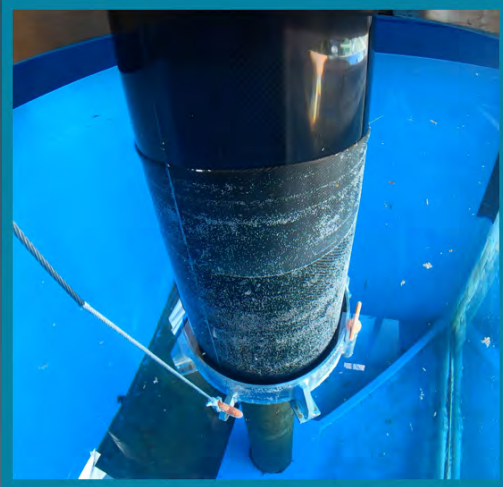



CarboShield



CarboShield

Advanced Carbon Fiber
**Marine Pile, Bridge and
Building Column Repair**

Patented Structural Repair System

CarboShield.com

U.S. Patent No. 10,689,868

COMPLETE PILE PROTECTION

CarboShield is an innovative application of advanced carbon fiber composites that create specialized shells used to repair, protect and strengthen existing marine piles. All work can be performed above water, in far less time and cost than most current repair methods, resulting in unsurpassed repair quality.

Highly corrosion resistance, durable and lightweight, these carbon half-shells are bonded by strong epoxy and fitted around existing pilings from a barge or platform, with minimal need for divers. The bonded casings form an enclosed full shell, which is lowered into the water around the existing piling, as deep as necessary - even to the mud line. The shell casing is then pumped full of grout, forming a new, strong, corrosion-resistant shield around the pile or column.

CarboShield technology is a cost-effective solution for restoring aging infrastructure. It does more than rehabilitate corroded, degraded or damaged structures: This engineered composite system forms a shield against future corrosion and can reestablish structural value.

ADVANTAGES

- CarboShield is made of engineered carbon fiber, which is virtually inert, highly corrosion resistant and will outlast nearly any currently available option
- High strength, lightweight pile encasement
- Minimal surface preparation needed
- Maintains structure's basic shape and appearance
- Maintenance free
- Faster and less expensive than complete replacement
- Stay-in-place form reduces steel reinforcement congestions
- Heavy equipment optional
- Minimal interruption of service
- Adapts to most shapes and cross section types
- Minimal underwater work needed
- Safe for sensitive marine environments.

APPLICATIONS

- Timber, steel or concrete pile repair at or below water line
- Refurbishes marine piles, utility poles, bridge columns and more
- Splice or extend existing load-bearing piles.

For more information, please contact the CarboShield technical staff today!

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AVAILABLE CONFIGURATIONS

CarboShield is a high strength composite shell made of carbon fiber reinforced polymer (CFRP). Each shell is custom-made and available in round, square and octagonal shapes. The thickness of these shells varies from 1/16" to 1/4" based on design loads. Some of the available shapes are listed below. Other shapes and sizes are available upon request with generally four weeks of lead time.

CS-C

CIRCULAR (SHELL THICKNESS 1/8" OR 1/4")					
DIAMETER (in)			LENGTH (in)		
12	18	24	24	36	48

CS-R

RECTANGULAR (SHELL THICKNESS 1/8" OR 1/4")					
CROSS SECTION (in)			LENGTH (in)		
12X12	18X18	24X24	24	36	48
12X18	18X24	24X36			
12X24	18X36	24X48			

CS-H

HEXAGONAL (SHELL THICKNESS 1/8" OR 1/4")					
SIDE LENGTH (in)			LENGTH (in)		
12			24	36	48
18					
24					
36					
48					



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SYSTEM PROPERTIES

CarboShield

CFRP Shell Properties

PROPERTY	TEST METHOD	RESULTS
ULTIMATE TENSILE STRENGTH	ASTM D3039	55.8 ksi
ULTIMATE TENSILE MODULUS	ASTM D3039	3830 ksi
ULTIMATE TENSILE STRAIN	ASTM D3039	1.1%

POLYGROUT Properties

POLYGROUT is a high-strength, fast cure polymer concrete specifically formulated to provide high compressive strength for underwater applications, as well as good bond to CarboShield shells. POLYGROUT provides an excellent bond to concrete, steel, timber and other common building materials. This product is highly hydrophobic, meaning it displaces water, and is easily poured into the CarboShield system while submerged in water.

PROPERTY	TEST METHOD	RESULTS
COMPRESSIVE STRENGTH	ASTM C579	> 9,000 PSI
BOND STRENGTH TO CARBOSHIELD SHELL	ASTM D4541	> 500 PSI
WORKING TIME @70°F	N.A.	45 MIN

EPOXY BONDING AGENT

The CarboShield system is bonded using a high strength, toughened, structural epoxy paste. This product is a two phase (toughened) epoxy resin produced using a CTBN elastomer and a flexible resin backbone for maximum stress and fatigue resistance. It also cures under water, bonding with an immediate high tack consistency, a long working life, and a quick cure time. The material mixes at 2:1 by volume, or 100:44 by weight (resin to hardener). The convenient color-coded components form a uniform color when properly mixed.

PROPERTY	TEST METHOD	RESULTS
TENSILE STRENGTH (ksi)	ASTM D638	4.5
TENSILE MODULUS (ksi)	ASTM D638	344
TENSILE STRAIN (%)	ASTM D638	2.15
FLEXURAL STRENGTH (ksi)	ASTM D790	12.2
FLEXURAL MODULUS (ksi)	ASTM D790	410.7
FLEXURAL MAX. DISPLACEMENT (in)	ASTM D790	0.178
COMPRESSIVE STRENGTH (ksi)	ASTM D695	11.3
COMPRESSIVE MODULUS (ksi)	ASTM D695	571
COMPRESSIVE MAX. DISPLACEMENT (in)	ASTM D695	0.196



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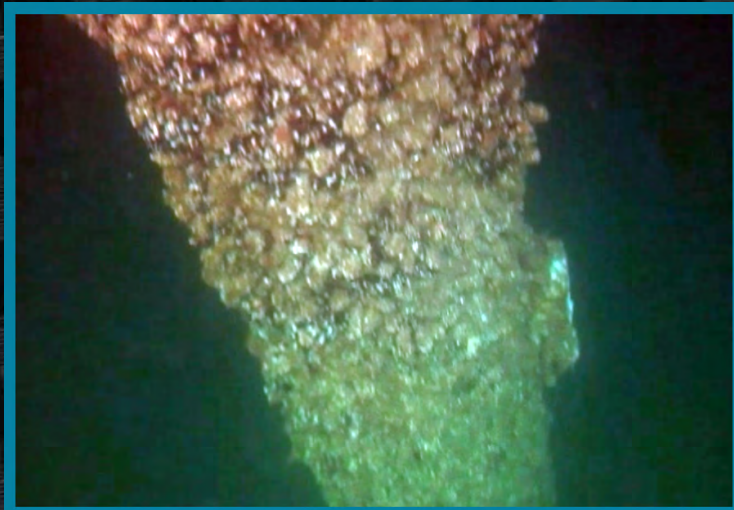
SURFACE PREPARATION

Standalone Pile

The CarboShield system can be designed to withstand all applied forces that are acting on the existing pile. In this approach, no surface prep of the existing pile is required.

Combined Action of Existing Pile and CarboShield

If composite action, or only protection of existing pile is desired, careful surface preparation of the existing pile is necessary. Surface preparation can be accomplished by high pressure water blasting or mechanical grinding. The prepared surface must be free of all biological buildups, laitance or other contaminants that can inhibit the bond of the grout with the existing pile surface.



CarboShield



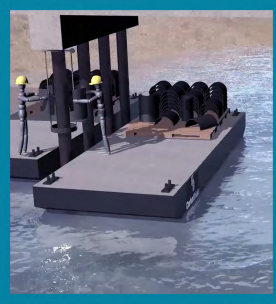
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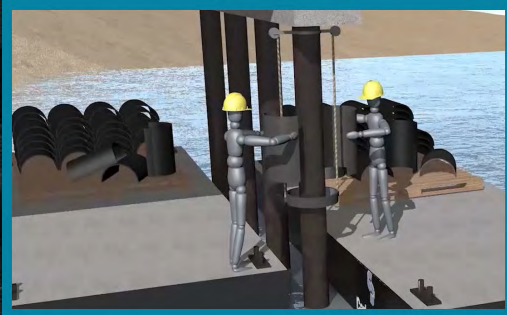
INSTALLATION INSTRUCTIONS

CarboShield

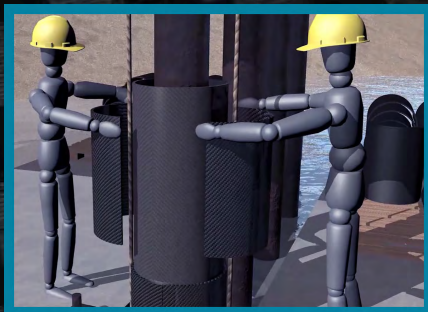
1. Place prefabricated half shells in desired size and length on the staging area near the pile.



2. Place the first set of shells onto the hanging tray platform.



3. Using a pneumatic dispensing tool, apply epoxy to the inner face of the outer shell to bond the inner and outer shells.



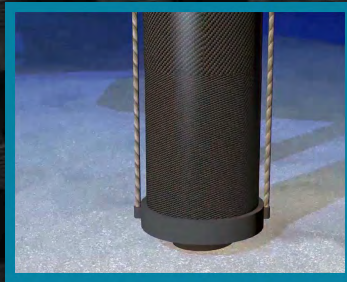
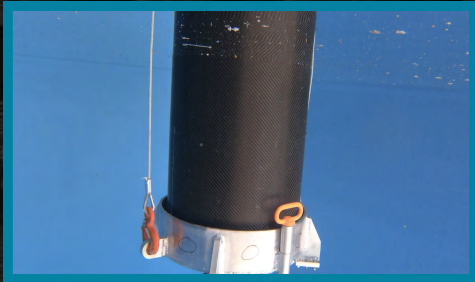
4. Outer shells are added and bonded together with joints staggered to complete structural continuity in both hoop and vertical directions.



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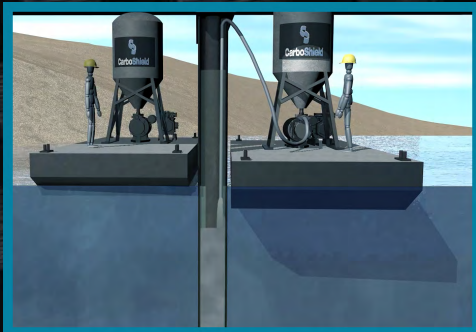
- 5.** Complete the shell around the pile as it sits on the tray, then lower the tray in water to the desired depth.



- 6.** Add and splice vertical and horizontal nonmetallic reinforcement, if desired, while lowering the system in water.



- 7.** Pump polymer grout into the annular space around the pile from bottom up to complete process.



NOTE: Grouting can be performed from bottom of outside of pile if the annular space is too small.

For more information, please contact the CarboShield technical staff today!

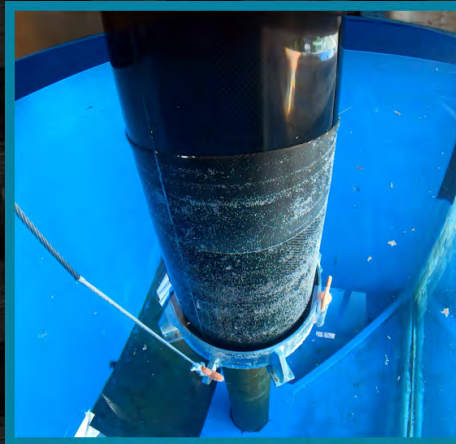


INSTALLATION NOTES

The annular space between the existing pile and CarboShield is uniformly maintained by placing spacers at two different heights as shown. Spacer thickness can vary depending on the desired annular space.

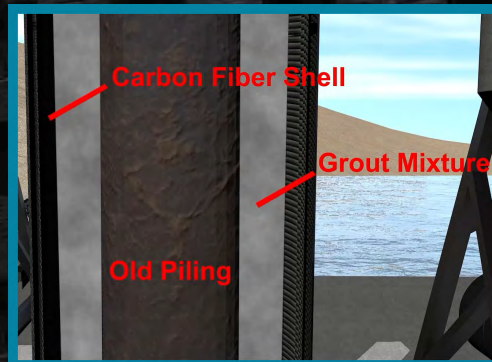


The tray assembly stabilizes the system while lowering in water. The unit is designed to be suspended from cables. The tray is constructed of two similar parts connected with a quick-release pin.



Epoxy grout fills the annular space between the CarboShield shell and the existing pile. This space is filled in two parts:

1. Approx. 12 inches of shell bottom is sealed and filled with grout, allowed to cure and create a plug.
2. The remaining annular space is filled with grout from the bottom up.



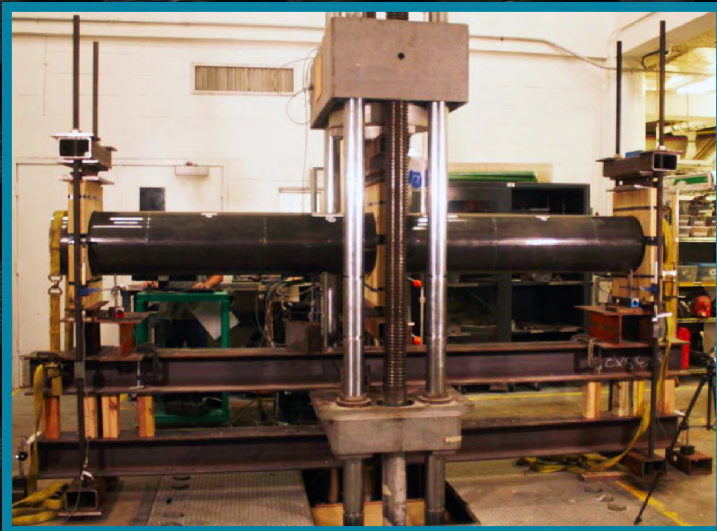
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LARGE SCALE STRUCTURAL TEST

- The CarboShield structural repair system was tested at the University of Miami in laboratory facilities accredited by the International Accreditation Service (IAS).
- Test results verified outstanding improvement of capacity compared to an unretrofitted pile.
- Pile capacity increased by more than 35 times compared to an unretrofitted pile.



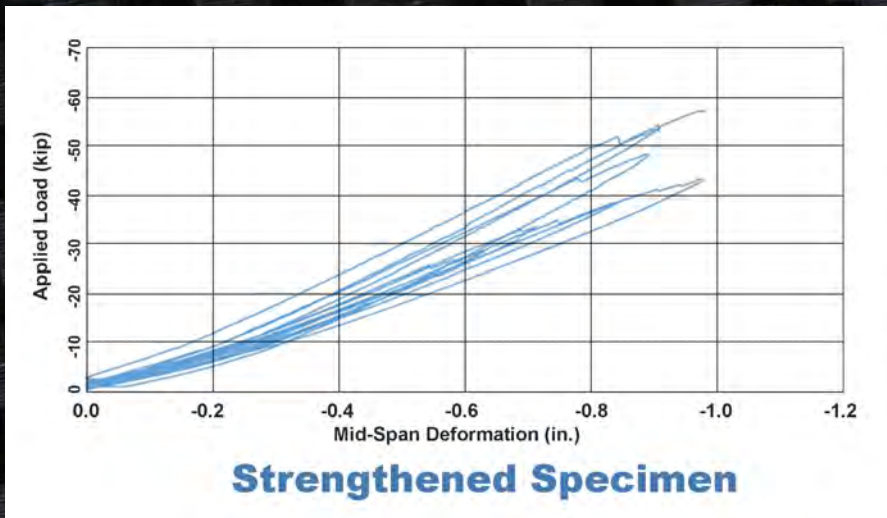
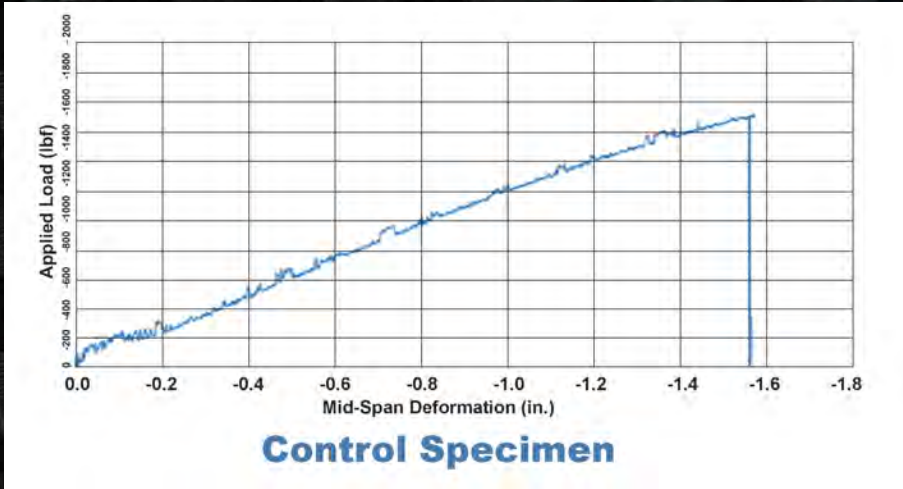
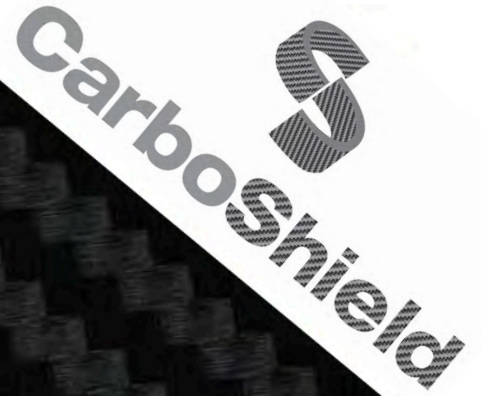
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TESTING RESULTS



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SERVICES AVAILABLE

Complete stamped engineering calculations and drawings

CarboShield shells in any shape and dimension

Installation support including equipment to install shells during immersion

PolyGrout resin and aggregates

Epoxy for bonding shells

Guide spacers and annular seal at bottom

Non-metallic rebar and splicing nuts

CarboShield 

PLEASE CONTACT CARBOSHIELD TODAY!



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