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Artikel: The angered bridge in Göteborg (Schweden)
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6. The Angered Bridge in Göteborg (Sweden)

Builder: The Street and Highway Department of Göteborg
Contractor and Engineer: AB Skanska Cementgjuteriet, Göteborg and Stockholm
Works duration: 35 months
Opened for traffic: 1978-12-03

Dimensions:
Bridge length: 925,4 m
Span length: 68 + 5 x 129 + 122 + 66 m
Total width: 17,0 m
Foundation: Four supports on rock, five piled supports
Structural design: Three frames linked together with hinges Boxgirder

Quantities of material:
Concrete: 20.000 m3
Re-bar: 1.500 tons
Prestressing steel: 500 tons
Number of piles: 800
Total length of piles: 30.000 m
Contract cost: 29 Million Swedish Crowns
Total cost: 40 Million Crowns

Introduction

The Angered Bridge (Fig. 1) is a northern link of a ringroad around the more central parts of Göteborg. The bridge passes over the valley of Göta River. In the valley there are two main roads and a main railway line.
Too many piers would give a screen effect in the valley and therefore rather long spans were chosen in the reference project which the tendering firms had to calculate together with their own proposals. The lowest tender was received for the reference project.

Foundation, Substructure

The ground consists of rock on both sides of the valley (Fig. 2). In the valley there is 0 - 20 m soft clay on layers of silt, sand, gravel and moraine. The gravel and the moraine can partly contain big stones. The clay near the river is rather sensitive. Bridge supports numbers 1, 2, 8 and 9 (Fig. 2) are founded on solid rock but the steep rockside between support 8 and 9 is stratified and had to be stabilized.

Under each support 3 - 7 there are about 160 concrete piles, pile length 20 - 50 m. Mainly two kind of pile with a permitted load of 600 kN and 675 kN were used. They were driven by hammer. The stones in the moraine caused some trouble in the driving.
The piled foundation slabs have the horizontal measures 13 x 21 m and a thickness of about 3 m. During hardening of concrete they were cooled with cold water circulating in pipes. A rather heavy reinforcement including shear reinforcement was needed.
The piers, 21 - 50 m high, have hollow sections with outer dimensions of 4 x 9 m and wall thickness of 0,4 - 0,45 m. They were cast in sliding form. The concrete had normally a cube strength of 45 MPa but in some parts a higher quality of 50 MPa was needed.

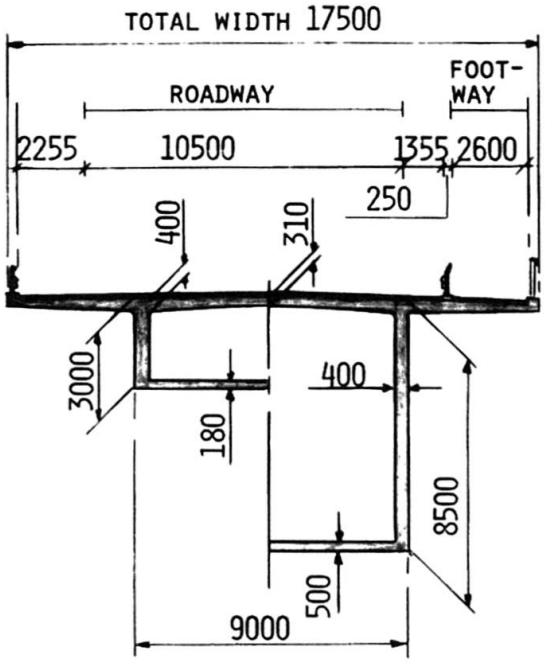

Fig. 3 Cross-section in the span centre and at the pier

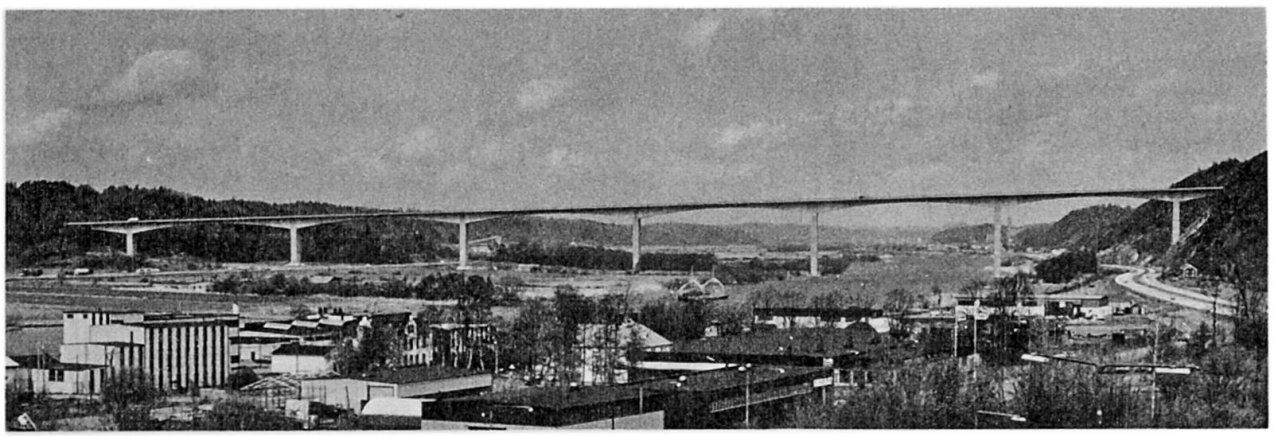

Fig. 1 The Angered Bridge. General View.

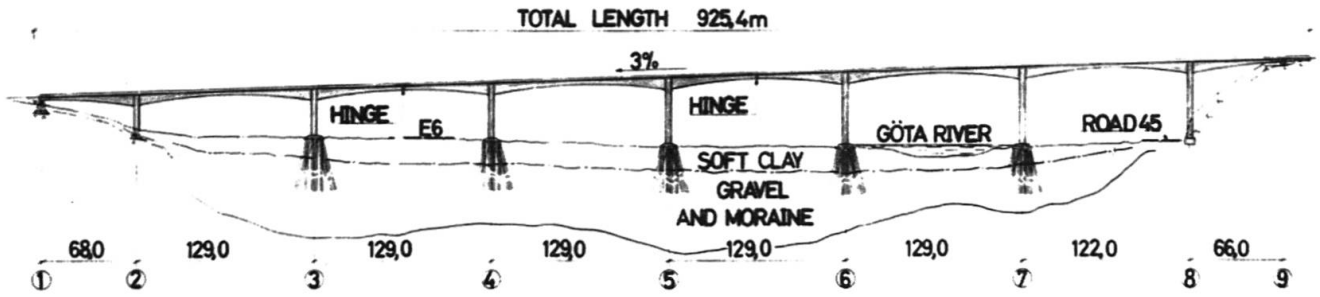

Fig. 2 Bridge scheme

Superstructure

The superstructure consists of a box-girder with a cantilever deck slab and has the measurements shown in Fig. 2 and Fig. 3. It was built with the cantilever method (Fig. 4) using scaffold waggons. Four waggons were used at the same time. The weekly progress with each waggon was 5 m near the pier and then 4,5 m, which gave 13 stages from pier to span middle. The concrete was transported by pumping up to a level more than 60 m above the ground.
The girder and the piers form three frames with hinges in the span centres 3 - 4 and 5 - 6. The hinges are designed as pendulum bearings, which permit longitudinal movements and transmit vertical forces. Horizontal transverse forces are transmitted by a separate construction.
Expansion joints, fabrication Maurer, are used in the deck at the hinges and the abutments.
The main prestressing is placed as straight cables only in the bridgedeck. VSL prestressing Dyform-units of seven 13 mm strands are used. Some of the spans are also prestressed in the bottom slab with the same kind of unit.
Depending on the width of the bridge and the rather thin walls of the box girder (Fig. 3) the shear stresses are high. Therefore it has been necessary to prestress the walls with inclined Dywidag-bars.
The concrete quality is the same as in the piers, mainly a cube strength of 45 MPa but up to 50 MPa in some parts.

(B. Lindeberg)

Fig. 4 The bridge under construction