# AESTHETIC INTEGRATION OF ATHENS OLYMPIC SPORTS COMPLEX FOR THE 2004 OLYMPIC GAMES

Originally built in 1982, the Athens Olympic Stadium underwent an extensive renovation to meet the needs of the Olympic games. A central contribution to this functional as well as aesthetic renovation was the addition of a roof over the stadium that covers the approximately 80.000 spectator seats. The design was commissioned to the architectural firm "Santiago Calatrava S.A." as part of the overall aesthetic integration of the entire Olympic Athletic Complex.

***General view of the Athens Olympic Sports Complex (OAKA)***

The Stadium roof covers a total area of 25.000 square meters and consists of two symmetric parts, which are attached to each other primarily at two points. Each part of the roof is practically a self-supported structure and has an average width of 50m. The main structural system that supports the roof is a pair of steel arch tubes, which have a total span of 305.0m. The maximum height of the upper tube (arch tube) is 87.0m, its' external diameter is 3.25m and its' thickness is 67-90 mm. The height of the lower tube (torsion tube) is 55.0m, its' diameter is 3.60m, and its' thickness varies from 78-100mm. Due to the fact the roof was designed to cover a preexisting stadium without interfering with it, its' foundation could only be located outside the stadium plan.

The roof structure is supported primarily at four points on massive pile foundations. Their size is 26.50x24.20m for the northern supports and 30.x16.0m for the southern ones. Each of the northern foundations has forty-two 1.50m diameter 30.0m long piles, while each of the southern foundations has thirty similar piles.

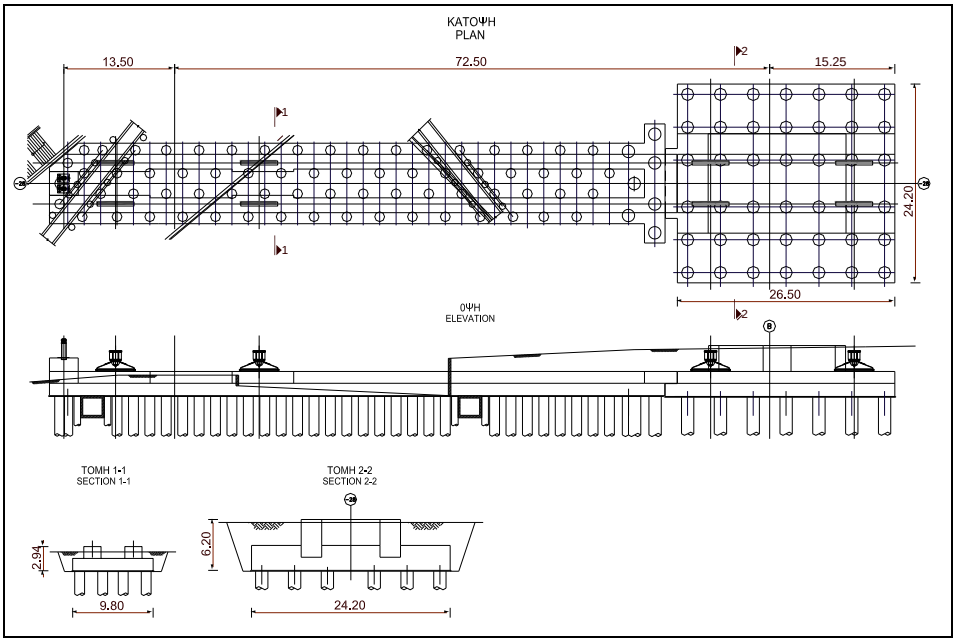
To facilitate the erection of the roof, each of the two parts was assembled separately at a distance of 70m from its' final location and were transported from the temporary erection location to the final location via a sliding process.


***Southwestern foundation's sliding beam of the steel structure for the coverage of the Olympic Stadium***

***General aspect of the western arch of the steel structure for the coverage of the Olympic Stadium and sliding beam of the northwestern foundation***

As the final assembly took place above the ground, a large number of temporary steel towers were constructed to support the various parts of the roof during erection. All towers were then anchored to pile foundations of various sizes, the smallest having four, 1.20m diameter 20m long piles, and the largest having fourteen, 1.50m diameter 25.0m long piles. Thirty temporary tower foundations were constructed.

To slide the structure into its' final position, four long foundation beams were required. The sliding beams had the shape of an inverted double T, with 10m wide flange and a clear distance of 5.0m between two 1.80m thick webs. At the top of the inverted T beams, the sliding surface was created with the use of steel plates coated with Teflon. The sliding of each part of the roof, which weighed approximately 8000 tons, was made possible by four hydraulic jacks with a pulling capacity of 150 tons each. The sliding beams were supported on 1.20m diameter piles 25.0m long. Overall, more than 500 piles with a total length of 12000m were constructed for the foundation of all the provisional structures.




***Plan, elevation, typical section of the sliding beam and the final northwestern foundation of the steel structure for the coverage of the Olympic Stadium: On the left is the starting position (erection position) and on the right the final sliding position (permanent roof's foundation)***

Foundations were constructed in three separate phases. During the first phase, the foundation pile cap - measuring at 3.0m thick - was cast. A second part of the foundation underneath the steel roof pedestal was also cast upon completion of the sliding process. At this time, all provisional structures that supported the roof could be removed, and the total weight was transferred to the foundation. As a result, anchors were pre-stressed and the third and final parts of the concrete foundation were cast.

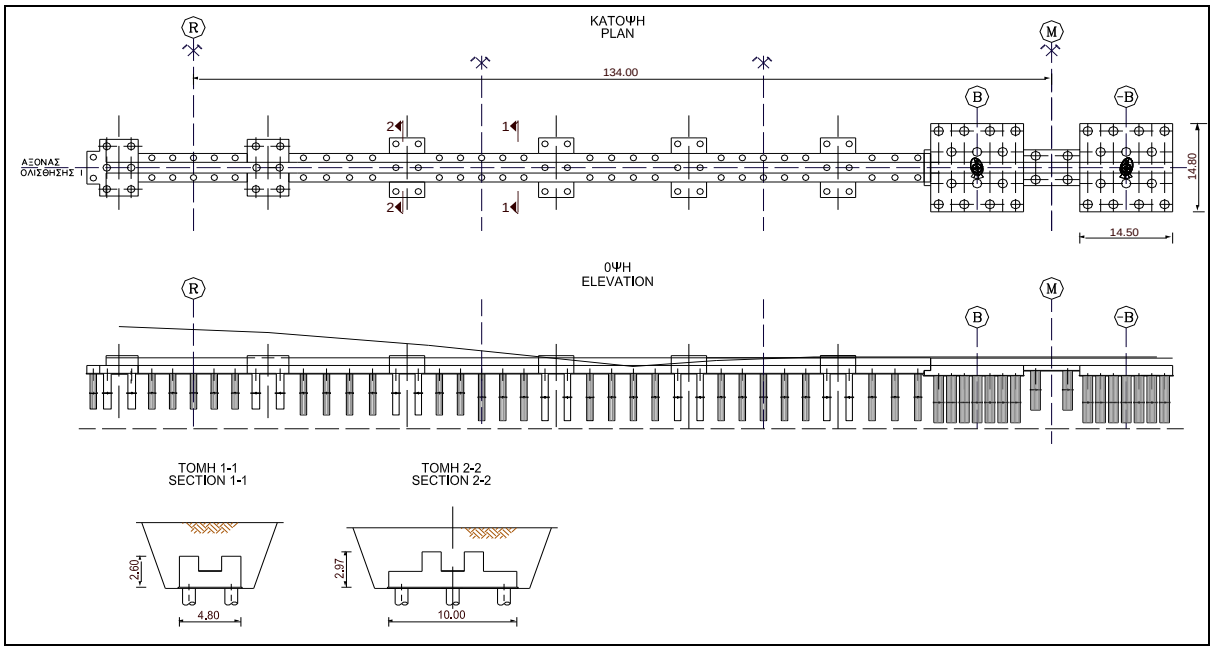
Our office was assigned the foundation design of all provisional erection towers, of the beam structures on which the sliding of the main steel structure took place, as well as the permanent foundations of the structure at its final position. The designs lasted approximately two years during which a series of adaptations and modifications were made to suit the continuously changing construction and erection demands.

***Northwestern foundation before the first phase of concreting***

## VELODROME'S COVERAGE STRUCTURE

The roof of the Velodrome was constructed at a distance of 135.0m eastward of its final location. The steel structure that weighed 7.000t was lifted up by hydraulic jacks and was then transported to its' final location in three days time. The steel structure transport beam was founded on 1.0m diameter, 20.0m long piles. These had the form of a canal, inside of which moved the hydraulic transportation mechanism. At the final position, the roof's support was achieved by pot bearings that were fixed at the north side and were movable at the south.

***Velodrome: On the left, roof's assembly position with the auxiliary steel towers and the sliding beams can be seen***




***Velodrome's roof sliding beam: Plan, elevation, and typical section.***
***On the left (axis R), is the initial assembly position and on the right (axis M), is the final foundation position***