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PRECAST / PRESTRESSED CONCRETE
MANUFACTURERS
ASSOCIATION OF CALIFORNIA

100 NORTH BRAND BOULEVARD
SUITE 200
GLENDALE, CALIFORNIA 91203
(818) 247-6177
FAX (818) 240-3041
doug@precastconcrete.org

YOUR QUALITY CALIFORNIA
PRODUCER MEMBERS:

ARTLO INDUSTRIES
DAVIS MANUFACTURING INC.
PERRIS,
CALIFORNIA
(909) 943-2091

CLARK PACIFIC
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CALIFORNIA
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SAN JUAN BAUTISTA, BLYTHE, GILROY,
LINCOLN & OAKLAND,
CALIFORNIA
(831) 623-2900

EXECUTIVE DIRECTOR
DOUGLAS M. MOORADIAN, A.I.A.



A NON-PROFIT ORGANIZATION
FOR THE ADVANCEMENT OF THE
DESIGN, MANUFACTURE AND USE
OF PLANT FABRICATED PRECAST
CONCRETE AND PRESTRESSED
CONCRETE.

PRECAST CONCRETE CLADDING

By Douglas M. Mooradian, AIA
PCMAC Executive Director - Architect

The term **Precast Concrete Cladding** refers to one of four different material systems as manufactured by the Precast / Prestressed Concrete Industry :

- ARCHITECTURAL PRECAST CONCRETE
- THIN SHELL CONCRETE
- GLASS FIBER REINFORCED CONCRETE (GFRC)
- STONE / BRICK-FACED PANELS

Each material has it's attributes as well as it's limitations with respect to design, weight, and plasticity. In all cases, however, precast concrete cladding is differentiated by it's long service life with good looks, quality of product and minimal required maintenance, particularly when produced in a **certified plant** and by a PCMAC Quality Assurance Company. Precast concrete can replicate traditional shapes from classical architectural periods and styles to exemplifying the contemporary forms and looks of tomorrow. The Architect and Engineer have total flexibility and versatility in what they do and how they do it. PCMAC recommends that the proposed project goals, budget, and design criteria be discussed in the schematic design phase with PCMAC or a PCMAC Producer Member Company in order to maximize the efficiency of the material selected and the cost effectiveness of the proposed design. Precast concrete cladding systems can be very cost effective when the material's low-cost repetition, mold complexity, and facade panelization are addressed from the beginning.

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ARCHITECTURAL PRECAST CONCRETE

Architectural Precast Concrete cladding is normally 4-1/2" to 6" thick depending upon the panel shape and reveal depths. A panel must be a minimum of 3-3/4" thick in cross section behind any reveal for structural purposes. Such a panel will weigh 55 to 60 pounds a square foot and is limited in size only by highway hauling regulations and the crane capacity to lift it. Aggregate size and sandblast depth are unlimited with panel returns limited to approximately two feet. Concrete mix designs and finishes are all custom made for the specific project and may be obtained through PCMAC or your local PCMAC Producer Member Company. This no cost or obligation service is especially important in California with California EPA requirements, as certain finishes or looks can be deceptively expensive.

Architects, Designers and Engineers will benefit from the information contained in the book Architectural Precast Concrete, Second Edition, published by the Precast / Prestressed Concrete Institute (MNL122-89). For your California projects, PCMAC has developed an industry specification tailored to quality California projects. The PCMAC recommended specification is included at the end of this section with the other standard specifications. Computer disks with these specifications are available at no charge by calling PCMAC at 818/247-6177 or your local PCMAC Producer Member.

THIN SHELL CONCRETE PANELS

Precast concrete cladding panels commonly referred to as **Thin Shell Concrete Panels** consist of a thin section of concrete, usually 2" thick. The concrete section is supported or reinforced by an external steel frame which is designed by the Precaster. Thin shell concrete panels (skin and frame) weight approximately 30 pounds a square foot and have a 4" to 6" concrete skin return limitation.

Concrete used for thin shell panels should be designed and produced in a PCMAC approved **certified plant** following good industry practices to minimize drying shrinkage. Aggregate size limits based on aesthetics and/or construction procedures may be a factor in the mix design. Contact PCMAC or your PCMAC Precaster for design and technical assistance. Quality control and an understanding of design limitations are essential for best results.

GLASS FIBER REINFORCED CONCRETE (GFRC)

Glass Fiber Reinforced Concrete (GFRC) is the most flexible and sculptural of the three cladding systems. It is also the most expensive due to its high cement content and minimal thickness. GFRC consists of a thin concrete skin made up of from 1/8" to 3/8" face mix and 1/2" backing mix of GFRC (approximately). This composite skin is supported by flex rods at 24" on center, each way, and/or gravity anchors to an external steel frame which is designed by the Precaster. GFRC (skin and frame) weighs approximately 15 to 18 pounds a square foot. Panel returns have limitations when exposed aggregate consistency is important from one face to the other.

The GFRC skin is usually limited in size to 20 feet in length, although frequently two skins are attached to one frame. The skin is allowed to float free from the frame which is held back from the frame about 1". The skin is made up of a face mix and a back mix. A 3/16" sand face mix is usually spray applied. An aggregate face mix, when used, is limited to 3/8". The GFRC backup is sprayed up, with a minimum of three passes (1/2") using a cement rich sand mix and alkali resistant (AR) glass fiber. The AR glass is cut at the spray gun and carried to the surface with the spray. The AR glass becomes approximately five percent of the GFRC weight. Architects and Designers will benefit from information contained in the GFRC Recommended Practice for Glass Fiber Reinforced Concrete Panels, Third Edition, published by the Precast Prestressed Concrete Institute (MNL 128-93).

Glass Fiber Reinforced Concrete (GFRC) is frequently used to renovate historically significant buildings to replace deteriorating terra-cotta. Actual terra-cotta pieces to be replicated are taken down by the precaster, repaired, cleaned and used to make reverse molds which can then be used to spray the GFRC replacement piece. GFRC, at approximately one-quarter the weight of terra-cotta, is colored and textured to match the piece being replaced. Upon fabrication, the new GFRC pieces are reinstalled with mechanical attachments to the building. This renovation frequently includes fascias, column covers and capitals, cornices, pediments, window and door frames. Depending on the casting, a structural backing frame may or may not be required to handle and support the GFRC pieces.

GFRC requires strict quality control and should be produced in a **certified plant** by a PCMAC Precaster. Contact PCMAC or your local PCMAC Precaster for design and technical assistance. For quality GFRC in California, see the PCMAC Standard GFRC specification at the end of this section. This specification is available on computer disk at no charge by calling PCMAC at 818/247-6177, or your PCMAC Producer Member.

STONE / BRICK-FACED PANELS

Today more and more stone or brick-faced buildings are being panelized with precast concrete backing for both cost savings and also as a secondary water intrusion barrier. The taller the building or the more intricate the pattern, the better potential for saving money. In addition, the precast option allows one to change materials as they go up the building for added cost savings or to contrast one material against the other. This option also saves time and money to scaffold the building as the exterior-cladding is set into place by a crane. Contact PCMAC or your PCMAC Precaster for budgetary comparisons, design and/or technical assistance to minimize panel joints and their locations on the building.

DESIGN CONSIDERATIONS

PANELIZATION

For seismic purposes, all precast concrete cladding panels are supported off the building's structural system by typically two gravity connections. In addition to the gravity connections, push-pull rods are installed as required to hold the panel in lateral alignment to the building. Panels are designed to move with the building by the precaster and it is recommended that PCMAC or a PCMAC Precaster be consulted in the design phase to optimize the panel to building connection requirements. Early coordination efforts are important not only for the project budget, but also when the structural system and cladding system are put together.

REPETITION AND MOLD CONCEPT

Since molds are an expensive item, tooling costs should be spread over as many units as possible. The more elements that can be cast with any one given mold, the more economical the project becomes. Although every project will have some atypical conditions, the more successful and cost-effective projects maximize the repetition of elements. This means careful planning is necessary to achieve good repetition without sacrificing design freedom.

The Architect or Designer can make a significant contribution to economic precast production by designing precast concrete panels with a knowledge of the **master mold** concept. This involves fabricating one master mold, with its appropriate additional tooling, that allows a maximum number of reuses per project. Units cast in this mold need not be identical, provided the changes in the units can be accomplished through pre-engineered mold modifications.

The number of forms required for a job is determined by the time allowed for completing the job and the number of castings required. Casting may proceed during the early part of the erection process if the panels have been manufactured in the correct sequence. However, this format may not coincide with the needs of the master mold concept. Fewer forms will be required if most conditions can be covered by modifying the master mold with bulkheads or blockouts.

THE LARGER THE BETTER

Most precast panels, for reason of economy, should be designed as large as possible and within normal handling and shipping limitations. This is because the smaller the panel, the greater the number of pieces required for enclosure. Handling precast components constitutes a significant portion of the expense involved in a precast job. The cost difference in handling a large unit, rather than a small one, is insignificant when compared to the increased square footage of the larger unit or piece. The exception to this is in the transportation of larger units and how they can be stacked on trailer beds for delivery.

In addition to providing cost savings during erection, larger panels provide secondary benefits by reducing the amount of caulking needed, offering better dimensional controls and requiring fewer connections. Thus, larger units are preferable unless they lack adequate repetition or incur cost premiums for transportation.

CAST FACE DOWN

Architectural precast cladding is normally cast exposed face down. In addition to mold release, the panel design should take into account the ease of panel removal from the form. Special attention needs to be given to panel returns and how the aggregate surface will match the panel face, particularly with large aggregate mixes and heavy sandblast finishes. PCMAC or your PCMAC Precaster are your best source of advice for specialized form needs and their relative cost.

At areas where negative draft is required, it may be necessary to incorporate slip blocks (i.e., removable plugs) to aid in stripping the precast concrete panel from the mold. Reverse or negative draft will create entrapped air voids that, if exposed, may be objectionable. Minimizing these surface blemishes will incur extra cost. In general, the greater the positive draft, the more economical and uniform the finish.

BULLNOSES

The bullnose offers a useful tool with which Architects can increase interest by adding dimensionality and allowing the design to avoid simple concrete planes. The light-and-shadow effect achieved with a bullnose produces a major visual impact when a building is viewed from a distance. The shadows cast by a horizontal bullnose profile can create strong lines that tend to reduce the apparent height of the structure.

In all instances, the most effective design, along with efficient connection details, can be achieved by discussing these aspects with PCMAC or your PCMAC Precaster prior to finalizing the plans. They will be able to give suggestions and designs that will ensure the maximum design efficiency is achieved at the lowest erected cost.

REVEALS

Reveal strips can add visual interest to a building clad with architectural precast panels while eliminating some of the aesthetic concerns that develop when planning panel configurations. Used effectively, reveals offer the simplest way to break up the expanse of an architectural precast panel by giving it visual interest and scale while helping diffuse any differences that may occur in texture or coloration between panels.

A reveal or demarcation feature is a groove or a step in a panel face generally used to create a desired architectural effect. Another name for it is rustication or false joint. Reveals can run vertically, horizontally or diagonally, and there may be several bands of them on a building. Reveals transform simple shapes into non-routine, visual arresting forms and are used to separate multiple panel colors, finishes or textures. Reveals typically measure 1/2" to 1" deep and 3/4" to 4" wide, with 3/16" to 1/4" beveled surfaces allowing for ease of stripping.

The exterior articulation helps modulate the scale of the building. When desired, the scale of large panels may be reduced by using reveals. The reveal should be wider than it is deep so the panel can be stripped without damaging the mold. Typically, the mold cost associated with reveals is insignificant in comparison to bullnoses and cornices, however, deep-set reveals requiring thickened sections may add some mold costs.

Precast by its nature is made up of panels or component pieces that are assembled to create the building's structure or skin. Those pieces obviously have joints between them, and the reveal's most pragmatic use comes in articulating those fundamental joints. These joints can be either emphasized or minimized and hidden by the addition of reveals. Some of the reveal's other uses come in providing drips and/or small horizontal shelves to protect openings and control moisture as it moves along the exterior surface of the precast.

Beyond the pragmatic applications of this most-important detail are the more practical uses. Reveals are typically designed where there are changes in the precast's surface. For example, a shift in the panel's finish from smooth to textured can be emphasized by using a reveal at the point where the surface texture changes. Reveals also work well where fundamental materials change within a precast panel, such an exposed-aggregate finish to a non exposed-aggregate finish within the panel. Reveals allow a crisp, clean transition between these different textures and finishes as well as between multiple color changes on a panel.

Lastly, reveals can be placed where there are directional changes in the precast surface, such as between a vertical surface and a cornice or bullnose detail. These elements within a wall design can be emphasized through the use of reveals. Reveals represent the most economical architectural technique for articulating panels or component pieces. They are by nature, relatively thin and small, and in general do not add significant thickness to the panel. As a result, the greatest value in precast is achieved when reveals express the design of a panel or facade.

CORNICES AND EYEBROWS

Cornices provide a number of significant aesthetic and functional advantages when designing virtually any type of building. Their ability to break up long expanses of the facade adds visual interest as well as shading windows from sun, reducing energy costs, and providing internal shading. A cornice consists of a horizontal projecting overhang comprising multiple surfaces, planes and profiles with infinite variations. It is usually located along a parapet or at the top of a given plane. The cornice crowns or finishes the part to which it is affixed.

Eyebrows offer a design element that can add interest similar to a cornice. An eyebrow is a horizontal projecting overhang comprised of a single profile that projects further than a cornice. It is usually located above a window or at a parapet.

Mold costs for either component will depend on the degree of complexity and the size of the projection. Both cornices and eyebrows may be continuous, interrupted, arched or peaked. Dissimilar finishes may be used on adjacent surfaces. The plasticity of precast concrete along with repetitive precasting of multiple units usually makes it economically feasible to use complex profiles and configurations as the form cost is spread over many similar units.

Whether used as the top piece or an eyebrow, the architectural precast cornice shape offers a multitude of design possibilities. For instance, a cornice can easily cantilever past the structural roof slab or project away from the facade's plane without needing complex additional support. Contact PCMC or your PCMAC Precaster for design and technical assistance as well as to optimize the impact to the building's structural system.

MULTIPLE MIXES AND TEXTURES

Design flexibility is possible in both color and texture of precast concrete by varying aggregate and matrix colors, size of aggregates, finishing processes and depth of exposure. A highly articulated pattern of color and texture achieves a richness of architectural expression in building facades that few materials can match.

A texture can be defined, in comparison with a smooth surface, as an overall surface pattern. The options for textured concrete finishes direct from the mold include the characteristic imprint, or pattern, from a form liner or mold. Other types of textured finishes can be achieved by the depth of the sandblasted finish. As a general rule, a textured surface is aesthetically more satisfactory than a smooth finish. Add stone or brick inserts and the possibilities become endless.

Combinations of different finishes using the same or different concrete mixes within a single precast concrete unit offer excellent possibilities for the architectural use of tones and texture in facade treatments. The use of combination finishes means the designer must make an early decision to ensure that the overall concept allows for the change in finish color and texture. A suitable reveal (that is, some demarcation) needs to be detailed to separate them.

Projects that effectively use multiple mixes and finishes create visual interest as well as better replication of some natural stone appearances, such as limestone, when viewed from a distance. Visual interest and a unified structure can be obtained by composing harmonious patterns into themes using a palette consisting of the form and rustification lines of the surface, texture and color of the precast.

The flexibility precast cladding offers for textural options makes it a strong contender for many buildings. Not only is it economical, it offers scheduling advantages as well. Most important, however, is the ability to masquerade as many different materials and forms by altering the texture. This flexibility lets Architects and Designers use a material they are familiar with without creating a tedious similarity in look. The perceived richness and quality look of the material along with its long life and no maintenance requirements makes precast concrete cladding a hard material to beat, particularly when viewed from a life cost perspective.

Contact PCMAC or your PCMAC Precaster for design and technical assistance to optimize the impact of the building's structural system.