

## REPLACEMENT BRICK

**S**urveys indicate that more and more construction projects are additions, rehabilitations, or maintenance of existing or historic brick masonry buildings. As a result, the demand for brick to match continues to increase significantly. This *Brick Brief* addresses the key brick properties to consider when selecting matching and replacement brick.

Brick used in additions and rehabilitations may be broadly classified as either matching brick or replacement brick, depending on their properties and use.

**Matching Brick.** Matching brick are units which have similar **aesthetic** properties to those found in the existing brickwork. Typically the aesthetic properties considered include the color, texture, and size of the brick. Matching brick may or may not have physical properties similar to existing brick.

**Replacement Brick.** Replacement brick are units which will be bonded into the existing brickwork. Replacement brick should have similar **aesthetic** properties and, to a certain extent, similar **physical** properties to brick in the existing building. Typically replacement brick are used to repair existing brickwork or may be used where new brickwork is “toothed” or bonded into existing brickwork.

Where a project involves an addition to an existing brick structure, it may be possible to detail the new brickwork of the addition so that it is not bonded into the existing brickwork, not requiring replacement brick. Typically this is done by detailing an expansion or separation joint between the new and the existing brickwork.

### Mortar

It should be noted that the mortar selected for use with either matching brick or replacement brick is often more critical to the performance than the selection of the brick itself. Using the wrong mortar may cause spalling and cracking in the existing brick masonry. The mortar used with matching brick does not necessarily have to have similar properties to the mortar in the existing brickwork. However, if extensive replacement of existing brick which are bonded into existing brickwork is necessary, replacement brick should be used along with a mortar having similar physical properties to the existing mortar to ensure the performance of both the new and existing brickwork. Generally, a soft mortar with high lime content

and low or no cement content is recommended for repairs to existing or historic brickwork. For more information about traditional lime mortar refer to ASTM C270, ASTM C1713, and NPS Preservation Brief 2.

### Aesthetic Properties

Whether restoring a building in Colonial Williamsburg or building an addition to a 1960s school, a paramount concern is maintaining the integrity and character of the original structure. This entails finding brick which are similar in color, texture, and size to the original brick.

**Color and Texture.** Brick has always been prized for its wide range of color and textures. While some of the manufacturing methods used in the past are also used today, contemporary manufacturing techniques use advanced equipment, mineral additives, surface texturing, and sprayed-on or rolled-on surface coatings such as sand, engobes, and glazes to produce a wide variety of brick.

**Size.** It is most economical to obtain matching and replacement brick by specifying a contemporary brick unit currently made by the brick manufacturer. The critical unit dimensions to match are typically those on the surface exposed to view. Dimensions not exposed to view may be different than the existing brick as long as design and constructability of the brickwork are not impacted.

Where the size of the existing brick varies extensively from currently available sizes, it may be necessary to use a larger brick size which matches the color and texture of the existing brick and cut it with a wet saw to the proper size. If a small number of brick are required, this is likely the most economical solution. If a substantial quantity of brick is required, it may be possible for a manufacturer to make the brick to the correct size, but this will require setup charges.

**Sample Panel.** To evaluate the accuracy of a match, the color, texture, and size of matching and replacement brick may be compared to the original brick by the use of a sample panel. The brick in the sample panel should represent the full range of colors and textures of the brick selected and should be distributed within the panel to represent the existing brickwork. The original brickwork and the sample panel should be cleaned prior to a visual evaluation. Slight changes in mortar color can make a dramatic difference in the perceived appearance of the brickwork.

## Physical Properties

Regardless of which brick is used, both matching brick and replacement brick should comply with the most appropriate, current ASTM standard - ASTM C216 in most cases. For most restoration and repair projects, matching the aesthetic properties of the original brick is the primary concern, while closely matching the physical properties of the original brick is usually not necessary. However, when the brick will be bonded into the existing brickwork, as is true of replacement brick, and an extensive amount of the existing brickwork needs to be replaced, the physical properties of the brick should be considered in relation to those of the original brick to ensure compatibility of materials. As a rule of thumb, extensive replacement of existing brick involves spot repairs larger than an area of 2-3 ft<sup>2</sup> (0.19 - 0.27 m<sup>2</sup>), or where more than 20 percent of the existing brickwork in a wall is replaced, or where 8-10 ft (2.4-3.0 m) in length of an existing brick course is replaced. For projects where extensive replacement is needed, the most critical issues for the replacement brick are achieving compatible movement when loads are applied and the accommodating the irreversible moisture expansion of the replacement brick. Improper combinations of physical properties may result in cracking or spalling of the softer brick.

**Deformation.** Brickwork deforms as loads are applied. In most cases when brickwork is constructed with the same mortar and the same brick, the deformation, or elasticity, experienced by each brick is similar. However, if the brickwork contains some brick which are “hard” and some brick which are “soft”, the harder brick will not deform at the same rate as the softer brick. In some cases, this difference in deformation may cause cracking in the softer brick.

Where small areas of existing brickwork are required to be removed and replaced, the existing brickwork will usually redistribute the load around the area to be repaired if, and only if, a softer mortar is used around the brick. For these cases, the physical properties of the brick used for the repair would not be critical and matching brick could be used as long as a softer mortar is placed around them.

Where large, extensive areas of existing brickwork are to be replaced, the brick will need to be similar in hardness to the existing brick. This is done to ensure that the repaired brickwork will have an elasticity or deformation similar to the existing brickwork, and thus, not result in cracking. This is usually accomplished by specifying a replacement brick manufactured by a similar method. For brick in older structures, this often means selecting molded brick.

**Irreversible Moisture Expansion.** A brick is the smallest size it will ever be as it exits the kiln during the manufacturing process. From this moment forward, the brick will undergo irreversible moisture expansion. Most of the irreversible moisture expansion of a brick will occur

shortly after leaving the kiln with approximately two-thirds complete after the brick has been out of the kiln one year. This expansion will occur regardless of whether or not the brick is placed in a wall.

Since brick in existing brickwork were made many years before, the majority of the irreversible moisture expansion will have already taken place; however, the majority of irreversible moisture expansion in new replacement brick may not have occurred yet. If this is the case and extensive repairs are completed on the existing brickwork with them, they may induce internal stress within the existing brickwork.

Where small areas of existing brickwork are in need of repair and a mortar softer than the new brick or the existing brick is used, the amount of irreversible moisture expansion of the brick can be handled by the mortar. In these cases, it is not critical for the brick to have already experienced the majority of their irreversible moisture expansion.

For large areas needing repair, where it is possible, isolation of new brickwork from existing brickwork with expansion joints is recommended. If expansion joints cannot be used, the most common means of addressing this issue is to give replacement brick an opportunity to experience the majority of their irreversible moisture expansion prior to being laid in existing brickwork. This is typically done by purchasing the brick and stocking them at the brick plant, mason contractor's yard or project site. The rule of thumb for the amount of time between the replacement brick's manufacture and its placement in the wall is at least 2-3 months.

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