PERFORMANCE OF CFRP/CONCRETE COMPOSITES AFTER CONDITIONING UNDER ACCELERATED ALKALINE EXPOSURE

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Environmental exposure leads to the degradation of the adhesive bond between externally bonded Carbon Fibre Reinforced Polymer (CFRP) and concrete in reinforced concrete (RC) structures strengthened with CFRP. Moisture penetration is a major factor that is detrimental to the durability of CFRP composites due to the high susceptibility of the resin matrix to moisture-induced damage. Furthermore, alkaline solutions pose a threat to CFRP-strengthened structures due to ionic compounds present in them which accelerate the process of deterioration. A series of single-lap shear tests were conducted to evaluate the bond performance of CFRP/concrete composites exposed to accelerated alkaline exposure. Strengthening of concrete samples was done by following the wet layup method. The conditioning was done by immersing the shear lap test specimens in an alkaline solution with a pH value of 12.6 to provide equivalent conditions as in concrete pore water solution for a period of 60 days. At the end of exposure, the specimens were left to cure under ambient conditions to provide equivalent conditions to the bond line during destructive testing. Then, a transient tensile load was applied at the displacement rate of 0.5 N/mm till failure. Scanning Electron Microscopy (SEM) was employed to assess the microstructure level degradation of CFRP laminates, bond, and interfaces after exposure. A maximum bond strength reduction of 23.8% was observed following the 60-day exposure period. The results indicated an accelerated drop of 20% within the initial 15 days of exposure. Microstructure analysis exhibited substantial damage, characterised by disintegration, swelling and cracking, of the resin matrix by the penetration of moisture and alkaline ions. Further evidence was provided by the observed failure mechanism which indicated the poor interface between concrete and epoxy.

Keywords: CFRP/concrete; durability; alkaline exposure; adhesive bond; interface degradation

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