11 No. 13 – Prague – railway bridge below Vyšehrad

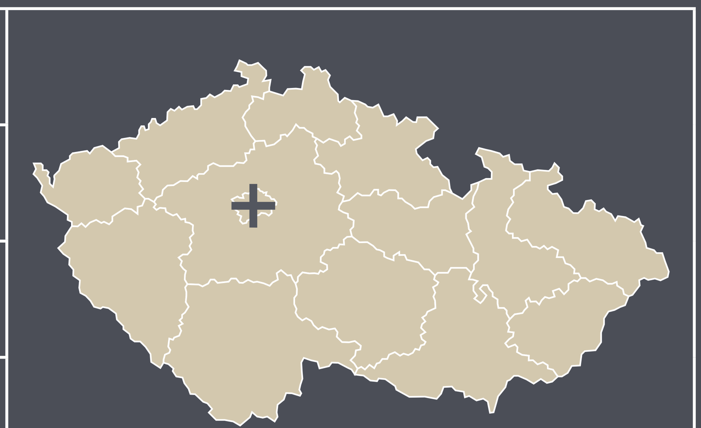
railway truss girder bridge

Capital City of Prague

cad. territories Vyšehrad, Smíchov

cultural monument*

TÚ 0201, DÚ 04, evd. km 3,706



50°04'00.52"N 14°24'48.35"E

CZECH TECHNICAL UNIVERSITY IN PRAGUE

View of the bridge from the southeast in 2021

History

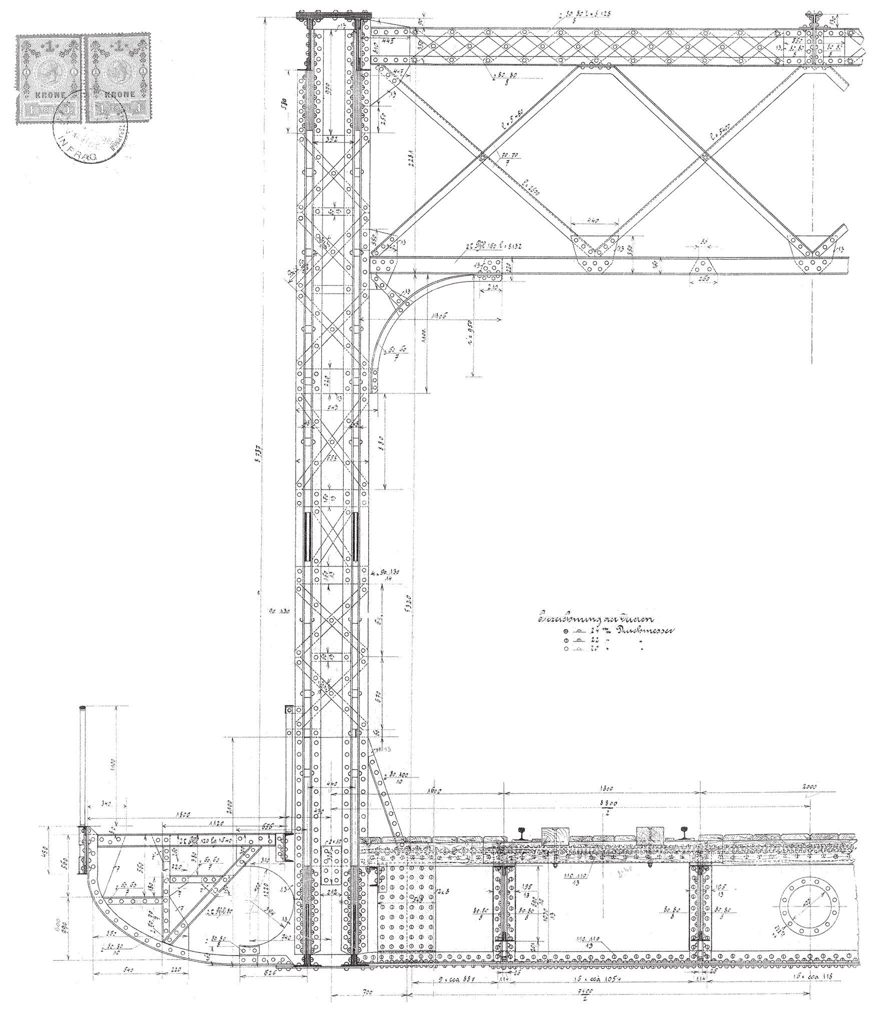
The series of railway bridges below Vyšehrad was built as a part of the so-called Prague Connecting Railway, which connected the railway station in Smíchov with today's Prague Main Railway Station. Dominant was the bridge over the River Vltava. However, the five-span bridge from 1871–1872 gradually became insufficient for the increasing amount of traffic. The grain wrought steel construction has insufficient strength, and there was also a requirement from the River Authority that the bridge be rebuilt from the original four spans located in the river to three, larger spans. Therefore, in 1900–1901, a new double-track bridge was built of mild steel. The bridge has three spans of 72 m each and is trussed with an upper semi-parabolic span with a lower bridge deck. The bridge over the River Vltava was undoubtedly the most remarkable in contemporary Czech bridge construction. It is recognised as a masterpiece amongst technical structures built in the style of late classicism.

Replacement of 1871–1872 bridge

The method of bridge replacement was conceived and designed in 1899. Five new piers (three of them as guide piers) were built using a pneumatic foundation. Each of the three steel spans was supplied by one of the Prague bridge works. The steel structure of the new bridge was assembled on a timber scaffolding on one side of the existing bridge. In addition, a dismantling scaffolding was constructed on the upstream side to allow for removing the old bridge.

After the original girders were slid out onto the dismantling scaffolding, new 560 t girders were moved to their place. The level of the bridge deck of the new bridge was 1,5 m higher to allow for placement on the piers. Extension and retraction were carried out by hydraulic jacks, cranes and hoists on transverse retraction tracks using trolleys or cast-iron balls. The entire bridge replacement took only two days. The extension of the old structure by 7.5 m took 5 hours, while it took only 25 minutes for the replacement girders to be slid into place. A successful load test was then carried out by three locomotives with fully armed tenders and two loaded four-axle trucks. The planned three-day shutdown could thus be reduced to two days thanks to the exceptional performance of all the companies involved.

Replacement of bridge in 1901

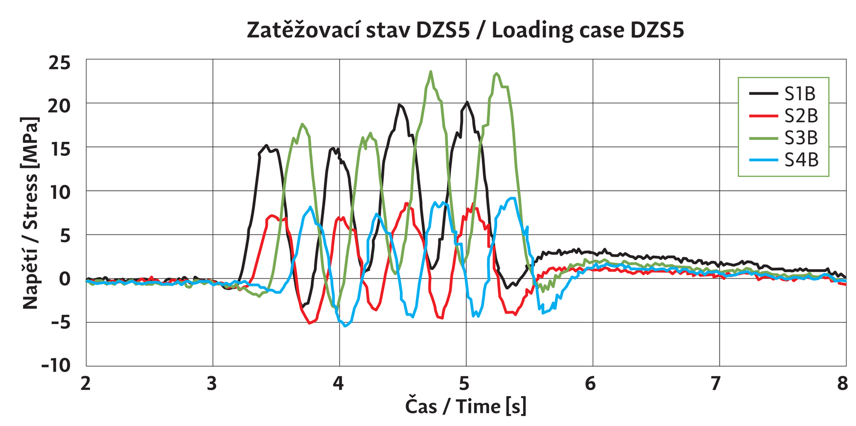


Original drawings:
Cross section of the bridge

No repairs have been carried out on the main superstructure during its entire existence. Since 2004, the bridge has been declared a cultural monument. It is a remarkable structure from an architectural, urban planning and structural point of view and became a landmark forming a view of the historic city of Prague.

The bridge dating from 1901 was designed and constructed in a highly professional and high-quality manner. It has thus been able to fulfil its transport function within TEN-T network for 120 years without the need of major repair work, which is truly exceptional in Europe. That is why the current public tender for the architectural and structural upgrading of the railway bridge below Vyšehrad is the focus of attention for both the technical community and the wider general public. It is believed that an elegant and technical solution will be found, befitting such an iconic landmark of Prague.

Load test



Time development of stresses during test

Bottom chord corrosion

Crevice corrosion

Gap between plates

Measurements and tests

The notch toughness impact tests revealed that the structural material is not suitable for such a dynamically loaded structure due to likelihood of brittle fracture. Static and dynamic load tests were carried out in 2017; the following variables were measured:

- vertical deflections
- deformations of the end crossbeams
- normal stresses on selected members (top and bottom chords, diagonals, crossbeams, stringers)

During the dynamic load test, acceleration of vertical and transverse deformation at mid-span and at approximately a quarter of the span and normal stresses on selected members (following the static tests) were measured.

Assessment of bridge condition

The condition of all three bridge spans were rated as "3 – the object requires major structural intervention" mainly due to:

- cracks in top flanges of stringers
- significant corrosion weakening of structural members
- excessive crevice corrosion
- missing bolts fixing bearings
- largely damaged corrosion protection of steel structure

Since the inspection of 2014, the bridge has deteriorated. No major repairs have been made to the main truss beams in 120 years of the existence of the bridge.