

Two Historical Bridges in One in Roudnice nad Labem

Dana KOLÁŘOVÁ

Dept. of Load Bearing Structures, Faculty of Architecture, Czech Technical University in Prague,
Thákurova 9, 166 34 Praha, Czech Republic

kolarova@fa.cvut.cz

Abstract. *This paper is focused on history of two bridges built over the Labe river in one location in Roudnice. Bridges connect regions, they have important economic and social roles. The paper is looking for an answer to questions why, when and how these bridges were built. The first one, a Gothic stone bridge, was built in the 14th century. The second one, a Modern steel bridge was built in the beginning of the twentieth century in the same location.*

Keywords

Bridge, Gothic bridge, steel bridge, historical bridge, bridge construction, history, history of technology.

1. Introduction

The importance of bridge construction has been very nicely captured by professor A.V.Velflík (see [1]):

“Jako za starodávna tak i za našich dob je stavitelství mostní vrcholem dovednosti stavebních inženýrů a je výsledkem hlubokého studia v mnohých průpravných naukách jako jest: nauka o pružnosti a pevnosti, stavební mechanika, grafická statika, stereotomie a ovšem v nejvyšší míře matematika; ano nynější úžasný a všeobecně obdivovaný rozvoj klenutých mostů je výsledek hluboké theorie, snoubené s mnohaletými zkušenostmi, důvtipem a odvahou stavebních inženýrů.“

"Bridge building both in the past days and nowadays represents the utmost accomplishments of civil engineers, being a result of thorough studies in many areas of preparatory disciplines such as the theory of elasticity and strength, structural mechanics, graphic statics, stereotomy, and, of course, to the highest extent, mathematics; yes, today's amazing and generally admired accomplishments in the area of arched bridges are a result of a profound theory supported by many years of experience, ingenuity and boldness of civil engineers." (translated by Ing. Markéta Vavrušková)

We can demonstrate the reasons for the conception and realization of such constructions, variability of their load-bearing structures and their benefits towards regional development on the example of two historical bridges over the Labe river in Roudnice.

2. The Gothic Stone Bridge over the Labe River in Roudnice

2.1 Brief Overview of Existing Research

Our examination of the history of a medieval bridge over the Labe river in Roudnice is based on historical sources and previous research.

The commemorative panel located in the Church of the Nativity of Virgin Mary in Roudnice is probably the oldest source in the form of inscription.

The information on the construction of an Augustinian monastery with concurrent information on laying of the foundation stone of a bridge on St. Bartholomew's Day, i.e. on the 24th August 1333 as well as the information on the seven year long construction time is recorded there.

Further historical research is connected with the construction of a new road bridge.

At this point, let's mention especially the leading representative of bridge constructions, professor A.V. Velflík, who was the first person to try to create the reconstruction model of the old stone bridge. Subsequently, we should mention professor Břetislav Tolman, a head construction supervisor of the new steel bridge in Roudnice, who took part in revealing the fragments of the original stone bridge (1904). Together with V. Chaloupecký, a head archivist and librarian of the House of Lobkowitz, they archived the objects that had been found and published the results of their research (see [2]).

An unexpected discovery of fragments of stone blocks and beams of a gothic bridge (surprisingly very well preserved) was made in autumn 2004 during a cleaning of the river bed, almost one hundred years after the new steel bridge structure was erected.

This discovery has refreshed an interest in a research of the original stone bridge over the Labe river in Roudnice. A detailed research was conducted by historians Michal Cihla and Michal Panáček (see [3]).

2.2 History of the Stone Bridge

The gothic stone bridge over the Labe river in Roudnice, considered the third oldest bridge in Bohemia (and the first over the Labe river), was commissioned to be built by the Prague Bishop John IV of Dražice.



Fig. 1. The coat of arms of Bishop John IV of Dražice (a copy; the original stone was found in the Labe river during an erection of the new steel bridge), contractor of the first stone bridge in Roudnice in 1333 (author's photo).

It is highly probable that John IV of Dražice did not find any bridge construction experts in the Czech lands, therefore he invited a French master builder Guillaume (Vilém), whom he met whilst staying in Avignon.

The influence of French construction methods and advanced technologies based on traditional Roman architecture is reflected in the structure of the bridge.

From a historical perspective, it is explicitly the technology of foundations construction in a river bed of big watercourse, the way of cutting of both stone and wooden parts, and their mutual joining by iron anchors what represents one of the most significant benefits this structure has introduced to the Czech lands.

Master Guillaume had come with his three apprentices, and spent one year at the construction site, a year during which he had built two pillars and an arch, and trained local builders.

The construction proceeded quickly compared to then common practices, showing an excellent coordination of all participants of the building process in the area of management and logistics, as well as in the methods of cutting stone and wood, and in other craftsmen fields.

In the years to come the structure proceeded at a comparable speed under the supervision of a Czech bridge builder Ota (one bridge arch per year).

As documented on the commemorative panel located in the Church of the Nativity of Virgin Mary in Roudnice over the River Labe, the bridge was finished in 1340.

The bridge has undergone a loading test during floods in 1342, when the Judith Bridge in Prague was damaged.

In the forthcoming period, the bridge in Roudnice is mentioned in preserved sources only insignificantly in connection with a toll collection (see [3]).

The bridge opened an important way to the north areas on the right riverbank of the Labe river, especially towards Budyšín, and thanks to it Roudnice became an important business centre.

The bridge was also an important strategic point, which, in the end, sealed its fate. It was battered by Saxon troops in 1632, and completely destroyed by General Banner's Swedish army.

There are proposals for the bridge rebuilding from an imperial military engineer Carlo Lurago, who planned to substitute stone arches with a wooden structure, from 1660. The bridge repair did not take place as well as another project by Antonio della Porta from 1670. The remnants of the bridge continued to deteriorate.

According to Petřík's technical report published in the *Technický obzor* (Technical Horizon), during the preparation for a new steel bridge construction at the beginning of the 20th century, it was originally assumed that the remnants of the bridge were going to be utilized, but in the end it was decided against it as the renovation of the bridge arches' remains would be much too difficult (see [4]).

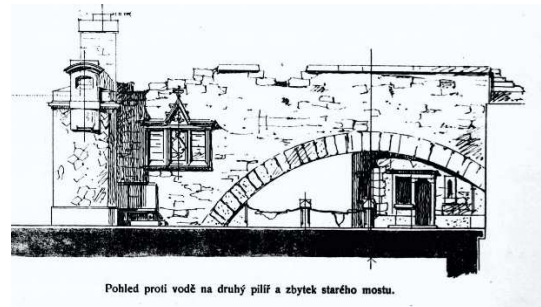


Fig. 2. Drawing of a remnant arch of a stone bridge in Roudnice over the Labe river created by J. Petřík in 1906 (see [4]).

2.3 Details of the Stone Bridge

No original plans have withstood, although it is obvious that geodetic surveying determining the number of arches as well as the bridge span took place and preceded the physical building of stone pillars of the steel bridge.

The basic information concerning the actual structure comes from the disassembled parts and from the original bridge fragments found during the construction of the new road bridge in 2005.

The stone bridge over the Labe river in Roudnice was a stone arch bridge with an upper bridge deck and a span of approximately 220 meters.

The width of the bridge was 6.4 meters. The loadbearing substructure consisted of seven pillars and two bank abutments. The height of the preserved arch was 7.9 meters. Assuming that the radius of a circle defining the bridge arches segments was the same and taking into account the fact that the distance between the pillars varied, the width of the arches fluctuated between 19.5 to 22 meters.

3. The Modern Steel Bridge over the Labe River in Roudnice

3.1 The Steel Bridge Design

An effort to replace the original stone bridge reemerged again in 1894 when Roudnice municipality and its mayor Erwin Spindler requested a proposal for a new iron road bridge from Pražská mostárna (The Prague Bridgeworks), the branch-office of První českomoravská továrna na stroje (The First Czech-Moravian Machine Factory).

The building of the bridge was supposed to bring an upsurge of trade and industry into the wide vicinity of Roudnice. However, the calculated costs were much too high, and therefore the project was not carried through.

A change arises between 1899-1901, when the simultaneous construction of a river lock and a bridge, which would be financially supported by the committee for the sewerage of the rivers Vltava and Labe, is being considered.

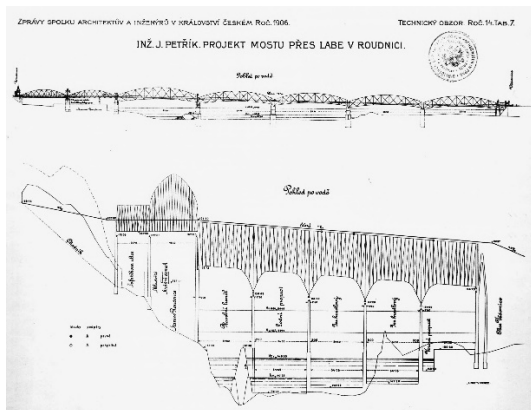


Fig. 4. Design of the new steel bridge in Roudnice nad Labem created by J. Petřík in 1906(see [4]).

The assignment was specified in more detail, the width of the bridge was determined as well as its load capacity, the position of the bridge pillars and spans specifications: the first span over a street, the second span over the rails of the State Railway Company and the remaining five spans overlapping the river.

Two companies, Pražská mostárna (The Prague Bridgeworks), branch-office of První českomoravská továrna na stroje (The First Czech-Moravian Machine Factory) and Mostárna bratří Prášilů (The Prášil Brothers' Bridge-building Company), were asked to create a design of a load-bearing structure of the bridge in spring 1904.

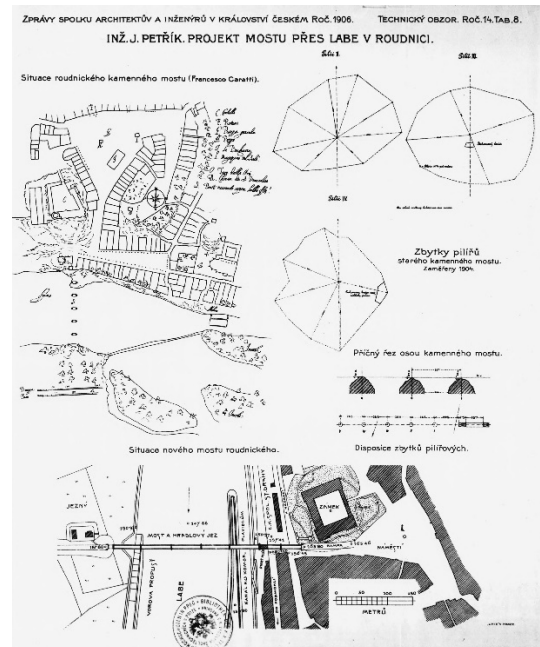


Fig. 3. Situation study of the new road bridge project in Roudnice over the Labe river created by Ing. J. Petřík in 1906 (see [4]).

The first proposals of the bridge design featuring a substructure primarily did not meet aesthetic aspects, the structure disrupted the views of the surrounding landscape.

After several adjustments, the project presenting the upper structure submitted by Pražská mostárna (The Prague Bridgeworks) was chosen.

The construction process started in 1908 and the grand opening of the bridge took place on 28th September 1910.

3.2 The Structure of the Steel Bridge

The design of the steel bridge in Roudnice is a joint work of Břetislav Tolman, the main engineer of the substructure and the bridge locks, Jan Kolář, at the time an employee of Pražská mostárna (The Prague Bridgeworks) and later a Rector of the Czech Technical University in Prague, who designed truss girders with curved flanges above supports and František Sander, an architect who designed the retaining walls of the bridgehead, staircase and the bridge pillars.

The final iron bridge structure is 370 meters long, is supported by four bridge pillars in the riverbed and by another four pillars on the banks. Altogether the bridge consists of seven spans (bridge fields) of the following

measurements: 31 meters wide span above the street, 46 meters wide span above the railroad, and five remaining spans above the river, each 54 meters wide. Altogether the whole construction including the embankments is 1130 meters long.



Fig. 5. Current view of the road bridge with the bridge locks (author's photo).

4. Conclusion

Both bridges have played a major role both in economical and urbanistic development in the history of the town Roudnice and of the whole region. The fact they were built in almost the same site shows the importance and logicity of historical paths. The way they were built shows a fundamental role in application of geometry in bridges construction, common also for different technology and material. The original stone bridge was used for around 300 years. The current steel bridge is also unquestionably a technically excellent structure, as it also withstood a major flood in 2002, though currently it does not meet the high demands of today's traffic.

Acknowledgements

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About Author

Dana KOLÁŘOVÁ was born in Prague in 1963. She studied Mathematics and Descriptive Geometry at the Faculty of Mathematics and Physics of the Charles University in Prague. Nowadays she is a PHD student at the Faculty of Architecture of the Czech Technical University in Prague. The topics of her thesis is Geometry of load-bearing structures of historic bridges.

