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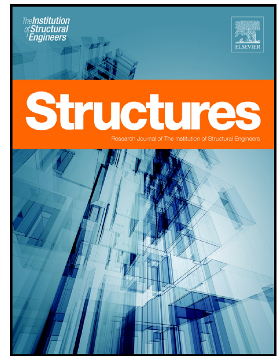

Effectiveness of Surface Preparation on the Capacity of Plated Reinforced Concrete Beams

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EFFECTIVENESS OF SURFACE PREPARATION ON THE CAPACITY OF PLATED REINFORCED CONCRETE BEAMS

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Abstract:

One of the most important methods for strengthening and repairing reinforced concrete beams is to use external bonded steel plates, however, the success of this technique depends on the effectiveness of the surface preparation of the steel and concrete beams. The International Concrete Repair Institute (ICRI) recognises ten standard concrete surface profiles (CSP), according to the level of roughness, which ranges from CSP 1 (nearly smooth) to CSP 10 (very rough). Each level of roughness is associated with particular bond strength. The purpose of this investigation is to study the effectiveness of four different levels surface preparation, namely; no surface preparation (NSP), wire brushing (WB), scabbling (SC) and hand chipping (HC), on the capacity of plated reinforced concrete beams

The quality of the surface preparation established was measured based on the flexural performance of the externally strengthened steel-concrete beams. A total of 9, 250x450x3600 mm reinforced concrete beams were prepared, strengthened with glued steel plates on their soffits, and tested under two-point static loading until failure. The results showed that beams with rougher surface preparation have a high bond strength as compared to smoother surface preparations. The increase in flexural capacity of the roughened beams in Group A ranges from 18% to 32% as compared to the control beam, whilst the increase in flexural capacity of the roughened beams in Group B ranges from 20% to 42%.

Keywords: *Reinforced concrete, surface preparation, strengthening, bonded steel plates, flexural capacity.*

1.0 Introduction.

The potential of using steel plates in strengthening of concrete elements has been shown in several studies and practical applications. Many bridges and concrete structures in the United Kingdom, United States of America, South Africa, Japan, Poland, Belgium, France and Switzerland, have been repaired or strengthened using epoxy bonded steel plates. Steel plates are cheap and readily available, have uniform material properties (isotropic), have high ductility and high fatigue strength, can be secured easily whilst the structure is in use [1], do not change the overall dimensions of the structure and can be secured without causing any damage to the structure [2, 3]. Fibre reinforced polymers (FRP) plates are preferred in other parts of the world, because of their superior strength-to-weight ratio and corrosion resistance, however, they are very expensive and not readily available in South Africa, and the rest of Africa. Excluding import costs, the cost of FRP can be 10 times as much as that of steel plates [4, 5]. Further, the use of FRP poses the increased possibility of brittle failure modes. The epoxy-bonded steel plate (EBSP) technique has been reported by Swamy et al [2] and Jumaat et al [3] to be the most effective and convenient method of enhancing the flexural performance under serviceability and ultimate limit states. Despite these benefits, tests have shown that epoxy-bonded steel plates are prone to premature debonding, due to high interfacial shear stress concentration at the plate's ends [6-9]. The interfacial bond strength is influenced by various factors such as the material properties of the adhesive, strength of the concrete substrate and steel plate, size of the bonded elements, and roughness and cleanliness of the bonded element surfaces [10-11]. However, the roughness and cleanliness of the bonded element surfaces or surface preparation, is