

# Problems and issues related to the care of historic stone bridge structures in the Czech Republic

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## Abstract

Using the specific example of the restoration of the Charles Bridge in Prague, the article presents the issue of the development of care for historic bridge structures in the Czech Republic. Currently, a scientific project is underway to investigate ways of restoring other important historical stone and brick bridges in the Czech Republic, taking into account the experience gained from the previous restoration.

## Introduction

In the field of stone restoration, the care of historic bridge structures represents a specific problem on which a considerable number of scientific studies have already been produced.<sup>1</sup> It is clear from the nature of the matter that the emphasis on preserving the function of the structure is a key condition of intervention in the case of these structures, but it can also significantly limit or even eliminate the

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<sup>1</sup> SARHOSIS, Vasilis, Stefano DE SANTIS a Gianmarco DE FELICE. A review of experimental investigations and assessment methods for masonry archbridges. *Structure and Infrastructure Engineering*. 2016, 1-26. ISSN 1744-8980.

ADELI, Hojjat, ed. *Historic Bridges. Evaluation, Preservation, and Management*. CRC Press, 2008. ISBN 9780429150807.

CITTO, Carlo a David B. WOODHAM. Evaluating Existing and Historic Stone Arch Bridges. *STRUCTURE magazine*. 2015, 14-18.

presentation of other values<sup>2</sup> that the historic structure carries.<sup>3</sup> The search for the possibility of maximising the preservation of other values while meeting safety parameters represents a major challenge associated with the restoration of historic bridge structures. In addition, modern engineering has long increased the requirements for meeting bridge structure safety codes, which are difficult to meet for historic structures. At the same time, in terms of material degradation, the bridge structure is often subjected to extreme stresses and the degradation processes are all the more intense.<sup>4</sup>

## History and description

There are several important historic bridges in the Czech Republic, which have become the subject of discussion in recent years about the appropriate type of restoration intervention.<sup>5</sup> The most iconic Czech bridge structure is undoubtedly the Charles Bridge in Prague, which is a symbol of the city and one of the most sought-after tourist sites. Restoration work has been underway on this monument for several years, and in particular the implementation of some parts of the intervention has aroused considerable controversy among the general public. The Charles Bridge was built in the 14th century on the site of an older stone bridge. It has been damaged by floods several times in its history and subsequently repaired; the last devastating flood was in 2002, which surprisingly did not destroy the bridge to any great extent.<sup>6</sup> During the 17th, 18th and 19th centuries, the gradual installation of sculptures by important contemporary sculptors led to the creation of a unique sculpture gallery.

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<sup>2</sup> RIEGL, Alois. *Der moderne Denkmalkultus: Sein Wesen und seine Entstehung*. Wien und Leipzig: W. Braumüller, 1903.

TORRE, Marta de la. *Assessing the values of cultural heritage: Research report*. Los Angeles: Getty Conservation Institute, 2002.

HUI, Sam C. M. a Anfernee H. M. LEUNG. Sustainable building services systems for historic buildings. In: *Joint Symposium 2004: Servicing Dense Built Environments, 16 November 2004, Hong Kong*. Hong Kong, 2004, s. 1-10.

GIOMBINI, Lisa. Conserving the Original: Authenticity in Art Restoration. In: RATIU, Dan-Eugen a Connell VAUGHAN, ed. *Proceedings of the European Society for Aesthetics*. Fribourg: The European Society for Aesthetics, 2017, s. 183-201. ISSN 1664 – 5278.

<sup>3</sup> KING SLOAN, Allan, ed. *The Preservation of Historic Bridges*. In: ADELI, Hojjat. *Historic Bridges*. CRC Press, 2008, s. 185-204. ISBN 9780429150807.

<sup>4</sup> BOUZAS, O., B. CONDE, J.C. MATOS, M. SOLLA a M. CABALEIRO. Reliability-based structural assessment of historical masonry arch bridges: The case study of Cernadela bridge. *Case Studies in Construction Materials* [online]. 2023, **18** [cit. 2023-09-13]. ISSN 22145095. Dostupné z: doi:10.1016/j.cscm.2023.e02003

<sup>5</sup> ŘEŘIČKA, Petr, Petr FAJMAN a Lucy DAVIS. Rescue of a stone bridge with respect to current condition and standards. *Acta Polytechnica CTU Proceedings* [online]. 2022, 2022-12-21, **38** [cit. 2023-09-13]. ISSN 2336-5382. Dostupné z: doi:10.14311/APP.2022.38.0630

<sup>6</sup> BROUKALOVÁ, Iva a Vladimír KŘÍSTEK. REMEDIAL WORKS AND REPAIRS OF HISTORICAL BRIDGE IN PRAGUE. *The Baltic Journal of Road and Bridge Engineering* [online]. 2017, 2017-12-13, **12**(4), 264-269 [cit. 2023-09-13]. ISSN 1822-427X. Dostupné z: doi:10.3846/bjrbe.2017.33

Until 1908 the bridge was even used for tram traffic and as late as 1965 it was left only for pedestrians.<sup>7</sup>

### **Discussion on the issues of restoration intervention**

The Charles Bridge is a very important historical monument whose protection requires a complex approach, the specific form of which, however, experts have not been able to agree on for many years, precisely because they thought about the form of intervention particularly through the lens of their profession. The most discussed aspect of the intervention was the replacement of the historic stone blocks with new blocks, but from a different quarrying site, exactly because the requirement for the physical and mechanical properties of the stone was set in such a way that the types of stones originally used were unable to meet it. However, the issue of replacing the original elements also concerns the sculptural decoration of the bridge. After a broader consideration of the experts involved, it was decided that the Baroque sculptures by the most famous Czech sculptors would be placed in the lapidarium and their place would be taken by carved reproductions. In contrast, the originals of the sculptures created in the nineteenth century have been left in place and are gradually being restored. The practical consequences of this decision are manifested primarily in the resulting colour presentation of the monument. The light colouring of the new copies probably led to the fact that when deciding on the degree of cleaning of the heavily darkened 19th-century statues, in several cases a more drastic cleaning than is normally applied in the Czech environment of monument care was carried out.

### **Conclusion**

Although a huge amount of work, expert discussion and efforts to find an optimal solution have gone into the repair of this important monument, the result has been a rather dramatic change in the overall look and feel of this famous structure. Thanks to successful sculptural reproductions, the bridge has retained its iconic silhouette, which is an essential part of Prague's skyline. On the other hand, on closer inspection, the colour appearance of the monument has been fundamentally altered and thus its overall appearance has dramatically changed. The restoration of this important monument has opened a discussion in the Czech environment concerning approaches to the restoration of this type of monument. Currently, a scientific project is underway to investigate ways of restoring other important historical stone and brick bridges in the Czech Republic, taking into account the experience gained from the restoration of the Charles Bridge.

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<sup>7</sup> BROUKALOVÁ, Iva a Vladimír KŘÍSTEK. REMEDIAL WORKS AND REPAIRS OF HISTORICAL BRIDGE IN PRAGUE. *The Baltic Journal of Road and Bridge Engineering* [online]. 2017, 2017-12-13, **12**(4), 264-269 [cit. 2023-09-13]. ISSN 1822-427X. Dostupné z: doi:10.3846/bjrbe.2017.33

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