CERAMIC TILE INSTITUTE OF AMERICA, INC.

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SUBJECT: UNDERSTANDING MOVEMENT JOINTS IN CONCRETE WORK
By John Gallup, CTC

-"Movement joints are essential for the success of most tile installations. Various methods require proper design and location of movement joints." [1]

- "Because of the limitless conditions and structural systems on which tile can be installed, the architect or designer shall show locations and details of movement joints on project drawings."[2]

- "All expansion, control, construction, cold, and seismic joints in the structure should continue through the tile work, including such joints at vertical surfaces. Joints through tilework directly over structural joints must never be narrower than the structural joint."[3]

- Handbook for Ceramic Tile Installation - Tile Council of America

Commonplace in the tile industry today is reluctance on the part of architects and designers to specify movement joints in concrete work in accordance with recommended industry standards. The fact that appropriately specified movement joints can disrupt and interfere with the aesthetic and cosmetic value of a particular project make this reluctance understandable; however, it does not make their presence any less necessary in order to maintain the overall integrity of the finished tile work. In addition, many throughout the industry fail to realize that movement joints must be brought up through the slab, and ultimately through the tile work, and never be bridged with tile or stone.

This report is intended to make clear the reasons for the appropriate application of movement joints, and to point out the design essentials required in their installation.

First off, let's take a look at the varying definitions of movement joints. The American Concrete Institute and the Tile Council of America (TCA) recognize four (4) different types:

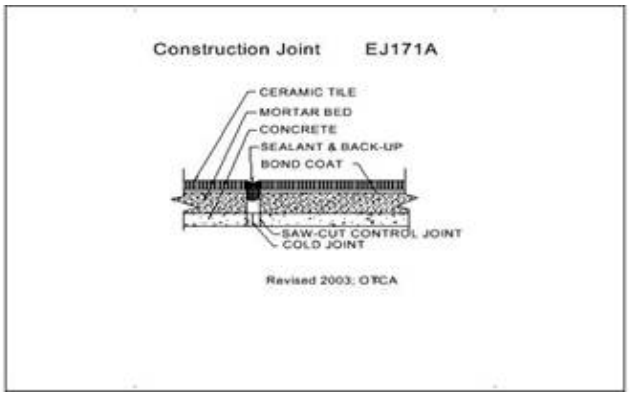
1) Construction Joint - The surface where two successive placements of concrete meet, across which it may be desirable to achieve bond and through which reinforcement may be continuous.

2) 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.

3) Expansion Joint - A separation provided between two 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.

4) 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 the 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.[4]

Let's now take a look at construction joints. Construction joints are placed where two successive pours (of concrete) join. In other words, one part of the slab is poured, and a second portion of the slab would be poured at a later time. This is done when areas specified for concrete are too large to be poured at one time. For tile installations, a mortar bed is then applied to the slab and tile is subsequently installed, sometimes in a "wet set" method, as depicted in the diagram EJ171A:

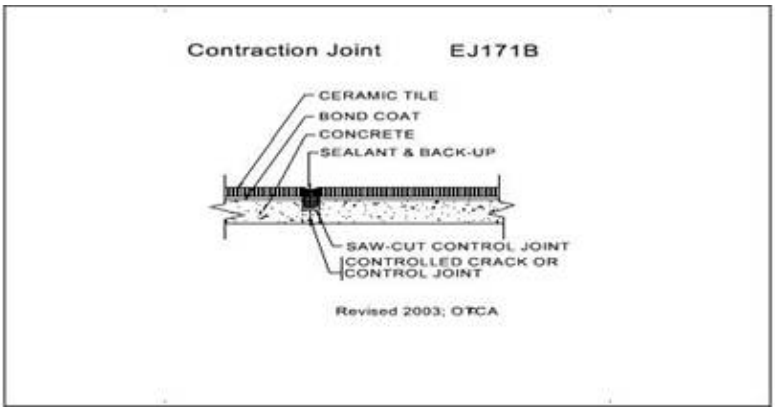


Now let's take a look at a contraction/control joint. Again, the term "control" refers to a type of movement joint which is cut or sawed into the body of a slab which creates a weak point where a crack would then be most likely to occur. Normal depth of the saw cut is 1/2" to 3/4" of an inch. It is important to note that a control joint must be sawed into the slab while the concrete is still "green", that is, while it is still in the curing process.

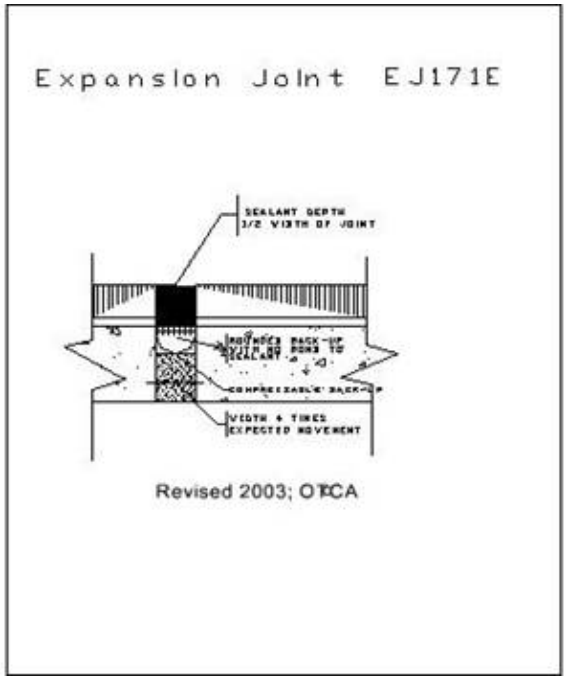
Normally, the window of opportunity to cut a control joint into a concrete slab is within 24 to 36 hours of the cure. Many contractors make the assumption that a control joint can be sawed after the concrete has fully cured. Applying a saw cut into a cured concrete slab does absolutely no good in terms of controlling where cracks occur in concrete. Bear in mind that concrete shrinks as it cures. Saw cuts, only when applied while the concrete is curing, will provide adequate relief from shrinkage as the concrete cures.

Therefore, applying a saw cut joint in a cured slab is irrelevant. If applied while the slab is still in the 24 to 36 hour window during the cure, the saw cut will in fact be wider at the mouth, or top of the joint, than at its base due to the fact that the concrete shrinks at a faster rate on the surface of the slab, this is due to moisture evaporation on the slab's surface. As is the case with a construction joint, a control/contraction joint is then dressed with a soft joint sealant and back-up, usually a poly-foam round backer rod, after tile

work is completed. See diagram EJ171B:

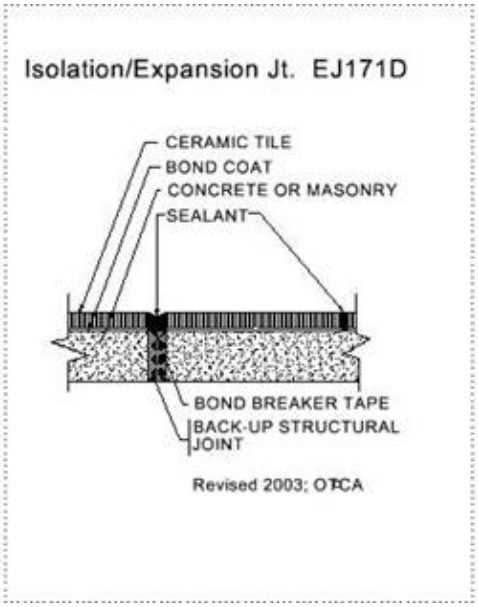


We now move on to the make-up of an expansion joint. The term itself has wrongly become an all encompassing term used to refer to all types of movement joints. First off, it is important to note that a true expansion joint is designed to move not only horizontally, but vertically as well.[5] Normally, “true” expansion joints are found where two completely separate structures meet. They are applied at a width which is 4 times greater than expected movement. The architect, in consultation with the structural engineer, determines anticipated movement in a given project. Expansion joints are used to isolate movement within the body (concrete slab), without disturbing adjoining structures. In exterior applications, the joint needs to be 3/8” in width for joints spaced 12’ on center, and 1/2” for joints spaced 16’ on center. In addition, the width must be increased by a 1/16” of an inch for every 15 degrees temperature change in the tile surface, greater than 100 degrees between summer high and winter low. [6]



Finally isolation joints. Isolation joints are very similar to expansion joints, in as much as they are placed where two separate structures, such as concrete slab and pavement, meet. Ordinarily, isolation joints are placed on a vertical plane, such as in tilt up pre-constructed walls. They, like expansion joints, allow for movement to occur both vertically and horizontally, without disrupting the performance of the structure.

Often times, a bond breaker tape is dressed over the backer material in the joint before the soft joint material is applied.



It is normal on a project spec to see that a generic movement joint or perimeter joint has been specified. A perimeter joint is simply a generic movement joint where a horizontal surface meets a vertical surface. The concrete work beneath perimeter joint is not necessarily prepared with a saw cut or expansion type joint prior to tile being installed. Rather, the slab is treated with a bond breaker tape, and the grout joint is treated with an approved soft joint sealant, rather than being filled with grout. The same holds true for generic movement joints, the difference being that a generic movement joint is found only in the field of the horizontal surface.

Now let's take a look at the types of materials used to finish a movement joint, including the specifications requirements for those products. First let's consider the backup strip material. The backup strip, remember, is the component which is embedded into the body of the joint. The TCA handbook states that "a backup strip shall be a flexible and compressible type of closed-cell foam polyethylene, butyl rubber, or open cell and closed cell polyurethane".[7] The size of the backup strip must fit neatly into the joint without compacting, and must allow a space for a sealant material to be applied which embeds 1/2 of the depth of the joint. Sealant cannot be bonded to the backing material.

Here are the requirements for a sealant material. Approved sealants include urethane, polysulfide, and silicone, the latter being the most readily available, not to mention the most cost effective. When specifying a silicone sealant, it is important to remember that the material must be 100 % silicone in its make-up. A common siliconized/acrylic bathtub caulk will have a tendency to shrink and subsequently pull away from the tile work. In addition, any material used as a soft joint compound to finish a movement joint in traffic areas must maintain a shore hardness of 35 or greater. Materials used for traffic areas will be noted as "Use T" materials, while "Use NT" materials are used in non-traffic areas. Most sealants which are formulated as a siliconized/acrylic hybrid only maintain a shore hardness of 10. For traffic areas, urethane based sealants are often best, due to the greater shore hardness they possess.

One major reason for the reluctance on the part of architects and designers to specify the appropriate volume of movement joints relates to the fact that the look and cosmetic value of a soft joint compound

disrupts the natural flow and appeal of the finish work. Quite simply, the shade and color of the soft joint compound used often times does not match the chosen grout color. One recommendation is to contact a local representative for tile installation, or soft joint materials. Quite often a sealant manufacturer will have a very broad array of colors available in sealant materials, or can even color match a sealant to the grout color in order to meet the specific color requirements for the project.

One advantage to a silicone based sealant is that it will contain a fungicide, and therefore can be specified for wet areas. Sealants used in the finish of movement joints must comply with ASTM standard ASTM C-920.

Sealant definitions are as follows: Type S - Single Component

Type M – Multi-component

Grade P - Sealants for joints on horizontal surfaces

Grade NS - Non-Sag sealants for vertical surfaces

Make sure sealant material complies with Uses “M and G” This denotes that the compound can be used with, and will adhere to, both mortar and glass. Remember, the glaze on ceramic tile is a vitreous, glass-like surface. The sealant compound must comply and bond to the tile work. Reference the manufacturerers’ data sheets to confirm these specifications and product compliance prior to specifying and applying the material.

Preparation of movement joints is done to insure that all areas are free of dirt, debris, and loose components prior to the application of the backup strip. It is imperative that all grout and tile work be fully cured and dry prior to installation of the soft joint material. Soft joint materials contain components which will shade cementious grouts during the cure process. Again, this potential for grout shading is eliminated if the grout is allowed to fully cure. Under normal, room temperature conditions, a cementious grout will require a full 24 hour cure time.

All of this information raises two big questions: First, how does the architect determine which type of movement joint to specify on a particular application? , and second, can any of the movement joints outlined in this report be bridged with tile or stone?

Let’s tackle the first question: What type of joint to specify and where?

Well, the answer to that question will depend on many things. First of all, many questions must be answered before we can approve a specific type of movement joint. Things such as , but not limited to, soil make up at the project site, water content of the soil, clay and sand ratios in the ground soil, must be determined, and certainly will be long before division 9 finish tile work is considered. In addition, freeze-thaw cycles and thermal conditions will also be a factor when considering movement joint type. Not to mention the estimated live and dead load which will be brought to concrete, size, square footage of the slab, must also be taken into consideration. Throughout the TCA Handbook, the phrase “Architect must specify type of joint and show location on details and drawings”.[8] The bottom line is this: The type of movement joint will be determined by the architect only after all consultation with the structural engineer and subsequent field reports relating to expansion, contraction, and movement, is completed.

Movement joint design essentials require that control, contraction, and isolation joints, complying with

EJ171-03, be placed 24’ to 36’ in each direction for interior work, and every 8’ to 12’ in each direction for exterior work. [9] However, as an example, if there is a thermal issue on an interior application, such as an interior floor on the north side of a glass wall with southern exposure, that slab must be prepared as if it was an exterior application, with movement joints every 8’ to 12’ in each direction.

Issues such as the one mentioned on the previous page show the need for the architect to specify proper placement and type of movement joint on a project, and to consult with the structural engineer.

Now, on to our next question: Can movement joints be bridged with tile or stone? Well, the TCA, as well as many representatives of the tile industry, have answered this question with a resounding NO! Let’s go back to the beginning of this report, and look at the quote pulled from the Tile Council of America (TCA) Handbook.

“All expansion, control, construction, cold, and seismic joints in the structure should continue through the tile work, including such joints at vertical surfaces”.

So, as the industry stands today, it does not recognize the application/installation of ceramic or natural stone in a manner that would bridge over movement joints of any type.

Some manufacturers of crack isolation membranes, uncoupling systems, etc., may state in their technical data that you can bridge certain types of movement joints in concrete slabs with their product. None of these methods, in which the movement joint is bridged with a membrane of any sort, are recognized by the Tile Council of America or ANSI.

Some manufacturers of crack isolation membranes and uncoupling systems may warrant their product over certain movement joints, as long as the control joint is carried into the tile work. Some manufacturers will go so far as to say that tile can be installed over certain movement joints, as long as a crack/movement suppression system is installed prior to the installation of the tile itself. As long as the membrane used is specified to compensate for lateral movement in the slab.

Consult the manufacturer for their recommendation. It is important to understand, however, that any method in which any type of system, other than what is specified by TCA specification EJ171, is not recognized by the TCA as an acceptable method. In the United States, the TCA is recognized by the UBC, Uniform Building Codes, as the guideline for the installation of ceramic tile. The UBC is the body which is recognized by the courts of law. The bottom line is this: Tile and stone is not flexible. Movement joints are placed in slab work to control and minimize movement. Control joints in particular are placed to direct a potential crack to the control joint. It simply does not make sense to bridge that area with something rigid like tile or stone. When specifying placement and type of movement joints in concrete prior to installation of ceramic or natural stone tile, it is important for the architect to gain all relevant information from the structural engineer for the project, and to place, prepare, and finish all movement joint work in accordance with TCA specification EJ 171-03. This will help to insure a trouble free tile or stone installation.

Bibliography and Credits:

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Www. thetiledoctor.com - website

Tile Letter - February 2004 - “The Misunderstood Joint” article by Patricia A Bohnert

ANSI - American National Standards Institute - Standard Specifications for the Installation of Ceramic Tile

David deBear – CTC

The preceding article was researched and written by John Gallup as a requirement for the Ceramic Tile Consultant Course. We wish to thank Mr. Gallup for his excellent report.

[1] Tile Council of America - Handbook for Ceramic Tile Installation 2003-2004 41st Edition - Page 7

[2] Tile Council of America - Handbook for Ceramic Tile Installation 2003-2004 41st Edition - Page 44

[3] Tile Council of America - Handbook for Ceramic Tile Installation 2003-2004 41st Edition - Page 44

[4] Definitions of Movement Joints - Tile Council of America - Handbook for Ceramic Tile Installation - 2003-2004 - 41st Edition - Page 7

[5] Tile Letter/ Article - February 2004 - by Patricia A. Bohnert Page 18

[6] TCA Handbook for Ceramic Tile Installation - 41st Edition - 2003-2004 - Page 44

[7] TCA Handbook for ceramic Tile Installation 41st Edition - Page 44

[8] TCA Handbook for Installation of Ceramic Tile 41st Edition 2003-2004 Page 25 spec RH130-03

[9] TCA Handbook for Installation of Ceramic Tile 41st Edition 2003-2004 Page 44