Retrofit with FRP elements and seismic performance assessment of the historic "Castagnara" Bridge in Padua, Italy

Gaetano RUSSO
Civil Engineer
University of Udin
Udin, Italy
gaetano.russo@uniud.it

Gaetano Russo, born 1950, received his civil engineering degree from the Univ. of Palermo in 1976

Otello BERGAMO
Civil Engineer
University of Udin
Jesolo, Venice, Italy
otellobergamo@libero.it

Otello Bergamo, born 1972, received his civil engineering degree from the Univ. of Padua in 1999

Luigi DAMIANI
Civil Engineer
Self - employed
Caorle, Venice, Italy
luigi.damiani@yahoo.it

Luigi Damiani, born 1982, received his civil engineering degree from the Univ. of Udin in 2008

Summary

Many times, the masonry arch bridges were not designed to withstand the heavy truck traffic that they are currently carrying, and they are therefore replaced by modern concrete or steel bridges. This kind of replacement occurs very often because methods of strengthening masonry bridges are not practical or economical. This project investigates whether applying composites in the form of either a fabric wrap or laminate strips to masonry constructions, it increases the load capacity of the structures. This research project demonstrates how advanced composite materials can be used to strengthen existing masonry arch bridges in order to increase its load capacity.

The paper deals with the application to "Castagnara" masonry bridge in Padua, Italy of an originally developed methodology to retrofit and repair. In this paper the investigations related to the damage of the bridge, the retrofit (by FRP elements) and the results of the consolidation are shown. The retrofit consists of the insertion of a prestressed steel cable in the abutment, consolidating injections, bonding of FRP strips on the extrados of the deck and demolition and reconstruction of the reinforced concrete slab. A non-linear analysis of the bridge has been performed.

However, a statistically significant number of masonry structures strengthened with carbon fibres need to be tested to reach definitive stress modification factors.

Keywords: Masonry, Historical Bridge, Italy, non-linear analysis, Retrofit, Bridge rehabilitation

1. Introduction

The first bridges ever built were most likely made of masonry, one of the oldest building materials known to man. Steel and concrete replaced masonry as the major building material for bridge construction in the 20th century, however, in the 21st century, masonry is still used for some short-span bridges.

A major contributing factor to structurally deficient bridges is that vehicles loads have increased since the bridges were built. It is common to see bridges that were designed for a 134 kN truck now having to be rehabilitated in order to carry the more modern tractor-trailerrig which has a design load of 320 kN [1, 6, 7, 8, 9] .

Due to budget constraints of the agencies responsible for the maintenance and replacement of bridges, it is not feasible to replace every deficient bridge. There are many deficient masonry bridges on rural roads that are owned by small agencies that do not have the money to complete bridge rehabilitation or replacement projects. The major priority of these bridges owners is not to strengthen the bridges to meet all AASHTO standards and carry HS20 (320 kN) trucks, but simply to strengthen the bridges so that school buses can cross them twice a day.

The method that was studied in this project was that of strengthening masonry arch bridge stringers with advanced fiber composites. Fiber composites were originally developped for the aero-space

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