Precast Concrete Panels: Quality, Strength, Speed, & Sustainability

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Precon Precast Panels: Quality, Strength, Speed, & Sustainability

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Description: Provides an overview of prestressed, precast, non-composite concrete wall panels, with a comparison of wall panel design, installation, and sustainability benefits over other common exterior wall materials, and a review of some of the available options.
Purpose: Provides an overview of prestressed, precast, non-composite concrete wall panels, with a comparison of wall panel design, installation, and sustainability benefits over other common exterior wall materials, and a review of some of the available options.

Learning Objectives:

At the end of this program, participants will be able to:

• explain what a prestressed, precast, non-composite concrete wall panel is and how it is used
• describe the manufacture, design, and installation benefits of using precast, non-composite concrete wall panels
• discuss the sustainability benefits of using precast concrete products, and
• describe the options, surface treatments, and applications of precast, non-composite concrete wall panels.
Concrete

Because of its high structural integrity and low maintenance requirements, concrete is often the material chosen for exterior walls on commercial buildings. Unlike other building materials, concrete gains most of its strength in the first 30 days but continues to gain strength over the life of a building. Since structures have a tendency to degrade over time, rather than improve, concrete is an interesting anomaly. The hydration process is the reason behind its nontraditional aging. Hydration continues and causes the compounds in cement to elongate; as the compounds lengthen, they intertwine and create a stronger unit.

The low maintenance requirements of concrete walls result in lower lifecycle costs. The finish can easily be cleaned, if required, with high pressure water. Many finishes, like exposed aggregate or sandblasted, are permanent and never need repainting. Panel joint caulk can be tinted for color, and the life of the caulk often exceeds 15 years. Because concrete is a high-weight material with strong heat retention capabilities, it also can take advantage of the thermal mass effect phenomenon (discussed in detail later).
Concrete

Yet not all concrete-based wall systems are created equal. There are three primary types:
• tilt-up
• precast composite, and
• precast non-composite.

Precast non-composite concrete wall panels have many advantages over the other two types, including consistent quality, speed of construction, and high strength. Additionally, precast concrete wall panels are a sustainable building option, offering durability, reduced moisture and air infiltration, energy efficiency, recycled content, recyclability, light weight, and low maintenance.

Before looking in depth at the many attributes of precast concrete products, we’ll compare the characteristics of the other two types of wall systems.
Concrete: Tilt-Up

A tilt-up concrete wall is typically cast on the building’s concrete floor slab or a nearby casting surface. The wall panel is formed and then poured. Once cured, it is tilted up and temporarily braced until the roof system is installed.

On-site casting can produce panels with inconsistent quality, and panel creation depends on good weather at the site. The concrete’s exposure to environmental conditions such as rain and freezing temperatures can alter the wall’s structural integrity, appearance, and durability. The quality of tilt-up panels is also dependent on the local ready-mix and skills of the installers. Floor slabs may suffer damage while walls are cast on-site, disrupting the site, adding to costs, and lengthening construction schedules.

Most tilt-up panels are created without integral insulation. This requires the interior surface to be furred out and insulation to be adhered to the interior surface, subjecting the insulation to damage, higher long-term maintenance, and concerns of condensation. Increased energy efficiency comes at an additional cost and exposes the entire structural panel to thermal forces.

Sitecast manufacture limits other trades’ access to the site and often impacts construction schedules. There are also limits on tilt-up panel aesthetic options compared to precast.
Concrete: Precast

Precast concrete is cast and cured in a manufacturing plant under controlled conditions, then shipped to a construction site and installed quickly with less site disruption, often in just a number of days. Precast is a time-saving alternative to sitecast concrete (which must cure for about 30 days to gain its full strength and stability) and reduces labor on-site and the risk of weather delays.

Even after weeks of curing, poured concrete can’t compare to precast when it comes to structural integrity. Precast concrete wall panels have a design strength of up to 9,000 pounds per square inch, compared to 5,000 for poured concrete walls at 30 days.

Precast wall panels offer other advantages. Because they are produced in a controlled environment, precast panels are more uniform and durable than concrete that is poured and cured out in the elements. Factors that affect construction quality on a job site—such as temperature and craftsmanship—are eliminated on the plant floor by skilled technicians operating under consistently optimal conditions.

The result: Precast concrete is less susceptible to quality and time impact, and is faster to produce and install with more consistent quality, more finish options, and less risk.
Prestressed, Precast Concrete

When precast concrete is prestressed, a further benefit to durability is realized. This active form of reinforcing keeps the concrete in compression, which minimizes cracking and increases the load-carrying capacity.

Prestressing refers to the steel tendon reinforcement in the wall panels. Steel tendons in the form are placed in tension (stretched) prior to the concrete being poured. This pretensioning takes advantage of steel’s inherent tensile strength. The concrete is then cast around these pretensioned strands and allowed to cure prior to the strand being released from the form. The result is that the concrete bonds continuously along the strand’s length, holding the steel in tension while the steel holds the concrete in compression. The net result is the synergy of steel and concrete presenting a much stronger, more efficient cross-section than either product is capable of independently.
The two types of precast panels, composite and non-composite, share many advantages but are fundamentally and structurally different.

A composite panel features two wythes of prestressed concrete. Steel ties and/or solid concrete penetrate the insulation to structurally tie the two wythes together. Each wythe contains steel reinforcing, steel ties, and insulation. Typical composite wall panels are constructed with a “sandwich” of a 3" to 7" interior layer of concrete, a 2" or more layer of foam, and another 3" to 7" exterior layer of concrete. Any penetrations through the insulation result in thermal “short-circuits” which greatly reduce the wall’s overall energy efficiency.

The components of composite panels are completely bonded together, acting—and reacting—as a single structure. This may cause thermal bowing, leading to structural weakness. Thermal bowing happens when, for example, hot summer temperatures cause the outside of a building to expand, while the air-conditioned interior remains cool. Because the two faces are completely bonded together, the wall may bow outward. Over time, thermal bowing can compromise the structural integrity of a building.
A non-composite panel, on the other hand, features an exterior layer that accommodates temperature extremes. This more flexible face is not structurally tied to the rest of the panel, so it can safely expand and contract without affecting the structure. The hydration and handling stresses may result in small fissures on the exterior face, but these will likely close up as the panel sits in place for about a year, so there’s no need for fixes like caulking.

A non-composite panel combines a structural core section, a rigid insulation layer, and a nonstructural facade for exceptional strength without a thermal bridge. Eliminating highly conductive thermal breaks increases overall energy efficiency. A typical non-composite panel is composed of an 8" hollow billeted core layer of concrete, a 2.5" layer of foam (typically expanded polystyrene or urethane), and a 1.5" layer of face concrete. These highly dense panels can achieve an R-value of up to R-24 for a 12" panel.

Composite wall panels constructed with 9% solid concrete, by comparison, could have an R-value as low as 2.34.
Precast Non-Composite Panel

Here is a diagram of a typical prestressed, precast, non-composite wall panel.
Sustainable architecture is the practice of designing and constructing buildings that have a positive impact on their environments.

A durable building contributes to sustainability because its long life means it will not need to be replaced as soon as less durable buildings. Minimizing the air and moisture infiltration into a structure not only reduces dangerous mold, but also increases a building’s thermal performance so that the resources needed for heating or cooling are reduced. When a material uses recycled content in its manufacture, requires less virgin raw materials, requires less fuel for transportation, and can be repurposed once its initial use is complete, the material reduces its environmental impact throughout the building’s lifecycle.

In this section, we’ll look at how precast, non-composite concrete panels provide sustainability benefits in all of these aspects.
Durability: Flexural Strength

One aspect of a building that contributes to its durability is its ability to withstand extreme loads. In the case of concrete, durability is often reflected by flexural strength, or the ability to resist bending. Measured by loading un-reinforced panels, flexural strength is expressed as modulus of rupture (MR) in psi. The results of such tests provide designers and constructors with improved methods to predict and assess the resistance of buildings and structures to wind and seismic loads.

The American Concrete Institute (ACI) standard recommends a concrete strength of 5,000 psi for walls. Some manufacturers significantly exceed this recommendation with strengths of 8,000–11,000 psi.
Durability: Fire Resistance

An all-precast concrete structure provides an exceptionally safe and secure envelope. Steel begins to fail at 1,200°F and completely fails at 1,600°F—temperatures fires reach easily. The mass of concrete building elements and their behavior under high temperatures allow them to continue to support loads long after steel structures exposed to the same heat will have failed.

Precast wall panels can extend into a building’s footings, which helps facilities cope with interior fire, water damage, and accidental impact. Fire typically destroys a building’s roof. When a structure is built on-grade, the collapsing roof often pulls the walls down into a building. To avoid this problem, continuous panels—unlike masonry or concrete block walls—are firmly anchored into the ground. As a result, they will not break apart.
A dramatic chemical fire in Minnesota included high heat and multiple explosions. However, the precast, which extended to the footing, stayed in place. The roof collapsed, but the walls did not.

Precast walls make it safer to fight fires due to the wall stability; firefighters are not endangered by collapsing walls.

Precast walls can minimize damage outside the perimeter. In this specific example, a propane tank adjacent to the exterior of the precast didn’t burn. The grass wasn’t even singed.

Some manufacturers’ core filled panels range from a three- to four-hour fire rating for 8” and 8.5” panels.
Durability: Weather Resistance

The structural performance of building materials is far from equal. Follow the path of a tornado through a community of stick-construction homes, farms, and a trailer park, and you see firsthand that some structures fare better than others. While some destruction and loss may be unavoidable, the use of durable building materials can help mitigate the damage.

Combined with precast architectural panels, a precast design can effectively resist hurricanes and tornadoes as well as heavy snow loads. In addition, these components won’t ignite during a lightning storm nor will they allow fire to spread if nearby buildings or grasses should catch fire.

In fact, precast construction offers the safest building envelope for all types of extreme climatic conditions. That’s why many high-profile companies that require absolute continuation of their services, such as insurance companies, computer firms and others with large databases, protect themselves by building total-precast facilities to ensure no interruptions will occur during emergencies.
Durability: Seismic Applications

Typically lasting between 10 and 15 seconds, earthquakes can cause billions of dollars in damage and extensive loss of life. While earthquakes can’t be prevented, precast concrete technology allows builders to achieve superior structural integrity and minimize losses.

For example, precast panelized designs allow movement to occur in wall systems during a seismic event, making it possible to use this approach in areas where masonry does not meet seismic codes. Metal-based walls are not as inherently strong as concrete, as each screw used in the extensive studwork acts as a miniature point of failure.

Moreover, some precast concrete structural systems use technology to create an even more effective earthquake-resistant structure. In essence, the systems treat joints not as weaknesses that must be covered up, but as advantages that isolate stress and counter it. Several of these new designs provide a re-righting aspect in which the building’s structural system bends with the seismic forces and then re-rights itself.
Reduction of Air and Moisture Infiltration

Of increasing importance in terms of public health and safety is concrete’s exceptional resistance to mold. When mold formation occurs in buildings, occupants may begin to report odors and a variety of health problems, such as headaches, breathing difficulties, skin irritation, allergic reactions, and aggravation of asthma symptoms.

Walls must be absolutely airtight to retard moisture, as vapor will move through even the smallest opening in a panel. Due to its low permeability, concrete is able to resist vapor transmission, which in turn, maintains strict humidity control.

Wall movement must also be kept to a minimum to maintain a tight building. Flexing and bowing, common with many other building materials, cause high air infiltration rates, leading to high moisture permeability and possible mold growth. Precast panels extend below the grade, so they prevent rain and snow runoff from penetrating the building exterior, further reducing moisture and air infiltration.
In the on-grade image below left, rain and snow runoff finds its way through the joint, while heat exits the building. Where the wall is anchored to the foundation, the right-hand image shows that moisture remains outside the building when the wall extends below-grade, and the heat remains in the structure.

A theoretical computation from Construction Technologies Lab (CTL) estimates the moisture permeability of one manufacturer’s 12" panel to be between 0.37 and 0.51 perms. This puts the performance of the panel between that of a vapor retarder and a vapor barrier.
Measuring R-Values Correctly

“R-value” is a unit of measurement that describes the resistance of construction materials to the flow of heat. The most common method of calculating R-values for wall systems is to add the R-values of all the materials that make up the panel. For example, with a wall panel that has a 3" layer of concrete, a 2" layer of foam, and another 3" layer of concrete, the total R-value would simply be the combined R-value of all the materials. This method assumes a steady-state heat flow, in which the difference in temperature across all material layers is steady at all times.

When R-values are calculated this way, the potential for thermal breaks is not taken into account. Thermal breaks are areas that violate the insulation area and greatly reduce energy efficiency. With wall panels, thermal breaks can range from the obvious, such as doors and windows, to those which are invisible to the eye, such as highly conductive structural ribs embedded in the wall. In the example of two concrete panels sandwiching a layer of foam, a wall panel like this often uses metal ties and concrete to hold the different layers together, as in the precast composite type discussed earlier. These metal ties create thermal breaks that allow heat to pass through the concrete layer, reducing energy efficiency.
Benefits of Thermal Mass

In real-life situations, inside and outside temperatures are not always constant. The force behind conductive heat flow between the exterior and interior of a wall can change significantly and even reverse during the day. For example, if a building’s exterior wall is dark-colored and in the sun, it will be significantly hotter than the outside temperature. If the temperature on the inside of the building is cooler than on the outside, heat will conduct from the outside surface of the wall inward. But as the exterior temperature falls at night, the driving force for heat flow reverses. Energy, as heat, is drawn from the inside to the outside of the building through conductive heat transfer.

With high mass materials, such as concrete, this heat transfer is delayed by the high heat retention capacity of the wall mass. This “mass effect” has an advantageous impact on a wall’s energy efficiency that cannot be determined by R-value alone. When choosing a building material, considering how mass effect can enhance energy efficiency is as important as determining a material’s R-value. Because concrete has strong heat retention capabilities, it can take advantage of the thermal mass phenomenon.
Increased R-Values and Reduced Energy Costs

Heating and cooling costs typically represent approximately 32% of a building’s operating budget. As this cost is multiplied over the average 10- to 20-year ownership period, energy expenses rank as a high-priority lifecycle issue.
Thermal Performance

U.S. Department of Energy labs examined the thermal efficiency of “common, insulated, concrete sandwich wall systems,” the composite method of wall construction. The DOE interim report indicated that 5% solid concrete and steel ties resulted in a 60.59 percent loss of the claimed R-value of 10.14, reducing it to only 4.13.
Other Sustainability Benefits

• **Lighter weight reduces transportation costs and fuel usage:** Advancements in panel construction determined that the “webs” or concrete “columns” are redundant in their structure; by removing concrete in specific areas, material is reduced without compromising structural performance. The lower weight saves on freight and handling costs and the related fuel consumption. An additional result is an increase in the amount of face area that is insulated, producing higher R-values. Some manufacturers offer panels that weigh 32% less than conventional composite panels while offering a 30% increase in R-values.

• **Low maintenance:** No harsh chemicals are required to clean concrete; even when cleaning is necessary, a high-pressure wash-down is all that is needed to maintain a concrete finish, and caulking often exceeds 15 years of life. Other building materials require much higher maintenance. With precast concrete, less than 1% of its surface area is caulked, compared to 20–30% of brick surface area that is mortar.
Other Sustainability Benefits

- **Indoor air quality:** Because precast concrete does not require coatings or finishes, volatile organic compound (VOC) emissions are minimized. Precast concrete is compatible with many water-based paint or stain products if a coating is desired.

- **Recycled content and end-of-use recyclability:** Up to 58% of the content by volume of some panels is from recycled material. Fly ash is a waste byproduct of coal refining and can replace some percentage of cement. In addition to fly ash, all of the steel and 20% or more of the insulation can be recycled. Precast panels can be disassembled and repurposed in other buildings at the end of their initial use. If demolished, all of the concrete waste can be recycled.
Some manufacturers are single source providers for precast, non-composite wall panels, creating one-party responsibility for the design, fabrication, and installation of the wall panels. In these cases, the manufacturer coordinates delivery to the jobsite.

Structural panels are used in single-height structures up to 63' tall.
Installation: Freestanding

Depending on the construction schedule, wall panels can be erected prior to the structural steel system in a method called freestanding. Since the structural steel and deck are not in place to take the diaphragm load from the building, a temporary wall brace is installed diagonally from the wall panel (to either the exterior or interior of the building) to a “deadman” anchor to take the construction loads until the steel structure and deck are completed. Bearing steel is installed to act as a ledge angle for the bar joist and to transfer the loads into the wall panels. Where the wall is parallel to the bar joist, a starter joist adjacent to the wall acts as a deck bearing angle.
Installation: Temporary Shores

Temporary shores are steel columns of various lengths furnished by the panel manufacturer to the job site prior to the arrival of the structural steel. The temporary shores support a ledger beam by the use of a friction connection along the bearing walls on which the bar joists are set. Use of the temporary shores allows for the installation of the structural steel system prior to setting the wall panels. The wall panels are installed by making the welded connections to the ledger beam and/or starter joist. The temporary columns are then removed and returned to the yard to be reused on the next project. Both freestanding and temporary shore systems are used to erect a load-bearing wall system.
Installation: Roof Connections

A variety of beams and truss girders can be attached to the wall panels.

A joist-girder connection is shown on the left, and a beam connection is on the right.
Installation: Keyed Foundation

A keyway is a trough created in the footing into which the panel is set. The inside edge of the keyway determines the interior building line, as panels with standard finish are set tight to the inside edge of the keyway. The depth of the keyway is typically 3", allowing shim space to adjust the panels to align bands and/or height of openings. The keyway is typically filled with grout after the panels have been erected. This detail eliminates welded connections below grade.

Panels can be set directly on the spread footing. This removes the need for a separate foundation wall and reduces time and costs. A keyed foundation also keeps the structure and insulation continuous past the floor to the footing, and eliminates the maintenance of a horizontal joint of a foundation wall.
Installation: Grade Wall Connections

For grade wall connections, welded angle connections can be used to the footing in lieu of a keyway.
Installation: Panel-to-Panel Connections

Structural plates can be cast into the panels during the fabrication process to allow the panels to be welded together in the field. This is typically done to meet one of three structural requirements:

• To support precast wall panels above openings such as overhead doors or entries: Two full headers can provide support off the adjacent structural panels without adding supplemental steel framing.

• To meet the seismic design: If higher overturning loads are called for, panel-to-panel connections are required. The size and number are dependent on each building’s characteristics and design.

• To meet the shear design of the building.

These connections can be added to existing structures using expansion or epoxy bolts.
Installation: Cast-In Openings

While traditional processes limited where door and window openings could be cast in billet panels, some manufacturers can produce panels with cast-in openings that fit any project design requirements, providing design engineers and architects with a new range of building options.
Load-Bearing vs. Non-Load-Bearing Walls

Precast non-composite panels can be used as either load-bearing (live and dead loads) or non-load-bearing walls.

The load-carrying capacity of precast concrete is derived from its own structural qualities and does not rely on the strength or quality of the surrounding backfill materials.

The panels can be free-stood prior to the roof construction, or set against the roof structure.
All-Season Construction

Traditional building materials and construction methods are highly susceptible to weather conditions. The building materials that are construction site-intensive are the most impacted by inclement weather. For instance, outside masonry requires special precautions to protect tools and mortar from freezing. Tilt-up panels are composed of concrete that is poured on site and allowed to set, but if temperatures are too cold or too hot, concrete can’t cure properly.

The American Concrete Institute’s definition of cold-weather concreting, as stated in ACI 306 is, “a period when for more than three successive days the average daily air temperature drops below 5°C (40°F) and stays below 10°C (50°F) for more than one-half of any 24-hour period.” Given that these conditions apply to large areas of the northern U.S. and Canada during the winter months, the need for versatile and reliable cold weather building products is an ongoing concern for building contractors in these areas.

Precast concrete panels help keep building projects on schedule, regardless of the weather. The panels arrive on the site ready to be lifted into place.
All-Season Construction

Precast also offers safer working conditions for builders. Harsh wind chills can make outside construction unbearable. Masons are continually exposed to the cold, putting them at risk of frostbite if they don’t take frequent breaks. When making tilt-up walls, workers need equipment such as cement mixers and molds that can be difficult to maneuver in the snow and ice.

Precast provides an immediate barrier to the elements, including insulating properties against the cold, allowing work to be done inside the building.
Speed of Installation: Quick Assembly

Precast composite wall systems contribute to speed of installation in several ways. Panels can be cast at the factory while site work is underway.

Once delivered to the job site, precast concrete walls can be erected in a fraction of the time needed for masonry or cast-in-place walls. Up to 250 linear feet of wall panels can be erected in one day.

Erecting the building shell more quickly allows interior trades to begin work earlier and provides a strong, sturdy work platform for construction on higher levels.

Quick delivery and erection not only saves time, but also adds to customers’ financial success.
Speed of Installation: Simpler Logistics

Simpler logistics are also a benefit of precast concrete panels. There is less need for storage or staging areas on the job site. Panels arrive on trucks on a set schedule in the order the panels are to be erected. This allows increased room for maneuvering other trades.

Logistics are minimized as is the number of crew members that must work in an often hazardous environment.
Versatility of Load-Bearing or Non-Load-Bearing

As stated earlier, precast non-composite panels have the versatility to serve as load-bearing or non-load-bearing walls.

One advantage is that there is very little cost difference between the options, yet the load-bearing panel saves significant steel costs because it eliminates the need for a beam and column structure. It increases the sustainability of precast since less steel and concrete are required in the building. It also gives site managers more flexibility over the construction schedule.

Non-load-bearing panels add speed to the project because they connect to the framing system rapidly and eliminate installation of the steel frame.
Quality: PCI Certification

The Precast/Prestressed Concrete Institute, PCI (http://www.pci.org/), develops and maintains codes, design guides, and certification programs for the precast, prestressed concrete structures industry. Sourcing a provider who is certified by PCI means that the components are consistently produced and meet PCI’s high quality standards.

A PCI Certified plant means that the plant is audited, unannounced, twice a year to ensure that it is meeting high industry standards set forth by the PCI. Personnel involved anywhere in the precast process, field crews, and contractors can all be certified by PCI.

PCI’s two designations for concrete are:
- MNL-116, Manual for Quality Control: Structural Precast/Prestressed Concrete Products
- MNL-117, Manual for Quality Control: Architectural Precast Concrete Products

Some manufacturers design, manufacture, and install structural wall panels under both designations. Structural wall panels (MNL 116) can be fabricated in a variety of decorative finishes that rival architectural panels.
Quality: Controlled Environment

Because the precasting of concrete takes place under strictly controlled factory conditions, better consistency and quality of product can be achieved than with site-cast concrete.

To help ensure the strength of concrete, a quality manufacturer should consider a number of other factors that impact durability, including: curing conditions, temperature, cement porosity, construction methods, and reinforcement supports.

For example, company engineers should perform separate tests on the inserts embedded into panels to prove that the product meets the same high standards. Testing and documentation of the mix via cylinder breaks ensures consistent, high quality concrete.
Scope: Single-Source Provider

Selecting a provider who is the designer, manufacturer, and installer of precast non-composite concrete panels allows precise communication and coordination at all stages of construction.

A complete, one-party provider is a single source of responsibility for the wall system.
Scope: Versatility

A variety of panel widths and thicknesses, as well as finishes, textures, colors, aggregates, patterns, and designs allows additions to complement existing structures.
Scope: Versatility

Electrical conduit can be cast into the wall panel in one of two methods:

• First, boxes and conduit can be cast into the wall panels during production.

• Secondly, special billets that contain an open chase can be cast into the panels easily with nominal cost. This chase runs vertically in the panels, or horizontally in the case of spandrel panels, in one or all billets. Electrical can be run from the top of the wall panel or cut in above the ceiling elevation to allow electrical lines to be dropped to the appropriate elevation and electrical boxes mounted flush in the wall. Openings for electrical boxes would be field-cut into the panels. This system allows the greatest future flexibility for electrical work.

• Locations need to be coordinated between the electrical and precast sub-contractors. Materials provided by the electrical sub-contractor to the precast manufacturer need to arrive on schedule to meet production needs.
Cast-In Openings

Some manufacturers have the ability to cast-in door and window openings. Tolerances for cast-in openings are defined under PCI MNL 116 and 117.

This allows cast-in window and door openings of any size, saving time in the construction process, helping control construction and shipping costs, and providing architects and engineers with a range of aesthetic options.
Size Options

Some manufacturers can produce various widths of panel, up to 13.5'. Panel thicknesses depend on product type, finish, and amount of insulation.

- **8" wall panel**: Cross-section contains webs of concrete that act as structural columns and run the full length of the panel.

- **12" insulated panel**: Same 8" structure + (typically) 2.5" of continuous insulation + another layer of concrete in a 1.5" non-structural finish facade. The 1.5" face is not prestressed and not required to carry any live or dead loads.
Openings and Finish Options

As discussed earlier, door and window openings can be cast-in. Accommodating design requests in the initial stage of panel creation versus on the job site saves time in the construction process, helps contractors control costs, reduces consumption of raw materials, and provides architects and engineers with a flexible range of design options and tools.

Many finish options are available:

- Imprint
- Top face exposed aggregate
- Raked
- Ribbed
- Cast-in brick
- Form liner
- Steel form
- Formsiding exposed
- Sandblasted

When the exterior finish is specified as ribs, rakes, exposed aggregate, imprints, etc., the interior building finish is the steel form side of the panel. However, when the steel form smooth surface is turned to the exterior, the interior can be a broom texture or a troweled finish.

Standard finish on the wall panels is a natural gray concrete which will vary in color due to a number of factors. Exposed aggregate and sandblasted panels can be fabricated in a variety of aggregates, typically local to the plant location.
The imprint finish is applied to the face of the panels during the casting process. The imprint is available in a variety of patterns (to simulate block, stacked stone, and brick) and combinations. This finish allows the steel form surface to be to the interior of the building.

A variety of aggregates are available; top face exposed aggregate has the steel formside finish to the interior.
Raked Finishes are created on the top face of the panels during the casting process.

Wide, standard, and random rake widths are available in aggregate or natural concrete.
Ribbed Finish

Tapered vertical ribs are extruded onto the top finish of the wall panels during the casting process.

Random, uniform, and low rib are among the available options.
Cast-In Brick Finish; Form Liner Finish

Casting thin-brick into wall panels eliminates the need to tuckpoint the brick, reducing project lifecycle costs. The brick is cast into panels in the controlled factory environment, which eliminates the waste and site disruption of field-applied brick finishes.

The form liner can act as a mold and transfer the pattern to the wet concrete.
Steel Form; Formside Exposed Aggregate Finish

The steel form finish creates a flat, smooth surface which may contain small bug holes or reflect imperfections in the forms. A steel form finish to the exterior results in an interior finish surface that may be broomed or have different levels of troweling.

Formside exposed aggregate is a variation of the steel form finish; a chemical retarder is applied to the form side of the panel, slowing the surface hydration. The panel undergoes a cleaning process, which exposes the natural color of the integral aggregate.
Sandblasted Finish

Heavy sandblasting minimizes the amount of matrix visible in the finish by exposing the maximum amount of aggregate, creating a rougher finish than other levels of sandblasting. The medium sandblasted finish is another option.

Light sandblasting is the least aggressive abrasion and can be referred to as brush blast; it removes a minimal amount of matrix, resulting in a “sandpaper” finish.

The combination of different levels of sandblasting, or in conjunction with other casting accents such as imprints, yields dramatic and creative options.
Applications

Shown on this and the next slide are some of the many applications for prestressed, precast, non-composite concrete wall panels.

• Schools
• Retail
• Theaters
• Churches
Applications

- Maintenance buildings
- Industrial warehouses
- Medical centers/hospitals
- Athletic centers
- Office complexes
Summary

- Precast concrete’s lasting benefits of inherent high strength and high density make it superior to other building products for durability and structural integrity. Other materials can deteriorate, experience creep and stress relaxation, lose strength, and deflect over time.

- Precast, non-composite concrete walls offer low maintenance, speed of construction, all-weather construction, and resistance to fire, weather, mold, and mildew. Production in a controlled environment means the quality and uniformity is reliable and consistent with every panel. Choosing a one-source provider who designs, manufactures, and installs the panels simplifies coordination and provides a single, responsible party to work with.

- Panels are fabricated with as much as 58% recycled content; energy efficiency from calculated R-values is as high as 24, with added benefits of concrete’s thermal mass effect, and the absence of metal ties that create thermal breaks in other types of panels.

- Precast concrete panels are a viable choice for a broader range of projects, with numerous additional options in finishes and textures. Adding design flexibility that is on par with other materials enables precast to compete head-to-head with options not as strong in shortening build schedules, cutting construction costs, and reducing operating expenses and energy consumption.
Conclusion