PCI MID-ATLANTIC
A Chapter of the Precast/Prestressed Concrete Institute

Project Profile
Flight 93 – Tower of Voices

The Flight 93 National Memorial honors the passengers and crew of Flight 93 who lost their lives as a result of the attacks on September 11, 2001. The Tower of Voices was designed to provide both a visual and audible reminder of their bravery on that fateful day. The tower is 93' tall and is designed to hold forty (40) wind chimes representing these heroes, passengers and crew members of Flight 93.

To achieve Paul Murdoch Architect's desired look and develop the intricate precast details needed for the project to be successful, PennStress utilized 3D BIM (TEKLA Structures, by Trimble) along with printing 3D scaled prototypes. The additional planning steps helped eliminate exposed patches, revised connection details, and helped in formulating a plan to construct the tower. Details from the 3D BIM were used to create one of a kind forms to be used for casting the project.

Precast concrete was the material of choice for creating a memorial that would withstand the harsh climate and allow for the design precision that was required for the complex and unusual shapes. The spliced columns were placed in a "C" shape to allow the sound to travel out from the structure. The beams were not only on a radius but a 20-degree slope

AT-A-GLANCE

Owner:
U.S. National Park Service; Flight 93 National Memorial

Design Team:
Paul Murdoch Architects & ARUP USA, Inc.

General Contractor:
Leonard S. Fiore, Inc.

PCI Certified Producer:
PennStress, a div of the MacInnis Group, LLC

PCI Certified Erector:
Precast Services, Inc.

Total Precast Used:
The 93' tall memorial was built using fifty-four (54) precast concrete components including sixteen (16) spliced columns, thirty-six (36) beams, and two (2) column caps.

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as well. The column caps were on a radius, sloped, and connected four (4) column tops together greatly reducing the fabrication & erection tolerances. Each of the pieces was sandblasted for a uniform, grey appearance. All the pieces together were designed to help create wind turbulence to move the forty (40) wind chimes even during low wind speeds.

The successful erection of the tower occurred with an extremely high level of difficulty due to the uniquely complicated geometry, nearly zero allowable tolerance and uncooperative weather.

PCI members participating in the project included PennStress, a division of the MacInnis Group (PCI Producer); Precast Services, Inc. (PCI Erector); and Architectural Precast Innovations (PCI Producer) provider of precast benches. PCI Associate Members directly supportive of the project included BASF Admixtures, Helser Industries, and Splice Sleeve North America.

ADDITIONAL LINKS AND INFORMATION:

www.nps.gov/flni