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Analysis of the Fatigue Behavior of Reinforced Concrete Beams Strengthened in Flexure with Fiber Reinforced Polymer Laminates

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# 1 **Analysis of the Fatigue Behavior of Reinforced Concrete Beams Strengthened** 2 **in Flexure with Fiber Reinforced Polymer Laminates**

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6 **Abstract:** This paper presents an analytical study on the fatigue response of reinforced concrete  
7 beams strengthened with fiber reinforced polymers (FRP). The study gathers the experimental  
8 results from the international literature and from authors' experiments and investigates the  
9 critical parameters that affect fatigue performance of reinforced concrete (RC) beams. A new  
10 analytical model is proposed for predicting the fatigue life of FRP strengthened RC beams. The  
11 parameters used are the maximum stress of tensile steel ( $\sigma_{\max}$ ) to the yielding strength ( $f_y$ ) ratio,  
12 as well as the axial rigidity of longitudinal steel ( $k_s$ ) and FRP ( $k_f$ ) reinforcement. The predictions  
13 of the proposed model are compared against the experimental results as well as against the  
14 predictions of fatigue models in the literature.

15 **Keywords:** analysis, fatigue, reinforced concrete beams, fiber reinforced polymers,  
16 strengthening, steel to FRP axial rigidity ratio.

## 17 **1. Introduction**

18 Several studies have identified experimentally and analytically the different parameters affecting  
19 the fatigue life of reinforced concrete (RC) beams, strengthened in bending through fiber  
20 reinforced polymers. In particular, the effect of the maximum stress and the stress range of the

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