

Marine News

MAY 2017

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Inland Waterways

*Improving Both
Infrastructure and Safety*

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NEW APPROACHES TO INLAND INFRASTRUCTURE RENEWAL

Economical repairs are being applied to rapidly corroding steel and concrete structures in U.S. ports and inland waterways. The new repair systems – PileMedic & SPiRe – might just be what the doctor ordered.

Recent advancements in using Fiber Reinforced Polymer (FRP) for major structural repair and strengthening of submerged marine piles made of concrete or even timber has led to an economical, less invasive infrastructure repair solution for inland port development compared to current systems. This new composite-based system, called the SPiRe (Sheet Pile Repair) system, is a new way of repairing and improving port-facing structures in the nation's inland waterways. A sometimes forgotten area of the nation's infrastructure, immediate improvements are needed where commercial maritime cargo transportation in critical corridors such as Mississippi River System and the inland and intercoastal waterways of the eastern U.S. are being threatened by a crumbling and corroding port infrastructure.

PORTS QUICKLY REACHING END OF SERVICE LIFE

Many of these inland waterways and ports were constructed decades ago, and their designated service life is reaching an end. The combination of ocean spray, unexpected inland floods, and dry/wet cycles caused by wakes, waves and tidal action often result in rapid corrosion of steel reinforcement in concrete structures. Examples of inland port structures typically using this construction include steel piles, seawalls and sheet piles. Ports using this infrastructure are rapidly corroding and require repair and strengthening.

Repair using conventional materials and techniques such as concrete is time-consuming, typically requires extensive use of commercial divers, and can quickly become expen-

A new engineered repair system for seawalls is based on fiber reinforced polymer (FRP) technology that has been used for several years to repair and strengthen worn and damaged marine piles made of timber or concrete using specialized composites. Pictured here are worn bridge piles being wrapped with FRP laminates in St. Louis, MO.



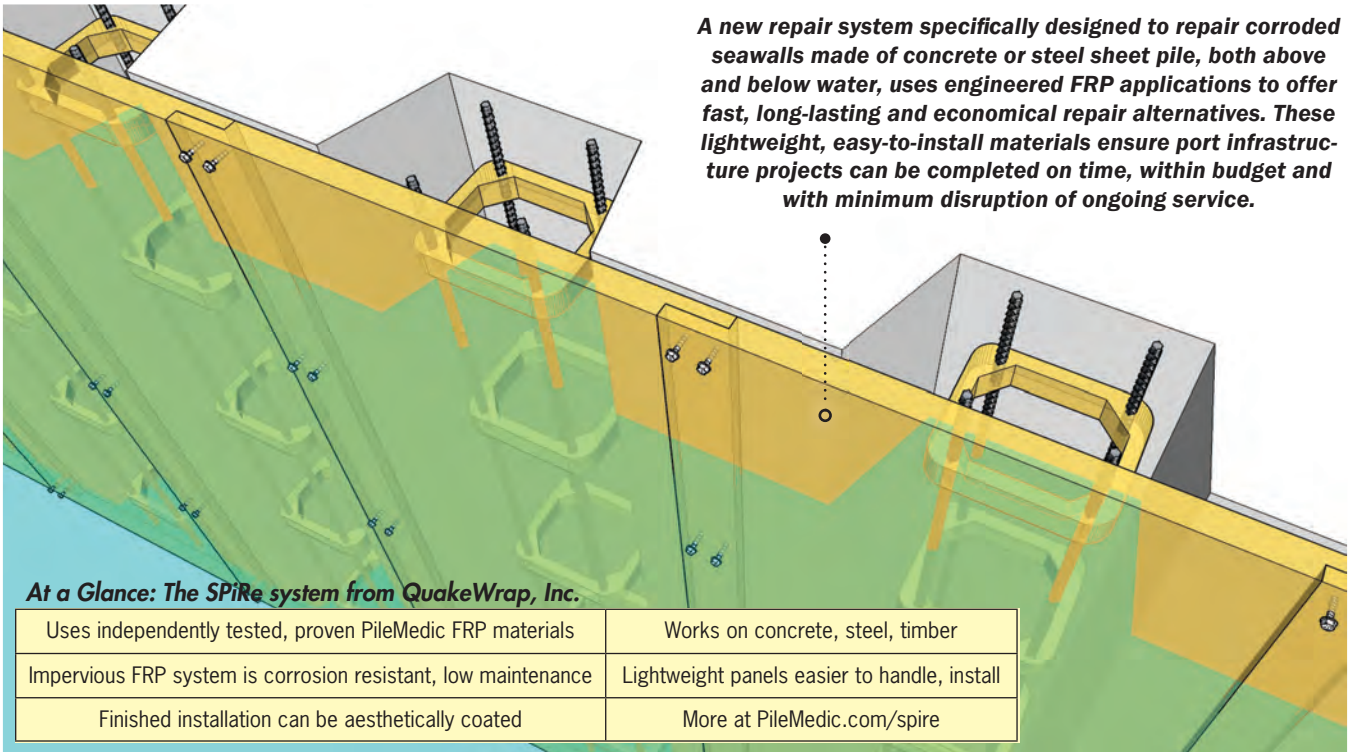
sive. These repairs also are not a long-term solution, as repairing or adding new concrete or steel to a structure will immediately begin to corrode again – just like the original structure.

CORROSION-RESISTANT SOLUTION

SPiRe is an engineered repair system that's based on FRP technology that has been used for several years to repair and strengthen worn and damaged marine piles made of timber or concrete using specialized FRP com-

posites. The system is now specifically designed to repair corroded seawalls made of concrete or steel sheet pile, both above and below water.

Repairing these structures using engineered FRP applications offer fast, long-lasting and economical repair alternatives for organizations charged with the maintenance of ports. These lightweight, easy-to-install materials ensure port infrastructure projects can be completed on time, within budget and with minimum disruption of ongoing service.



A new repair system specifically designed to repair corroded seawalls made of concrete or steel sheet pile, both above and below water, uses engineered FRP applications to offer fast, long-lasting and economical repair alternatives. These lightweight, easy-to-install materials ensure port infrastructure projects can be completed on time, within budget and with minimum disruption of ongoing service.

At a Glance: The SPiRe system from QuakeWrap, Inc.

Uses independently tested, proven PileMedic FRP materials	Works on concrete, steel, timber
Impervious FRP system is corrosion resistant, low maintenance	Lightweight panels easier to handle, install
Finished installation can be aesthetically coated	More at PileMedic.com/spire

SPiRe is a patented system provides added strength in addition to an impervious barrier that keeps water and oxygen away from the original structure material. By eliminating the inflow of oxygen, the corrosion rate reaches near zero levels.

This effective solution uses customized, engineered FRP panels made of lightweight honeycomb 3D fabric layered between sheets of resin-saturated carbon or glass fabric. These panels are designed to match the shape of the steel sheet pile or concrete seawall being repaired, and also by design are impervious to water, forming a barrier in front of the original wall that keeps oxygen – and thus further corrosion – away. The type of fabric (glass or carbon) and the orientation of the fibers within the fabric layers are calculated by the design engineer, and is based on the project load requirements.

The SPiRe repair system is engineered to be installed directly on submerged sheet piles without the use of coffer dams or other heavy equipment. Panels are typically four feet wide and as long as necessary. Multiple panels can be joined together either above water (prior to installation) or under water during the installation process.

INLAND INFRASTRUCTURE RENEWAL: ADVANTAGE SPIRE

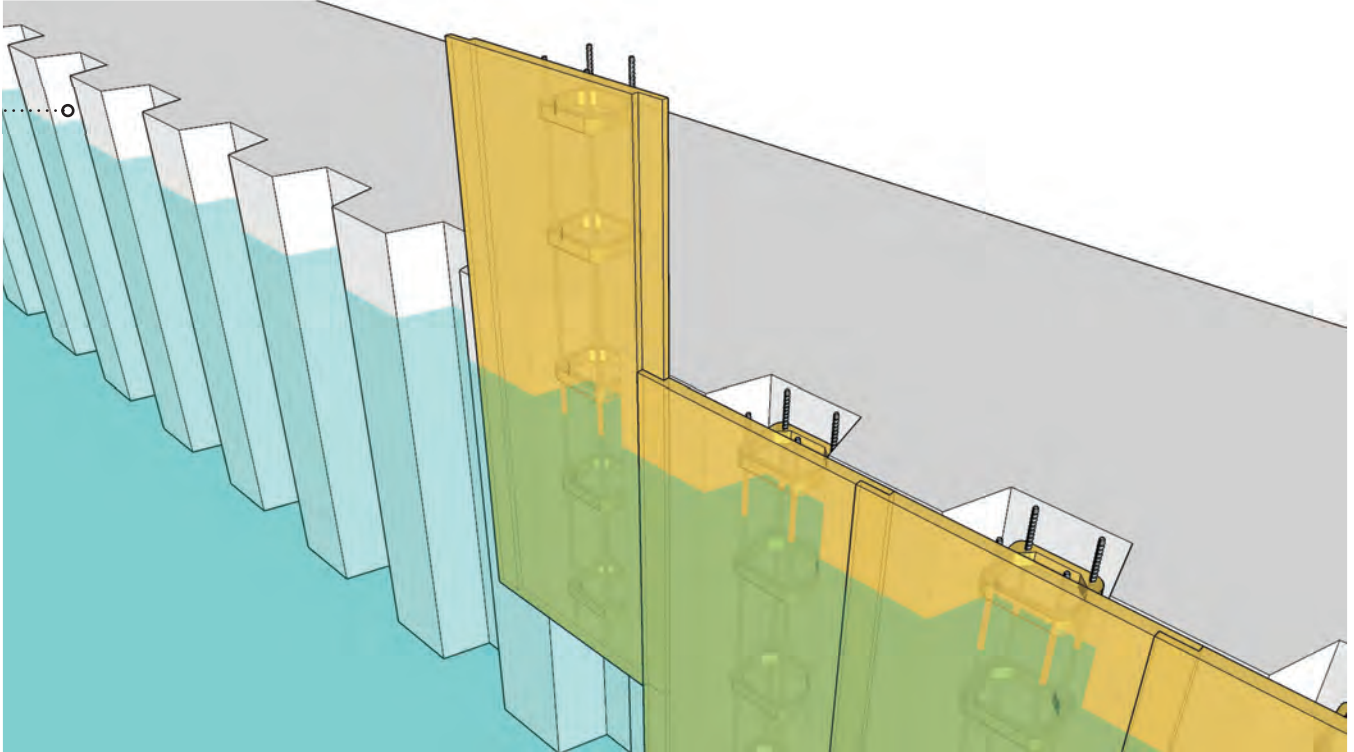
SPiRe repairs and restores sheet piles and sea walls in depths of up to 50 feet. This more than covers most average mean navigation depths for inland and intercoastal ports. SPiRe is an engineered solution that improves

structural integrity using fiber reinforced polymer (FRP) technology. It can be engineered to almost any thickness and strength, as required by the original structure. FRP marine pile and sheet pile repair systems can be engineered to handle any kind of large debris the structure or structures may regularly encounter due to floods or tidal surges, as requested by the contracting organization. Some of the repair and strengthening projects in the marine and waterfront space that can benefit from professionally engineered FRP solutions include:

- *Repair of corroded seawalls and steel sheet piles;*
- *Reinforcing barriers between industrial surface water bodies and sensitive open waters;*
- *Fast and economical repair of the underside of concrete floors and beams in decks and piers damaged by corrosion; and*
- *Strengthening of concrete or timber floors and beams in decks and piers to carry heavier loads.*

The FRP materials used in the SPiRe system are the same used in the PileMedic by QuakeWrap system, which has a solid track record of successful underwater pile repair and strengthening. An article describing how this system was first used for underwater surface structural repair can be found at: <http://pilemedic.com/pdfs/PileMedic-Underwater-Repair-in-Miami-Building.pdf>.

In most cases, QuakeWrap engineers can provide a com-



plete “turnkey” design-build sheet pile or seawall repair solution that includes sealed engineering drawings by experienced, in-house engineers, needed materials, and installation by one of our approved certified installers. This unique design-build approach results in significant efficiency, time and cost-savings, and minimizes the potential errors and delays that can result when multiple groups are involved in one project. In a nutshell, the patented technology can result in stronger, corrosion-resistant structures that represent significant cost savings in the repair of inland port facilities and waterways.



Mo Ehsani, Ph.D., P.E., S.E., is founder and president of QuakeWrap, Inc., developer of the SPiRe seawall repair system and its sister product, PileMedic by QuakeWrap, for repair of marine piles. He is a Professor Emeritus of Structural Engineering at the University of Arizona.