Wānaka Mountain Guides

Technical Ice Climbing

Ice climbing in New Zealand

Venues

Water ice climbing in New Zealand is mainly confined to cold, higher elevation and south facing aspects with a good supply of drainage. During the shortest days of early winter, these venues see little sunshine and later in the season, snow can accumulate, covering less steep climbs and more consideration needs to be given to the increased avalanche risk.

Great alpine ice can be found in the high mountains of the Aoraki/Mount Cook and Westland regions well into spring when longer daylight hours reduce the time pressure on longer routes. At this time, winter snows have consolidated to make firm cramponing conditions and more stable avalanche conditions. Classic areas and routes include the South Face of Hicks from Empress Hut and the South Face of Douglas and the Mallory-Barnicoat ridge from Pioneer Hut.

Grading

Ice climbs are given a Water Ice (WI) grade from 2 through to 6 or 7. The grade that takes into account a number of factors including length, technique required and commitment. Routes are generally graded for normally expected conditions but variations in the amount and consistency of ice can greatly affect the difficulty of a route and judgement is required to determine the current condition of the route.

For more routes of WI 3 and above, 85° or steeper ice can be expected for longer sections and protection may need to be placed from less restful positions From WI 4 and above, protection will need to be placed on vertical sections and WI 5 and above will have prolonged sections of vertical climbing.

Grading for mixed climbing roughly follows the WI system with respect to its physical

and technical demands and can be compared to rock climbing grades with M6/7 being the transition into the Eubank grade 20s.

Hazards

Avalanche

Whenever snow is above threshold above or at an ice climbing venue, an avalanche hazard may exist. Ice climbing areas are often found below slopes that provide drainage to the ice formation. If these slopes are between 30 and 45 degrees, it is avalanche terrain and exposes the ice climbing venue. Similarly, approaches may cross avalanche terrain. It is well known that even small avalanches are severe for climbers due to the equipment used and carried and their inability to move quickly out of the path compared to skiers.

Climbers should be aware of the avalanche conditions from the public forecast and be cautious whenever there is change from new snow, rain or rising temperatures. Avalanche safety gear (shovel, transceiver and probes) and knowledge on how to use them are essential for most ice climbing venues.

Cooling

Ice expands when heated and contracts when cooled, which can introduce mechanical stress. If cooling is slow, the ice can adapt to the stresses and deform plastically. However, if cooling is quick, the ice becomes brittle and additional stresses, such as those created by an ice axe, can create cracks. During contraction, a free-standing column will shorten, creating strong vertical mechanical stresses in the structure.

Thaw

As can experienced at any point of the season in New Zealand, a spike in temperatures or strong winds can affect safe climbing conditions. Prolonged periods of mild temperatures above 0 °C, including at night, can cause running water behind the ice and can result in the separation of the ice from the underlying rock. Particularly early in the season when hanging daggers and freestanding ice forms that have not been connected to the ground can collapse with little warning. By late August, the sun is higher in the sky and can quickly lead to the deterioration of conditions. Under these conditions, avoid being under hanging or steep features that may come down on top of you.

Periods with stable temperatures of around 0 °C (little warming during the day, no drastic cooling at night) generally provide the most favourable climbing conditions.

Us and other climbers

Other climbers can knock off ice or ice daggers or drop (sharp) ice climbing equipment so helmets should also be worn when at the bottom of ice climbs. Belayers should position themselves away from the firing line, especially in multi-pitch situations where they are attached to the mountain and can't quickly move out of the way of anything falling. Similarly, never climb under another party.

Ice climbing uses sharp equipment so skin should be covered and some form of eye protection is good to prevent injuries from ice tools popping out of the ice.

Any lead fall whilst wearing crampons and using ice tools has the potential to cause injury. It is not sport climbing and climbers should climb within their limits focusing on good feet, often the first thing to blow during a fall, and good, secure sticks with tools.

Equipment

Boots

For technical ice and mixed climbing, a fully rigid (full shank) mountaineering boot is required. Single boots constructed from leather or more modern synthetic materials (some newer models have an integrated gaiter) are suitable for conditions encountered during winter and spring in New Zealand. Double plastic or synthetic boots, designed for higher altitude alpine climbing, do provide extra warmth and have the advantage of being easier to dry out on multi-day trips camping in the snow but are often excessively warm for New Zealand conditions. Whether boots have an integrated gaiter or not, a separate snow gaiter is useful for approaching through deep snow.

Crampons

While general mountaineering crampons and axes can be used for ice and mixed climbing, a range of specialist ice gear is available. Crampons used for ice climbing need to be sharp so if you are using crampons for general mountaineering in the summer months, they will need to be sharpened for use on the ice. This eventually reduces their lifespan so if you plan on spending a lot of time ice or mixed climbing, having specialist gear can save money in the long term.

Vertically aligned front-points penetrate harder ice more easily with less shattering. Dual vertical front-points provide a more stable platform to stand on but in hard and brittle ice they can cause the ice to dinner-plate or shatter, requiring several more kicks to ensure a secure placement. Mono vertical front-points excel on hard brittle water ice where the points can be placed in the holes left by ice tool placements and allow very efficient and positive climbing. They are also good for mixed climbing and provide good balance on small rock features.

Ice tools

On steep water ice, modern highly curved ice tools make a big difference, especially when making placements over bulges and generally minimising effort on steep terrain.

Dedicated ice tools are shorter than general mountaineering axes and the curve and any handle will make it more difficult to plunge into the snow for security on the approach and descent.

Leashes

When using curved ice tools with ergonomic handles, wrist leashes are often not used at all. This makes it easier to recover, place ice screws and opens up a variety of techniques to make things more efficient on technical climbs. If climbing without a wrist leash, an umbilical leash is recommended as they provide the benefits of leashless climbing whilst still maintaining an attachment and limiting the potential to drop the tools. Dropping ice tools could be a potentially serious issue on a long mountain route.

Wrist leashes, whilst not as popular since the arrival of umbilicals. They provide support and can promote a more relaxed grip on the ice tools which conserves effort but makes placing ice screws more awkward. Clipper wrist leashes allow the leash to be quickly detached from the tools, providing the benefit of having wrist leashes while making it easier to place ice screws and shake out tired arms.

Gloves

Keeping hands comfortable ice climbing takes a bit of management when ice climbing. It is good to have a range of pairs available to swap between for different tasks and to keep your warm pairs dry. Thin softshell or freezer worker gloves are dexterous for leading, especially on mixed terrain, and usually warm enough for the duration of a pitch providing tools aren't gripped too hard. Warmer, more durable, leather palmed gloves can be

swapped into for belaying and abseiling or mitts for long stints belaying a lead climber. In between use, gloves can be kept warm and dry inside a jacket.

Other useful items

A V-Thread tool, whether it is a purpose-made one or a homemade one from a wire coat hanger, is a vital piece of equipment for making V-Threads.

A good method for racking ice screws is also useful. The most popular nowadays are ice clippers. These are inverted plastic carabiners that can neatly rack a number of long handled ice screws. Other options that can be attached to the harness include flutes or tubes that hold an ice screw each.

Petzl Multihook®

Black Diamond® Ice Clippers

Gear considerations for mixed climbing

Mixed climbing can put considerable wear on hardware and if a lot of dry tooling and mixed climbing is expected, it is worth having dedicated crampons or ice tool picks. Picks are either B or T rated. B rated picks are optimised for ice climbing with a narrower profile at the expense of strength. T rated picks are stronger in order to withstand the higher forces put on them by mixed climbing. Mixed climbing and dry tooling does dull the points of tools and crampons and having dedicated equipment also means that points do not need to be sharpened as regularly and they will last longer. Sharp points are required on pure ice routes, especially in very cold conditions. It is still possible to inadvertently snap a pick when mixed climbing and on long, commiting routes it may be worth carrying a spare.

Protecting ice and mIxed climbs

Judging ice quality

Ice can vary greatly in its structure. At one extreme it can be little more than frozen snow with a white, opaque appearance caused by lots of small air pockets. This is known as Alpine Ice and is great to climb on with easy, solid pick placements but is not strong or reliable enough to provide good opportunities for protection. At the other end clear water ice can be hard but potentially brittle, especially at when temperatures are very cold. Pick placements may be shallow but can still be very secure and ice screw protection is good.

When placing ice protection, climbers should look for areas of more mature ‘blue’ ice and features of compression rather than tension. Imagine that the ice is ‘flowing’, and areas where it is flowing slower such as slabs offer stronger ice. Avoid areas of tension such as bulges.

Ice screws

Ice screws are used almost exclusively on pure ice routes. They come in a number of different designs but most modern options have a fold out handle that helps screwing them in and out. They come in a variety of sizes up to 22cm long. The strength of the ice screw placement comes from the thread so longer ice screws do not necessarily make for a strong placement, but just engages the thread deeper and through the softer surface ice.

In good quality ice, the placement can potentially be stronger placed 10° down in the direction of potential pull. In less reliable ice, a placement 10° upwards in the opposite direction will be stronger. Perpendicular placement can provide high strength protection in both circumstances so if unsure stick with this.

Placing and removing ice screws

To place an ice screw clean off the softer surface ice to reach the good quality ice underneath. It may be useful to use an ice tool to make a small indentation to help get the ice screw to bite initially. Push and rotate the screw into the ice, aiming to place the screw perpendicular (90°) to the surface of the ice. Once the screw has bitten, start cranking on the handle. The quality of the ice and the reliability of the placement can be monitored by feeling the resistance as it screws into the ice and the consistency of the core being bored out of the centre of the screw.

Placing ice screws is worth practising including placing them one handed, with either hand from the security of a top rope before having to place them on lead.

Before placing an ice screw, place ice tools securely and high in order to hang from a straight arm on the upper tool. Bent arms will accelerate fatigue. Ice screws should be placed at waist level or below. Too high above waist level is difficult, tiring and dangerous as it ends up pulling outwards on tools.

Place ice screws from restful positions in good quality ice, extending them with longer runners if required to keep the rope running direct. The best ice to climb may be different for the best ice for placing screws.

When removing ice screws, always clear the ice out of the inside of ice screws by gently tapping the top of the screw (not the thread or teeth!) against the head of an ice tool or blowing to prevent the ice core freezing in place which can make it very difficult to place the ice screw again.

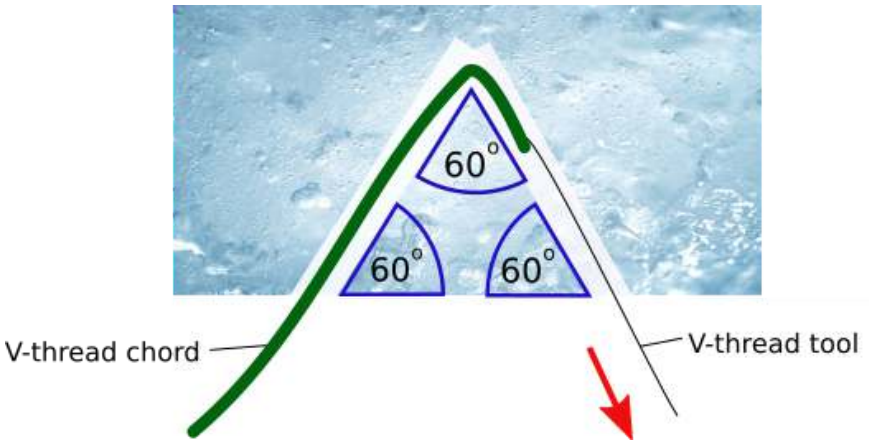
V-Threads

V-threads (also known as an Abalakov thread) are a strong type of ice protection that are often used as abseil anchors as it avoids leaving expensive ice screws behind. They can have a similar strength to a single ice screw placed in the same ice but their strength is usually limited by the breaking strain of the cord being used. V-Threads do take longer to build than placing an ice screw, but practice does improve the process. A piece of wire or

purpose designed V-Thread tool is needed to pull the cord or tape through the V in the ice.

A V-Thread anchor can be built using a single ice screw. Begin with placing the screw 60° to the surface of the ice on the horizontal place. Remove it and measure out the position for the second hole using the length of the ice screw. The second hole will also need to be 60° and will need to be eyed up to intersect with the first hole. If all goes well and the holes meet up with the end of the cord can be poked into the first hole and using the V-Thread tool, hook and pull it out of the second hole. The cord can then be tied off with an overhand knot.

Although traditional practice was to build V-Threads in the horizontal plane, recent research has indicated that V-Threads built in the vertical plane (also known as A-Threads) have the potential to be slightly stronger.



Other ice protection

Threads can be constructed from a sling or cord threaded around features such as pillars of ice. Threads can potentially withstand loading in a number of directions so can be considered multi-directional. A V-thread tool can be useful for threading cord or slings around features. It is useful to carry long slings for this purpose. Depending on conditions or the nature of the route, more obscure pieces of protection such as Bulldogs and Warthogs can be useful to be used in mediums like frozen turf.

Rock protection

Rock protection is usually preferred where available the first choice for protection and anchors as it is easily placed and removed and can be more reliable.

Wires (also known as chocks, nuts Rocks® or Walnuts®) are a passive type of protection placed behind constrictions in cracks. Wires rely upon the strength of the rock around them and a sufficient amount of surface area in contact with the rock for their strength. Wires are usually only good for loading in a certain direction. A Nut key or ice axe pick is quite often necessary to remove wires.

Hexentrics (also known as Rockcentrics®) are another passive type of protection used in cracks. They have a hexagonal cross section and can be cammed or wedged into cracks. Although Hex's have largely been superseded by the invention of Cams they still offer cheap, solid protection, especially in winter when cracks can be iced up.

Spring Loaded Camming Devices, most commonly known as cams or by the product names of Friends® or Camalots® are an active form of protection using spring-loaded, cam-shaped lobes that expand outward until held in place by the rock around them. They have the outstanding property of actively camming in place in parallel-sided cracks. Ice in cracks can affect the holding power of rock protection such as cams and in some situations passive protection such as nuts, hexentrics and pegs provide more secure placements.

Pitons (also known as pegs or pins) – are steel wedges that are hammered into narrow cracks. There are a number of different designs each coming in a range of different sizes, known by names such as angles, knife blades and lost arrows. They can be especially useful in winter for mixed climbing when cracks can be filled with ice and can provide reliable protection in narrow cracks when no other options exist. If carrying pitons, a piton or ice hammer must be carried to insert and retrieve them.

Spikes can be used for quick pieces of protection. Slings can be hooked over the spike providing the spike is solid and that the sling sits well when loaded in the anticipated direction of pull. Spikes are commonly used to construct abseil anchors only necessitating leaving behind an inexpensive length of cord.

Bolts are the most common form of fixed protection and often found in popular ice climbing areas where there is good but compact rock adjacent to the ice and especially useful for abseil anchors. Bolts in ice climbing areas should be checked for the tightness as the cold can cause the metal to contract slightly, eventually loosening the bolts. It is therefore useful to carry a spanner to tighten loose bolts.

When climbing in the mountains it is common to find pieces of protection, mainly slings or pitons, that have been left behind by previous parties, especially on standard abseil descents. It is important to thoroughly check any fixed protection of this nature before trusting it, especially old, worn or UV damaged slings.

Mentally use a rating system of 1 to 10 to help realistically assess the effectiveness of a piece of rock protection as a runner or component of an anchor. A piece of protection with a rating of 1 is not really worth the effort to place and retrieve it. A 10-rated piece of protection is commonly referred to as Bombproof and will have a high confidence of withstanding even the biggest lead climbing fall. Practice placing and testing protection in circumstances where no harm will result.

Climbing techniques for steep ice

Using ice tools

Swing tools from the elbow with a final rotation of the wrist to drive the pick in. If the picks get stuck, avoid pulling outwards on the handle and instead pull the pick out the way it went in, pulling upwards on the head. Tapping upwards on the head of the ice axe can help loosen it.

More reach can be achieved by choking the tool. This is moving the grip up the shaft and modern tools have grips for this purpose. Maintaining a low pull is vital when choking as it puts more outwards force on the placement that can pull it out of the ice.

On very steep ice that is very featured with lots of air pockets and hollows, it is possible to simply hook the picks of the ice tools into an ice pocket or existing tool placement without swinging. This can feel insecure initially in contrast to the picks being firmly embedded in the ice but can be much more efficient than repeatedly swinging the ice tools. It is important to maintain a downwards force on the tools.

Swinging ice tools

Removing a stuck pick

Front pointing

When front pointing the soles of boots should be horizontal and shoulder width apart. If the heels of the boots are raised too high, the rubber toe of the boot will strike the ice first making it difficult to get a secure placement or front points will tend to shear downwards out of the ice. No amount of kicking will get a rubber boot to grip in the ice. If heels are too low, calves will become tired quickly and the points will not positively engage in the ice. With dual front points, the boots should be perpendicular to the ice to ensure both points are equally engaged.

It is common for beginners to kick too hard or repeatedly resulting in wasted energy. Usually a confident and well directed single kick is enough to get enough front point into the ice for a secure placement. Features of the ice can be used as when rock climbing, looking for edges and pockets to place the front points in to save effort.

Front pointing

On anything less than vertical most of the weight should be just on the feet and the stronger leg muscles with tools only being used for balance. Pulling excessively on tools may cause them to rip out. Keeping in balance and taking small steps will save valuable energy in the arms for when the going gets steeper.

The triangle position

At all times when climbing steep ice (75° or steeper), climbers should aim to adopt the triangle position with feet placed wide and tools placed as close to the centreline of the body as possible. Hips should be tilted inwards with knees slightly bent so they are over the front-points. In this position, the torso is leaning back which makes even vertical ice feel overhanging. This stable balanced position avoids swinging out of balance if one of the tools or feet were to pop out of the ice.

Triangle position - knees over toes and ice tools close to centreline

Progression on steep ice

Moving upwards on ice can be tiring and it is important to use an efficient and balanced technique that keeps the weight over secure feet and avoids pulling on bent arms. Good technique is the key to moving efficiently with the minimum of effort.

1. Point elbow at the ice, eye-up where to aim the pick placement at full reach above the head. Aim to place your tools close to the centreline of the body to maintain the stable triangle position;
2. Swing from the elbow and flick the wrist at the apex of the swing, using the weight of the tool to drive the pick into the ice. If any tool placement is in any way questionable then place it again until it sounds and feels secure but avoid potentially weakening a placement by repeatedly striking different points of the ice. The tool should be positioned so that the climber can hang on it with a straight arm. With a secure high placement, wiggle the lower tool loose but leave it hooked in the ice and pulling downward.
3. Move feet upwards which require moving the body away from the ice. Always move the lowest foot first and avoid big steps that will put excessive weight on the top tools and maintain a downwards pull on the tools. Use two or three steps finishing with feet placed level and equally spaced either side of the top tool making the stable triangle position.;
4. Stand up straight, using the legs to lift the body upwards and pulling the pelvis into the ice, bending the arms and pulling down on the tools;
5. Remove the lower tool and aim for a secure placement at full reach close to the centreline. Always aim to move the lowest tool when making upwards progress;
6. Move feet up and stand up, pulling pelvis into the ice and bending arms. Move the feet after every tool placement.

Progression on ice © George McEwan Collection

Transitioning from steep to lower angle ice

There is a specific technique for transitioning from steep to lower angle ice that avoids reaching too far with the tools, a manoeuvre that commonly results in the heels raising up and crampons shearing out:

1. Place tools in the low angle ice, just above where the angle eases and careful to not reach too far;
2. Make a number of small steps up with the feet until one, then the other, can be placed on the lower angle ice. Hands can be slid up the shaft of the tools but avoid pulling outwards on the pick. This will result in the centre of gravity sticking out from the ice and may temporarily feel precarious;

3. With both feet on the lower angle ice, in turn place each tool higher and stand up to reestablish a less strenuous standing position, balanced over your feet.

Strategies for leading on ice

Climbers should move quickly and efficiently through steeper sections between positions where they can rest and recover with weight on good feet. Mentally map these positions from the ground to plan a strategy for the route. Good foot placements will be relaxed and promote confidence.

The purpose of the mental map is also to ensure there are enough ice screws for the whole pitch without running out near the top of the pitch or for the belay.

Falling whilst leading must be avoided. Climbers should climb down to a rest position before falling due to fatigue. If arms are getting pumped, a solidly placed ice tool can be clipped into to rest or place an ice screw. Ice climbing should be in control and over gripping tools or climbing with bent arms accelerates fatigue.

Multi-pitch ice climbing

Anchor systems principles

Two or more ice screws can be combined into an anchor system that can be used for multi-pitching or top roping. In these situations reliability is paramount as climbers will often have their entire weight on an anchor and its failure can be catastrophic.

When creating an anchor system the following 5 principles apply:

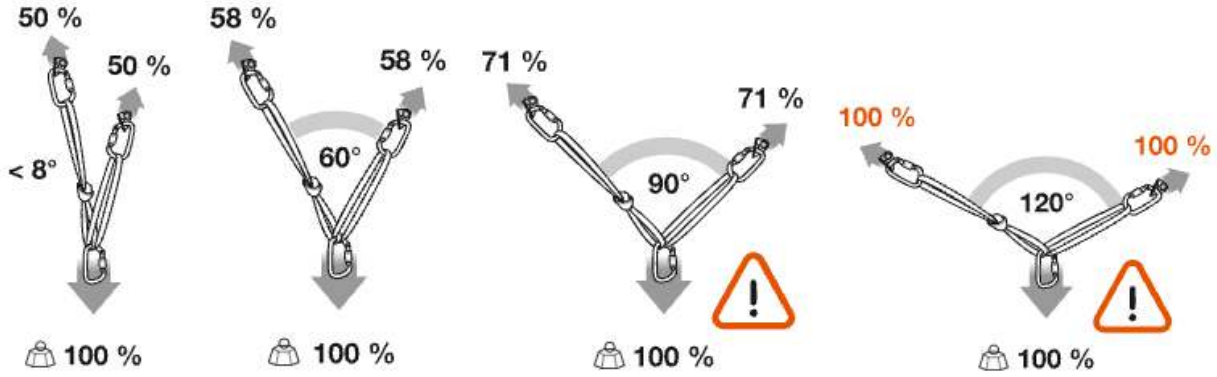
Secure - Each ice screw used within an anchor system must be secure. This means that it is placed in good quality ice and there is good confidence in its strength and reliability.

Independent - Each piece of protection must be independent. On good water ice, this means that at least two well spaced ice screws. Separation avoids the ice screws affecting the strength of each other and the ice fracturing around the entire anchor system. You should aim to separate each screw by at least 2 screw lengths and in different horizontal and vertical planes.

Equalised - To minimise the force on individual ice screws and maximise the strength of an anchor system, it is important that the initial load is equalised or shared between all of the individual pieces of protection.

Redundant - If a protection piece within the anchor system fails, then there must not be a shock load on the other protection pieces of the anchor system.

Angle - The angle created at the focal point when equalising multiple pieces of protection points into an anchor system is of paramount importance because of the Magnification of Vectors. This always needs to be considered, especially if the pieces are separated.

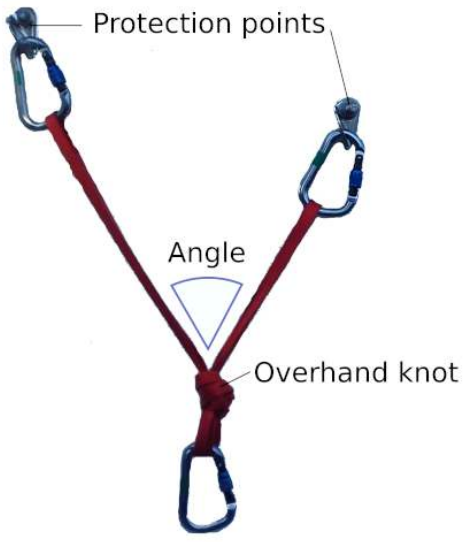


Magnification of vectors (Petzl)

Anchor system configurations

Anchor systems built using slings are preferred and used with a direct belay as it keeps the rope and other members of the climbing party out of the system.

The simplest anchor system is the double strand using a sewn or tied sling. The sling is clipped through 2 (or more) anchor points and an overhand knot on a bight is tied at a point in line with the direction of pull and equalised on both anchor points. This focal point provides 3 separate attachment points which can be used to keep the anchor organised. This double strand setup does require anchor points that are relatively close together using a long sling to ensure the angle between the strands is within the acceptable range.



Retreating off ice climbs

A common practice when the intention is to abseil back down a multi-pitch ice climb is to spend time building V-Threads as one component of each anchor on the way up the route. This means that abseil anchors are ready to go for the descent and should be conveniently located a rope length apart. It is important that the V-Threads are placed well in good ice and haven't been weakened by the sun or elevated temperatures in the intervening period.

As V-Threads are commonly abseiled on individually, there should be high confidence in their strength. They should be tested whilst having the backup of a secure anchor and for all but the last person down, they can be backed up with a secondary ice screw anchor. It is important that this secondary anchor is not taking any of the load but backs up the V-Thread if it were to fail. The V-Thread and secondary anchor will not be equalised but the intention is to test confidence in the V-Thread. Excess slack should be avoided though as any significant shock load on the secondary anchor could cause it to fail as well.

If the ice is poor and there is insufficient confidence in a single V-Tread then a multiple number of V-Threads can be built and equalised together.


V-Thread, V-Thread backed up with and ice screw for abseiling

Mixed climbing

Mixed climbing combines ice and rock climbing techniques. A good repertoire of rock climbing movements are useful such as layaways and bridging. Mixed climbs include alpine ridges and faces or crags in winter conditions where snow and ice conditions will dictate the difficulty of the climb.

Crampons on rock

Crampons can be surprisingly effective on rock, even if it's iced over with *Verglass*.

Despite not having the feedback associated with climbing in soft rock climbing shoes, using the points on small rock edges and features, with some practice, can feel secure. As potentially only a small amount of metal and rock is in contact, feet must be kept steady during movements to avoid the points levering off. When this happens, it does so explosively. At all times, crampons should be placed accurately and confidently, with minimal scraping.

Dry tooling

Dry tooling is the use of ice tools on dry rock. Dry tooling techniques can use tools in a wide variety of placements and often requires imagination and creativity. Tools increase reach and can be used where there would be no purchase with hands or fingers.

Picks can be hooked on small positive rock features, such as flakes or chock stones, that are either too small to hold on to with hands or out of reach. When moving upwards, a downwards pull needs to be maintained on the tool.

A tool-cam (also known as a stein-pull) relies on keeping the pick in place on a rock feature by pushing or pulling the back of the axe against an opposing surface. This can put a lot of force on the pick and tool, so choking the tool can minimise the leverage.

Tools can also be torqued by placing the pick or shaft into cracks that are too small for fingers and twisting it to wedge it in place. Care must be given to maintaining the position and force throughout the movement to maintain the torque. As with tool-camming, the grip can be choked to adjust the leverage.

Excessive forces placed on tools when dry tooling can cause picks to snap.

At all times when using tools in rock, each placement must be checked before committing to it, especially if it can't be seen. It takes practice to develop a feeling through the tools for the integrity of placements. Weight must be kept low and close to the rock and kept steady during the movement to avoid the placement failing, similar to when using crampons on rock.

Hands and feet

On more subtle or sloping features, hands may be more efficient and useful. In this case, ice tools need to be stowed on the harness or backpack, draping it around the climber's neck or hooking the pick over the thumb of the climber's other hand. It is common to go leashless when mixed climbing. In some situations, thicker gloves may be removed for more purchase in which case a chord around the wrist is useful.