# Influence of Material Stiffness on Bond Behaviour for CFRP and BFRP Strips Glued to Concrete Surface

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## Abstract

In the last years, the development of fibre reinforced polymers poses new challenges in the creation of new construction and in retrofitting of old buildings and in some cases also bridges. Advanced solutions for refurbishment and strengthening should be an alternative to demolishing old structures and building new ones. One of the established retrofitting methods is the system with carbon fibre reinforced polymer (CFRP) strips. New and innovative materials like basalt fibre reinforced polymer (BFRP) strips can replace well-known CFRP. So far more extensively analysed are the mechanical properties of composites materials like tensile strength, modulus of elasticity and fracture point. Till yet unexplored field of BFRP strips is the bond stress-slip relationship on the concrete surface. This unexplored field is necessary for the calculation of external reinforcement in concrete elements. The aim of this article is to investigate the force transfer between the concrete member and BFRP strips. The intermediate crack element specimens were carried out. The experimental part serves to determine the bond stress–slip relationship of BFRP glued to concrete. In this paper, the effect of material stiffness on the load-bearing behaviour of reinforced concrete structures strengthened with BFRP strips will be considered.

**Keywords:** Strengthening method; carbon fibre reinforced polymer (CFRP); basalt fibre reinforced polymer (BFRP); reinforced concrete (RC); pull-out resistance.

## 1 Introduction

The increase in traffic volumes in recent decades has greatly increased the loads on existing bridge structures [1]. For these reasons, many bridge structures will have to be rehabilitated or renewed in the coming years to maintain their current functionality [2]. The flexural load-bearing capacity of a reinforced concrete member can be subsequently increased by applying an external bonded FRP reinforcement [3]. Furthermore, the use of FRP-strips leads to an extension of the service life of the buildings and bridges [4]. The strengthening method with bonded fibre reinforced polymer (CFRP) strips is a common method for building in existing structures [5]. In the last years, the fast development of materials contributed to new strengthening methods of reinforced concrete (RC). One of the advanced materials is basalt fibre reinforced polymer (BFRP) strips [6]. The new innovative material consists of basalt fibres embedded in matrix resin and is characterised by their high mechanical properties [7]. BFRP strips compared with more conventional types of fibre strips as a composite made from basalt rock have cost and environmental benefits [8]. BFRP strips differ from CFRP strips in their mechanical properties, which are reflected in a lower stiffness. As a result, engineering and