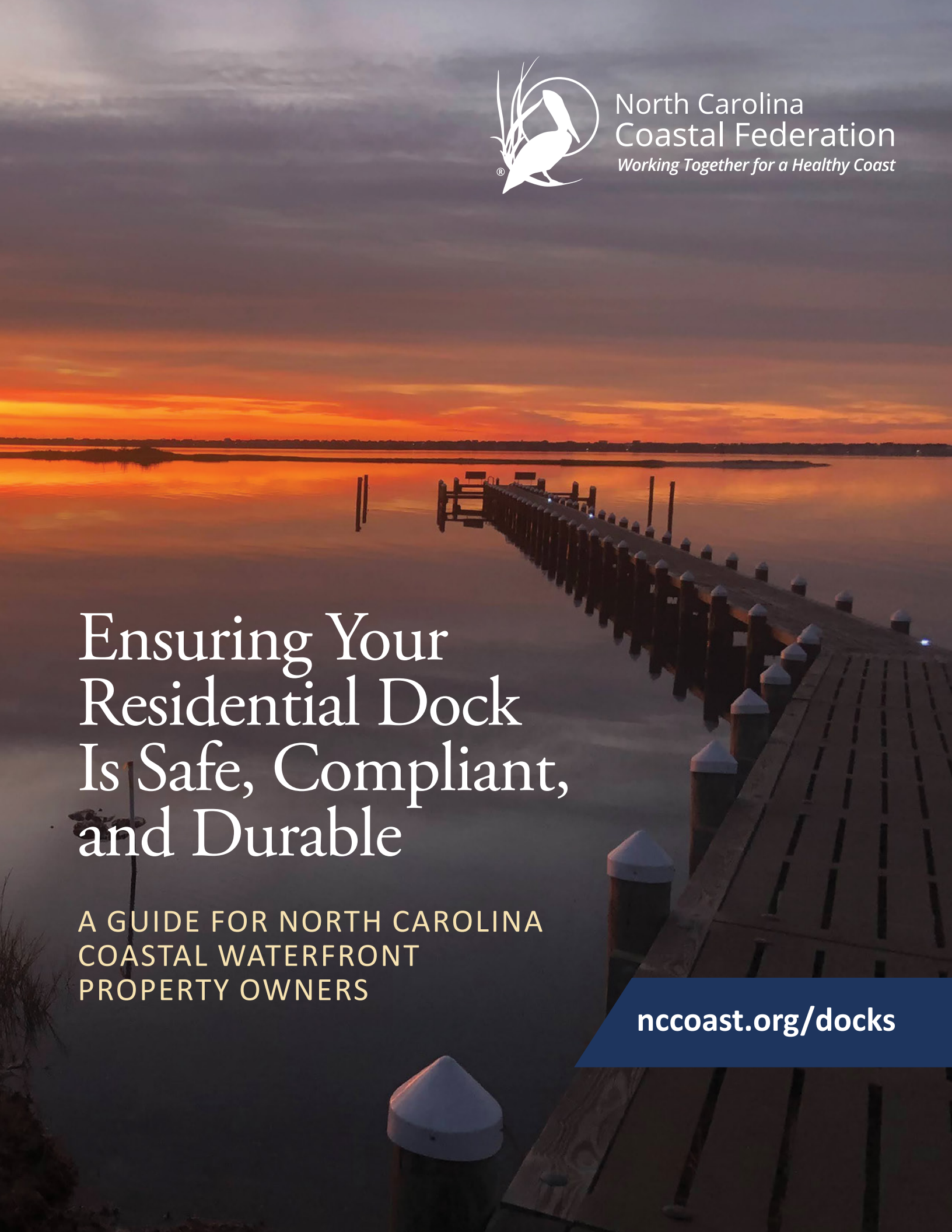


North Carolina
Coastal Federation
Working Together for a Healthy Coast

Ensuring Your Residential Dock Is Safe, Compliant, and Durable

A GUIDE FOR NORTH CAROLINA COASTAL WATERFRONT PROPERTY OWNERS

nccoast.org/docks

What does a resilient dock look like?

As a coastal waterfront property owner, ensuring your dock is safe, compliant, and durable is crucial.

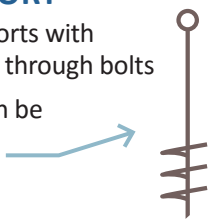
This guide will help you understand why and how to build a residential dock designed and built to meet the North Carolina Building Code.

PILINGS

- Pilings driven, not jetted in
- Ensure that ~ 1/3 of a piling is driven below grade

STRUCTURAL SUPPORT

- Attach structural supports with galvanized/hot dipped through bolts
- Structural supports can be tied to Helix anchors before a storm

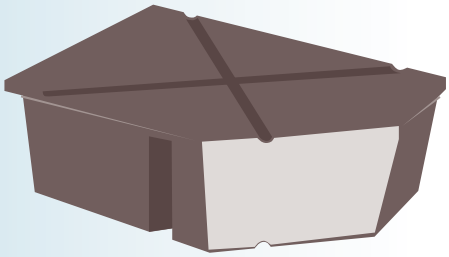


DECKING

- Flow-through/slatted decking allows waves and water to easily flow through the structure and keep boards in place
- If using wood, make sure it is treated, and is washed regularly
- Increase deck spacing to minimize "lift" during storm events

FASTENERS

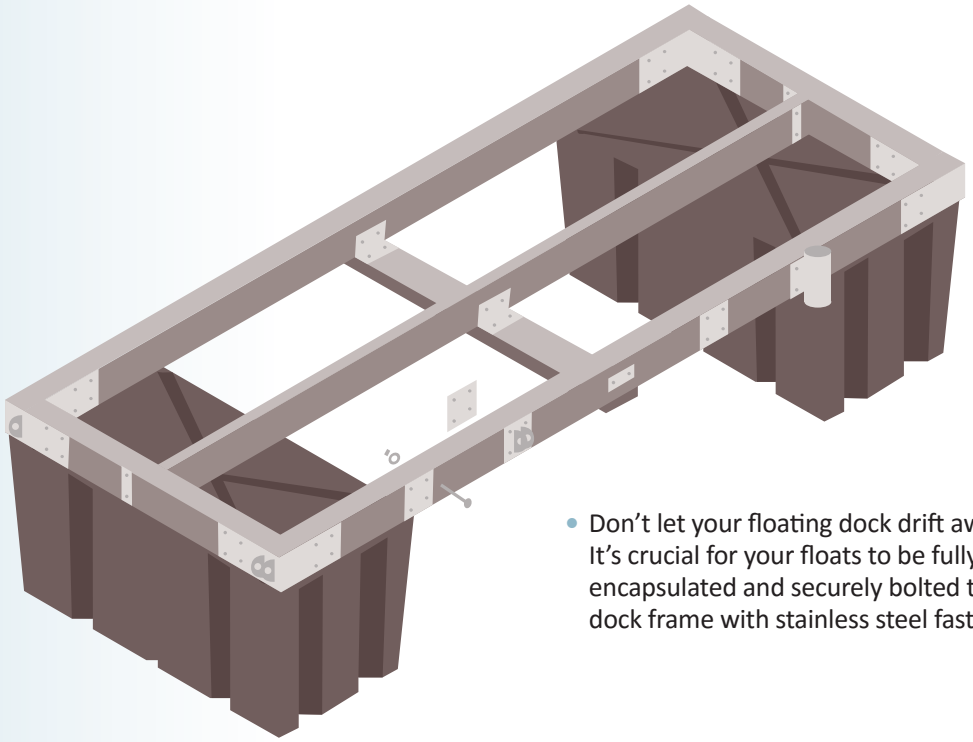
- Stainless steel screws, not nails to secure decking



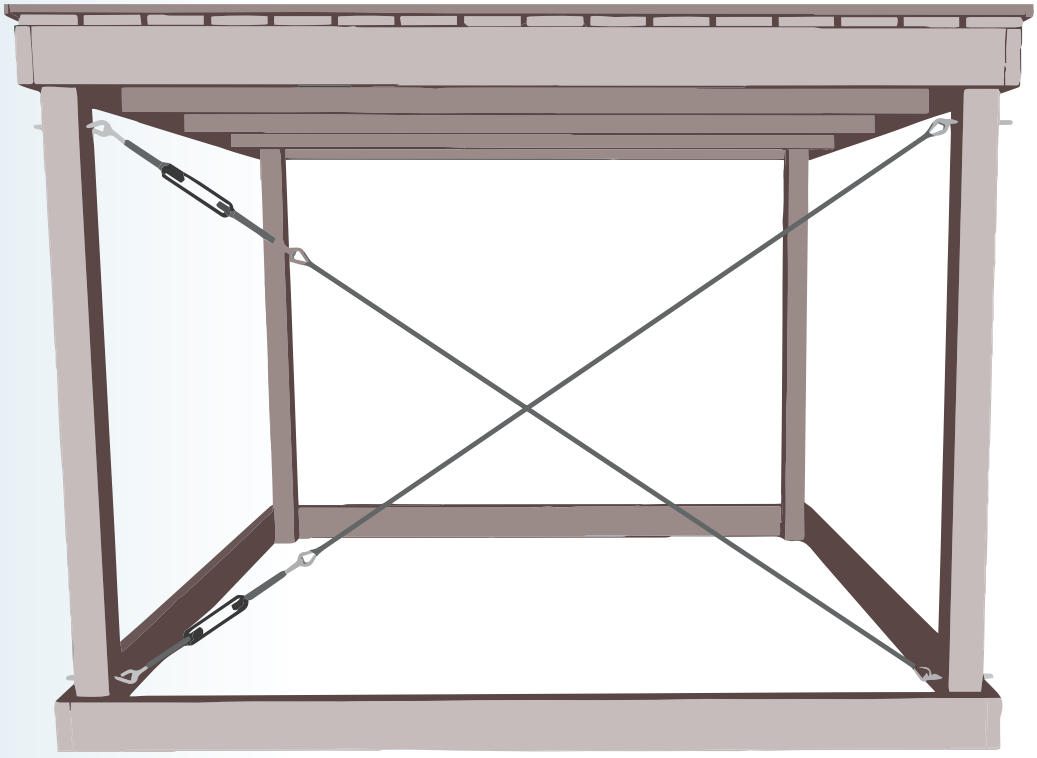
FLOATS

- Foam inside floating structures should be fully encapsulated

To ensure the appropriate design, location, and construction of your dock or pier, it's important to identify the needs and conditions of your soundside property and select a licensed, reputable marine contractor with adequate experience, expertise, and a commitment to quality and responsible construction techniques.



- Don’t let your floating dock drift away! It’s crucial for your floats to be fully encapsulated and securely bolted to the dock frame with stainless steel fasteners.



- Depending on your wave energy, cross ties can significantly increase the resiliency of your structure. Structural supports can also be tied to helix anchors before storm events for extra durability.

Why Compliance Matters

The Importance of Compliance with the North Carolina Building Code for Residential Docks and Piers

Owning a waterfront property comes with unique responsibilities, especially when it comes to structures like docks. Ensuring your dock meets the North Carolina building code is essential for several reasons:

Safety	Properly constructed docks reduce the risk of accidents.
Durability	Compliance ensures your dock can withstand harsh weather conditions, including hurricanes.
Legal	Adhering to state regulations helps you avoid fines and legal issues.
Property Value	A compliant dock maintains and enhances your property value. Because docks generally cannot be insured against damage and loss, building a durable dock is your best protection against major financial losses caused by storms.
Financial	A well-built dock saves you money in the long run. Our cost-benefit analysis suggests a 75% savings over time. This amounts to over $100,000 in savings over 35 years!
Environmental	A resilient dock prevents thousands of pounds of lumber, metal, foam and other materials from being dislodged and becoming marine debris during storm events.

UNDERSTANDING THE
North Carolina Building Code

What is the North Carolina Building Code?

The **North Carolina Building Code** sets the standards for construction to ensure safety and resilience. For residential docks, this includes specifications on setting pilings, materials, design, construction practices, and environmental considerations. Key aspects include:

- **Structural Integrity:** Ensuring the dock can withstand load and environmental stress, including uplifting from floods.
- **Material Standards:** Using approved, weather-resistant materials.
- **Construction Practices:** Following best practices for installation.
- **Environmental Impact:** Minimizing ecological disruption during construction.

Thanks to funding provided by the N.C. General Assembly and NOAA's Marine Debris Program, and the tireless work of our debris removal crews, over 4 million pounds of marine debris have been removed from North Carolina's coastal waters since 2019.

Over 85% of this debris is the result of damaged and/or lost docks, piers, boat houses, and similar structures.

Many examples of damaged and/or lost structures are the direct result of substandard marine construction techniques, including lack of expertise/experience, substandard materials, and cutting corners on both construction methods and materials.

Short-lived dock construction methods threaten the health and beauty of our fragile coastal habitats. Impacts can be prevented by incorporating more resilient building practices into marine construction.

STEPS TO

Ensure Your Dock Is Code Compliant

Property owners and professionals need to consider a number of site-specific factors when determining marine construction needs. Overall, it is important to understand the use needs, specific site conditions, history of wave energy and weather conditions, and the qualifications of the marine professional.

1 Hire an Engineer to Work with Your Marine Contractor

- Verify the credentials and references of both the engineer and contractor to ensure expertise and reliability.
- Confirm the engineer and marine contractor have a strong working relationship to support effective implementation.

2 Approve Design

- Ensure the dock design complies with the North Carolina Building Code, including 2022 updates for residential docks and piers and verify compliance with severe weather resistance standards (NC Residential Code Section R327).
- Ensure the design meets state siting and environmental regulations under the Coastal Area Management Act (CAMA), including limitations on dock size, placement, and ecological impact.
- Confirm the engineer coordinates with local code officials for proper design review and approval.

3 Select Materials

- Specify materials that meet or exceed applicable code requirements for durability and weather resistance.
- Verify that all selected materials are appropriate for use in marine environments, with proven performance in saltwater exposure and high-humidity settings.

4 Monitor the Construction

- Make sure your engineer regularly inspects construction to ensure compliance with approved designs.
- Ask for records to document these inspections and any deviations from design requirements.

5 Complete the Final Inspection and Obtain Certification

- Obtain a copy of the final inspection from local authorities to certify compliance.
- Keep records of all permits, inspections, and approvals.

Purchasing a property with a dock already in place?

Get it inspected by a licensed marine contractor or engineer.

TIPS FOR

Choosing the Right Engineer and Marine Contractor

1 Conduct Research and Request Referrals

- Ask for recommendations from other waterfront property owners.
- Research online reviews and ratings.

2 Interview Multiple Contractors

- Get multiple quotes and compare.
- Ask about their experience with similar projects.

3 Check Licensing and Insurance

- Verify their licenses with the North Carolina Licensing Board. All engineers must be licensed, and any marine contractor that undertakes a job that costs more than $40,000 should also be licensed.
- Ensure they have adequate insurance coverage.

4 Review Past Work

- Visit completed projects to assess quality.
- Speak with past clients about their experiences.

5 Expect Clear Contract Terms

- Ensure the contract specifies compliance with the North Carolina building code.
- Include detailed timelines, costs, and warranties.

The resilience of marine construction results from both the materials selected and the methods of construction. The following pages include recommendations for consideration in more resilient marine construction, with the goal of reducing marine debris and increasing the longevity of residential docks and piers.

MATERIAL CHOICE

Flow-Through/Open-Slatted Decking

Materials

Flow-through/open slatted decking involves composite or heavy rubber-coated flow-through decking, which is sold in varying sizes of decking modules.

Composite docks are made of durable dock surface materials. In both freshwater and saltwater environments, these polyethylene docks will not rot or splinter like wooden docks.

Design and Construction Methods

Open-slatted or other open designs that allows water to easily flow through during storm events, preventing boards from popping off due to high wave energy.

Upkeep

There is minimal upkeep compared to wooden or aluminum docking options.

Warranties for composite docks average about 50 years under normal conditions.

Benefits

Allows for water to easily flow through, potentially reducing the pressure and potential failure of the structure during periods of extreme storm surges and waves associated with coastal storms and hurricanes.

The open structure allows for significant light penetration below the deck, preserving marsh and coastal plants' growth, leading to greater stabilization of the shoreline during storms.

The mobility of the relatively lightweight sections could allow for the removal of some or all of the sections prior to hurricanes, extreme storm surges, etc. If a resin or plastic dock section is damaged, it can be easily replaced.

Examples of flow-through decking at the Morris Landing Clean Water Preserve

MATERIAL CHOICE

Wooden Decking

Materials

Untreated wood is not recommended for the coastal zone because it will soon decay if it comes in direct contact with seawater. In marine applications, timber is attacked by marine borers, insects, fungus, and rot. Marine plants, algae, crustaceans, and marine worms attach to treated timber piles; however, these do not appear to harm the strength characteristics of the wood.

Typically, timber elements that are directly subject to the marine environment are pressure-treated with some infused protective treatment. Treated to withstand sea and brackish water, pressure-treated timber maintains its relative strength and lasts longer than untreated timber.

Pilings made from exotic hardwoods are highly durable and resistant to marine borers, making them a recommended option for dock construction. These commercially available materials are marketed as being more durable than treated wood in withstanding the structural demands of marine environments. An additional advantage is that, unlike chemically treated alternatives, they do not pose a risk of harmful substances leaching into surrounding waters.

Design and Construction Methods

Failed or damaged docks, piers, etc., very often use undersized support pilings/posts during construction. In areas prone to heavy storm forces, strong currents, etc. the use of larger, more substantial round pilings (i.e., 10”–12” -diameter round pilings vs. 4” x 4” square pilings) is recommended for long-term stability.

Decking screws are preferable to nails when building a deck; they hold down your decking more securely than nails and will stop your decking from warping. Also, you can easily remove screws for deck maintenance without causing damage.

Clockwise from top: Wooden docks are very popular choices all along the NC coast; Concrete hog slat docks are durable and heavy lessoning damage and displacement from storms; If not constructed carefully, wooden docks can generate immense amounts of marine debris.

Upkeep

Wooden docks in coastal environments require regular upkeep due to constant exposure to saltwater, sun, humidity, and shifting tides. Routine maintenance includes inspecting for rot, warping, or corrosion of fasteners; cleaning to remove algae and salt buildup; and reapplying protective sealants or stains to extend the wood’s lifespan. Pilings and structural components should be checked after major storms for damage or loosening. Consistent upkeep helps ensure safety, prolongs the dock’s functionality, and reduces the risk of costly repairs.

Benefits

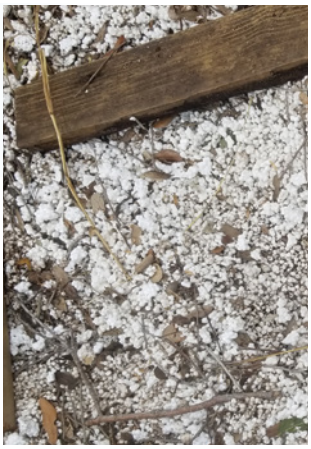
While wood isn’t as resilient or long-lasting as composite decking in harsh coastal conditions, it remains a solid, cost-effective second choice when properly maintained.

Floating Docks

Floating docks are platforms, most often made of decking placed over airtight, buoyant "float" structures that float on the water's surface and support the dock. They are also available as pre-built sections that can be attached in a variety of configurations and shapes. Floating dock structures are versatile and rise or fall with the water level, helping them adapt to nearly any condition, including extreme fluctuations in water levels (surges) during hurricanes and other coastal storms.

In addition, during severe weather or seasons in which the structure is not in use, floating docks can often be removed, stored, and put back in place when needed. This is extremely useful in hurricane- or storm-prone areas. Additionally, boats secured to fixed docks often require constant monitoring and adjustment of the securing lines (especially during more significant tide changes and/or water fluctuations during storms). Finally, because floating docks rise and fall with water levels, any critical electrical systems attached to the dock surface will not be submerged.

It's important to be sure your floating dock is properly encapsulated, as storm damage and general wear and tear can impact floating docks made from **polystyrene foam**. This foam material breaks into small beads that can spread through our waterways into our beaches, marshes, wetlands, and seafood. The good news is that it can be prevented!



Examples of polystyrene floats broken apart in NC marshes.

What is unencapsulated polystyrene?

- Traditional dock floats composed of polystyrene foam are light, inexpensive, and wrapped in filter cloth, which offers limited protection from the elements.
- This unencapsulated foam becomes brittle and breaks apart when exposed to wave energy, sunlight, and temperature fluctuations.
- Free-floating foam fragments and beads pollute critical coastal habitats like wetlands and beaches.

How do we manage polystyrene pollution?

- It is nearly impossible to remove pea-sized polystyrene beads, and the material is non-biodegradable, meaning it never goes away.
- Recycling and waste management facilities do not accept this kind of material.
- The only preventative solution for issues with pre-existing polystyrene foam is to remove larger foam fragments from waterways by hand.

Wildlife

33% of microplastics found in marine wildlife – including a number of commercially important seafood species – contain polystyrene beads.

Physical Environment

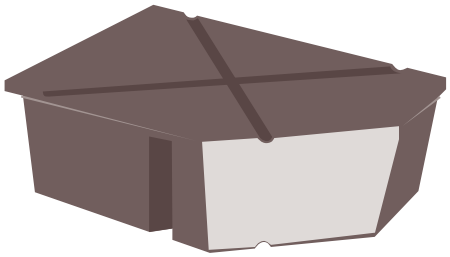
Foam debris has been found in every single debris removal location surveyed by Federation staff and crews. Most of it cannot be removed, and impacts persist.

Toxicity

Foam materials contain chemicals including benzene, styrene, and ethylene, which can pose serious health risks when leached into water.

What is encapsulated polystyrene?

- To prevent foam deterioration and pollution, a process known as encapsulation secures the floating foam material, protecting it from the elements.
- A thick polyethylene shell is thermally formed around the foam bricks, making them more resistant to impacts, impermeable to water, and a more rugged component for the floating dock system.



FLOATS
Foam inside floating structures should be fully encapsulated.

Benefits of Encapsulated Polystyrene

- ✓ **Defends against foam breakdown and pollution**
- ✓ **Lasts longer and is more durable**
- ✓ **Saves dock owners replacement and repair costs in the long run**
- ✓ **Works with multiple dock styles and materials, including concrete and wood**
- ✓ **Prevents damage to the coastal environment and wildlife**
- ✓ **Compliant with new legislation aimed to prevent pollution**

Encapsulated Polystyrene Foam

Unencapsulated Polystyrene Foam

Design Considerations

Install Breakaway Decking Panels and Increase Deck Spacing

Minimize what breaks and design where you want it to break. Often, designing breakaway panels or removing panels before a storm surge arrives can prevent more significant damage to, and/or total loss of, docks and piers.

In addition, constructing docks with increased deck spacing and/or flow-through materials can minimize damaging "lift" of the structures and damages during rising water and wave energy conditions.

Slotted decking and/or increased spacing between boards also enables more sunlight to reach shoreline and underwater vegetation. The healthier they are, the better job their roots will do protecting your shoreline.

Build to Withstand Predicted Wind Loads Based on Past Storm Forces

Build docks to withstand, at a minimum, the erosion, scour, and loads accompanying a 50-year storm event (or whatever storm event is represented at this site during the past decade). The evaluation should also include the historic tidal, current, surge, and wave energies at this site.

Increase Deck Height

In many coastal areas, adjusting deck level (for fixed docks/piers) for certain storm frequency is important. Building docks higher than expected breaking waves and storm surges/tides can reduce damage and losses of fixed docks.

Reinforce Bracing and/or Anchoring for Docks/Piers

In higher-energy and/or storm-prone coastal areas, provide additional bracing of the construction elements. This reinforcement may include modifications to girders/connections to pilings.

In addition to reinforcing construction elements, adding support anchoring is recommended to reduce damage and losses of docking structures.

Incorporate stainless tie-downs at support points and anchors to reduce lift of structure during storms. These often include stainless steel cable that goes around the entire dock structure at each support point (pylon and cross-member section that makes contact with the seafloor) that is then affixed to an anchor under the mud. This adds additional strength and reduces the likelihood of the structure becoming dislodged or "washed out" during a storm event.

Protect Connectors from Corrosion

For energy-prone areas, it is recommended to attach docking elements and supports with galvanized/hot-dipped through bolts rather than lag bolts. The use of galvanized or stainless-steel hardware, including screws, bolts, nails, plates, cross-bracing, and anchors is recommended for marine environments, but ceramic-coated is an option as well.

Helix anchors should be tied down before a storm. For floating dock structures, the use of rubber buffer pads and/or rollers are recommended to reduce the damage to the support pilings over time, adding years to the life of the structures.

Marine Pilings

When determining the best type of dock piling, you should consider the water conditions that your dock will have to withstand as well as the overall weight and load of the dock.

Pile Driving vs. Jetting

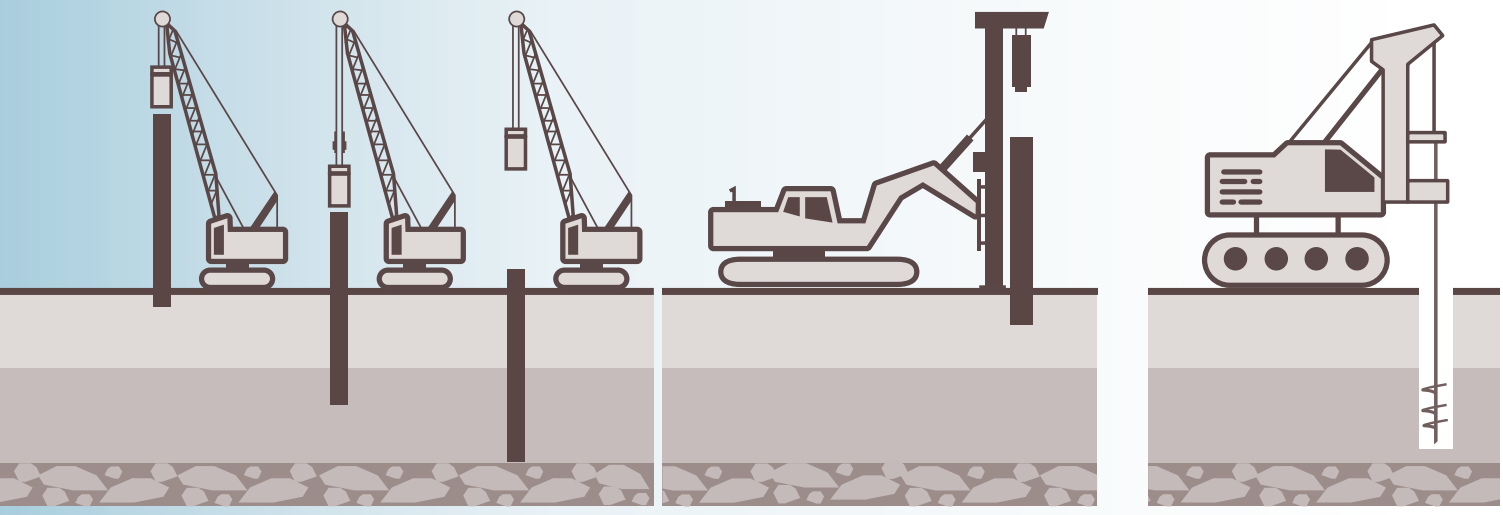
A driven pile is a relatively long, slender column that offers support or resistance to forces and is made of material with a predetermined shape and size that can be physically inspected prior to and during installation. It is installed by impact hammering, vibrating, or pushing into the earth. Driven piles maintain their shape during installation, do not bulge in soft soil conditions, and are typically not susceptible to damage from the installation of subsequent piles.

Driven piles displace and compact the soil. Other deep foundation options can require the removal of soil and considerable subsidence, which can undermine the support of adjacent structures and cause excessive deformations, both of which can result in structural problems.

"Pile jetting" is a technique that is frequently used in conjunction with, or separate from, pile-driving equipment for pile placement. Pile jetting utilizes a directed and pressurized flow of water to assist in pile placement. The application of a concentrated jet of water at the pile tip disturbs a ring of subgrade soils directly beneath it. The jetting technique liquefies the soils at the pile tip during pile placement, reducing the friction and interlocking between adjacent subgrade soil particles

Pile Driving Techniques

Drop Hammer (left), Screwing (right), and Steam (not shown)



around the water jet. This greatly decreases the bearing capacity of the soils below the pile tip, causing the pile to descend toward its final tip elevation with much less soil resistance, largely under its own weight.

When piles are 'jetted' or 'washed' in, the hole is blown out and it takes a long time for the sediment to build back up and does not fill in as well. By 'driving' or 'vibrating' the pilings, the seal is tight.

Driven piles provide a stronger foundation and are much longer-lasting than jetted piles.

Piling Heights/Depths

No standard best practice exists for piling heights and/or depths, but it is a significant consideration for the long-term stability of any pile-supported marine structure. Regardless of piling materials (e.g., wood, concrete, steel), ensuring adequate piling depths below grade is a critical component of stability, especially in areas with less cohesive soils and/or areas of high wave energy, strong currents, and frequent tidal or storm surges.

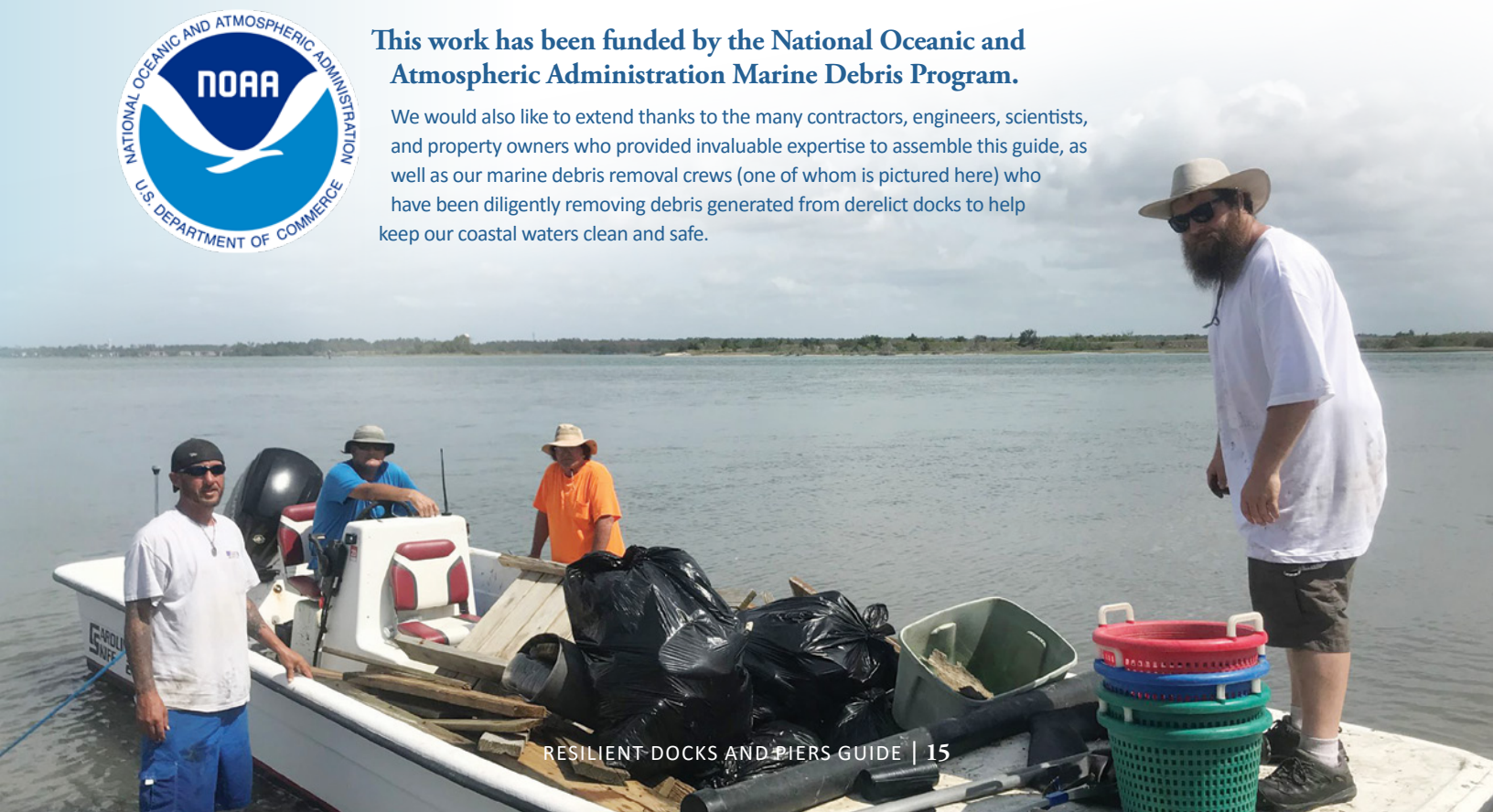
Equally important is the elevation of the pilings, which allows for a floating dock structure to rise and fall during normal tide ranges, as well as during extremely higher water levels associated with hurricanes and other coastal storms.

One general rule of thumb for "average" coastal dock construction within North Carolina is to ensure that ~ 1/3 of a piling is driven below grade (e.g., 10' below grade for a 30' piling), and ~ 10'-12' of the piling is elevated above normal mean high water, to allow for extremely high storm surges. One innovative approach involves standard height pilings with a telescoping "T" Bar option to create extended pilings during periods of higher tides and storm surge conditions.

Also be sure to use treated wood, as untreated wood will decay when in contact with seawater. It is recommended to use durable hardwood pilings, such as greenheart. Regular cleaning of your wooden dock (power washing, removing barnacles, oysters, algae, etc.) is crucial to its longevity.

This work has been funded by the National Oceanic and Atmospheric Administration Marine Debris Program.

We would also like to extend thanks to the many contractors, engineers, scientists, and property owners who provided invaluable expertise to assemble this guide, as well as our marine debris removal crews (one of whom is pictured here) who have been diligently removing debris generated from derelict docks to help keep our coastal waters clean and safe.



***NOTE:** Always consult with professionals and local authorities to ensure full compliance with all regulations and requirements.*

PROTECTING
Your Investment

Investing in a code-compliant dock is crucial for safety, durability, and peace of mind. By following the steps outlined in this brochure, you can ensure your dock is built to last, withstand severe weather, and comply with North Carolina regulations.

Visit **nccoast.org/docks** for more resources, including a full reference guide, videos, and ordinances.

For more information and assistance, please contact the North Carolina Building Code Council or your local building authority.