Swivel Lowering Operation of the Viaduct over the River Tera

Manuel BIEDMA
MSc. Civil Engineer
Acciona Ingenieria
Madrid, SPAIN
mbiedmag@acciona.es

Manuel Biedma, born 1964,
received his civil engineering
degree from the Univ. of Madrid,
Spain. He works for Acciona
Ingenieria, Madrid. His main area
of work is steel structures.

Javier MARTINEZ
MSc. Civil Engineer
Acciona Ingenieria
Madrid, SPAIN
fmlopez@acciona.es

Javier Martinez, born 1972,
received his civil engineering
degree from the Univ. of Madrid,
Spain. He works for Acciona
Ingenieria, Madrid. His main area
of work is steel structures.

Summary

The deck is a concrete box girder which shall be launched from one the abutments and has a total length of 645 m. It is simply supported on concrete piers spaced 75 m. However, because of the wide riverbed, one of the theoretical piers has been replaced by a pair of inclined steel semi-arches. These semi-arches are joined at their upper end so they provide the support that the deck needs. At their lower end they are fixed to the foundation of that adjacent concrete piers. A distinct feature of this viaduct lies in the special construction method used for the erection of the inclined semi-arches: they have been lifted into a vertical position and, by means of a swivel lowering operation and external cables, erected and joined at their upper end. This method involved the provision of pins at the base of the semi-arches. In addition, the hinges were designed to be able to allow the adjustment of the semi-arches during the final phase of the erection.

Keywords: Viaduct, semi-arches, steel, swivel lowering, pins, cables, wind.

1.   Description of the viaduct

The Viaduct over the River Tera has a total length of 645 m. It has nine spans of 60 + 7×75 + 60 m span lengths. It is located in the North-Northeast high-speed Corridor connecting Madrid and Galicia, in the Zamora-Lubian section, subsection Otero de Bodas-Cernadilla. The deck is a prestressed concrete box girder that has been launched from one of the abutments and has a total width of 14,00 m where two railway lanes two pedestrian walkways are located.

The viaduct main span, see Figure 1, is 75,00 m long in relation to the deck but 150,00 m long in relation to the substructure. This is because the theoretical center pier was replaced by two inclined semi-arches of S460 steel. The angle to the horizontal is about 30°. Those semi-arches have an approximately rectangular cross section with variable width and depth, ranging from 6,00 × 3,00 m at the base to 5,40 × 2,50 m at the crown. Each one has a length of 81,00 m and their total weight is 3.000 kN. The crown element has a parallelepiped shape and supports both the definitive bearings as well as the temporary guiding bearings. For maintenance reasons both semi-arches as well as the crown are accessible in safety conditions.

2.   Erection method

Basically, the erection method of the semi-arches involved its assembly in a basically vertical position and a subsequent rotation with the aid of guy cables, detent hydraulic cylinders and the force of Gravity. The semi-arches are rotated in relation to a pin located at the base and the guy cables are anchored to the adjacent footings. See Figure 2.