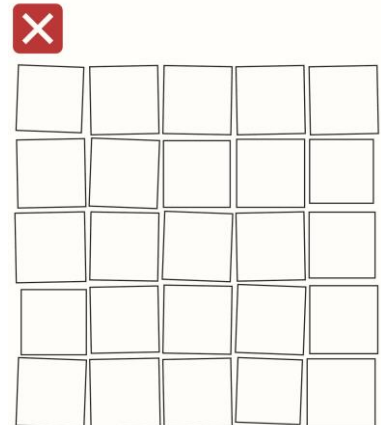


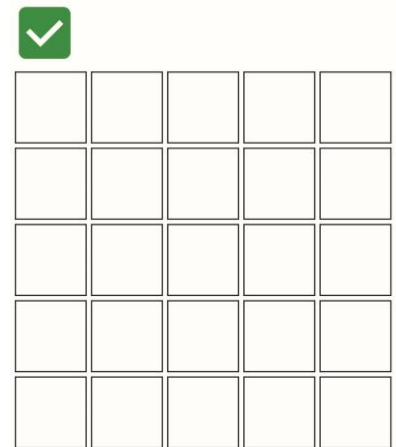
Necessity of embedding tile joints and movement joints in ceramic tiled surfaces

In coverings with porcelain ceramics or other covering materials such as tiles, stones, etc., considering joints and filling them with proper grouts will help in a durable and lasting performance. Here are some of the benefits of considering joints in ceramic tiled surfaces:

1- Create an integrated frame around ceramic tile: Due to low water absorption of porcelain ceramic tile, considering joints and filling them with proper grouts, which have a strong bond with this type of ceramic, an integrated frame is created between ceramic tiles, which add to the strength and durability of the ceramic covering. In case of using traditional sand-cement slurry (combination of white cement and stone powder or other similar compounds) due to low water absorption of porcelain ceramics, the slurry will not bond with ceramic tiles and over time, the slurry separates from them.



2- Preventing the growth of fungus and bacteria in the case of using proper grouts: If no joint is embedded between ceramic tiles, considering that it is theoretically not possible to reduce the gap between the two ceramic tiles to zero, and there will always be a gap, which due to its very small width, cannot be filled with slurry or grouts, it will be a good place for fungus and bacteria to accumulate and grow.



3- Covering of allowable tolerances and installation issues: Due to the possibility of human errors in the installation of ceramic tiles and the existence of allowable tolerances, the installation of porcelain ceramic tiles with proper joint width will help to solve these resulting problems.

4- Ease of replacing damaged ceramic tiles: If the ceramic tiles are installed with proper joint width, if any of the ceramic tiles are damaged by impact or any other reasons, due to the joints and sufficient gap, it's possible to empty the grouts with suitable tools and replace damaged ceramic tiles without affecting the adjacent tiles.

5- Visual integration: Embedding joints between the ceramic tiles and filling them with proper grouts gives a uniform and desirable appearance to the tiled surface.

Recommendations of official technical resources regarding the embedding of the joints:

Code 55:

7-3-1-4- floor covering with ceramic: The joint width between ceramic tiles is 2 to 5 mm and generally an average of 3 mm

National Standard of Iran No. 12495-3:

23-5- Connections: It is recommended that the width of the ceramic tile joints should not be less than 3 mm.

AS 3958.1:

5-4-6- Finished surfaces and joints: for the joint width, the following values are suggested:

Floor:

- Dry-pressed tiles: 3 mm
- Extruded tiles: 6 mm

Wall:

- Dry-pressed tiles: 1.5 mm
- Extruded tiles: 6 mm

Note 1: Wider joints may be required to accommodate larger tiles, provide a decorative effect and other reasons.

Note 2: Joint widths are normally measured at the tile face.

Warnings and tips related to joints between ceramic tiles:

- * The joint width must be at least two-thirds of the ceramic tile thickness
- * Before grouting, all excess adhesive in the joints must be removed before drying. Care must be taken not to damage the ceramics during this operation. The width of the joints must also be constant throughout the tiled surface.
- * To achieve a uniform width for the joints in ceramic tiled surface, it is recommended to use spacers.



- * Joint alignment should be consistent throughout the installation. The final alignment should be within a tolerance of ± 4 mm in 2 m from the specified joint alignment.
- * Before grouting, especially when the ceramic is installed with adhesive, the joints must be completely dry, as the humidity may cause destructive effects.

The necessity of embedding movement joints

As we know, all materials have a coefficient of thermal expansion and depending on their physical characteristics, they respond to temperature changes. The increase in length due to temperature changes is determined by the "linear thermal expansion coefficient". This coefficient actually states how long the length will increase for each degree of temperature increase. The coefficient of linear thermal expansion depends on the material and is one of its characteristics. The amount of this coefficient is proportional to the length and temperature change of the material. In the case of porcelain ceramics, this coefficient averages about $\alpha=6 \times 10^{-6}$.

In addition to changes in temperature, other factors such as changes in humidity and passing traffic also cause the ceramic to move relative to the adhesive mortar bed. By embedding a sufficient number of movement joints, additional stresses that may be caused by the movement of the ceramics will be prevented and the ceramics are protected from possible damages.

Recommendations of official technical resources regarding the embedding of movement joints:

National Standard of Iran No. 12495-1:

5-6- Movement joints

Embedding movement joints should be considered in the design stage. Factors such as drying shrinkage and humidity and temperature changes cause displacement pressures on the tiled surface, which can sometimes cause the ceramic tile to lose adhesion or crack. Sometimes it may be necessary for the tile movement joints to pass through the tile layer and its bed and be at least 6 mm wide. The location of movement joints is determined by the designer in the design stage. Examples of these locations include: on structural expansion joints, at internal vertical angles and in centers of 3 m to 4.5 m vertically and horizontally, in places where the possibility of accumulation of stresses (for example, change in alignment directions) and so on.

TCNA:

Movement joints spacing:

Interior areas 6-8 meters in each direction

Interior or exterior areas which are exposed to direct sunlight or humidity 2.5-3.5 meters in each direction

BS 5385.1:

6-5- Movement joint:

- It is recommended to consider movement joints in the following locations:
- Over existing and/or structural joints
- Where tiling abuts other material
- Where tiling is continuous across junctions of different background materials
- In large tiled areas, at internal vertical corners and at 3 m to 4.5 m centres horizontally and vertically
- Where stresses are likely to be concentrated, for example at changes of alignment

AS 3958.1:

5-4-5- Movement joints:

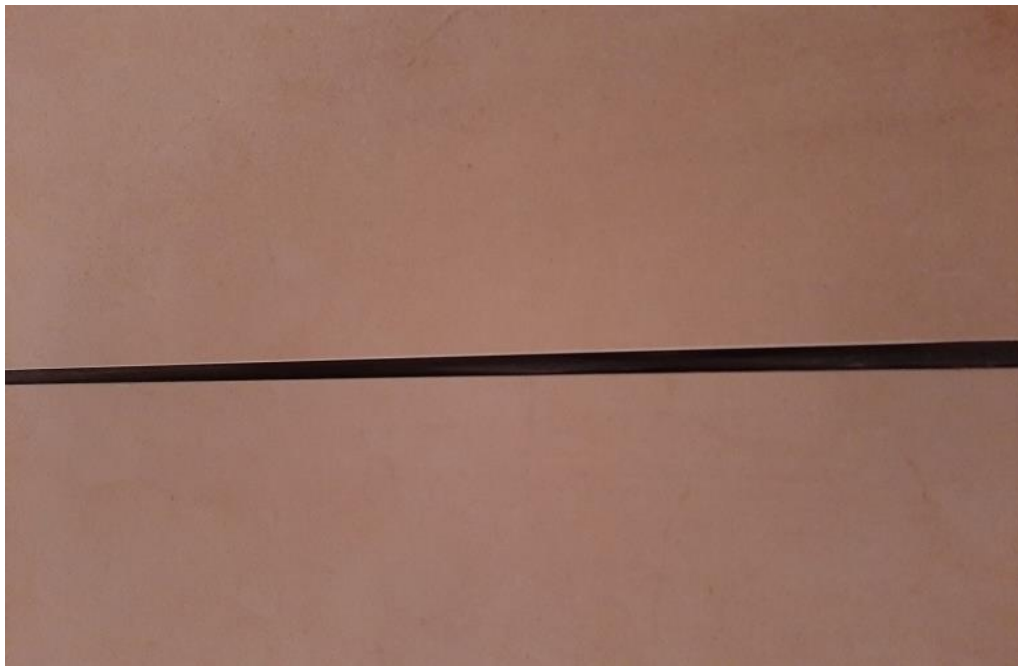
Movement joints are embedded on ceramic tiled surfaces for the following reasons:

- Separation of the tiled surface from fixed elements such as columns and walls
- Subdivision of large areas of tiled surface into smaller sections to compensate for induced strain from various causes.

- To interrupt the tiled surface to match discontinuities in the substrate such as construction joints and movement joints

Warnings and tips related to movement joints:

- * All joints should be rectangular in section, with firm, straight, smooth edges free from cavities and irregularities. The width:depth ratios and dimensions of the sealant profile in a joint should accord with the recommendations of the sealant manufacturer.
- * Where it is suspected that moisture movement or thermal movement of the background and/or tiling threatens the stability of the installation, provisions of additional movement joints should be considered.
- * When forming the joints, it is useful to insert a temporary filler strip that can be removed when the tiling is sufficiently firm; care should be taken to avoid grout and other materials becoming trapped in the joint cavity that prevent proper application of the sealant and might prevent movement of the joint, resulting in damage or displacement



Temporary filler strip inserted in movement joint

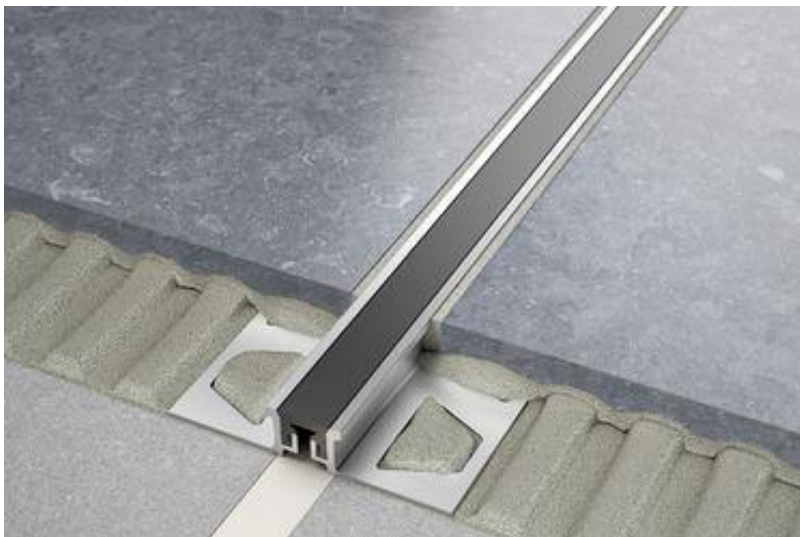
- * Using a special type of sealant may not be suitable for all ceramic tiles. In this regard, the manufacturer's recommendations should be considered.
- * The movement joints should have a rectangular cross-section and their width should not change in depth and there should be no holes in them.

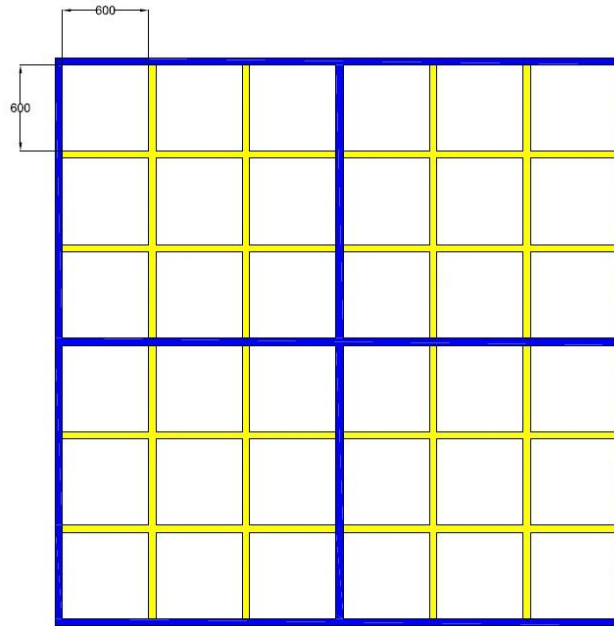
* In order to prevent the ceramic tiles from contamination when applying the sealant, it is recommended to cover the edges of the ceramic tiles with paper tape.



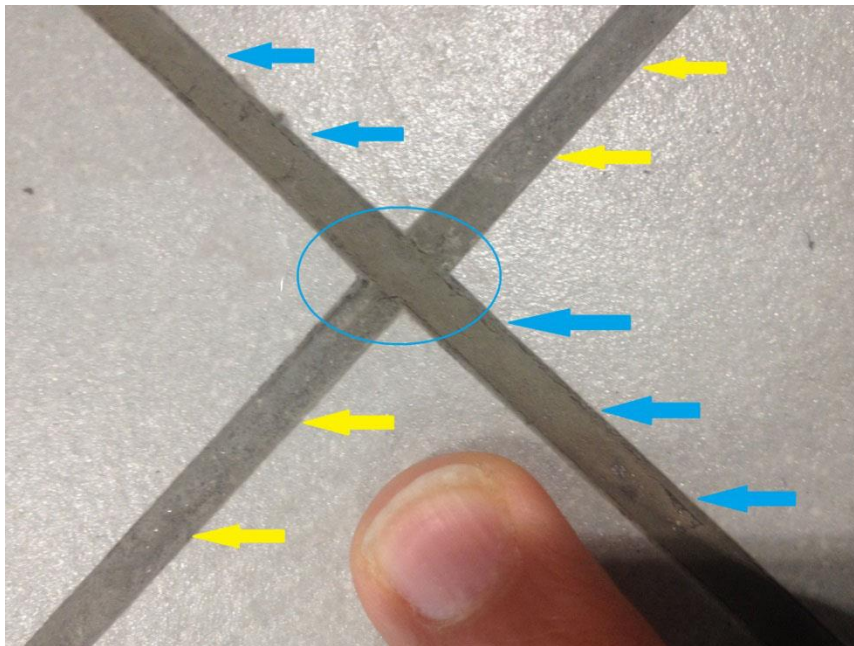
Recommendations for grouting and filling the movement joints on the surface coated with porcelain ceramic tiles:

It is recommended by dividing the tiled surface into blocks of appropriate dimensions, fill the joints inside the blocks with cement-based grout and also use movement joint profiles for the movement joints around the blocks. If it is not possible to use movement joint profile, a combination of cement-based grout and flexible polyurethane material which has a flexible property can be used. For example, in the picture below, it can be seen that the tiled surface is divided into 4 blocks and the joints are filled with a combination of cement-based grouts (yellow color) and flexible grouts (blue color). In this case the width of all joints should be the same.





In the picture below, it can be seen that the tiled surface is grouted with a combination of cement-based grout (yellow color) and flexible grout (blue color). As shown in the picture, the joints filled with flexible grout are uniform and not interrupted by cement grout and form a frame around tiled surface.



Ceramic tiled floor of Bologna-Italy airport