



## **OUTSTANDING COMPOSITE STEEL-CONCRETE BRIDGES IN THE SPANISH HSRL**



Francisco Millanes

PhD. Civil Engineer. Universidad Politécnica de Madrid  
Docteur Ingénieur par l'École Nationale des Ponts et Chaussées de Paris  
Professor on Composite Steel Concrete Bridges and Structures. Universidad Politécnica de Madrid  
Project Team Member for Spanish Code on Structural Steel Draft  
President - IDEAM. S.A. Madrid, SPAIN  
general@ideam.es

**Abstract:** A wide programme for development of HSRL infrastructure is being carried out in Spain. Concrete solutions were always chosen for the first HSRL. Shortly ago, the proposal for a composite deck for the Arroyo de las Piedras viaduct was accepted by ADIF (National Railway Network Administration Office). Finished in 2005, with a standard span of 63.50 m, slightly longer than the 63.00 m in the Orgon viaduct, at the French TGV, being the longest span for this typology. The French twin plate girder solution was modified according to the Spanish double composite action technology. Its success has opened the way for the acceptance of more composite steel and concrete solutions for the Spanish HSRL projects. The new viaduct over the Ulla river is the most representative one of all of them. The Ulla viaduct is 1620 m long, with three main spans of 225+240+225 m in length and several approaching spans of 120 m long each, which means a main span about 20% longer than the current world record, the Nantenbach bridge in Germany. The solution is a composite truss bridge with double composite action at the hogging zone. The depth ranges from 9.15m to 17.90 m in the five main spans, in which the deck is rigidly connected to the four central concrete piers, creating composite frames.

### **1. “ARROYO DE LAS PIEDRAS” VIADUCT: THE FIRST COMPOSITE BRIDGE IN SPANISH HSRL**

Arroyo de las Piedras bridge [Ref. 1, 2] is the first composite steel-concrete high speed railway bridge in Spain, located on the Córdoba-Málaga HSRL. The structural typology is a continuous beam with spans of 50.4 + 17 x 63.5 + 44 + 35 m (*Fig. 1*). When designed and