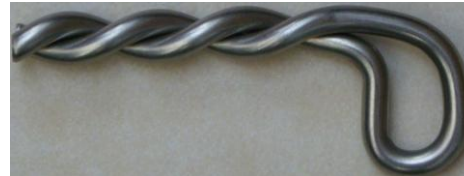


Bolt Products Anchor Test Report 02nd November 2011

Introduction

This test report is for the Bolt Products 8mm twisted stainless steel bar anchor installed using KMR RES.



Ingleton Quarry 22nd October 2011

Method

Six Bolt Products anchors were installed in limestone on 15th October 2011. The anchors were installed in compliance with the BCA E&T Committee document "Permanent Resin Bonded Anchors – Installation Procedure, Training and Documentation" (IPTD); which is the same as the recommend procedure by the manufacturer. Five holes were drilled to a depth of 100mm using 16mm drill bit and the sixth hole was drilled to depth of 100mm using an 18mm drill bit. The holes were cleaned using water (pressure wash), brushed and washed until all the limestone dust had been removed. They were then dried using absorbent cloth. The anchors were secured in the substrate using KMR RES chemical anchor mortar. This is the chemical anchor mortar that was used for installing Eco and Peco anchors. The anchors were left unloaded for 7 days until test to failure on 22nd October 2011.

Ingleton Quarry 29 October 2011

Twenty six Bolt Products anchors were installed in limestone on 29th October 2011. The anchors were installed in compliance with the BCA E&T Committee document "Permanent Resin Bonded Anchors – Installation Procedure, Training and Documentation" (IPTD); which is the same as the recommend procedure by the manufacturer. Five holes were drilled to a depth of 100mm using 16mm. The holes were cleaned using water (pressure wash), brushed and washed until all the limestone dust had been removed. They were then dried using absorbent cloth. The anchors were secured in the substrate using KMR RES chemical anchor mortar. This is the chemical anchor mortar that was used for installing Eco and Peco anchors. The anchors were left unloaded for 4 days until test to failure on 02nd November 2011.

As a consequence of the high pull out loads the mode of failure has changed. Normally (Eco anchor) the mode of failure is the anchor to resin bond. When testing the Bolt Products anchor in most cases the substrate failed and the resin/rock bond with it.



On a number of the tests the mode of failure was rock cone fracture and delaminating of the substrate subsequently followed by the failure of the resin to rock bond. However, as demonstrated in the photo opposite even with delaminating of the substrate the anchor placement still held 51.73kN.



With the reduced hole size (16mm) the amount of resin in the placement is also reduced, this causes the resin the fragment and become almost pulverised by the load during extraction of the anchor. This pulverisation is more evident lower down in the placement.



An interesting observation was that the anchors were still holding only a little less than the peak load when half to two thirds of the anchor had been extracted. Whilst no meaningful conclusions can be drawn from the extraction of six bolts it would appear that, because of the styrene, mean failure loads are 10kN higher with the KMR resin.

Another interesting observation was that the shank of the Bolt Products anchor unwound and elongated under loads approaching 50kN. (5th anchor from right picture below).



Peak load

The ultimate failure load i.e. the peak load at which the anchor started to egress from the resin or the load required to extract the anchor from the resin, or substrate failure, whichever was higher, was within the range 24kN with a mean of 44.91kN.

Conclusions

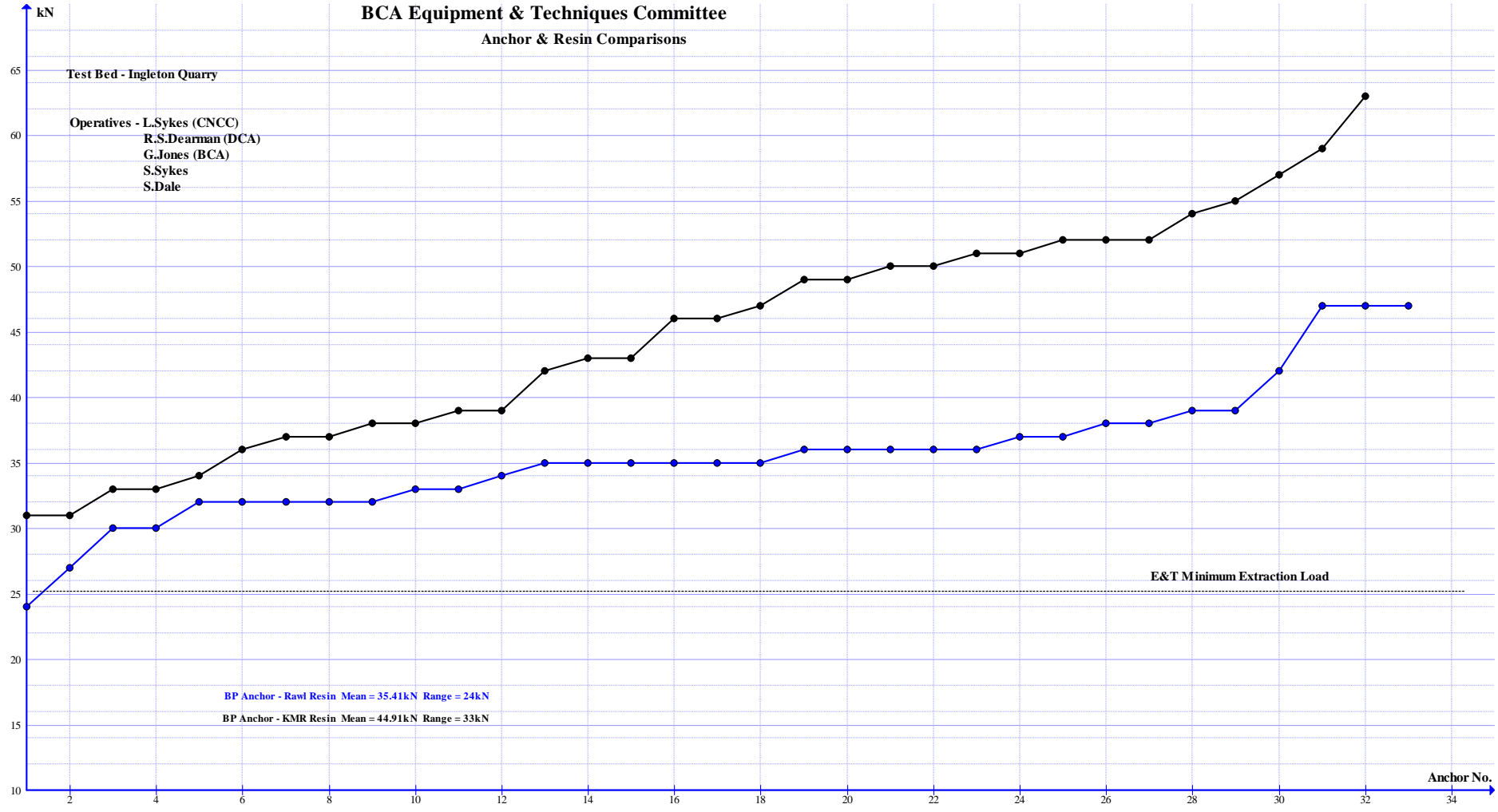
From the data gathered from these tests, comprising in total 32 Bolt Products anchors, it is evident that the combination of the Bolt Products 8mm twisted stainless steel bar anchor and the KMR-RES does produce a high strength bond.

The graph below demonstrates the difference in peak load force between the Bolt Products anchors installed with RAWL fixings resin and KMR-RES.

The next objective is to test a number of the Bolt Products anchors with KMR-RES in a shear load location.

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Photographs: G. Jones

BCA Equipment & Techniques Committee
Anchor & Resin Comparisons



BP Anchor - Rawl Resin Mean = 35.41kN Range = 24kN
BP Anchor - KMR Resin Mean = 44.91kN Range = 33kN

E&T Minimum Extraction Load