

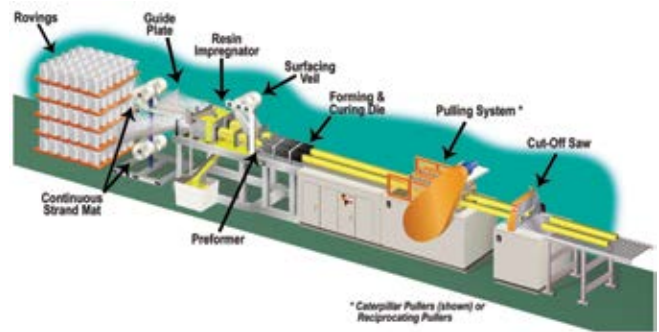
STORMSTRONG[®] PIPE PILE INSTALLATION MANUAL



StormStrong Pipe Pile Overview

Creative Composites Group's (CCG) highly engineered composite pile is designed and manufactured exclusively for fender, mooring and compression pile applications. The pipe pile is manufactured by the pultrusion process. A continuous process in which resin and reinforcements are saturated and guided into a heated die where the curing process commences.

StormStrong pipe pile is manufactured with a two component polyol/isocyanate polyurethane matrix, with a fiberglass reinforcement architecture comprised of 11Msi Modulus/290 ksi tensile strength fiberglass, manufactured to ASTM D578 specifications. The outer layer is comprised of a 10 mil thick, synthetic UV protection veil. StormStrong pipe pile is environmentally friendly featuring a low carbon footprint. It will not leach chemicals or harm the environment.



Shipping & Receiving

The pipe pile is shipped to the job site via flatbed dedicated truck. The continuous manufacturing process permits CCG to manufacture piles to long lengths eliminating the need for splices.

Prior to shipping, the contractor shall communicate with CCG regarding the packaging and shipping method.

Considerations shall include but may not be limited to:

- Length of piles
- Quantity of piles on the truck
- Weight of the pile packages
- Unloading method



Proper Handling Upon Delivery

Proper care should be taken during handling. The piles were packaged and loaded on the flatbed with a tow motor. Contact CCG for the weights of the piles and individual packages.

Proper care should be taken when removing the tie-down straps. Although the piles are cradled in wood chocks, never assume that the wood chocks will keep the piles from shifting.

The pultruded piles are smooth and can be very slippery if they become wet. Never use steel chokers or chains to unload the piles. A nylon strap, preferably with a neoprene skin is recommended. This will reduce the chance of the pile sliding during the picking process. CCG prefers to use light pole handling slings, made by Lift-It® (<http://www.lift-it.com>). The slings must be double wrapped and the manufacturer's recommendations must be followed.



Visual Inspection Upon Delivery

Upon delivery of the piles, the piles shall be inspected for damage that could affect the long term performance of the piles. Normal wear and tear including abrasions and scuff marks are common and shall not cause concern.

The piles shall be free from delaminations.

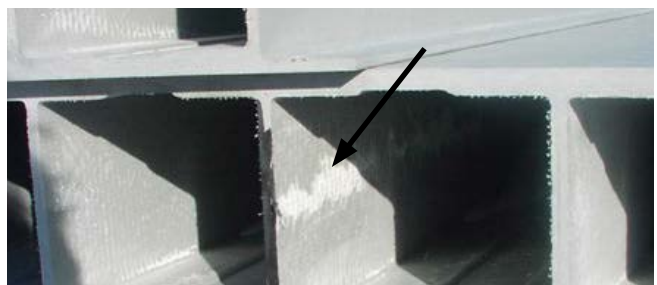
A delamination is a separation of two or more layers or plies of reinforcing material within a pultrusion. The separation can be penetrated by a needle. If the defect is over 3/8" wide, it is a delamination and not a process shrinkage crack.

The piles shall be free from dry fiber, a condition in which fibers are not fully encapsulated by resin during the pultrusion process.

The piles shall be free from fracture caused by improper handling during shipping.



Example of Delamination in a FRP Square Tube



Example of Dry Fiber in a Pultruded Panel

Dimensional Inspection Upon Delivery

Bow: Piles shall be straight to within .020"/ft. of length measured by weight minimizing the bow. (Note: Weight minimizing refers to the pile laying flat on the ground in contact with the flat ground and the bow measured at peak height.).

Length: Piles shall meet the specified length to +/- 2".

Wall thickness: Shall be ±15% of the nominal wall thickness.

Drilling & Cutting Instruction

StormStrong pipe pile can be drilled with carbide tipped drill bits. CCG recommends B & A Manufacturing Company (<http://www.bamanufacturing.com>) FGH series drill bits, for applications that require multiple holes in a short period of time. Many contractors and utilities have had success when utilizing the FGH series drill bits. The bits will save time and drill thousands of holes before needing to be replaced.

The pipe piles can be field cut with a concrete, skill or reciprocating saw. An abrasive blade should always be used. Concrete saws work the best and can be utilized with a standard concrete cutting blade. During drill and sawing operations dust will be emitted. The dust is considered a nuisance dust, which can irritate your eyes and skin. Therefore, safety glasses, gloves and long sleeve shirts are recommended during the cutting and drilling process.

As documented by OSHA, FRP dust millings have potential to cause eye, skin, and upper respiratory tract irritation.

- Cause - mechanical-irritant properties of the glass fibers.
- FRP particulate is Non-Hazardous.
- FRP particulate is greater than 6 microns therefore, it cannot reach the alveoli.
- The International Agency for Research on Cancer (IARC) classified FRP particulate as non-cancer causing in June of 1987.



Concrete Saw

Connection Details

StormStrong pipe pile connections should be made with galvanized or stainless steel connectors as designed and approved by the Engineer of Record (EOR). Holes should be drilled based on the nominal bolt diameter oversized by 1/16".

PIN BEARING STRENGTH

Pin bearing strengths are detailed in the technical data sheet for the various StormStrong pipe pile sections. Note that the pin bearing strength varies based on the direction of the load. The Length Wise (LW) bearing strength is normally higher than the Cross Wise (CW) pin bearing strength and must be considered during the design process.

In the event that signage, conduits, or other non-structural appendages are required to be mounted to the FRP piles, stainless steel self drilling screws should be utilized to make the connection as lag screws; nails and staples cannot be utilized.

TORQUE LIMITS

Proper care must be taken not to over torque the through bolts during construction. The pipe pile, like any hollow section, is susceptible to damage due to over tightening and "egg shaping" or crushing the pile. Therefore, a maximum torque of 30 lb-ft. is recommended. If a torque wrench is not available or utilized during construction, tighten the nut until

the compression spring washer has been collapsed and then, turn the nut another 1/2 turn. This method has been utilized by the utility industry, successfully for over 10 years.

OVERSIZED WASHERS

Connections should always be made with oversized washers that match the radius of the pile. FRP piles are extremely strong. However, the Modulus of Elasticity is about 1/5th that of steel. Therefore, highly concentrated loads are required to be dissipated over a larger area of the pile section. CCG recommends that washers measuring 6"x 6" x 3/8" manufactured in galvanized or stainless steel, be utilized for all bolted connections into the pile. (Note: All testing was performed with 50 ksi 4" x 4" x 3/8" and 6" x 6" x 3/8" steel washers.).

POINT LOADS

The pipe pile was designed for an ultimate crush strength of 27 kips, spread over a nine inch length of the pile. In the event, the pile connection or impact loads will be greater than the ultimate strength, with the appropriate safety factors applied, the crush strength can be increased by increasing the wall thickness of the pile. Always consider the crush strength capacity when designing the pile to dock connections. The reaction loads may require a thicker pile with a saddle connection.

Installation Options

VIBRATORY HAMMER

StormStrong pipe pile can be efficiently driven with a vibratory hammer. When utilizing a vibratory hammer an adaptor shall be fabricated to connect the pile to the vibratory hammer. The adaptor shall include an interior steel pipe that fits into the pile, to guide it. The interior tube should be between 0.5” and 2” of the interior diameter of the FRP pile. The interior pipe shall be welded onto a flat steel plate. The steel plate will apply the compression force into the top of the pile. The steel plate shall be connected to a beam that can be clamped by the vibratory hammer.

The contractor is cautioned that on some occasions the pile may require an FRP insert for added compression or pin bearing strength. Therefore, the interior diameter of the pile will change. The contractor should base the vibratory adaptor fabrication on the approved pile drawings.

In the event that a pile needs to be pulled, a vibratory hammer can be utilized to pull the piles. Through bolt the pile and the drive head with three 1” diameter bolts spaced a minimum of 5” apart. Vibrate the pile and pull tension until the pile begins to move. Once the friction has broken, pull the pile without the vibratory hammer engaged. The vibratory hammer oscillation will cause the bolt holes to elongate if engaged for an extended period of time.



Example of Vibratory Hammer Steel Fabrication

Typical Vibratory Drive Hammer Specifications

HAMMER - V-5C

DRIVING FORCE	53 tons	472 kN
FREQUENCY	1,700 CPM	
ECCENTRIC MOMENT	1,300 in-lbs.	1,500 kg-cm
AMPLITUDE	1 in.	25.4 mm
CLAMPING FORCE	62 tons	550 kN
MAX. LINE PULL	30 tons	267 kN
HEIGHT	91 in.	2,311 mm
THROAT WIDTH	13 in.	330 mm
SHIPPING WIDTH	79 in.	2,007 mm
WEIGHT W/ CLAMP	7,200 lbs.	3,276 kg
HOSE BUNDLE LENGTH	100 ft.	30 m

Courtesy of RPI Construction Equipment



IMPORTANT NOTICE: In reference to the proper use of this equipment, please be advised that job site conditions may vary due to a change in the geology of a particular area. It is always a good practice to consult with a geotechnical engineer prior to starting a project. Also, a good rule of thumb is to know your soil conditions before selecting pile driving equipment. This can be accomplished by reviewing test soil borings before every project. The above equipment is being used in a granular soil condition which is recommended when using vibratory driver/extractors.
~ RPI Construction Equipment

AIR & DIESEL HAMMERS

Diesel and Air Hammers have been utilized to drive the 12” and 16” StormStrong pipe piles. A pipe insert driving head or steel pipe cap is required for driving the hollow FRP piles. It is important that the piles are impacted so that the driving force is dissipated over the cross section of the top of the pile.



Vulcan 01 Impact Hammer Driving 16” Diameter Pile



Pipe Insert Driving Head for Driving Hollow Piles

Pile Dynamic Analysis

CCG contracted to Crofton Construction Services Inc. and to Atlantic Coast Engineering in order to have a Pile Dynamic Analysis (PDA) performed on StormStrong pipe piles.

Crofton Construction Services Inc. installed two StormStrong pipe piles, one with a Vulcan 01 Impact Hammer and one with an APE D30-32 Impact Hammer. Both piles were driven with a steel toe plate bolted to the bottom of the pile in order to increase the driving resistance of the soils. The pile driven with the Vulcan 01 Air Hammer was driven to refusal (120 blows/ft.) at a depth of 35 feet and then extracted for visual inspection. The pile driven with the APE D30-32 hammer was driven to a depth of 50 feet, allowed to set overnight, and was re-driven on the following date with dynamic test gauges attached to the pile.

Testing was performed to aid contractors in the selection of the appropriate impact hammers for installation of the piles. And, to establish, for Geotechnical Engineers, the feasible soil resistances in which the piles may be driven without damage and to identify the allowable driving stress.

The rated capacity of each hammer is utilized in the PDA as follows:

Hammer	Rated Driving Energy	Typical Energy Expected to be Delivered to Pile
Vulcan 01	15 kip-ft	6-9 kip-ft
APE D30-32	74 kip-ft	20-40 kip-ft

The test pile driven with the Vulcan 01 Impact Hammer, to refusal, demonstrated a driving resistance of 160 kips, a driving energy of 8 kip-ft., and a compressive driving stress of 8 ksi. The pile was extracted, inspected and revealed no signs of damage.

The test pile driven with the larger APE D30-32 Impact Hammer was driven through the same soils at a blowcount of 9 blows/ft. ending at a blowcount of 12 blows/ft., which was evaluated to represent a resistance of 200 kips with a compressive stress of 11 ksi. No evidence of damage was observed.

After a one day set up period, the pile was driven with the APE D30-32 Impact Hammer at a substantially greater resistance. At 235 blows/ft. a driving resistance of 340-370 kips, an average energy transfer of 30 ksi and a recorded compressive driving stress of 13-15 ksi, the pile head split and the pile failed.

The PDA testing indicates that impact hammers with a rated energy of 15 to 35 kip-ft are appropriate for the installation of the piles. Hammers with rated energies in the range of 35 to 50 kip-ft should be used with some level of caution.

Compression Loads

StormStrong pipe piles exhibit very high compressive strengths and load carrying capabilities. The following chart depicts the ultimate compression loads that the piles can sustain during the driving process without buckling. The loads are considered ultimate loads and should be factored accordingly.

Column Length Feet	Ultimate Compression Load (lbs.)		
	16" x 1/2" Pile	12" x 1/2" Pile	16" x 3/8" Pile
5	1,698,424	1,265,081	957,829
10	1,586,362	1,226,963	824,797
15	705,050	602,793	366,576
20	396,590	339,071	206,199
25	253,818	217,005	131,967
30	176,262	150,698	91,644
35	129,499	110,717	67,330
40	99,148	84,768	51,550
45	78,339	66,977	40,731
50	63,454	54,251	32,992
55	52,442	44,836	27,266
60	44,066	37,675	22,911
65	37,547	32,101	19,522
70	32,375	27,679	16,833
75	28,202	24,112	14,663
80	24,787	21,192	12,887
85	21,957	18,772	11,416
90	19,585	16,744	10,183
95	17,577	15,028	9,139
100	15,864	13,563	8,248

K = 1 Pinned-Pinned End conditions assumed

Choose Creative Composites Group for Comprehensive Project Support

Your Single Source for Innovative Engineered Waterfront Solutions Using StormStrong FRP Composites

Advance your products and projects beyond the limitations of traditional concrete, steel and wood by leveraging the combined strength of Creative Composites Group. We are a leader in technical innovation that is backed by the industry's most comprehensive FRP manufacturing group for infrastructure.

Creative Composites Group can help you engineer and manufacture waterfront infrastructure projects to ensure durability and protection against extreme weather with our StormStrong products.

Other companies commoditize FRP in off-the-shelf shapes and forms; Creative Composites Group does not. We offer comprehensive engineering, design and consultation for shoreline and asset protection. Our manufacturing capabilities include the broadest range of StormStrong FRP solutions to build your ideal projects. That's possible only with our proven engineering processes, end-to-end collaboration, service and support resources. Since StormStrong FRP composites last longer than conventional materials they often have a lower lifetime cost when you consider longer service life and low to no maintenance costs.



Discover Your Custom Engineered FRP Waterfront Infrastructure Provider

Creative Composites Group is committed to becoming a trusted business partner who is keenly interested in your project's success. Creative Composites Group works alongside your team, from facility owners to design engineers and contractors, to help you develop a customized FRP solution that meets the most demanding structural requirements and environmental conditions.

Contact us for your next engineered FRP pipe pile or waterfront infrastructure project. We'd be thrilled to discuss it with you.



Creative Composites Group

814-839-4186

214 Industrial Lane
Alum Bank, PA 15521

CreativeCompositesGroup.com

DLR10302024R4
©2024 Creative Composites Group Inc.
All Rights Reserved Worldwide