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Mechanical Behavior of Corroded RC Beams Strengthened by NSM CFRP Rods

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Abstract : Corrosion of steel in reinforced concrete leads to several major defects. Firstly, a reduction in the crosssectional area of the reinforcement and in its ductility results in premature bar failure. Secondly, the expansion of the corrosion products causes concrete cracking and steel–concrete bond deterioration and also affects the bending stiffness of the reinforced concrete members, causing a reduction in the overall load-bearing capacity of the reinforced concrete beams. This paper investigates the validity of a repair technique using Near Surface Mounted (NSM) carbon-fibre-reinforced polymer (CFRP) rods to restore the mechanical performance of corrosion-damaged RC beams. In the NSM technique, the CFRP rods are placed inside pre-cut grooves and are bonded to the concrete with epoxy adhesive. Experimental results were obtained on two beams: a corroded beam that had been exposed to natural corrosion for 25 years and a control beam, (both are 3 m long) repaired in bending only. Each beam was repaired with one 6-mm-diameter NSM CFRP rod. The beams were tested in a three-point bending test up to failure. Overall stiffness and crack maps were studied before and after the repair. Ultimate capacity, ductility and failure mode were also reviewed. Finally some comparisons were made between repaired and non-repaired beams in order to assess the effectiveness of the NSM technique. The experimental results showed that the NSM technique improved the overall characteristics (ultimate load capacity and stiffness) of the control and corroded beams and allowed sufficient ductility to be restored to the repaired corroded elements, thus restoring the safety margin, despite the non-classical mode of failure that occurred in the corroded beam, with the separation of the concrete cover due to corrosion products.

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