2020 Outstanding Architecture | New Construction Project

Los Olas Corridor Improvements – Shade Canopy

By Douglas Wood and Christopher Foster

INTRODUCTION

Near the corner of Las Olas Boulevard and route A1A in Ft. Lauderdale, FL a contemporary architectural pavilion has recently opened to the public. This pavilion is a new landmark and focal point for a famous, urban beach. The pavilion functions as a location-orientating feature, shade shelter, outdoor performance venue, and passenger drop-off and pick-up point. The pavilion includes a shade canopy, public restrooms, and a police substation. The pavilion and its park are the eastern anchor of a larger set of civic improvements designed to provide greater beach access and an enhanced beach-going experience.

The shade canopy is 24 ft (7.3 m) high and has a footprint of 77 ft (24 m) by 64 ft (20 m). The visually striking shade canopy is supported on two corners of the conventionally constructed flanking buildings and on three large, gracefully flared columns. The canopy roof, with its wave-like undulations, cantilevers up to 29 ft (8.8 m) from the columns. The sumptuously curved, 3-dimensional, shade canopy was constructed using wet-mix shotcrete placement, applied by ACI-certified nozzlemen.

PROJECT TEAM

The shade pavilion was designed by Arquitectonica, as the architect, and Douglas Wood Associates, Inc., as the structural engineer. EDSA, Inc. was the landscape architect and prime consultant for the project for the City of Fort Lauderdale. Skanska USA Building Inc. was the general contractor for the project and COST of Wisconsin, Inc. (COST) was the sub-contractor for the shade canopy section of the project.

Douglas Wood Associate, Inc. (DWA) was founded in 1992 and has developed a reputation for innovative solutions and technical excellence in the full range of structural engineering services. Their award-winning projects include repair and restoration of existing and historical buildings, engineering of artwork and sculptures, as well as new building constructions of all types. DWA has been involved in

shotcrete projects for decades and has specified shotcrete to be used both to perform repairs on existing structures and to construct new structures with challenging geometries. Some examples include artwork, structures with curved walls and roofs and repair work for concrete restoration.

COST began using shotcrete for decorative purposes in 1957 developing naturalistic zoological habitats. Today, the COST team utilizes shotcrete in several ways to deliver both organic finishes like simulated rockwork, earthen textures, coral reefs, and even artificial trees to architectural finishes such as the Las Olas structure. Examples of their award-winning shotcrete work can be visited at zoos, aquariums, theme parks, casinos, resorts, museums, botanical gardens, golf courses, theme retail stores, and restaurants throughout the world. COST's integration of technology during design phases through construction has streamlined construction processes and improved efficiencies at all organizational levels.

DEVELOPMENT

The architect, Arquitectonica, designed the shade canopy with 3-dimensional, wave-like curvatures. The 3-dimensional curves and large cantilevers presented a challenge for engineering and construction.

During the schematic design phase, the design team and the contractor held multiple brainstorming sessions, to evaluate engineering and construction issues and solutions. DWA explored a number of options to achieve the desired shapes and meet all performance requirements while also meeting the construction cost budget. For cast-in-place concrete to achieve the desired shapes, it would have been necessary to surround the concrete in forms of carved expanded polystyrene. Forming top and bottom surfaces in this way would have been logistically difficult and expensive, and the thick, expanded polystyrene forms would have trapped the heat of hydration in the concrete during curing, potentially degrading the quality of the concrete. It was also determined that if cast solidly, the concrete volume was excessive, thus adding cost and exacerbating the problem of the heat of hydration. DWA explored other options such as a concrete shell with embedded steel spines and a concrete shell with concrete spines. After multiple engineering design iterations, it was determined that a 5 in. (125 mm) concrete shell with 12 in. (300 mm) deep and upturned concrete spines at spacings of approximately 6 ft (1.8 m) would meet all the design, performance, and budgetary criteria. The structural engineer used a 3-D computer model to develop the structural design model, which was then analyzed using sophisticated finite-element software. In addition to the usual gravity loads, the subtropical, beachfront location also required high hurricane wind resistance.

Due to environmental exposure to windblown chloride ions in the pavilion's beachfront location, all reinforcement was decided to be galvanized. The low water content used for shotcrete reduced concrete shrinkage cracking, thus providing additional resistance to chloride ion penetration.

IMPLEMENTATION

The bottom surface of the pavilion was formed with carved expanded polystyrene (using CNC equipment), coated to provide a smooth, clean surface to receive the shotcrete. The forms were sculpted by robotic routers, guided by the 3-D computer model.

Steel reinforcement was laid out over the forms and shotcrete was applied from above to create the shell and the spines. COST artisans were responsible for delivering the smooth, almost fluid-like, character. Upon completion, an anti-graffiti coating was applied to the surface, providing a brilliant white coloration and sheen. The form and finish blend seamlessly with the bookend buildings and the serpentine walls that separate the beach from the boulevard. The elements together form a consistent architectural theme.

SUSTAINABILITY BENEFITS AND CONSIDERATIONS

- The structural design, utilizing a 5 in. shotcrete shell with 12 in. deep shotcrete spines, greatly reduced the volume of concrete, thus reducing the volume of cement.
- The durability of the structure contributes to its sustainability. The pavilion's subtropical, hurricane-prone, beachfront location presented durability challenges. These challenges were met by:
  - Thoughtful and thorough structural analysis and design to meet all hurricane wind loading criteria,
  - Use of dense, high-quality, shotcrete to resist water and chloride ion intrusion,
  - Use of galvanized reinforcement to guard against future corrosion, and
  - Night-time placement of shotcrete to prevent any negative effects to the fresh concrete due to the heat of the subtropical, August afternoon.
- The use of shotcrete eliminated the need for topside formwork. Therefore, the amount of material used in forming was substantially reduced. Additionally, support structures for the topside formwork were eliminated.
- Speed of construction was improved by elimination of the topside formwork and use of shotcrete process compared to conventional form and cast method.
- The pavilion provides much-desired urban shade while using ocean breezes to provide comfort, without the use of mechanical ventilation or cooling.
- To reduce urban "heat island effect," all surfaces of the pavilion, its flanking buildings and park hardscape are high-reflectance white.
- To guard against potential hurricane tidal surge and future sea-level rise, the pavilion and building floor elevations are set at least 12 in. above the FEMA-designated Base Flood Elevation.

2020 OUTSTANDING ARCHITECTURE | NEW CONSTRUCTION PROJECT

Project Name
Shade Canopy

Location
Fort Lauderdale, FL

Shotcrete Contractor
COST of Wisconsin, Inc*

Architect
Arquitectonica

Landscape Architect
EDSA

Material Supplier
CEMEX USA

Equipment Manufacturer
REED Concrete Pumps & Shotcrete Equipment*

General Contractor
Skanska USA Building, Inc

***ASA Sustaining Corporate or Corporate Member**

Douglas Wood, P.E., SECB *has over forty-two years of experience providing structural engineering in South Florida. He is the founder and has been the president of Douglas Wood Associates since 1992. Mr. Wood's reputation for thoughtful consideration, creative solutions, thorough analysis, detailed design, and client-responsive service is unsurpassed.*

Christopher Foster *is the Vice President of Sales and Marketing for COST of Wisconsin, Inc. He has been actively involved in shotcrete theme and specialty construction throughout his 27-year tenure. Chris and the COST team's solution-driven approach has proven to be successful when delivering truly unique and iconic shotcrete structures, attractions, exhibits, and visitor experiences.*