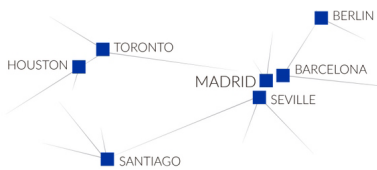
High speed railway viaduct over EX-A1 and EX-108 highways

Extremadura, Spain / 2021-2025

Structural type	High speed railway viaduct, combined steel truss-concrete deck
Characteristics	Total length of 613 m with 2 stell truss sections over EX-A1 and EX-108 highways, and 3 sections of concrete deck
Owner	ADIF Alta Velocidad
Client	FERROVIAL
Scope	detailed design



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The new viaduct will allow the High-Speed Rail line to cross over the EX-108 road and the EX-A1 highway near the town of Malpartida de Plasencia. The crossings over these two roads involve a significant skew—approximately 19° and 17° at the intersections with the EX-108 and EX-A1, respectively. This pronounced skew heavily influences the span layout of the viaduct.

The design speed for train circulation is 330 km/h.

The Modified Project for the viaduct proposes a structure with a total length of 613 meters, divided into five sections: two made of steel trusses for the crossings over the EX-108 and EX-A1 roads, and three made of concrete to complete the total length of the viaduct. The characteristics of each section are as follows:
- Section 1 (E1 to P2): Concrete. Spans: 31.50 + 31.50 m
- Section 2 (P2 to P4): Steel. Spans: 45.00 + 45.00 m
- Section 3 (P4 to P8): Concrete. Spans: 31.50 + 36.00 + 36.00 + 31.50 m
- Section 4 (P8 to P11): Steel. Spans: 57.70 + 67.00 + 57.70 m
- Section 5 (P11 to E2): Concrete. Spans: 31.50 + 36.00 + 36.00 + 31.50 m

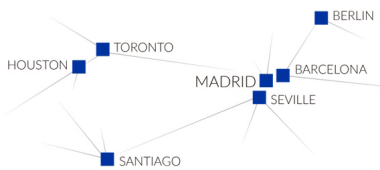
The viaduct features two clearly distinct typologies. On one hand, two sections employ steel trusses for the crossings over the existing roads, continuing the concept developed in the original project. On the other hand, three concrete sections are proposed to complete the total length of the viaduct.

The proposed solution pays particular attention to the transitions between the two types of structures, aiming to ensure that the viaduct presents a formal unity and is perceived as a single structure rather than a juxtaposition of different ones. In this way, the solution preserves the concept of the original project and places the primary structural elements along the edges of the deck in both the steel and concrete sections. This allows for the visible depths of the steel and concrete structures to be the same at the transition piers and for the piers to be placed directly under the longitudinal load-bearing elements in both types of sections, improving structural behavior and also simplifying and unifying pier typologies across the entire viaduct.

The steel sections consist of variable-depth trusses located along the edges of the deck. Each truss includes upper and lower closed-section chords connected by diagonals, also of closed section. At the center of the 67-meter span and at each end of the trusses, the upper and lower chords are connected by a solid web, which enhances structural efficiency compared to a solution using diagonals along the entire length of the truss. The lower chords are connected by transverse steel beams placed every 3 meters, supporting a concrete slab with a variable thickness between 22 and 35 cm. The upper slab is cast in place over precast panels, in accordance with the original project concept.

The steel structure is completed by the inclusion of two secondary longitudinal beams that connect the transverse beams.

For the concrete sections, a nearly fully prefabricated structure is proposed, with joint details specifically designed to facilitate construction and ensure high quality, thus enhancing durability and reducing maintenance costs. The structure includes the following elements:
- Post-tensioned prefabricated longitudinal beams placed at the edges of the deck. Each beam includes four prestressing tendons, tensioned during the construction process.
- Post-tensioned prefabricated transverse struts placed between the longitudinal beams over the pier support sections. Each beam contains four prestressing tendons, which are tensioned after the connection with the longitudinal beams has been made.
- Reinforced prefabricated transverse beams placed between the longitudinal beams, including the portion of slab on which the train will run.



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