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CONTRACTOR'S CLEARINGHOUSE

To repair exposed-aggregate concrete panels, you must first remove all damaged portions and prepare the concrete surface.

Precast-Concrete Cladding: Patching

BY BRETT LAUREYS

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Q1

Q1: Our firm is working on a repair project in the Midwest that includes patching some 25-year-old, exposed aggregate, precast-concrete cladding panels. The exposed aggregate panels are light in color with fairly large, angular aggregate. The surface condition of the panels' concrete is poor, which makes it difficult to remove only the small, damaged portions. Also, the panels have been previously patched, and the concrete surrounding the patches is cracking and failing. Can we select a proper concrete-patch material without petrographic analysis? Should we face bed a matching angular aggregate into the concrete patch material? Or should we cast it into the patch material and then aggressively clean the surface to expose the aggregate? Or should we simply recommend complete replacement of the panel because the surface condition is so poor?

A1: Typically, exposed-aggregate, precast-concrete panels are plant-cast with an integral aggregate. The manufacturer applies a retardant to the form on the exterior surface of the concrete panels to prevent the thin cement layer from setting. After detaching the forms, the manufacturer removes this uncured cement layer from the panel's surface to expose the underlying aggregate. This process provides an aesthetically pleasing cladding material. Unfortunately, over decades of time, exposure and weathering typically reduce the strength of the concrete on the panel's exterior. Generally, as the larger and more angular exposed aggregates weather away, the strength of the panel's exterior decreases.

> Over decades of time, exposure and weathering can reduce the strength of concrete on a precast panel's surface.

Therefore, without determining the physical properties of the specific precast-concrete panel, it is very difficult to select an appropriate patching material for exposed aggregate panels. Due to the variability in surface conditions of the different types of exposed-aggregate concrete panels and the location/exposure of the building, it is common to perform material testing and petrographic analysis to determine the type of patching material your project requires.

From the description you've provided, it is likely that someone previously used an inappropriate patching material (with high compressive strength) on the panels. That unsuitable product resulted in

Take care when installing brick on walls where rapid cooling will occur (such as parapets, site walls or other sections exposed on two sides).

the cracking and deterioration you see around the patched areas. If an incorrect patching material is used, there is a potential for damage to the existing concrete substrate.

When patching/repairing exposed-aggregate concrete panels, the most durable method is to first remove all of the loose, damaged portions of the panel. Next, properly prepare the concrete surfaces and any exposed metal reinforcement. Finally, form and pour the concrete patch material with an integral aggregate.

Similar to the original fabrication of the panels, you can apply, a retardant to the exterior formwork to prevent the cement film on the panel's surface from curing. After you detach the formwork, you can remove this thin cement layer to expose the aggregate. When matching an existing exposed-aggregate panel, you should perform this form-and-pour patching technique (with the retardant) on several mockups before performing full-scale repairs. Doing so is necessary because you will likely spend a considerable amount of time adjusting the aggregate type and amount of retardant necessary to achieve the desired appearance.

Depending on the as-built conditions (structural and architectural) of the concrete panels, you also can patch the exposed-aggregate panels using Dutchman repairs, similar to stone Dutchman. This technique of patching allows the patch material/Dutchman to be formed and poured off-site in a controlled condition rather than casting on-site in a vertical or overhead position.

Working off-site, you can more easily control the quality of the patch material and the consistency of the exposed aggregate. When performing a Dutchman repair, saw-cut the damaged section of the concrete panel (either fully or partially) and anchor the new piece of precast concrete in its place. Before performing this repair, thoroughly evaluate the cladding system so your repairs do not compromise the structural component of the precast-concrete panel.

Even though the surface of the concrete may appear to be in poor condition, the condition of the concrete should improve as the depth of the panel increases. Even so, take special precautions when removing portions of these precast panels.

While individual projects vary based on conditions, full-panel replacement is generally not necessary and can be extremely costly. The most common reason for full-panel replacement is when the panel anchorage fails or deteriorates–not the concrete material itself. When repairing any precast wall cladding, always evaluate both the concrete materials and its anchorage to the structure.

Masonry: Absorption Alternate

Q2: We have a project for which the architect specified brick-masonry units that meet ASTM C216, Grade SW. The specification also specifically disallows the "absorption alternate" in ASTM C216. We have an excellent brick match for the project, and the brick-test data shows that the brick meets ASTM C216, Grade SW.

Manufacturers typically test brick units to more than 50 freeze-thaw cycles per ASTM C67. But, depending on the project climate, it may be worthwhile to increase testing to 100 cycles (typical for stone) or 300 cycles (typical for concrete).

Nevertheless, the architect says the brick only meets ASTM C216 by the "absorption alternate" and, thus, he/she has rejected the brick. What is the purpose of the "absorption alternate" in ASTM C216? Should we be worried about the durability of the brick that only pass ASTM 216, Grade SW, by the "absorption alternate"?

A2: ASTM C216, paragraph 7.1.2, states, "The saturation coefficient requirement does not apply, provided that the 24-hour cold water absorption of each unit of the five units tested does not exceed 8 percent." In addition, Section X7.4 Absorption Alternate of C216-19a Appendixes states the following: "For this alternative, the required saturation coefficient need not be met, provided that the cold-water absorption of each unit in a representative sample of five brick does not exceed 8 percent. Some bricks sold in the United States meet these requirements and have performed well in service. Correlation of physical property test results and freeze-thaw tests have shown the cold-water absorption alternative is a viable method of indicating freeze-thaw durability."

The saturation coefficient or c/b ratio (24-hour absorption divided by 5-hour boil absorption) is one means of predicting a clay brick unit's resistance to freeze-thaw cycling in exposed conditions. This coefficient indicates the capacity of the unit to accommodate the expansion of freezing water after it has become critically saturated. Critical saturation is the amount of water that a unit will absorb at conditions of standard temperature and pressure (submerged for 24 hours). The maximum saturation coefficient in ASTM C216 is 0.78 for the average of five units and 0.80 for individual units. The ASTM C216 standard also allows units with a 24-hour absorption value of less than 8 percent to meet the standard even if the saturation coefficient requirement is not met (the "absorption alternate").

Historically, brick units meeting Grade SW by passing the "absorption alternate" have performed well

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in service. Nevertheless, some architects/engineers choose to exclude this "absorption alternate" because of the exposure of the masonry wall or their history with failures of Grade SW brick that passed using the "absorption alternate." It is more common for architects in northern climates with significant freeze-thaw cycling to exclude the alternate. In addition, "absorption alternate" brick can be of particular concern when you install the brick units under conditions where they will be subjected to near-saturated conditions. (For example, their installation would be beneath poorly installed flashings, behind leaking gutters, where roof runoff is directed onto the brick or in poorly draining walls.) You also should be concerned about installing them in areas where rapid cooling of the walls will occur (such as parapets, site walls or other sections exposed on two sides).

While exclusion of the "absorption alternate" is not common, some architects/engineers choose to exclude it due to the exposure and detailing of the brick-masonry units. Many cases exist in which Grade SW brick did not perform well in a saturated condition, yet many additional cases exist where Grade SW bricks have been in service without any problems. Because the raw materials that make up the brick units are natural products that each behave slightly differently, the only true method for predicting the freeze-thaw durability of a specific brick is to perform freeze-thaw testing on a random sampling. Manufacturers typically test brick units to more than 50 freeze-thaw cycles per ASTM C67. Depending on the project climate, it may be more worthwhile to increase the testing to 100 cycles (typical for stone) or 300 cycles (typical for concrete). The higher the number of cycles, the better the prediction of durability. •

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