

RECONSTRUCTION AND RESTORATION OF THE UPPER BRIDGE IN NIN

I. Štimac Grandić¹, D. Grandić¹, P. Šćulac¹, L. Matešić^{1,2}, P. Krolo¹

¹University of Rijeka, Faculty of Civil Engineering, Rijeka, Croatia.

²Geokon Zagreb dd, Zagreb, Croatia.

e-mail: istimac@gradri.uniri.hr; davor.grandic@gradri.uniri.hr; paulo.sculac@gradri.uniri.hr; leomat@gradri.uniri.hr; paulina.krolo@gradri.uniri.hr

SUMMARY

The Upper Bridge originates from the 16th century and is inscribed in the Croatian Registry of Cultural Objects as part of the cultural-historical city of Nin. The bridge was built on low bearing capacity and soft soil. For the most part, the bridge deck is supported on the stone embankment while the passage of sea under the bridge is allowed through three vaults. During its 450 years of existence, the Upper Bridge has been destroyed several times due to river floods or damaged as a result of the ground settlement. In the catastrophic flood that occurred in 2017 the middle third of the bridge was completely destroyed. The presented project of bridge reconstruction and restoration solved the problem of foundation of the bridge and flow problem through the extended flow profile underneath the vaults taking into account the earthquake resistance, durability of the structure and original appearance of the bridge.

Keywords: *Heritage, masonry, stone bridge, restoration.*

1. INTRODUCTION

The historic centre of Nin is located on a small island connected to the mainland with two pedestrian stone bridges: the Lower Bridge and the Upper Bridge. The subject of this paper is the Upper Bridge, which connects Nin with the road leading to the village Vrsi. The bridge was built on low-bearing capacity and soft silty soil. It has been destroyed and rebuilt several times, while the last reconstruction took place ten years ago. The reconstructed bridge consisted of two parts – for the most part, the bridge deck was supported on the stone embankment while the circulation of the sea was provided through three vaults with maximum span of approximately 4 m. The total length of the bridge was about 90 m. The spandrel walls were made of stone, while the space between them was filled with a compact material over which the stone pavement was laid. The width of the bridge and pavement width were from 4.9 to 6.2 m and from 3.9 to 5.3 m, respectively [1].

In the catastrophic flood that occurred in 2017 the middle third of the bridge (where the three vaults were located) was completely destroyed and carried away by the water. This happened mostly due to the upthrust that affected the vaults and due to undercutting caused by the hydrodynamic action of the water wave. Although almost two-thirds of the bridge remained in place, significant damage occurred on spandrel walls (and parapets) which were tilted and separated from the core of the bridge.

This paper gives a description of the reconstruction and restoration of the bridge in the way to satisfy the requirements of both the investor and the conservators: (i) to restore the bridge in its original function (re-establish pedestrian and emergency vehicles traffic), (ii) to improve the soil bearing capacity, (iii) to increase the seismic resistance, (iv) to allow for greater flow of water under the bridge and (v) to maintain the original layout of the bridge and the existing supporting system.