

SOLUTIONS



The piers at the terminal each measure 1,100 feet (340 m) and are situated 400 feet (120 m) apart; each pier is supported by roughly 1,500 untreated Douglas Fir timber piles, and concrete pedestals support a 10-inch (25 cm) reinforced concrete deck and the superstructure columns of the two-story steel-framed terminal building with roof parking deck.

The Challenge

New York City's Passenger Ship Terminal, located in New York Harbor off the Hudson River on Manhattan's West Side, encompasses docking space at Piers

88, 90 and 92 as well as exhibition space at Pier 94 and the home of the USS Intrepid at Pier 86. Originally built in the 1930s to handle cargo and to replace Chelsea Piers as the city's luxury liner terminal, the piers were renovated in 1970 and are currently undergoing another \$150 million renovation.

As water quality improved due to numerous water clean up efforts over the years, marine borer activity rose. The *Teredo* (or Shipworm), a type of mollusk, enters submerged timber pile when very small and grows rapidly inside the wood—slowly eating away at its interior leaving the pile susceptible to sudden collapse. In contrast, *limnoria* (or Gribbles) are small crustaceans which bore just under the surface of a wood timber. Once the surface layer is worn away and the damage exposed, the borer tunnels deeper into the next layer of wood, and so on.

Pile degradation due to marine borer activity has been escalating at an alarming rate over the last 15 years. Some pile diameters now exhibit an hour-glass shape above the mud line, indicative of extensive damage, and in some extreme cases, piles are left dangling from the pile cap they were originally intended to support. A second area of concern is rot decay observed

in tidal areas just below the deck, with a large area of Pier 88 at one time deemed structurally unsound and incapable of supporting any live load until repairs could be made, greatly restricting the terminal's operation.

Initial repairs to combat borer activity included installation of plastic barrier wraps, but this effort was met with limited success. The seals proved ineffective in reducing oxygen content sufficient to suffocate the borer organisms.



PROJECT:

Pier Pressure: The Rehabilitation of NYC's Passenger Ship Terminal Piers 88 & 90

OWNER: Turner Construction Company

YEAR: 2013-present

The Five Star® Solution

In 2012, the New York City Economic Development Corporation awarded the contract for rehabilitation of Piers 88 and 90 to Reicon Group, LLC. Project engineers initiated an extensive two-part testing program to examine if alternative methods – namely, epoxy products – could remediate this pressing problem and satisfy both protective and structural repair requirements in a cost-effective manner.

Engineers determined that a pumped epoxy-fiberglass jacket option would best meet their requirements as they would provide a hard-shell barrier protecting the wood against intrusion of marine organisms with an indefinite lifespan and almost maintenance-free protection. **Five Star's PileForm™ F fiberglass reinforced plastic (FRP) pile rehabilitation jackets were specified due to their ability to perform in hostile marine environments, with benefits that included easy installation and ease of pumping of the Five Star® Pile Jacket Epoxy Grout LPL.**

Phase One of the project began in June 2012, and comprised repair and re-encapsulation of 190 single piles. Five Star Products quickly formed a team to tackle the intricacies of the job. Although no special formulation was required for the Pile Jacket Epoxy Grout LPL, the grout did have to be pumped over distances in excess of 150 linear feet – and for one hard-to-reach area, 200 feet of hose were needed.

Teams worked on 10 or 12 piles at a time. "We would cut them out, fabricate them, make the repair pieces on deck, then go back down and fill them," recalls Paul Boudreau, Supervisor at Reicon Group. "There were four or five steps to complete each pile."

Five Star Products provided technical support at every stage of the job – from bidding through design and throughout installation. "Whenever we had a question, I'd call," says Paul. "The project engineer was in touch with Five Star Products quite often in the beginning, and technicians were on site several times over the course of the job." The main challenge for the crew was familiarizing themselves with how to mix the product and then pump it over long distances. "Once we cracked the code, there was no problem!" Paul states.

"The project went exceptionally smoothly – a calm, casual job," claims Paul. Phase One was completed in fall 2013, but the project is far from done. "This is ongoing," explains Paul. "There are thousands of piles down there, and as they are specified by inspectors as needing rehabilitation, we put the next phase out to bid." He adds, "We like the Five Star product and look forward to being able to work with Five Star Products again on future phases of the project."



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Specified by the World's Best™

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PRODUCT SOLUTIONS

Long Pot Life Underwater Epoxy Grout System

PILE JACKET EPOXY GROUT LPL

Five Star® Pile Jacket Epoxy Grout LPL is a three-component, 100% solids epoxy system specifically designed for underwater grouting and marine pile encapsulation where a longer pot life system is required. Five Star® Pile Jacket Epoxy Grout LPL is a low viscosity resin and hardener system which is mixed with aggregate to encapsulate concrete, timber, or steel pilings in hostile marine environments.

USES

- Marine Pile repair and restoration when used with Five Star® PileForm™ F Fiberglass Jackets
- Engineered epoxy grouting system offers corrosion protection for concrete, steel and wood marine piles
- Excellent adhesion to masonry, concrete, wood, steel and most marine structural materials

ADVANTAGES

- Pumpable and Pourable, with Adjustable Aggregate
- High Strength jacket fill material
- 100% Solids, No Solvents
- Long Pot Life for Hot Weather Placement
- Low Odor Formulation

FIVE STAR® SERVICES

- Design-A-Spec™ engineering specification assistance
- Technical on-call center with field and project experienced staff
- Field support representatives for on-site consultation
- Corporate research laboratory available to customize products for unique applications

Fiberglass Reinforced Plastic (FRP) Pile Jackets

PILEFORM™ F PILE REHABILITATION JACKETS

Five Star® PileForm™ F fiberglass reinforced plastic (FRP) Pile Rehabilitation Jackets meet and exceed marine engineering specifications for use in hostile marine environments where exposure to ice, floating debris, chemical pollution, oils, acids, salt water and where tidal action may occur. Jackets are available in translucent or may be gel coated to any specified color.

USES

- Used around timber, steel or concrete piles
- Available in permanent and reusable varieties that can be assembled topside or in the water.

ADVANTAGES

- Easy installation
- Lightweight for easy maneuvering by divers
- Non-corrosive
- High strength
- Excellent solvent and chemical resistance
- High abrasion and impact resistance

For worldwide availability, additional product information and technical support, contact your local Five Star® distributor, local sales representative, or you may call the Five Star Products' Engineering and Technical Service Center at +1-203-336-7900.

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