



Expo
bolting

Hang
Fix anch
or
training

Why change?

- We have been having a failure rate of a couple of hangers per year.
- Current anchors are intended for hanging air ducts on uncracked concrete, not humans on limestone.
- Local cavers have expressed concerns regarding our current anchors.
- Experience shows that with current anchors, they can all be underset, risking all the anchors of a pitch pulling out.
- Current anchors rust, reducing tread strength. With time they will need replacing and we have limited pitch head real estate.



Argument for Safety

- We are a training expedition with members with wide ranges of experience in knowledge, ability to evaluate risk and different risk tolerances.
- We all have a moral and legal responsibility for the safety of ourselves, other members of the expedition and potential rescuers.
- Having someone get hurt makes for a shit holiday

Force - What is safe?

- 1kN = caver statically hanging
- 6kN = typical load, eg bad fall on to cow tails
- 20kN = typical load \times safety factor. Also approx. breaking strength of ropes, karabiners, hangers, anchors etc.
- Safety factors is required:
 - To allow for equipment degradation with repeated falls
 - To support higher loads in case of misuse
 - To allow for accidental placement in poor rock

Anchor Failure modes

- Pre-existing Cracks
 - Hammer sound
 - Anchor depth
- Rock Conical / Pry-out failure
 - Anchor depth
 - Anchor spacing
 - Rock tensile strength
- Rock Edge fracture
 - Anchor set close to an edge
- Steel shear failure
 - Material strength
 - Diameter
- Stress Corrosion Cracking
 - Chlorides / 30km from sea
- Thread failure
 - Material strength
 - Thread engagement depth
 - Corrosion
- Anchor Pull out
 - Wedge not properly engaging, rock dust in hole, anchor designed for different rock hardness

Hang Fix anchors



Hang Fix anchors are through bolts designed for use in hard compact rocks such as Limestone, Marble, Dolomite (Not suitable for soft rock eg sandstone or harder rock eg granite)

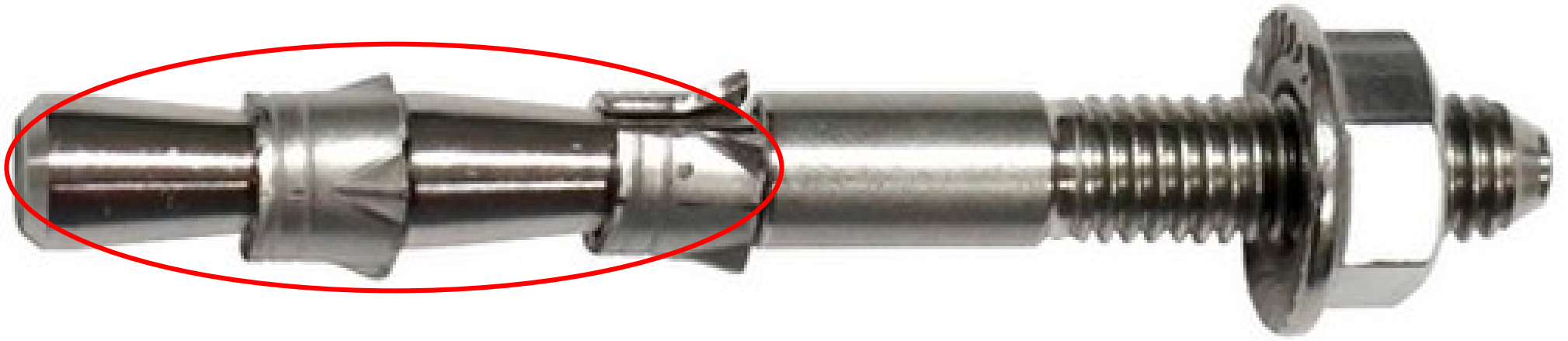
Hang Fix anchors



Properties:

A4 Stainless steel

Hang Fix anchors



Properties:

Double Wedges

Hang Fix anchors



Properties:

Spiky collars

Hang Fix anchors



Properties:

Integrated washer

Hang Fix anchors



Properties:

Anti-loosening texture

Hang Fix anchors



Complies with BS EN 959:2018

Mountaineering equipment. Rock anchors. Safety requirements and test methods

(M8L& M8XL when used with Raumer Annelox hangers)



New anchors

- M8 HANG FIX inox M8L (\emptyset M8x78)
~50mm effective depth
- These both require 13mm spanners

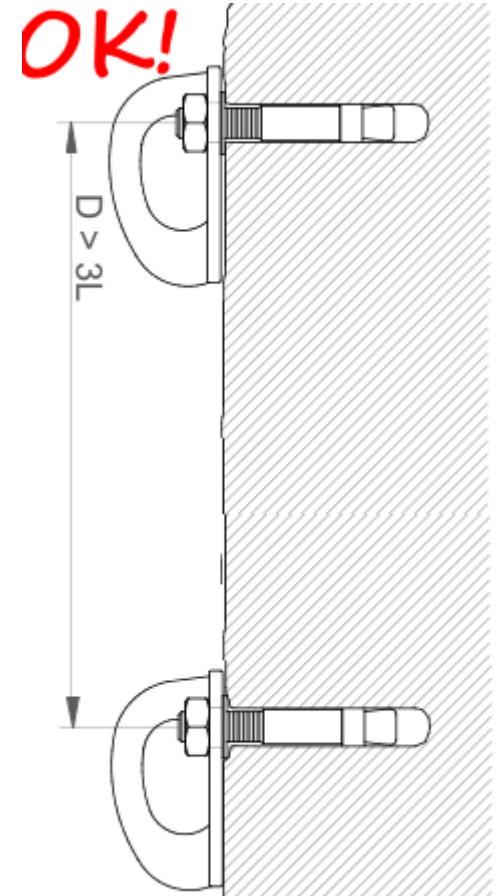
Nb. With the reduced strength, especially with our limestone the M8C (\emptyset M8x60) is not appropriate, (effective depth ~33mm)

Anchor placement

- High anchors generally make it easiest to get on and off pitches, especially if hauling a casualty
- Where might the rope rub?
- In a flash flood where will the water and rocks fall?
- Where will might other cavers kick down rocks from?
Are there loose rocks to garden, before there are ropes and cavers below?
- Am I better traversing before going down?

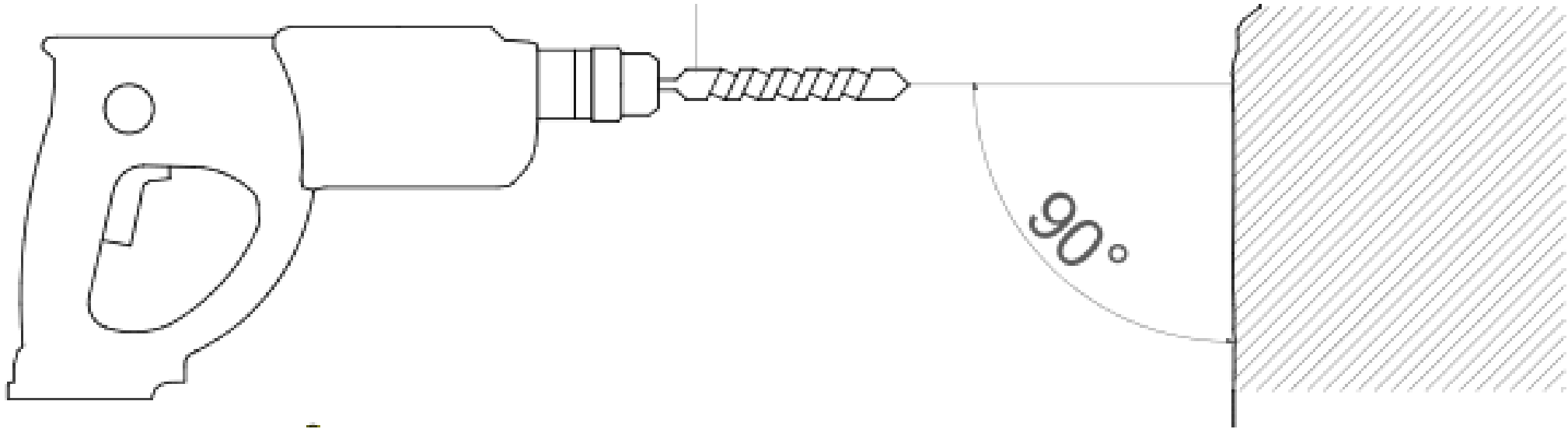
Check the rock

- Choose a patch ~30cm diameter of rock:
 - sharp ringing sound when hit by a hammer.
 - no edges, cracks, beds of weaker rock etc
- Make sure that there is a flat footprint around the anchor for the hanger to sit flush. Hammer the rock flush if required.
- Anchors should be spaced ~30cm apart.



Install anchor

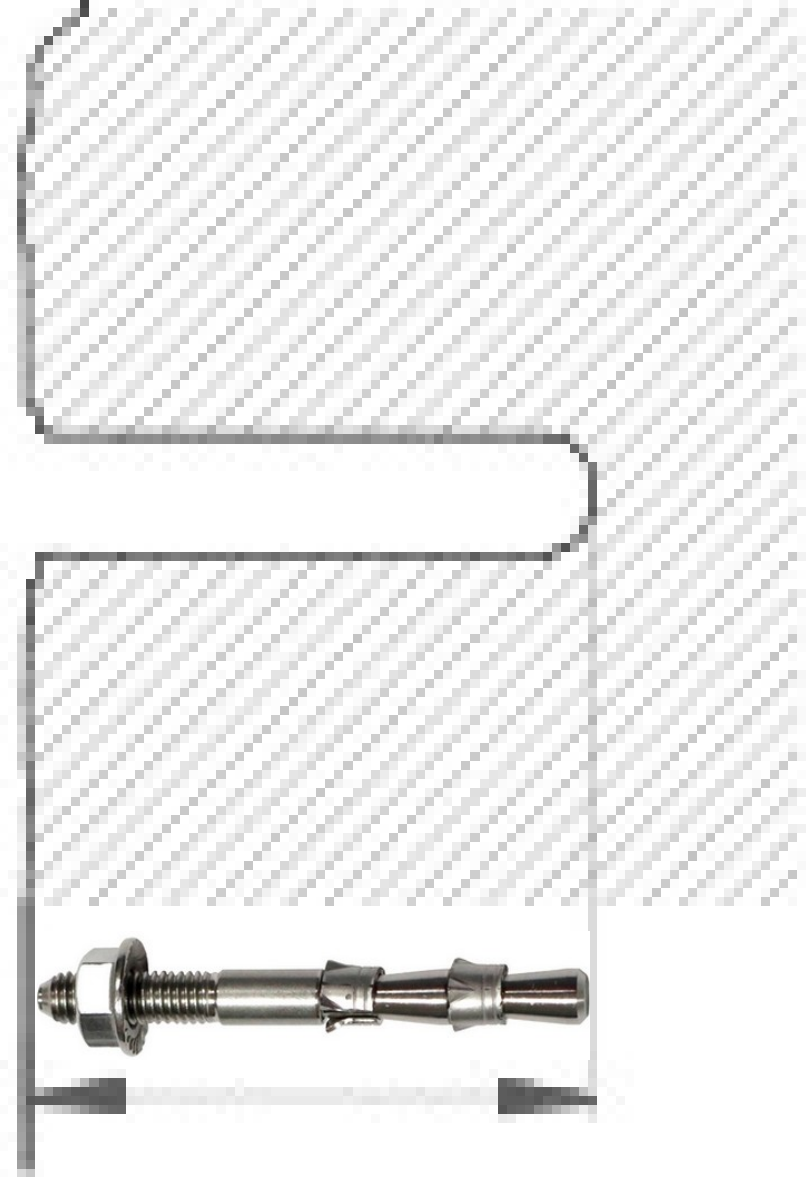
Drill hole perpendicular to rock such that the anchor plate sits nicely



Install anchor

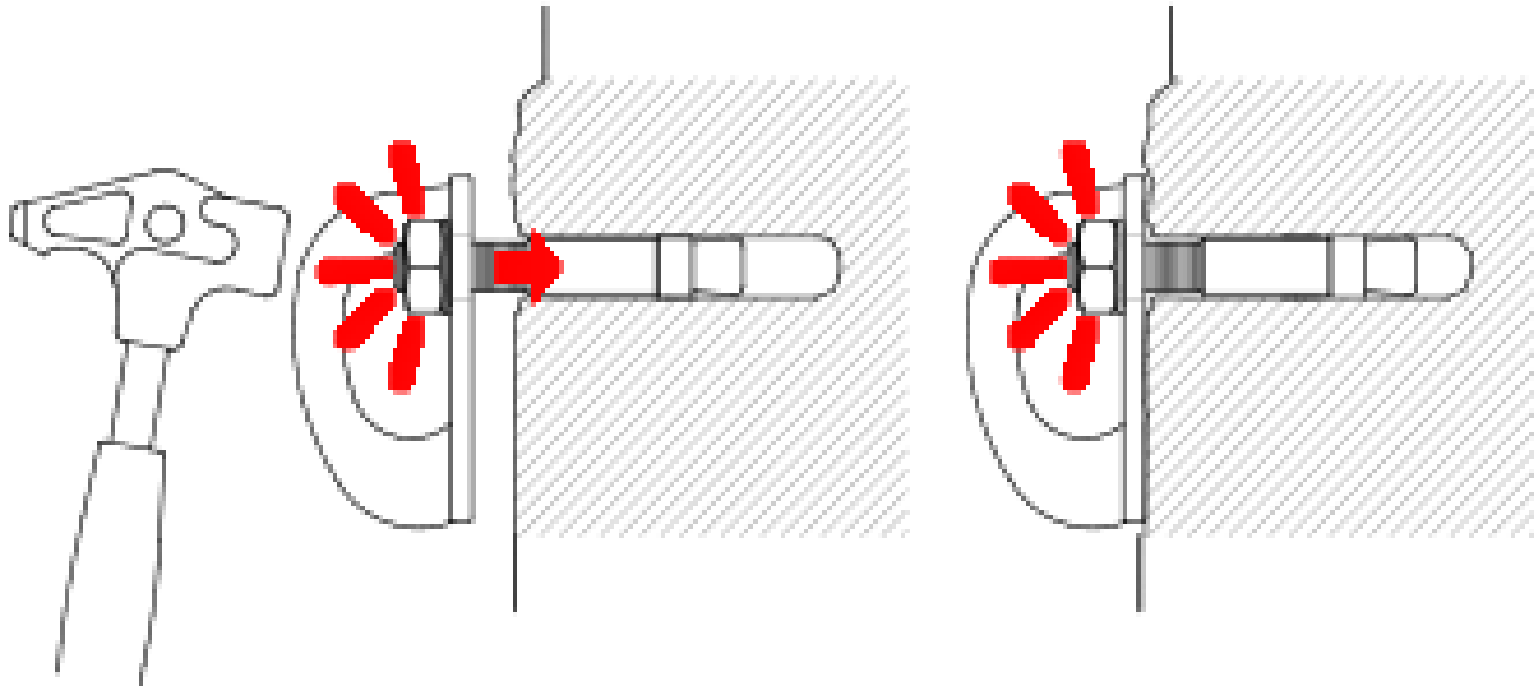
Drill hole to the full depth of the hanger, this will allow it to be hammered into the rock if it becomes dangerously damaged.

Blow dust out of hole

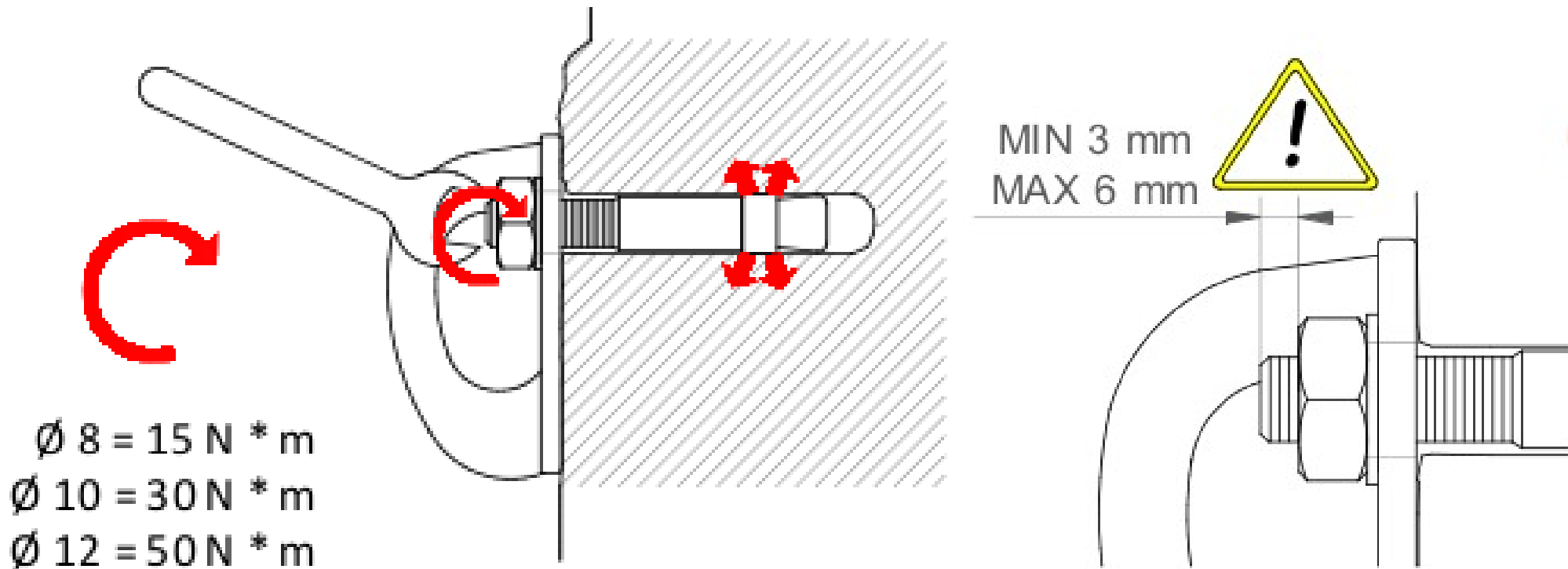


Install anchor

With hanger/nut at the end of the thread to act as a depth stop, gently tap anchor into hole.



Install anchor



M8: approximately 2 fingers 15cm along a spanner.

Tightening anchors

- With Hiltis, use a lower torque of ~2 fingers 5cm along a spanner, due to risk of stripping rusted thread. (Design max 8Nm)
- With stainless steel Hang Fix hangers higher torques (15Nm) should be used to set the wedges and reduce risk of them coming loose.
- All threaded anchors can be come loose, therefore it is important to check bolts/nuts for tightness whenever you pass.

Notes on galvanic corrosion

When connected to stainless steel,
Aluminium will corrode at an increased rate



Notes on galvanic corrosion

When connected to stainless steel,

Galvanised steel will corrode at an increased rate



Notes on galvanic corrosion

- Aluminium and galvanised steel do not significantly corrode each other
- This is what has been historically used on expo



Galvanic Corrosion Likelihood

	Zinc	Galvanised Steel	Aluminium	Mild Steel	Stainless Steel	Examples
Zinc			Yellow	Red	Red	Sacrificial layer in galvanised steel
Galvanised Steel			Yellow	Red	Red	Hiltis, spits, maillons, Petzl bolts
Aluminium	Yellow	Yellow	Grey	Yellow	Red	Petzl Hangers, Karabiners
Mild Steel	Red	Red	Yellow	Grey	Yellow	Galvanised Steel gone rusty
Stainless Steel	Red	Red	Red	Yellow	Grey	Hang Fix, Raumer hangers and bolts

Leaving gear in situ between expeditions

- Lightly grease HKDs and spits
- Hang rope out of the way of water and falling rocks (eg. pull rope up pitches)
- Do not leave stainless steel in contact with aluminium or galvanised steel
- Do not leave aluminium or galvanised steel where it may get wet/damp.
- If in doubt remove gear from cave.

Stainless A4/316



Galvanised Steel/Aluminium



In situ – acceptable gear

- If the pitch is to be permanently rigged, when packing the rope, thread stainless steel ring hangers on the rope at the top of the bag. These can then be placed in the bite of rope as you tie the knot.



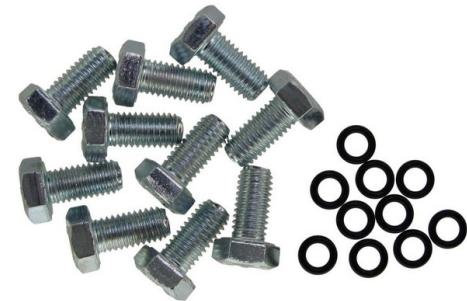
In situ – old gear

- Any other gear found in situ, should be removed from the cave
- Galvanised steel metal work should be inspected to ensure it still has a zinc coating.
- Aluminium hanger corrosion can be hard to spot. If found in situ between expeditions should be retired.
- Existing Hiltis should be replaced where possible, especially where there are signs of corrosion:
 - the threads are iron oxide brown rather than spiny zinc
 - the bolt can not be screwed in by finger



Replacing bolts

- Bolts will be removed, when used with Hang Fix anchors.
- Later the bolts may need to be replaced:
 - Due to their thin diameter and cut threads, bolts can easily be the weakest part of the system, especially if they are made from a substandard grade of metal or if they are not properly quality checked.
 - The length of the bolt is also critical.
 - To ensure a safe bolt is used, it should be bought from a reputable caving gear shop.
 - 8.8 Galvanised Steel bolts for all hangers, as they will be in contact with hiltis



Replacing bolts

- When a galvanised bolt has gone rusty, it has lost its protective zinc layer
- It will corrode the zinc / not protect the steel in our hiltis
- Therefore rust bolts should be replaced with shiny galvanised bolts



Immediate equipment retirement

- Unused Hilti HKD anchors and setting equipment must be retired
- Petzl 'ring' hanger must be retired, as:
 - They require longer bolts than other hangers to be safe,
 - Having both steel and stainless steel rings is likely to lead to confusion.

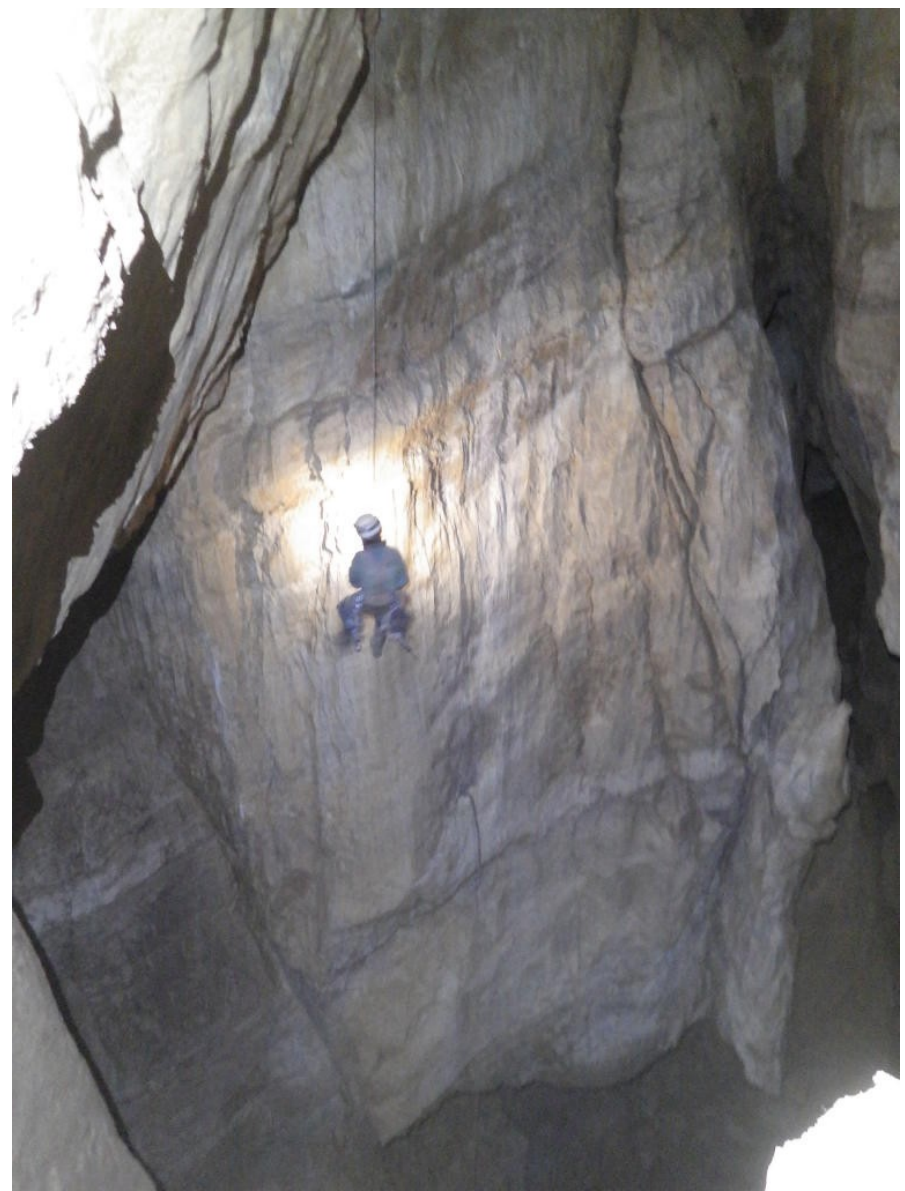
Training Requirements

- When bolting or rigging on expo, you should either be supervised or signed off as trained.
- To be trained a person must
 - Have gone through and understood this presentation with someone who is trained,
 - Have some under ground experience of selecting good anchor positions,
 - Have set a though bolt under supervision,
 - Has identified what 15Nm feels like using a torque wrench or similar,
 - Listed as trained, along with date and trainer, on the expo website.

Questions?



Lets descend some
itches,



Lets descend some
itches,

BITCHES

