La Vicaria Arch over La Fuensanta reservoir

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Summary

La Vicaria Arch is a through arch bridge placed over La Fuensanta reservoir on the river Segura, Albacete (Spain). The total length of the viaduct is 260 m, with 2 arches that spans 168 m. Each arch is inclined 10º inwards at both sides of the deck. The arch sections are quasi-rectangular formed by folded steel plates filled with self-compacting concrete. The deck section comprises two longitudinal steel beams connected with a concrete slab. The construction system involves assembling a 120 m bowstring arch on the ground and after that, lifting it 40 m with hydraulic jacks to connect it to the rest of the structure, built as a cantilever erection.

Keywords: Arch; self-compacting concrete; composite section; anchoring; elevation; tied bridge; hangers; cantilever, bowstring, lifting.

Fig. 1 The Vicaria Arch. 3D simulation.
1. Main parameters

Deck:
- Spans length: 20+25+170+25+20
- Depth section: 1.25 m
- Span/Depth section: 136

Arch:
- Span: 168 m (120 m over the deck).
- Rise: 48.9 m (25 m over the deck).
- Depth section (crown): 1.2 m
- Depth section (spring): 2.4 m
- Span/Rise: 3.4
- Span/Depth section (crown): 140
- Span/Depth section (spring): 70

Fig. 2 Section of the arches

Ratios Span/depth sections show a great slenderness of the structure, that implies high flexibility to the group arch-deck. This required special attention to deflections during design of the constructions stages and the life-time of the bridge.

2. Construction Stages

1- Construction of foundations, piers, abutments.

2- Construction with falsework of the 120m central zone of bridge (deck and arches) on the ground of the reservoir. Arches-deck connection. Once the falsework is removed, this central part of the structure works as a bowstring supported at its ends.

3- Construction with cranes of approaching spans and initial zone of arches from the foundation to the intersection of arches and deck. Connect arches and deck in cantilever. Anchor the deck to the abutment through retaining prestressed tendons.

4- Lifting of the bowstring to its final position. Connect of both partial structures.

5- Casting concrete inside the arch. It is divided in many watertight chambers, 5m long each. Those are filled in 2 phases for keeping the balance of loads applied on the arches at any time.

6- Casting concrete of the deck top slab.

7- Finishes. Installation of dampers in the abutments. They are designed to reduce the vertical deflections produced by asymmetric live loads in the arch, and in the other hand, they will allow slow deflections in the deck due to thermal and rheological actions.

Fig. 3 Structural transmission of forces during the lifting.