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UHPFRC versus RC jackets for the seismic upgrade of columns

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Abstract

Strengthening Reinforced Concrete (RC) columns using jackets is a common technique used for the seismic upgrade of existing structures. In this study the effectiveness of traditional RC jacketing techniques is compared with the use of Ultra High Performance Fibre Reinforced Concrete (UHPFRC) for the seismic upgrade of existing elements. Numerical models have been developed using ATENA Finite Element Analysis (FEA) and a parametric study has been conducted taking into account normal concrete to UHPFRC interface, and the differential shrinkage effect. The results of the parametric study indicate that the use of UHPFRC can considerably improve the strength and the stiffness of existing reinforced concrete columns.

Keywords: Columns; Jackets; Reinforced Concrete; Ultra High Performance Concrete; Shrinkage

1 Introduction

The technique of column jacketing is extensively used in earthquake prone areas in order to improve the performance of existing structures. Concrete reinforced with steel bars is traditionally used for the enhancement of the structural performance of deficient buildings. Extensive experimental and numerical work has been performed in this area [1–18] and the crucial effect of the connection procedures between the jacket and the original column and the shrinkage of the new concrete has been highlighted [16-18].

Remarkable development has been achieved in the last decade in the use of high performance materials and Ultra High Performance Fibre Reinforced Concrete (UHPFRC). UHPFRC is a material with enhanced strength in tension and compression and significantly high energy absorption in the post crack region. A high percentage of steel fibres is used to increase the tensile strength and enhance ductility. There are published studies focused on the mechanical properties of UHPFRC and it has been concluded that the steel fibres amount and the fibres orientation and distribution considerably affect the mechanical characteristics [19-21]. UHPFRC's superior mechanical properties, particularly its high tensile strength and the durability, make it suitable for the seismic upgrade of existing structures. However, there are very limited studies on the application of UHPFRC for strengthening and retrofitting of existing members and they are mainly focused on beams. Farhat et al. [22] examined beams strengthened with UHPFRC strips and the application of the

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