Izmit Bay Suspension Bridge – Construction

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1. Introduction

The Izmit Bay Suspension Bridge will carry the new Gebze-Orhangazi-Izmir motorway across the Sea of Marmara at the Bay of Izmit in northern Turkey. The main span of the bridge is 1550m and the side span is each 566m. The suspended deck is 2682m long and continuous between two side span piers. The main cables are deviated at the side span piers toward the cable anchorages located below the deck of the transition spans. The anchor spans of the main cable between the side span pier and the splay saddle are 92.05m and 67.25m for the north and the south respectively. There are 120m and 105m transition spans on the north and the south. The construction of the Bridge has started in January 2013 to be completed early 2016. The construction of large scale of suspension bridge over the sea to be completed in such a short period requires a sufficient knowledge and experience of construction of large scale marine work and of large scale suspension bridge. The papers describe the construction planning of the substructure and superstructure of the Izmit Bay Suspension Bridge and the current status at the construction site.

2. Substructure

2.1 Tower Foundation

Tower foundation construction consists of caisson construction including erection of steel shaft at dry/wet dock and sinking of caisson followed by plinth and tie beam construction at the foundation location, where caisson is placed on soil strengthened by pile inclusion at -40m below sea level. Two caissons are constructed partially in the dry dock until the weight hence draft is allowed to be towed out, where the base slab is cast in three stages on working platform of 20cm deep aggregate followed by casting of the inner wall to the mid height and of the outer walls to the full height in three stages vertically. The caissons are towed to the wet dock, where the inner walls are completed, the top slab are cast on the PC panel, the steel shafts are installed, and lower part in the steel shaft is cast. Following the completion of caissons in dry/wet dock, the caissons are towed to the final position, sunk and placed on the gravel bed at -40m of sea level.

2.2 South Anchorage

The south anchorage is constructed on the common large concrete slab constructed on the reclaimed land on which the side span pier and the transition pier are placed to reduce a risk of relative movement between the cable anchorage and the deviation saddle on the side span pier hence a huge force introduced in the main cable under a strong earthquake. The construction of the south anchorage consist of construction of retaining wall (diaphragm wall), excavation inside the retaining wall, construction of large concrete slab and construction of triangular cable anchorage.

2.3 North Anchorage

The north anchorage is constructed on land at the Dilovasi Cape of north side. Not similarly to the south anchorage, the north anchorage is placed on relatively favourable rocks and no faults have been discovered in the geotechnical investigation, thus the front and rear legs of the triangular cable anchorage are place on separate concrete slabs that are connected to each other by tie-beam, and the total volume of concrete is smaller than for the south anchorage. The construction procedure is

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almost the same as that adapted to the south anchorage, e.g. block by block construction vertically and horizontally to suit concrete supply capacity and limit the rise of temperature in concrete below the permitted value.

3 Superstructure

3.1 Steel Tower

The tower is 235.425m high steel structure consisting of two tower legs and two cross beams. The tower legs are divided into twenty two (22) segments and connected to each other at the horizontal joint by welding for the perimeter plates and by friction resistance bolts for the vertical stiffeners. The fabrication process consists of the panel fabrication, the segment assembly and the trial assembly. The tower leg segments no. 1 thru. 11 and the lower cross beam are erected using a floating crane, while the tower legs segments no.12 thru. 22 and the upper cross beam are erected by using a self-climbing crane mounted on the support structure connected to the lower cross beam.

3.2 Cable Works

The main cable is made up of 110 numbers of pre-fabricated parallel wire strand (PPWS) each consisting of 127 numbers of 5.91 mm in diameter cable wires having the breaking strength of 1760Mpa in the main span and plus two extra of the same strands in the side spans. The main cables are supported on the cable saddles at top of the tower, at the side span pier and at the anchorage and anchored to the anchor blocks. The PPWS method is chosen to complete the strand erection faster and the quality better as compared with Aerial Spinning method. The PPWS are pulled out from the reels installed on the un-reeler located in the back of the north anchorage and hauled to the south anchorage by the hauling system as placed on the guide rollers provided on the catwalk. The PPWS pulled during the day time are connected to the cross head slab at the anchorage and adjusted to its design length by sag control during the night time of the same day.

3.2 Suspended Deck

The suspended deck is a 30.1m wide and 4.75m deep single stream-lined orthotropic deck box girder with a 2.8m inspection walkway attached to the both edges. The suspended deck is 2682m long continuous between two side span piers and supported transversely both at the tower location and at the deck ends and vertically only at the deck ends.The suspended deck is divided into one hundred and eleven (111) segments to suit the planned fabrication, transportation and erection capabilities. The general fabrication process consists of the panel fabrication, the segment assembly and the trial assembly. The deck erection is carried out by two different ways, i.e. the unsuspended deck segments at the tower and at the deck ends are lifted using a floating crane having 1600 ton lifting capacity and the suspended deck segments are lifted using a lifting devise having 350 ton lifting capacity. The self-propelled barge capable of dynamic positioning is used for the transportation to minimize interruption of the marine traffic.