

SeaCure™ - The Future of Marine Construction

PVC Dock Piling Design and Installation Recommendations



SeaCure™ Installation Equipment

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Design & Installation Recommendations for PVC Piling

The design and installation of a dock using SeaCure PVC pilings is essentially the same as the design and installation of a dock that uses wood pilings with some exceptions.

Bending Strength

The SeaCure piling is extruded as a dense, hollow thermoplastic material. Since the pilings are hollow they can be filled to obtain various bending strengths, i.e. filled with sand, gravel, crusher run and concrete (see "Filling" below), or left unfilled. On low profile docks in unexposed or back water areas, unfilled PVC pilings will provide good support and the addition of unfilled batter pilings (PVC pilings driven at a shallow angle) will provide stability. For high profile docks in exposed areas, we recommend that dock designers and installers analyze the need to fill a percentage, or all, of the pilings and reinforce the dock structure with "batter" pilings. See the **Guidelines** section below.

SeaCure pilings can also be used to sleeve new or existing wood pilings. See the **Sleeving** section below.

Weight Considerations

The light weight SeaCure PVC pilings are easily moved to the job site and driven or jetted by all conventional methods making it a perfect candidate for use where access to job-sites is limited or restricted by adjoining properties, or over shallow environmentally sensitive areas. (reference: A pressure treated Southern Pine piling 9" butt x 20 ft. long weighs approximately 250 pounds. A SeaCure PVC piling 8.4" diameter X 20 ft. long weighs 82 pounds.)

Design Considerations

SeaCure's compounded PVC is an elastic material produced by the polymerization of HCl and natural gas with a specific gravity of 1.2. With our formulated impact modifier added it is an ideal candidate for conventional pile driving methods. Actual bending test were performed on unfilled SeaCure PVC piling's to provide base data for calculations on PVC pilings filled with sand or concrete. The results are shown on Attachment I. Flexibility can be viewed as a positive, for instance, if a boat hits a dock with some flexibility, less damage may be incurred to both the boat and the dock. See Attachment II for

deflection loadings. However, in many installations such as narrow, long docks, this degree of freedom is unacceptable and filling the PVC pilings and/or the addition of "batter pilings may be required.

Guidelines

Pilings supporting docks extending no more than four feet from the mud line to the first stringer abutment can generally be left unfilled or filled with clay or sand from the surrounding area. (See below for the advantages of filling). Batter pilings, PVC pilings driven at a shallow angle, (see drawing) are recommended to be driven in alternating directions every thirty feet of run on docks with piling supports of five feet or longer. On docks with nine feet of piling support length or longer, we recommend the use of a batter piling approximately every fifteen feet of run.

Pile Driving Methods for PVC Pilings

SeaCure's 8, 10 and 12 inch pilings can be driven by all of the current driving methods that are used to install wood pilings, i.e. drop hammers, vibratory methods and jetting. However, two areas of caution must be observed.

- In all installations in which drop or impact hammers are used, a drive cap that fits over the piling must be used. We recommend a buffer at the impact point on the drive cap, constructed of an elastic material such as wood or hard rubber to moderate the impact (see drawing attachment). Do not exceed 10,000 ft-lbs (or the equivalent of a 2,000 pound weight dropped 5 feet).
- PVC is a strong, dense, thermoplastic material that becomes more brittle as the temperature decreases. Therefore, greater care must be observed when driving with impact methods in temperatures below 35 degrees Fahrenheit. That is the hammer drop should be shortened and additional care should be used to assure a uniform "hit".

SeaCure supplies concrete Drive Tips (patent pending) for 8", 10" and 12" pilings. Installation of PVC pilings with these tips will require either an impact drop hammer or a heavy (hydraulic type) vibratory hammer. In cases where the piling length exceeds 12 feet, we recommend the use of a set of "column reinforcement angles" (see drawing attachment). Fabrication of this fixture can be performed by the installer and added to his pile driving equipment.

Batter pilings are an excellent method of dock stabilization as the angled piling acts in both tension and compression in the same way as conventional cross bracing. However, batter pilings must be driven with a drive apparatus capable of shallow angle driving, such as a portable vibratory hammer or a water jet (see Design and Installation notes for portable pile drivers).

Filling PVC Piling for added strength

Recommendations for filling with concrete

By filling PVC piling with concrete from two or more feet below the flexure point or mud line, to a point just below the bolt set, the piling will nearly duplicate the strength of a monolithic concrete piling. This filling can be accomplished by driving the piling with SeaCure's Driving Tip for maximum strength (see drawing attachment). On larger jobs, the concrete tip is also the most cost effective as no evacuation of the bottom slurry or water are required. The quality of the concrete fill is also improved and will extend throughout the entire piling length without the possibility of undermining the piling. Filling should stop at a point 4" to 6" below the first bolt set.

Note: In all cases where concrete fill is used, a SeaCure catch basin should be used if you are filling over water. This basin mounts on the SeaCure stringer support tool and fits snugly to the piling (see drawing).

Note: If you chose not to use a driving tip, filling can be accomplished by driving the PVC piling to refusal and washing out/pumping out the internal mud to a point below the flexure point or mud line. Take care not to undermine the piling by washing out the mud to a point below the piling. The remaining water must be evacuated before filling with concrete. Filling with concrete should extend down two or more feet below the flexure point or mud line. All

other recommendations above apply.

Note: It is an option to fill the PVC piling with concrete prior to driving the piling in place, i.e. on shore at or near the job-site. Again, we recommend the attachment of SeaCure's's concrete tip prior to filling. Handling and transport requirements to handle the added weight should be evaluated and planned out thoroughly if you chose this option.

Recommendations for filling with sand or crusher run

By filling with a sand/clay mixture or crusher run, the piling will also be strengthened, but to a lesser degree than cured concrete. With a sand/clay or crusher run fill, it is not necessary to evacuate the internal sediment or mud. In this filling application, the fill starts at the flexure point or mud line and stops 4 to 6 inches below the first bolt set.

Note: In sleeving applications a non-hardening aggregate such as sand or crusher run is recommended to fill the interface between the SeaCure piling and the existing wood piling. This fill continues to "pack" after the application and installation with any relative movement between the original wood piling and the new PVC piling.

Note: Providing a Weep Hole:

Filling the pilings and providing a "weep" hole just above the fill line will also prevent water and moisture from building inside the piling, which can cause corrosion to the fastener system and internal pressure during a hard freeze. (See attachment III).

Piling to Stringer/Header Attachment Recommendations

SeaCure recommends that attachments to stringer, headers or any other abutment be made as shown on Attachment III.

1. Drill holes using a bit 1/16 larger than the nominal bolt size through the "stringer", the PVC cushion and the piling, (SeaCure's stringer support with a drill clamp will hold the stringer in place during the operation (see Installation Equipment).
2. Using the SeaCure "bolt insertion tool" loaded with a flat washer, a oversize rolled washer and a PVC doublers plate, made from a short section of piling stock with a predrilled hole approximately matching the installed location of the first bolt. Insert the bolt from the inside of the piling through the stringer (see Installation Equipment).
3. From the "stringer" side, place the flat washer and nut, tighten to normal torque, approximately 50 ft-lbs for 1/2 inch fasteners and 70 ft-lbs for 5/8 inch fasteners. As the fastener nut is tightened, the bolt head is slowly pulled out of the insertion tool.
4. For a two bolt arrangement, simply drill again through the assembly, repeating steps 1 through 3.

Note: SeaCure Docking does not recommend the use of "through bolting" attachment methods for stringers and headers. Under over torque or over tightened conditions the PVC piling wall may be compressed and creep allowing the fasteners to loosen.

Sleeving

Sleeving is one of the advantages offered with use of the SeaCure PVC piling system. With this system, a deteriorated piling can be "sleeved" to restore or enhance the original strength of the piling system as well as add a housing for lights, water and other amenities. It is even possible to sleeve all of the pilings on an existing dock without removing decking or underpinning. The following procedures outline the sleeving method.

1. Remove all stringer and/or header bolting from the first piling.
2. Cut the existing wood piling about six inches below the lowest fastener hole.
3. Place the SeaCure PVC piling over the existing piling "stub" and drive or jet to depth.
4. Make all abutment attachments per Attachment III before proceeding to the next piling. If two or more teams are working on the dock, maintain at least three piling sets between teams.
5. After all of the pilings have been sleeved, fill the interface with a non hardening aggregate such as sand/clay or crusher run, a driveway material, to a point 4 to 6 inches below the first bolt.
6. After the aggregate has vibrated down to a stable point, drill a 1/4 inch hole about 3 inches above

the top of the aggregate level . (See Attachment III).

Note: Before selection of the PVC piling diameter to be used for sleeving, the installation contractor must verify the butt diameter of the wood pilings to be sleeved. Measuring the wood pilings at the dock level is not sufficient to determine the butt diameter. Without a verifiable measurement of the butt diameter, driving a test PVC pile is the best method to verify clearance between the PVC piling I.D. and the wood piling butt O.D.

Spar or Anchor Pilings

Anchor pilings that stand alone to moor a vessel, should in all cases be driven well below the flexure point (mud line) and concrete filled as defined above under [filling](#). It is recommended that the concrete drive tip be used when driving these pilings.

Load Bearing Pilings

Pilings used to support loads such as boat houses and boat lifts should be filled as detailed in the above [filling](#) section. For sever loading, i.e. 5000# or greater, a drive tip should be used. If the concrete fill is added by the evacuation method described above, a minimum of three - ¼ inch dia. X 3 inch long stainless steel fasteners should be driven into the wall of the piling in the area that will be concrete filled (see drawing). For ease of installation, the fasteners should be added prior to driving. The addition of these fasteners will prevent any relative movement between the concrete fill and the piling.

Day Markers

The light weight, highly visible light color, the ease of driving and if required, removal, slip on marker installation and the low modulus of elasticity that allows the piling to bend if hit by a boat, makes the SeaCure pilings a natural for both private and governmental Day (Channel) Markers. The pilings can be handled and driven by one man, with either a small impact hammer or a vibratory hammer. The piling can then be capped with a prefabricated assembled marker mounted on a belled or flared extension piece (see drawing). Due to the light weight of the pilings and markers, all work can be accomplished from a small trailer-able work boat.

Design and Installation Notes:


1. Portable Pile Drivers;









SeaCure PVC Pilings can be driven with light weight pile driving hammers. Both impact and vibratory hammers, with optional water flush, are available. SeaCure Docking Systems, Inc. can supply the hammers or assist in supplying information on obtaining them from other commercial sources.

2. Design tables for SeaCure PVC pilings;


- a. [Attachment I](#) – Deflection Versus Loading Calculations - Unfilled and Filled
- b. [Attachment II](#) - Total Force Required to Produce 1" Deflection
- c. [Attachment III](#) – Stinger/Header Abutment Attachment to PVC Piling.
- d. [Attachment IV](#)- PVC Piling Stock Physical Properties.

SeaCure™ Docking Systems, Inc.
List of Installation Equipment Products and Part Numbers


	Item	Description	SDS Part Number	Detail
a.	<u>Stringer and Header Installation Fixture</u>			
	Fits			
	8", 10", 12"	Stringer to Piling Tool	22002	 photo
	Pilings			description

b.	<u>Bolt insertion tool</u>					photo
	Fits 8", 10", 12" Pilings	Wrench W/Extension	22001			description
c.	<u>Cut-off Tool for 8" PVC Piling</u>					photo
	Fits 8" Pilings Only	Slotted Guide W/Hinge	22000			description
d.	<u>Wrap-Around Cut-off Tool for 10" and 12" PVC Piling</u>					photo
	Fits 10" & 12 " Pilings	Commercial Flat Belt	N/A			description
e.	<u>Concrete Drive Tips</u>					photo
	8" 10" 12"	Formed W/PVC Strip	22006 22007 22008			description
f.	<u>Steel Drive Cap</u>					photo
	Fits 8", & 10" Pilings	Reusable drive cap	22005			description

SeaCure™ Installation Equipment Product Detail

- a. **Stringer and Header Installation Fixture** 
- After the pilings have been installed and cut to the proper height, stringer supports are hung from the top of the pilings and clamped with an “over center” chain binder (see drawing). Three clamps are used to support sixteen foot stringers or use two clamps to support the headers. The stringers or headers are simply laid in the “trough” of the clamp and a drill adapter holds the stringer tightly against the cushion which in turn is held against the piling for drilling (see photos). After drilling through this assembly, bolts with specially formed washers are inserted from the inside of the piling, through the stringers, and tightened against the stringer. The bolts are placed inside the piling with a locking wrench on a four foot long extension handle. (see **Bolt Insertion Tool** below for details). When installed properly, this results in an unblemished piling exterior surface .

Note: SeaCure Docking does not recommend the use of “through bolting” attachment methods for stringers and headers. Under over torque or over tightened conditions the PVC piling wall may be compressed and creep allowing the fasteners to loosen.

- b. **Bolt Insertion Tool** 
- This long handled wrench closes around the hex bolt and firmly supports the bolt, washer set and doubler plates as the installer inserts the assembly through the piling, abutment cushion and stringer(s) and/or headers. As the installer tightens the

fastener nut the bolt head is pulled out of the wrench jaw and the extension tool is removed (see drawing attachment).

c. **Cut-off Tool for 8" PVC Piling** 

A manufactured slotted guide, which is hinged, clamps around an 8 inch SeaCure PVC piling and is used in conjunction with a "Saw-All" and 12" blade to assure smooth, level cuts (see photo).

d. **Wrap-Around Cut-off Tool for 10" and 12" PVC Piling** 

A commercially available "flat belt" that is used to mark a straight cut-off line in larger diameter pipe is available commercially from local hardware stores to assure a straight level cut line on our 10" and 12" PVC pilings.

e. **Concrete Drive Tips** 

The SeaCure glue able, concrete drive tips provide the answer to a piling that can be manually transported, driven by conventional methods and filled with concrete up to the bolt line, or if installed as an anchor piling, completely filled with concrete. Since the cap displaces the mud and water, no purging or pumping is required before filling. Stringer/header connections are made above the concrete level and the piling extension can be used for all the utility connections detailed above. These tips can be field attached to 8, 10, or 12 inch pilings. Drive tips are recommended for PVC piling applications where the design requires the piling to be filled with concrete.

f. **Steel Drive Cap** 

This circular steel pipe and cap fabrication is designed to fit in and around the circumference of a PVC piling during installation with portable impact driving equipment. See attached drawing for details.