Laboratory tests on strengthening steel and concrete elements with high-strength concrete

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Abstract

In the University of Architecture, Civil Engineering and Geodesy in Sofia a research project has started in 2018 aiming to investigate the possibilities of local production and application of high-strength concrete (or even UHPFRC) for strengthening existing structures in Bulgaria. Under this project laboratory tests of steel orthotropic bridge deck specimens as well as reinforced concrete beams, strengthened with high-strength concrete are performed. All elements are strengthened with an additional layer of high-strength concrete with thickness of 50mm on top.

The results obtained from the tests are summarized in this article. Comparative analysis showing the effect of this strengthening method is also presented. At the end summary and conclusions are drawn. Future steps for enhancing and promoting this strengthening technique in Bulgaria are outlined.

Keywords: high-strength concrete; strengthening; concrete beams; orthotropic bridge decks; laboratory tests.

1 Introduction

Contemporary design solutions for the rehabilitation and strengthening of structures, as well as the philosophy of sustainable construction, are directly related to the use of high-tech materials. This fact determines the need for a thorough knowledge of the characteristics of these materials, as well as the ability to effectively apply them to various design solutions. In Bulgaria, these challenges are multiplied by the need to provide structures for earthquake impacts. Very often the solutions with conventional materials and technologies are inappropriate.

UHPFRC, which is a new structural composite material for Bulgaria, but is increasingly used in many countries, provides an opportunity for both: new solutions and rehabilitation and strengthening of structures. The aim is to overcome a number of challenges concerning the mix and the technology of the in-situ application. It is necessary to develop a national regulatory framework / recommendations for design / and / or adapting existing recommendations to the specific features of the UHPFRC in Bulgarian conditions.

The study and the implementation of UHPFRC in the specific conditions of Bulgaria is imperative in order to clarify the ways for the actual implementation in the construction practice. For this purpose, it is necessary to carry out preliminary laboratory tests. The laboratory experiments aim to prove the effectiveness of this method of strengthening by using UHPFRC, developed according to original Bulgarian recipe.

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