ADHESIVELY BONDED CONNECTIONS OF COMPOSITES/CONCRETE STRUCTURES: BEHAVIOUR, DURABILITY AND DESIGN

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Over the last decades, the use of Carbon Fibre Reinforced Polymer (CFRP) as a reinforcing material for the strengthening of existing reinforced concrete (RC) structures has been significantly increasing. These composite materials can be used through two main strengthening techniques: (i) the Externally Bonded Reinforcement (EBR) and (ii) the Near Surface Mounted (NSM). While in the EBR the composite is externally glued to the tensile face of the member to be strengthened, in the NSM the composite is installed on grooves opened in the concrete cover. Typically, epoxy adhesives are used as bonding agent. After more than 20 years of investigation and applications, EBR and NSM strengthening techniques have succeeded and, currently, they are considered state-of-the-art and are included in several design guidelines.

The durability of structures strengthened with CFRP materials is still an open issue. Although FRP composites have been successfully used in the automotive, marine, wind energy, and aeronautics sectors among others, there are critical differences when compared with Civil Engineering applications in terms of: (i) loading conditions; (ii) environmental conditions; (iii) types of materials used; and, (iv) processes. Furthermore, a huge variety of different constituent materials is commercially available, increasing the complexity on the analysis of such solutions. The knowledge on the durability of RC structures strengthened with FRP systems is essential for structural safety, and the overall durability of such systems depends on the durability of the involved materials (concrete, adhesive and FRP composites), as well as on the durability of the bond between the substrate and the FRP material. Furthermore, accelerated ageing protocols under laboratory conditions have been used for the assessment of the durability; however, very few studies have been performed in outdoor environments (natural ageing), which are of paramount relevance to the establishment of the relationships between them.

In this lecture provides an overview about adhesively bonded EBR and NSM connections of composites to concrete structures focusing on the behaviour, durability and design.