

Few areas remain in the United States where you can find true isolation, but Dry Tortugas National Park is one such place. Located 68 miles west of Key West in the Gulf of Mexico, the collection of seven islands that comprise the park is only accessible by ferry or seaplane, and two of the islands are officially off-limits to visitors. Although camping is allowed in the park, visitors must bring their own drinking water since no source of fresh water exists on the islands—hence the name *Dry Tortugas*.

wrought-iron structures designed to open with each cannon blast and then immediately swing closed to protect the soldiers within. However, construction of Fort Jefferson was never finished despite 30 years of work, and the structure was never used in battle. It became a prison during the Civil War, most famously incarcerating Dr. Samuel Mudd for his involvement in the assassination of President Lincoln, and it was later used by the military as a quarantine station, seaplane basin and wireless radio station. The fort was declared a national monument under the National Park Service in 1935. In 1992, Dry Tortugas officially became part of the national park system.

BY CHRISTINE L. GRAHL

# Preserving a National Treasure

A historic fort on a remote island affirms the value of laser scanning.

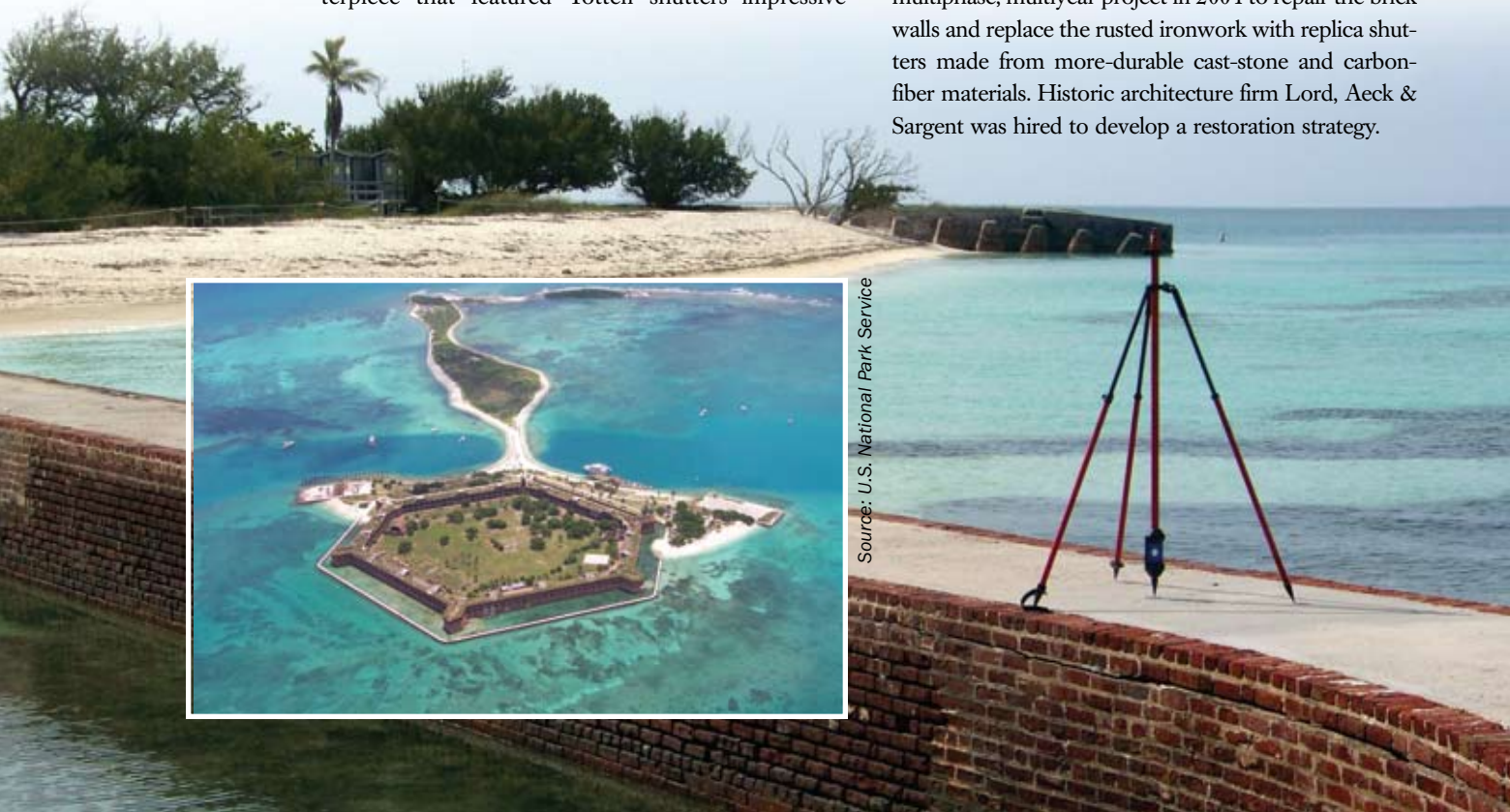
It seems an odd place for a national park—until you consider the region’s rich history. On the park’s Garden Key lies Fort Jefferson, an imposing six-sided fortress built in the mid-1800s under the direction of Gen. Joseph Totten, chief of the Army Corps of Engineers. Constructed of 16 million hand-made red bricks, the 23-acre fort was an engineering masterpiece that featured Totten shutters—impressive

Fort Jefferson still stands as one of the largest coastal forts ever built, but time and salt water have taken their toll. The Totten shutters, in particular, have come under assault; extensive rusting has caused the wrought-iron structures and supporting ironwork to expand, substantially damaging the walls of the fort. As a result, entire chunks of the fort’s exterior have fallen into the gulf.

Under the founding legislation of Dry Tortugas National Park, the National Park Service is required to “protect, stabilize, restore, and interpret Fort Jefferson.” To that end, the agency embarked on an \$18 million multiphase, multiyear project in 2004 to repair the brick walls and replace the rusted ironwork with replica shutters made from more-durable cast-stone and carbon-fiber materials. Historic architecture firm Lord, Aeck & Sargent was hired to develop a restoration strategy.



Source: U.S. National Park Service



The first phase of the project involved removing the existing brick surrounding the cannon openings to access the original ironwork as well as documenting, cleaning and setting aside the brick for reuse. In 2007, a contract for the stabilization work was awarded to Enola Contracting Inc., and by early 2009, the second phase of the project was well under way. But as the skilled masons from Union, Conn.-based Joseph Gnazzo Co. Inc. began disassembling one area of the fort, they encountered some separation deep inside the 8-foot-thick brick wall—separation that neither the contractors nor the architects expected to see so far beneath the surface. “As we examined the situation, we realized that we could correlate the separation with changes in the surface of the brick on the wall’s exterior,” says Susan Turner, AIA, Lord, Aeck & Sargent principal. “We knew that obtaining an accurate assessment of those surface changes would allow us to more easily identify other areas with internal damage.”

### **A Value-Added Proposition**

Lord, Aeck & Sargent contacted the Florida offices of the multidisciplinary firm PBS&J. The two firms had worked together on previous projects that required engineering and surveying work, but in this case, the architectural firm was primarily interested in PBS&J’s laser scanning capabilities. “Our structural engineer, Craig Bennett of 4SE



Inc., suggested that if we had a scan of the surface of the fort, we could understand how the bricks were slightly bulged in areas on the surface and begin to correlate that with what was happening inside the fort walls,” Turner explains.

However, the budget was a substantial concern. The restoration project had already been delayed numerous times due to lack of funding. The National Park Service couldn’t afford to “upgrade” the project simply to obtain better data. To be practical, the solution would have to be cost-effective. “Initially, Lord, Aeck & Sargent thought it would be less expensive to survey the project conventionally,” says Roberto Mantecon, associate vice president and project director for PBS&J. “But doing

the work conventionally would have taken a long time and would not have provided the required accuracy. Additionally, the walls of the fort are surrounded by a moat and aren’t easily accessible. There were also environmental and safety issues to consider. And the scans would provide value from a historical perspective because of the amount of detail they could capture. Scanning the walls would provide a number of benefits and would actually save the client money as the project moved forward.”

This information made the decision easy. “Once we talked with PBS&J and learned more about their capabilities, we knew that scanning was the approach that would give the design team the information they needed,” Turner says. “We suggested this



**Fort Jefferson is located on the Garden Key in Dry Tortugas National Park. The fort was scanned in May 2009 as part of a multiphase restoration project. Inset: An aerial view of Fort Jefferson looking east.**

**All images courtesy of PBS&J except where noted.**

# Dry Tortugas National Park Quick Facts

- Dry Tortugas National Park is composed of seven islands, or keys: Garden Key, Loggerhead Key, East Key, Middle Key, Bush Key, Hospital Key and Long Key.
- Despite more than 30 years of construction, massive Fort Jefferson was never truly completed on the islands of the Dry Tortugas. Advances in weapon technology would come to render the fort obsolete by 1862.
- Fort Jefferson served for a time as a remote prison facility. One of its most famous inmates was Dr. Samuel Mudd, who set the leg of John Wilkes Booth following the assassination of President Lincoln. Mudd was incarcerated on the Dry Tortugas for only four years, from 1865 to 1869.
- The USS Maine made a brief stop at Fort Jefferson before its ill-fated voyage to Havana. Following the sinking of the Maine, the Dry Tortugas served as an important staging area for U.S. battleships during the Spanish-American War.
- The Dry Tortugas islands derived their name from the abundance of turtles (*tortuga* in Spanish) in the area. Even today, lucky visitors may be able to spot loggerhead, green, hawksbill, and leatherback sea turtles plying the waters.
- Between March and September, some 100,000 sooty terns come to nest on the islands of the Dry Tortugas. They are joined by brown noddies, roseate terns, double-crested cormorants and brown pelicans.
- The Carnegie Institute's Laboratory for Marine Biology was established among the Dry Tortugas in 1905. Based on Loggerhead Key, this research facility laid the foundation for 20th century tropical marine science, with an emphasis on coral reef systems.
- Dry Tortugas National Park protects the southwest tip of South Florida's coral reef tract. This represents the third-largest barrier reef system outside of Australia and Belize.
- The islands of the Dry Tortugas are in a constant state of flux. Due to the erosive effects of tropical storms, shorelines are constantly being reshaped. In fact, entire islands have been known to disappear or reform following the passage of particularly violent hurricanes.

Source: [www.nps.gov](http://www.nps.gov)



Source: U.S. National Park Service

**The park's coral and sea grass communities are among the most vibrant in the Florida Keys.**



approach to the National Park Service, and they immediately realized the long-term value of having the scan data on areas of the fort, even where we're not working yet."

## A Streamlined Process

As a consultant under Lord, Aeck & Sargent's indefinite delivery/indefinite quality (IDIQ) contract, PBS&J was readily awarded a task order to handle the scan work. The PBS&J team spent some time upfront defining the needs of the National Park Service and learning how everyone involved in the project planned to use the data. Then, in May 2009, the firm sent a two-person crew equipped with a Leica ScanStation 2 to the Garden Key. "We have handled difficult projects before, but

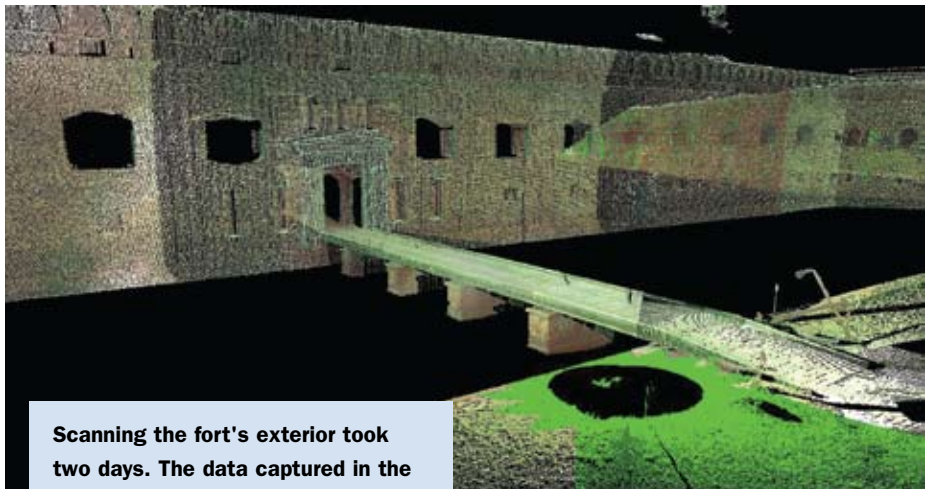
this one was a bit different because the location was so remote," Mantecon says. "Getting to the island was a challenge in itself. And we were concerned that communication would be difficult once we were onsite since cell phone service isn't available. But we were prepared with everything we thought we might need."

The crew loaded camping gear, plenty of water and extra batteries on one of the ferries headed to the island from Key West. They also brought more than six years of scanning experience. The work was so straightforward that communication wasn't a problem. Within two days, the crew had scanned the exterior of the entire fort and returned to the office to process the data using Leica's Cyclone

**Working closely with the client throughout the project was key to ensuring successful results.**

software. (Mantecon says that a traditional survey on the same scale would have taken at least 10 to 14 days in the field.) Five days later, the PBS&J team delivered individual wall profiles in AutoCAD Civil 3D that showed how far the fort walls were expanding. "All the data we collected went in the point cloud, but we just took the areas where we needed to cut the wall sections and used those data to create the deliverables," Mantecon explains.

As a result, the architects and clients received exactly the information they needed at that point in the project while



**Scanning the fort's exterior took two days. The data captured in the scans will remain valuable for years to come.**

having access to additional details in the future. "A major selling point of the scan work was that there was only funding to do a certain portion of the fort, but the information is readily available and can be obtained very efficiently without anyone having to physically go back onsite to get it," Mantecon says.

The results were impressive. But perhaps the most-remarkable part of the project was the simplicity of the process. Mantecon points to the experience of the team as key to streamlining the workflow and optimizing the results. "We worked very closely with the client to identify their needs, and our team had the experience to provide what was needed," he says. "As a result, we were easily able to satisfy our

client's needs on a very complex project at a reasonable cost."

Armed with the scan data, the team at Lord, Aeck & Sargent has been able to guide the restoration work with a higher level of confidence. The current phase of the project, which involves restoring two of the front walls and portions of four bastions, is on track to be finished in July 2010, thanks in part to more than \$2 million in additional funding received in 2009 through the American Recovery and Reinvestment Act. Much work remains to be done to preserve this historic structure; one wall in particular is in very poor condition. Although the timeline for future phases of restoration is still undetermined, Turner said she expects the scans to remain a valuable resource.

As for Mantecon, he's convinced that laser scanning is the future for obtaining topographic data. While PBS&J views its scanning equipment as "just another tool in the toolbox," the firm is increasingly using scanning as a matter of practice because the technology is less intrusive, more cost-efficient, faster and more comprehensive. "Ultimately, the bottom line on any project is whether you can be profitable and still save your client money," Mantecon says. "On an increasing number of projects, scanning allows us to do that." ☺

*Christine Grahl is the editor of POB magazine. She can be reached at [pobeditor@bnpmmedia.com](mailto:pobeditor@bnpmmedia.com). For more information on PBS&J, visit [www.pbsj.com](http://www.pbsj.com). Lord, Aeck & Sargent's Web site is [www.lordaecksargent.com](http://www.lordaecksargent.com). More information about Fort Jefferson can be found at [www.nps.gov](http://www.nps.gov).*