

## **CUCC Expo 2020 Anchor Appraisal by Martin Green**

### **Background**

We are looking at anchors, because Robert Seebacher has questioned whether they are suitable, it seems we having approximately 2 failures a years with our anchors at present and we have had incidents of entire pitches being underset. Obviously choice of anchors, needs to sit along side comprehensive training of choice of anchor placement and judging the integrity of the rock we are putting the anchors in.

In the attached spreadsheet I have started with some details of the anchor, and then at the bottom I have scored the options. I equally based the scores on the following points.

### **Intended for caving/Due diligence**

As a training expedition we have a duty of care to provide safe working systems and training to inexperienced members, As a person placing an anchor there is also likely a duty of care to subsequent users of the anchor. We therefore should ensure that we have undertaken due diligence in our anchor selection, training and anchor placements.

As we are unlikely in the expedition to have the expertise to fully evaluate the suitability of anchors, perhaps the best way of demonstrating due diligence is to follow manufactures guidance and stated intended purpose. Bear in mind that we may have to demonstrate due to diligence, not to a caver, but to the university or the judiciary. Ideally the anchors would conform to EN 959 a standard for the manufacture of rock anchors.

### **Longevity/Conservation**

There is limited space at the top of many pitches and we all know that we want to avoid the situation where they need to be rebolted and perhaps turn into a bolt farm of dodgy anchors without enough room to place more. Therefore we should if practicable to looking towards using anchors that are going to last many decades or preferably longer.

### **Cheapness**

We of course do not want to spend lots of money of anchors. However nor do we want to be so cheap that we compromise safety. There are limits, after all we do not use gear crabs.

### **Expansion Depth/Mitigate Bad Rock**

In the first instance we need to make sure we are putting our anchors into decent quality rock. However the deeper an anchor goes into rock, the greater the likely hood that any defects in the rock will not cause anchor failure.

### **Strength**

Standards for fall arrest systems allow loads to be placed on humans of 6-10kN. I suspect that around 15kN we are likely to end up very broken. Ideally the anchors should be able to take such loads with a little additional safety factor. In rescue situations, where there may be tyroleans or multiple people on a rope, the standards suggest the anchors should be able to take 22kN.

## **Battery Life**

No one likes turning around as they have run out of battery, or carry more than necessary.

## **Known/Likely failures**

Having a new anchor system that requires hangers with different sized holes than we have historically used, is likely to lead to aborted trips or use of hangers with oversized holes. Over sized holes are likely to be dangerous, so we should try to avoid this situation.

We currently have the risk of rigging entire pitches with underset anchors, so we ought to look to see if we can choose an anchor that can not be mistakenly used in this way. With through bolts, we need to determine appropriate installation torques and keep an eye out for nuts coming loose, however if the installation torque is underset, it will self tighten if it is pulled out of the wall. This is likely to reduce the risk of the anchor in inexperienced hands.

## **Single Handed Use**

We have taken to using multiple types of anchor where single handed use is desired. This leads to an increased training burden or risk of inappropriate use. Ideally we would have one type of anchor appropriate to all uses.

## **Recommendation**

Subject to:

- Robert Seebacher thinking them appropriate
- Determining the correct installation torque
- Appropriate training
- Ideally some testing of pull out force in well and poorly drilled holes

I recommend that we standardise on Raumer M8 Hang Fixe anchors. Additional features of these stainless steel through bolts is that they:

- have thick sleeves reducing the likelihood of failure due to corrosion of the sleeves
- big spikes on the sleeves, reducing risk of failure to set the anchor, due to it instead rotating in its hole rather than setting
- have combined nuts and washers, making placement easier and risk of use without a washer.
- bumps on the back of the nut/washer, which almost eliminates the nut loosening itself

I suggest that we could change over to these through bolts for existing caves, as most of our normal hangers can be used with them, by removing the rubber O-ring and the bolt. This requires the nuts are left in situ, and that we do not have too many cerclips on our hangers.

	Hilti M8 x 30	Raumer Fix ETD III Ø8x55mm	Raumer FIX ETD III (Ø8x67mm)	Raumer Fix SITA GBK CE7 Ø8x75 mm	Raumer HANG FIX inox M8C (ØM8x60)	Raumer HANG FIX inox M8L (ØM8x78)	Raumer HANG FIX inox M8XL (ØM8x100)	HANG FIX inox M10C (Ø10x66mm)	HANG FIX inox M10AL (Ø10x86mm)	Spit Fix3 M8 70mm	Mason Mate M8	Petzel Coeur Bolt Steel 10mm	Petzel Coeur Bolt Stainless 10mm
Drill Diameter/mm	10	8	8	8	8	8	8	10	10	8	8	10	10
Drill Depth/mm	33	55	67	75	60	78	100	66	86	70	100	85	70
Expansion Depth	30	39	51	59	44	62	84	50	70	54	84	69	54
Reference	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>	<a href="#">Link</a>
Drilled Volume/cc	2.6	2.8	3.4	3.8	3.0	3.9	5.0	5.2	6.8	3.5	5.0	6.7	5.5
Drilled Volume/Hilti Volum	100%	107%	130%	145%	116%	151%	194%	200%	261%	136%	194%	258%	212%
Material	Steel	Galvanised	Galvanised S	Galvanised S	Stainless	Stainless	Stainless	Stainless	Stainless	Galvanised	Galvanised	Galvanised	Stainless
Intended Medium	Concrete	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Limestone	Concrete	Concrete	?	?
Intended for STICK-IP aid climbing	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE
Intended for Caving and Rescue	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	FALSE	FALSE	TRUE	TRUE
Meets EN 959 Rock Anchor	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	TRUE
Characteristic Resistance Tension	8.3				17	20	20	21	21		8.4	15	15
Characteristic Resistance Shear	7				18	20	20	26	26		8	23	25
Recommended Tension	3.3	10	10	9						3.57	2.8		
Recommended Shear	3.9	10	10	9						5.71	3.2		
Current failure Rate	~1%												
Can be removed if not set	TRUE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE
Requires hangers with non 8mm holes	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE	FALSE	FALSE	FALSE	FALSE
Estimated Usable Life / years	15	6	6	6	100	100	100	100	100	6	6	6	100
Approx Unit Cost Euro	0.40 €	1.50 €	1.29 €	1.50 €	2.00 €	2.72 €	2.99 €	2.20 €	2.30 €	0.30 €	0.45 €	2.23 €	5.85 €
Approx cost per expo per year	4.00 €	15.00 €	12.90 €	15.00 €	20.00 €	27.20 €	29.90 €	22.00 €	23.00 €	3.00 €	4.50 €	22.30 €	58.50 €
Includes hanger	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	FALSE	TRUE	TRUE
Single Handed Placement	FALSE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE	TRUE
Scores													
Intended for caving/Due diligence	0%	0%	0%	0%	70%	70%	70%	100%	100%	0%	0%	70%	100%
Longevity/Conservation	50%	0%	0%	0%	100%	100%	100%	100%	100%	0%	0%	0%	100%
Cheapness	87%	50%	57%	50%	33%	9%	0%	27%	23%	90%	85%	25%	15%
Expansion Depth/Mitigate Bad Rock	36%	46%	61%	70%	52%	74%	100%	60%	83%	64%	100%	82%	64%
Strength	40%	40%	40%	40%	80%	100%	100%	100%	100%	40%	40%	100%	100%
Battery Life	100%	96%	81%	72%	90%	68%	42%	38%	0%	78%	42%	2%	30%
Known/Likely failures	50%	100%	100%	100%	100%	100%	100%	50%	50%	100%	100%	100%	100%
Single Handed Use	0%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
<b>Average Score</b>	<b>45%</b>	<b>54%</b>	<b>55%</b>	<b>54%</b>	<b>78%</b>	<b>78%</b>	<b>76%</b>	<b>72%</b>	<b>70%</b>	<b>59%</b>	<b>58%</b>	<b>60%</b>	<b>76%</b>