

## Bolt Products Anchor Test Report 22<sup>nd</sup> October 2011

### Introduction

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



### Ingleton Quarry 22<sup>nd</sup> October 2011

#### Method

Six Bolt Products anchors were installed in limestone on 15<sup>th</sup> 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 22<sup>nd</sup> October 2011.

When calculating the mean loads from the results of the test it is evident that the Bolt Products anchor peak loads increased from 35.5kN to 45.3kN as a result of using the KMR RES resin when compared to the results for the RAWL fixings resin. The range also decreased but this is probably not significant as only six anchors were installed and tested to destruction.



The distortion loads were virtually identical on both resins. However, the mode of failure has changed. Normally the mode of failure is the anchor to resin bond. In most cases the substrate failed and the resin/rock bond with it. During one of the tests the mode of failure was rock cone fracture subsequently followed by the failure of the resin to rock bond.



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.



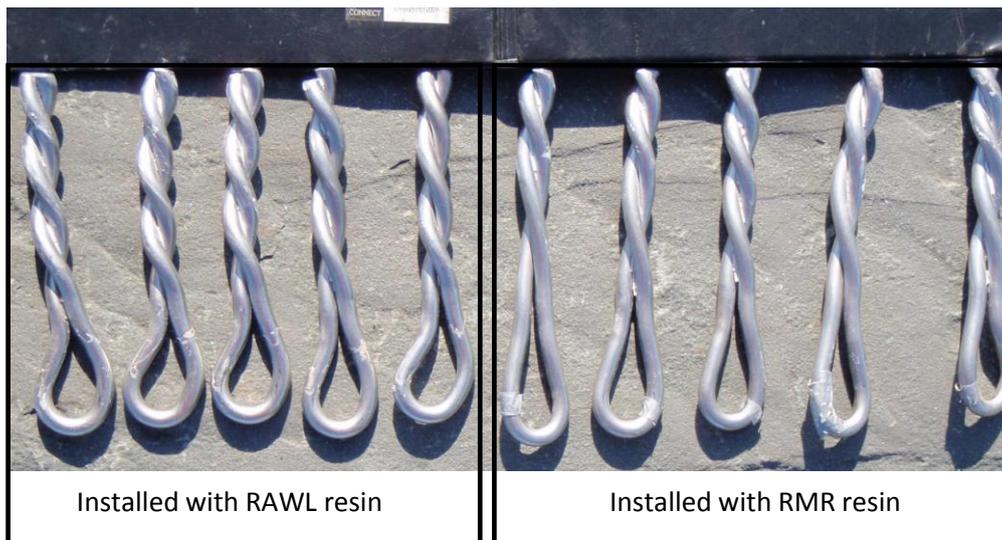
Another interesting observation was that the shank of the Bolt Products anchor unwound and elongated under loads approaching 50kN. (5<sup>th</sup> anchor from right picture below).

### 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 38-49kN. with a mean of 45.3kN.

### Conclusions

From the data gathered from this test, comprising in total 6 Bolt Products anchors, our next objective is to test to destruction a further 26 Bolt Products anchors using KMR RES resin. This will give a sample size of the usual test batch of 32 anchors. The results between the resins can then be accurately compared. This next range of tests should hopefully provide us with a solution to the anchor replacement problem. From there we can move on to the assessment of performance in other substrates.



## Anchor Extraction Test Sheet

Anchor Type - Bolt Products	Resin Type - KMR	Date - 22/10/11	Venue - Ingleton Quarry
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No.	Deformation kN	Peak Load kN	Comments
1	20	46	
2	21	49	
3	20	38	
4	20	43	
5	21	47	Distortion kN - Mean 20.7 Range 3
6	22	49	Peak Load kN - Mean 45.3 Range 12

Operatives:- L.Sykes (CNCC), R.S.Dearman (DCA),  
S. Sykes.

Report compiled by L. Sykes & R. Dearman.