

 **Marine Structures****Reference Details:**

Owner City of New York
Parks and Recreation
Flushing, New York +++

Structural Engineering
Mueser Rutledge
Consulting Engineers
New York; LEAP
Associated
International, Inc.,
Tampa, Florida +++

Execution Simpson &
Brown, Inc., General
Contracting, West
Cranford, New Jersey
+++ **Precast Concrete**

System - Manufacturer
Precast Structures, Inc.,
Auburn, Main +++

Precast Concrete
System - Designer
Marina Components,
Inc. in cooperate with
Precast Structures, Inc.

DSI Services Supply of
post-tensioning
materials, stressing
equipment and technical
service.



Marine application of DYWIDAG post-tensioning joins precast prestressed segments

Flushing Bay, New York, USA: Floating Wave Attenuator

A new breakwater had to be built to protect the World's Fair Marina on Flushing Bay in New York after removal of the existing rubble mound breakwater. Environmental issues prohibiting any filled-type structure, the soft subsurface soils of the marina site as well as the limited navigable area led to the selection of a cantilevered steel pipe pile anchorage system that was capable of developing the required lateral resistance in the soft soil while maintaining the structure's location within acceptable limits. To meet the required design and performance criteria a precast, prestressed, post-tensioned, prismatic structure was chosen. The 503 m long wave attenuator is executed in three stages, with the first stage of 293 m having been completed in March 1996. Second and third project phases were planned for the future.

The floating wave attenuator structure consists of individual 2.4 m wide, 1.3 m deep and 12.2 m long segments, which were prefabricated, shipped to the jobsite and there connected to build three 97.5 m long structures. In order to meet permanent floating requirements the segments were conceived as polystyrene-filled, thin walled concrete boxes. Prestressing provides strength and water tightness for the structure. Longitudinal prestressing envelops each concrete segment with the bottom slab and side walls being prestressed with pre-tensioned strand and the top slab being post-tensioned with 0.5" DYWIDAG monostrand tendons.

The individual segments were connected to each other in a unique way. The structure consists of two rows of precast segments placed side-by-side in a staggered pattern and spliced to each other at butt joints at 6.1 m intervals. The transfer of the loads from one segment to the adjacent one is performed by transverse post-tensioning consisting of two 32 mm Ø DYWIDAG THREADBARS[®] (St 835/1030, grade 150) placed at both sides of each butt joint in 102 mm Ø sleeves. The bars were designed to resist the combined effects of all occurring loads (horizontal, torsional and vertical bending moments). At each set of post-tensioning bars a 152 mm wide keyway between the precast segments provides transfer of the vertical shear forces. The back surface of the keyway is formed to make an undulating surface in the concrete to ensure a definite shear connection after epoxy filling of the shear key. The post-tensioning was executed in two stages: the first portion of the post-tensioning force was applied against the neoprene pads and gaskets to seal the keyway for grouting; after the epoxy grout had set, full post-tensioning force was applied.

Long-term durability of the floating structure is achieved by prestressing of individual segments in combination with high performance, low water-cement ratio concrete, and calcium nitrate corrosion inhibitor well as the use of galvanized and/or epoxy-coated reinforcing steel. As far as the post-tensioning bars are concerned, they are encapsulated in cement grout DYWIDAG 65 mm Ø corrugated PVC sheathing. The anchorage ends, including the bearing plates and the nuts, are recessed in a pocket and encapsulated in DYWIDAG PTI mastic corrosion inhibitor.

The precast prestressed system used on this project proved to be a very economical and effective solution allowing both ease of installation and environmental compatibility.