Formliner Artistry

Architects and precasters are using cutting-edge technology to expand the artistic capabilities of formliners to feature textures, embedded materials, and photo realism

— Craig A. Shutt

CAD-CAM technology was used to manufacture the master molds for the photo-engraved rose images used on the precast concrete panels cladding the Cleveland Medical Mart & Convention Center. Photo: Architectural Polymers.

Formliners have been used for decades to provide creative finish details for precast concrete. Today, however, new techniques and technologies are allowing a wider array of designs at lower costs. But to maximize success, the design team should be in close communication with the precaster early in the design process.

"The technology of formliners has progressed tremendously," says Marshall Walters, president of Architectural Polymers Inc. "In the past, some architects avoided formliners because they couldn't get the design they envisioned. Now, it's possible to achieve most designs if the designer and precaster communicate well about it."

Shane Calmes, owner of Advanced Formliners, agrees. "Architects are really challenging us to create intricate designs. They're thinking outside of the box, and we're creating new custom designs that bring their vision to life."

One of the most dramatic enhancements has come from the growth of Computer Numerical Control (CNC) routers, which use computer programs to precision cut patterns, shapes, or even photos into formliners. But intricate molds, expanded texture options, embedment capabilities, and creative layouts are also providing new techniques that architects can use to meet owner needs and produce a dramatic, arresting aesthetic statement.

Using a few designs that repeat in nonlinear ways can reduce costs while creating an attractive design, such as in this design by artist Vicki Scuri of Siteworks. Photo: A.L. Patterson.

Textures

The range of textures has expanded as new forming capabilities have allowed formliner producers and precasters to provide more detail and configure forms to minimize the appearance of repetition. Reuse of formliners creates a significant cost savings, but architects often want to change forms to avoid creating a panelized appearance. In many cases, textures are created to hide joints and eliminate repeating highlights that stand out.

A new technique called "puzzle-piecing" uses each texture as a module and fits them together in different ways within each panel, explains Buck Scott, president of Scott System Inc. "The goal is to shift the textured liner 90 degrees or turn it so that it looks entirely different in the next panel."

This technique is also used to maximize the impact of shadow lines, he notes. Designs can be cut so that when they are seen from one direction, the images are deep and dramatic, while they can't be seen at all when viewed from the other direction.

In many cases, the textures appear more realistic because they are made from formliners produced from molds of actual stone or other materials. Often natural stone can be used to make custom molds.

The new techniques are attracting designers' attention. "Rock textures are big, and they're not going away." Says Jim Bohrer, vice president of Custom Rock Formliners. "They provide a timeless design for any type of building, soundwall, or mechanically stabilized earth (MSE) wall."

Attaching veneered stones to panels also is gaining in popularity. Formliners are often used to hold natural stone in place during the precast manufacturing process while the concrete is being cast. Most recently, terra cotta was embedded into structural precast concrete panels to clad the CONRAC (Consolidated Rental Car Facility) at Logan International Airport in Boston, Mass. It was the first such use in North America and one of the few in the world. (For more on this project and other veneered-stone applications, see the Spring issue.)

> 'Rock textures are big, and they're not going away.'

Another new technique has created a granite-like concrete appearance that sparkles when reflected by sunlight. Using either black or white aggregate creates distinctive, eye-catching designs that replicate the appearance of quartz, says Calmes. Three or four color shades can also be created with only one aggregate through different finishing techniques.

Thin Brick

Bricks have been inset into concrete panels since 1971, when an elastomeric formliner with pockets to hold brick pavers was used for a high-rise residence in Denver. The range of brick options has grown as more designers utilize this high-performance method of constructing a brick wall. The ½-inch-thick to ¾-inch-thick thin bricks are precision engineered to fit into molded forms that offer a variety of faux brick joint configurations. The joints never require repointing, since they are formed from the body of the 6000 psi concrete panel.

"There are new players supplying brick, because precast panels embedded with thin brick have

Formliners and forming techniques can be used to create intricate patterns of buildings such as this church in Dallas, Tx. Photos: Gate Precast

This photographic reproduction was created using a CNC router on a panel with white cement and black aggregate. Photo: Gate Precast.

grown in popularity," explains Mike Denson, sales manager for Innovative Brick Systems LLC. "More brick companies are supplying thin bricks." Bricks with an aged appearance are growing popular to provide a historic appearance or to match existing buildings in the neighborhood."

The designs are becoming more complicated, he notes, including herringbone patterns, soldier or vertical courses, and arches with keystones. "Designers are looking for more detail and trying to hide joints or the panelized design by adding more visual interest."

Bricks used in formliners must maintain tolerances outlined in PCI's *Standard for Thin Brick*, stresses Mark Porreca, sales manager for architectural finishes at A.L. Patterson. "ASTM tolerance standards aren't tight enough. With so many layers of bricks being stacked, being off slightly means the last rows must be cut off or adjusted in the field. Tight tolerances when placing bricks into molds is critical."

Designs and Lettering

Lettering and more intricate designs, even artwork, can be impressed into precast concrete panels, using molds created from the original artwork, lettering, or logos. These are particularly popular for institutional and governmental buildings to provide a solid, chiseled appearance.

The key to designing these pieces is to ensure appropriate draft or taper for stripping the pieces from the forms. Recessed letters should have right-angle shoulders and a flat back to stand out, according to PCI's *Architectural Precast Concrete Manual*.

Often, more elaborate designs are crafted as clay pieces from which the molds are made. In some cases, CNC routers are used to cut foam pieces to the proper shape. This can be less expensive, but it doesn't leave room for error, notes Scott. "If you don't like the clay design, you can change it before you make the molds. You can't do that with a routered design."

Scenery Options

Elaborate designs, intended to evoke natural scenes including fauna and flora, are being created more often. Soundwalls and MSEs in particular offer long, unbroken canvases on which to produce creative scenes. "More highway departments are getting involved and hiring artists to create images," says Walters. CNC routers work well for these options, he notes, because the artist can provide his drawings and see the resulting three-dimensional image. "A CAD rendering speeds up the process by allowing the artist's work to be approved and manufactured in a predictable time frame and accurate manner."

"A CNC router with five-axis capability allows a high degree of detail," says Porreca. "But turning a two-dimensional image or drawing into a three-dimensional piece to be cut into the liner can consume a lot of time as depths are defined and interpreted. Providing a three-dimensional file early in the process assures that all parties know what is required and eliminates assumptions that can be costly."

'A CNC router with five-axis capability allows a high degree of detail.'

These designs can be hundreds of feet long and up to 30 feet high,

CNC routers are being used to create patterns and grayscale designs by cutting to precise lines and cutting deeper to create a darker tone. Photos: Architectural Polymers.

Combining color and forms in a puzzle-piecing type of application can create attractive designs that work well on long surfaces such as soundwalls. This design, which changes every five panels, was created for a Las Vegas soundwall using Rocky Mountain flagstone with bands of purple Oregon Basalt texture, puzzle-piecing the two textures for a continuous pattern along its face. Photo: Scott System.

combining molds and moving from panel to panel. The designs can become quite intricate. "I can put a quarter onto a 5-foot by 5-foot panel and read all the markings on it," says Scott. "Concrete provides great reproduction." In some cases, designers are specifying high-flowing, self-consolidating concrete (SCC) to provide greater detail and a smoother finish.

Photographic Designs

CNC routers also are being used to replicate photographic images. These are accomplished by programming the image into the router and having it cut vertical lines through the concrete, cutting deeper to produce darker lines. "It's a trick of the eye, and not that expensive," says Walters. "For highway soundwalls, it's a great idea—they have large expanses and a lot of eyes looking at them."

Designers are taking advantage of these capabilities to produce creative images. "Anything can be translated, particularly if we receive a CAD drawing, and more designs are being created today with CAD-CAM or BIM programs," Walters notes. "The routers are very accurate. The only concern is creating ridges so thin that they break off during stripping or handling."

Graphic Concrete

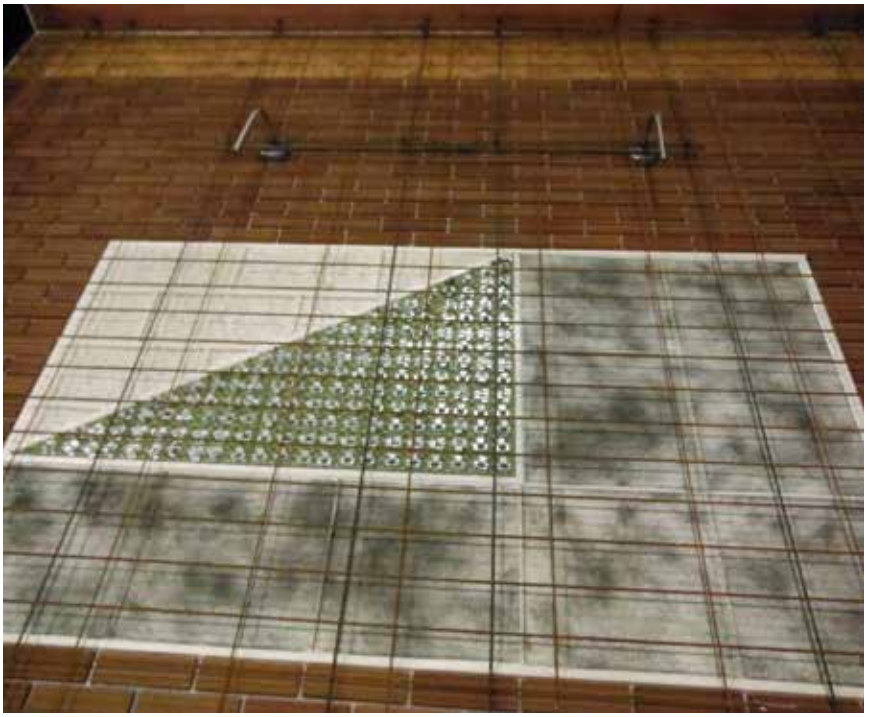
A new process, graphic concrete, allows designers to use obtain unique concrete surfaces. The technology is based on applying a surface retarder to a special membrane that is placed over the mold. The designed pattern or picture is created by the contrast between the fairface and the exposed aggregate finish. The images may be existing patterns, repetitive patterns created by designer, or photographic images. The images created by exposing the aggregate may be viewed from any angle.

Considerations

Creating custom formliners that accurately reproduce the designer's vision can be a complex process. Involving the precaster early in the design phase, so he can work with the formliner manufacturer, will ensure schedules are maintained and problems are resolved early in the process. Some considerations include:

Scheduling: Brick can require six to eight weeks to manufacture, and mock-ups or prototypes often are created prior to final design approval. Selecting brick early so formliners can be created to their exact dimensions is critical. "These issues need to be addressed early to ensure there is time to order materials and create the forms and retain the schedule," says Porreca. Brick manufacturers often fire brick in a rotation going from lighter colors to dark, so the order must be placed early enough so it will be produced and shipped on schedule.

Repetition: Designers often want to avoid a repetitious, panelized appearance to what is planned as a natural, flowing façade. Adjusting patterns to turn them or otherwise break up the repetition can create



This design features inset thin brick and tile in several patterns to create a dramatic appearance. Photo: Advanced Formliners.

that appearance at a low cost. Using formliners for many pours helps reduce costs.

Casting Schedule: Efficiencies are created if repeating forms can be used to cast the largest pieces first, then cut down to cast smaller pieces, Porreca says. Having time in the schedule to allow pieces to be cast out of erection sequence and staged will minimize the number of liners and the ensuing cost.

Cost Factors: A wide range of factors impact the cost of a formliner, including material used, detail of the design, changes made after the original design, and size. For instance, increasing a shallow recess to several inches in depth can increase costs significantly due to the amount of material needed to create that depth. Larger molds also become more expensive as they grow in size due to shipping and handling costs—but the larger size may reduce the number of molds needed, reducing costs. "We have a number of tricks we can use to help reduce costs," Walters says. The main trick is to begin working with a precaster or formliner as early as possible.

Material Choices: Urethane liners are often more expensive than other types, but they are designed for reuse, and their durability allows more repetitions, which cuts the cost per mold. But urethane liners require proper panel-production sequencing, built-up material on casting beds or rails, as well as enough panel production to warrant the initial square-foot cost, says Calmes.

"In current building trends, we're seeing architects mix up building façades so they lend themselves to a single-use type formliner, which can be cut inexpensively and quickly to match the custom-panel design," he notes. "They eliminate the intricate production-panel sequencing that can slow erection schedules, saving the precaster—and the project—both time and money."

There are even semiclear polystyrene formliners that allow the designs to be seen through the formliner as they are cast. "They make it easy to see how the design has been placed in the casting bed," says Calmes.

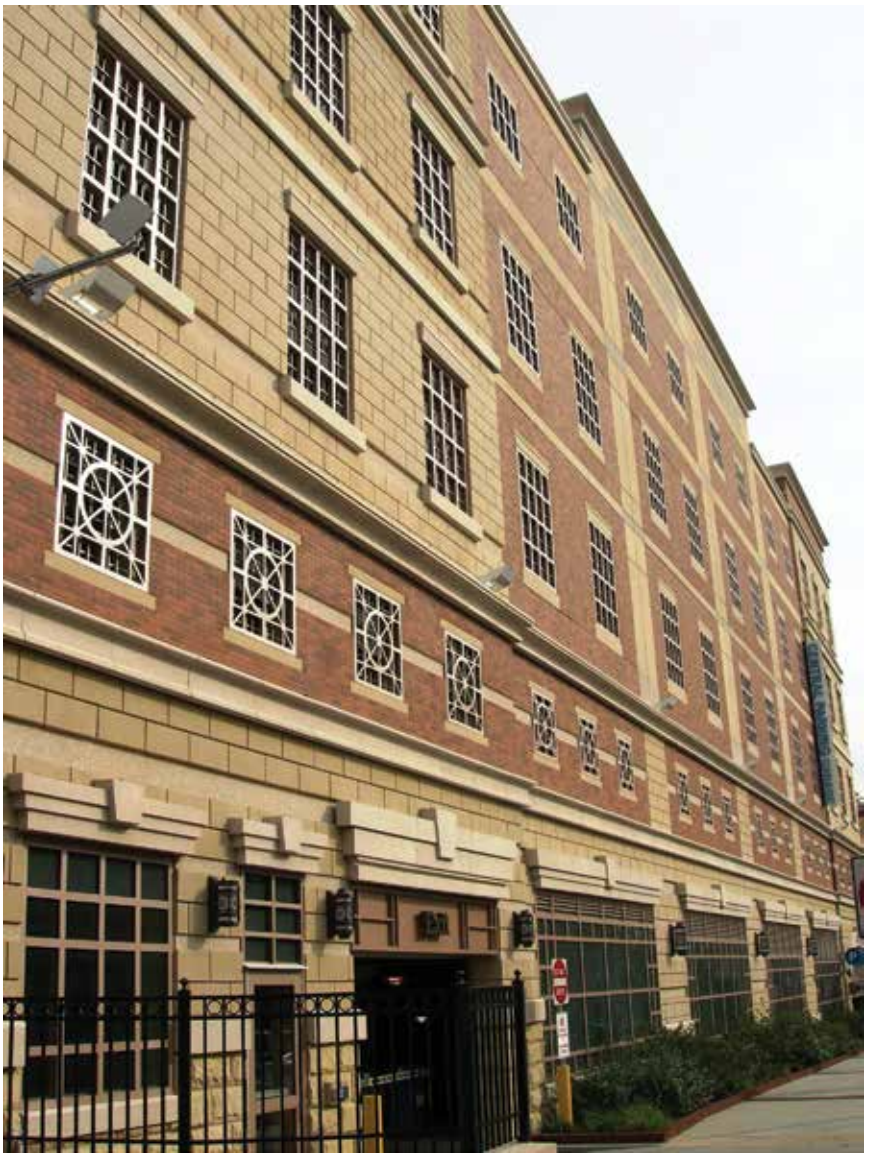
The range of designs that can be created with formliners today ensures that virtually any vision created by the designer can be accomplished. Early input by the precaster can help ensure that the result matches the intent and that it is created an inexpensively as possible.

For more information on these or other

Soundwalls provide long, flat canvases for images. Some states imprint their panels with state birds, flowers, and other personalized images. This swallow mural was created on soundwalls along Route 5 in San Juan Capistrano, Calif. The birds were sculpted from foam and cast into multiple large urethane formliner parts. Photo: Custom Rock Formliners.

projects, visit www.pci.org/ascent.

Textures with significant depth create shadow lines and add aesthetic value to buildings. Photo: Advanced Formliners.



Architects are becoming more creative in combining textures, shapes, and designs to create distinct aesthetic treatments in precast concrete panels. These panels with embedded thin brick using Scott Brick Snap Systems are featured on the parking structure for Lancaster Newspaper in Lancaster, Pa. Photo: A.L. Patterson.

Puzzle-piecing is a technique in which one form is used to cast a number of panels, but the design is turned 90 or 180 degrees to create a less repetitious pattern. This design was used on a highway ramp in Shoreline, Wash., with designs by Vicki Scuri of Siteworks. Photo: Scott System.

Bridge designers are incorporating formliner designs into their structures, especially in highly visible locations. This design on a bridge in Nashville ties into the railroad yard that the bridge spans. Photo: Scott System.

This three-piece soundwall design, called Thunderstorm over the Mesa, splits into clouds, diagonal striations, and foundation pieces for easy installation of a complex image. The design was created by Sites Southwest in Albuquerque, N.Mex. Photo: Scott System.