

## 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.



### Ingleton Quarry 05<sup>th</sup> October 2011

#### Method

Thirty three Bolt Products anchors were installed in limestone on 01<sup>st</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. The 16mm holes were drilled to a depth of 100mm and cleaned using water (pressure wash), brushed and washed until all the limestone dust had been removed. The holes were then dried using absorbent cloth. The anchors were secured in the substrate using R-KER Epoxy Acrylate Styrene free resin. This is manufactured by RAWL Fixings. The anchors were left unloaded for 3 days until test to failure on 05<sup>th</sup> October 2011. On 05<sup>th</sup> October 2011 twelve anchors were tested to destruction.



During the test period it became apparent that the chemical anchor mortar had not thoroughly mixed during application into a hole. The peak load to remove this anchor was 36kN. RAWL have been contacted and from the information supplied by us have initiated an investigation.

The failure mode initially is similar to a DMM Eco anchor with elongation of the eye towards the direction of the applied load. However, unlike an Eco anchor as it is extracted from the substrate the anchor twists until the load is released as the anchor suddenly egresses from the resin; the load is then gradually increased until the anchor starts to twist and the process is repeated until the anchor is extracted from the substrate.



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

The remaining 21 anchors from the original installation on 01<sup>st</sup> October 2011 were tested to destruction. In all the placements the resin had cured which demonstrated that the original problem with the resin was an isolated incident (05/10/2011).

The failure mode was anchor to resin bond failure. Generally the anchor's failure range was consistent. However, anchor test numbers 20 and 26 was below 30kN. As the failure mode is anchor to resin bond this is probably due to poor adhesion of the resin.

### **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, whichever was higher, was within the range 24kN with a mean of 35.5kN.

### **Conclusions**

From the test data gathered from these tests comprising a total of 33 Bolt Products anchors it is evident that the anchor and peak load force is consistently similar in performance and strength to the DMM Eco anchor.

The disparity in peak load range (24kN) is due to the resin as is indicative of the mode of failure. Although there is enough strength in the system offering an acceptable safety margin it is apparent that the resin does not provide consistent results as demonstrated in the peak load figures.



## Anchor Extraction Test Sheet

Anchor Type - Bolt Products		Resin Type - Rawl	Date- 12/10/11 + 22/10/11	Venue - Ingleton Quarry
No.	Deformation kN	Peak Load kN	Comments	
1	20	33	Anchors 1 - 12 extracted on 12/10/11	
2	18	35		
3	19	35		
4	21	47		
5	19	34		
6	21	47		
7	21	32		
8	23	47		
9	23	42		
10	21	36		
11	20	35		
12	22	35		
13	21	30	Anchors 13 - 33 extracted on 22/10/11	
14	19	36		
15	21	33		
16	22	38		
17	23	36		
18	21	30		
19	21	37		
20	20	24 *	* - Below E&T Committee agreed limit	
21	20	39		
22	22	36		
23	22	39		
24	20	32		
25	24	37		
26	21	27		
27	21	35		
28	20	36		
29	18	32		
30	21	32		
31	17	32	Distortion kN Mean - 20.6 Range - 8	
32	21	35	Peak Load kN Mean - 35.5 Range - 24	
33	18	38		

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Photographs G. Jones