

Acoustical Wave Wall

By Bruce Russell



Fig. 1: Dr. Phillips Center for the Performing Arts Orlando, FL

Magnificent. A beautiful sight to see, the project CROM calls “The Wave Wall” stands tall in the new Steinmetz Hall at Dr. Philips Center for the Performing Arts, located in Orlando, Florida. CROM was one of the many contractors working in close proximity, under the direction of HKS Architects Inc. and the general contractor, Whiting Turner. The project included construction on two different structures: the Wave Wall and Egg Wall.

The Wave Wall, second of its kind, was intended to match the first, both on the same site, part of the lobby in the Walt Disney Theater. The purpose of the Wave Wall was to serve as an architectural and acoustical barrier between the lobby and the theater. The mass of shotcreted concrete, curvature of the wall, and the attention to air-tight sealing of joints between the structural elements all served to keep the sound of the lobby from entering the theater. The Egg Wall allows access via walkways from three levels of the lobby into the seating area of the arena while maintaining the acoustical barrier.

Both the Wave Wall and Egg Wall structures were designed to be 6 ½ in. (165 mm). thick, heavily reinforced shotcrete structures, with no construction joints, without cracks, and covered by an architectural plaster polished to a high sheen. The Walt Disney Theater wave wall provided the on-site full-scale specification to meet and to beat in appearance and function (Fig. 2 & Fig. 3).

The Wave Wall is roughly 110-ft (34 m) long horizontally, measured along the curvature, and 70-ft (21 m) tall. Beginning 10 ft (3 m) above the floor of the structure, the Wave Wall is supported by a tubular structural steel framework and reinforced cast-in-place concrete columns and beams (Fig. 4). To eliminate the possibility of cracking in the outermost finished surface, the Wave Wall is reinforced with #4 (#13M) bars at 4 in. (100 mm) on center each way near the outer surface of the wall.

The Egg Wall is roughly 48 ft, 6 in. (15 m) tall, and in plan, the shape of the Egg Wall can best be described as half of an egg; 12 ft (3.6 m) wide across the opening and 11 ft

(3.4 m) deep. Similar to the Wave Wall, the Egg Wall was designed to have a crack-free surface covered with the architectural plaster. Beginning at the ground floor, the Egg Wall extends to the underside of the fourth floor of the lobby.

In the initial inspection of the first phase Wave Wall, it revealed what the design drawings showed, the form for the back of the walls was paper-backed lath. After careful planning and analysis, CROM's extensive shotcrete experience led the way for a proposal to utilize roll-formed galvanized steel shell "diaphragm" and shotcrete instead. To prove that this method was the superior method and that CROM was certified and qualified to perform it, CROM fabricated a tubular steel mock-up at our Project Support Facility in Gainesville, FL, (Fig 5). The method devised, was that of incremental reinforcement installation coupled with PVC form strips to provide a strategic and carefully controlled layered approach to the shotcrete application, rather than the benching that was originally specified.



Fig. 2: Walt Disney Wave Wall completed in 2016 (unknown contractor)



Fig. 4: Tubular structural steel framework and reinforced cast-in-place concrete columns and beams

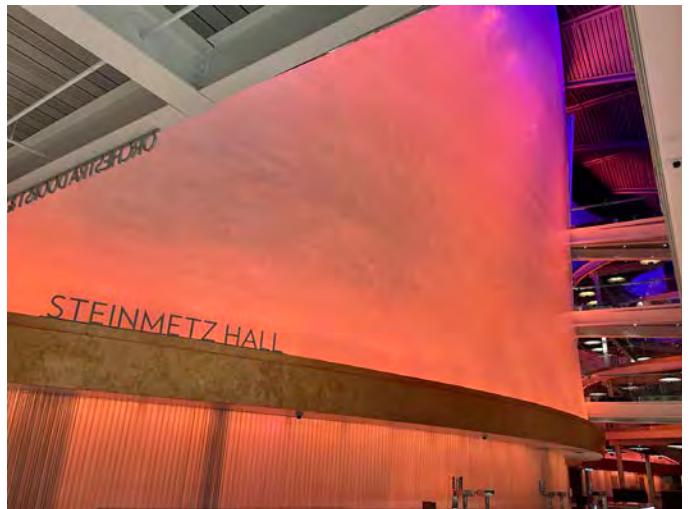


Fig. 3: Steinmetz Hall Wave Wall completed January 2020 (CROM)



Fig. 5: Mock-up for alternative method of formwork (CROM Project Services Facility Gainesville, FL)

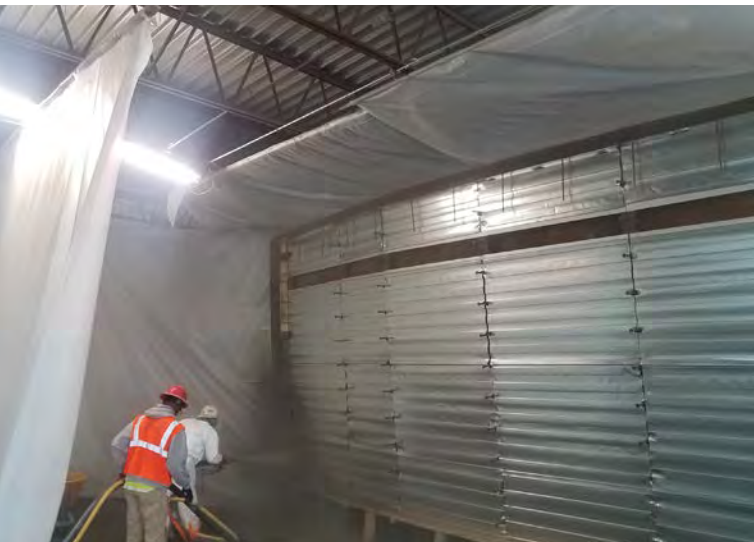


Fig. 6: shotcrete mockup warehouse



Fig. 7: Off-site project mock-up with final eggshell coating system

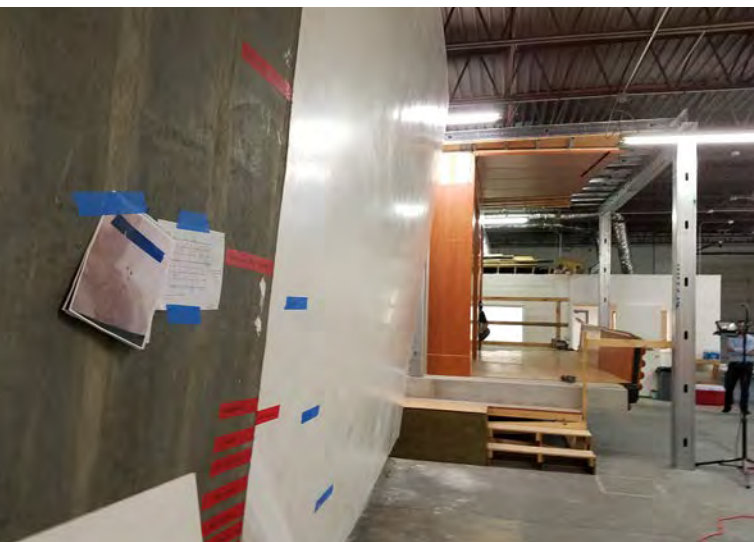


Fig. 8: Clean-up control measures put in place to protect surrounding personnel and existing structures



Fig. 9: Shotcrete application, note extensive containment to control overspray and protect surrounding structures



Fig. 10: Extensive containment measures taken to control overspray and protect surrounding structures during shotcrete application

The General Contractor and Owner's representatives joined us to observe this method during the mock-up phase and agreed with the proposed approach (Fig. 6) Subsequently, per the contract documents, CROM also produced a prototype of the curved Wave Wall approach in a warehouse near the jobsite in Orlando, Florida (Fig. 7). The outcome of this demonstration led to acceptance and approval of the materials, and methods of construction.



Fig. 11: Completed Wave Wall West end upper level (CROM)

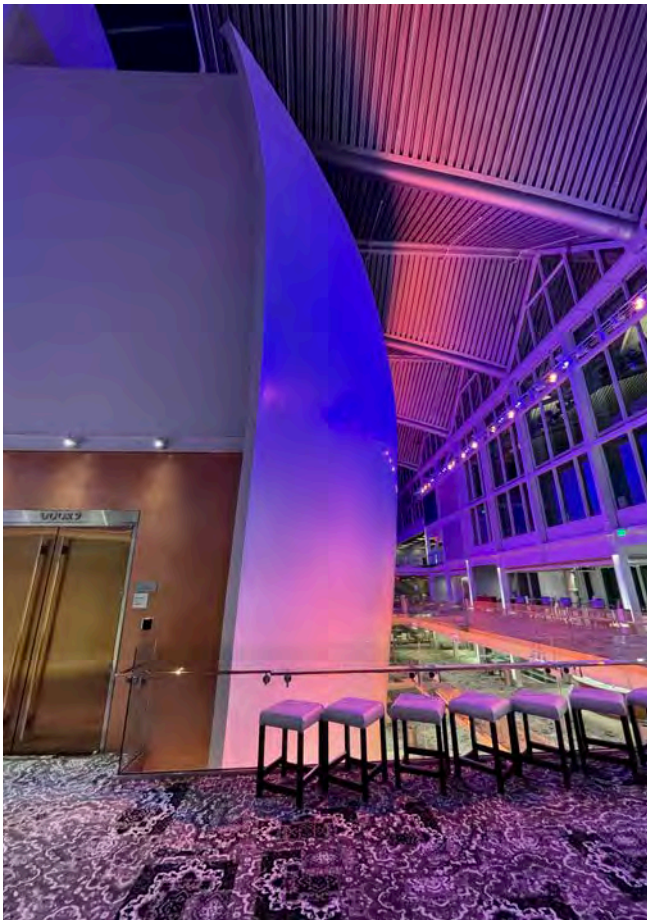


Fig. 12: Completed Wave Wall East end upper level (unknown contractor)



Fig. 13: Wave Wall upper lobby entrance through Egg Wall opening



Fig. 14: Wave Wall upper lobby entrance through Egg Wall opening

As construction was underway, as is often the case, time was of the essence and before the Wave Wall was completed, the project schedule required that the interior portion of the project be air-conditioned, and that glass installation would proceed in certain areas around the site. A new level of care and attention needed to be observed to insure clean, shotcrete placement (Fig. 8). Our skilled and professional crews installed diaphragm, reinforcing steel, and shotcrete in a well-organized and highly productive manner, as usual, even in some unusually tight space conditions (Fig. 9 & Fig. 10). The Wave Wall and Egg Wall were completed as required by the design and on schedule (Fig. 11, 12, 13, 14).



Fig. 15: Steinmetz Hall Wave Wall Dr. Phillips Center for the Performing Arts Orlando, FL

In summary, there were 7500 ft² (700 m²) of diaphragm installed for formwork, 17 tons (15,400 kg) of reinforcing steel bar installed, and 235 yd³ (180 m³) of shotcrete placed. The shotcrete was pumped through over 300 ft (91 m) of 3 in. (75 mm) steel pipe, and 75 ft (23 m) of rubber line. The finish was a steel-trowel finish coated with a Venetian plaster material that created a porcelain eggshell finish.

Due to the complex shape, thickness, and required reinforcing, shotcrete placement was the only practical method of construction. CROM's highly trained and skilled teams executed the Wave Wall and Egg Walls within the project schedule. Successful execution of the shotcrete process was performed while working within close proximity to other trades with no hindrances. CROM's teams maintained high safety standards, quality workmanship, and exceptional aesthetics to these architectural elements. Steinmetz Hall is advertised as one of the world's most acoustically perfect spaces. Truly, this is a magnificent sight to see (Fig. 15).



Bruce Russell is the Restorations Director and Bid Manager for CROM. He has been involved in the construction of ground water storage tanks ranging from 100,000 gallons to 10,000,000 gallons in the water and wastewater industries since 1984. In 1987 he became, what at the time was considered, a dry-mix "CROM Certified Nozzle-

man" under standards that Ted Crom created, which he instituted internally to insure quality shotcrete application. In 2004, Bruce became ACI Certified in wet-mix and remains certified today. In 2014, he took over CROM's Nozzleman Certification/Re-certification program. He serves on the ASA Board of Directors, ASA Contractor Qualification Committee and ASA Safety Committee.

2021 OUTSTANDING ARCHITECTURE | NEW CONSTRUCTION PROJECT

Project Name
Acoustical Wave Wall

Location
Orlando, FL

Shotcrete Contractor
CROM, LLC

Design architect
Barton Myers Associates, Inc.

Executive Architect
HKS Architects, Inc.

*Structural/Mechanical/
Electrical Engineer*
TLC Engineering Solutions
Arup Los Angeles

Materials Supplier
A1-Block Corporation

General Contractor
**The Whiting-Turner
Contracting Company**

Project Owner
**Dr. Phillips Center for
the Performing Arts**