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Influence of Concrete Cracking in the Tensile Strength of Cast-in Headed Anchors

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Abstract : Headed reinforcement bars are increasingly used for anchorage in concrete structures. Applications include connections in composite steel-concrete structures, such as beam-column joints, in several strengthening situations as well as in more traditional uses in cast-in-place and precast structural systems. This paper investigates the reduction in the ultimate tensile capacity of embedded cast-in headed anchors due to concrete cracking. A series of nine laboratory tests are carried out to evaluate the influence of cracking on the concrete breakout strength in tension. The experimental results show that cracking affects both the resistance and load-slip response of the headed bar anchors. The strengths measured in these tests are compared to theoretical resistances calculated following the recommendations presented by fib Bulletin no. 58 (2011), ETAG 001 (2010) and ACI 318 (2014). The influences of parameters such as the effective embedment depth (h_{ef}), bar diameter (d_s), and the concrete compressive strength (f_c) are analysed and discussed. The theoretical recommendations are shown to be over-conservative for both embedment depths and were, in general, inaccurate in comparison to the experimental trends. The ACI 318 (2014) was the design code which presented the best performance regarding to the predictions of the ultimate load, with an average of 1.42 for the ratio between the experimental and estimated strengths, standard deviation of 0.36, and coefficient of variation equal to 0.25.

Keywords : cast-in headed anchors, concrete cone failure, uncracked concrete, cracked concrete
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