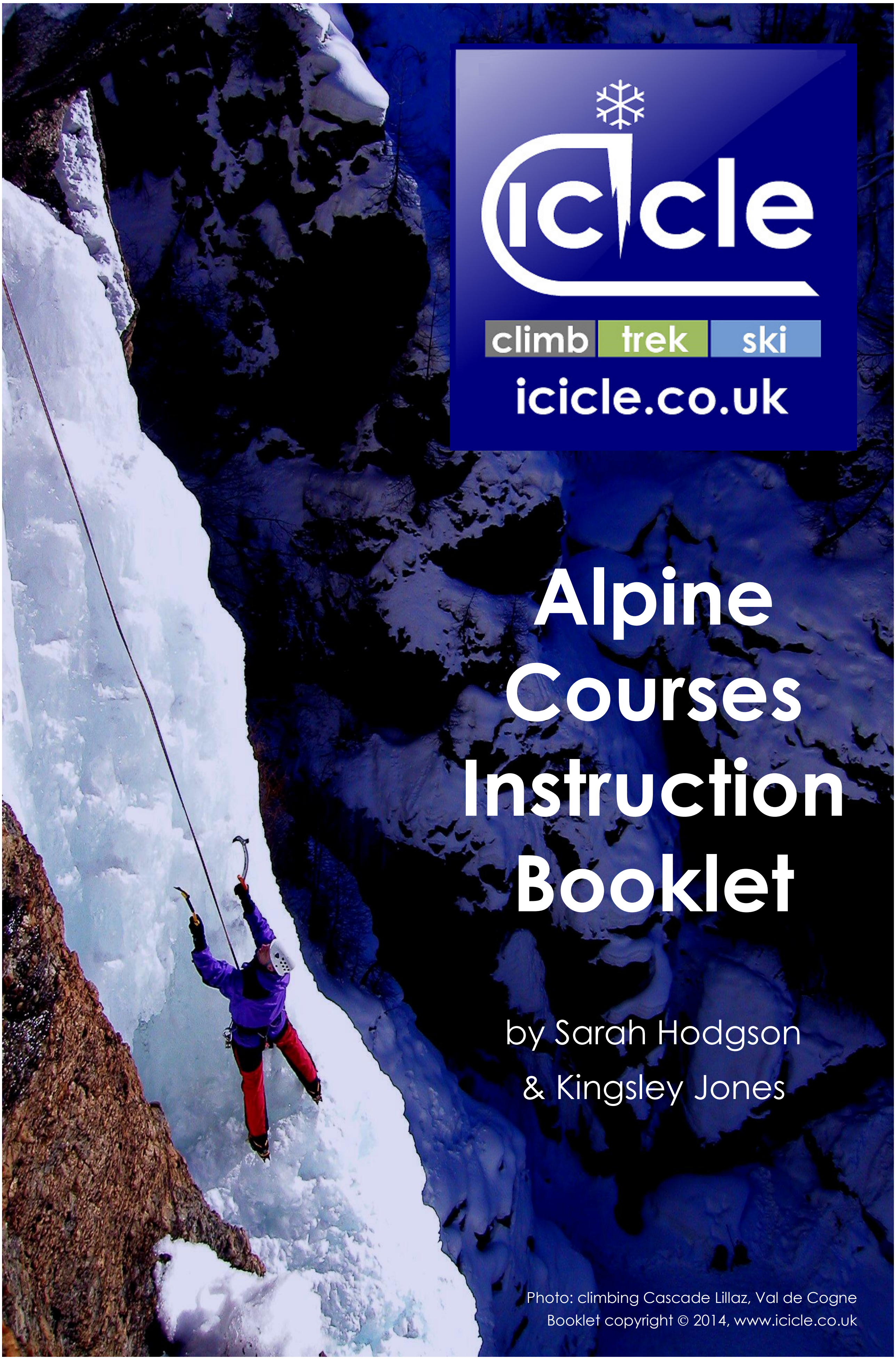

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Alpine Courses Instruction Booklet

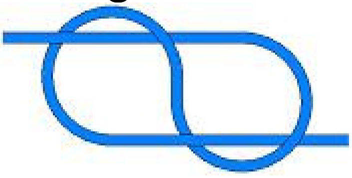
by Sarah Hodgson
& Kingsley Jones

Photo: climbing Cascade Lillaz, Val de Cogne

2: Basic Alpine Ropework – Knots

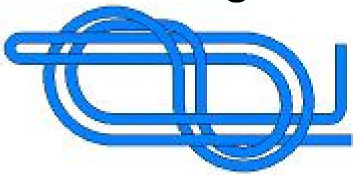
This section covers the key knots that you will require in the Alps. You only need to know the knots pictured below, and there is an explanation of the situations in which you would use each one. In all the diagrams the rope is either a half or full rope (8-11mm), and the thinner ropes (bottom three diagrams) are prussic cord which is 7mm in diameter.

Figure of 8



This diagram is just so that you can ensure that you can make the initial figure of 8 to start tying on, before retracing the shape with the loose end of rope.

Doubled Figure 8

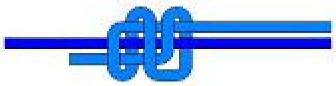


This is the preferred way to tie on, as it is essentially two opposing figure of 8 knots tightening against each other. A stopper knot on the end is optional.

Bowline

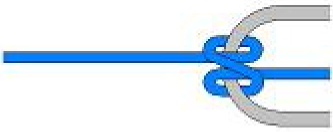
A quick method of tying on, but it is not as easy to check as a Double Figure of 8. It must be used with a stopper knot, and it is easy to undo after a fall.

Stopper Knot



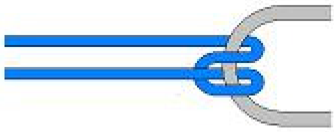
This knot is to be used if you have tied on with a bowline, or two can be used against each other to form a prussic loop on a 1.5m length of 7mm cord.

Clove Hitch



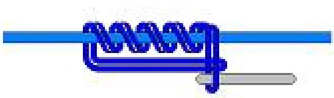
For locking off a rope at a belay stance, this knot is the best method. It is very adjustable, so that you can either take in or give some slack on the rope / sling.

Italian / Munter



This hitch is clipped onto a karabiner, and is used to either lower off or belay. It is very useful if you are running short on kit, but has lots of braking friction.

Traditional Prussic



This prussic is similar to the Autoblock, but only one end is clipped into the karabiner, so it has better braking properties, and is a great abseil back up.

Tress Prussic

Can be made either with a sling or a long prussic, & is useful when the main rope is iced up or very wet. This can be used as an abseil backup or for self-rescue.

Autoblock Prussic

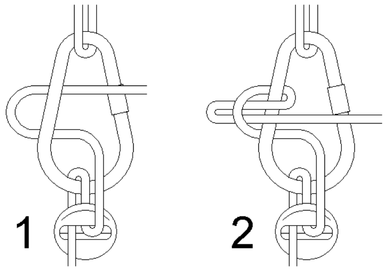
To make this prussic, the loop is wrapped around the main rope, and the two ends are clipped together with a karabiner. This is used in crevasse hoists.

The good news is that these are the only knots that you need to know for mountaineering in the Alps, and any others you see are only different methods of doing the same job. These knots must be practised often so that they become intuitive to you.

3: Basic Alpine Ropework - Safety

This section covers basic safety ropework that is used in the Alps, including locking off a rope, belaying, and making safe. In effect all three systems set out to achieve the same goal, to control the rope and to make you safe. There are many methods of doing each of these actions, but the ones described below are the most popular. Although this talk is on the very basics, don't worry if you know more as there are many different options to learn for more advanced climbers. The aim is not to confuse you with too many methods of ropework, but to show you the key elements that you will use every day.

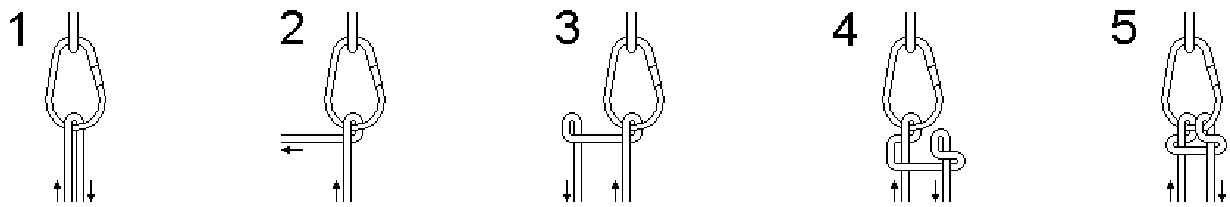
BELAYING: when the word 'belay' is used as a verb, it means the control of the rope to protect a climber. There are many devices used for belaying, but their effects are the same in that they break the rope in event of a fall. The rope leading to the climber is called the live rope, and the rope on the other side of the belay device is the dead rope. The key rule is that one hand must always be on the dead rope at all times, so that it can be locked off.



LOCKING OFF A BELAY / ABSEIL: these pictures shows a belay plate being used, though other devices can be used from a figure of 8 to a Reverso. In picture 1 the dead rope locked back and a loop is passed through the shoulder of the karabiner. A new loop is made further down the dead rope. In picture 2 the new loop is passed through the original one (and extra loops can be put in). The locked off rope can then be undone with a pull on the loose end of the dead rope.

You must be sure that you keep the dead rope in the locked back position when you start to release the system, until you are ready to take in or feed out the rope again. The main reason for learning how to lock off is that it frees up the use of your hands for another task such as checking the protection or taking a photo. It is not a good idea to lock off using the old technique of wrapping the dead rope around your leg, as this is slow to undo, and may invert you in event of a fall, not to mention the fact that is it very uncomfortable on the leg.

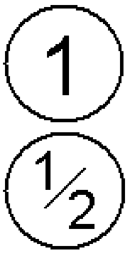
MAKING SAFE - THE CLOVE HITCH: the diagrams below show how to make yourself safe by using the rope alone. It is best to clip in the rope first, so that you are always safe, as if you were leading you would still be protected by the belayer in event of a fall. If this occurred whilst you were doing the hitch on the karabiner you would only fall the rope stretch, rather than past the last piece of protection if you were doing the hitch by hand.



MAKING SAFE - THE COW TAIL: a cow tail is a sling attached to your harness at one end by a larks foot, and with a karabiner on the other end. The tail is wrapped around to the back of the harness for storage, and is quickly accessible to make yourself safe at a belay by holding the tail in front of you, and attaching the screw karabiner to the anchor point.

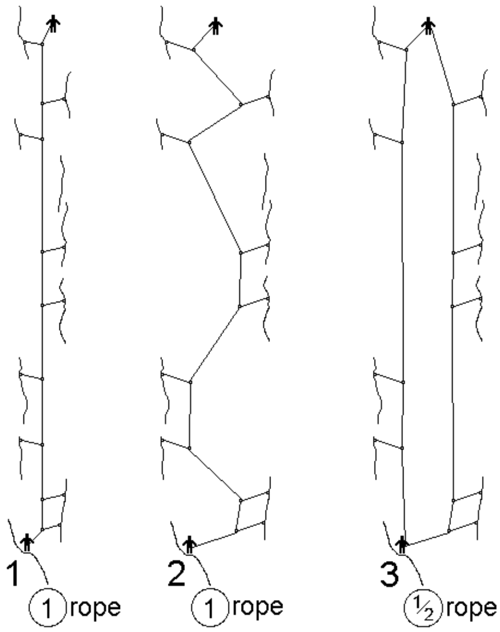

PHOTO: sunrise from the Grand Jorasses

4: Basic Alpine Ropework – The Ropes



There are two types of ropes normally used in the Alps, which are denoted by the symbols on the left. A full or single rope is marked by the upper symbol. To find the markings look at the end of a new rope, and you will see a small sleeve with the key data on it and CE and UIAA accreditation mark. The single rope measures between 10 and 11mm diameter, and is between 30 and 60m long. It can be used on its own, with a maximum abseil distance of half its length. The bottom symbol denotes a half rope, and so for pitched climbs there will always be a pair of half ropes. Each half-rope measure between 7 and 9mm, are between 30 and 60m long. As there is a pair of ropes the maximum abseil is the length of each rope.

One of the key factors in choosing the type of rope to use on a climb is the rope drag. In diagram 1 to the right, the climber is able to place protection so that the rope runs directly through it with the minimum of friction. In this case a full rope should be used. In diagrams 2 and 3 the differences of using a full and two half ropes are shown. In diagram 2 the climber has had to zig-zag to place protection, and cannot extend it enough to avoid rope drag. Consequently the rope is running to and fro, causing a lot of friction. Diagram 3 shows the same climb and protection placements, but using two half ropes. As you can see there is almost no drag, so for the same climb in diagrams 2 and 3, two half ropes are the ideal choice. If you have not climbed the route before, look in Guidebooks for advice and information to see whether to take full or two half ropes. The rope drag isn't the only factor to take into account when using a rope. You should also consider if you have to do any abseils, where two half ropes would make things quicker, or if the climb has lots of sharp edges that cannot be protected against, so two ropes may be preferable than one. Another factor is that all we have considered is pitched climbing.



If you are climbing Mont Blanc, or another snow route, there are no pitches and the weight is a key issue at altitude / when the rope gets wet or icy. Here it may be a good idea to just take one half rope, as there can be no vertical falls (just slides), so the full rope strength is not required. It is quite common in the Alps to see a roped pair on a snow ascent, to have just one a 30m half rope. This saves a lot of weight, and enables the team to move quicker than those battling with a 60m full rope. When climbing with a Guide, they will always choose on the side of caution when picking ropes, as they have to maximise your safety and so usually use two half ropes on pitched climbs, so two clients climb simultaneously.

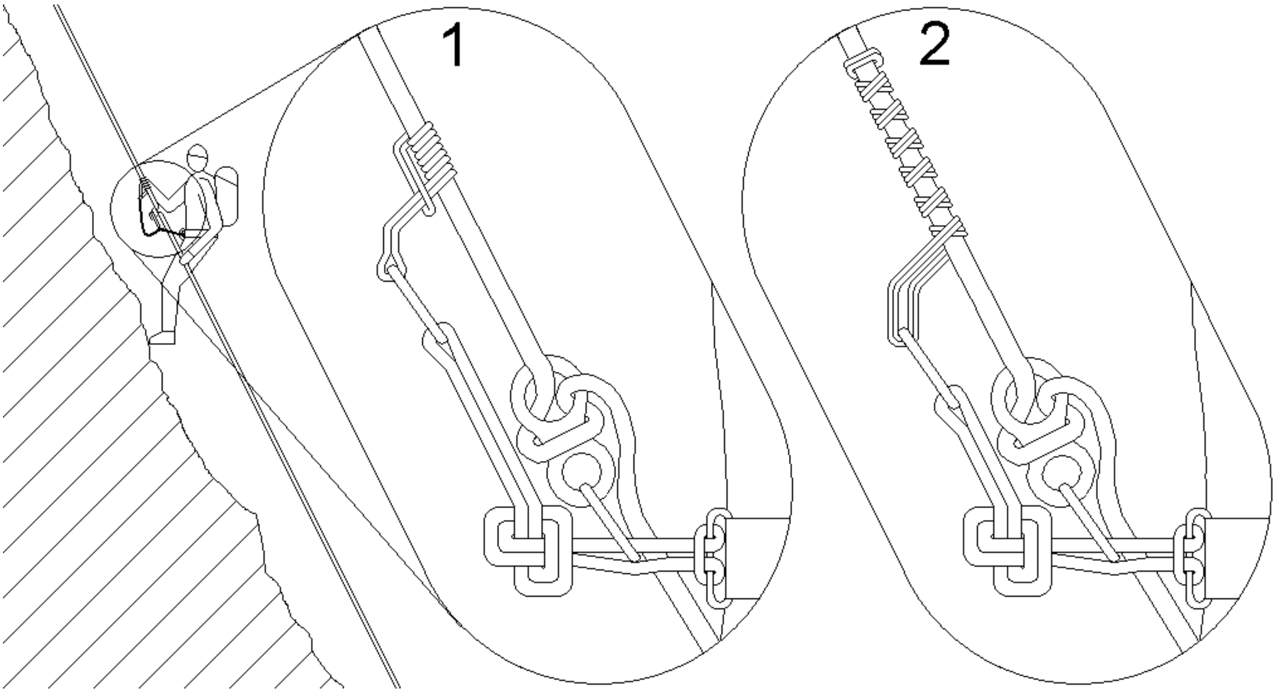
PHOTO: artificial big wall climbing in Verdon

5: Basic Alpine Ropework – Abseiling

It is common knowledge that most accidents occur when climbers are descending. This is for a multitude of reasons including; the fact that the climbers are likely to be tired and so are more prone to making mistakes, there is often insufficient protection at the top of the abseil so that the rope becomes detached, the climber descends off the ends of the ropes, or the climber loses control or the ropes possibly caused by being knocked unconscious by a lump of falling rock or ice. This page describes a method to minimise these risks.

Whenever you abseil, you should get into a fixed routine of setting it up, so then even when tired, the sequence is automatic. Below is a sequence for using two half ropes:

1) Attach yourself to the anchor, using the cow tail and screw gate karabiner
2) Pass one rope through the anchor (abalakov loop, around rock, through sling)
3) Tie ends of the two ropes together, using an overhand knot 50cm from the ends
4) Attach yourself to the two ropes with your abseil device and lock it off for safety
5) Tie a knot 50cm from the end of each rope, to stop you abseiling off the ends
6) Throw the coiled loose ends of the ropes down, one by one, so they don't snag
7) Attach a prussic / tress to the ropes above your belay device (see diagram below)
8) Connect the prussic to the end of the cowtail, and check that it would lock in a fall
9) Put one hand on the prussic to keep it loose, and one hand firmly on the dead rope
10) Commence your abseil, and if you find any rope below you snagged, throw it down



If you follow the sequence above, you will make a very safe abseil. The worst that could happen is that you were knocked out and so let go of the ropes altogether. If this occurred the prussic / tress would lock off automatically until you can around. You cannot abseil off the end of the ropes due to the knots in place. At the bottom of the abseil, make yourself (and any others) safe, then undo the knots in the end of the rope and pull down on the rope which had the overhand knot at the top and was to one side of the anchor (to reduce the friction), and this will retrieve your ropes. Just remember, that this is one method for abseil set ups, and there are many, as some prefer to swap the position of the belay device and the prussic (i.e. device above prussic). Find a system that works and stick to it.

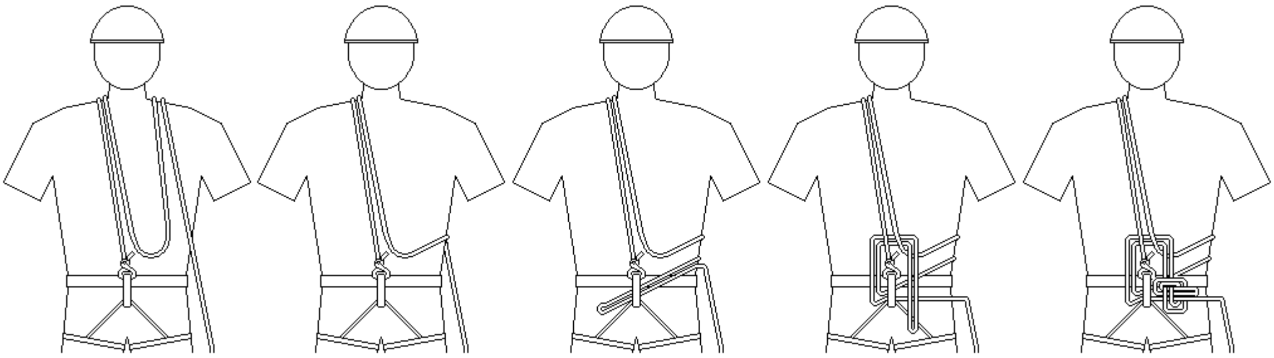
PHOTO: Mont Blanc massif

6: Basic Alpine Ropework – Coils

When you climb a route in the Alps, you have to make one choice of rope for the day, and you have to make do with that choice, whatever the terrain. This means that there are some situations where you require a longer rope between you, and others where a much shorter rope would be ideal. The main categories are listed in the summary below:

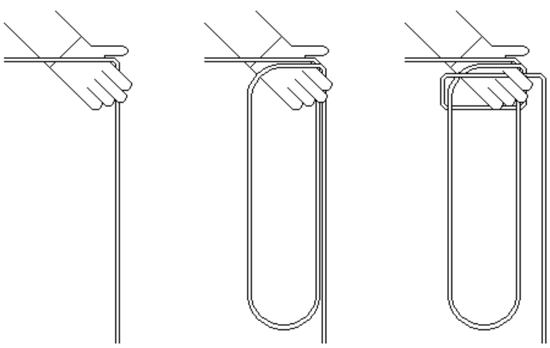
LONGER ROPE – wet (snow covered) glacier, rocky ridges, pitched climbing, ice sections
SHORTER ROPE – snowy arêtes (ridges), snow descents, on short rock or ice steps

As you can see from this summary, on a typical Alpine climb, you will need to adjust the length of the rope many times during the day. The best way of doing this is for both of the climbers on the rope to take in / drop coils between them, to vary the rope length. The five diagrams below show you the sequence of how to put on and tie off your Alpine coils.



Tie on to the rope, then run it up over your shoulder and around the back of your neck, then drop the rope down your front.	Take in coils as necessary, & use your hand at the tie in to make the right coil size. Then put the other arm through the coils.	Pull a bight of 60cm of the slack rope from the end of the coils behind your back, and pass the bight through your rope tie in loop.	Bring the bight up behind all the coils and the original tie in end of rope still ensuring that there is about 50cm of the bight left.	The bight is then tied in an overhand knot round the rope running to the other person on the rope, and is clipped to a krab.

Practice adjusting the coils many times for shorter & longer rope lengths, as it could be unsafe if you forget any part of the sequence. For example, if you do not pass the bight through the tie in loop of the harness, then fall into a crevasse, the coils could be lifted into your face. Correctly put on, the coils raise your centre of gravity & help stop you inverting in a fall. For ease of adjustment the coils are worn on top of the rucksack straps.



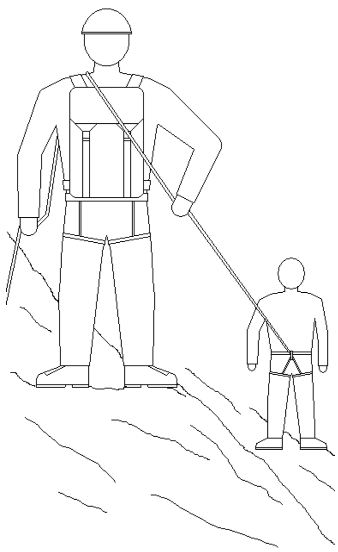
Hand coils should only be used by an experienced climber as if they are incorrectly held there is a lot of loose rope in event of a fall. They are used to protect a weaker climber for a short section (which is why Guides often use them), but they should not be used instead of adjusting the Alpine coils. In the diagram you can see how to take the coils. A suitable number of coils are to be taken in. The rope running to the other climber is passed around the back / outside of your hand, then around the coils held in the hand, and back across the palm of the hand and through the middle two fingers. In event of a fall this hand wrap will tighten and no loose rope is involved. Only do this with gloves on, as in falls, your hand is squeezed hard.

7: Basic Alpine Ropework – Roped Pairs

Now that you are familiar with Alpine coils, you are ready to work as a roped pair. The control of the rope between you, as described below, is referred to as Short Roping, as some of the length of the rope is carried as coils. When Short Roping, you are using the rope as a method of protection in it's own right. Many people focus a lot of their time in the UK hills in winter learning how to do an ice axe arrest. This is because many gully climbs are done unroped. When Short Roping, a fall can always be held, and a difficult section protected. This is why there is a much lower focus on axe arrests in the Alps than the UK.

Always the stronger climber should be uphill of the weaker climber, so when ascending the stronger climber is in the lead, and when descending the weaker climber is in the lead with the better climber above them. This is so that in event of a fall the better climber can hold the fall by bracing against it, or using their ice axe to hold it (see page 9 for ice axe belays). The key to good climbing is to prevent a fall by pre-empting one before it occurs. That is down to the skill of the better climber's judgement. If they think that the second will struggle on a section, they should consider a shoulder belay, as shown in the diagram below.

The lead climber reaches a good stance, and then takes in the slack and runs the rope from the weaker climber to the leader at waist level, and then diagonally across and up their back. The rope goes over the opposite shoulder to the side that the rope came in at, and then runs down the front of the leader to their hand, which locks the rope down. In effect the leader has turned themselves into a belay device, and the rope must be taken in accordingly, with one hand always on the dead rope. The leader generally takes in the slack live rope (right in the diagram) and pulls down on the dead rope (on the left in the diagram). When the dead rope arm is at full stretch the hand on the live rope moves across to hold the dead rope, whilst the arm on that side is moved upwards. Then both hands return to the positions in the diagram. This is exactly the same sequence as when belaying. You must practice this with the rope swapped to either side of your body, as it may only be practical to use one way in a mountain environment. If the leader is in any doubt that they may be pulled over then they should set up an anchor system, and the climb should be pitched until easier ground is then reached, and the climbers can move together.



Moving as a roped pair is the quickest and safest way to climb on any mountain. The only advantage of more people on a rope is for crossing a wet glacier, where safety in numbers is apparent. Although it seems paradoxical to consider it, you maximise your safety by minimising your time on an ascent, and therefore you minimise time in the mountains that you wish to climb in! You will learn that you can ascend many routes very safely just by learning and practising how to use the rope as a means of protection in its own right.

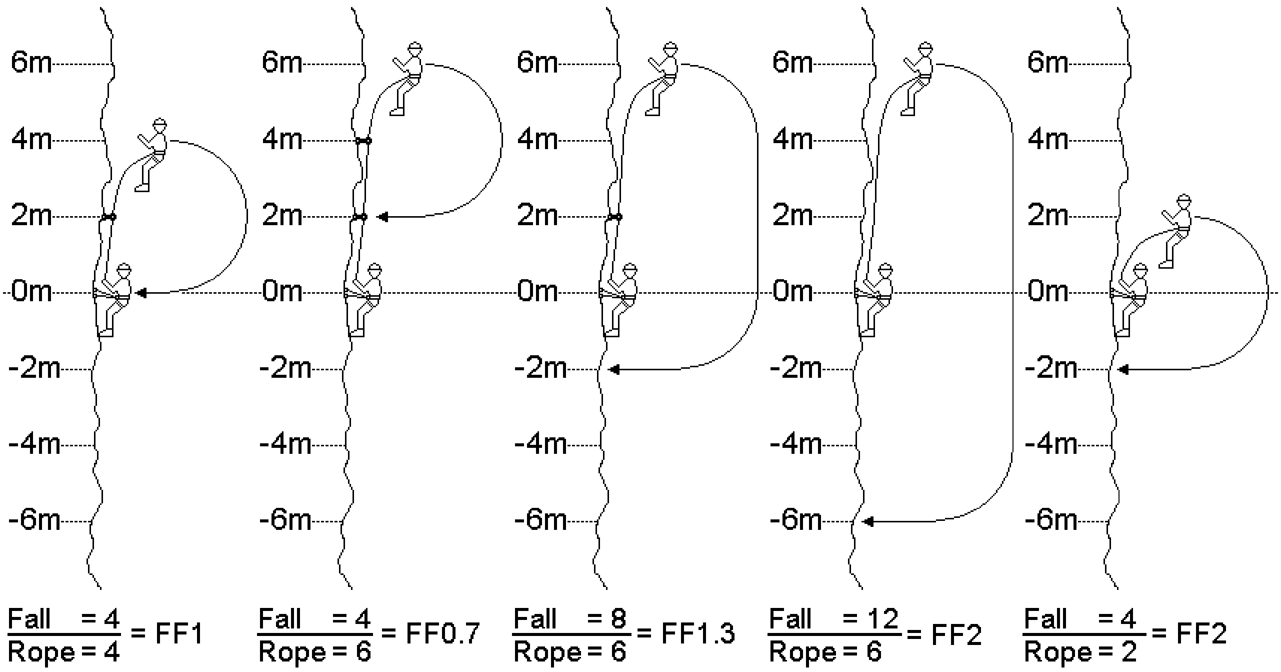
PHOTO: ski touring on the Haute Route

8: Protection – Fall Factors & Basics

This next section of the booklet covers protection. This is used on all climbs where you consider that you could not hold a fall alone without some assistance, or would not want to fall any significant distance for fear of injuring yourself. Essentially it is a piece of equipment attached to the mountain in some way, with rope clipped into it. Examples of protection include ice screws, camming devices & nuts. Protection is used in three formats:

1) ANCHOR – When you clip yourself into protection to make yourself safe after a pitch
2) RUNNING BELAY – An intermediary piece of protection before reaching an anchor
3) POINT OF AID – Protection placed to take the climbers weight so they can move up

Before you consider how or what to place as protection, you need to consider how often the protection needs to be placed. The reason for this is that you need to calculate the potential force that is exerted on the rope, running belays and anchors in event of a fall. The good news is that you don't need a physics degree to work it out. There is a simple method of calculating the force exerted in a fall, and we refer to it as a Fall Factor. This is calculated by dividing the length of the fall by the length of rope involved. Assuming that none of the pieces of protection fall out, you will fall to the last piece of protection, and the same distance past it as you were above it. The diagrams below show some examples.



Whenever you fall further than your belayer you have had a greater then Fall Factor 1 fall, and if you don't fall to reach the belayer, a Fall Factor under 1 has occurred. The basic rules are to always try to have a Fall Factor less then 1. To do this, always place protection over half way up between you and the belayer. Count the amount of times you have a fall greater than Fall Factor 1, and refer to the manufacturers guideline for how many of these falls it has been certified for. If you ever have a Fall Factor 2 fall, even if it is tiny such as in the right hand diagram, the rope must be immediately retired, as it is dangerous to climb with. Fall Factors are one of those elements of climbing that many people worry about too much. By following these easy guidelines, and by placing protection, you should avoid ever having a fall that exceeds a Fall Factor 1, so don't worry!

9: Protection – Running & Natural

There are very few routes in the UK where there is a real risk of benightment, and so you can afford to climb very methodically and in pitches at all times. In the Alps the possibility of staying out on the mountain for the night is very serious, and so wherever possible it is best to move together, and just to pitch climbs when it is necessary. This means that there is a greater requirement for using running belays and natural protection. This page considers the key options on rock, snow, ice, and using your basic safety equipment.

A natural belay is using simply the rope to run around / behind a natural feature on a climb, so that as the climbers more forwards, the rope runs behind the feature, so that if either of the climbers falls, the rope will snag behind the feature and halt the fall. A running belay is normally a karabiner or sling attached to a feature in some way, so there is less friction on the rope. Running belays have far less friction, but generally take longer to place.

ROCK – Gendarmes are rock towers on Alpine ridges (e.g. Hornli or Cosmique Arêtes), and are generally turned on either side. If possible the rope can be attached to the tower, usually by a sling and karabiner, to protect the climbers as they traverse below it. On a broken ridge the climbers can zig-zag from side to side, so that the rope passes around rock spikes as natural protection. If the climbers have to stay on one side of the ridge then as they climb along, the lead climber can lift the rope over a spike every 10m or so.

SNOW – Most UK based climbers are unfamiliar with using snow as protection, as snow depths experienced there are rarely significant. In the Alps there is often be 10's of metres of snow beneath you, that can be used for natural protection, and for placing static protection. The classic natural belay on snow is a bucket seat belay, where the lead climber digs a seat and foot rests into the snowpack, and then does a rope belay around their waist, to bring the second up to them. A snow bollard can be used as a running belay or an anchor point. Essentially these are snow mushrooms with up to a 1m diameter, but they can only be constructed in very hard snow, to lessen the risk of the rope cutting free.

All the other types of running belays or natural protection use some of the basic safety kit that you would have on you at all times. Ice screw placements are discussed on Page 11, and are a very popular piece of protection, but can also be used in a multiple abseil or long traverse, to make Abalakov belays. These are two holes drilled into the ice at 45º to meet each other about 15cm beneath the surface, with a 90º angle between them. A length of 7 or 8mm cord is threaded through the holes and tied off. The rope can be threaded through for an abseil, or a sling can be attached with a karabiner on the end, to use as a running belay. Another device for protection in snow is the deadstop plate, which has to be precisely angled (40º above the horizontal, with no upward lift created by a slack or indirect route for the wire) to work safely. For most routes in the Alps the weight of this kit means it is often not carried, unless in the winter on snow slopes (e.g. Cherie Couloir approach).

On any snow route, you will be carrying an ice axe, and this can be used in many ways for a belay. There are two key methods to consider for using your axe as an anchor. Firstly the axe can be rushed vertically into the snow beside a boot, for a footbrake belay. The rope is passed over the front of the boot, around the axe, and round the downslope side of the boot. This creates lots of friction for a belay. Alternatively the axe(s) can be buried in a T-slot, at 90º to the rope with a narrow exit slot for the sling / rope to pass through. As with the deadstop, the ropes must run in a straight line to avoid lifting the axes up at all.

PHOTO: snowshoeing in Chamonix

10: Protection – Rock Belays

There are four key categories of rock protection in addition to the use of ropes and slings for use on natural protection. These are described below, with explanations of how to use them in various situations. The advanced use of bolts / pitons is considered on Page 13.

HEXES – When climbers started using protection on rock, these were drilled machine nuts on threads that were lodged in cracks to protect the climber. These simple prototypes have now been developed into a wide range of sized irregular hexagon shapes, made in very strong light alloys. The sides of the hexagons have also been narrowed at their base, to allow for a wider range of placement possibilities. Due to the irregular shape of the hex, they can be placed in cracks, so that when loaded the loaded thread will cam them tighter. The hexes are threaded either with sewn slings, or even with tied off cord.

CAMMING DEVICES – There are many different variations on these devices, but the basic configuration is a stem with a trigger that controls a set of retractable cams on the top of the unit. The trigger is pulled to retract the cams, as the unit is pushed into a parallel sided crack, then it is released and the spring loaded cams grip the rock. When loaded in a fall situation, the cams are further locked against the surface of the rock. If the connection of the rope to the device is too short, the rope movement may cause the cam to ‘walk’ into a crack, and so become impossible to extricate or unclip from without untying – beware!

NUTS / WEDGES – Today these are available in just about any shape or size, and they are the most popular piece of protection for a rock climber, as it is possible to carry a selection of about twenty of them without any significant weight. Obviously the best place to locate these is in a crack that narrows to the base, or has a restriction in it. The nuts can be placed in just about any position as long as the wires lead downwards. As a word of warning always climb with a nut key to help you remove the nuts once they have been used, as they can become very difficult to move after they have been heavily loaded.

PRE-PLACED PITONS / BOLTS – These require no adjustment, and all you need to do is to clip directly into them with a quickdraw, as usually these are placed in line with the run of the rope. Be careful on sea cliffs or unfrequented routes, as the placements may have become loose over time or even degrade where there is salt or lots of minerals in the rock.

WARNINGS – Many people are concerned about placing protection on rock climbs, as they fear that it may fall out. Here are some pointers to make you climb safer. Page 4 has a diagram of how the ropes should be selected, but inherent in that discussion of friction is that you can extend your protection with quickdraws or slings, so that the rope runs better. This will also avoid pulling on the protection when it is placed. One way of getting around this is to weigh down marginal protection with spare kit, so that it cannot be moved by the rope running through the karabiner. Always test your protection when you place it by jerking down on it. Never place your protection or rope over sharp edges in case they are broken or cut in a fall. Finally, check your equipment after use each day, and store it dry.

ETHICS – This paragraph is the only mention of ethics in this booklet, though it seems to dominate some books and websites. Respect the local way of doing things is the golden rule, as they usually have a valid reason for doing things like that. This ranges from the etiquette on a route to the way they do ropework. Also please ignore the stupid debate of if trad (placing protection) or bolted climbing is better – they are both valid forms of climbing.

PHOTO: ski touring on the Vallée Blanche

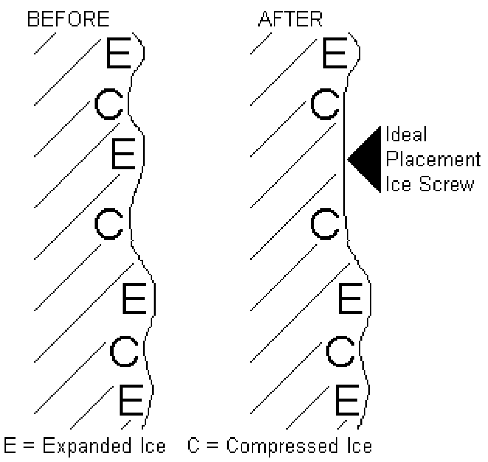
11: Protection – Ice Belays

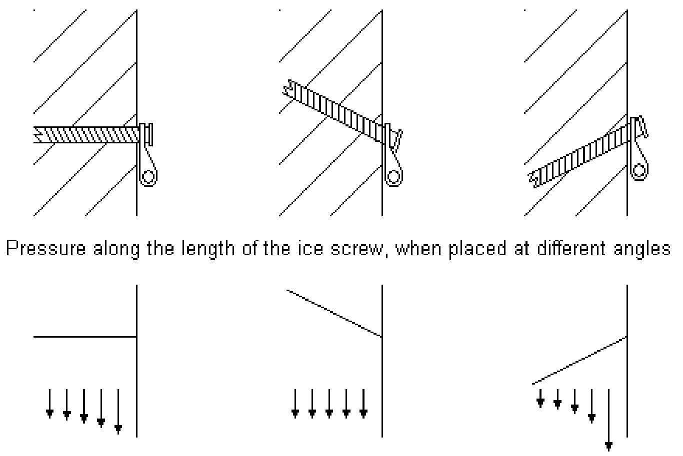
Ice screws when well placed in strong ice can hold up to 3000kg, though a load of 1200kg created by a fall is the average strength of an ice screw. In other words, an ice screw can easily hold climbers clipped into it. The next page discusses anchor systems in detail, but as with all protection at a belay, you should always clip into two or more. As a running belay a single ice screw is sufficient at any one point. There are three types to consider:

DRIVE IN – These were the first type of ice screws to be invented, and they normally look like long knobbly nails with a hoop on the end to clip. An example is the Warthog, that is still used today, especially on mixed climbs where no rock protection can be placed, but a drive in can be hammered into an ices up crack. To remove them they can be rotated and then levered or pulled out. Where there is lots of ice, these tend to shatter the ice when they are placed, and so are not ideal. Also the pressure is on a very small surface area.

DRIVE IN, SCREW OUT – These are hollow tubes with small or no teeth, but a fine thread on the outside of the tube, and a hanger to clip on the top. To place these screws they are placed against the ice, and hammered in up to the hanger. To remove they are unscrewed until they can be pulled out. Again these damage the ice when being placed, so if there isn't a lot of ice they are a bad idea, but they are very quick to place and clip in to.

SCREW IN – These are the most popular type of ice screws, and look similar to the drive in, screw out type, but have really defined threads and very sharp teeth. The teeth and tread can be damaged if you hit any rock, so are for pure ice such as frozen waterfalls. They are placed and removed be screwing inwards or outwards. For high level climbers there is greater variety in that there are a devices to give greater turning force when placing the screw, such as fold out handles. Carry these with care so as not to cut yourself.





The diagram above shows where to place an ice screw, and the angles to consider placing the screw. This shows that in terms of physics a slightly downward angled screw is best, but there is a danger of it melting out under load. Most people therefore prefer the 90º to the surface of the ice placement. An ice screw severely angled upwards from the load is quite weak. Remember not to worry too much about this debate, as ice is a fragile medium, and it is more important to consider potential fall factors than the angle of screws. Page 8 considered the fall factors, but the impact force can be reduced by using screamer quickdraws, that are designed with rip stitching which will absorb some of the force as the quickdraw comes under load. The use of screamers will therefore reduce the impact force on the ice screw, so should be carried for climbing icefalls or protecting weaker screws.

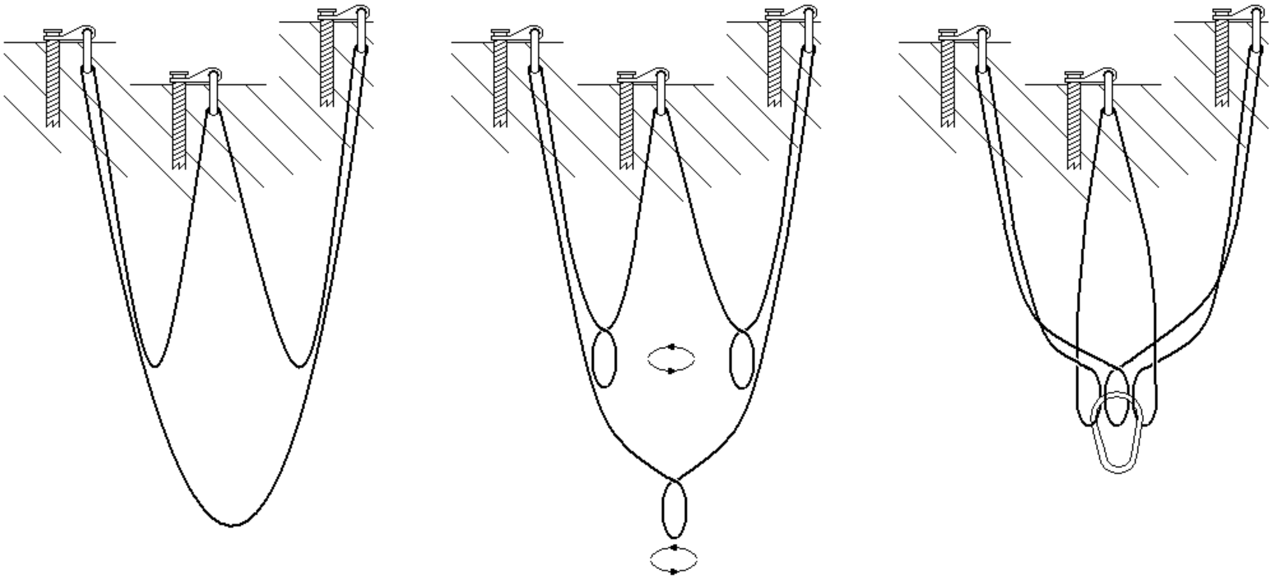

PHOTO: summit views from Gran Paradiso

12: Protection – Anchor Systems

An anchor system is simply the method by which you attach yourself to the mountain, and to stop you falling off, or being pulled off due to a fall incurred by someone else on your rope. You use an anchor system at a belay point, and on a multi-pitch climb the anchor must be designed to protect both climbers when climbing both below & above an anchor.

An anchor should always consist of two pieces of protection, and three wherever possible. There is no such thing as a bombproof placement, and there is always the chance of human error. The next stage is how to select a position to set up your anchor system, and the list below details the main considerations:

a) Visibility: if possible you should see the person whom you are belaying
b) Comfort: you may be at the stance for up to an hour, so check it is comfy
c) Safety: look for dangers to you at the stance, such as ice or rock fall
d) Protection: are there enough possibilities of protection placement



Once you have chosen your belay stance and placed your protection, you need to set up the anchor ropework that is going to attach you to the various protection points. In the UK it is common to see people rigging the anchors using the ropes. This is safe, but time consuming and assumes short pitches, and is not automatically adjustable. As has already been outlined, speed and efficiency is the key in the Alps. The most common anchor system is using a sling, as shown in the diagram above. Firstly the sling is clipped through all the anchors, and loops are brought down from in between each piece of protection. Then a half turn is put in each loop. Note that this turn must be in the same direction for each loop. Finally all the loops are clipped together into a screw gate karabiner.

You can move the karabiner from side to side, and the loop lengths will automatically adjust to equally weight each piece of protection. In the worst case scenario, a piece of protection fails, and the turns brake the slack and the karabiner remains safely attached. The anchor point would drop slightly due to the increase in length of available sling, but it would still automatically adjust. If the load is likely to come from one direction only, then once the three stages in the diagram are finished, you can tie an overhand knot in the joined strands just above the karabiner. This means that if any pieces of the protection should fail, then the anchor karabiner would not move, and the remaining protection would receive no impact force whatsoever, though remember the anchor is unidirectional only.


PHOTO: the Aravis mountains, French Alps

13: Protection – Bolted Climbs & Aid

Bolted climbs are very popular on the continent, and also on rock such as limestone where no other protection is readily available. A bolt consists of is a clip hanger for a quickdraw to be attached to, and a stem that measures around 6cm, and is buried into the rock. There are two types of bolt. The most common are expansion bolts, which fit loosely into a hole drilled into the rock, and then when an internal bolt is tightened, they expand to form a tight and secure grip against the rock. The other kind of bolt is called a resin bolt, and has a knobbly stem, which is pushed into the drilled hole that had been filled with fast setting resin. Essentially this type is glued into the rock. Bolts are very secure pieces of protection, and very rarely fail. Bolts are generally placed by the first person to ascend a route, and are replaced by others when they are becoming worn or loose with age and heavy usage.

To climb a bolted route, all you require are quickdraws to clip into the bolts, which are placed at regular intervals. At the top of the pitch there are always two or more bolts at which you can form an anchor (see previous page). On very popular routes, especially on single pitch routes, chains with one or more large round links join the bolts to allow top roping. When the climber reaches the chain, they attach themselves directly to it with their cow tail system. They call to the belayer to say that they are safe, and pull up some slack rope. Then they pass a bight of rope through one of the large links, passing the bight from above to below. To pass the rope from below to above risks the rope snagging and locking when the climber is lowered down, which can be dangerous and hard to escape from.

Once the bight is passed down through the link, the climber ties the bight to their harness with a figure of 8 knot, exactly as they would have done initially, but just with doubled up rope. When they are tied on the belayer takes in the slack, so that the climber is protected by the belayer and their own cow tail. Then the climber unties their original tie on knot (on the single rope, that they tied at the base of the crag). Next they unclip their cowtail, and the belayer can lower then. There is always a length of about 2m rope loose that is created when the climber untied their original tie in knot to release them from the chain. When the climber is lowered they can remove all the quickdraws from the intermediary bolts, and when back on the ground, they can untie from the rope and pull the end down. By following these simple routes, bolted climbs become the safest Alpine routes to climb.

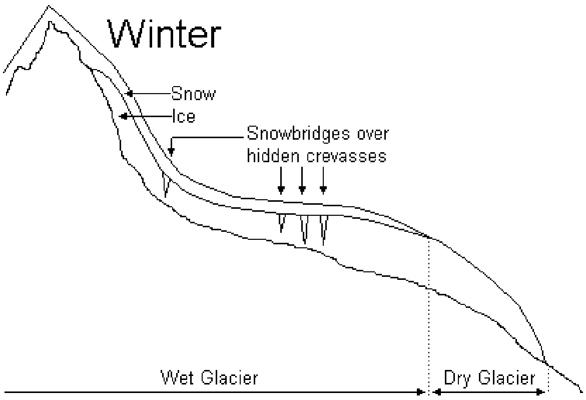
Aid climbing is where you cannot ascend the route and protect it without weighting the protection, or clipping sling ladders on to the protection to gain height. All the protection described to date is used, and in addition a lot of use of pitons is made. Where the cracks cannot accept a piton, there may be small ledges where curved hooks can be hammered into place for the climber to gently load then with their weight, and progress that way. When leading a pitch, an aid climber is belayed as normal, in event of a fall, but the rope may also be used for a tension traverse or even pendulum to reach another crack system. Most of the major Alpine routes involve a section of aid climbing. The second normally ascends to the leaders belay stance, by using ascender devices on a rope that the leader has fixed. As so much kit is required for these climbs, the second often has to hoist the equipment behind them in big haul bags. Another point is that the climbers can wear big boots or trainers, as they are not free climbing on the rock, but standing in slings all day.

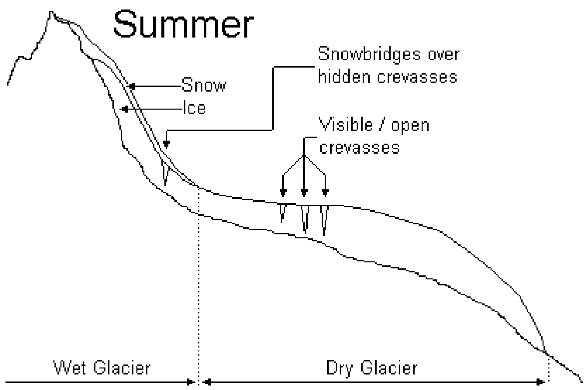
As with all other types of climbing, aid climbing has grades to indicate the level of severity and safety. If you have never done any aid climbing, you should practise lots on lower crags, as it is surprisingly hard and requires a good level of technique and communication.

PHOTO: sunset from the Couvercle hut

14: Glacier Systems – Formation

A glacial region is one which has permanent snow cover, and as such glaciers can form. They are made over hundreds of years in a process called firnification. This is when snow compresses to form ice. The ice further compresses, and coalesces to form a small glacier (normally on a niche of a north face of a mountain in the Alps). Through the force of gravity this glacier flows in a plastic way downwards. More ice is added at the top, and eventually a glacier is formed. Some of the glaciers in the Mont Blanc massif are over 20km long and have maximum depths of over 200m. As the glaciers move downhill, they bulldoze everything before them, and with the rocks that become embedded in their sides and bases they scrape (striate) all the bedrock around them. As it gets hotter towards the valley floor, the glacier starts to melt (ablation zone), though there is a throughput of new ice from above (accumulation zone). Glaciers are erosive machines which remove many hundreds of tonnes of rock annually. There are also many seasonal variations (see below):





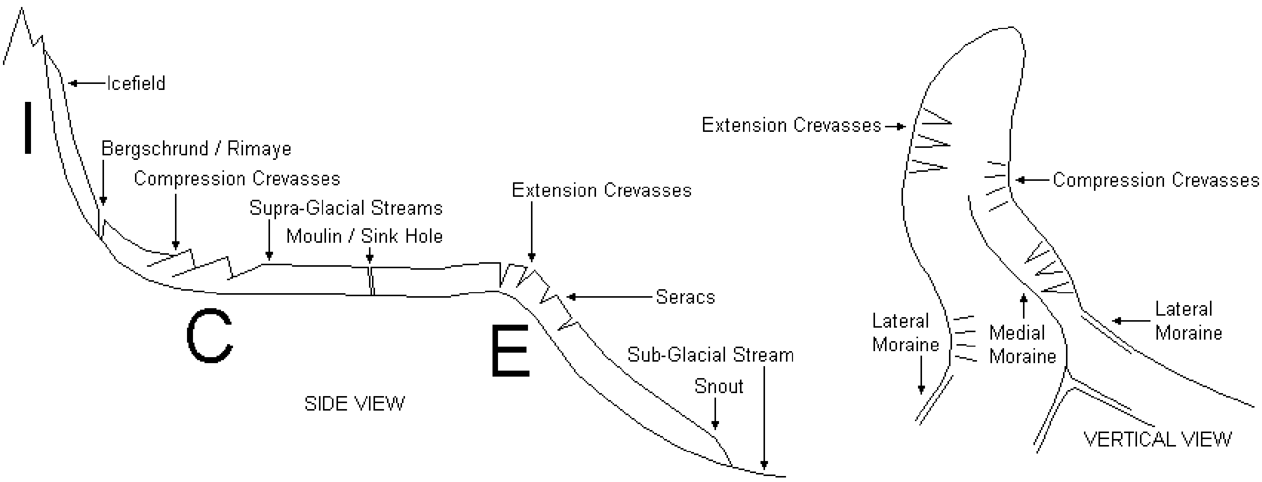
During the winter there is a snow covering over most or all of the glacier. A snow covered glacier is called a wet glacier, and all the crevasses are covered by snow bridges. This means that climbers should be roped up whenever they are on a high glacier in winter. The only exception is when they are ski touring, as the skis spread the weight over a larger area and so lessen the chances of a snow bridge collapsing. The diagram on the right above shows the typical summer conditions, when the snow had melted back or become permanent firn or ice. The section of dry glacier is much larger, and many crevasses are now visible. On this section climbers do not need to rope up, as all the dangers are easily visible and no snow bridges exist. The climbers can move quicker unroped, and it is very hard to hold a fall when roped up on bare ice. As the climbers ascend the glacier they will reach the wet glacier, they need to rope up, as all the crevasses are now hidden, and often you will be crossing crevasses that you aren't aware of. The exact position of crevasses moves every day, as there is a constant throughput of ice. In winter this flow is slower as the ice becomes colder and harder, though in the summer the glacier the throughput is at is peak, and so consequently the position of glacier features changes constantly.

There have been a number of periods of glacial advance and retreat over the last 100,000 years (Quaternary period). These are due to a number of factors which contribute to the average temperature. Currently we are in a period of warming; most of this is a natural cycle of warm and cold phases, though this warming trend has been accelerated by all the anthropogenic influences (greenhouse effect, pollution, ozone depletion etc). Whatever us humans do to the atmosphere, the temperature will eventually peak, and then another ice age will occur. The best guess is that this could occur in a million years. This may be short on a geological timescale, but all the ice in the world will have gone by then. All the glaciers is the Alps are now in retreat, some by over 50m per year (e.g. Mer de Glace).


PHOTO: Les Dorées & Aiguille du Tour

15: Glacier Systems – Features

On the previous page the formation of glaciers was explained, as was the seasonal snow covering. Here we examine the features of glaciers and the location of crevasses fully.



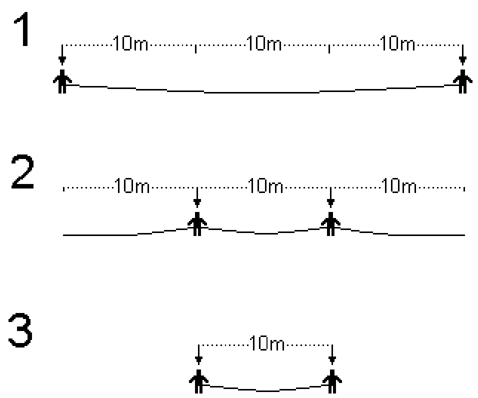
The left hand diagram gives a side view of a glacier, and it can be summarised from the top to bottom as a hanging icefield ('I'), then a period of compressive ('C') flow, and then extended ('E') flow near the snout. The icefield ('I') is frozen to the mountainside and is where the greatest zone of accumulation occurs. Due to gravity the ice flows downwards and has great potential energy. As it reaches the base of the mountain the glacier compresses and starts to flow horizontally. This creates compression or shear crevasses. Often the glacier breaks away from the Icefield and so creates a rimaye (large crevasse), which is hard for climbers to cross. This is one of the two types of crevasses which reach the base of the glacier. Below the compression zone, the glacier is generally dry in summer and so supraglacial meltwater streams flow over the glacier surface. They cut down to form channels and when they enter a deep crevasse they exploit the weakness to the base. This is the second type of full depth crevasse, termed 'moulins' (sink holes).

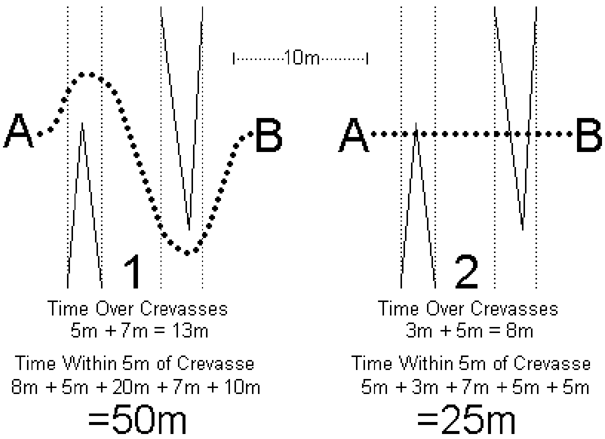
Lower down the glacier the heat is greater and the ice stops compressing, and goes into a period of extended flow. Here the glacier is falling away to the snout, and starts to break up to form an icefall. The crevasses formed are extension crevasses, and the islands of ice between them are termed seracs. At the base of the glacier the tip of ice is called the snout, and the meltwater that entered the moulin, emerges from under the glacier as a river. In icefalls the seracs are very unstable, so these zones should always be avoided. Examples of icefalls are the Bossons icefall in the Chamonix Valley beneath Mont Blanc, and the Khumbu icefall above the basecamp on Everest. The seracs constantly move, so if you ascended through an icefall one day, your route might be blocked on the next day.

On the vertical view diagram of the glacier, you can see that extension and compressive crevasses occur on the edges of glaciers opposite each other, and the ice shears on the inner corner and is stretched on the other edge. The main other feature is the location of the moraines. These are collections of rock and debris that have been ground up at the edge of a glacier. The moraines are often ice cored and so are unstable to cut across. When two glaciers meet, the lateral moraines of the glaciers join to form a large line of medial moraine on the surface. This also is awkward to cross, and you should take off your crampons to avoid damaging and blunting the points on the rocks. Moraines may also hide crevasses, so be careful when you choose to cross a medial or lateral band of moraine.

16: Glacier Systems – Glacier Travel

Now that you know the key features of a glacier, you can consider how to travel up one and how to cross a crevasse. As this is a non technical climb, you already know that you would be using a 30m rope if there were two of you in a climbing team. The diagram below on the left shows the principles. In stage one the climbers tie on the ends of the ropes, then the climbers take in Alpine coils so that there are 10m left between them. This means that should either climber fall into a crevasse, they have 10m of spare rope on them to either make themselves safe, or to drop down to the fallen climber (see Pages 18 to 21 for full details on crevasse rescue). Once you are tied, you can start to ascend a glacier basin.





The 10m of rope is sufficient distance between the climbers for travelling on a wet glacier, as it enables one climber to be a safe distance from the edge of a crevasse, whilst the other crosses a snow bridge. The diagrams above on the right consider two ways of crossing a couple of crevasses. In the first diagram the climbers follow what seems to be the path equidistant from the visible crevasses, but it does not interpret where the crevasses continue underneath the snow bridge. In diagram 1 the path that the climbers take has 13m over a crevasse / snow bridge, compared to 8m in the direct route taken by them in diagram 2. This does not seem too significant, but when you factor in the length of time that they are within a small distance of the edge of a crevasse / snow bridge, then the results change significantly. In diagram 1 the climbers spend 50m within 5m of an edge compared to 25m in diagram 2. The direct route is twice as safe if you consider a climber could be pulled 5m in event of the other falling into a crevasse, causing both to fall in.

In summary all crevasses should be crossed at 90º, to minimise the time spent either over the crevasse, or within a distance of risking being pulled into one. As with the choice of deciding whether to move together or pitch a climb, if you feel insecure when about to cross a crevasse then you could consider setting up an anchor on one side, belaying the other climber across, letting them set up an anchor on the far side, and finally belaying you across to them. This assures you of a safe crossing, but takes a lot of time, as good anchors in snow are hard to find / construct (see Pages 9 and 11). If you are very unsure about crossing a potentially weak snowbridge, then cross it crawling to spread your weight. One method that used to be popular for teams of two people crossing a heavily crevassed glacier was to tie knots into the rope between them, so that in event of one of them falling into a crevasse, the knots would help hold the fall. This works, but it is very difficult to hoist a fallen person on a knotted rope, so the technique is best avoided these days. There is a safety in numbers for wet glacier travel, so two teams of two could all tie onto one longer rope until they reach safe ground. Also note never to carry hand coils on a wet glacier, as in event of a fall the climber trying to hold the fall will be pulled over, and then rope is slack.

17: Glacier Systems – Route Planning

The final stage to considering glacier travel is the planning of the route and the evaluation of the potential dangers. This page consider the essential factors for you to judge / assess.

- Moulins – look on a map to see if any are marked, and if so, then plan your route across a glacier to be below the moulin to avoid having to cross supra glacial streams. Another factor is that when crossing streams is necessary for a route, there will be less flow in the morning than in the heat of the afternoon, where meltwater is at its fastest.
- Moraine – this is shown as grey shading on maps. Beware that the moraines cover ice or crevasses and are very unstable. Where possible move on the clear ice or snow.
- Crevasses – from your understanding of the formation of glaciers, you should be able to study a map to interpret where crevasses are likely to form. Compression crevasses are comparatively safe to cross, but expansion crevasses / icefalls should be avoided.
- Another factor that you can plan from a map is the access to a hut. Many Alpine huts are built on the safety of rock islands, where they are safe from avalanches and serac falls. Access to huts often gained by ladders, which are marked as 'echelle' on maps.
- Ski routes are often marked as coloured lines on maps, and are the easiest routes of descent in winter. Beware that they are not necessarily the best route in the summer.
- When you have gained all this information from a map, check out the guidebook description, as this will confirm your reading of the map, and may add some points that you could not infer from it. Also you can get information from the hut guardians or from local mountain guides and guide agencies, or even the local mountain rescue centre.
- Before you actually set off on the glacier, make sure that you have the latest weather forecast, suitable equipment, maps, and compass / GPS. Now you are ready to set off.
- When ascending the glacier, remember the rules that have been covered already, so cross crevasses at right angles, minimise your time on snow bridges, rope up only on the wet glacier, and ensure that each person has a full crevasse extraction kit.

Here are some extra points to consider as you encounter then, to which you must adapt your plans, as they are variables that cannot be planned beforehand so must be related to.

- Often there are rocks wedged across crevasses that you must evaluate. Just because there are crampon scratches on it does not mean that it is still stable, as the crevasse may have opened up. Other rock bridges are very stable and safely wedged in.
- Marked paths are often made up crevasses by the hut guardians, and are marked by paint blobs, signs, or painted boxes on rocks on the edges of glaciers. Beware that as the glacier moves, so do the markers, so you have to interpret if the markers are new.
- You have to judge if you require crampons on or not. On a dry glacier you may not need them due to the rough texture of the surface, so you may be quicker without them on. On wet glaciers you should always wear crampons in case of a fall. Also ensure that you have anti-balling plates to prevent snow building and slips occurring.
- In fresh snow, or during winter, you may require snowshoes or touring skis with skins, as on foot you would sink deep into the snow, and make little headway. This kit may be left at the base of a climb or the ladders to a hut, and collected on the way down.

The main factors to judge in-situ are the objective dangers that may cause you to alter your route. Near the edges of glaciers stonefall is an issue from the moraines or the mountainside above the glacier. Closely linked to this is the avalanche danger, and you need to judge if an avalanche could reach your route. The final aspect to consider is the risk of icefall. If your route must pass near seracs, then you can make few judgments, but need to minimise your time passing through this zone – so run!!!


PHOTO: sunset on the East Face of Tacul

18: Crevasse Rescue – Basic Principles

One of the main fears that people express when visiting an Alpine area for the first time is that of falling into a crevasse. You already know about the formation of a glacier, so can interpret the likely location of the crevasses. These can be summarised as at the very top where the glacier separates from the icefield at the rimaye, on corners where expansion and compression crevasses occur, on convex slopes where expansion crevasses form, on concave slopes where compression crevasses occur, and even in the mid glacier where there are crevasses caused by the lateral and basal friction. This list may seem to include the whole glacier, but if you interpret this it means that flatter, straighter and wider glaciers have less crevasses on them than steeper, more curved, narrow glaciers. The fear of falling into a crevasse should not put you off glacier travel, and in all mountainous areas, the glaciers afford a highway directly into the peaks you are travelling to climb on. When planned carefully, the route up a glacier can be the safest section of a mountain ascent.

Obviously you must always try to avoid falling into a crevasse, but you must also prepare for the actual eventuality and what you would do in that event. The first thing is to practice the ropework that you would use for both glacier travel, and in event of a person falling into the crevasse (don't worry about that ropework as it is outlined in the following pages). Next you need to develop a good communications system with your regular climbing companions, so that they all understand any commands and replies that are necessary in event of an emergency or climbing with you. The UK crag communications system of "climb when ready", "climbing", "OK" etc is very good, but in event of a fall into a crevasse it may not be possible to talk / shout to each other, so a system of tugs on a rope is more useful. The next consideration is to always ensure that when travelling on a glacier, that you are wearing the most suitable clothing to protect you. This includes trousers and a long sleeved top, which protect you from the abrasive texture of the ice in event of a fall.

When climbing without a Guide, it is your choice as to whether you should wear a helmet or not. It is always good practise to wear a helmet at all times, as a fall can never be predicted. Many people opt to wear a helmet on a dry glacier when they are practising their crampon skills or ice climbing. This obviously makes sense in case you fall, as generally you would be unroped. On wet glaciers many people opt not to wear a helmet, as in event of a fall in a crevasse they are unlikely to hit their head, and it can be very hot with the sun reflecting off the snow on a wet glacier surface. If you are in any doubt, wear a helmet.

The next aspect to consider is how you should train for the eventuality for falling into a crevasse. It takes a long time to find exactly what equipment works best for you, and so consequently you need to practice both hoist rescue and self-rescue systems. You can simulate a crevasse down your stairs at home, with a rope over a tree branch, or even on a climbing wall or crag. The more realistic the simulation, the more you will learn about how to reach to a fall, and which equipment works best for you. You also need to try and improvise the rescue without some of the equipment you usually use. For example if you usually use autolocking pulleys then go back to karabiners and prussics, or use your shoe laces instead of the prussics to simulate you losing them. This training is not contrived as in event of either a fall in a crevasse, or holding a fall of someone else, it is highly likely that some of the equipment may have been lost off your harness. You will find it a good idea to carry different bits of kit in varying positions. Suggestions are to attach a sling to the haul point in the rucksack so it hangs down your back, and carry prussics on the back of the harness so that they are protected in event of a fall by the rucksack just above them.

PHOTO: climbing on the Plan d'Aiguille

19: Crevasse Rescue – Basic Principles

It is very difficult to advise on what is the best method of doing a crevasse extraction. As has been alluded to, it is a very personal choice. There are some other factors to consider that will also influence this choice, and they are considered here. Any crevasse fall is an emergency situation, and the best system of crevasse rescue should be chosen in seconds, as time is of the utmost importance for both the fallen climber, and for the team working well. Firstly you should consider if any member of the group has sustained any injuries. The fallen climber may have been knocked unconscious, but if they were roped on with Alpine coils they are unlikely to have inverted, and so are not in danger of falling out of their harness. Don't forget the climber(s) who arrested the fall, as they will have suffered abrasion injuries from sliding across the hard ground or landing on top of sharp equipment. This clearly illustrates that items such as ice screws should be carried in positions where they are unlikely to injure you in event of a fall, either into the crevasse or on the surface.

The next influence is time. In any circumstances the rescue should be done as quickly as possible, as if time is left then if untreated, shock and injures can develop over time, and new difficulties such as the effect of cold can develop. The rescue must also balance speed and safety. When trying to work quickly, you must ensure that you are being as efficient and safe as possible. When under stress it is a common mistake to make assumptions that can complicate matters. For example, if the fallen climber is in contact with the ice, and has crampons and ice axe, they may be able to climb out, protected by a surface belay system. Don't always assume that you need a hoist system straight away.

Other factors to consider are your knowledge of the capabilities of the other member(s) in your roped team. You may have to adapt the system you use for each member. This is as a result of their weight, the friction, how well they make themselves safe, and if they may be able to rescue themselves. Friction is another major factor, as described on Page 21, and your ability to lessen this is a function of what equipment and spare rope you have available to you. The final variable is the cold which will affect all group members whether on the surface or in the crevasse. All of these elements make it impossible to suggest one rescue method as the best option, so you should study the following pages on crevasse extraction with a very open mind, trying to understand the process first, then practice the procedures, whilst recognising that there are many ways to produce the rescue result.

The last question to think about is how to minimise the risk of falling into a crevasse. Firstly gain as much information possible, before venturing onto any glacier, some of which will be applicable to any glacier, such as the likely location of crevasses, but much of it is local knowledge (the speed of the glacier or the position of the supraglacial melt-water streams). Risk is minimised by knowledge, an eye for "reading" the terrain (telltale signs of crevasses) and careful probing of snow bridges. After practising crevasse rescue, you realise the effort involved, and so you will move much more carefully on crevassed terrain, and will have found a technique that you are happy to employ. Here is a summary for you:

WHO: any member of a group, in any position on the rope, can fall into a crevasse.
WHAT: a roped group reacting quickly will make a crevasse fall only a short distance.
WHY: a fall is usually due to a snow bridge failing as a group member walks over it.
WHEN: falls can occur at any time, more likely later in the day due to sun, heat, & fatigue.
WHERE: crevasses occur in a variety of positions along the length of glaciers, be careful.

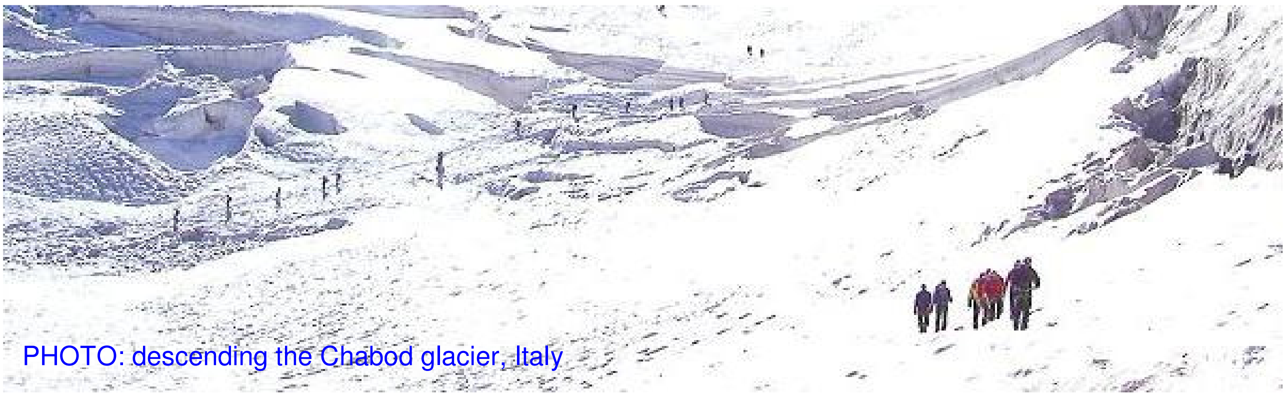
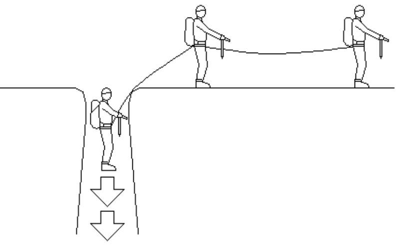


PHOTO: descending the Chabod glacier, Italy

20: Crevasse Rescue – Emergency Hoists

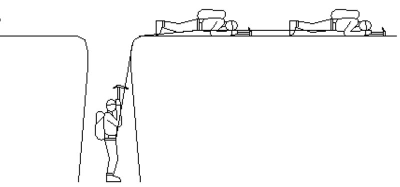
The diagrams below show the sequence of events following the fall of a climber into a crevasse, to their successful extraction. There are no potential variations to these steps. In this example there are three climbers, but the same sequence is followed with two people.

1.



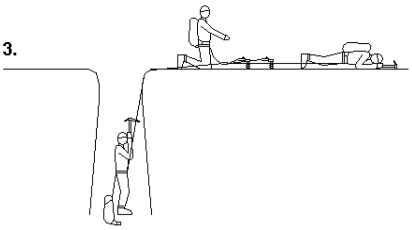
Three mountaineers are walking along a glacier when one of the group falls into a crevasse. The roped distance between each of the climbers is 10m. Each of the climbers must carry their ice axes in case of such an event, and each person must carry their own kit for setting up an anchor and crevasse rescue hoist.

2.



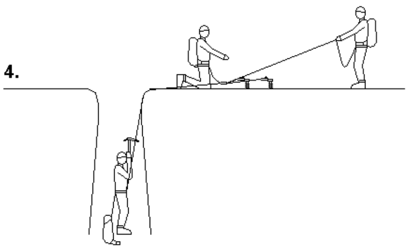
As soon as a climber starts to fall, the others in the group immediately get into an arrest position. They dig in their ice axes and crampons to fully arrest the fall. At this point the fallen climber can, if possible, make themselves safe in the crevasse using an ice screw. Note that there is no rope slack between the climbers.

3.



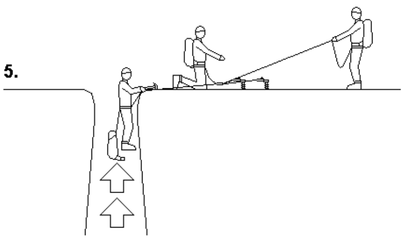
The next stage is for the fallen climber to suspend their rucksack beneath them (on a sling or rope), and for the climber nearest the crevasse on the surface to set up an anchor system. Page 21 outlines the options for the anchor. The climbers on the surface then escape the system, and the fallen person hangs on the anchor.

4.



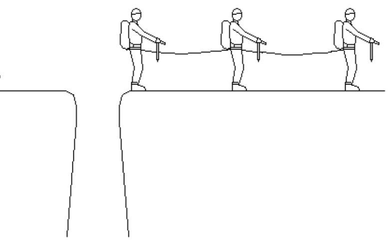
Here a choice needs to be made as to whether the fallen climber is able to climb out of the crevasse whilst being belayed from above, or whether a hoist system will need to be set up in order to raise the fallen climber to the glacier surface. If they cannot communicate then a hoist system should automatically be commenced.

5.



By whichever means the fallen climber reaches the surface of the glacier. At all times at least one of the climbers on the surface will need to monitor the anchor / hoist / belay system, and to assist the communication between all of the climbers. The fallen climber is raised towards the surface, and all the slack is taken in.

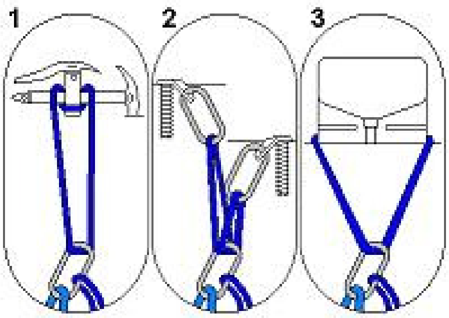
6.

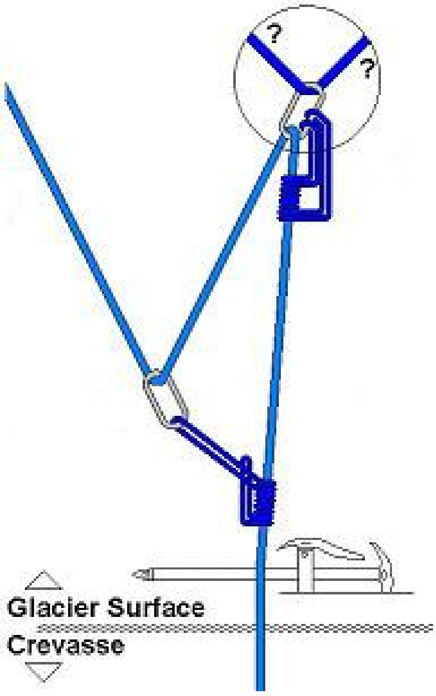


As soon as all the climbers are back on the glacier surface, a full equipment check is required before the group moves on again. It is useful to discuss why the fall occurred in order to prevent another fall on the climb, and to evaluate the safety of the team. It is likely that everyone will be tired after the crevasse extraction.

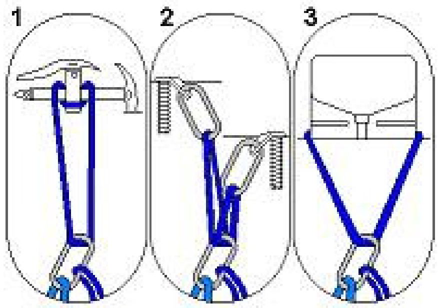
First aid may be required at this stage for both the fallen climber, and for all the rescuer(s).

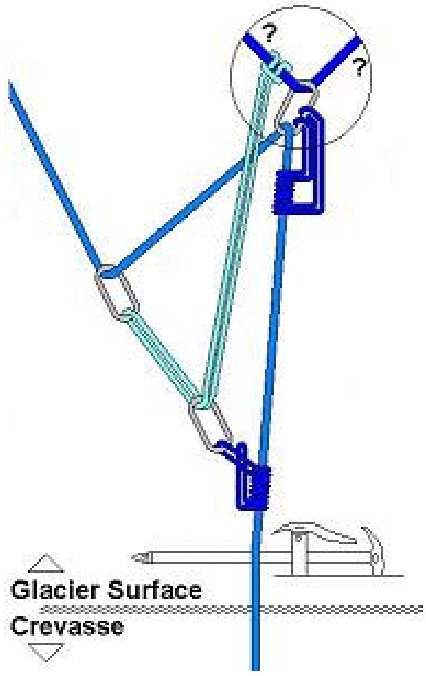
21: Crevasse Rescue – Emergency Hoists





When it is decided that a hoist is necessary to raise a fallen climber (or other load), the aim is to create significant mechanical advantage to overcome both the load and the effect of friction. As these two diagrams show, there is a choice of anchors that can be selected. Two ice axes in a T-slit or set at right angles is the first of the options. Secondly you would be able to place ice screws on a dry glacier. The third option is the most likely and is to bury a piece of kit in a hollow in the snow, and to put a sling around it for an anchor. Items that you could use include a rucksack, crossed skis or even use another climber or rock. These three systems are the most popular options.



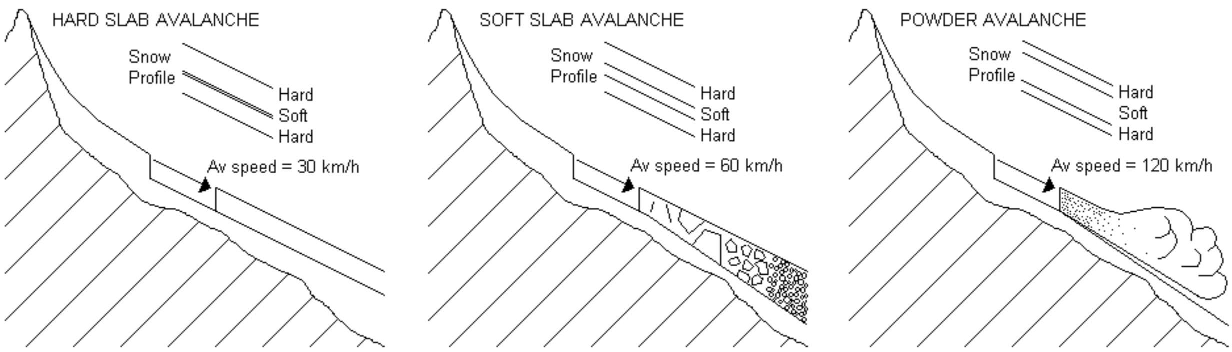


A prussic is used to allow the climber to escape the system and to load the anchor. Initially the dead rope has a figure of 8 knot tied in it and clipped into the anchor karabiner to back up the fallen climber in event of the prussic slipping. A second prussic is put on further down the live rope, and a karabiner is clipped into it. The two diagrams above indicate how to set up a 1:3 (left) and 1:5 (right) mechanical advantage hoist system. The only extra equipment that is used is one sling and a karabiner. You are now ready to start your hoist, so untie the back up figure of 8 knot that is clipped into the anchor karabiner, and pull on the free end of the dead rope. Try to ensure that you pull in line with the load and anchor.

Friction is the key enemy and it is very significant at the crevasse lip. It can be reduced by ice axes (as shown), or by a rucksack under the rope(s). This will make the hoist easier. If the rope has really cut into the lip, then it may be easier to drop down the spare 10m of rope to the fallen climber and to protect the edge before it comes under load. In this case the hoist system will have to be transferred to the newly loaded ropes. The diagrams above show the minimum use of basic equipment, but you can use a variety of friction reducing and autolocking pulleys. It is implicit that each climber must carry enough equipment on them to rescue the other in event of the other climber falling into a crevasse.

22: Snow & Avalanches – Why & How

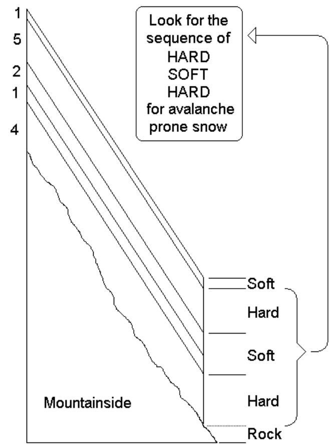
- Snow falls as flakes, which settle. Through freeze thaw cycles, gravity, and many other natural physical processes, the snow gradually condenses. This process is called nivification. The ultimate stage in this process is where the snow becomes ice. This explains why snow forms layers of different densities and characteristics in a snowpack.
- As well as the nivification process, snow varies in its consistency on a 24 hour basis due to freeze thaw cycles, the geothermal heat released, pressure, water content, and air percentage. As a result, layers can change during the time it takes you to do a climb, and so the avalanche conditions measured at 3am may be different from those at 11am.
- Avalanches can occur on slopes anywhere from 13° upwards, though the most common maximum is about 50°, as beyond there the slope is steep enough to shed snow as it falls. Most people underestimate the shallowness of angle that the danger of avalanche can occur. Steep ground is safe, but approaches to climbs are the greatest exposure.
- There are many types of avalanche, from slab to powder, as shown by the diagrams below. The next page explains how to analyse a snow pack, but this shows the forms of the avalanche types. A hard slab is a section of snow that slides down. A soft slab is a slab that has 'liquefied' into tumbling blocks, & powder avalanches look like snow clouds.
- The common themes between the types of avalanche is that they follow the relief, so are more common in couloirs than on buttresses, and that they all start with a trigger factor and form a break out line, which is often a small snow cliff from which the slab has detached. Generally when one avalanche has occurred the slope is safe to cross.
- Secondary avalanches are generally triggered by the first avalanche due to the pressure waves or reverberations. It is a myth that shouting can trigger avalanches, though very loud noises such as helicopters passing close by can trigger very prone slopes. Just remember that 95% of avalanches occur naturally, and 95% of the people who die in an avalanche that they caused themselves. This means that most deaths are avoidable.



- Naturally occurring avalanches generally occur due to the weight of a snow layer being too great for a weaker layer beneath to support it. The whole slope becomes charged with snow, and when one section gives way this normally sets off the whole weak pack. Whole mountainsides can avalanche instantaneously, so beware of charged slopes.
- Factors that can protect a slope from avalanching are the ground cover and terrain. If there are trees growing in the snow this will help bond the snowpack. Also rough ground under the snow helps hold the snowpack in position. Knowledge of the mountain under the snowpack is very useful in judging how likely a slope is to avalanche in the winter.

Learn how to examine the snow crystals, and you will find that complex crystal shapes lock together very well to form very strong layers, while smaller less complex crystals do not stick together well, and so form weaker layers. Crystals that loose their spikes retract into sugar crystal shapes, and so fail to bond at all, forming the weakest layers of all.

23: Snow & Avalanches – Snowpits & Kit



ASSESSING THE SNOWPACK - The graphic on the left shows a snow pack lying on top of a mountain slope. The harder layers of snow given a higher number on a five point scale, and the softer layers have a lower number. The way to determine whether a slope is prone to avalanche is to study the snow layers, to look for a sequence of hard, soft, and hard. Where this contrast occurs an avalanche is likely. There are many ways of measuring the snow hardness (density). The classic method is to dig a snow pit, and to carefully brush the vertical face of the snow with something soft such as a glove. The hard layers will stick outwards, while the softer layers will easily brush away. Another method is to feel the resistance while probing the snow with a pole or even your ice axe. The most obvious advice is to look for avalanche debris. Where one has occurred, another will fall one day. If in doubt about the stability of the snow pack, get off the slope and debris zone.

The main way of determining the type of avalanche that will occur, is to examine the thickness of each of the key layers. The diagram on the previous page shows the different types of avalanche, with the corresponding likely thickness of each layer. All you need to know is that this sequence will cause an avalanche, and you need to get out of the region as quickly and safely as possible. The best way is generally to retrace the incoming steps.

EQUIPMENT TO CARRY – There are three items of equipment that you must always take whenever you are on a snowpack that may be unstable, whether on foot or touring skis.

- ARVA: These letters stand for the Appareil de Recherche les Victimes d'Avalanche which translates as the device for searching for avalanche victims. These are often nicknamed as "Peeps" due to the noise that they emit when they lock onto a signal.
- Avalanche Probe: The probes come in collapsible poles, with a piece of cord or elastic running down the middle to assist rapid assembly in event of a search, where they are used to probe the final search area to try and find the buried body of a avalanche victim.
- Shovels: These are for digging into the snowpack once the probe has located the buried avalanche victim. There are a variety of types, from hardened plastic to stamped metal, though they are all collapsible for easy carrying in or on the outside of a rucksack.

It is essential that you practice using this equipment regularly, and are familiar with its use.

WARNING – Recco Pads: These are effectively strips of a highly radio reflective material that can be detected by an ARVA device. The Recco Pads are often attached to ski boots or jackets, as these won't be lost in event of an avalanche, unlike skis or rucksacks. The pads are usually worn by people who are not using ARVA's, which is not a good practice as it relies on the rescue services to bring in equipment.

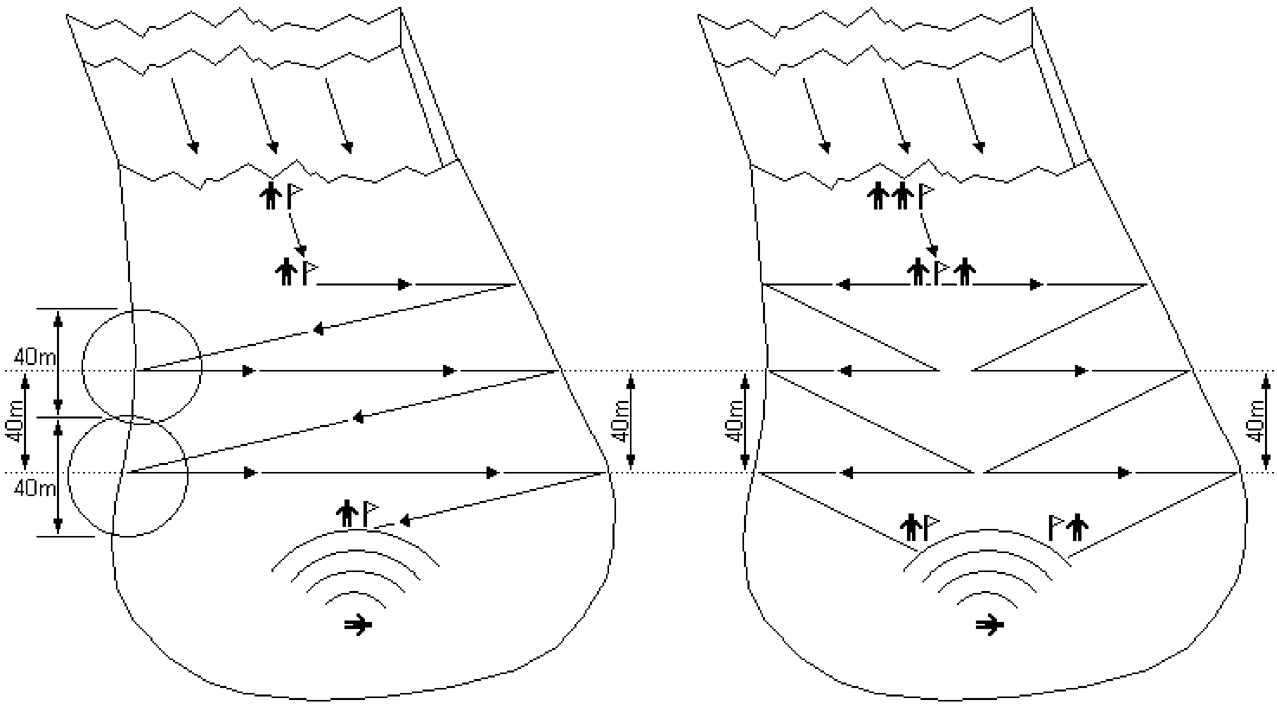
FURTHER INFORMATION – These pages advise how to predict and react to avalanches, but it is not all down to you. In the Alps you can get avalanche warnings and ratings on the radio, internet, and from the cable car stations. There is also a flag warning system for ski areas. Mountain Guides, Ski Patrol and Instructors are also great sources or information.

PHOTO: avalanche debris near Leschaux

24: Snow & Avalanches – ARVA's

When an avalanche occurs, and someone is buried you have 15 minutes maximum to dig them out alive on average, and just remember that brain damage can occur after the brain is starved of oxygen for more than five minutes. Time isn't on your side, but you can react very efficiently, and have a high probability of recovering the victim alive. Firstly whenever there is a potential for avalanche you should always wear an ARVA avalanche beacon. These are radio transmitters on 457mHz, and are also signal locators in a search mode.

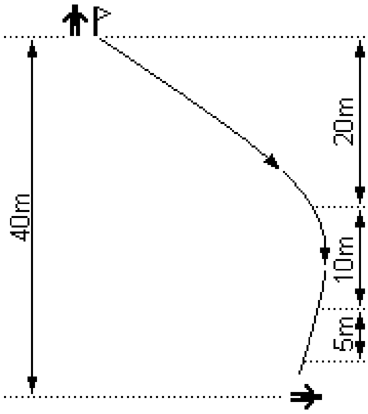
The ARVA is worn under your jacket on a strap system, which holds it to your body. This is to conserve battery life, and to stop the ARVA being torn off you in an avalanche. When an avalanche occurs and someone is caught in it, you must firstly run to the point where you last saw the victim. Look down the slope for sign of the person, and if they are not visible then get out your ARVA and turn it onto search mode. The maximum signal transmission distance is 60m, but you can only trust a third of this (see overleaf for reasons), so when an avalanche occurs, you must cover the whole avalanche debris with a maximum of 40m between your zig-zags. The diagram on the left shows what to do if there is only one of you searching, and the one on the right shows a multiple rescuer search pattern.

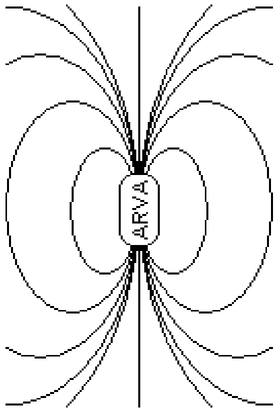


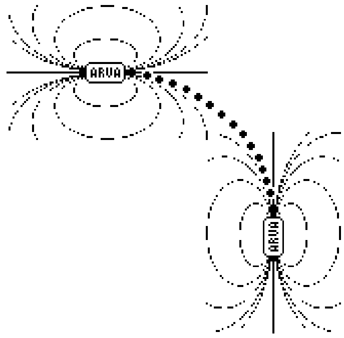
Marking where you start the search, and then where you last saw the victim, as this gives you reference points to return to if you can't find a signal. When you turn on your ARVA into search mode and there is no signal, there is generally white noise, no beeps, LED's, or lights. One or all of these will occur at the first sign of a signal. When you set off you should also carry your first aid kit, a shovel, and an avalanche probe, for use in the final stages of locating and recovering the victim. Don't forget these or you lose vital minutes. Once you have first heard a signal, you should mark the point with a pole or flag, in case you loose the signal, and require a reference point to return to. The diagram overleaf shows how the ARVA works with signal field similar to a magnetic field. In this next search stage be aware that the track the ARVA will lead you on will not be a straight line, as the strongest signal between the two devices (rescuer and victim) is a curve.

25: Snow & Avalanches – ARVA's

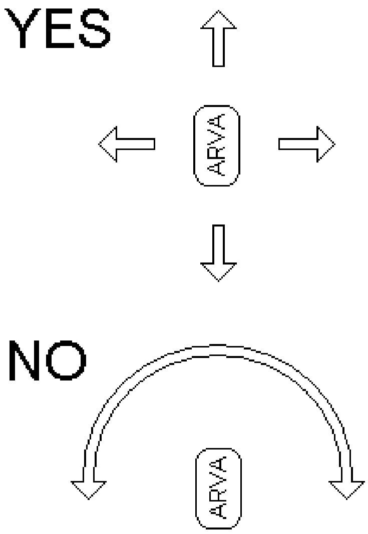
The diagram on the right below indicates how the signal strength on the sides of an ARVA is weaker than head on. This is why an ARVA can detect up to 60m head to head (with fresh batteries), but you should only trust one third of this signal strength by assuming one ARVA will be side on, and the batteries partially used. Underestimate the signal strength.

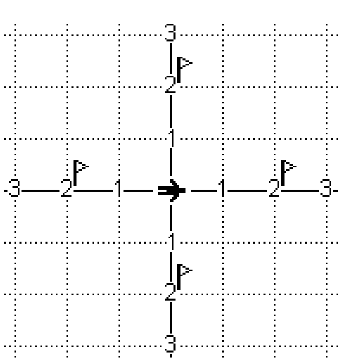


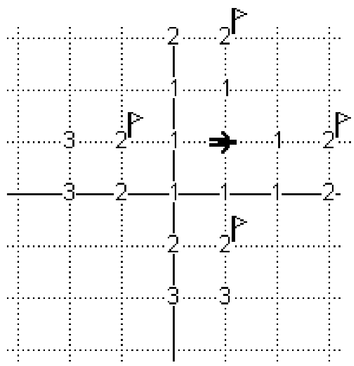




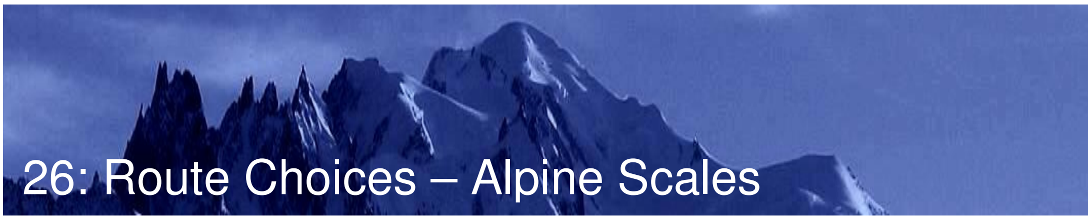
The left hand diagram above shows that when you first get a signal you should run 20m then check the ARVA again, then run 10m, check again, and run a final 5m. This will bring you into the final search area as quickly as possible. Speed is of the essence, so hurry.







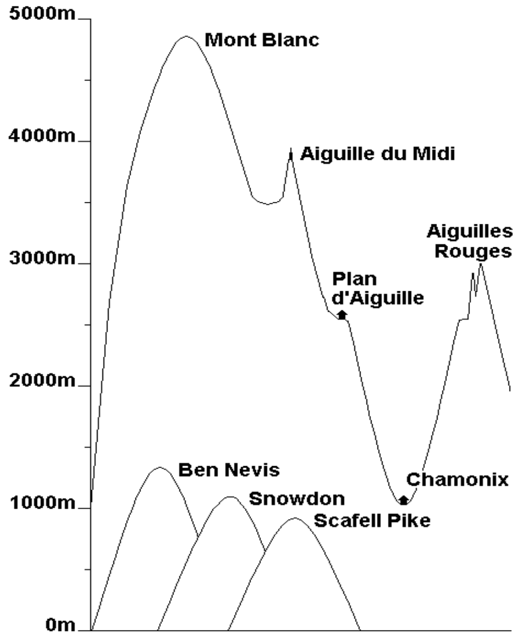
In the final search area, you are within 5m of the victim. You must remove as many variables as possible to pinpoint their position accurately, so instead of moving the ARVA from side to side as in the previous stages, it is locked in one plane and moved to and from, and side to side. The final stage of pinpointing the victim is to move in a cross shape as shown by the middle diagram above. If you are accurate so far in your search the victim will be in the middle, but you find exactly where by marking a particular signal strength on each axis, then narrow it and dig the victim out. If you are slightly out, as shown in the diagram on the right, you must interpret the signal strength on each axis to locate them. If you are unsure how many victims are in avalanche debris, once you have recovered a victim turn their transceiver off, return to where you first found their signal, and zigzag over the rest of the avalanche debris to see if anyone else is buried. Causes of unnecessary avalanche deaths include not searching the rest of the debris, and other people arriving on the scene wearing ARVA's in transmit mode, which distracts the search and wastes time.



26: Route Choices – Alpine Scales

The Alps stretches in a wide arc from Nice on the south coast of France, to Vienna in Austria. The length of this range is over 1200km. At their widest point the range is 200km across. This is at Chamonix, where the range stretches across from Lake Geneva to the Italian Piedmont. In geological terms, the Alps were formed at the same time as the Himalayas and the Pyrenees. This was in the tertiary era, about 65 million years ago, when according to the theory of plate tectonics, the African plate moved northwards into the European plates. An immense amount of folding and plate subduction ensued, and the Alps were formed. The most crumpled rocks were the old, crystalline rocks, which formed the central Alpine massifs of the Ecrins, Pelvoux, Mont Blanc, Gran Paradiso, and Mercantour. These tertiary upheavals splintered the old rocks to form lines of needles, as well as some huge ridges. The best examples of these massive geological upheavals are the spiked ridges Aiguilles du Chamonix (Chamonix Needles), and Mont Blanc.

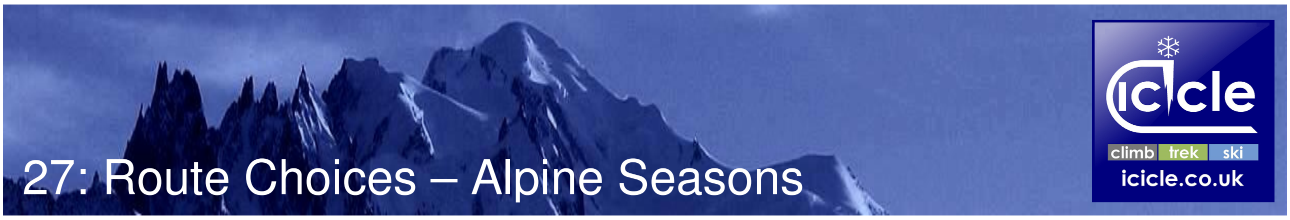
Indeed, the Alps are still growing in many places, and the exact height of Mont Blanc is altered almost every year. In 1999 the recorded height was 4807m, and was increased to 4810m in 2002. This was then decreased in 2003 to 4808m. Some of the variation is due to the ice accumulation and ablation at the summit. This famously buried the tiny shelter built there by Jansen, designed by Gustaffe Eiffel (who designed the Paris tower). Most of the geologists agree that at least half the height gain is tectonic, the rest glaciological.



The graphic to the left gives a good idea of the scales you contend with in Chamonix. The key detail is that when you are in Chamonix town, you are already at the height of Snowdon in the UK. From here cable cars can transport you to over 3800m. From here the vertical height gain to the summit of Mont Blanc is over a kilometre. The intermediary cable car stations, such as the Plan d'Aiguille, and the Aiguille Rouges stations, are situated at about 2500m. Most mountain huts are built between 2500m and 3500m. Glaciers run from the summit of Mont Blanc to within 100m of the Chamonix valley floor. When you travel up the valley to Chamonix, you will see several glaciers snaking down through the trees towards the valley floor, that they once reached about 2000 years ago. When in the centre of Chamonix you are standing at the height of Snowdon, and the summit of Mont Blanc is three Ben Nevis's above you! Also beware with the scales that ascending the height of Ben Nevis from 3800m to reach Mont Blanc is a little harder than in the UK where you start from sea level. The other point to note is that the South Face of Mont Blanc is nearly four kilometres high, from the Courmayeur valley.

Just looking at the diagram above is enough to get most people training hard, but it may also influence your choice of routes during a week. The first day can be at about 2000m, and then you can increase the altitude by roughly 1000m each day without feeling too bad, as this is really the maximum rate that you can acclimatise efficiently for hard climbing.

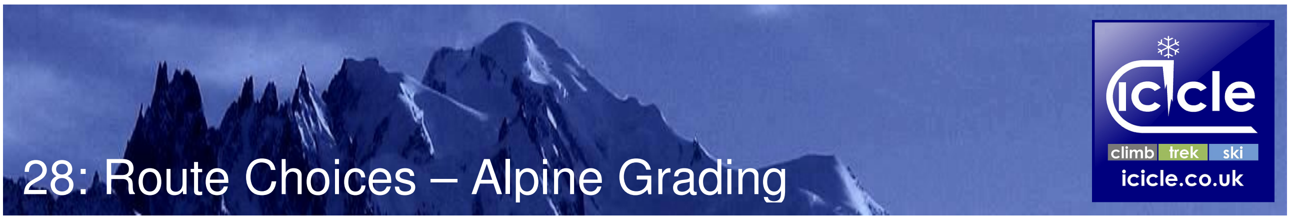

PHOTO: the Mont Blanc massif



27: Route Choices – Alpine Seasons

SUMMARY OF THE NORMAL CONDITIONS	WHAT ROUTES ARE GENERALLY POSSIBLE	WHAT ROUTES ARE NORMALLY IMPOSSIBLE
WINTER SEASON – beginning of December to the end of March		
Snow often falls over the night, and so each day there is a fresh cover. Ice routes come into condition from early December, and are peak condition until early March. The days are short and cold, though the conditions are good.	Chere Couloir (Tacul) The Cremerie (Argentiere) Cosmiques Arete (Midi) Gervasutti (Tour Ronde) Mer de Glace (Montenvers) Index (Aiguilles Rouges) Grand Bleu (Argentiere) Cascade du Dard (Dard) Deferlante (Lognan lift)	Mont Blanc (the snow too deep, or wind far too high). Argentiere glacier basin climbs, as this glacier bowl collects a huge depth of snow, and even with skis can be nearly impossible. Most rock routes are also covered by snow and ice.
SPRING SEASON – end of March until mid June		
Variable snowfall, often interspersed with big periods of melt. Rain can fall instead of snow. Very good time for ski-touring.	The Haute Route is in key condition from March. Also the very end of the period, routes such as Aiguille Verte and Mont Blanc.	Many of the rock routes will now have lost their snow covering, but many will still be wet with seepage lines, rendering them impossible.
SUMMER SEASON – mid June to mid to late September		
July and August are famed for mainly anticyclonic (high pressure) conditions. Either side of these months the weather is a little more unpredictable though the conditions are still good, and it is much quieter. It is very warm during the days, and there is only a brief freeze at 3000m+ at night.	Non-North facing major snow / ice routes until end of June (e.g. the Whymper Couloir). Mountain routes such as Mont Blanc and the Domes du Miages are in their key condition at this time. All the rock routes in the Aiguilles Rouges and on the Chamonix Aiguilles are in their driest period.	At the end of this season beware of glaciers opening up and of the snow bridges collapsing. Routes such as Grands Mulets are unsafe as a route to descend from Mont Blanc, and routes such as the traverse will be far harder. Also avoid all the North faces and ice routes, due to warm nights.
AUTUMN SEASON – mid to late September to beginning of December		
Good conditions may even survive until October then it rains and snows every day.	Often the rock routes are still dry, until the regular rains start in October.	Avoid couloirs, as this is the key rockfall time due to lack of high permafrost.

Each year many climbers come out to the Alps with ideas of routes that they wish to do, irrespective of the seasons. This section aims to give you a clearer understanding of what is possible in which seasons, and what to expect in terms of weather and conditions. This table is only a guide, as each year the seasons arrive at slightly different times. If you use this in conjunction with the daily weather updates and webcams etc, that are available on the internet and TV, you should be able to get a realistic impression of whether your planned route is possible. If you are in any doubt, e-mail us, or check out the website for the latest route information details. By getting all this information, as well as details of which mountain huts are open (or have open winter rooms), you will be able to decide what equipment you will require, and should have realistic objectives by the time you arrive. There is no point taking a week to wade through snow up Mont Blanc in winter!



28: Route Choices – Alpine Grading

There is an unhealthy obsession with grades that does not help anyone climb better. The easiest way of considering them is that for each climber there are two grades: possible and impossible. What is possible for you to achieve in a climbing wall when warm, dry, and not carrying a rucksack, is very different to when cold, wet, and with a heavy bag and big boots on your feet. The climbing wall may be great training, but it is not representative of your actual likely performance in the Alps. Many people ignore these differences and try to attempt climbs that are too hard for them. Grades should therefore always be taken with caution, and remember that whatever your choice of route, if you are not 100% sure don't attempt it, as it will always be there next year! The Alpine grades are listed below, with some examples of routes in each grade. After each route is a reference taken from the Alpine Club guidebook description. It is important to understand the grades, and the style of climb that you are attempting, as it will determine what equipment you take and your likelihood of success. Be aware that conditions can vary from the guidebook description as a result of the different seasons, glacial movement, rockfall, or due to the weather.

Grade		UIAA Rock	Snow / Ice
F	facile (easy)	I	walk up
	Dômes de Miages traverse F/PD [MBv1:4&5] Mont Blanc, Grands Mulets F/PD [MBv1:58]		
PD	peu difficile (little difficult)	II	35°/45°
	Petite Aiguille Verte, Ordinary Route F+/PD- (one move III) [MBv2:116] Mont Blanc, Goûter Ridge PD- (II,40°) [MBv1:57] Mont Blanc du Tacul, Ordinary Route (NW Face) PD- [MBv2:189] Mont Blanc, Three Mont Blanc -route PD+ (>45°) [MBv1:62]		
AD	assez difficile (quite difficult)	III	40°/55°
	Aiguille du Midi, Arete des Cosmiques PD+/AD (IV/Aid) [MBv2:1] Matterhorn, Hörnligrat AD- (III) Dent du Géant, Normal Route (SW Face) AD (III;V) [MBv1:5] Aiguille Verte, Whymper Couloir AD+ (55°) [MBv2:90]		
D	difficile (difficult)	IV - V	50°/70°
	Mont Blanc, Brenva Spur D- [MBv1:73] Tour Ronde, North Face D- (52°) [MBv1:273] Mont Blanc du Tacul, Chere Couloir D-/D (75°, Scottish 4) [MBv1:225] Aiguille du Midi, Frendo Spur D+ (V,55°) [MBv2:15]		
TD	très difficile (very difficult)	V+ - VI	65°/80°
	Aiguille du Plan, North Face Direct TD- (IV,60°) [MBv2:28] Mont Maudit, Cretier Route TD- (IV+) [MBv1:165] Aiguille Noire de Peuterey, South Ridge TD (V+,A0;VI) [MBv1:142] Petit Dru, Bonatti Pillar TD+ (V+,A1) [MBv2:133]		
ED	extrêment difficile (extremely difficult)	VI+ - VIII-/aid	- 90°
	Mont Blanc, Peuterey Integral TD+/ED1 [MBv1:86(142,143,135)] Grandes Jorasses, Croz Spur TD+/ED1 (V+,60°) [MBv1:48] Mont Blanc, Central Pillar of Frêney ED1 (VI,A1;VIII/VIII+) [MBv1:91] Petit Dru, American Direct ED1 [Mbv2:138]		

Most accidents occur when people lose confidence, or have continued on a route when they knew they had pushed too far. Before starting a grade of route be realistic, if your plans are outside your experience then downgrade to something that is achievable.

29: Route Choices – Timings & Style

Of all the pages in this booklet, this is the most important by far. It has no diagrams or pretty pictures, and is solid text, but soldier on as the points it makes will save your life many more times than all the other pages combined. Intuition is impossible to measure, hard to describe, and easy to ignore. If you are unhappy at any stage in the mountains, then do something about it. Don't continue a climb on ice you think is weak, or if you think you should pitch the climb instead of moving together, or consider the slope avalanche prone. You can always afford to trust your intuition if it warns you, but may only ever have one opportunity to ignore it if you then have an accident. The oldest climbers have had the courage to say 'no' many times in their life, which is why they are old climbers. Today there is a lot of pressure on people to perform, and people see not succeeding on a route or not gaining a summit, as failure, not as a learning experience and a good day out anyway. Try to enjoy what you are doing and as Paulo Coelho writes in the Alchemist, remember that the journey is as important as the dream. You show great strength by being able to say no.

The Guidebooks to the Alps describe many routes, and give times for how long each route should take a fit and efficient Alpine roped team. The timings are not those of Olympians, and should be trusted as the safety margins. If a climb is quoted as to take between 6 and 8 hours, and half way through you realise that it will take you 10 or more then stop. Often the timings are to indicate the latest time by which a climb can safely be completed. For example on the Whymper Couloir of the Verte you must start the descent of the couloir by 09:00, as afterwards there is significant rockfall. On other routes the snow bridges over the crevasses will become weaker after the time limit has been exceeded. If you are likely to need more time to complete the climb, then consider the safety implications, and you must either choose a more realistic alternative objective, or turn around. Other factors that will obviously influence the timings are your fitness, acclimatisation, weather and temperature.

There are over 4000 routes in the Mont Blanc Massif, and realistically the majority will not be an option for you at any one time due to either their grade or condition. The next consideration is the style of route. By this I am not referring to whether it is snow or rock or ice, but rather to the type of movement and whole type of day that the climb will produce. Some people find their preferred style to be short technical climbs, whilst others enjoy snow plodding along ridges for hours upon end. The style that suits each individual is a function of their comfort on different terrain, and a person with excellent crampon skills will find that they do not tire on steep snow faces, whilst others who may be higher grade rock climbers may not as efficient on crampons, and so are less comfortable on these styles of route. Style comes through being efficient in movement & the suitability of the route to you.

The word 'attitude' may well be one of the misused of our generation, but in this context it means your outlook, determination, and reaction to others. The attitude of any climber should be assured and calm, though with a great drive and motivation. People who rush or are arrogant make mistakes. Summits are never guaranteed, they are earned. Those who climb peacefully yet purposefully, are methodical, enjoy the mountains, and are far more likely to succeed. Preparation in both psychological and physiological terms makes you a very resilient and confident climber. The best way of describing the often-opposing types of climbers, are that some see mountains as things to be conquered. Others like Mike Stroud say that we are but like flies privileged to walk across the face of a sleeping giant.

Trust your intuition, abide by timings, climb with style, & climb peacefully but purposefully.

PHOTO: Aiguilles du Chamonix through Icicles

30: Route Choices – Huts & Refuges

There are over twenty mountain refuges in the Mont Blanc Massif, and they vary from solidly built stone structures for over 60 climbers, to tin sheds for 4 people. The variety is massive, & this gives you some pointers to what to expect. Ownership of the huts is below:

a) Club Alpin Francais (CAF) – club owned and operated guardianed huts
b) Italian Alpine Club (CAI) – club owned and operated guardianed huts
c) Swiss Alpine Club (CAS) – club owned and operated guardianed huts
d) Privately owned and operated guardianed huts – e.g. Plan d'Aiguille
e) Company operated mountain huts – e.g. Cosmiques and Charpoua
f) CAF / CAI / CAS Bivouac Shelters without guardian – e.g. Eccles
g) Mountain Hotels with mountaineers bunk rooms – e.g. Montenvers

The majority of huts are operated by the Club Alpin Francais, though others are operated privately. Most huts with more that ten spaces have a guardian who is responsible for the day-to-day running of the refuge. Their role encompasses everything from cleaner, accountant, cook, and advisor. They know what condition routes are in, as they get reports from climbers every day, so it is well worth getting their advice. It is usual to pay for a bunk bed space, evening meal and continental breakfast. This half board stay means that you don't have to carry anything to the hut apart from your climbing rucksack. The evening meals are usually good, consisting of three courses (usually soup, main course and dessert), and breakfast is served anywhere between midnight and 9am, depending on the time that the climbers wish to start on their route. For Mont Blanc in summer, breakfast is normally at 1am. The average cost of a night half board in a hut is £35, paid in cash.

Above Chamonix, huts should be avoided at weekends, as they are often very busy and noisy! In order to book the hut, you must reserve in advance by telephone. This is essential as often there is no room in the peak of season if you just turn up. Before setting off you should check if there is drinkable water at the hut. Most have no running drinkable water, so you must decide how much to carry with you and how much money to take to buy water at the hut. As the huts are supplied with their food and water by helicopter, the cost of buying extras such as chocolate and bottled water for your climb is very high.

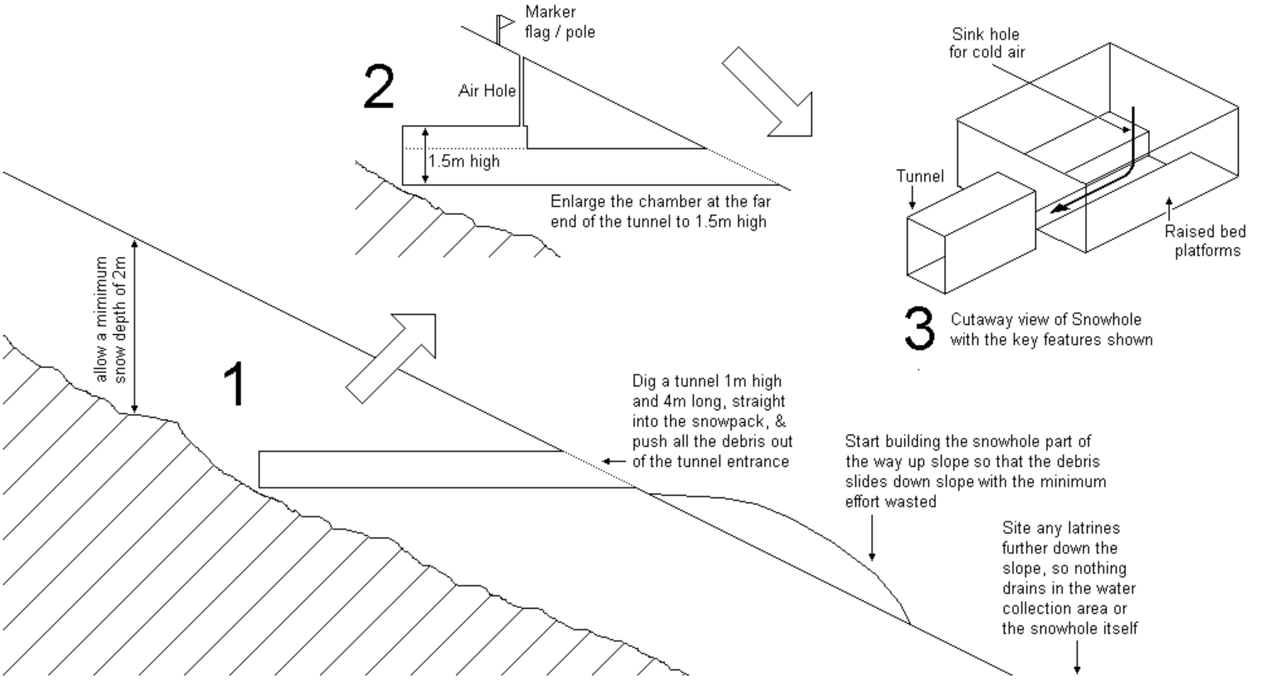
Upon arrival at a hut, you should check in with the guardian. They will tell you where the equipment room is, and where your bunk is (or in which room). You should leave your all wet equipment out of the dormitory rooms. If you have a choice of where to sleep, the lower bunks are cooler (warm air rises) as the huts are usually very warm. The evening meal is served around 18:00, and afterwards most people talk for a short while and then go to bed from about 20:00. The last thing you should do before going to bed is check that your bag is packed for the next morning, and then get some sleep. The hut provides blankets and pillows, and each bunk space has a mattress and sheet, so you do not need to carry any bedding to huts. Most people sleep in their base layers for comfort. Try not to go to the toilet during the night, as the noise will disturb everyone's precious sleep. In the morning the key is to get ready quickly. You do not want to be held up by a slow group on your route, and you want to get the best advantage out of your early start. If you go into breakfast with all clothing and harness on, then all you need to do afterwards is put on your boots and to tie onto the rope. Getting ready the night before makes a big difference.

To find out about the style of the hut you are planning to stay in, you should firstly read the Guidebook for your planned ascent as they generally give short descriptions of the hut and how to reach them. Alternatively visit the Maison de Montagne or the CAF Office in the middle of Chamonix to get full details of the huts, prices, and availability of water.

PHOTO: off piste glacier skiing in Chamonix

31: Route Choices – Snow Holes / Bivvies

There can be few techniques that attract as many column inches in climbing magazines and books as the snow hole. In summary they are cold, wet and take ages to build. So why do we hear so much about them? They are great shelters from the wind or in event of a serious storm, and avoid the weight of carrying a mountain tent. It is worth learning how to build a snowhole in case of an emergency, but they should only be for that scenario.



The diagram above shows the rough size that you need for a party of two climbers. Always remember to build a snow hole part of the way up a slope so that when the snow is being tunnelled out, it can be pushed out of the doorway and can slide down the slope. This will save you a lot of time and energy. Wrap up warm and waterproof before you start digging! When the snow hole is finished you will require waterproof bivouac bags to put your sleeping bag in to keep it dry from the drips. Try and keep everything off the floor as it invariably gets trodden in and lost in the snow. It is also worth sleeping on ledges above the floor level, as a frost hollow forms and the floor is very cold at night. Also remember to leave an air hole, and keep unblocking it in event of heavy snowfall. And remember to mark the outside of your hole so that noone walks over your roof in the middle of the night!

The other option instead of a snowhole, is a bivouac. There seem to be many myths about what a bivouac actually involves. All they are is sleeping in your sleeping bag (with a waterproof cover) on a mountainside, without the use of a mountain hut or tent. The main advantage of bivouacs is that they enable you to sleep exactly where you want / need to. They are often used on multi-day routes, or at the base of a climb where an early start is required for the best conditions. The negative aspects of bivouacs are that they need more equipment to be carried (sleeping bags, cooking kit and food), and so are not lightweight. They become self fulfilling prophesies; the extra weight slows the party down to the extent that a climb that could have been done in one day with the slight risk of a bivouac becomes a guaranteed two day route, climbed at a slow pace. The positive side of bivouacs is that they avoid huts and so you avoid the noise, heat and bustle. Often you will get a better night sleep in a bivouac, and you can leave the kit at the bottom of the climb in order to collect it during the descent. Bivouacs do avoid the time of building snowholes!

32: Alpine Equipment – The Basics

The equipment list below contains all the kit you will require for mountaineering, ski touring or ice climbing in the Alps without a Guide. It assumes you are staying in mountain huts.

GENERAL EQUIPMENT

- Mountaineering Boots: crampon compatible (B3) leather / plastic boots, e.g. Sportiva's
- Rock Climbing Shoes: worn in, lace up or slipper style, that are comfortable for long days
- Climbing Rucksack (40L max): compact rucksack for day climbs & high altitude ascents
- Head Torch & Batteries: a halogen or LED bulb head torch with new spare batteries
- Sunhat / Cap & Fleece / Wool Hat: when hot to hide from glare / when cold to keep warn
- Goggles & UV Sunglasses: for all times of year, especially for altitude or ice climbing
- Trekking Poles (Pair): these help minimise knee damage on ascents and descents
- Water Bottle & Hot Drink Flask (1L+): drinking tubes freeze at altitude or in winter

GENERAL PROTECTION

- Ice Screws: for ice pitches, a selection of ice screws should be carried of different lengths
- Nuts: on rock or mixed climbs a range or metal wedges should be taken on wire / cord
- Cams: for rock protection on parallel-sided cracks, camming devices are the only option
- Pitons: on some climbs these may be necessary where no other protection is safe to use
- Aid Kit: where free climbing is impossible, hooks, beaks, pegs, and etriers may be used
- Rope: see page 4 for advise on what type of rope should be used for your planned climb

PERSONAL TECHNICAL KIT

- Mountaineering Crampons: Of a 12-point design e.g. Grivel G12 or Charlet Black Ice
- Mountaineering Ice Axe: classical style axe (max 60cm) e.g. Stubai Mountain Star
- Alpine / Rock Harness: comfortable & adjustable, e.g. Black Diamond Alpine Bod
- Safety Helmet: essential for all Alpine climbs, e.g. Petzl Ecrin or Camp Rock Star
- Slings x2 (long e.g. 8ft circumference): essential personal kit for safety and rescues
- Screw Gate Karabiners x3: large size to use when wearing gloves, & taking thick ropes
- Belay Device or Figure of 8: heat-dissipating devices such as the ATC or Petzl Reverso
- Prussic Loops x2: each loop should be 30cm diameter when tied, made with 7mm cord

THERMAL LAYERS

- Fleece Jacket: this is the most important part of your versatile layering system
- Base layer thermals x2: the tops should be long sleeved to protect your arms in a fall
- Duvet Jacket / Vest (optional): useful as light, especially bivouacs, Alpine starts, & winter
- Windstopper Gloves: excellent for thermal capabilities even when windy, & for ropework

WATERPROOF LAYER

- Goretex Jacket: a breathable windproof jacket e.g. The North Face Mountain Jacket
- Waterproof Trousers / Salopettes: for climbing & when breaking trail in snow, or if it rains
- Gaiters: well fitting, quality, breathable gaiters e.g. Mountain Hardwear Ventigaiters
- Waterproof Gloves (not mitts): in addition to fleece gloves, and must be waterproof

SURVIVAL & MEDICAL

- Personal Medication & First Aid Kit: to keep you going, such as blister kits & plasters
- UV Sunscreen & Sunblock: high factor sunscreen is needed as you burn easily in snow
- Survival Blanket: a lightweight reflective blanket to use in event of an emergency
- Knife: in order to cut rope or tape for climbing, or bandages in an emergency situation

ICE CLIMBING / EXTREME LEVEL CLIMBS… On these climbs you require technical Ice Axes & Crampons, though should have mountaineering crampons & ice axes if needed.

SKI MOUNTAINEERING… Ski touring requires no gaiters, or mountain boots. You do require all the other equipment on this list above, including all the Technical Kit. As well as these you will require touring skis & boots, skins, ski crampons, & skin glue.

33: Alpine Equipment – Safety Basics

The key phrase that is often repeated in this booklet, is achieving a balance. If you think that carrying all the safety equipment available will make you safe, think again; you will be carrying too much weight, will travel slower, have a greater chance of collapsing snow bridges etc. You must select a suitable collection of safety gear that is suitable for the type of route that you are attempting. Below is an analysis of the safety kit you should carry at all times, as it has applications on all types of Alpine route, from rock to ice and mixed.

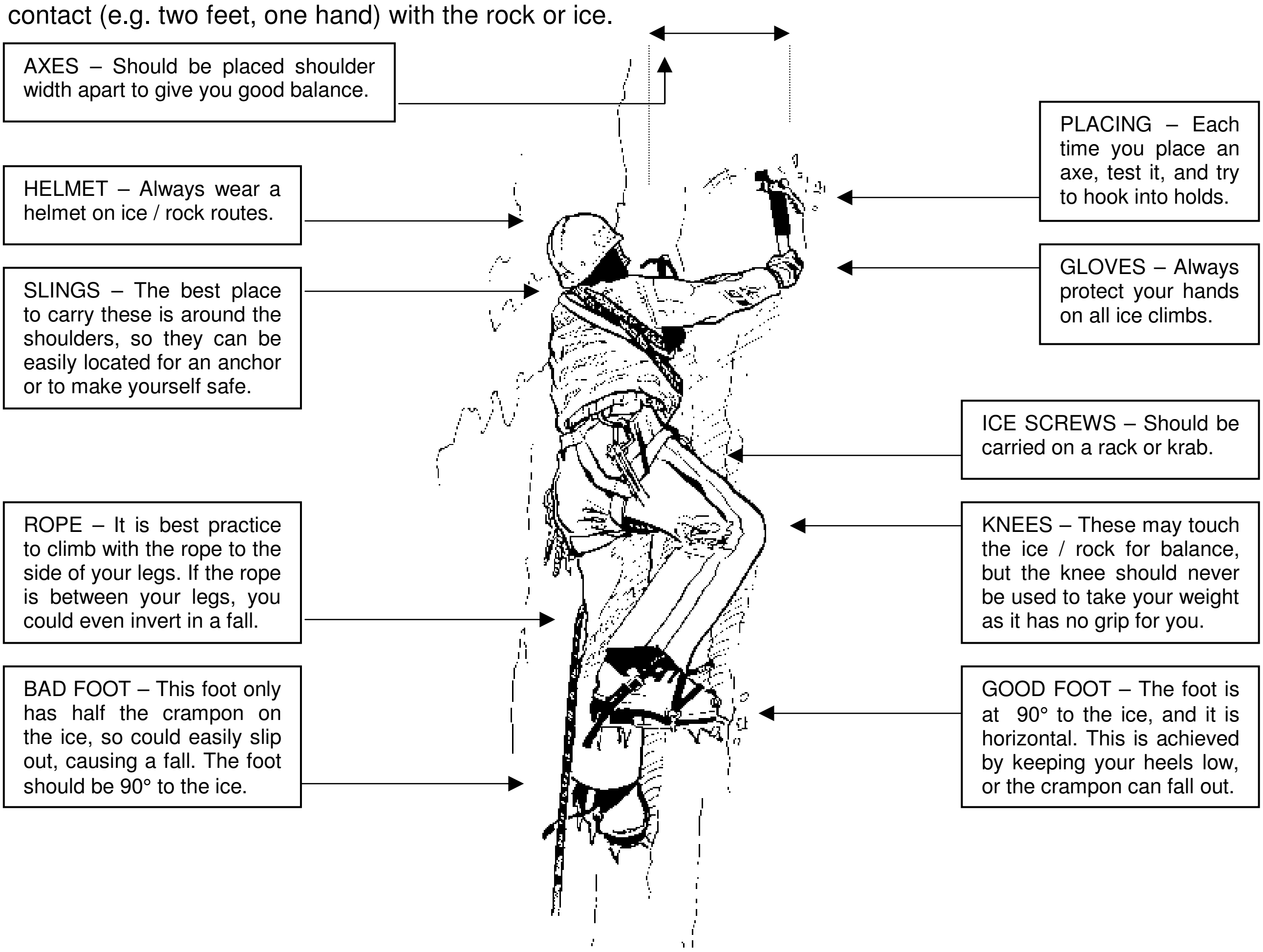
ITEM OF GEAR	USES OF EQUIPMENT IN THE FOLLOWING ENVIRONMENTS			
	Ice Climbing	Mountaineering	Alpine Rock	Emergency
Slings X 2	These are used at all times for belays, anchors, and in rescue situations. Sewn slings are stronger than tied slings. Carrying some spare untied sling tape is a good idea. This can be cut when a sling would usually have to be left behind (such as in a multi-pitch abseil descent).			
Karabiner Screw Gates X3	Screw gates can be locked to increase safety, so won't accidentally open on sharp edges. Three karabiners are recommended; one to go onto the front of your harness at all times (to attach ropes or slings into), one to be used to attach to points of security on the end of a cowtail, and the third to use in emergencies or to carry spare gear (such as in hoist systems).			
Ice Screw 15-20cm X2	As protection at a running belay, or two screws to make a belay stance. Also use a screw to make Abalakov holes.	On icy sections the screw can be used for a running belay, or in case of safety for anchors in a crevasse rescue	Ice forms in the cracks of altitude rock routes. Also the ice screw can be used for Abalakovs for abseil descents.	A fallen climber in a crevasse can use the ice screw to make safe, and those on the surface to make an anchor.
Prussic Loops X 2	To protect abseil descents or as cord to thread through an Abalakov belay.	To ascend ropes in event of a fall, or for safety on abseil descents.	To ascend fixed ropes, or for use in a bag hoist lifting system.	For climbing out of a crevasse, or they can be your spare boot laces
Knife	On all types of climb, or travel, a situation could arise where a knife is needed, either to avoid an accident (e.g. cutting a length of cord to repair a crampon strap), or in the event of an accident (e.g. cutting tangled ropes, or cutting bandages for first aid). Every day, you will use it for lunch anyway.			
Lighter	To light stoves for cooking food, seal cut rope ends, and sterilise needles.			
Headtorch	To show you the way at night, and to signal for rescue in an emergency.			

When on a course, you only need to carry your slings, karabiners, and prussic loops. The other items are recommendations for when you climb without a Guide. As these items are your key safety kit, you should get good quality kit and carry them in readily accessible places. A good ice screw will place with a quarter the effort of a cheap ice screw. Slings should be around your shoulders or bunched on your harness, never store them knotted as if they get wet they freeze, becoming difficult to untie. Karabiners, ice screws and prussics should also be clipped to your harness, and never stored in a rucksack, as in the event of an emergency you need immediate access to them. The knife and lighter can easily be carried on a cord around your neck, or in an easily accessible pocket of your outer jacket. The headtorch should have fresh batteries and be stored in an easily accessible location for you to find it when required.


PHOTO: piles of climbing equipment

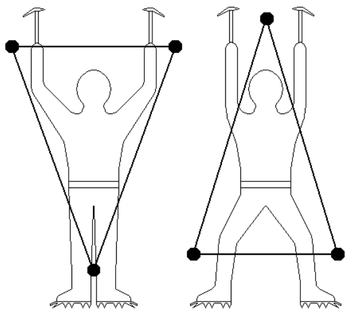
34: Climbing Techniques – Key Points

CLIMBING STANCE – The key to good climbing is to always consider your stance on the rock or ice, and to carry equipment is readily accessible positions. For stability, always try to always keep three points of contact (e.g. two feet, one hand) with the rock or ice.



BALANCE & POSITION – The key to good climbing, on either ice or rock, is good balance. The easiest way of considering this is to think of the shape that you make when climbing. The diagrams below show the key stances that can be summarised as two triangles.

BAD – this triangle is not stable, as it is balanced on one point at the base. If either hand is moved, there is a chance of a fall, as that side of the body is no longer supported at all by the feet. Another point is that this position often blocks your view of your feet, so your footwork is going to be very unstable.



GOOD – this triangle is so stable because the feet provide a good base and the triangle rests on a flat side, with the point at the top created by the hands being shoulder width apart. When either foot or hand is moved the shape is stable, and the shape allows you to look down to see your feet.

35: Your Course Diary & Notes

Day & Date	Course Activity / Route	Grade / Skills
Sunday		
Monday		
Tuesday		
Wednesday		
Thursday		
Friday		
Saturday		
Sunday		

NOTES: ....

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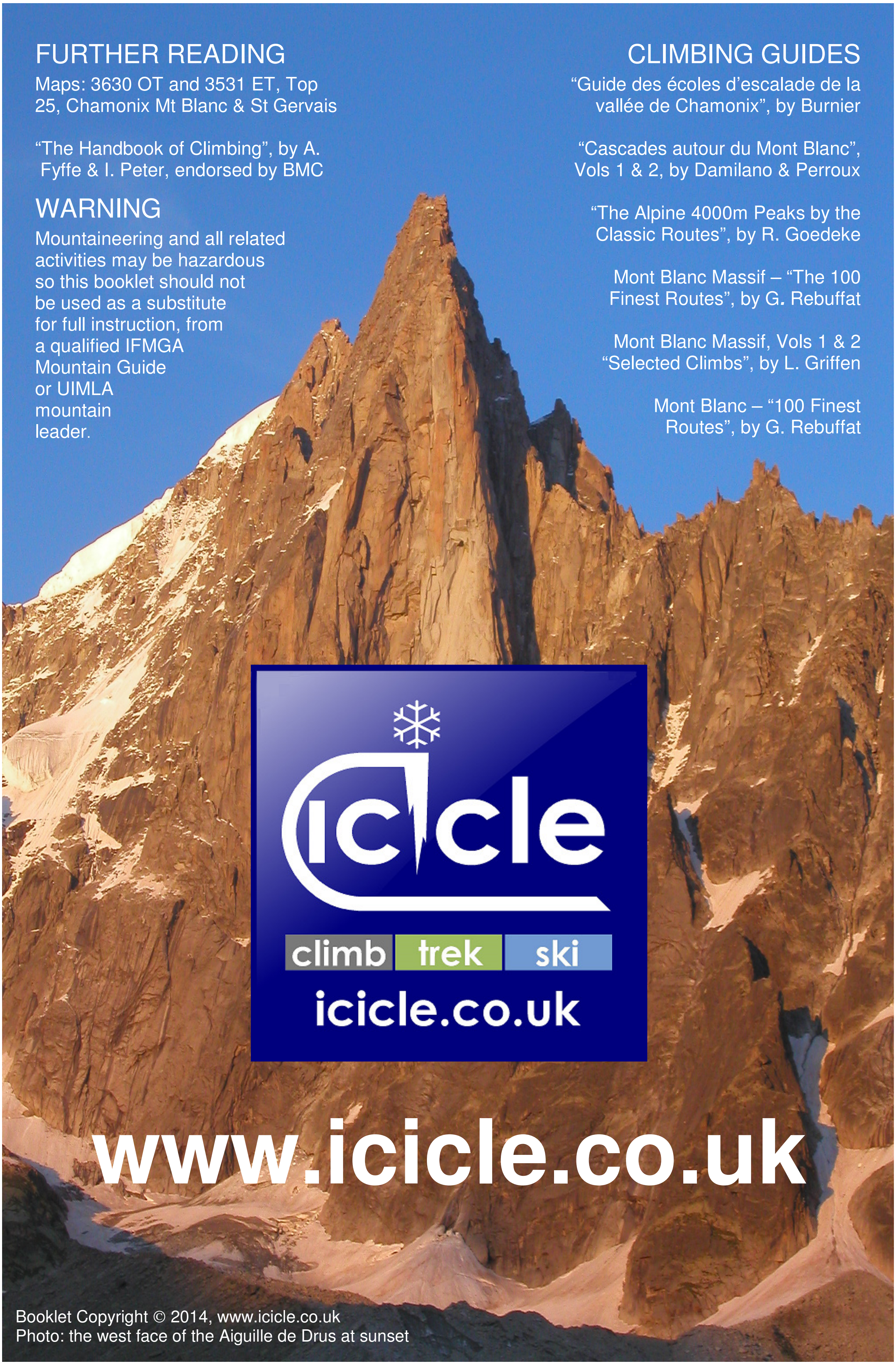

FURTHER READING

Maps: 3630 OT and 3531 ET, Top 25, Chamonix Mt Blanc & St Gervais

“The Handbook of Climbing”, by A. Fyffe & I. Peter, endorsed by BMC

WARNING

Mountaineering and all related activities may be hazardous so this booklet should not be used as a substitute for full instruction, from a qualified IFMGA Mountain Guide or UIMLA mountain leader.

CLIMBING GUIDES

“Guide des écoles d’escalade de la vallée de Chamonix”, by Burnier

“Cascades autour du Mont Blanc”, Vols 1 & 2, by Damilano & Perroux

“The Alpine 4000m Peaks by the Classic Routes”, by R. Goedeke

Mont Blanc Massif – “The 100 Finest Routes”, by G. Rebuffat

Mont Blanc Massif, Vols 1 & 2 “Selected Climbs”, by L. Griffen

Mont Blanc – “100 Finest Routes”, by G. Rebuffat

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Photo: the west face of the Aiguille de Drus at sunset