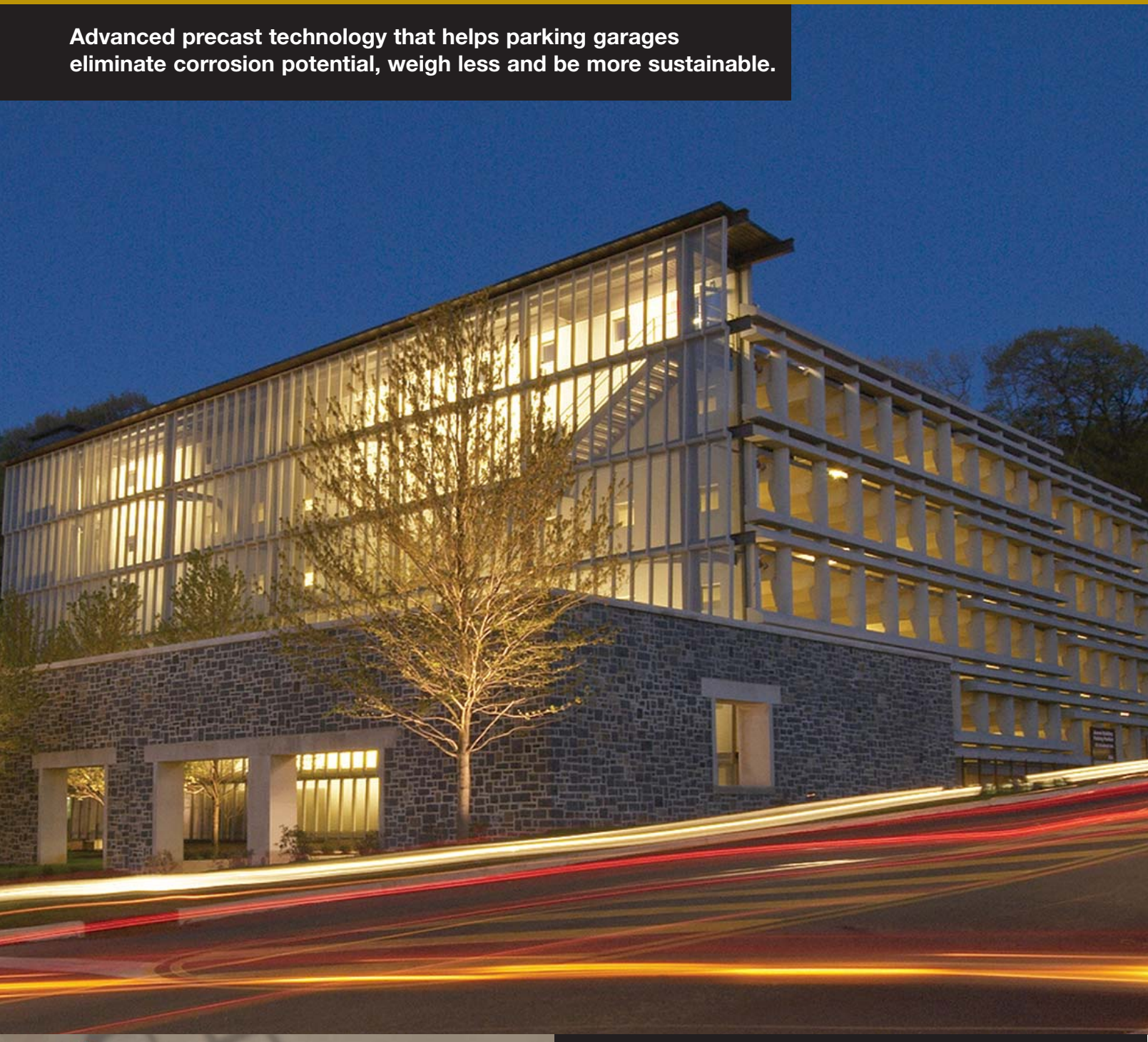
Double Tees

carboncast®

Advanced precast technology that helps parking garages eliminate corrosion potential, weigh less and be more sustainable.



altusgroup®

carboncast®

C-GRID® REINFORCED
C-GRID is a trademark of Chomarat, NA

CarbonCast Double Tees: Less weight. More durability.

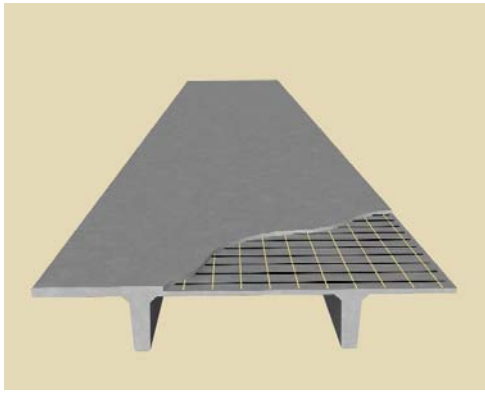
- **Up to 8% lighter, reducing superstructure and foundation requirements**
- **Eliminate the need for chemical sealers and corrosion inhibitors**
- **Reduce the carbon footprint of parking garages**
- **Offer superior durability, strength and crack control**

C-GRID® reinforces the benefits of precast.
For years, architects, engineers and parking consultants have looked to precast double tee parking decks as a superior alternative to cast-in-place decks. Precast double tees offer unmatched consistency, erection speed and long-term durability in addition to aesthetic flexibility, fire resistance, low maintenance and high overall value.

Parking structures represent one of the most demanding applications for concrete. They're exposed to the elements 24 hours a day, seven days a week. They're expected to support hundreds or even thousands of vehicles—including heavyweight SUVs. They face a barrage of corrosive agents such as salt used to clear roads from winter precipitation and chloride-laden air and moisture along coastlines. Although corrosion isn't a problem everywhere, it has the potential to be a garage owner's worst nightmare.

Now there is an alternative. CarbonCast® Double Tees from AltusGroup® replace conventional steel mesh reinforcing in the flange with C-GRID carbon fiber grid. Because C-GRID does not corrode, you don't have to worry about the potential for concrete degradation, cracking or spalling. At the same time, CarbonCast Double Tees can use less concrete cover in their flanges—reducing weight up to 8%, which reduces embodied energy and associated greenhouse gas emissions. Using lighter weight components can be an important strategy in achieving energy efficiency in sustainable projects, particularly for open air structures such as parking structures that typically have few if any conditioned spaces.

Historically, pretopped double tees made with high strength concrete outperform field-topped double tees made with low-strength concrete. Additionally, pretopping CarbonCast Double Tees eliminates the trade coordination and time required to field top and seal conventional double tees.



C-GRID's corrosion resistance and strength allow you to reduce the amount of concrete in each double tee flange by up to 1/2". The result: CarbonCast Double Tees can weigh less and can have longer life cycles than other concrete options.

Ballantyne Garage
Charlotte, N.C.
Precaster: Metromont Corporation

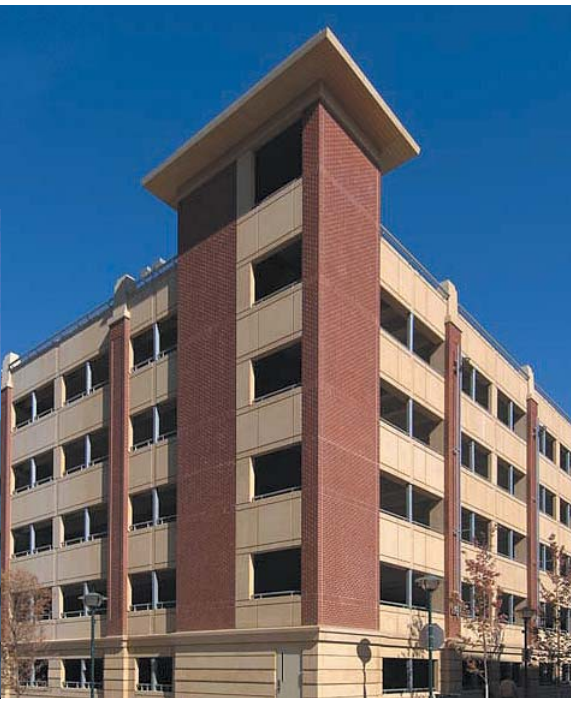
Universities at Shady Grove
Rockville, Md.
Precaster: Shockey Precast Group

Children's Place Garage
Secaucus, N.J.
Precaster: High Concrete Group LLC

Factory fabricated to a higher standard.

Lighter. Stronger. And just plain better.
As a non-corrosive "enabling technology," C-GRID® epoxy-coated carbon fiber reinforcing grids enable double tees to be lighter, more durable and less costly in the long run than concrete that relies on steel reinforcing. Exceptionally strong, C-GRID used in double tees provides over 6,000 lbs/lf of tensile strength to support flange loads. The high strength carbon fibers used to make C-GRID are over four times stronger than steel by weight and their close spacing and near-surface placement contributes to superior crack control behavior in concrete structures.

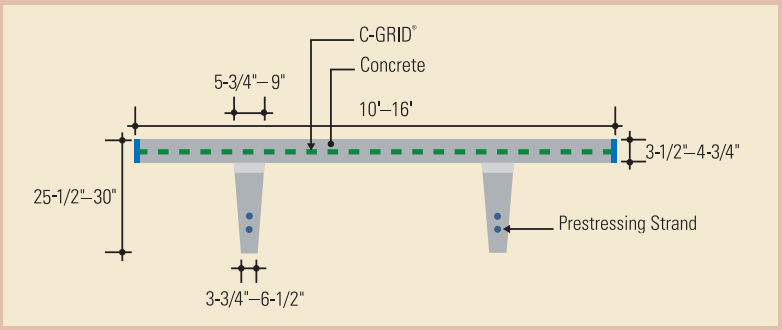
C-GRID's highly-efficient structure, corrosion resistance and strength allow AltusGroup precast manufacturers to reduce the concrete thickness in the double tee flange by up to ½". Conventional prestressed strands are still used for flexural reinforcing in the stems because they are extremely well protected by more than 12" of concrete as measured from the top of the flange. The result: CarbonCast Double Tees can weigh up to 6 lbs/sf less and last considerably longer than other concrete options.

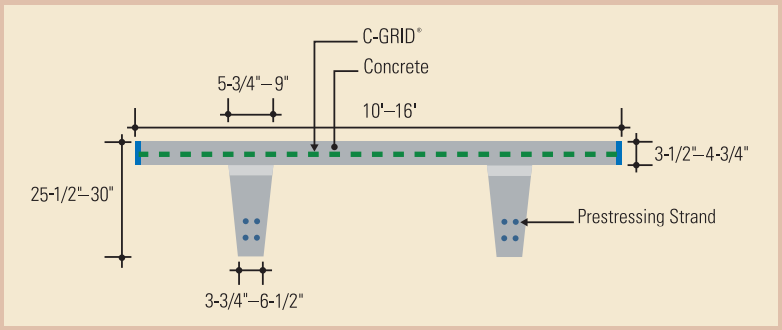


Delivered ready to erect, CarbonCast® Double Tees avoid the costly scheduling, quality and safety issues associated with coordinating the many trades required to complete a cast-in-place deck. They also minimize weather delays and site congestion caused by laborers and stored materials and equipment.

Factory fabrication brings the highest level of quality control to the casting process and painstaking oversight ensures structural uniformity from the first CarbonCast Double Tee to the last. Unlike field-cast concrete, factory-casting enables low water-cement ratios for greater impermeability and allows for temperature and humidity control during curing to deliver maximum strength, impermeability and long-term durability. And we use more advanced concrete—such as self-consolidating concrete and high-strength concrete—to optimize performance and appearance.

AltusGroup precasters use a patent-pending C-GRID Embedment Machine that introduces carbon fiber grid into the flanges at the optimum depth for crack control and smoothes the concrete in preparation for final finishing. The automated process streamlines double tee manufacturing and ensures optimal placement of C-GRID in the flange.





C-GRID reinforces the flange or deck of the double tee (the driving surface) which is most exposed to water, vehicle exhaust and corrosive salts. Prestressed steel strands for primary reinforcing (either single strand or double strand) are used below the deck because these areas are deeply embedded in the concrete and are not exposed to as much moisture as the decks. Carbon fiber reinforced flanges can be as thin as 3½" and perform as well as 4" steel-mesh reinforced flanges. (Dimensions and flange thickness vary from precaster to precaster, and based on design.)

The Lower Weight Solutions

Decrease the weight, increase the benefits. When you lower the weight of structural components, a multitude of benefits follow: lighter (and less costly) foundations, reduced seismic loads and less robust connectors are several. CarbonCast® Double Tees give you all these benefits, in addition to more value over the long term.

The fact that steel corrodes if untreated forces double tee manufacturers to add concrete cover to the flange to protect the steel. That's extra concrete and weight just to safeguard the reinforcing. Non-corrosive C-GRID® reinforcing does not need extra cover. In fact, C-GRID can be positioned in the flange for optimal performance, providing even better crack control. Thinning the flange by ½" by using C-GRID removes six pounds per square foot of dead load, so you have more reserve capacity to support greater loads on the deck. All CarbonCast Double Tee flanges are engineered to exceed IBC requirements.

In addition, less concrete means less embodied energy in each CarbonCast Double Tee, which reduces the structure's carbon footprint and can help contribute to LEED® certification.

CarbonCast Double Tees Potential Precast Point Contributions to LEED®

Category	Credit or Prerequisite	Points Available LEED 2009	Comments
Sustainable Sites			
SS Credit 5.1	Site Development: Protect or Restore Habitat	1	• Erection practices limit site disturbance to prescribed distances from the building
SS Credit 7.1	Heat Island Effect: Non-Roof	1	• Parking structures place 50% or more parking under cover • High albedo concrete reflects energy back into the atmosphere and decreases cooling loads
Materials and Resources			
MR Credit 2.1, 2	Construction Waste Management: Divert 50% from Disposal; Divert 75% from Disposal	2	• Recycling crushed concrete into road bases or construction fill; used to form artificial barriers for shorelines • Erection does not contribute to construction site waste, since components are manufactured off site
MR Credit 4.1	Recycled Content: 10% (post-consumer + pre-consumer)	1	• Recycled concrete or slag as aggregate (post-consumer content) and supplementary cementitious materials, such as silica fume and slag cement (pre-consumer content); doubling this requirement may contribute to an Innovation and Design credit • Steel reinforcement can be manufactured from recycled steel
MR Credit 5.1, 2	Regional Materials: 10% and 20% Extracted, Processed and Manufactured Region	2	• Components are most often transported and erected within 200 miles of the plant; use of local cements, aggregates and other raw materials keeps transportation distances to a minimum
Indoor Environmental Quality			
EQ Credit 3.1	Construction Indoor Air Quality Management Plan: During Construction	1	• No on-site fabrication, reducing airborne particles; is not damaged by moisture, and concrete does not support mold growth
Innovation and Design Process			
ID Credit 1.1	Innovation in Design	1	• An ID credit may be achieved due to exemplary performance of credit MRc4.1, 2
ID Credit 1.2	Innovation in Design	1	• Lighter weight, alternative reinforcement and materials reduce embedded energy and permit non-corrosive and more durable concrete
ID Credit 1.3	Innovation in Design	1	• Eliminate need for high carbon-footprint chemical sealers
ID Credit 1.4	Innovation in Design	1	• Reduce use of cement without affecting structural performance
ID Credit 1.5	Innovation in Design	1	• Reduce superstructure and foundation requirements
ID Credit 2	LEED® Accredited Professional	1	• LEED AP: Many precasters have qualified LEED APs on staff to lead and support a project

*LEED= Leadership in Energy and Environmental Design

Eliminates Corrosion, Hassles and Headaches

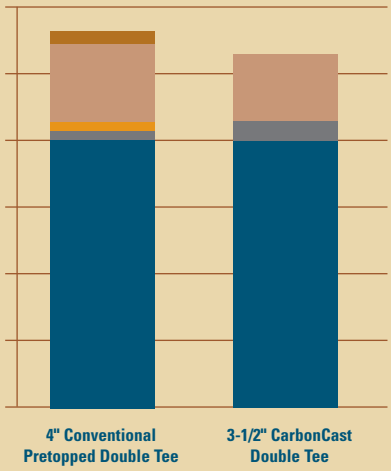
Make concrete maintenance a distant memory.
Protecting conventional concrete decks on precast and cast-in-place parking structures requires vigilance. A litany of chemical treatments are typically used to inhibit and delay the potential corrosion of steel mesh reinforcing in the deck.

With non-corrosive C-GRID® reinforcing in CarbonCast® Double Tees, you can forget about epoxy or sacrificial barrier coatings on the steel and eliminate the need to add corrosion-inhibiting admixtures to the concrete or apply sealers to the deck surface. And best of all, you can eliminate the cost and hassle of re-applying these sealers every five years.

All of these savings add up to dramatically reduced life cycle costs in terms of ongoing maintenance expenditures of time and materials. In fact, with high-strength concrete mix design and proper maintenance, CarbonCast Double Tees should last more than 50 years without retopping.

The use of C-GRID in the double tee flange eliminates the need to use sealers or corrosion inhibitors.

CarbonCast Double Tee Cost Comparison Chart



When one considers the cost of steel, and corrosion inhibitors, the use of less concrete, potential reductions in superstructure and site costs, and increased life span, C-GRID reinforcing can lower life cycle costs significantly—especially after the first decade of operation.

(Note: Chart is for comparative purposes only. Actual costs may vary depending on precaster and region.)

Cast-in-place garages are susceptible to deck corrosion, which can lead to durability issues and water infiltration.

Tested. And Tested. Then Tested Some More.

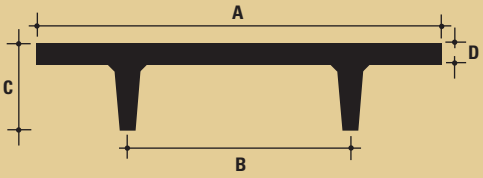
Create a lasting connection.
Parking decks that use CarbonCast® Double Tees need superior connectors. Even though CarbonCast Double Tees eliminate carbon steel mesh in the flange, steel is still needed to connect the tees to each other and to the surrounding structure. For these applications, AltusGroup precasters use high performance stainless steel connectors that control rust and corrosion to ensure a long-lasting, low-maintenance structure.

CarbonCast Double Tees measure up.
CarbonCast Double Tees generally are available in the same sizes and configurations as conventional double tees. Depending on the precaster, they are available in depths from 26" to 30", widths from 6' to 15' and lengths up to 65'. The only difference is the depth of the flange, which can be reduced to 3½" for uses where a one-hour fire rating is required. As a result, you can use the same design protocols you're familiar with.

CarbonCast Double Tee Size Chart

A	Width Range	B	C*	D
10'-0"	6'-0"–10'-0"	5'-0" O.C.	26", 30"	3½", 4", 4⅝", 4¾"
12'-0"	7'-0"–12'-0"	6'-0" O.C.	26", 30"	3½", 4", 4⅝", 4¾"
15'-0"	8'-6"–15'-0"	7'-6" O.C.	30"	3½", 4", 4⅝", 4¾"

*As measured from the top of 4" flange to the bottom of stem. For other flange depths add or subtract flange thickness as appropriate.



CarbonCast Double Tee Design Table

Flange Thickness	Mix Design	Lbs/SF	Fire Rating
3½"	Std Weight	44	1 hour
4"	Std Weight	50	1 hour
4¾"	Std Weight	59	2 hour

*Assumes mix design @ 110 psf; not available in all areas

Flange Thickness	Mix Design*	Lbs/SF	Fire Rating
3½"	Light Weight	32	1 hour
4"	Light Weight	36	2 hour
4¾"	Light Weight	44	2 hour

High performance stainless steel connectors prevent rust and corrosion and ensure a long-lasting, low maintenance structure.

George Washington Auto Park
Winchester, Va.
Precaster: Shockey Precast Group

Fire test validate performance.

Rigorous laboratory testing has affirmed a number of CarbonCast's performance characteristics. Load testing shows that CarbonCast® Double Tees will stand up to the heaviest sport utility vehicles. Fire tests show that they can meet ASTM E119 requirements for a one-hour fire rating. Calculations based on ICC codes and accepted design criteria show that, just like steel mesh reinforced tees, they can provide a two-hour fire rating with 4¾" thick flanges.

From design to fabrication to erection to long-term maintenance, garages using CarbonCast Double Tees offer a lower cost, higher performance alternative to cast-in-place and, in some cases, conventional precast.

Test: carbon fiber beats steel on shrinkage cracks.

Three different configurations of C-GRID carbon fiber reinforced polymer (FRP) grids were tested for the control of plastic shrinkage cracking of concrete. Test results using AC-32 protocol showed that carbon FRP grids met or exceeded the acceptance criteria of a minimum 40% reduction of shrinkage cracking of concrete. Overall, carbon fiber grid outperformed steel mesh in reducing or controlling cracks.

C-GRID and CarbonCast Testing

- Tensile strength of C-GRID carbon fiber grids
- 12'-wide CarbonCast Double Tees subjected to concentrated loads
- 12'-wide CarbonCast Double Tees subjected to uniform loads
- 15'-wide CarbonCast Double Tees subjected to concentrated loads
- 15'-wide CarbonCast Double Tees subjected to uniform loads
- One-hour fire endurance testing in accordance with ASTM E119.
- Effects of 100-Year Aging in a High Alkalinity Environment On the Strength of C-GRID® Carbon/Epoxy Grids (Chomarat Report)

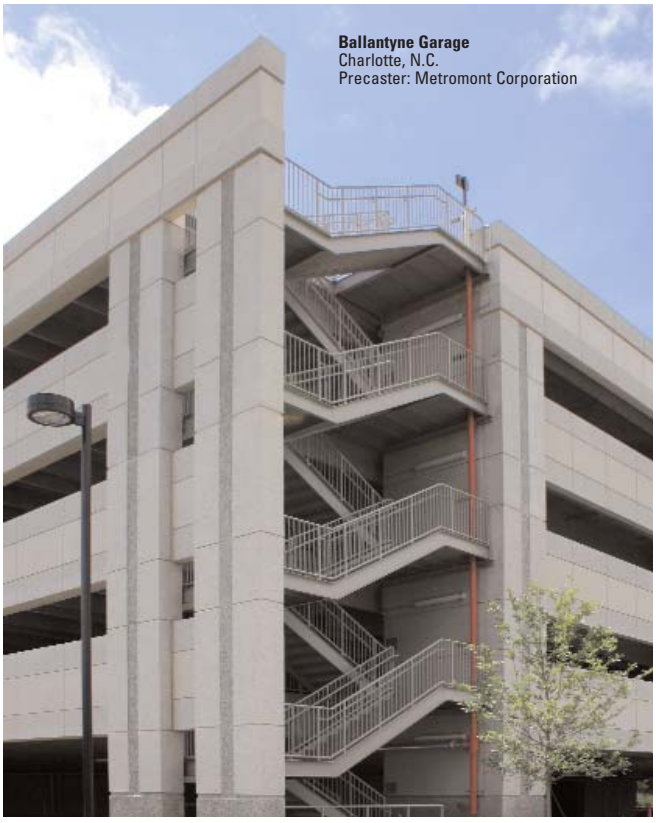
1. Uniform load testing of CarbonCast Double Tee
2. Concentrated load tests of cantilevered flange
3. Double Tee being prepared for storage in yard prior to transportation
4. CarbonCast Double Tee being hoisted for installation at the jobsite

All the benefits of precast.

For decades, architects and engineers have depended on the strength, durability and design possibilities of precast concrete to achieve a variety of outcomes.

- Design freedom: unlimited aesthetic options; excellent plan flexibility
- Outstanding durability, including fire and impact resistance
- Peace of mind: quality-assured, consistent factory fabrication enables greater quality control, superior consistency of finish and greater strength and impermeability
- Fast-track construction: faster to erect, fewer uncontrollable delays and lower costs (up to five times faster than field construction)
- Low maintenance and life cycle costs
- Less embodied energy and no VOC-emitting sealers

AltusGroup® precasters will provide extensive design and specification assistance, connection detailing, erection planning, erection and other services to ensure a hassle-free, high quality installation.



Ballantyne Garage
Charlotte, N.C.
Precaster: Metromont Corporation

Channel Club Condominium Garage
Monmouth Beach, N. J.
Precaster: High Concrete Group LLC

AltusGroup® Producers:

Blakeslee Prestress
Branford, Conn.
www.blakesleeprestress.com

Central Pre-Mix Prestress Company
(an Oldcastle company)
Spokane, Wash.

EnCon Utah LLC
Tooele, Utah
www.enconunited.com

Enterprise Precast Concrete
Omaha, Neb.
www.enterpriseprecast.com

GPRM Prestress
Kapolei, Hawaii
www.gracepacificcorp.com

Gage Precast
Sioux Falls, S.D.
www.gagebrothers.com

Gate Precast Company
Oxford, N.C.; Monroeville, Ala.; Kissimmee, Fla.; Jacksonville, Fla.; Ashland City Tenn.; Winchester, Ky.; Hillsboro, Tex.; Pearland, Tex.
www.gateprecast.com

Heldenfels Enterprises, Inc.
San Marcos, Tex.
www.heldenfels.com

High Concrete Group LLC
Denver, Pa.; Springboro, Ohio; Paxton, Ill.; Buena, N.J.
www.highconcrete.com

Knife River-Northwest Oregon Region, Prestress Division
Harrisburg, Ore.
www.kniferiverprestress.com

Metromont Corporation
Atlanta, Ga.; Greenville, S.C.; Charlotte, N.C.; Nashville,Tenn.; Richmond, Va.; Bartow, Fla.
www.metromont.com

Oldcastle Precast Building Systems
Baltimore, Md.; South Bethlehem, N.Y.
www.oldcastlesystems.com

Shockey Precast Group
Winchester, Va.; Fredericksburg, Va.
www.shockeycompanies.com

Wells Concrete
Wells, Minn.; Albany, Minn.; Grand Forks, N.D.
www.wellsconcrete.com

Chomarat North America LLC (C-GRID® supplier)
Anderson, S.C.
www.carbongrid.com

Innovation Partners:

BASF Admixtures, Inc.
Endicott Clay Products Company
Essroc Italcementi Group
High Concrete Accessories
JVI
Meadow Burke Products
Owens-Corning
Toray Carbon Fibers America Inc.

carboncast®

C-GRID® REINFORCED
C-GRID is a trademark of TechFab, LLC

Revolutionary thinking from the leading minds in precast.

AltusGroup,® Inc., a company founded by some of the industry's largest precasters and C-GRID® manufacturer Chomarat North America LLC, was incorporated to make CarbonCast® technology—and future precast innovations—available throughout North America.

AltusGroup members collectively support more than 40 manufacturing and sales locations in the United States and over 300 specification-oriented sales, marketing and engineering professionals, and generate more than $1 billion in annual revenue. With pooled research resources, knowledgeable manufacturing engineers and a national network of quality-conscious, PCI-certified plants (www.pci.org), sales support staff and university collaborators, AltusGroup can help you achieve your design, construction and budget objectives.

Innovative CarbonCast products are available across the United States and in Canada, with an unparalleled network of service and support, offering:

- Extensive testing and the backing of trusted industry leaders
- A central source for complete technical information, including CAD details, specifications and engineering design standards
- Local sales and technical representatives to help with design and construction challenges
- Uniform quality standards and details consistent with the IBC and local codes

Other high performance CarbonCast precast products available from AltusGroup Precasters include:

- **CarbonCast High Performance Insulated Wall Panels**
- **CarbonCast Insulated Architectural Cladding**
- **CarbonCast Architectural Cladding**

For more information about AltusGroup, CarbonCast precast concrete components and the C-GRID technology, call 866-GO-ALTUS or visit altusprecast.com.


See us in Sweets in section 034500/ALT

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