

Technical Brief

CarbonCast® and military applications



Above: Security Forces headquarters at Wright-Patterson Air Force Base, Fairborn, Ohio Architects: Emersion Design Precaster: High Concrete Group LLC

@carboncasť

C-GRID[®] REINFORCED C-GRID is a trademark of Chomanal, NA Designing and building for the military can be challenging and demanding. In an effort to safeguard the public's money, governmentfunded projects are typically accompanied by extensive regulations, rigorous processes and exhaustive bidding processes. Nonetheless, military projects can also be rewarding. They are usually designed to last longer and perform better than most commercial buildings.

From an exterior wall system standpoint, military projects present architects with a challenge to optimize three independent variables: cost, performance and aesthetics. In many cases, CarbonCast can be an ideal solution. CarbonCast's versatility, energy efficiency, strength and overall cost-effectiveness can provide a military building with a proper balance of performance characteristics.

Military applications

CarbonCast enclosure systems have a proven track record of addressing the necessity of reducing demand for traditional energy.



Energy efficiency critical

Throughout the federal government, there has been a movement toward improving the energy efficiency of buildings. The intent was codified in 2009 with *Executive Order 13514*, which requires the federal government to implement high-performance, sustainable building design, construction, operation, management and maintenance. Considering that the federal government occupies 500,000 buildings, the order has the potential to save a significant amount of energy and cost. In fact, the Department of Defense (DoD) spends \$4 billion a year on the energy to power its fixed installations.

The U.S. General Services Administration (GSA), which governs all federal buildings including those in the DoD, has required basic LEED[®] certification since 2003 and LEED Gold since 2010. Every five years, GSA is required to review the certification standards it uses to measure building efficiency. In May 2013, GSA's Green Building Advisory Committee officially recommended LEED as the best measure of building efficiency. A final decision is pending. Additionally, the GSA has recently endorsed the Green Building Initiatives - Green Globes 2010 system at an industry-friendly alternative to LEED.

According to its website, DoD's facility energy strategy is designed to reduce energy costs and improve the energy security of our fixed installations. This includes:

- Reducing the demand for traditional energy through conservation and energy efficiency
- Expanding the supply of renewable energy and other forms of distributed (on-site) energy
- Enhancing the energy security of our installations directly
- Leveraging advanced technology

CarbonCast enclosure systems have a proven track record of addressing the first bullet: reducing demand for traditional energy. With edge-to-edge continuous insulation, CarbonCast panels provide the full R-Value of their insulation. And the negligible thermal conductivity of the C-GRID carbon fiber connectors virtually eliminates the possibility of thermal transfer through the panel. The thermally efficient performance of CarbonCast panels can reduce HVAC system first costs in addition to providing substantial long-term energy savings to heat and cool buildings.

And in terms of meeting LEED requirements, CarbonCast panels have the potential to add up to 33 points to a project based on LEED 2009 guidelines when properly integrated with the whole building envelope including glazing, doors and roofing.

Terrorism and blast

While there are a number of options available to address Anti-Terrorism/ Force Protection (AT/FP) needs, a major consideration is the exterior façade. It is second only to the impact of standoff distance in the ability to protect building occupants from the impact of an exterior blast. Not only does the building's skin protect the structure from the elements, but it also has the potential to limit the blast pressure and high-velocity projectiles that can damage the workspace and injure its occupants. Furthermore, under blast loads, the integrity of any loadbearing walls must be maintained to prevent building collapse.

AltusGroup plans to conduct additional blast tests and behavior design analysis on CarbonCast insulated panel products.

AltusGroup, through precast partners Metromont and High Concrete Group, participated in blast research, conducted at Tindall AFB and initiated by the Precast/Prestressed Concrete Institute. the Portland Cement Association and Lehigh University. Two CarbonCast High Performance Insulated Wall Panels were tested alongside conventional reinforced precast insulated wall panels at typical standoff distances and explosive blast forces. The results of this specific blast test were published in the November-December 2007 edition of PCI Journal after considerable study. The report noted the lighter carbon fiber reinforced panels performed well and comparable to the solid walls that were part of the test. Armed with this success. AltusGroup plans to conduct additional blast tests and behavior design analysis on CarbonCast insulated panel products and enclosure technology to advance future performance, given the increasing importance for precast concrete blast mitigation in building design and construction for government, military and mission critical facilities around the world.

In addition to terrorist-related blasts. the impact of extreme weather can also damage structures that are not able to withstand extreme wind loads and other forces. CarbonCast enclosure systems have been tested to verify their ability to ensure high winds and wind-driven rains. The attributes are important considering that military installations must continue operating during significant weather events and are often used as shelters for base inhabitants. Additionally, many military bases are close to coastal zones for easy deployment and transportation, so the ability to withstand hurricaneforce winds and wind-driven rain is paramount.

When identifying AT/FP protection needs, owners and architects must work closely with structural engineers and blast consultants to assess the multitude of variables that will ultimately affect exterior wall performance. Ideally, the process will occur early in the design stage as the selection of an exterior wall system will invariably influence aesthetics options, accessibility, fire safety regulations \and budget.

Analytical assessment of blast resistance of precast, prestressed concrete components

licholas Cramsey and Clay Naito totection against blast has become a high priority for many building wors. Blast reforist and structural hardening, much like carthquake trofisk, can be costly. For this reason, it is important to understand at any structural element has an inherent capacity to absorb energy at resist some level of blast demand.

capacity of a structural element muy preclude the need for a Natuspecific restoff. To Human this increase, the Nature resistances of non-loadbarring precisal, prostressed concrete sandwide, wall panels are to for cludding of Mulling systems and effects provide a significant level of protection from blast events. This paper investigates the behavior of precisat, prestressed concrete sandwides the blast to blast loads. Four captionive experisions were performed on four sets of vall panels. An analysical model

ak displacements. The analytical model is used to predict wall-panel mage for varying levels of peak pressures and impulses. An extenon of this method is proposed for assessing the blast resistance of rizontal displarigm elements, such as double tess or hollow-core. An ample analysis for a double-tee floor system with a localized blast is noted.

As part of this issue's theme on blast, this paper presents a series of four explosive detensions that were conducted on precast concrete wall panels at Tyndall

explosive charge. Detonation occurs over a short period of tim nanoseconds—and results in the generation of elevated pressus temperatures. The pressure loading that is generated is compledepends on many factors, including the type and size of explos the location of the explosive relative to the structure, and the of between the high explosion and the structure.

Above: PCI Journal, November-December 2007 issue



Above: Projectile test performed at Clemson University on a CarbonCast panel to determine performance for hurricane codes.



Above: Armed Forces Reserve Center, San Marcos, Texas Architects: PBS&J Precaster: Heldenfels Enterprises, Inc.

PROJECT SUCCESS STORY Armed Forces Reserve Center

The United States Army Corps of Engineers chose a fully integrated, design-build approach for the \$4 million, 109,000-square-foot Armed Forces Reserve Center in San Marcos, Texas. The structure boasts a total precast building system including solid walls, columns, beams, double tees and hollow-core.

The exterior walls consisted of 54,000 square feet of CarbonCast High Performance Insulated Wall Panels with C-GRID® carbon fiber grid for shear transfer. Each load-bearing panel is comprised of two concrete wythes separated by 3-1/2" of continous EPS insulation that delivers a steady-state R-14 value. The energy-efficient building was designed to achieve LEED Silver certification. It meets U.S. Army AT/FP requirements as federally mandated.

It took just 14 days to deliver and erect the CarbonCast[®] High Performance Insulated Wall Panels on all three buildings despite limited site access. The compound will serve as a training facility for U.S. Army Reserves and Texas National Guard units. AltusGroup member Heldenfels Enterprises, Inc., supplied many of the precast elements including the CarbonCast panels.

It took just 14 days to deliver and erect the CarbonCast® High Performance Insulated Wall Panels on all three buildings despite limited site access.

Air Force Base

PROJECT SUCCESS STORY

at Wright-Patterson

The \$14 million, 52,000-square-foot Security Forces headquarters on Wright-Patterson Air Force Base, Fairborn, Ohio, used CarbonCast High Performance Insulated Wall Panels for thermal efficiency, durability and aesthetics.

Security Forces headquarters

"Precast is an appropriate language for civic buildings, in part because it recalls limestone," says Jim Cheng, project architect for Emersion Design, the design architect for the project. "CarbonCast gave us a thermally efficient envelope that is also durable, a main consideration for wear and tear and antiterrorism and force protection."

The new facility includes base-wide security for its armory, office space, dispatch center, detention area and warehouse. Thermally efficient CarbonCast High Performance Insulated Wall Panels encapsulate a 2" layer of rigid XPS foam insulation for continuous insulation as defined by the ASHRAE 90.1 energy code. Panels contribute to sustainable performance since the building was designed for LEED[®] Silver Certification.

CarbonCast technology utilizes C-GRID[®] carbon fiber grid wythe ties for fully composite structural performance with relatively low thermal conductivity for an R-10 value in this application.

Reveals in the precast formwork were combined with real and false panel joints to create a block-like image that suggests limestone. First-floor blocks are scaled, giving the illusion of height to the two-story section. The second story is set back to enhance this effect. Both stories have regular panel details that suggest columns with pedestals. A bullnose and cornice create a strong horizontal line above the columns. Exterior walls are highly articulated to match the adjacent precast building completed by Emersion Design 10 years ago.

Additional application successes are available at altusprecast.com/project-portfolio.



Right: Security Forces headquarters at Wright-Patterson Air Force Base, Fairborn, Ohio. Architects: Emersion Design



PROJECT SUCCESS STORY Fort Carson Division Headquarters

The \$5.6 million, 141,000-square-foot Fort Carson Division Headquarters in Fort Carson, Colo., is a military building constructed with CarbonCast High Performance Insulated Wall Panels. Original in its use of materials and completed on an accelerated schedule, the installation is a model of energy efficiency and design performance.

The first structure on an Army installation to achieve a LEED[®] Gold Certification for new construction, it also pioneered use of carbon fiber wythe connection materials in this region of the country and served as a prototype for future United States Army Corps of Engineers' buildings of this type, verifying environmental performance, occupant health and financial return.

A total of 57 insulated composite wall panels used C-GRID® epoxy-coated

carbon fiber grid shear connectors. The 8" CarbonCast panels satisfy AT/FP blast requirements and maintain continuous EPS insulation for an R-13 value, the minimum required by the Army Corps of Engineers.

Under the auspices of the DoD and the Defense Priorities and Allocations Systems Program, the project was given the highest priority and an accelerated schedule during January and February. CarbonCast enclosures are an all-weather material manufactured in a plant. Casting, stripping and field finishing were performed at the casting facility so fabrication, shipping and erection could be completed in harsh winter conditions.

The slant position of the panels enabled the erector to use a single line crane and erect the steel and precast

Integration with building team

AltusGroup partners have capability and experience with BIM and dealing with leading government contractors as a supplier of quality precast. In fact, it is worth considering a total precast system for speed of erection and cost savings, which otherwise might leave a project undelivered if other technologies and trades are chosen. simultaneously. As openings were cast into panels, frames and doors were installed immediately, hastening the enclosure of the building's perimeter. Although the architectural skin was composed primarily of inset red-brown thin brick to resemble hand-laid brick, a contrasting white brick was chosen to offset the entrance. Integral corners produced during the casting process further enhance the natural appearance of the façade. Block-outs for electrical conduit and connection boxes were cast into the panels to achieve finished interior and exterior surfaces.

Additional technical information, product specifications and literature are available at altusprecast.com. You can also find a listing of AltusGroup precasters close to you or your project.



AltusGroup Inc. 833.GO-ALTUS (1.833.462.5887) info@altusprecast.com altusprecast.com

Call us today to speak with a technical representative or request a lunch-and-learn program.