PULLOUT PERFORMANCE OF CHEMICAL ANCHOR BOLTS IN FIBRE CONCRETE

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Abstract

Very little independent research is available on whether adding fibres to the concrete will increase the ultimate stress of the anchor bolt pullout value. Previous investigations have focussed on the anchor and considered the anchor, in terms of dimensions and adhesive agents, but not specifically on the addition of synthetic or steel fibres to concrete. This paper addresses the practical aspect of anchor fixings and means of improving pull out performance, that will reduce the risk of failure for the designer and contractor or allow greater design loads.

This work has examined the pull out force required to cause cone shear failure to unreinforced structural concrete when resin anchor bolts were subject to an axial load. Anchor bolts were fixed in unreinforced plain and fibre concrete of different fibre dosage and type for comparisons to be made. The findings show that when compared to plain concrete increased loads can be transferred to the concrete with the use of fibre technology, when used to reinforce the concrete matrix. When the quantity of steel fibres was increased there was a corresponding increase in the pullout values of the bolts.

Bond, shear and anchorage length are well understood with rebar in concrete, however chemical anchor bolts rely heavily on manufacturers data and this study provides an independent assessment of pull out values in various fibre concrete types based upon concrete shear failure of the concrete.

Key words: Resin anchor bolts, concrete, steel and synthetic fibres, pull out.

Introduction

The most important point to be considered when an anchor bolt is used in concrete is its pullout strength (Soparat and Nanakor, 2008). Many engineers and researchers have

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focused on investigating pullout behaviour of anchor bolts in plain concrete while little literature exists on the behaviour of anchor bolts in fibre concrete. This work will investigate the performance of anchor bolts when fibre is included in the concrete design mix.

When suspended bolt fixings are used to support loads on concrete soffits, they rely largely on the tensile strength of the unreinforced concrete between the reinforcing bar to transmit and sustain the load. This is due to the fact that reinforced concrete has areas between the reinforcing bar that is essentially plain unreinforced concrete which has a limited capacity to transfer tensile forces.

Figure 1 shows the mean pull out values and the change in values, when compared to the plain concrete slab. The following increase in pull out force was recorded, 5.7% for 20 kg, 8.6% for 40 kg, 11.4% for 60 kg steel wire fibres and 10% for synthetic Type 2 fibres. The manufacturers pull out design strength for C 45 concrete was 34.5 kN and 35 kN was recorded from this test. The increased pull out values for the fibre concrete is due to the fibre inclusion in concrete providing an enhanced tensile strength.

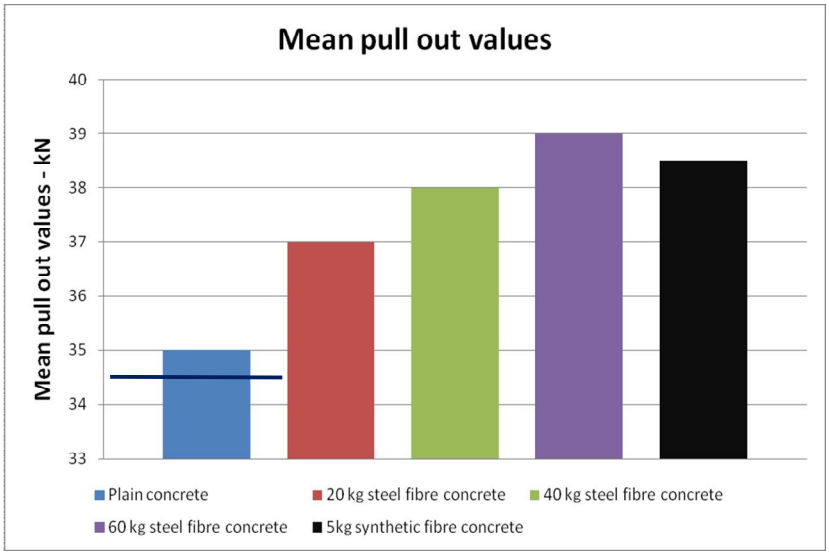

Fig. 1: Mean bolt pull out values (kN)

The anchor bolts performed beyond their design strength values and the pull out performance was enhanced with fibre additions in all cases. An increase in fibre dose produced an increase in pull out values. The use of synthetic fibres may provide a designer with an alternative to steel when fibres are used in concrete, within a corrosive environment. An additional benefit of synthetic fibre inclusion in concrete, is the ease of drilling for anchor bolts when compared to steel fibre concrete.

References

[1] Soparat P and Nanakor P, (2008), "Analysis of anchor bolt pullout in concrete by the element-free Galerkin method", *Engineering Structures*, Vol 30, pp 3574 - 3586