

Petrographic analysis solves masonry mysteries

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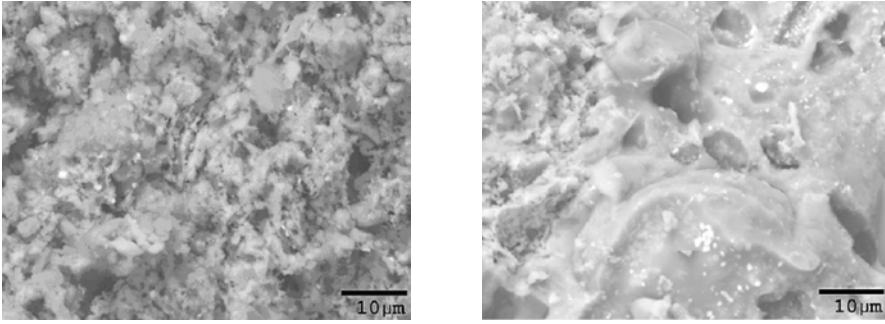
Petrographic analysis is a valuable forensic tool used when construction materials don't perform as expected. For masonry construction using mortar, brick or concrete masonry units, problems involving efflorescence, excessive retempering, freeze/thaw distress, cracking and discoloration can be identified.

For mortar, petrographic analyses in combination with chemical analyses can allow an estimation of the original mortar proportions. During cold weather construction, exposure to subfreezing temperatures can result in freezing of free water within the mortar. The creation of frost lenses (usually observed in the typical crow's feet pattern — Photo #1) introduces more porosity and can tie up water needed for hydration with a subsequent decrease in mortar strength. Where frost crystals are present, the full potential strength likely will not be realized and the mortar joints might leak.



Photo #1: Frozen mortar with frost crystal impression in the typical crow's feet pattern.

The freeze/thaw durability of brick is dependent on its porosity and pore structure. The degree of vitrification, which is a result of the temperatures the brick is exposed to in the kiln, has a profound effect on porosity. An under-fired brick will have a crystalline matrix that has high porosity while a brick that is properly fired will be more vitreous, or glassy, with less pore space (see Photos #2 and #3).



Photos #2 and #3: Scanning electron microscopy (SEM) images of two different brick surfaces. The brick on the left represents brick that failed in freeze/thaw testing. The brick surface on the right represents brick that easily passed freeze/thaw tests. Note the crystalline nature of the brick on the left due to under-firing.

Efflorescence on brick surfaces can be identified using petrographic analysis. The composition of the efflorescence material can indicate whether it is related to the brick or mortar. For those working with stucco, petrographic analysis can identify the number, thickness and composition of the individual stucco layers (single-, two- or three-coat systems), as well as, factors contributing to cracking and bond failure.

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