Test of the AS – Amarrage Suplee on extraction

24. and 26. 10. 2018

Miha Staut

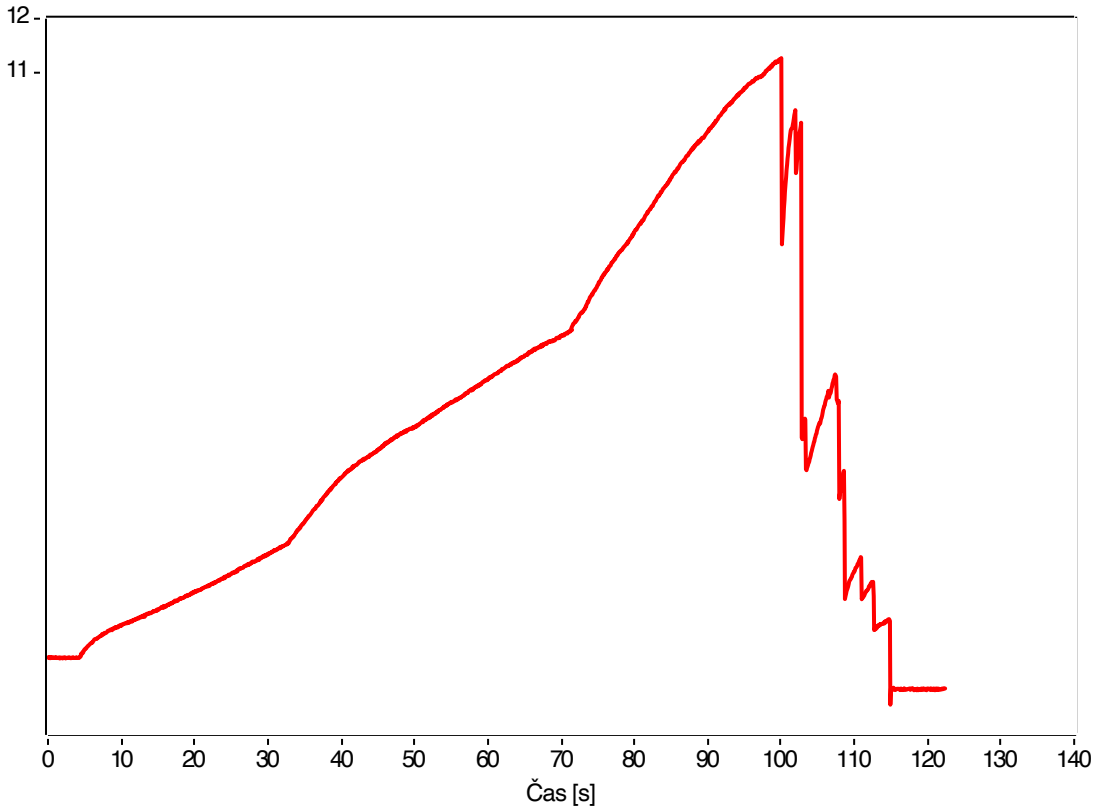
The AS is composed of a cylindrical forged aluminium hanger with two through holes for a 5 mm rope and one 8 mm hole for the bolt. The hanger is fitted with a 5 mm kernmantle full dyneema cord branded by Beal but might be originally produced by the Teufelberger group. Dyneema cords feature a very low coefficient of friction. Not many knots are reliable with it. In the tested specimen the dyneema cord was tied with a triple fisherman's knot.

The specimen was tested on extraction (axial pull). Due to the deformation of the fixation ring on the underside, the pull gradually deviated from axial direction. This fact should not have influenced the test in a crucial way.

The test was performed with a tensile testing machine with low speeds of pull (roughly 25 mm/min).

Test 1: one-sided loading, hanger = Old CT

Figure 1: time vs. force graph of the one-sided loading pull.



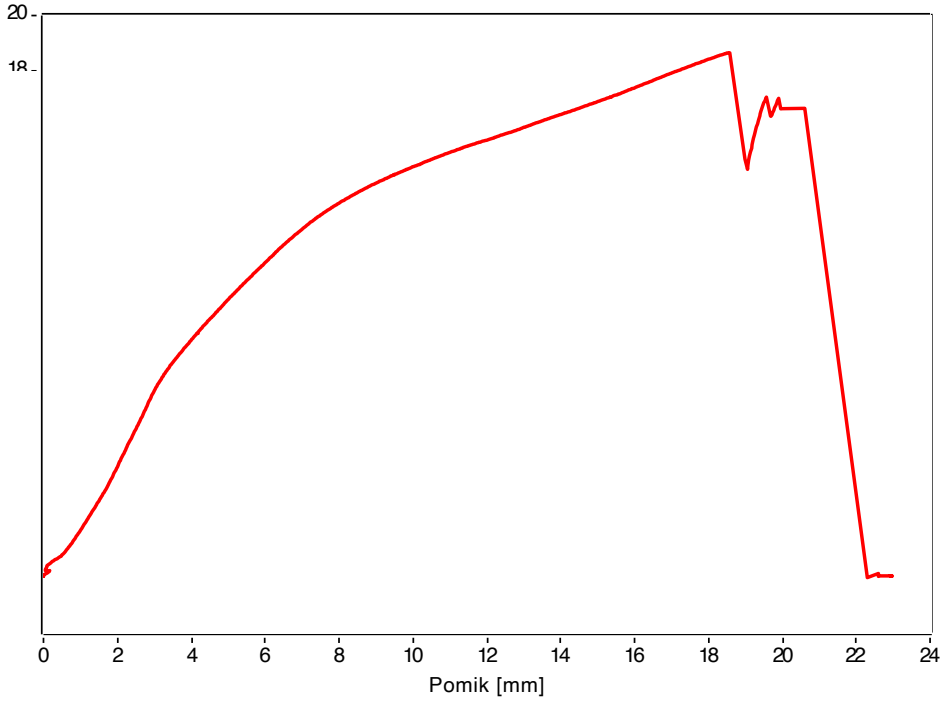
F_{max} = 11,28 kN

On F_{max} the wall of one of the through holes for the rope partly broke away. The resulting sharp edge severed the rope that was eventually cut.

Figure 2: Specimen 1 after the test.

Test 2: two-sided loading, hanger = Old CT

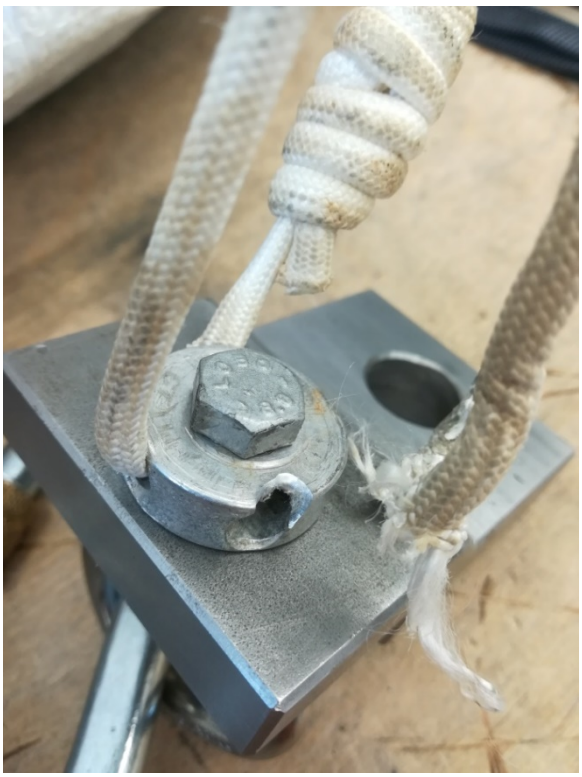
Figure 3: time vs. force graph of the two-sided loading pull.



F_{max} = 18,67 kN

The consequence was equal to test 1. On F_{max} the wall of one of the through holes for the rope partly broke away. The resulting sharp edge severed the rope that was eventually cut.

Figure 4: Specimen 2 after the test.



2nd series of testing of the AS – Amarrage Suplee on extraction

8. 11. 2018

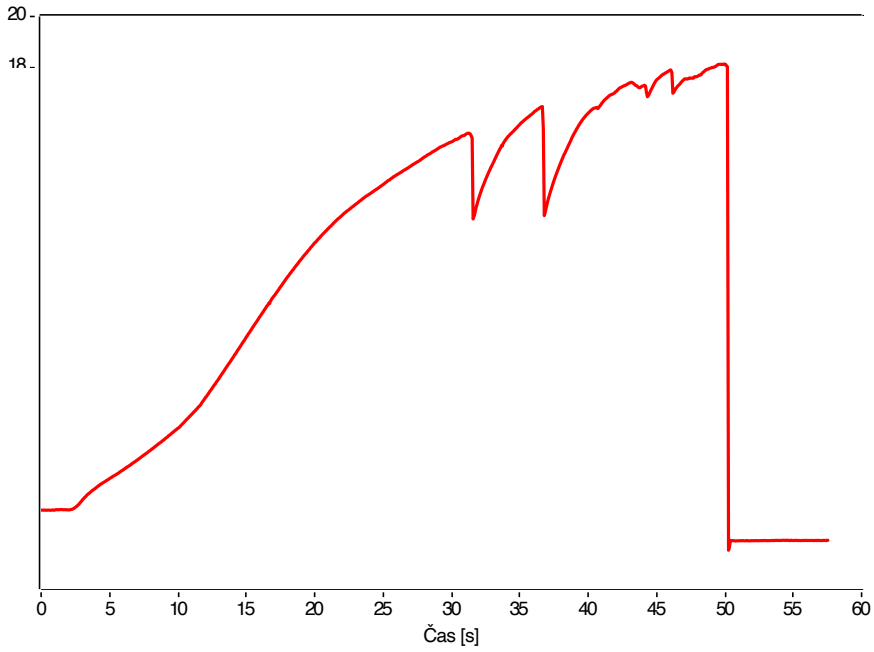
Table 1: model dimensions

MODEL	CT - NEW	EXPE	CUSTOM	ANTHRON
diameter	27,9	28	29,75	29
thickness	9	9	10	9,5
rope hole	5,6 bevelled	5,6 bevelled	6	
screw hole	8,5	8,5	10	8
lower wall thickness	1,55	1,55	2,1	
upper wall thickness	2	2	2,4	3,5

Figure 4 and 5: Tested models

3. Custom made with sharp edges. Two-sided pull.

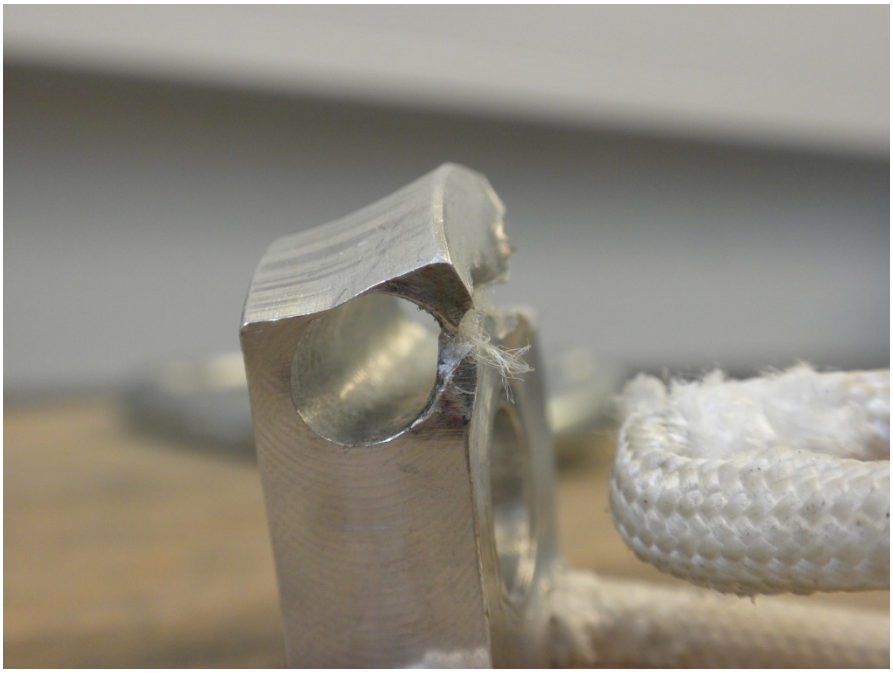
Figure 4: time vs. force graph of custom made hanger with the two-sided loading pull.



F_{max} = 18,16 kN

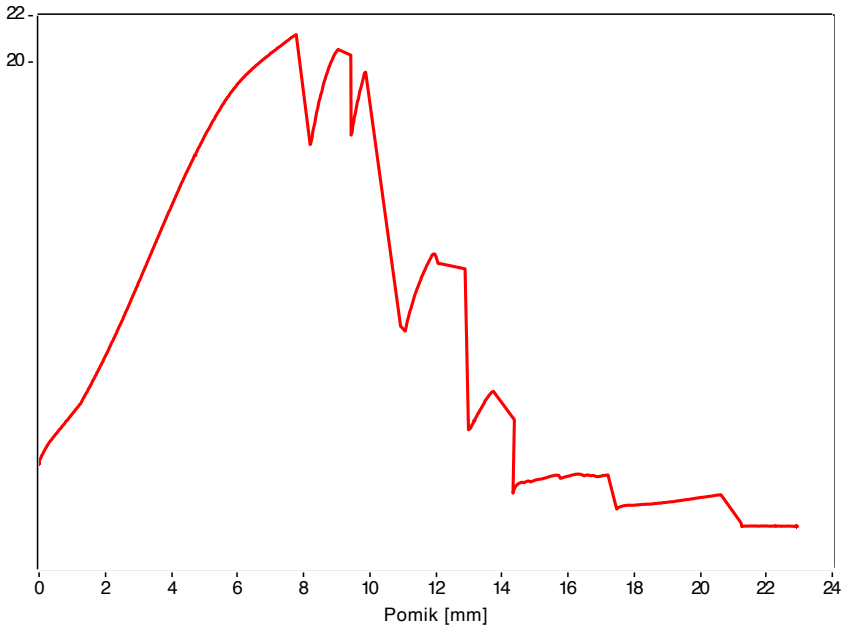
One of the through holes for the rope broke open. Rope was damaged but held. Apparently it was made either out of a different type of aluminium or with different heat treatment characteristics than the rest.

Figure 5: custom made hanger after the test.



4. CT new type. Two-sided pull.

Figure 6: time vs. force graph of the new CT hanger with the two-sided loading pull.



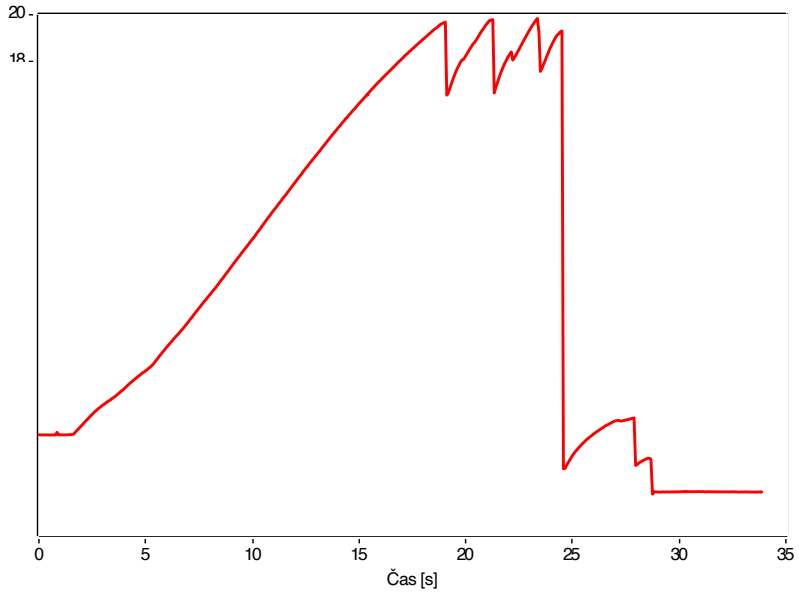
F_{max} = 21,18 kN

Beginning of through holes deformed and eventually one of them chipped away. The resulting sharp edge tore the rope.

Figure 7: CT new hanger after the test.

5. Expe. Two way pull.

Figure 8: time vs. force graph of the Expe hanger with the two-sided loading pull.



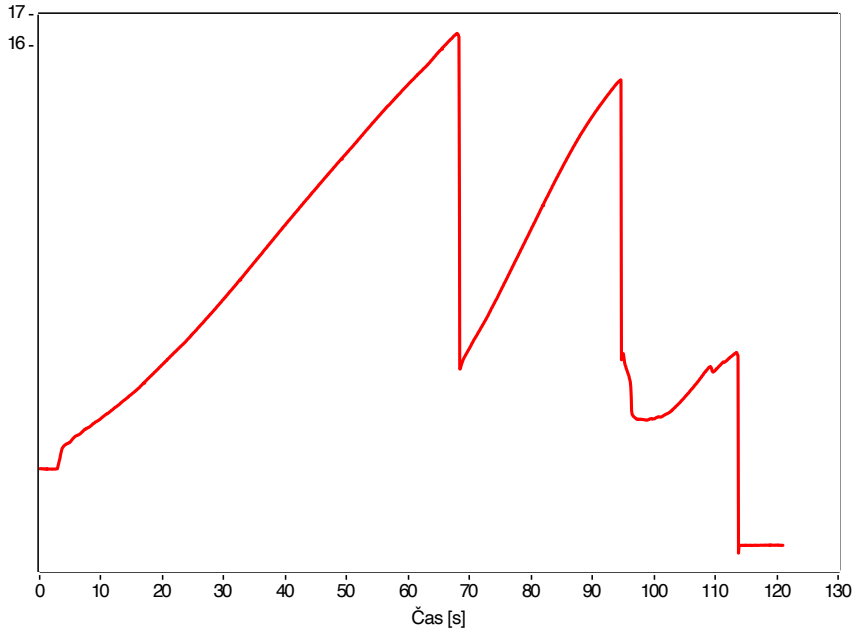
F_{max} = 19,85 kN

Beginning of through holes deformed and eventually one of them chipped away. The resulting sharp edge tore the rope. The recurring peaks result from tearing of the cord. The hanger is dimensionally equal to the new CT hanger. It may be produced by the same company but sold OEM.

Figure 9: Expe hanger after the test.

6. Anthron model with spliced dyneema loop. One way pull.

Figure 10: time vs. force graph of the Anthron hanger with spliced dyneema loop, the one-sided loading pull.



F_{max} = 16,39 kN

The pull gradually deformed the top retaining plate of the slot. At first one and then the other (two higher peaks) sides broke away. The remaining backside of the slot broke at roughly 6 kN. The spliced dyneema remained in good shape.

Figure 10: Anthron hanger loop after the test.

Fatigue test on the custom hanger.

5. 11. 2018

Axially applied force (extraction)
One-sided pulling.

1st series:
m = 30 kg
n = 4935 cycles
Barely visible incision on the rope at the point of exit from the hanger.

2nd series:
m = 80 kg
n = 6845 cycles
Breakage.

AN ATTEMPT TO PUT THE AMOUNT OF CYCLES INTO PRACTICE

What would 6845 cycles mean in a cave?

At average cavers ascend rope with 3 pulls/m. Having a 20 m pitch this would give 90 pulls on the pitch per person. 6845 cycles would then amount to 76 persons' ascent. Lack of any shock absorption in the system probably gives higher force pulses than experienced by an average cave anchor. On the other hand the above calculation does not account for descent shocks which are higher than on ascent.

Visible sheath damage (cut through to the core) occured at about 1/3 of the cycles. The dyneema cord would, therefore, have to be discarted after the passage of about 25 people in the cave.