2019 Outstanding Infrastructure Project

# Shotcrete in the Urban Jungle

*By Jason Myers*

In today's complex urban jobsite, easy sites to build on are diminishing, while available sites are becoming harder to reach. In addition, the remaining sites often require creative solutions to develop. The project 1395 22nd St. is a complex of five apartment buildings built into one of the many hillsides in San Francisco, CA, and is surrounded by existing buildings and adjacent properties. Several of the tallest buildings for the project have one level below grade, one level at grade, and ten stories above grade. As part of the foundation system of the project, horizontal and vertical grade beams were installed along the hillside for the first five stories of the buildings and then anchored into the hillside with prestressed tiebacks. The excavated slope was up to a 1.5:1 slope, making for very difficult access to each of the grade beams. Each of the first five floors of the project were anchored into the hillside by the placement of the floor slabs onto the grade beams, which were over 550 ft (167 m) long and positioned as much as 75 ft (22.8 m) up the slope. A typical grade beam was around 3 ft (0.9 m) square, but some of the grade beams included larger footings that were 3 ft deep and up to 5 ft (1.5 m) across. The volume of concrete for the grade beams was more than 1350 $yd^3$ (1030 $m^3$).

## SHOTCRETE SOLVES PROJECT CHALLENGES

The General Contractor was considering a difficult form-and-pour formwork process to try for the grade beams with very little access to each of the grade beam locations. As

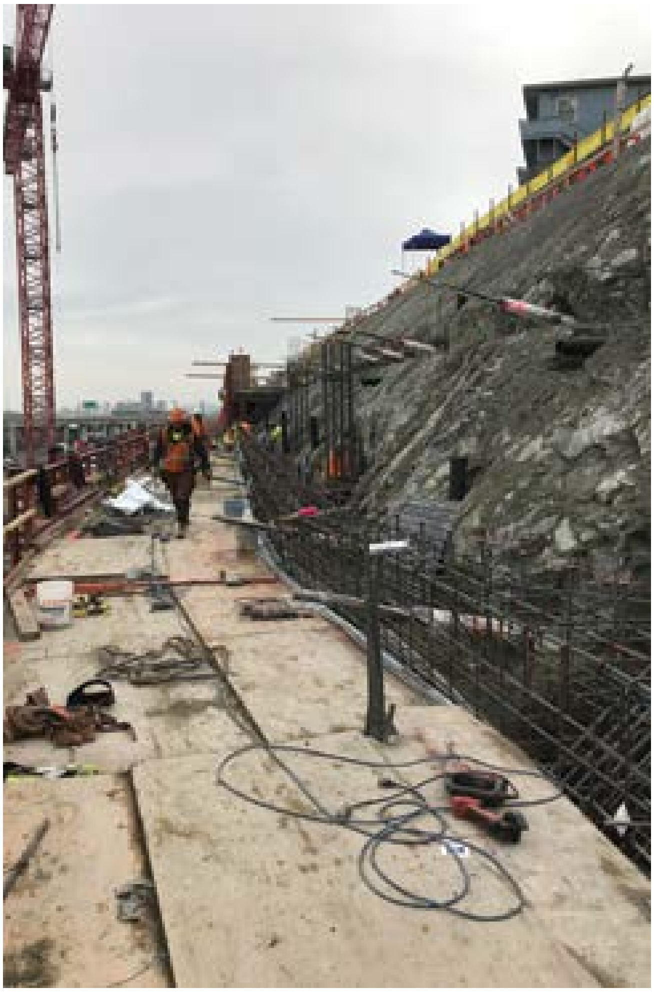

*Fig. 1: Grade beam with work platform*

*Fig. 2: Grade beam during shotcrete installation*


Fig. 3: Finishes on grade beam


Fig. 4: Typical shear wall and boundary elements

the General Contractor started developing the project's detailed schedule, they realized that the formwork sequencing was not going to fit into the original timeline. The General Contractor contacted Dees-Hennessey Inc. (DHI) to help with the project's budget, construction limitations, and timeline issues. After some initial brainstorming, DHI selected shotcrete as the perfect concrete placement method. Some of the constraints the General Contractor faced that DHI took into consideration included the access limitation, formwork difficulty (how to brace the forms on a hillside when there is nothing to brace to), timeline to install the formwork, and getting the concrete to cure so that the tiebacks could be stressed and the next level could be started. Shotcrete was a solution to all of these issues.

## THE PROJECT

The General Contractor's plan was to develop a work platform that could sit on top of a previously placed grade beam. Because the grade beams were uniform in distance, height, and setback, the deck could provide a work platform easily lifted to each level by sitting on the previous grade beam with little modification (Fig. 1). Once the platform was installed, the reinforcing bar cage could be set before shotcrete was placed on each of the grade beams. Shotcrete turned an almost impossible formwork situation into one not requiring any formwork at all.

Shotcrete placement also facilitated the ability to work around the anchor bolts while providing proper finishes for the tieback anchor plates (Fig. 2). The grade beam used a nozzle finish because it was going to be buried, and the design 28-day compressive strength of the grade beams was 5000 psi (35 MPa). However, to decrease the timeline for the stressing of the tiebacks, an accelerator was used to decrease the set time of the shotcrete, and a 6000 psi (41 MPa) compressive strength mixture was used to offset any potential strength loss due to the rapid set accelerator. The plan called for the grade beams to reach design strength and then stress the tiebacks 5 days after shotcrete placement. However, the shotcrete normally reached design strength in 3 days and the grade beams were typically turned over for stressing early (Fig. 3). The overall schedule originally planned for each grade beam to take 3 to 4 weeks per level to get access, formwork installed, poured, stripped, and stressed, but with the shotcrete process we were able to get a grade beam level every 1-1/2 weeks.

As the grade beam contract was wrapping up, DHI negotiated a change order for shotcrete placement of concrete for all of the vertical concrete walls on the project including shear walls, parapets walls, and retaining walls (Fig. 4). This provided schedule and economic benefits to the project, as well as the flexibility of shotcrete placement, as we could shotcrete some of the first structural walls the same day as the grade beams, and then some of the retaining walls at the end of the shift (Fig. 5). The characteristics of the shear walls, parapet walls, and retaining walls included shotcrete with up to 8000 psi (55.2 MPa) compressive strength, pumping distance up to 1000 ft (305 m), and a volume of over 3400 $yd^3$ (2600 $m^3$) with coverage areas of 90,000 $ft^2$ (8360 $m^2$).

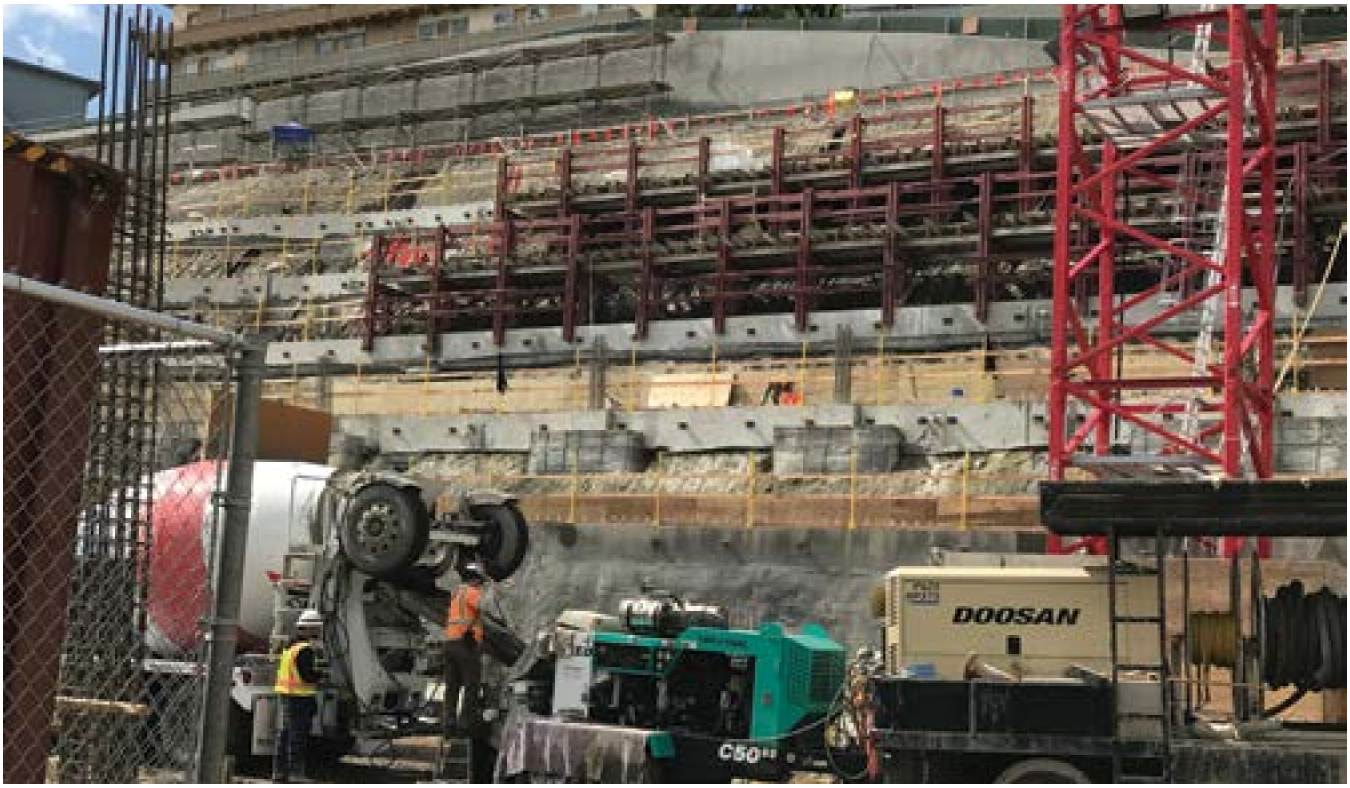


*Fig. 5: View of the jobsite with multi levels of grades beams and rear retaining wall to the project*

## 2019 OUTSTANDING INFRASTRUCTURE PROJECT

*Project Name*
**1395 22nd Street**

*Location*
**San Francisco, CA**

*Shotcrete Contractor*
**Dees-Hennessey Inc.***

*Architect/Engineer*
**Perry Architects**

*Materials Supplier*
**Cemex**

*Equipment Manufacturer*
**REED Shotcrete Equipment***

*General Contractor*
**Pacific Structures**

*Project Owner*
**RP Pennsylvania, LLC**

*ASA Sustaining Corporate or Corporate Member

***Jason Myers*** *received his bachelor's degree in civil engineering from California Polytechnic University at San Luis Obispo, San Luis Obispo, CA, in 1995, and his MBA with an emphasis in project management from Golden Gate University, San Francisco, CA, in 2015. Myers began his professional career working for an earth retention subcontractor where he learned the importance of budgeting, scheduling, and client relationships. Also, during this time he was introduced to the use of shotcrete and its applications. After working for a general contractor for a couple of years he realized that he enjoyed the tighter knit of working for a subcontractor and the ability to construct projects on a tighter time frame with several going at once. Myers also enjoys the process of handling most of the procedures that go into constructing a project rather than seeing only a small portion of the process. He joined Dees-Hennessey Inc. in 2004 and has been a part owner of the company since 2007. Myers serves as the Vice President of Operations as well as the Safety Director. He is Chair of the ASA Membership Committee as well as a member of the ASA Board of Directors, Contractor Qualification, Education, and Safety Committees.*