



## **Diagnostic approaches to assess natural stone quality on historical bridges: a comparative study of the Liberty Bridge (Budapest, Hungary) and the Charles Bridge (Prague, Czech Republic)**

Török Á. (1), Görög P. (1), Vásárhelyi B. (1), Prikry R. (2)

(1) Budapest University of Technology and Economics, Department of Construction Materials and Engineering Geology, Sztocek u. 2, H-1111 Budapest, Hungary, torokakos@mail.bme.hu, (2) Institute of Geochemistry, Mineralogy and Mineral Resources, Faculty of Science, Charles University in Prague, Albertov 6, 128 43 Prague 2, Czech Republic

Historic bridges are very often eye-catching structures and thus often considered as symbols of towns or cities. Most of these bridges were partly or entirely constructed from stones. The diagnosis, the preservation and structural analyses of these stone elements invoke special approaches that are less commonly used for other monumental stones. In this study two emblematic bridges are compared; Charles Bridge in Prague (Czech Republic) and Liberty Bridge in Budapest (Hungary). The history, the stones and the application of stones in the two bridges are very different, although the methodology of diagnosis was very similar and proved to have been sufficient to analyse these very distinct stone bridges. Accordingly, the applied methods can be recommended for the diagnosis of other historic stone bridges.

Liberty Bridge was constructed in between 1894 and 1896. The three-span cantilever bridge has two piers which are covered by grey Austrian granite of Mauthausen. The granite blocks show signs of deterioration, especially on the top of the piers. To assess the weathering and to diagnose the present state of the granite decay non-destructive strength tests such as Schmidt hammer and water content measurements were carried out on site. To visualise granite decay and to help restoration weathering forms were mapped. It was also possible to take drill-core samples which were used to determine air-dry and water-saturated compressive strength and modulus of elasticity. No deep weathering were documented on core material, thus weathering only affected the top-

most 1-2 centimetres of the granite.

Charles Bridge is the oldest preserved bridge in Prague being constructed during 1357-1406 period. The facing masonry of this 16-arches bridge is represented by large sandstone ashlar. Various types of sandstone show distinct decay features, partly caused by improper repair during 19<sup>th</sup> and 20<sup>th</sup> centuries. The diagnostic survey involved detailed mapping of stone types and decay forms for each ashlar. Because of the special status of the bridge (national monument, UNESCO zone), it was prohibited to conduct either extensive sampling or in situ measurement (e.g. Schmidt hammer). The evaluation of the facing masonry of the bridge thus mostly relies on the interpretation of observed decay forms.