



$$WP1 = 62.43 \text{ lb/ft}^3 \times 28\text{ft} = 1748.4\text{lb/ft}^2 = 12.13 \text{ psi}$$



Project Description

One-of-a-kind, corner-less tank at the Phillip and Patricia Frost Museum of Science.

- Tank size: 100-foot wide
- 9,500sf.-surface area which supports 4.5 mill. pounds of water.
- 3-story of innovative elevated conical-shaped design.

Design Features:

- The tank walls vary between 28-in (71 cm) and 56-in (142 cm) of thickness.
- 200 tons of epoxy coated steel reinforcement and 50 tons of high-strength PT cables to prevent it from cracking.
- Approx. 120 ft. diameter at the top and 27 ft. in height.
- Bonded PT system - tendons were primarily 12-0.6" dia.

Miami, FL

CAPABILITIES

- **Post-tensioning**
- **Formwork**

Developer:

The Phillip and Patricia Frost Museum of Science

Architect:

Grimshaw Architects

General Contractor:

Skanska

Project completion:

2015

Industry

Entertainment

Project type:

DEVELOPMENT

SPECIALTY PT

Full Project Description

In 2007, the renamed Phillip and Patricia Frost Museum of Science embarked on an ambitious relocation and expansion project in the heart of downtown Miami. The new energy-efficient home for the Museum features state-of-the-art interactive exhibits and optimizes the surrounding environment while emphasizing South Florida's culture and ecosystem.

One of the highlights of this \$305 million project includes a one-of-a-kind 100-foot wide, 500,000-gallons of seawater vessel with a corner-less design that allows open-water marine species to swim continuously as they would in the actual Gulf Stream. This structure is at the heart of the site, and thanks to its innovative elevated conical-shaped design that comprises a 30-foot diameter acrylic oculus at the bottom of the basin, museum visitors can be amazed by the view of the tank from below. The three-story, unique tank design offers a variety of views from the shoreline to greater depths of the aquatic ecosystems while enhances the museum's interactive aquarium experience.

Kline Engineering & Consulting, the specialty structural design team, was tasked with the structural design for the post-tensioned three-story, 500,000-gallon aquarium tank's wall to safely withstand the pressure due to seawater without compromising its shell-like aesthetic design. Made of concrete as opposed to structural Steel to dampen the interference with the shark's sensory system, and without the use of construction joints, this innovative engineering design incorporates bonded post-tensioning reinforcement oriented in three directions throughout the tank walls. The available post-tensioning (PT) software packages were well suited to design the beams and flat slabs; however, no PT software package could model a structure of this complexity. Kline used SAP 2000 to model the unique geometry and the bonded PT.

The completion of this landmark achievement of architectural design required not only a continuous concrete pour that lasted 25 hours, and 1,200 cubic yards of concrete, but an innovative post-tensioning and specialty structural design team. Working under a symbiotic collaboration concept with all contributors, our team provided a robust design that minimized both the project cost and complexity, which reduced costs and increased the ease and speed of construction.

*Photography: @Grimshaw Architects
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