

Shotcrete Foundation Walls at the Smithsonian Portrait Gallery in Washington, DC

by Howard L. Robbins

The National Portrait Gallery, located on the campus of the Smithsonian Institution in Washington DC, is one of the oldest government buildings in that historic city. It was the original location for the U.S. Patent Office and it was used as the site of the inaugural ball celebrating the election of Abraham Lincoln in January 1861. When a recent renovation and expansion project was started on the building, shotcrete was selected as the material of choice

to construct the foundation walls for a new underground storage annex and office complex.

Hensel Phelps Construction Company, Chantilly, VA, was selected by the General Services Administration as the general contractor for the project. The project was awarded on a "best value selection" basis. This bid evaluation process uses weighted criteria to determine the best overall bidder not only on price but technical factors such as project management experience, key personnel, company experience, construction schedule, and plan preparation. When the project is completed, the total amount of the contract will exceed \$102 million. Completion is expected in January 2006.

The overall scope of work includes the renovation and expansion of a building that was originally constructed in 1836 and completed in 1860. Plans called for excavation for the 30,000 ft² (2790 m²) center courtyard to a depth of 20 ft (6 m). A new underground storage annex and office space was to be constructed with a new concrete deck over the new storage annex. Structural foundation walls were constructed using shotcrete for the storage annex and office space. Current plans call for a custom-fabricated glass atrium to be installed to enclose the entire courtyard area following restoration to its original condition.



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After the project was awarded, Hensel Phelps selected Commercial Shotcrete, Inc. (CSI), Gilbert, AZ, to construct the structural foundation walls for the deck that would ultimately cover the new underground storage annex. CSI was selected because of their vast project experience and ability to meet a fast track schedule requirement while working in a challenging site environment. All access to the courtyard work site was through 10 x 10 ft (3.1 x 3.1 m) service tunnels. Shotcrete pumps were placed at the entrance of each service tunnel. Hoses were then run up to 400 lineal ft (125 m) to reach each placement area.

The construction process started with excavation. The excavation had to be completed using equipment that fit into the service tunnel profile. Soil that was excavated was placed on conveyer belts and sent out to a service alley at the rear of the building for removal. After completion of the excavation, drilled piers were installed followed by installation of wood lagging and forms. The next step called for a waterproofing system that consisted of a geo-composite membrane with bentonite to be placed over the forms and lagging. Next, a steel reinforcing cage composed of No. 4 (12 m) bars was installed at 12 in. (305 mm) on center. The final step was to protect the existing granite block walls from any shotcrete overspray. Protecting the historical façade of the structure was of major importance.

The surface was now ready for shotcrete application. After guide wires were set, 4500 psi (31 MPa) shotcrete was placed to a thickness of 16 to 22 in. (406 to 559 mm), depending on location. Great care was taken to assure proper



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reinforcing bar encapsulation and to also ensure that the integrity of the waterproofing material was not compromised. Because the ultimate use of the annex is storage of priceless oil paintings, it was vital that these walls meet the waterproofing specifications. The waterproofing material had to be in perfect condition after shotcrete application. The shotcrete wall surface was given a steel trowel finish. Finally, the completed wall areas received a light broom texture to give the entire wall surface a uniform appearance.

After completion of the foundation walls, cast-in-place concrete support columns were constructed. Steel beams were then placed and secured to the foundation wall system in preparation for the construction of the 14 ft (356 mm) thick post-tensioned concrete deck. Ultimately, this deck will be enclosed with a custom-fabricated glass atrium structure. The landscaping in the courtyard will be restored to its original condition including replanting some of the trees that date back to the original construction of the building.

Ultimately, 700 yd³ (536 m³) of shotcrete was placed in just 8 working days under very difficult site conditions. The construction of the shotcrete foundation walls was one of many critical path schedule elements. Challenges arose on a daily basis, including a presidential funeral. The events related to the State funeral of President Ronald Reagan made access for the last week of the job

an unusual challenge. The project team met each and every challenge successfully toward completion on time and within budget.



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to arch culverts, Commercial Shotcrete, Inc., builds structural walls, sculpted architectural shotcrete features, canal and lake linings, and soil stabilization projects. Robbins has more than 18 years of experience in sales, marketing, construction management, and project management of commercial concrete and shotcrete projects in the Midwest and southwestern U.S. For the past 9 years, he has been involved in the marketing and construction of arch culvert projects for the public and private sector markets in Arizona, California, Nevada, and New Mexico. He can be reached at (602) 290-0362 or via e-mail at hlobbins@earthlink.net.