Progressively Erected Bridges

Jiri Strasky [1] ✉
✉ e-mail: jiri.strasky@vut.cz
[1] Brno University of Technology, Faculty of Civil Engineering, Concrete and Masonry Structures, Brno, Czech Republic
DOI: https://doi.org/10.14459/icbdb24.002

Abstract Recently we have had a nice opportunity to participate in design of several long span bridges which deck was progressively erected.

The first structure is a 2,932 km long viaduct which is a part of the Bratislava D4R7 Bypass, Slovakia. The bridging consists of a bridge over the Danube River, a bridge over a rowing track and an eastern and western approach viaduct. The bridges, which have a unified architectural and structural solution, have a 35.0 m wide deck consisting of a spine box girder with large overhangs supported by precast struts. The bridges over the Danube River and the rowing track were cast segmentally in symmetrical cantilevers, the viaducts were cast span-by-span in an overhang movable scaffolding with a so-called organic prestressing. The deck was created progressively, at first, the spine girder was made, then the overhangs were cast in a movable scaffolding at 20 m long sections. Static and construction problems of the design of the western viaduct and the bridge over the rowing track, with the main span length of 210 m, will be discussed in a greater detail. The Bypass was constructed as a PPP project.

The second structure is the Slovak longest viaduct, which is being constructed on the R2 Expressway between cities of Kriváň and Mýtna. The 4.36 km long viaduct, which is being erected in an environmentally sensitive mountain area, runs through the beautiful valley of the Kriváňský Creek. The viaduct carries both directions of the 24.5 m wide expressway R2 on one 27.5 m wide bridge structure. It has a uniform architectural and structural solution along its whole length. The viaduct, which forms semi-integral structural system, is constructed as a Design Build Project.

While at both ends the viaduct is led on the mountain slopes, the central viaduct portion crosses the existing highway and creek several times. That is why the span lengths of the viaduct's side parts are from 60 to 70 m, while the span lengths of middle part, due to the skew crossings of the creek and the highway, is from 70 to 150 m. It was evident that the viaduct's side parts can be either cast in a movable scaffolding or incrementally launched, while the central parts require balance cantilever construction.

The viaduct is formed by a spine box girder with large overhangs supported by narrow piers. This structure requires minimum excavation in the steep slopes and create clear and clean order of supports minimally disturbing beautiful countryside. The bridge deck is being constructed incrementally. At first, the spine box girder is being cast and longitudinally prestressed, then precast struts are suspended on the spine girder and the deck slab is progressively cast in simple formworks supported by precast struts. After the deck is transversally prestressed, external cables situated inside the box girder are installed and the whole structure is longitudinally prestressed.

To simplify structural details and eliminate bearings, the structure was designed as an integral structure. Since piers formed by twin slender walls guarantee the stability of the cantilever structures during construction and in the same time allow large longitudinal movement of the completed multi-span structure, they were used not only for cantilever structures, but also for the viaduct's side parts. Here the twin walls support an advance constructed pier tables supporting the front legs of the overhead movable scaffoldings.

The viaduct is divided into eight expansion units. The expansion joints between the first and second unit and between the forth through eight units are situated in the gap between units' end diaphragms which each is supported by a slender wall. The expansion joints of the cantilever structures are situated at middle of the shortest spans. Long term deformations of the adjacent cantilevers are reduced by steel girders inserted into the spine box. Static and construction problems of the design will be discussed in a greater detail.

The progressive construction of the bridge structures was also utilized in the design of our latest arch, cable-stayed, suspension and stress ribbon pedestrian bridges. These structures will be presented briefly, too.