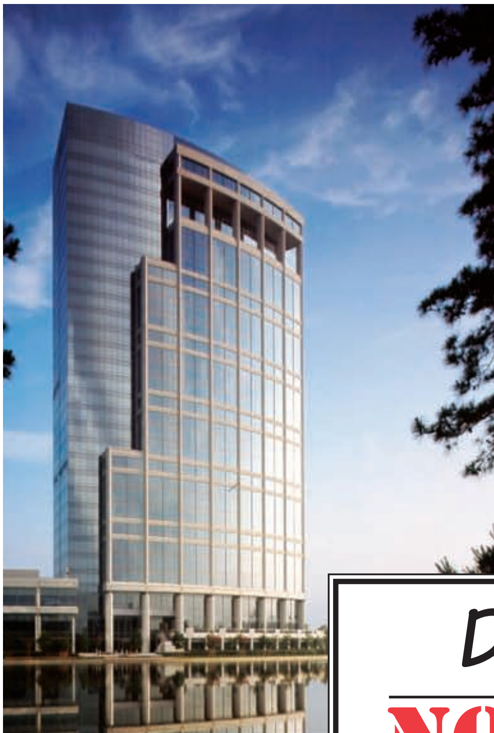
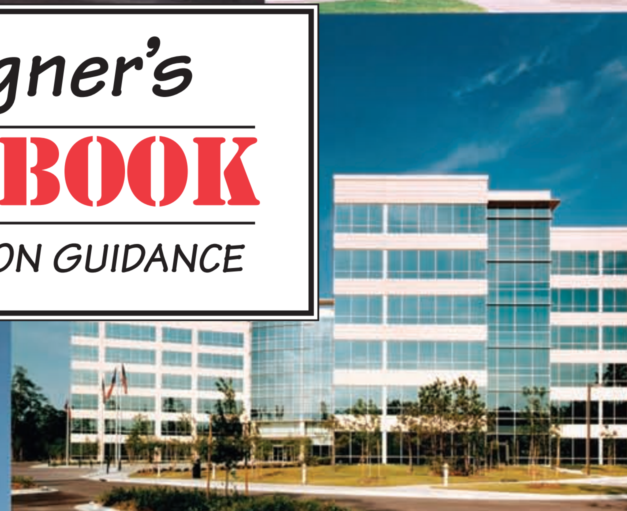


Designer's

NOTEBOOK

SPECIFICATION GUIDANCE





Part III Guide Specification for Brick-Faced Precast Concrete Panels

PCI's Architectural Precast Concrete Services Committee shows items to consider in specifying brick-faced architectural precast panels

A Guide Specification for Architectural Precast Concrete is being developed jointly by PCI, Gensler and the American Institute of Architects (AIA), Master Systems publishers of MASTERSPEC®, and will be available on PCI's web page (www.pci.org/guide specifications) around June 2003. The following is an excerpt on brick-faced precast.

Guide Specification

This Guide Specification is intended to be used as a basis for the development of an office master specification or in the preparation of specifications for a particular project. In either case this Guide Specification must be edited to fit the conditions of use. Particular attention should be given to the deletion of inapplicable provisions or inclusion of appropriate requirements. Coordinate the specifications with the information shown on the contract drawings to avoid duplication or conflicts.

PART 1 - GENERAL SUBMITTALS

Shop (Erection) Drawings: Indicate locations and details of brick units and joint treatment.

Samples: Samples for each brick unit required, showing the full range of color and texture expected. Supply sketch of each corner or special shape with dimensions. Supply sample showing color and texture of joint treatment.

Material Certificates: Brick units

PART 2 - PRODUCTS
THIN AND HALF BRICK UNITS AND ACCESSORIES

Type TBX brick units feature the tightest dimensional tolerances but may be too dimensionally variable to fit securely within form liner templates. Pre-select brick and name prior to bid or establish set cost allowance. If full-size brick units are required, use Division 4 Section "Unit Masonry Assemblies.

A. Thin or Half Brick Units: ASTM C216, Type FBX or ASTM C 1088, Grade Exterior, Type TBX, **[not less than 1/2 inch (13 mm)]** **[3/4 inch (19 mm)]** **[1 inch (25 mm)]** thick with a tolerance of plus or minus 1/16 inch (1.59 mm) and as follows:
   1. Face Size: Standard, 2-1/4 inches (57 mm) high by 8 inches (203 mm) long.
   2. Face Size: Modular, 2-1/4 inches (57 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
   3. Face Size: Engineer Modular, 2-3/4 to 2-13/16 inches (70 to 71 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
   4. Face Size: Closure Modular, 3-1/2 to 3-5/8 inches (89 to 92 mm) high by 7-1/2 to 7-5/8 inches (190 to 194 mm) long.
   5. Face Size: Utility, 3-1/2 to 3-5/8 inches (89 to 92 mm) high by 11-1/2 to 11-5/8 inches (292 to 295 mm) long.
   6. **[Where shown to "match existing,"]** provide face brick matching color, texture, and face size of existing adjacent brickwork.
      a. **<Insert information on existing brick if known.>**

Show details on Drawings of special conditions and shapes if required.

   7. Special Shapes: Include corners, edge corners, and end edge corners.

Thin brick units with higher rates of absorption than values in first subparagraph below should be wetted before placing concrete to improve bond. Before retaining paragraph, verify that thin brick selected complies with requirements.

   8. Initial Rate of Absorption: Less than 30g/30 sq. in. (30g/194 sq. cm.) per minute when tested per ASTM C 67.
   9. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."

Delete subparagraph below if surface-colored brick is not used.

10. Surface Coloring: Brick with surface coloring, other than flashed or sand-finished brick, shall withstand 50 cycles of freezing and thawing per ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet (3 m).

Options in subparagraph below are examples of descriptive requirements for appearance where a proprietary specification cannot be used. If approving a color range for brick, view 100 square feet of loose bricks or a completed building. Edit to suit Project or delete if brick is specified by product name.

11. Face Color and Texture: **[Match Architect's samples] [Medium brown, wire cut] [Full-range red, sand molded] [Gray, velour].**

Retain first subparagraph below, deleting inapplicable descriptions if required.

12. Back Surface Texture: Scored, combed, wire roughened, ribbed, keybacked or dovetailed.
13. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:

Retain subparagraph above for nonproprietary or subparagraph below for semiproprietary Specification. Refer to Division 1 Section "Materials and Equipment."

14. Products: Subject to compliance with requirements, provide one of the following:
    a. **<Insert manufacturers' names and product designations for acceptable face brick.>**

Retain paragraph below if mortar setting brick unit joints before placing precast concrete mix.

B. Setting Mortar: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144. Mix at ratio of 1 part cement to 4 parts sand, by volume, with minimum water required for placement.

Delete paragraph and subparagraphs below if not filling thin brick unit joints with pointing grout after precast concrete panel production.

C. Latex-Portland Cement Pointing Grout: ANSI A118.6 and as follows:

Select one or both types of grout from first two subparagraphs below.

1. Dry-grout mixture, factory prepared, of portland cement, graded aggregate, and dry, redispersible, ethylene-vinyl-acetate additive for mixing with water; uniformly colored.
2. Commercial portland cement grout, factory prepared, with liquid styrene-butadiene rubber or acrylic-resin latex additive; uniformly colored.
3. Colors: **[As indicated by manufacturer's designations] [Match Architect's samples] [As selected by Architect from manufacturer's full range].**

D. Setting Systems
1. Place form liner templates accurately to provide grid for brick facings. Provide solid backing and supports to maintain stability of liners while placing bricks and during placing of concrete.
2. Securely place brick units face down into form liner pockets and place precast concrete backing mix.
3. Clean faces and joints of brick facing.

Retain paragraphs below if thin brick, ceramic tile, or full brick will be laid after casting of panel.

4. Thin brick Units: **[Dry-Set Mortar: ANSI A118.1] [Latex-Portland Cement Mortar: ANSI A 118.4]**
5. Full Brick Units: Install **<Galvanized> <Type 304 stainless steel>** dovetail slots in precast: not less than 0.5 mm thick, felt or fiber filled or cover face opening of slots. Attach brick units with wire anchors, ASTM A82 or B227, Grade 30HS not less than 3/16 inch (W2.8) in diameter and hooked on one end and looped through a 7/8 in. (25 mm) wide, 12-gage (2.68 mm) steel sheet bent over the wire with dovetail on opposite end.

FABRICATION TOLERANCES

For tolerances, see Designer's Notebook (DN-8) Clay Product-Faced Precast.

Match Architect's Samples: Tips for Specifying Clay-Faced Finishes

Timothy Taylor, director of specifications with Gensler, shares his perspective on writing specifications for architectural precast concrete.

The combination of architectural precast concrete that is partially or wholly clad with clay-bodied materials has many precedents. Numerous examples throughout the U.S. where brick, ceramic tile, and terra cotta are used in conjunction with architectural precast concrete have achieved stunning, award-winning aesthetic designs with exceptional records for durability.

Some architects, such as Rob Jernigan of Gensler's Santa Monica, Cal., office, express their preference for using architectural precast concrete because it's a cladding material that is "plastic, three-dimensional and a lot of fun."

As with any material intended to be exposed to the weather, quality-assurance and -control requirements are critical. This is especially important in these designs, as clay-bodied materials supported by precast shapes are usually thinner than those supported by cast-in-place concrete, unit masonry, steel or wood framing, support or back-up systems.

The selection and specification of clay-bodied cladding materials and their attachment to precast should primarily, and preferably, be based on previous installations using identical materials and assemblies. Alternatively, selection and specification should be made from physical-properties testing of individual component materials combined with laboratory testing of mock-up assemblies to evaluate performance under anticipated project-specific conditions.

Compensating For Differences

Clay-bodied cladding materials are inherently dissimilar from precast concrete. When combined into a composite assembly, they need to behave in a compatible manner. One basic aspect of compatibility focuses on expansion and contraction caused by project-specific temperature and moisture conditions. Expansion, contraction and moisture-absorption characteristics for each of the cladding materials must be known and specified. Some clay-bodied materials possess the physical property of dimensionally increasing when wet but not decreasing when dry again. After its initial set, however, concrete materials will lose water and shrink. If a cladding material is bonded to a precast concrete backup, this shrinkage may be restrained by the cladding.

The Denver-based Gensler, designers of Gallup's Corporate Headquarters in Omaha chose two-toned, thin brick-faced precast panel accent strips supplemented with exposed monochromatic architectural precast concrete. Precast was chosen in order to avoid complications to project schedule and cost that conventional handset face brick, backup support framing, and associated scaffolding would have required. Photo: courtesy of Gensler.

Deformation resulting from this restraint to shrinkage may manifest itself as an outward bowing of the panel. In extreme cases, cracking of the cladding may occur. If a cladding possesses a large thermal coefficient of expansion, stresses in the panel under decreasing temperature may be the reverse of those manifested by shrinkage.

If the cladding materials and the precast concrete do not have similar expansion and contraction characteristics, the specification and detailing should provide for compensation or separation. Compensation is partially made by using precast concrete mixes containing aggregates that have expansion and contraction coefficients selected to be close to those of the cladding. Shrinkage is partially compensated for by mix water content. Cladding materials with large differentials of expansion and contraction, inadequate concrete bonding capabilities or a combination of the two typically are mechanically anchored and separated from the precast backup with bond-breaking sheet materials.

Mechanical Anchors

Mechanical anchors used for exterior cladding must be inherently noncorrosive under the project-specific environmental conditions. Each selected anchor should be evaluated for its performance when attached to the precast, when attached to the cladding and when functioning as an assembly. In isolating these three components of behavior, the anchorage designer can assess the ability of each proposed anchorage assembly to resist the flexural stresses imposed by handling, transportation, erection and in-service use.

Cladding panels using mechanical anchors are usually specified with a minimum number, location and placement symmetry based on the height, width and thickness of the cladding unit and on the preferred anchor model, style or type. Criteria for the quality of drilling, insertion and setting of anchors also should be specified. Pre-engineering of anchors is sometimes exercised if small amounts of cladding material are required, their physical properties are historically consistent and certifiable, and the anchor being tested in the pre-engineering exercise will be used for the project being specified.

Clay-Bodied Cladding Materials

Clay-bodied products (brick, ceramic tile and terra cotta) are man-made and therefore engineered to a measured degree. Their properties are usually well understood by their manufacturers, so their performance is more easily assessed for use as a cladding material. Some are not suitable for exposure to the exterior elements. Brick, ceramic tile, and terra cotta units with and without glazed faces should be evaluated for their ability to absorb water and resist freeze-thaw cycling.

Some clay-bodied cladding materials have ranges in color and shade caused by manufacturing processes and variations in raw materials. On a recent project, for instance, a brick supplier had not indicated to the architect, precaster or contractor that there would be a significant amount of variation in the brick to be cast into the precast panels. The precaster's crews laid up the bricks in a normal manner, not suspecting the wide color swings that were discovered when the panels were pulled from the forms. The brick faces subsequently were stained to achieve a degree of color uniformity.

If variations are anticipated and are deemed undesirable, the specifier should require blending of the cladding units prior to being placed into the formwork or laid up onto the panels. Clay-bodied materials have successfully performed in both mechanically anchored and bonded assemblies. Clay-bodied cladding materials not supplemented by mechanical anchorage should possess grooved, keyback, dovetailed or scored-back surfaces for long-term bond performance.

Three Combination Approaches

Precast concrete and cladding materials are successfully combined in three formats: in precast plants as an integrally anchored or bonded component, as plant laid-up onto cast panels and as laid-up to erected precast panels at the project site. Plant anchorage and bonding methods are the most commonly specified, as they support the advantages of panelization and factory quality control. Panelization typically lessens the time and site space necessary for precast erection, creating the potential for an earlier weathertight building enclosure and an earlier delivery time of the facility for tenant occupancy.

Plant laid-up claddings often require the precaster to provide special handling procedures to avoid damage from vibration caused during delivery and erection. Site laid-up claddings often result in the need for another trade at the site to erect the cladding to the precast, creating new complications that must be considered, such as the coordination of manpower, weather conditions, space allocation and in some cases the need for on-site scaffolding to erect overhead cladding. Specifying plant and site laid-up cladding systems may require tighter casting tolerances in order to receive cladding backings. The tolerances should be specified to reflect the clearance required for the specified anchorage or bonding materials.

To avoid the potential of edge-to-edge misalignments and staining caused by particles with deleterious properties, it is a good specification practice to require forms to be cleaned with vacuum or oil-free air hose to remove unwanted particulate matter prior to placing cladding units into the formwork. Cleaning the cladding material on both front and back immediately prior to placing it into the formwork is also a good practice, as it will avoid the potential for staining and bond reduction.

Joint Treatments

Joint treatment and anchorage placement for the cladding material must be carefully selected and specified. For instance, ceramic tile, and terra cotta claddings require continuous spacers and neoprene buttons to maintain joint widths, lines and levels that may shift when anchors, reinforcing, and backup mixes are being placed. Ron Huff of Gensler's Denver office adds that "detailing and modular spacing must be meticulous to get the coursing right and avoid orphaned mortar joints that can mar the overall look of a brick-faced panel." Fine sand is sometimes placed between the cladding units as an alternative to continuous spacers.

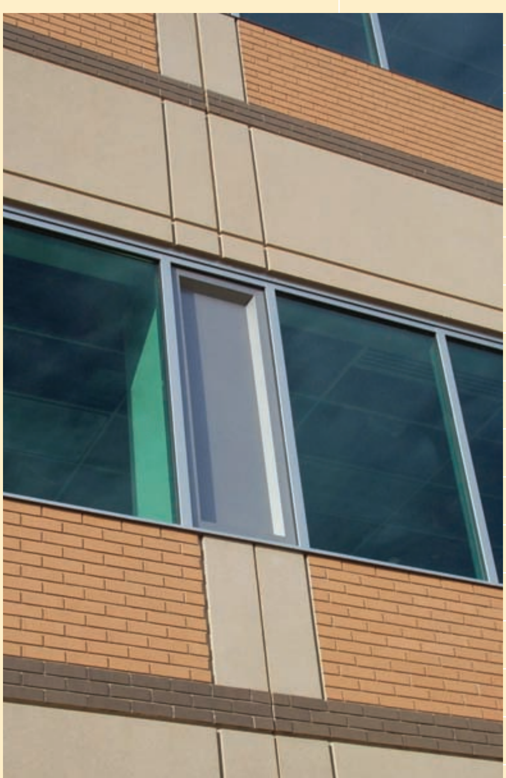
Brick-cladding joint widths can be controlled with spacers, but more typically they are controlled by placing the bricks into prefabricated form liner grids with prespaced joints. The grids are commonly manufactured from elastomeric or plastic materials and feature raised and semi-recessed joints. Raised joints may be selected for later tuck-pointing operations. Semirecessed joints may be selected to simulate various raked or tooled joints not requiring subsequent pointing.

Caution is advised in the specifying of proprietary form liners for brick claddings, as not all grids and brick products are manufactured to the same face dimensions and tolerances. Oversized grid recesses or undersized brick thicknesses may cause unacceptable levels and occurrences of tipping (rotation) of bricks from the panel plane of the exposed brick surface and brick step-in from the adjacent panel plane of exposed brick surfaces. Surface textures of brick units and exposed face-plane warpage can cause plastic precast concrete matrices to flow onto the exposed face of the brick units in the formwork. Huff observes that this flow, or seepage, "is usually more pronounced with dark-colored bricks than light-colored bricks."

Once the forms and joint-spacing materials are removed, joint sealants or grouting materials are mixed, placed and tooled to detailed profiles. Sealant and grouting mixing and placement should be clearly specified.

Bonding Clay-Faced Units

In general, ceramic tiles are recommended by their manufacturers to be bonded to precast backup using cast-in or laid-up methods.



Close-up of orphaned light-colored, thin-brick units at accent field to vertical exposed precast column cover transition. Photo: courtesy of Gensler.

Cast-in specifications are similar to those for the factory casting of thin-brick units, wherein a grout material is applied to the back faces of the ceramic tile prior to the placement of the precast backup. However, the type of bonding material depends on the absorption characteristics of the ceramic tile being used. For example, tiles with low-absorption characteristics may result in low bond strengths with water-based, non-modified Portland cement-based grouts. Tiles with high-absorption characteristics can remove the water necessary for non-modified Portland cement based grouts to hydrate.

Terra-cotta cladding units generally are cast into the precast panels. Since terra-cotta units have high absorption characteristics, they are soaked in water for a period of time, usually an hour, to reduce suction. Then they are positioned, while damp, into the formwork immediately prior to the placement of the precast backup.

The multitude of ceramic tile and terra cotta cladding product installation variations necessitates research, detailing and specifying on a project-specific basis. Language that is specific to these types of cladding materials has not been addressed in the new specifications in response to these variations.

—Timothy Taylor, Director of Specifications, Gensler, Washington, D.C.

To be continued in the Summer 2003 issue.