

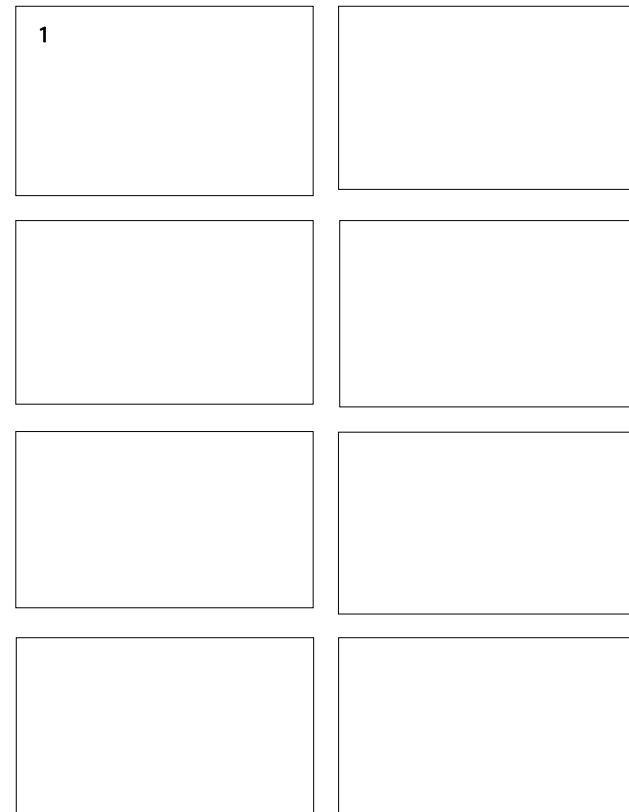


## VTR® (VerbundTrägerRost)

The Romanian highway and railway infrastructure is presently involved in a large operation of construction, renewal and modernization. Beside the classical solution, the new ones with efficient design and construction enter the market. SSF-RO welcomes this trend with the VTR® (VerbundTrägerRost = Composite Steel – Concrete Girder System) solution.

The VTR® solution for composite bridges consists in simplifying the structure as much as possible. At very long composite bridges, the concrete carriageway is usually executed with the help of a formwork carriage. The short erection time enforces the usage of a girder system, on which the prefabricated concrete slabs can be placed. This is proposed by the VTR® concept. In order to simplify the work on site there has not been employed an exclusively steel cross beam, but a precasted concrete cross beam. This construction procedure – conceived by SSF Ingenieure AG – permits wide concrete joints and large overlapping lengths of the reinforcement bars.

- 1 VTR® construction stages
- 2 Pier node erection details – for integral or semi-integral bridges



Generally the erection time of composite and concrete bridges depends on the casting of the concrete slab, especially for large bridges. This was the idea for the development of the SSF-Rapid solution known as VTR®. This solution uses prefabricated elements and reduces strongly the in situ operation and consequently the erection time, offering a better quality of the structural elements. Due to the fact that the VTR® - solution uses intermediate composite sections beginning with the construction stages it is also important to mention that the solution presents increased performances in steel economy.

The VTR® constructive method doesn't imply a high degree in complexity and also doesn't refer to bridges with very large spans. This constructive solution – remarkable in its simplicity, modularity and execution fastness – is instead characterized by the premises which could be very important for beneficiaries (structural robustness, durability, certainty to respect the imposed deadlines) as well as for execution firms (economy, facile execution, increasing of weather protection and on competitiveness respectively, not least, gratification of contract requirements).

## Mures River Viaduct

The VTR® solution was first introduced in Romania on the A1 motorway, sector Deva – Orastie at km 19+857, for a viaduct over the Mures River. The structure is a curved composite bridge with a radius of 1800 m. The bridge with 12 spans each of 60 m and a total length of 720 m is one of the longest in Romania.

The bridge is made of two independent parallel structures for each driving sense. The steel main girders are made of steel S355 J2 + N with a total height of 2,45 m and the width of 1,70 m. For the entire structure 4100 tons of steel were used, which lead to a consumption indices of 199 t/m<sup>2</sup>.

The static system of the bridge is semi-integral. Three central piers are bounded to the superstructure to permit the taking over of the seismic and breaking loads. In the remaining axes of the structure, pairs of calotte bearings are used, one on each pier-column.

- 3-7 Construction stages – site photos
- 8 In-situ test
- 9 Bottom view of the bridge



The usage of prefabricated elements leads to fast execution speeds. The high degree of prefabrication reduces the possibility of unwanted situations on site and offers simplicity in execution. VTR®, by using the performance of the steel and optimal utilization of this material in the cross section, achieved cost indices that rival with existing classical concrete solutions.

The high execution speed of the concrete carriageway slab practically contributed to keeping the deadline. It took only 4 months to finish the entire deck of the bridge which has a total surface of approximately two hectares.

The structure is robust having details with reduced corrosion and fatigue risk. The bridge has been tested in situ with 30 t - trucks laid in different positions. The results have been very good and in tight correlation with the ones obtained through static calculations.

The bridge is under traffic since December 2012, being inaugurated two and a half months earlier than the given deadline. The Mures Viaduct was at that date the longest motorway bridge in Romania.

