinkage of concrete.
Cold Joints – occur between two adjacent pours of concrete.
Perimeter Isolation Joint – occurs at the perimeter of an installation.

In all cases, it is best to honour all movement joints and carry them up through the setting bed and tile or stone finish layer. These joints should follow the profile and maintain the minimum required width of the joint. In no instance should the movement joint in the tile work be narrower than the existing joint in the substrate. In some instances, a crack isolation membrane (e.g. LATICRETE HYDRO BAN®) can be used over the control and cold joints. If there are no existing movement joints in the substrate, that does not absolve the tile or stone finish layer of requiring an expansion joint at the finish layer. Expansion joints are still required to be placed at the finish layer.

Type of Expansion Joint Materials:

Possibly the best type of expansion joint material that can be used is a flexible silicone (e.g. LATASIL™) or urethane sealant placed over a closed cell foam backer rod. The sealant used in expansion joints should achieve a minimum SHORE A hardness of 35. It is best to achieve a two-sided bond only to the flanks of the open joint in the tile. The two-sided bond allows for maximum movement of the sealant. A three-sided bond to the substrate can restrict the total capable movement of the flexible sealant and cause premature joint cracking and disintegration. Bond breaker tape (a narrow sliver of tape) can be placed in joints that are too shallow to receive the closed cell foam backer rod. This bond breaker tape also makes provision for a two sided sealant bond. In certain cases, a suitable primer should be used in wet area conditions or when using a porous finish material (e.g. sandstone).

Pre-fabricated expansion joint strips are also available and can be used in many applications. An advantage to these strips is that they protect the exposed tile edge better than the flexible sealants. However, there are a few drawbacks to some of the pre-fabricated joints. Firstly, some do not allow for full joint movement as do the sealant joints. Some of these strips are composed of very hard plastic or metal and are not as forgiving as the sealant joint. If they are used, it may be a good idea to increase the frequency of placement and/or allow for a wider space when they are placed. Secondly, when they are installed, it is vital that they are fully bedded along with the tile and in doing so, it is vital that the tile adhesive does bridge the movement zone and impede the pre-fabricated joint effectiveness.

Latex- or acrylic-based caulks are not suitable for flooring applications or for vertical applications that will be exposed to moisture or the elements.

Effects of Renovations:

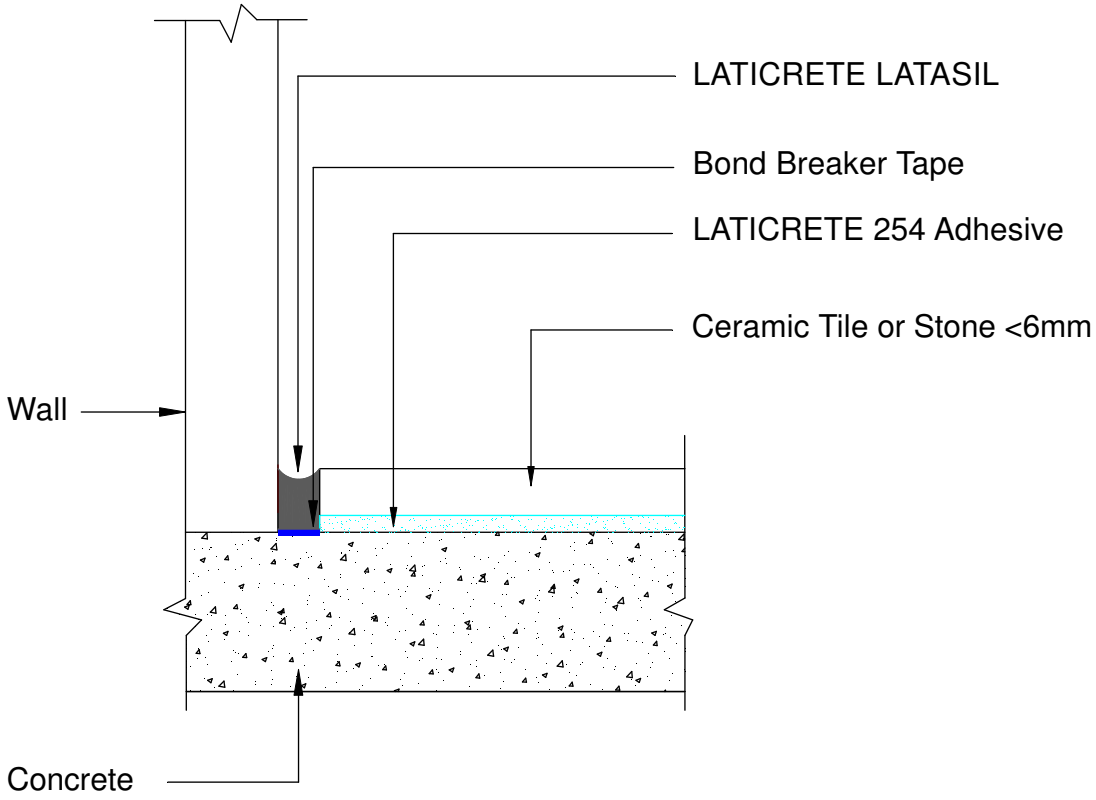
At times, a failure can occur within a tile or stone installation after construction or renovation has taken place on an installation. For example, a large skylight is cut into an existing space and now the tile installation is exposed to direct sunlight, whereas in the past it never saw the light of day. When this type of renovation takes place, the tile and stone installation should be re-evaluated to determine if it now complies with its new environment. In far too many cases, it is taken for granted that the tile will be just fine. Unfortunately, that really is not the case and a failure can result.

Expansion Joint Placement:

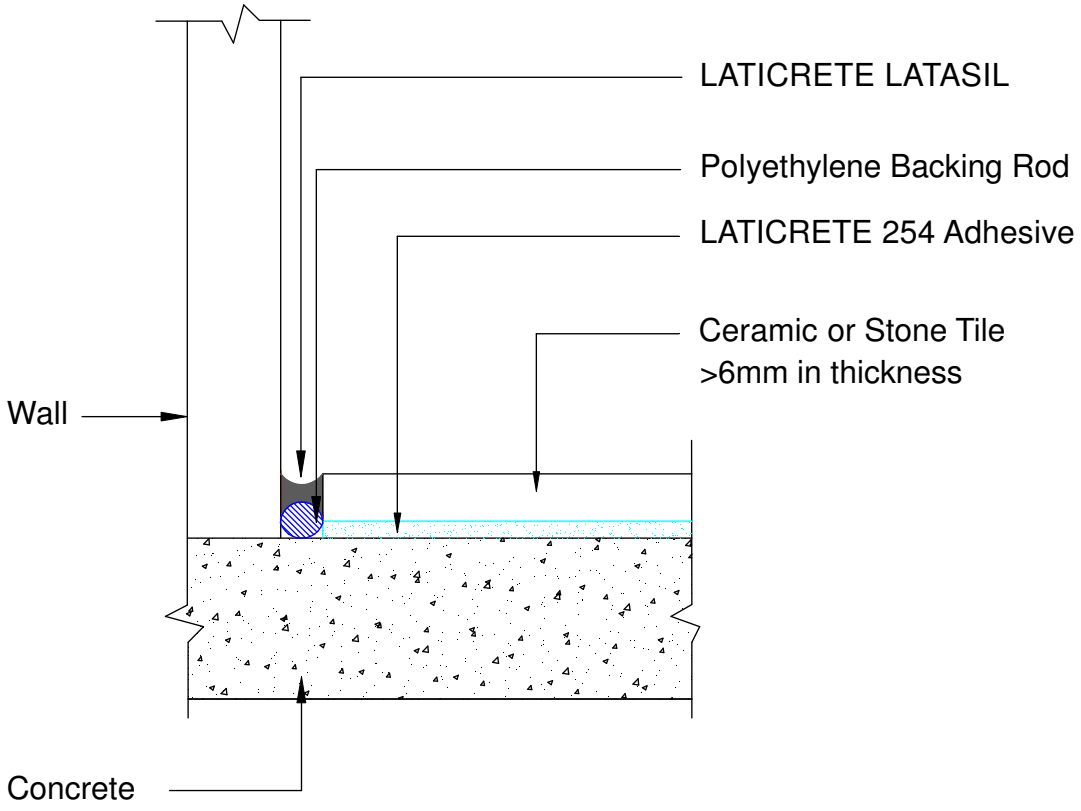
All installations require perimeter expansion joints. The minimum width for the perimeter joints is 6mm. If the perimeter will be covered with a shoe moulding, then the joint can be left open to allow for the movement. If the joint will be exposed, then it should be treated with a suitable flexible sealant. In addition, if the size of the installation is large enough to warrant field movement joints, then they should be placed as directed and outlined by the construction documents, AS3958 or the TCNA Handbook for Ceramic, Glass, and Stone Tile Installation detail EJ-171. Exterior applications will require more frequent and wider expansion joint placement and width.

It is also not advisable to cut in expansion joints after the tile or stone installation has been placed and grouted. The damage that can occur before the saw cutting takes may be irreversible. Therefore, following industry requirements to construct the joints as the work progresses is the best course of action. In addition, the space left for the movement joint should be clear of anything that can potentially restrict movement, including thin set mortar, spacers, dirt and debris.

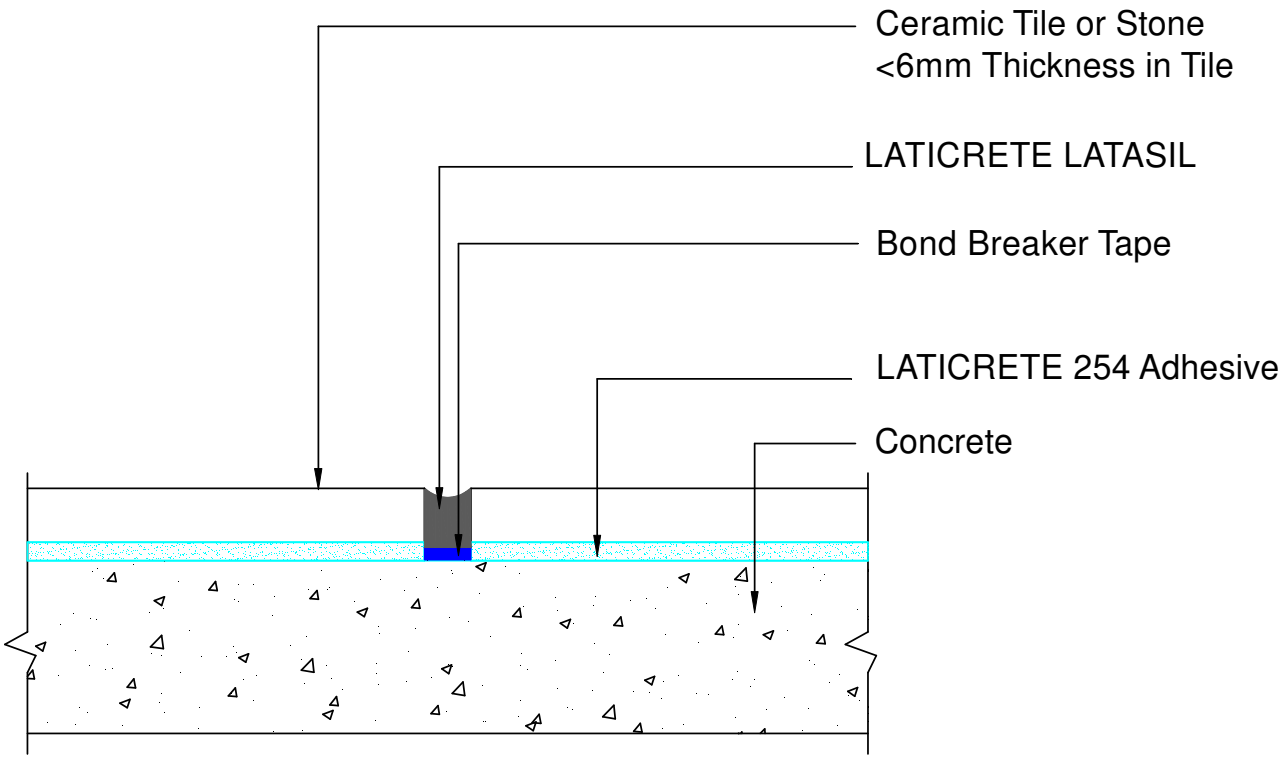
To summarize this discussion, all tile and stone installations require expansion joints. All buildings will move. Therefore, accommodation for this movement is necessary. To properly review and place expansion joints, the best time to discuss and deal with the issue is before the installation takes place. This will help to avoid problems and finger pointing after the installation is completed.



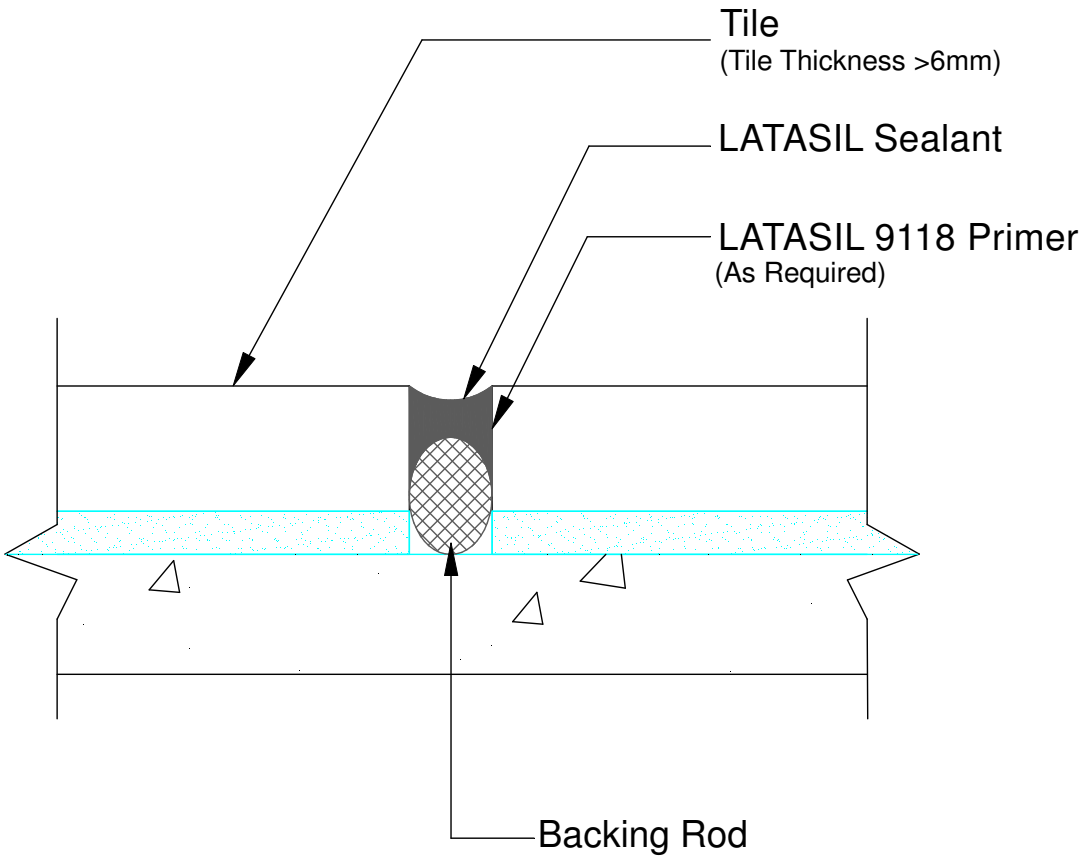
Detail 1. Perimeter Joint With Bond Breaker Tape



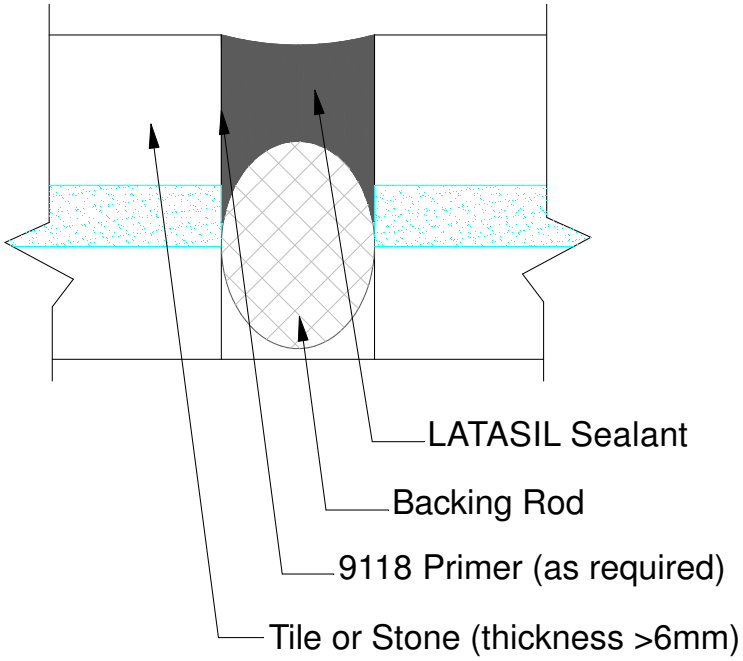
Detail 2. Perimeter Joint with Backing Rod



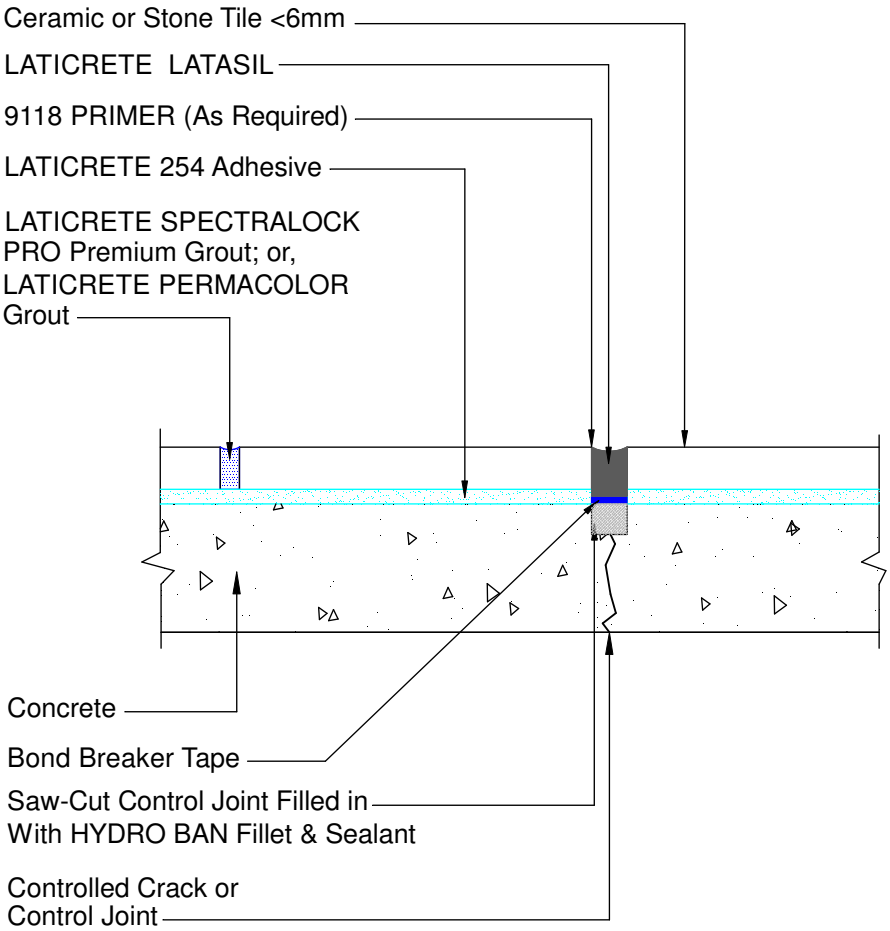
Detail 3. Intermediate Joint with Bond Breaker Tape



Detail 4. Intermediate Joint with Backing Rod



Detail 5. Construction Joint for Pedestrian Traffic



Detail 6. Saw-Cut Control Joint

NOTE: Inspect joints periodically and maintain accordingly. Traffic and service duties, usage, exposure to water and chemicals, and the like will effect the life of the sealant.

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