

The Equipment & Techniques Committee

BP anchor angled load test report 14th September 2013

Location

Ingleton Quarry NGR: SD700735. The block of limestone is a quarried block on an angle of 21 degrees.

Introduction

This test report is for the Bolt Products anchors 304 stainless steel. Four anchors were installed as part of an anchor installation course with the intention of pulling the anchors out with the applied load at four different angles. The anchors were installed using KMR-RES (Resifix 3+) chemical anchor.

Method

The Bolt Products anchors were installed on 10 August 2013. During the installation the hole was drilled vertically utilising a spirit level to ensure that the anchors were perfectly vertical. This was essential because we wanted to use the angle of the substrate (21 degrees) to create different angles of loading during the test.

Test results

BCA 67

This anchor was loaded at 0 degrees to the installation (true axial load) this was achieved by wedging the test rig and using a spirit level to ensure it was level.



20kN elongation of the attachment eye towards the direction of the applied load.

39kN spalling of the surface resin.

44kN egress of the anchor from the substrate, the anchor starts to twist out of the placement.

30kN was required to fully extract the anchor from the placement.



BCA 64

This anchor was loaded at 60 degrees to the installation, this was achieved by wedging the test rig and using a spirit level.

26kN elongation of the attachment eye in the direction of the applied load.

24kN spalling of the substrate.

38kN maximum load applied.

38kN was required to remove the anchor from the placement.



BCA65

This anchor was loaded at 45 degrees to the installation, this was achieved by wedging the test rig and using a spirit level to keep the test rig at 45 degrees from the axis of installation.

34kN elongation of the attachment eye in the direction of the applied load.

39kN was required to remove the anchor from the placement.



BCA70

This anchor was loaded at 30 degrees to the installation this was achieved by wedging the test rig and using a spirit level.



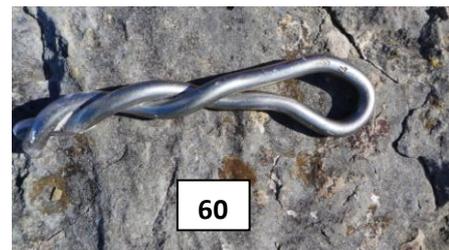
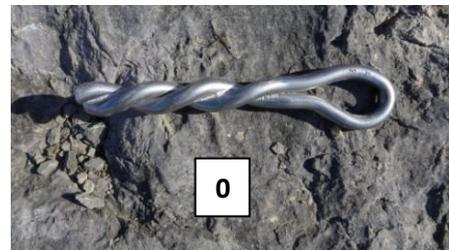
36kN elongation of the attachment eye in the direction of the applied load.

46kN the anchors supporting the test rig started to bend as a precaution the test was abandoned.

Additional information

The tests demonstrate that as the angle of the applied load is changed the load required to initiate deformation of the anchor's attachment eye increases.

Anchors that have been pulled with an axial load have been observed to unwind as they are extracted from the placement. On the angled tests 60 and 45 degrees to the placement the twists in the anchor shafts have unwound, but unlike the axial tests the anchor did not twist as the shafts have unwound.



Conclusions

During practical use, cavers tend to generally load the anchors at an angle of between 90 (shear) and 30 degrees to the installation.

Rigging from these anchors within these angles of use offers cavers the maximum strength from the anchor placement. These tests have again proven that the actual substrate is the weakest part of the anchor placement and that ensuring a sound substrate is used for the placement is paramount in getting the maximum strength from that anchor placement.

Operatives:- L.Sykes (CNCC), G.Jones (CNCC)

Report compiled by L. Sykes

Photographs G. Jones