Arch all-metal bridge over the Arpa River in Jermuk

11. Arch All-Metal Bridge over the Arpa River in Jermuk

Designed by: TSIIproektstalkonstructsiya
Dimensions:

Overall length: 168 m
Arched span: 120 m
Width of the roadway: 10.5 m
Width of the foot-ways: 2 x 2.25 m
Material:
Grade of steel for main structures: C 46/33
Mass:
Steel consumption per m2 of effective area: 323 kg/m2
Load:
Cars and lorries: H30
Pedestrians: 400 kg/m2

The metal bridge over the Arpa river in the town of Jermuk, Central Asia, the structure of which provides a combined behaviour of the roadway orthotropic slab and stiffening girder was put into operation in 1972. Designed by engineer G.D. Popov.

A combined behaviour of the orthotropic slab and main girders improves the service conditions of the superstructure and its technical and economical characteristics. The use of structures with orthotropic slabs constitutes one of new trends of modern bridge construction both in the USSR and abroad.

The Arpa ravine at the construction site has a depth of about 100 m with vertical (upright) walls 70 - 80 m high of sharply projecting basalt.

The overall length of the superstructure is 168 m, the arched span length is 120 m. The total width of the bridge is 15 m, including the width of the roadway (10.5 m) and of two foot-ways (2.25 m each).

The bridge superstructure is designed as a continuous seven-span stiffening girder with a flexible strengthened arch in the middle span having a length of 120 m. The rise of the arch is 16.69 m which constitutes about 1/7.2 of the span length.

Along the whole length the arches have a constant H-shaped cross section. The posts over the arch supports and those of the abutment spans are anchored in the foundations to take tensile forces.

The continuous stiffening girder of the superstructure in its cross section consists of two girders 1.8 m high placed at a distance of 8.1 m.

The orthotropic slab is made of separate panels 4 by 2.68 m. All over the width of the bridge four panels of the orthotropic slab are placed of which two end ones are placed on the upper chords of the stiffening girders and connected to them by high-strength bolts.

The longitudinal joints between the panels of the orthotropic slab are butted with cover-plates which are welded during erection.

The erection of such 120 meter long metal superstructure was carried out as the erection by overhang for the first time in our country. This required a number of design and technological solutions, including the installation of temporary erection diagonals in the arch panels as well as placing of the members decreasing the free length of the posts and lateral bracing in the plane of posts; fixing of the stiffening girder to the bridge abutment by the horizontal anchor tie rods ensuring stability of the cantilevers being assembled during the erection; providing of the free rotation of the supporting section of the assembled cantilever by means of a temporary hinge in the place of crossing between the arch axes and the over-support posts; development of a special technique for closing the superstructure; systematic control of strains and stresses in the most critical members at all erection stages; a preliminary complete space control assemblage of the superstructure.

The erection by overhang of the abutment and arched spans was carried out simultaneously from both banks by cranes using the pneumatic passageway K-161.

The bridge superstructure was erected during 3 months and a half.

Metal consumption per 1 m2 of the roadway, including the railing and observation devices, was 323 kg, without the railing and observation devices 298 kg.

Metal consumption for secondary structures was 39.7 kg per m2. A total consumption of steel for the bridge superstructure was 814.2 t.

Labour consumption directly on site, including that for erection by large units, handling of members, mounting and dismounting of scaffolding was 3.55 men/hours per 1 ton, excluding mechanical operators 2.24 men/hours.

An estimated labour consumption for the control space erection (carried out at the testing ground of Bridge-Building Team-10 in Rostov) per 1 ton was about 2 men/hours.

(Popov, Ruzhansky, Poliakova)

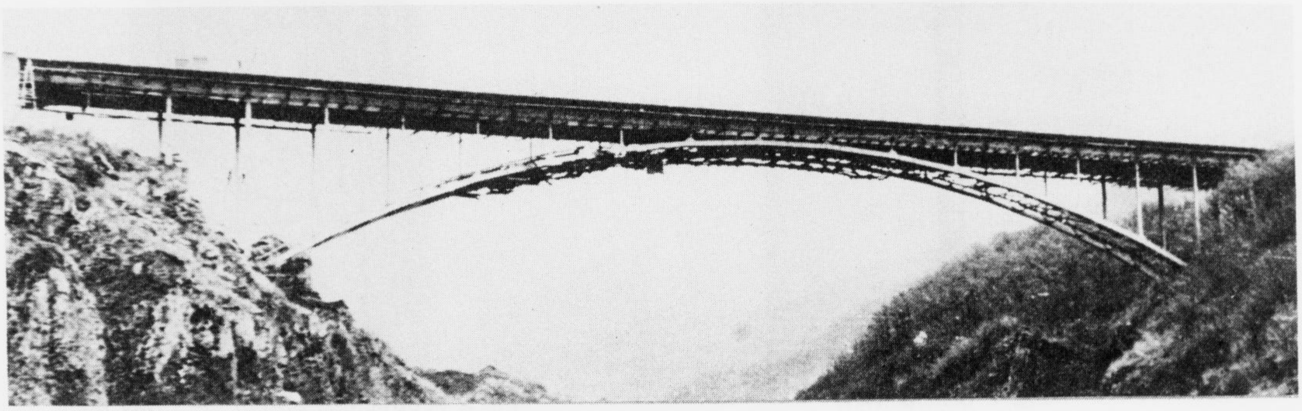

Fig. 1 General View of the Bridge