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Bridge across the River Vah's Reservoir Hricov and over the road I/18, Motorway D3 in km 7.500

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Abstract

This bridge structure is designed as twin bridge of total length 1.40 km, the structure has only two expansion joints in its length. Each bridge structure is designed as precast concrete girder with 29 and 30 spans.
Three methods of casting were designed for this project, symmetrical cantilevers (part 3); stationary (part 1) and movable scaffolding system (part 2 and 4). The cross section of part 1,2 and 4 is double „T“ beam, part 3 is box girder. Because of shortage of time all parts of structure had to be built together. Construction of the bridge has started in December 2014, the main prestressed concrete superstructure should be finished until December 2016 and all remaining works should be finalized in 2017.

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1. Introduction

The paper describes the technical solution adopted and the current status of construction on the bridge overpass construction project that is part of the D3 motorway being built in the Zilina (Strazov) – Zilina (Brodno) section. This section constitutes a part of the D1-D3 motorway network being designed and built along the Bratislava – Trencin – Zilina – Skalite route, with a connection to Poland and a branch off to the Czech Republic Completion of this section of the D3 motorway will create conditions favorable for a substantial alleviation in terms of load reduction on the motorways I/11 and I/18, and primarily for diverting the transiting traffic in the north-south direction within the Zilina

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urban area. The bridge structure is situated at the beginning of a section having 4.25 km in length that has already been completed. The structure is being executed according to the contract terms of FIDIC "Yellow Book" (the design & build system); thus, the launching proper of the construction was preceded by several months of designing work.

2. Description of the bridge

The bridge structure 223-00 is comprised of two bridges where there is a separate, self-contained structure designed for each direction of traffic. In terms of static design the two bridges are identical. The superstructure of each bridge is designed as a continuous beam made of a single-piece (monolithic) pre-stressed concrete having 29 and 30 spans in the case of the right-hand side and the left-hand side bridge, respectively. The superstructure of the left-hand side and the right-hand side bridge is of a total length of 1492.64 m and 1436.67 m, respectively; these two constitute one single dilation unit.

Owing to the complexity of the structure and for reasons of complying with the stipulations of the tender documents the bridge has been subdivided work-wise into four technological units. Each technological unit makes use of its own construction technology, and the progress of their construction is independent of one another. The breakdown has been determined based on the construction technology used for the superstructure. The first part of the bridge traverses at a very sharp angle the motorway I/18 which is in operation, whereupon it passes an access ramp of the D3 motorway and a double-track, electrified railroad of the Bratislava – Zilina line of the Slovak Railways System. This is why a fixed centering method of construction was chosen here for building the supporting structure. In its second and fourth parts, the supporting structure is built using two MSS type push-out centering supports, while in its third subsection where the river basin authority requested a 110 m span, the balanced cantilever technique (casting of segments in situ) has been chosen.

In the technological units 1, 2, and 4 the supporting structure cross-section is of dual beam type with a constant beam height, while in the technological unit 3 this is a chamber type cross-section of variable height. The free width of the roadway is the same on both bridges: 11.25 m.

3. The bridge construction proper

In the technological units 1, 2, and 4 the bridge is founded on large-diameter drilled piles having 1.2 m in diameter; in technological unit 3 it is supported on piles of 1.5 m in diameter. The piles penetrate beneath the groundwater level and are contained in pits lined with sheet piles (pile planks). Class C30/37 concrete is used for all piles. The average length of the piles is 14 m; the drilling operations were discontinued on reaching R4, R5 natural bedrock. In locations where the bridge traverses the Hricov Pond and Hricov Water Reservoir the piles were anchored in artificially constructed peninsulas previously built of backfilled material. The artificial peninsulas were constructed gradually in the Hricov pond and reservoir from construction-site access roads. Once the piles were in place, temporary pits lined with single-wall sheet piles (pile planks) were constructed on the peninsulas; these were braced by steel sections having no special sealing of the end match devices. The excavations and dugouts for the foundations and piers were mostly performed underneath the water level of the local Hricov pond and reservoir. Percolating water was pumped away using pumps which were in permanent operation.

The foundations of the third technological unit are of square shape, having 11.0 by 11.0 by 2.2 m in size; in the other technological units they are rectangular, of 5.7 by 7.6 by 1.5 m in size. Class C25/30 concrete was used for the foundations which employed shuttering of Framax system. The technological units 1, 2, and 4 make use of piers of the same cross-section, of rectangular shape 1.7 by 4.5 m, with steamlined endings on both sides. The piers are from 5 up to 17 meters in height. The piers were constructed using a bressumer type load-bearing formwork in layers of 4.5 m in height, made of class C 35/45 concrete. In the third technological unit, in consideration of the balanced cantilever concreting method, dual piers were chosen having a ground plan cross-section of the halves of an inclined letter D; these were placed facing each other and spreading out up to the height of 16 m in a fan-like arrangement. The concrete was also laid using a falsework system, in 4.5 m layers. Owing to the complex shapes of the piers, the formwork had to be supported by specially constructed supports made Staxo type centerings; this imposed exacting demands on ensuring bedrock stability within the water reservoir. Here the concrete used for the piers was class C50/60 concrete.

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