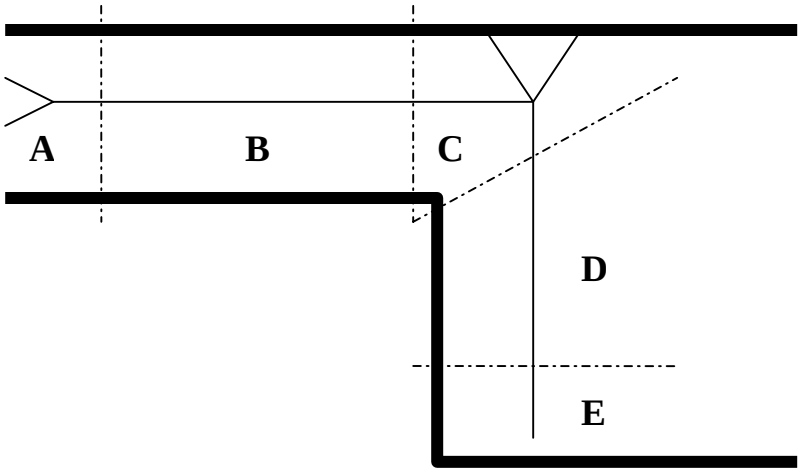
West Brecon Cave Rescue Team
Rescue Pitch Belay Guidelines

Version 1.0 - Alastair Garman – July 2007

1. Introduction
The purpose of this short document is to offer a set of guidelines and considerations with respect to belay selection and bolt placement, for the rigging of pitches for rescue. The emphasis is on the word 'guidelines' because all pitches, casualties and rescue situations have their own unique problems. This document also only discusses the general case, other scenarios, eg. tyroleans, would have to be extrapolated from these concepts. This document also highlights the environmental impact of bolting and how it can be minimised. This document does not attempt to instruct on how to rig or how to install bolts.

The overriding consideration in all circumstances is safety. Riggings decisions should not be based on any other considerations, eg. speed or whether this is a training or live exercise. This said bolts should only be placed as a last resort, where no natural alternative exists. If bolts are placed, their visual impact should be minimised, see section 5.

2. Different Types of Placement
A typical pitch can be broken up into the following zones, each zone having its own belay characteristics :-



Key			
	Name	**Visible Impact of Bolting**	**Likelihood of Bolting Required**
A	Backup Belay	Medium	Medium
B	Pitch Head Approach	High	Low
C	Pitch Head	Medium	High
D	Mid Pitch	Low	Medium
E	Bottom Belay	Medium	Medium

2.1 Backup Belays (A)

Backup belays in cave rescue are much more important than for a typical SRT scenario. This is because the backup belays are the only point where the stretcher (life & haul lines) are physically attached to the rock. The pitch head is nothing more than a glorified deviation. You will often find a good natural belay within 5m – 10m of the pitch head. Occasionally a bolt may be required in order to reposition the line of ropes, so that there is a straight line to the pitch head. The altitude of backup belays relative to the pitch head is not that critical, ie. Floor or ceiling. Backup belays are normally in walking passage, which means that any bolts are likely to have a visible impact, although because positioning does not have be exact it is normally possible to hide them a little.

2.2 Pitch Head Approach (B)

The pitch head approach is normally a traverse line, which may or may not be taking the weight of cavers. The key fact is that it is **not** directly part of the stretcher's rigging, other than acting as a backup to the pitch head belays. Its purpose is to allow cavers to safely access the pitch head, work at the top of the pitch and occasionally to secure the hauling team. Therefore normal SRT rigging rules apply to this zone, ie. stay high! Typically it is rigged using the naturals or bolts used when the pitch is rigged for sport caving. You can normally get away without installing new bolts, unless it is a pitch that is only required for a rescue and has an exposed approach. Traverse line belays are normally in walking passage, which means that any bolts are likely to have a significant visible impact.

2.3 Pitch Head (C)

The pitch head belays also take the most strain, as they belay pulleys (ie. in excess of twice the rescue load) and therefore must be 'bomb proof'. For this reason many existing pitch head bolts are of little use for rescue, ie. not strong enough, worn out or of unknown origin. The hang point of the haul and life line ropes is absolutely critical to the successful negotiation of a pitch. Therefore the positioning of the pitch head belays is also critical. The differences between standard SRT and rescue pitch Y-hangs are critical :-

- **Height** – The distance from the centre of the Y-hang to the head of the stretcher is at least 50cm, more if doing a horizontal lift. This is made up of Delta MR, pulley, and the head of stretcher Y-hang and MRs. This is not the case for standard SRT and therefore normal belays are often not good enough for rescue use.
- **Perpendicular to haul** – The pitch head Y-hang is a glorified deviation between the backup belay and the stretcher. Due to the heavy strain they are under it is critical to correctly load the Y-hand. When the haul line is loaded the hang point shifts horizontally and vertically from it's natural hang below it's belays, towards the backup belays. The distance of shift is determined by the length of the Y-hang 'arms'. In order to successfully split the load evenly between the 2 belays, they should therefore be perpendicular to the direction of haul. This normally means they should be on facing walls (ie. right and left) rather than both on the same wall. An alternative is to rig a 3 way Y-hang, but think carefully about the final loading angles.
- **Distance out** – Due to the horizontal swing of the Y-hang and the technique of moving the stretcher horizontally at the pitch head, by splitting the haul and life lines, it is normally required to have the hang further out over the pitch than for normal SRT.

Due to the above considerations it is likely that one or more bolts would need to be placed at a pitch head. However because the belays are likely to be higher and further out than normal, their visual impact is lessened.

2.4 Mid Pitch (D)
When moving a large cumbersome stretcher it is often necessary to alter the hang of the rope mid pitch. This is typically done using floating deviations. It is sometime necessary to place bolts in cases where the rock is poor or is very smooth. The visual impact of these placements is very low, because of their obscure locations.

2.5 Bottom Belay (E)
Bottom belays are used where the pitch head is constricted. The guidelines for bottom belays are basically the same as for backup belays. The only difference is that pitch bottoms are normally much bigger than pitch heads and therefore you are more likely to find a good natural belay.

3. Designing the Rigging
It is important to decide how the pitch is going to be rigged before starting to rig, particularly before placing any bolts. This is best done by an experienced rigger who has experience of the differences between a rescue rig and a standard SRT rig. If a less experience rigger is making this decision, it should be talked through with a more experienced rigger or other members of the rigging team. The criteria being: safety of the casualty / rescuers, minimisation of environmental impact and simplicity. The principles set out in section 2 should be used in this design decision.

The design process would typically involve :-

- Visual inspection of pitch head, looking for naturals and good rock
- Quick look down pitch to identify likely hang and possible obstacles
- Visualise how the stretch will get off the pitch head
- When will the haul team be?
- Identify suitable natural backup belays.
- Casualty's likely medical condition
- Available equipment and person power

4. Natural Belays
Suitable natural belays should always be used in preference to placing new bolts. There are many factors that should be considered when checking the suitability of a natural belay, including :-

- Quality of material – limestone, calcite etc.
- Direction of loading under normal conditions
- Direction of loading under failure conditions, eg. pitch head belay failure
- Type of natural – Spike, thread, choke stone, boulder etc.
- What is the natural's most likely mode of failure? Is it thick enough, heavy enough?

It should be noted that natural belays can often be made by jamming a rock in a crack or drilling a flake.

5. Bolt Installation
As a last resort bolts can be placed to ensure the safety of both casualty and rescuers. There are several types of bolting methods and hangers which are applicable to rigging for rescue. These are not discussed here as they warrant a separate document. The only thing I would say is that rescue loads far exceed those for normal SRT and therefore many bolts already installed in caves should not be used, eg. 8mm spits.

I do not want to cover the practicalities of actually installing different types of bolts, as this should be learnt on the surface as a practical exercise, or by watching someone doing it underground. The following are a list of relevant considerations :-

- When installing through bolts it is essential that they are over drilled (ie. at least total length of bolt), so that the option to 'knock them in' is always available.
- Where possible through bolts should not be used in situations where the force applied to them directly pulls them out of the wall. This is for 2 reasons :-
    - This is their weakest loading scenario
    - We do not currently have any hangers that are designed for this loading scenario, ie. passing load directly down the line of bolt.
- Make a conscious decision about the quality of the rock, if it is poor move elsewhere or use longer / bigger bolts.
- Attempt to hide bolt placements to lower their visual impact. Anyone using them in the future will find them if they know what they are doing.
- **Do not drill the holes in the most comfortable position for the installer**. This invariably results in bad placements. Often the rigger must expose themselves to a potentially large pendulum in order to get the best placements. If you are not prepared / able to make the best bolt placement then maybe someone else in the rigging team is, please check.

6. Training Scenarios

When training scenarios are decided upon, a careful look at any pitch should be made to determine whether bolts are likely to be required. If they are, then the decision to continue with the scenario should be made at that point. This decision would take into consideration the likelihood that the pitch would be used in a live rescue. An important part of training is learning where and how to install bolts.

7. Conservation Considerations

Although the primary consideration is safety, where ever possible the environmental impact of the rigging must be minimised. This means only placing bolts where it is not practical and therefore safe to do otherwise. When choosing a bolt placement, thought should be given to its visual impact. It is often possible to hide bolts, the limitation here being the 2ft long drill that is used to place them. All through bolts should be over drilled so that there is always an option to 'knock them in'.

Disclaimer – The guidelines and ideas expressed in this document are intended to raise awareness of the issues surrounding rigging for rescue and are not intended as instruction on how pitches should be rigged.