# Tech Brief – Veneer



While precast concrete plays an important traditional role in both underground and above ground construction, it has many more creative uses than most design professionals and specifiers may expect.

In the 1960s, engineers and architects began combining precast concrete with traditional cladding materials. By marrying these two product lines, they were able to speed up construction and reduce weather-related delays and concerns. Buildings could be enclosed more quickly with a greater overall cost savings. From this marriage of quality and convenience, veneered precast concrete was born.

Veneering precast involves attaching a veneer material to the face of a precast concrete unit during casting of the product. The attachment may be through direct bonding with concrete (common with clay products) or by mechanical anchorage with a bond breaker between the precast backer and the veneer (common with stone products). The precast units can be made into almost any shape (flat panels, column covers, curved sections, angled or more detailed shapes). Thickness and final design of the units are based on properties of the veneer material, project design and loads and should be determined by the qualified professional in conjunction with the precaster.

## Advantages of veneer precast concrete

Quality control – Plant-produced concrete is known to exhibit higher quality than concrete produced on site.

Speed of installation – Precast concrete allows for faster trade progression and quicker project completion. For example, one 400-square-foot wall panel can be erected in approximately 15 minutes.

Detailed Designs – Architectural features are easier to create in forms than in traditional field installations, (e.g., arch or lintel).

Construction site impact is greatly reduced – There are no forms and less waste on site, and less storage space is required since precast concrete is delivered when it's needed for installation.

Avoid weather-related delays – Precast concrete can be erected in most weather conditions, and since precast concrete is already cured when it arrives on site, no extra steps are necessary to protect it from rain, snow, wind, sun and extreme temperature changes.

Structural advantages – Precast concrete helps transfer the weight of the veneer material to the columns instead of edge loading the floor slabs in between the columns.

Reduced maintenance and life cycle costs – For most veneered precast concrete the number of real joints is reduced, reducing maintenance costs and potential points of leakage.

Project owners hire qualified representatives to coordinate and approve veneer materials. This involves pre-production testing to determine the veneer's properties for design and incorporation into precast concrete units. It is recommended to overrun veneer orders by 4 percent to 5 percent to allow for potential breakage and repairs. Production of precast concrete units does not always follow the erection sequence and should be discussed in advance with all project representatives. Allow enough lead time for the precaster to have flexibility in the production schedule in order to reduce the cost of building extra molds to meet tight deadlines. Communication and planning are crucial when manufacturing veneer precast concrete.

## Design considerations

When designing with veneer, it is important to take into account differences in properties between the veneer material and the concrete backer. These and other factors such as concrete shrinkage rates, exposure, span lengths, connection design and thickness of veneer material and precast backer may lead to an increase in potential bowing (typically outward). The differences in coefficients of thermal expansion between the veneer material and the concrete backer should be minimized (see Table 1). Otherwise, length change may occur at different rates resulting in differential stresses that may result in outward bowing. To offset this concern precasters may build an inward bow or camber into the form when casting the panels, use prestressing or, when panel thickness allows, use a double reinforcing cage. Additional tie-back connections have also been known to help restrain bowing potential.

Veneer products are commonly divided into two groups: stone and clay. Stone products would include granite, marble, limestone or other similar materials. These materials are typically installed in relatively large sections (usually measured in feet). Clay products include brick, terra cotta and ceramic tiles and are typically smaller (usually measured in inches).

## Stone products

A bond breaker is typically used to prevent concrete from directly bonding with the stone. Bond breakers allow for differential movement between the precast concrete backer and the stone veneer, helping prevent staining and cracking of the veneer.

Some common materials used to create a bond breaker are:

- 6 to 10 millimeters polyethylene sheet
- Closed cell, 1/8- to 1/4-inch-thick foam pad
- Thin liquid bond breaker (such as polyurethane)

A flexible, mechanical anchor should be used to attach stone to precast concrete. Anchors should also be corrosion-resistant. Anchors differ in shape, depending on the type and strength of the stone. However, most anchors have a recognizable cross pattern with the veneer-embedded portion arranged at a 30 to 45 degree angle from the back of the stone, penetrating approximately 3/4-inch or half the thickness of the veneer – whichever is greater.

## Clay products

Clay products are typically cast into or bonded to the concrete, creating a monolithic unit. Properties of the clay product, such as coefficients of thermal expansion (see Table 1), absorption, modulus of elasticity and volume change should be considered in the design as well as in-service conditions, such as temperature differentials between the exterior and interior surfaces.

Many clay products are “fired” and expand in the presence of moisture, including effects from humidity. However, this can be compensated in the precast concrete panel. For example, grout or concrete mortar between the clay products shrinks and helps compensate for expansion. The mortar joints may also experience elastic deformation under stress, which can compensate for expansion of the clay brick.

There are specific recommendations when using certain clay products in precast concrete. First, while there are several types of bricks available, not all bricks are acceptable for use in precast. Precast concrete requires tight tolerances in the individual bricks due to the form tolerances and the alignment of units. Bricks should meet ASTM C1088, Type TBX. (Note: the recommended tolerance for bricks used in precast is plus zero or minus 1/8 inch.) Otherwise, bricks may be moved or tilted by concrete placement and require repair. As for non-brick clay products, glazed or unglazed ceramic tile should conform to ANSI A137.1 and adhere to a tolerance of 1 percent. Terra cotta is usually a custom product and has a maximum length and width tolerance of plus or minus 1/16 inch.

## Absorption

The absorption and initial rate of absorption of clay products directly bonded to precast concrete will have an affect on bond. Brick absorption should be between 6 percent and 9 percent when tested in accordance with ASTM C216. Bricks should have an initial rate of absorption less than 20 grams per minute per 30 square inches, according to ASTM C67. These bricks are not required to be wetted. Bricks exceeding this value should be wetted to avoid removing moisture from the concrete and reducing bond. Terra cotta is typically soaked prior to use to avoid excessive suction of the moisture from the curing concrete. Generally, the bond strength between a veneer material and precast concrete exceeds the bond strengths of conventional field-laid applications.

Clay products should also have some physical characteristic for mechanical means of bonding with the concrete such as grooves or scoring on the back side of the piece.

Almost any pattern, such as running bond or stack patterns for brick, can be used. Custom designs or combinations of materials may also be incorporated. Units should be designed to minimize cutting of the smaller veneer products.

## Precast concrete veneer

Many precasters are now making veneer products that simulate traditional cladding materials. Some commonly seen products are lightweight precast concrete stone veneer used in residential and commercial applications. Some precast

concrete veneer products currently on the market mimic thin brick, full brick, limestone, tile, pavers, terra cotta and travertine. With so many colors and textures available, the options are limitless.

## Why use precast concrete veneer over traditional materials?

Quality control – As a homogenous material, the properties of precast concrete veneer are consistent, whereas other materials may have irregularities such as granite, limestone and wood that require a greater factor of safety.

Lightweight – Precast concrete veneer embedded with lightweight aggregates helps reduce product weight, thereby reducing shipping costs and dead loads on structures. This reduces the size of the foundation, resulting in cost savings. Stone and brick veneer are good examples of popular lightweight products.

Availability – Precast manufacturers are located in every U.S. state and in most Canadian provinces. This proximity makes shipping less cumbersome and product costs more bearable. Securing qualifications for LEED credits is also more favorable with precasters nearby.

Color and finish – Precast concrete can be designed to maintain or reduce these unwanted variances in color and finish, depending on the desired results. Precast concrete veneer can match older weathered materials for restoration or addition projects.

You can always make more – Exhausting a particular vein or quarry is only an issue for owners looking for natural veneer materials. If precast concrete runs short or becomes damaged on the job site, the manufacturer is quick to correct the shortcomings and produce more.

Veneered precast concrete and precast concrete veneer offer many advantages over conventional materials and methods of construction. There are advances in technology every day and other materials being veneered to precast concrete. For more information on veneered precast concrete or precast concrete veneer, contact NPCA or one of our precast concrete producing members by visiting the FIND A PRECASTER page.