



# IMPROVING LIFE SAFETY WITH PRECAST CONCRETE

## Protects against fire, mold, seismic forces, inclement weather and explosions.

THE RISING NUMBER OF DEATHS AND INJURIES on commercial properties has raised new concerns about the safety of building construction. As a result, builders and developers are turning to precast concrete technology to better protect the lives of the public and rescue personnel alike.

Due to its economical cost, concrete is the most commonly used construction material in the world. In fact, commercial builders have long used concrete wall systems for fast, cost-effective erection of buildings. Precast concrete components will not corrode or rust and require little maintenance to retain their durability. No painting is needed to protect a structure built with precast concrete, nor is it necessary to apply any other protective coatings.

Most of these advantages are due to the natural characteristics of concrete, which is exceptionally strong. It gains most of its strength in the first 28 days, but it 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. Its hydration process is the reason behind its nontraditional aging process. Hydration causes the compounds in cement to elongate; as the compounds lengthen, they intertwine and create an impermeable surface.

While its inherent durability is irrefutable, builders are increasingly choosing precast concrete for an entirely different reason: the significant life safety advantage it provides over conventional masonry, steel, wood frame or block designs.

## Preventing Fire Losses

A 2001 study by the National Fire Protection Association (NFPA) found that the rate of on-duty firefighter deaths in structure fires has remained steady since 1977. This has occurred in spite of a decline in the number of structure fires and improvements in protective gear, equipment, training, and rescue procedures.

The NFPA study raises a red flag about how well buildings are designed and constructed to protect not only the lives of

occupants, but also to enable fire and rescue personnel to do their jobs effectively with the least risk to themselves. The answer to the enormous challenge of fire safety lies in developing a more balanced design. A balanced approach relies on three key fire protection elements: fire detection, fire suppression and fire containment.

The first two elements involve the use of active fire protection systems such as smoke detectors, fire alarms and automatic sprinkler systems. While fire detection and fire suppression are both critically important, they rely on mechanical devices, which can and do periodically fail. In fact, a 2001 NFPA study reveals that sprinkler systems fail in one out of six commercial building fires.

As such, a reliable fire safety strategy also incorporates the third protection element – fire containment—which includes fire barriers, firewalls and exterior walls built of noncombustible fire resistant materials. Materials like precast concrete do not burn, nor do they contribute to the production of lethal smoke and gasses. More importantly, its effectiveness is not diminished by mechanical malfunction, neglect or sabotage.

Designing a building using a compartmentalized approach adds to the protective capabilities of precast technology. In this format, the building is designed in sections or modules, which contain the fire, minimizing its spread to allow more time for detection, evacuation and suppression. For example, in hospitals, most occupants are generally not able to evacuate the building by themselves due to physical restrictions. Because of this, vertical evacuation in an emergency may not always be desirable or possible. Therefore, areas of refuge, which are properly fire-separated from the remainder of the floor area, must be constructed in addition to the required exits in order to accommodate horizontal evacuation.

An all-precast concrete structure – including precast columns, beams, hollowcore planks and panels – provides an exceptionally safe and secure envelope. Wood is a natural fuel source, while steel begins to fail at 1,200 degrees F. and completely fails at 1,600 degrees F.—temperatures fires reach easily.



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In a recent test conducted by Omega Point Laboratories, a gypsum and steel stud wall assembly was exposed to fire for two hours, and then a hose-stream test. The wall disintegrated in less than one half of the 2-1/2 minute requirement. Conversely, 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.

Also, precast wall panels 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.

In addition to life safety, the high level of protection available with precast provides bottom-line benefits in the form of reduced insurance premiums. A 24,000 square foot building constructed with concrete, for example, costs \$12,000 less in annual insurance premiums than a building with combustible framing.<sup>1</sup>

#### **Withstanding Seismic Forces**

Typically lasting between 10 and 15 seconds, earthquakes can cause billions of dollars in damage and extensive loss of life. While many events of nature such as earthquakes are unavoidable, there are measures designers can take to help minimize losses and bring a cost-effective approach to life safety. With today's precast concrete technology, builders don't have to sacrifice aesthetics or design flexibility to achieve superior structural integrity.

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. Likewise, metal-based walls are not as inherently strong as concrete, as each screw used in the extensive stud work acts as a miniature point of failure.

Today, new design approaches using existing panel wall technology have created innovative precast structural systems that provide better safety and structural security than any other system available. 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.

Fabcon, for example, produces non-composite precast sandwich wall panels composed of an 8-inch hollow core layer of concrete, a 2.5-inch layer of insulating foam, and a 1.5-inch top layer of concrete. Fabcon VersaCore precast concrete wall panels combine a unique structural core, a rigid insulation layer and a non-structural façade for exceptional strength without the need for a thermal bridge. 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.

#### **Fighting Mold Problems**

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. In fact, it is believed that molds play a major role in cases of Sick Building Syndrome—a term used to describe situations in which building occupants experience acute health and comfort effects that appear to be linked to time spent in a building, but no specific illness or cause can be identified.

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



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panels extend below the grade, so they prevent rain and snow runoff from penetrating the building exterior, further reducing moisture and air infiltration. For example, computations using the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) standards estimate the moisture permeability of Fabcon's VersaCore precast concrete panels to be between 0.21 and 0.27 perms. This puts panel performance comparable to a vapor retarder or barrier.

#### Standing Up To Weather

It's no secret that the structural performances of building materials are 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.

Hurricanes and tornados cause billions of dollars in damage each year. Unless your building can be easily disassembled or quickly hoisted onto wheels and rolled out of its neighborhood, attempting to dodge the weather is not a viable safety strategy. However, a total-precast concrete structural system does give designers a practical defense.

Combined with precast architectural panels, a precast design can effectively resist hurricanes and tornados 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.

#### Combating Explosive Forces

Although building codes are intended to safeguard life and property, they are not designed to prevent damage to buildings. That is unrealistic given the magnitude of possible events of

nature, accidents and deliberate actions. Rather, the aim is for buildings to resist catastrophic damage and thus prevent deaths and serious injuries.

New concerns about explosion protection inside and outside buildings have led to tighter federal requirements, which are being followed by sensitive private-sector facilities as well. Precast concrete can meet these new bomb-blast requirements with a variety of approaches, including self-supporting façades and designs with additional bracing. In the event of a bomb blast, the concrete structural frame takes the first hit and absorbs some of the force, minimizing the damage that could be caused by collapsing. The precast concrete wall then takes most of the force and serves as a "crumple zone" to protect the rest of the structure.

These designs provide support for building envelopes and protection for occupants, while creating attractive designs that mimic a variety of stone or other materials that readily fit into the surrounding neighborhood style.

#### On-Site Safety

Even during construction, precast concrete components offer enhanced life-safety attributes. Because they are factory-cast away from the site, logistics are minimized as is the number of crew members that must work in an often dangerous environment. And because precast components are erected quickly once they arrive on site, the time needed to complete the structure is lessened. The quickly completed building shell allows interior trades to begin work earlier and provides a strong, sturdy work platform for construction on higher levels.

#### The Durability of Concrete

The lasting benefits of precast concrete are inherent. High strength, high density, precast concrete is superior to other building products for durability and structural integrity. Other materials can deteriorate, experience creep and stress relaxation, lose strength and/or deflect over time. 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. Because precasting concrete takes place under strictly controlled factory conditions, better



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consistency and quality of product can be achieved. In contrast, concrete is generally poured outside for tilt-up panel construction so its exposure to environmental conditions, such as rain and freezing temperatures, can alter the wall's structural integrity and durability.

Additives used in precast components ensure that even salt and harsh chemicals do not penetrate the materials in high-traffic facilities, such as parking structures. 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 load-carrying capacity.

#### **Life Safety and Beyond**

Decisions made during a building's design and construction stages will affect cost and performance for decades to come. Building owners and designers now recognize that improving life safety can lower operating expenses and enhance tenant peace-of-mind. The economic and life safety benefits of precast concrete also make a property more desirable, resulting in better tenant retention, higher net-operating income and increased property value.

*For more information, contact Fabcon at 1-800-727-4444.*

<sup>1</sup> "For Unquestionable Strength & Energy Efficiency"—Fabcon