

Forming and Constructing Structural Shotcrete Walls

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Chinese Garden Project, Seattle, WA



5000 ft² (465 m²) of structural shotcrete walls



Difficult roof line and highly congested reinforcing steel

For contractor Krekow Jennings, shotcrete proved to be a time-saving, cost-effective alternative for a cast-in-place job in Seattle, WA. The 2008 Chinese Garden Project, originally designed as a two-sided form cast-in-place job, was instead shot against a braced forming system. This value and time-driven change was achieved without any redesign by the structural engineer.

Project Superintendent Robert Hermes was looking for a process that would allow him to gain time for his critical schedule. Because he had used shotcrete applications as a time-saver on other projects, it was considered a viable option. MKA Engineering of Seattle, designer of numerous state-of-the-art projects, had a long history of structural shotcrete design and had no reservations about the use of shotcrete instead of cast-in-place concrete. With experience and knowledge working in their favor, the general contractor contacted Johnson Western Gunitite and the team went to work.

This project had many features that cast-in-place concrete would have a hard time dealing with. For example, large block out areas for windows with congested reinforcing bar can cause complications in cast-in-place concrete placement but are easily accomplished when shotcreting. Additional obstacles included the steep rakes of the roof line, tall walls (20+ ft [6.1+ m]) and



Window block outs



Wireman during setup



A completed wall



Rodding and finishing the wall

relatively thin (9 in. [229 mm] thick) congested reinforcing bar configurations.

MKA was well aware of the fact that this project may have been considered unsuitable for shotcrete in the past but knew that with a qualified shotcrete contractor, it would be constructible. Veterans of shotcrete design projects recognized that Johnson Western Gunitite Company and its ACI Certified Nozzlemen had proven their ability to perform this task given their past work history. A preconstruction meeting with the general contractor, structural engineer, shotcrete contractor, testing agency, and the building department helped ensure that the proper procedures and expectations were understood by everyone involved. In this case, because of the long work history of Johnson Western Gunitite Company and the structural engineer, the requirement for preconstruction test panels was waived.

After the preconstruction meeting, the discussion quickly moved to forming methods. A gang form panel system was perfect for the situation and well understood by the general foreman. Despite many footing elevation changes and wall intersections, the contractor was able to install well over 5000 ft² (465 m²) of back form in one day. Scaffolding and steel erection took approximately 5 days. After 3 days of shotcreting, the general contractor was

stripping forms on his completed shotcrete walls. What was previously scheduled for 20+ working days had been cut in half.

The biggest concept that the general foreman was able to grasp was that forming systems are like an easel for shotcrete. Using uniform panels and minimizing custom panels is the key. At the upper elevations, panels should run past the shotcrete. The setup person, or wireman, used a guide-wire system to map out the line and grade for shotcrete placement. As shown in the top right photo above, the sloped top sections of the wall are not a problem with this system but would be much more time consuming if you were setting up this form for cast-in-place concrete.

What about the shotcrete force when shooting? In reality, the pressure that the shotcrete exerts on a form is very low. Wind load requirements are usually the main issue for the contractor when building large panels outdoors. Form pressure that becomes an issue with cast-in-place concrete is not an issue with shotcrete. This gives shotcrete a real advantage in areas that can't be easily formed. In this case, many intersections of walls were blocked off with metal lath that was nailed on and would never hold up under cast-in-place liquid head pressure. This job, however, can easily be done with shotcrete.



Bench gunning placement method



Cutting and finishing shotcrete wall



Bench gunning and blow-pipe operator

The most interesting part of this project is that there is nothing new about it. It's nothing but a series of tried-and-true systems coming together in a different way. Every company involved was extremely experienced in its field but, more importantly, was excellent in communicating issues and concerns before they became problems. The end result was a high quality structural shotcrete structure constructed rapidly and economically.



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