Swiss railways' double track Aar Bridge at Ruppoldingen / SO

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14. Swiss Railways' double track Aar Bridge at Ruppoldingen / SO

Owner and project management: *Swiss Federal Railways, Region 2 (Lucerne)*
Designer and resident engineer: *Dr. Max Herzog, Aarau (collab. B. Fent)*
Contractor: *Locher & Cie AG, Zürich, and Rüegger Bau AG, Olten, in joint-venture*

Dimensions:
length: *320 m*
spans: *32 + 40 + 46 + 62 + 80 + 60 m*
width: *10.7 m*
Superstructure: *six span continuous single-cell box-girder with variable height above the river*
Substructure: *slender piers with elliptic cross-section and box-type abutments*
Foundations:
- *southern abutment and land piers on stepped footings in shallow depth*
- *river piers each on two bored piles of 3.0 m diameter and 40 m length*
- *northern abutment on two bored piles of 1.75 m diameter and 18 respectively 38 m length*

Quantities:
excavation: *3'000 m3*
formwork: *11'500 m2*
concrete: *5'000 m3*
reinforcement: *620 t*
prestressing steel: *180 t*
sheet piling: *1'800 m2*

years of construction: *1977 – 1978*

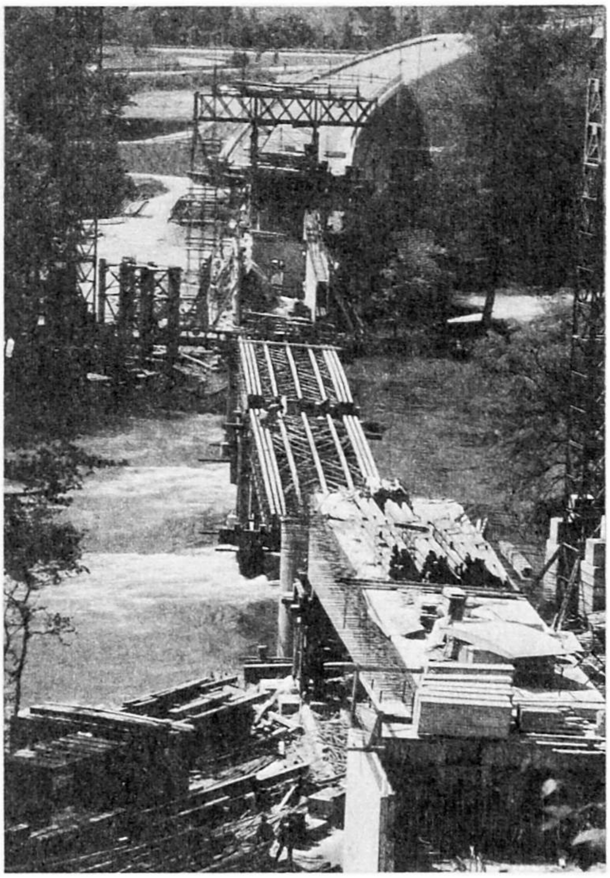

Fig. 4 Construction phase

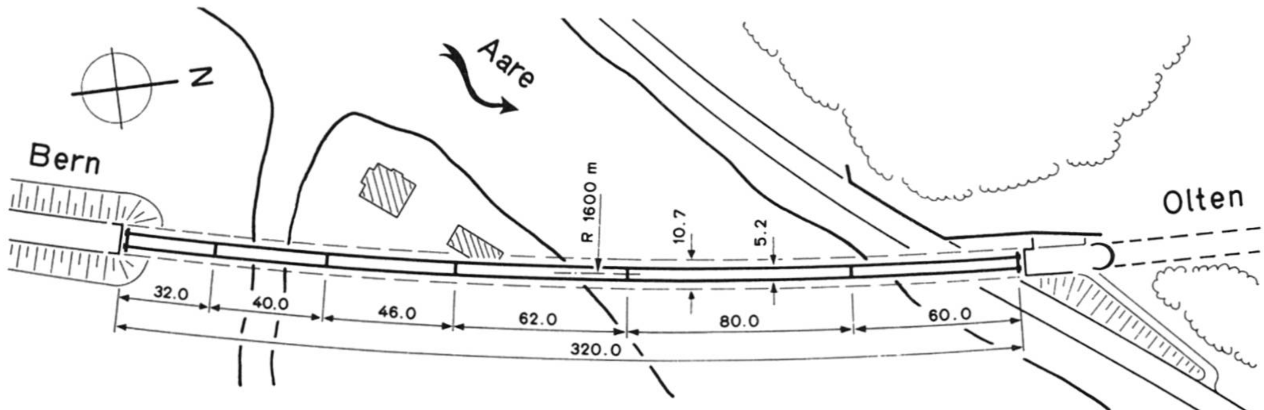

Fig. 1 Plan

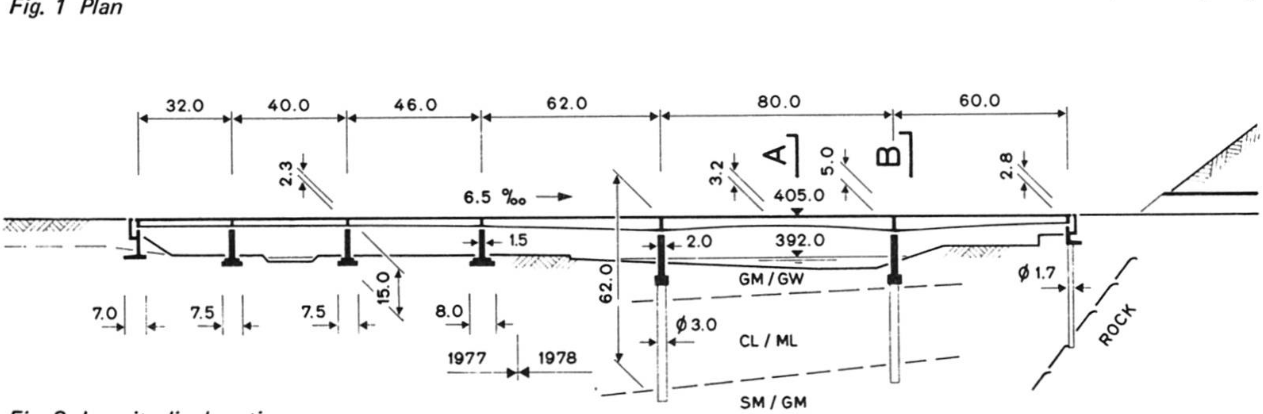

Fig. 2 Longitudinal section

Introduction

To permit the realization of a rigid time-table on Switzerland's main line a new line has to be built between Olten and Rothrist. The Ruppoldingen Bridge is situated immediately southwards of the Born Tunnel and crosses the Aar River near Aarbrugg at about 45 degrees skew. The bridge as-built was chosen from a design competition among five consulting engineers.

Design and Construction

Special features worth mentioning are:

Slurry piles of 3.0 m diameter were a first in the country (concrete cube strength 40N/mm2 at 90 days)
The river piers' cross-section was verified in hydraulic model tests
Instead of steel bearings concrete hinges were built (cube strength 100 N/mm2 at 90 days, extreme working stress 70 N/mm2)
Jumbo tendons (system VSL) consisting of 33 normal strands with 0.6" diameter ($0.65 \beta_z \cdot A_s = 5600$ kN) and of 37 compact strands with 0.6 " diameter (7500 kN) respectively
Construction of the box-girder in several steps with section lengths of 20 - 45 m (southern half in 1977 and northern half in 1978):

1) Bottom slab of constant thickness in transverse direction (0.30 – 0.70 m) and webs of constant thickness (0.70 m) on normal scaffolding only as wide as the box-section
2) Top slab of variable thickness in transverse direction (0.30 – 0.50 m)
3) After construction of all box-sections for half the bridge length the tendons were pushed into previously cast ducts and the shrinkage gaps were closed. Five days later 50 percent of the final prestressing force were applied
4) Cantilever slabs were cast with help of an overhead travelling formwork
5) After construction of the cantilever slabs for half the bridge length the full prestressing force was applied and the tendon ducts were grouted

There is a full splice of tendons between the two halves of the superstructure
Specified concrete cube strength of 50 N/mm2 at 28 days (60 N/mm2 at 90 days) was reached under strict control
The bridge has no fixed bearings. It is elastically restrained by the piers' bending stiffness
The design was checked against the most recent developments in the understanding of variable-amplitude fatigue loading and strength

Measurements

Because of the bridge's importance a large program of measurements is under way. Besides the usual deflections also
- temperature distributions in several cross-sections
- reinforcement strains under prestressing and different loadings to obtain information on the local strain distribution in the box-girder's cross-sections next to the piers
- displacements of the superstructure and ground-relaxation under longitudinal forces
- concrete hinge rotations

and other values are measured systematically.

(M. Herzog)

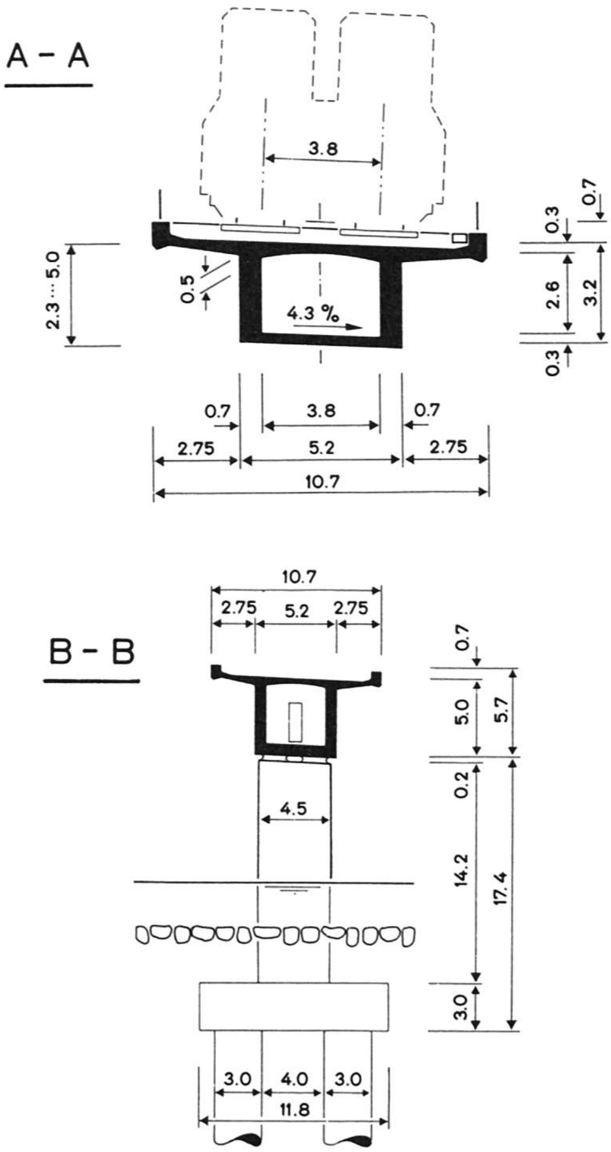

Fig. 3 Cross-sections

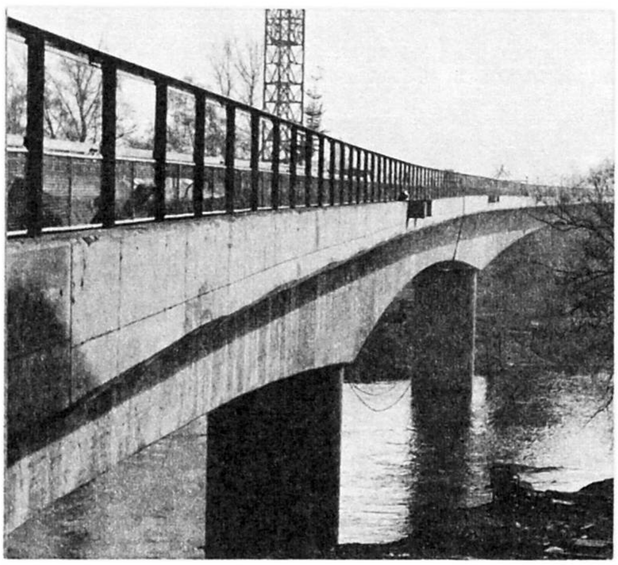

Fig. 5 Completed bridge