

# Outstanding Shotcrete Project Award Winner

2008 Outstanding Repair & Rehabilitation Project

## Manchester Terminals, LLC, Dock Rehabilitation



*Finished product*

In the summer of 2006, our company was presented the challenge of restoring the largest independently-owned shipping terminal in Houston, TX, to its original state. Built in 1926, Manchester Terminals had seen its share of spot repairs. This hurricane-rated concrete facility, however, never had full-scale rehabilitation. At first sight, this project seemed to be an impossible task. The 1500 ft (457 m) international shipping facility showed significant damage and deterioration to over 90% of its existing concrete supports. Entire columns were missing in some areas, and

the entire concrete dock system was in danger of crumbling. During the site inspection of this project, company officials noted that it was the most extensive and challenging rehabilitation project our experts had ever seen.

Early discussions of the project with engineering staff included plans for accomplishing the repairs while keeping the facility in full service. Initially, it was believed that this project could only be accomplished by hand-patching and form-and-pour operations. The engineers, however, were willing to explore the idea of shotcrete as an alternative method if cost savings could be realized and accepted by the owner. Discussions then began focusing on the ability of shotcrete to be placed on nearly any surface and at any angle with little to no formwork needed. The engineers were also sold on the compressive strengths and past performance of shotcrete. Test reports from previous projects allowed our company to show data-backed examples of shotcrete testing at much higher strengths than required. Of additional importance was the ability of our company to maintain such a small work area to accommodate ongoing shipping operations at the facility. After discussions with both the owner and engineer, shotcrete was the overwhelming choice. Contracts were then issued and the project was underway.

Dry-process shotcrete was used for the project. Our staff set lofty goals beginning at Station 0000 with plans to work continuously to Station 1500 and complete the over 20,000 ft<sup>2</sup> (1858 m<sup>2</sup>) project



*Typical damage due to environmental effects on concrete*

# Outstanding Shotcrete Project Award Winner

in less than 180 days. Work began on the meticulous removal of deteriorated concrete to sound concrete with special care given, ensuring that the demolished waste was not introduced back into the Houston Ship Channel. The owner quickly came to appreciate the small footprint that our operations consumed and pointed out that, contrary to initial concerns, no disruptions in service were seen as a result of our project.

Our company was faced with an additional challenge shortly after beginning the shotcrete operations. A loaded ship struck the dock, causing significant damage. The damage could have shut down that portion of the dock, significantly limiting the owner's ability to meet the demands of signed contracts for ships en route to the facility.

The flexibility of shotcrete allowed us to immediately mobilize our operations to the newly-damaged site. Within a matter of weeks, we were able to repair and reopen the damaged area. In contrast, it was estimated that form-and-pour repairs would have taken significantly longer and forced both the previous work area and the emergency repair area to stay closed to ship traffic throughout the process. It was at this point that the owner truly came to appreciate the value of shotcrete. The owners embarked on a full-scale rehabilitation of the entire dock system, adding an estimated 21,000 ft<sup>2</sup> (1951 m<sup>2</sup>). The total dock rehabilitation included the repair of all support columns and beams, as well as a large number of spall repairs to the underside of the deck floor. Additionally, the owner opted to install a state-of-the-art fender system to help prevent future damage.

All loose and unsound concrete was removed by pneumatic chipping and steel reinforcement. Surface preparation was accomplished by concrete. A corrosion inhibitor was applied to the reinforcing steel prior to the application of shotcrete. A minimum 2 in. (50 mm) clearance was used throughout the process to ensure proper encasement of the steel.

As one can imagine, with the booming chemical, gas, and oil refining operations in the Houston area, care needed to be given to provide a consistently solid material that could resist the natural effects of salt water and chemical attack common in this region. In response to this challenge, our company chose to use a prepackaged fiber-reinforced, silica-fume enhanced, structural dry-process shotcrete mixture. In doing so, we were able to ensure that no contaminants were introduced during the batching process as a result



*B & A Contractors, Inc., uses a bolted rubber bumper system to protect Manchester Terminals dock system from future damage resulting from ship strikes*



*Typical state of the dock system prior to repairs*



*Typical damage to Manchester Terminals prior to shotcrete application*

# Outstanding Shotcrete Project Award Winner



*Damage as seen in over 90% of support columns prior to repair*



*Using pneumatic tools, deteriorated concrete was removed, allowing for shotcrete repairs*



*Using one-sided form technology, damaged support members were rehabilitated to their original state after being struck by ships*

of other environmental unknowns. This material was of great interest to this project due to our past experience with the product and its high bond strength, low permeability, and excellent resistance to freeze-and-thawing cycling and salt scaling. This project also called for a high compressive strength due to the large ships, which have a tendency to “bump” the docks. In response, our material choice proved to have an average 28-day compressive strength of over 7000 psi (48 MPa), which far surpassed other application methods and materials explored. Once application was completed, the area was trimmed to true lines, relieved of any excess material, and given a natural gun finish to beams and deck underside and a steel trowel finish to the columns and dock facing.

Shortly after the completion of the dock face repairs and installation of the new fender system, another large fully-loaded ship “bumped” the dock. To the owner’s amazement, the only visible damage was to the bolts anchoring the fenders. In fact, the steel bolts bent to the point that the ends were touching the shotcrete surface of the dock. No damage was present on or around the shotcrete repair. This incident proved the importance of shotcrete to this project and caused the owner to have a newfound trust in this method of repair.

This project was initially slated for only one phase, which included the dock face along with associated columns and beams. By completion, the project had seen the addition of three phases. This is a testament to what we in the industry already know—that shotcrete, when installed properly, is a far superior product to other types of similar materials.

In summary, our company took on a project that many in the industry deemed the “impossible, company-breaking” project. Yet, through the innovations seen in recent years within the industry, we were able to take a project never designed for shotcrete and not only make the repairs cost-effective but also underbid all other methods explored. It should also be noted that we did not “break” the company and in fact were able to complete the project on time and within budget. Since the completion of this project, we have been fortunate to have the opportunity to make other engineers and construction managers aware of the shotcrete method, its ease of installation as compared to other forms or repair, its cost effectiveness, and its varied type of application.

The importance of shotcrete to the Manchester Terminals project cannot be overstated. This project was initially engineered to be a hand-

# Outstanding Shotcrete Project Award Winner

patch, form-and-pour project. Not only would this have proven to be an unwise choice, but it would likely have caused the owner to endure countless additional repairs, a substantially larger amount of money over the course of several years, and several lengthy repair cycles. The notion that shotcrete could be a viable repair option for such an extensive project was initially hard to swallow. In reality, the project was an easy sell. Shotcrete's past performance record truly worked to our advantage. Shotcrete's versatility and history of success was without a doubt the single most important selling point for this project.

As the project progressed, our method showed shotcrete's durability as evidenced by a ship striking the dock and causing no structural damage. This reaffirms that the proper application of shotcrete produces a substantially stronger product than like material installed using other methods. The project owner's appreciation for the shotcrete method was shown by the full rehabilitation of the dock system, which more than doubled the initial contract and amount of shotcrete applied at this facility.

Our company also saw first-hand the importance of the shotcrete method with the addition of several other projects that were initiated by other engineers and contractors viewing and witnessing the advantages of the shotcrete method at the Manchester Terminals project. As the saying goes, "we in the shotcrete business have a single disadvantage over other types of repair in that we tend to work ourselves out of business." In other words, our process is so reliable that one repair is all it takes to outlast our lifetime!

## Outstanding Repair & Rehabilitation Project

### *Project Name*

Manchester Terminals, LLC, Dock Rehabilitation

### *Project Location*

Houston, TX

### *Shotcrete Contractor*

B & A Contractors, Inc.\*

### *General Contractor*

B & A Contractors, Inc.\*

### *Architect/Engineer*

Hollie Stanley at Stanley Engineering Company, Inc.

### *Material Suppliers*

Builders Products, Inc., and BASF Admixtures, Inc.\*

### *Project Owner*

Manchester Terminals, LLC

\*Member of the American Shotcrete Association



*Manchester Terminals dock begins to find new life as shotcrete application progresses*



*Finished product from a distance*