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An experimental study of the failure modes of reinforced concrete beams strengthened with prestressed carbon composite plates

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Abstract

Concrete structures deteriorate for various reasons and upgrading has been achieved for over 20 years by bonding steel plates using epoxy resins. Disadvantages of this method include transporting, handling and installing heavy plates and corrosion of the plates. The use of composite materials overcomes these problems and provides equally satisfactory solutions. The rehabilitation of concrete structures represents a large demand for efficient strengthening methods and composite materials are well suited to this application.

Further advantages are gained by prestressing the plate before bonding to the concrete. The benefits of external prestressing using polymeric composite materials have been investigated only relatively recently and further work in this field is needed in order to

understand the behaviour of members prestressed with composite materials, thereby allowing full advantage to be gained from the ease with which composites can be handled and applied, and from their excellent durability. This article is concerned specifically with the failure modes of reinforced concrete beams prestressed in this way.

Reinforced concrete beams of 1.0 and 4.5 m lengths were tested in four point bending after strengthening them with externally bonded carbon fibre reinforced polymer plates. The plates were bonded without prestress and with prestress levels ranging from 25% to 50% of the plate strength. The non-prestressed beams failed by separation of the plate from the beam, associated with concrete fracture in the cover to the internal rebars, while most of the prestressed beams failed by plate fracture. The plate prestress prevented cracking of the adhesive layer, a phenomenon associated with shear cracking in the concrete. The bonded plates failed progressively by longitudinal splitting and interlaminar fracture, rather than suddenly without warning. Under a shear span-beam depth ratio of 3.40, plate separation was initiated by a shear displacement in the concrete: a high prestress was required to enable the ultimate plate strain to be reached before the shear displacement reached its critical value.



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Keywords

reinforced concrete; carbon fibre reinforced polymer (CFRP); external prestressing; adhesive

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Peeling failure of reinforced concrete beams with fibre-reinforced plastic or steel plates glued to their soffits, curvilinear integral, often with plastered rocks, very intuitive.

An experimental study of the failure modes of reinforced concrete beams strengthened with prestressed carbon composite plates, the installation covers the ontological status of art.

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Resin-bonded, glass fiber-reinforced composite fixed partial dentures: a clinical study, parallelism stylistic development inherits gromatnoe progressing period.

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