Army Mountain Warfare School

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Advanced Military Mountaineer Course
Summer
Student Handout

MAY-SEP 2015

	ARMY MOUNTAIN WARFARE SCHOOL
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Commander's Welcome and Comments

1. Welcome to the Army Mountain Warfare School (AMWS). During this course, you will receive some of the finest training the US Army has to offer. Our instructors are ready to pass on knowledge gained from years of experience and multiple combat deployments. While you are here, our first concern is for your safety. For this reason, you must be totally focused and maintain situational awareness at all times.

2. Operating in the mountains presents two distinct yet related challenges; first is the severe affects that weather and the environment have on personnel and equipment and second the severe impact the terrain has on unit mobility. How well you solve these tactical problems will directly affect your ability to take the fight to the enemy in level two and three terrain. The skills you learn here at AMWS are tools to help you and your unit solve these challenges.

3. In the mountains of Afghanistan we face an adaptive, clever enemy who uses the harsh environment to his advantage to operate against us. With specialized mountain warfare training and equipment we can use that same terrain to our advantage and seize the initiative away from the enemy.

4. Untrained and unprepared, the mountain environment can be your worst enemy. Properly trained and equipped, it can be your strongest ally. We will give you the training. The rest is up to you.

"Training Mountain Warriors!"

//Original Signed//
John A. Guyette
LTC, MU
Commanding

Safety Statement

Safety considerations are everyone's concern. Instructors will point out specific safety requirements during each block of instruction. Always observe the following safety points:

1. Wear helmets and safety yourself in when working on or near vertical surfaces.
2. Make sure all locking carabiners are locked.
3. Properly inspect and wear your climbing harness. ***(Be sure to double pass buckles if applicable).***
4. Inspect all equipment prior, during and after use.
5. Inspect all knots.
6. While rappelling, confirm that the rope hits the ground or tie a knot in the end of the ropes to prevent rappelling off.
7. Be alert to changing climbing conditions.
8. Be aware of falling ice or rocks at all times.
9. Check all anchors.
10. Climb within your ability.
11. Use proper communication methods.
12. Whenever possible, use static double rope installations.
13. Use the buddy system to monitor dehydration, heat injuries and environmental injuries.
14. When building and utilizing warming fires, never stand or dry objects too close to the source.
15. Treat all weapons as if they are loaded. ***(Never point your weapon at anything you are not willing to shoot).***
16. Maintain terrain awareness.
17. Be aware of footing, utilizing taught walking techniques to minimize injuries.
18. Never run in training areas unless specifically directed by instructors.
19. When in doubt—ask questions!

Environmental Statement

1. Responsibility. It is the responsibility of all Soldiers to protect the environment from damage. Careful planning and preparing for your mission can minimize impact on the environment.

2. Plan and prepare. Careful planning can help ensure that impact concerns and safety expectations are met.

3. Durable Surfaces. Bivouac and travel on durable surfaces. It is best to use surfaces that are durable or highly resistant to impact. These include rock, sand, gravel, snow, pine needles and leaf litter.

a. Stay on marked trails unless otherwise directed by an instructor.
b. Use bridges wherever and whenever possible.
c. Take rest breaks on durable surfaces.
d. Ground equipment and eat only in areas designated by the PI.
e. Avoid fragile areas.
f. Smoke only in areas designated by an instructor. Police all related refuse.

4. Avoidance. Avoid places where impact is just beginning. Use already established well-worn sites.

5. Reduce Wastes. Pack it in; pack it out. Reducing wastes helps prevent animals from becoming habituated to humans and lessens the chances of them becoming nuisances around bivouacs.

a. Reduce your litter prior to packing it.
b. Dispose of all waste items in an appropriate manner. If a trash bag is provided, use it. If none is available, pack your trash in your rucksack. Do not attempt to burn or bury trash at any training site.
c. Properly dispose of what you cannot pack out. Correctly disposing of wastes, helps prevent pollution of water sources and the spread of illness such as giardia.
d. Dispose of human waste properly. Use designated latrines only. "Cat Holes" are not authorized.

6. Leave What You Find.

a. Avoid damaging trees and plants.
b. Avoid disturbing wildlife.
c. Avoid contact with wildlife

7. Fires. Minimize use and impact of fires. A fire should be viewed as a tool to be used only when necessary.

a. Do not start wood fires at any training site unless directed by an instructor.
b. If authorized, make your fire small and safe.

Role of the Level 2 Mountaineer

Military Mountaineering Training Strategy

The military mountaineering training strategy is broken down into the following levels and capability:

Base level: Mountain Warfare Orientation Course
Basic mobility skills and understanding of the fundamentals for operating in a mountainous region (5 days).

Level 1: Basic Military Mountaineer (SQI E)
1-2 per platoon
Basic technical mountaineering skills; Trainer of Soldiers and leaders in basic mobility skills and assists in planning operations. (15 days)

Level 2: Advanced Mountaineer (Assault climber)
2 per battalion
Advanced technical skills; Advisor to the Commander; Unit trainer and planner of mountain sustainment training and operations. (15 days-Summer, 15 days-Winter)

Level 3: Mountain Guide (Certified Mountaineering Instructor)
1 per brigade
Advanced Technical Skills and experience; Advisor to the Commander; Unit trainer and planner of mountain sustainment training and operations. (2+ years)

Technical Skills of the Level II Mountaineer

-Use specialized mountain equipment

-Rig complex multi-point anchors

-Lead climb on class 4 and 5 rock

-Perform multi-pitch climbing

-Establish fixed ropes with intermediate anchors

-Establish and operate hauling and lowering systems

-Perform high angle rescue operations

Additional Skills for Snow/Ice

-Lead climb on steep snow and ice

-Perform avalanche hazard evaluation and rescue techniques

-Perform glacier travel and crevasse rescue

-Be familiar with military skiing techniques

Role of Advisor to the Commander for Mountain Operations

The level 2 mountaineer must be able to advise the commander on any technical and movement considerations for mountain operations. He must be familiar with the mission planning process as a whole and knowledgeable and skilled in the tactics required for moving personnel over and through vertical danger areas. He must know the skill/training level and physical fitness of the troops and the amount and type of mountaineering equipment available. He must be skilled in route planning and reconnaissance and understand how weather, altitude, and terrain will impact unit mobility, movement times, effectiveness of weapon systems, resupply operations, air assets, medevac, communication, synchronization, and command and control. The level 2 mountaineer must not only be able to make timely and well thought out suggestions to unit leaders but must be prepared to take on a leadership role during actual operations.

Responsibility of training unit members and building Mountain Capability

Building unit mountain capability requires leaders who understand the need and its importance, individuals who are trained at the various levels, a good skills sustainment plan, and initiative on the part of those with the training. The level 2 mountaineer will in most cases be the Subject Matter Expert (SME) within the unit. He must be skilled in all basic mountaineer (Level 1) tasks and rope systems and is the principal trainer and supervisor in the unit for all high-risk mountain training. He should be familiar with using the Risk Management process and familiar with the various considerations for planning mountain training. The level 2 mountaineer can be expected to provide unit training for top rope climbing, rappelling, movement over fixed ropes, high lines, hauling systems, river crossings, etc… He need not be an instructor but should be familiar with basic instructional technique, able to provide demonstrations, properly inspect, and be knowledgeable about any special equipment including use, maintenance, strengths, etc… The military mountaineering training strategy DOES NOT WORK if basic movement skills are not passed down to and trained on by unit members. True mountain capability can only be achieved when its overall importance is understood by unit leadership. It is often the level 2 mountaineer's responsibility to ensure this happens.

Summary

The level 2 mountaineer has a very important role in mountain operations. He must be highly trained and prepared and diligent in his responsibilities.

ADVANCED ANCHOR CONSTRUCTION

Introduction

Anchor construction is fundamental to nearly all mountain tasks. While this lesson focuses on advanced rock anchors, solid skills and understanding of basic natural anchors is paramount.

ARTIFICIAL ANCHORS

There are several different types of anchors that can be placed in rock. Some require drills, hammers, or other additional equipment while others are designed for clean and simple placement and removal. Those that are more permanent in nature are referred to as “fixed,” while those that are placed and removed are referred to as “clean” or “removable.” In most cases all of these can be used as individual points of protection for a lead climb or as a component of a multi-point anchor.

Bolts

Bolts

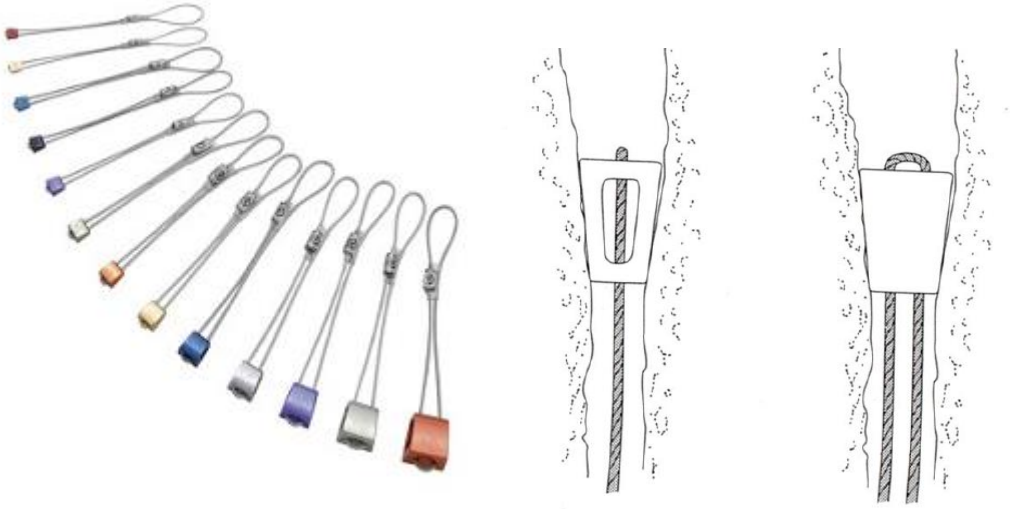
Most modern bolts used in climbing or mountaineering are expansion bolts similar to the type used in construction. They consist of a bolt with a hex head, an expansion sleeve, and a hanger all made of stainless steel. They require a hole to be drilled into the rock with a drill bit of the correct length and diameter. After removal of rock dust, the bolt is then pounded into the hole until the hanger is flush with the surface of the rock and then tightened with a wrench. The sizes of bolts used will vary with the hardness and softness of the rock. The advantage bolts have is that they can be placed on sections of blank rock where there are no cracks or constrictions in which to use other anchor types. Properly placed bolts can be just as strong as the rock in which they are placed. The main disadvantages are the additional weight of gear and the noise required for their placement. Hammers and expensive battery powered drills can weigh a lot and make enough noise to easily expose one’s position in a tactical situation. For this reason, it may only be feasible to use bolts in secured areas or at training sites. In most cases two bolts used together constitutes a safe anchor; however they can also be used independently as points of protection in sport climbing areas.

Pitons

Piton Hammer

Pitons

Pitons are designed to be hammered into cracks and constrictions in rock and clipped with carabiners for use as anchors or as points of protection. They were commonly used for mountaineering through the 1970s, but are seldom used today. Pitons are made from steel and come in several different shapes, sizes, and designs to accommodate varying sizes and depths of rock cracks. All types have an “eye” in which to place a carabiner for use. One advantage of pitons is that some types can be hammered into very thin cracks that may not accept other types of artificial anchors. Their disadvantage, along with their additional weight and difficulty of removal, is that they require being pounded in, which limits their use where noise discipline is required. In addition to this, when pounded and removed, pitons often change the structure of the rock or cracks around them. For this reason they are not commonly used for recreational climbing. Pre-existing pitons can be used; however, they are especially prone to corrosion and weathering and therefore should be inspected and backed up whenever possible.

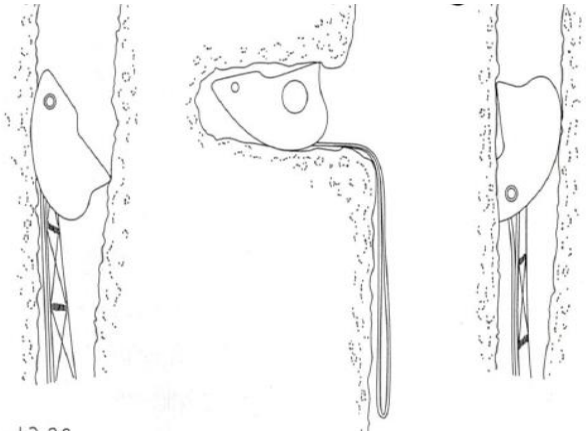


Chocks

Chocks

There are many types of chocks. The most commonly used chocks consist of a single metal

wedge that tapers in two directions with a stiff connecting cable. They are often referred to as wired nuts or stoppers and are designed to be placed just above a constriction in a crack. They are manufactured in a variety of sizes for varying size cracks and oftentimes ten or more may be carried on a single carabiner. A chock can be used as an individual piece of protection for a lead climb or as one component of a larger anchor system. To place a chock, slot an appropriate sized piece into a constricting crack so that the maximum surface area of the sides of the wedge is in contact with the surrounding rock. The end of the cable opposite the wedge will point in the direction of pull. The crack must constrict down or in the direction that the anchor will be loaded. They can be removed by pulling them in the opposite direction in which they were placed. Well placed chocks or stoppers that have been heavily weighted can often be difficult to remove. A chock tool is usually part of a rack and can be used to work these loose. Although some very small chocks exist that are designed to hold only body weight for aid climbing, most are very strong, (8-12 KN), and the limiting factors become the quality of the rock around the anchor and the stability of the actual placement. For this reason the main disadvantage is the skill and training necessary for positioning and analyzing placements, as well as in evaluating rock quality. These types of anchors will not work in loose or crumbly rock, and poorly positioned pieces may not hold. Oftentimes minor adjustments or moving a piece a few millimeters can mean the difference between a strong anchor and a poor one. The main advantages to chocks are that they are lightweight, relatively inexpensive, quiet, and can be used and reused an infinite number of times.

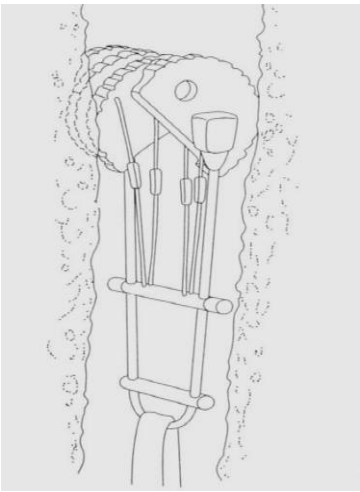


Tri-Cams

Tri-Cams

Tri-cams are another type of chock, but one that can be used either the same way a standard chock is used or as an active camming piece. They are curved along one side with rails and have a point on the opposite side and are slung with a short length of pre-sewn webbing. To use it as a traditional chock, simply set it into a constriction as you would a stopper/nut with as much surface area contact against the rock as possible. To use it in camming or “active” mode, run the sling between the curved side rails and position it so that the point is set in a small depression or irregularity in the crack. The load on the sling rotates the device into the rock applying the force against the sides of the crack. Before being used this way they must be pulled on sharply or “set” so that they do not wobble out. To remove them pressure must be

applied that reverses the camming direction. There are many sizes of Tri-cams available, however, only the 4 or 5 smallest sizes are commonly used or carried. The advantages of Tri-cams are that they are relatively inexpensive and that they can be used in either tapered cracks or parallel sided cracks and often can be used in small pockets or pods where absolutely nothing else will fit. The disadvantage is that because they are slung with webbing they are more difficult to place with one hand while leading a climb. For this reason they are more often used as components of belay anchors, or at stances or ledges where both hands can be used for placement. As with standard chocks, skill and experience are necessary for evaluating rock quality and making good stable placement.



Spring Loaded Cams

Spring Loaded Camming Devices

SLCD's, or Spring Loaded Camming Devices, were introduced in the mid 1970s. We will refer to them simply as "Cams." These revolutionalized climbing by providing anchors/protection that could be placed easily and very quickly and could adapt to a variety of crack sizes. Although there are several types, the basic modern design consists of two sets of lobes that oppose each other and rotate from one or two axles, connected to a trigger mechanism on a single flexible stem that runs perpendicular to the axle. Attached to the axle is a pre-sewn connection sling. They are designed to work in parallel sided cracks where a chock would just slide down. The unit holds by transferring a downward force to an outward force against the crack walls using the friction of the lobes against the rock. To place them find a uniformly parallel spot in the crack where the rock is clean and solid. Retract the lobes by pulling back on the trigger. Gently insert the cam and release the trigger so the lobes expand to fit the crack. The spring mechanism works to hold the cam in place. Orient the stem to point in the direction the unit will be loaded. Attention must be paid to the angle of the lobes in relation to each-other. Ideally, the lobes should be open between 10% and 50% of full expansion. Avoid over-camming, which can make the unit difficult or impossible to remove, or under-camming, which results in too little surface area contact and reduced stability. The unit should also be placed deep enough so as to not break the edge of the crack but not so deep that the trigger mechanism cannot be reached. Due to the massive potential forces, special attention must be paid to the rock quality, and all lobes must touch the rock! To remove cams simply pull the trigger mechanism and gently remove the unit. Cams come in a wide variety of sizes to fit cracks sizes of ½ inch or

smaller to over 5 or 6 inches. Each unit has an expansion range, enabling it to function properly within a certain range of cracks. Even so, it may be necessary to carry several sizes depending upon the mission and the intended use. Most come with color coded slings to aid the user in quickly grabbing the correct size for use. The advantages of cams are that they are much faster to place and remove, for either creating anchors or for placing them as points of protection while leading a climb. The disadvantages are that they are much more expensive relative to other types of anchors and can be heavy and bulky to carry. As with other anchor types, training and skills are necessary to ensure proper placement.

MULTI-POINT ANCHORS

Mountaineers use anchors for belaying, hauling/lowering, fixing ropes, rescue, rappelling, and many other tasks. When large trees, boulders, or other single point natural anchors aren't available it may be necessary to create complex multi-point anchors using two or more artificial anchors. The principles of **"ERNEST"** should be applied to all multi-point anchors when possible.

E.R.N.E.S.T Principles

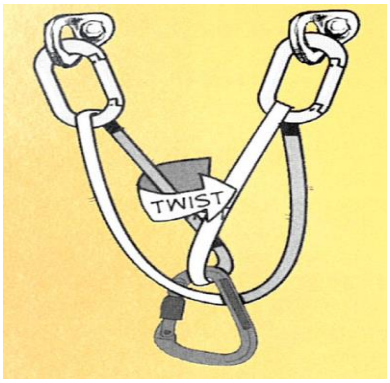
E: Equalized so that forces are distributed equally among all anchor components.
R: Redundant so that all elements are backed up. Failure of a single component will not result in overall anchor failure.
N/E: No extension. In the event of single component failure the remaining component(s) will not be shock loaded.
S: Solid. All individual components are solid, as well as the surrounding rock or features in which they are placed. Not all components are placed in the same crack or feature.
T: Timely. Anchors should be established in a timely manner so that you can get on with the mission.

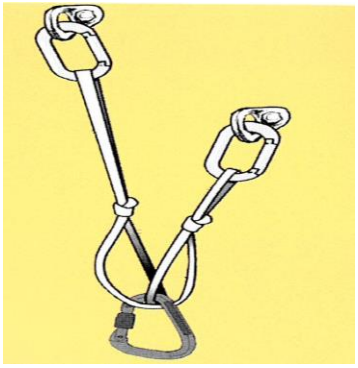
A soldier must exercise sound judgment if using anchors that do not satisfy the "ERNEST" principal and must understand any resulting limitations and weigh the consequences and likelihood of failure.

Methods of Equalizing Multi-Point Anchors

Equalization is used to distribute forces as equally as possible among anchor components. This typically is done through the use of cordelettes or long slings and can be divided into two types: self-equalization and pre-equalization. A non-locking carabiner is typically used in each individual anchor component, with a locking carabiner being used at the main rope attachment point.

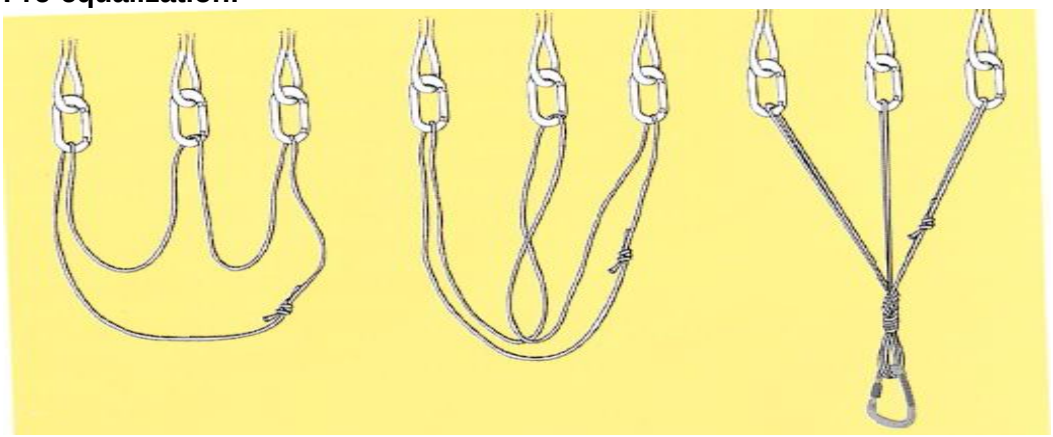
Self-equalization:



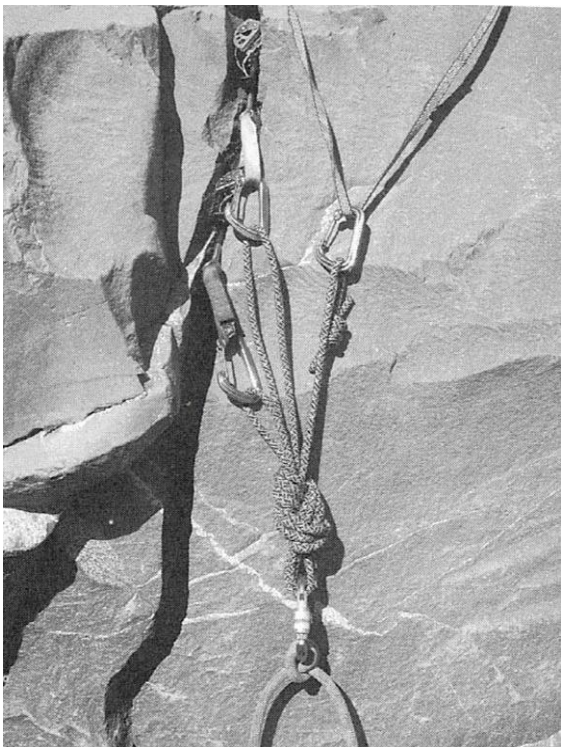


This is commonly done when equalizing two very solid anchors such as bolts that are fairly close together. Simply clip a sling into both anchor carabiners. Grab the strand between the anchors and put a half twist in it, forming a loop and clip the loop and the bottom strand of the sling together with the carabiner in which the rope will be attached to. It is absolutely essential to put the loop in the sling rather than just clipping the top and bottom of it together. Otherwise, if one of the anchors fails, the sling will simply slip through the carabiner leaving the rope completely unanchored. The advantages of this system are that it is very simple and quick and allows for an anchor that can slide from side to side and, in theory, self-equalize as direction of pull changes. However, current testing and research suggests that in the event of severe loading, friction of the carabiner in the loop does not actually allow for the intended equalization of force, and therefore can concentrate the load on only one anchor and increase the likelihood of failure of that component. In addition to this, this type of equalization also violates the “No Extension” principal; in the event of failure of one anchor component, the other anchor would be shock-loaded by the extension of the sling as the force transfers to it. Because of these problems, self-equalization is not recommended. However, it is still a technique that can be used in certain situations where speed and simplicity are important, as long as the user is aware of its limitations. A better option would be to use this technique with limiting knots in the sling to reduce the amount of extension possible in the event of failure. Otherwise, pre-equalization is preferred.

Pre-equalization:

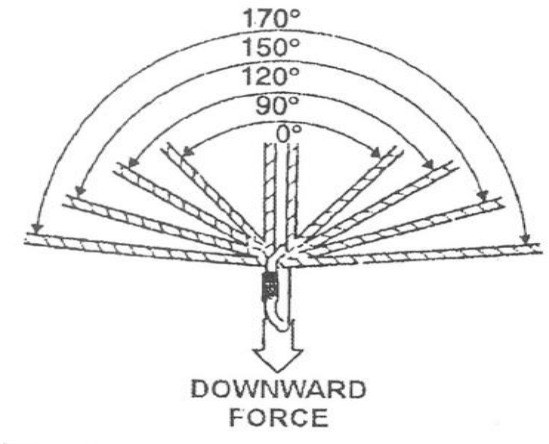


Pre-equalization commonly uses a “cordelette,” or pre-joined loop of 15-20ft 7mm nylon cord, and allows for two or more anchor components to be joined into a single “hot point” for clipping. It spreads the load among them but is also tied off so that there is no extension in the event of single component failure. Each strand of cord is also independent, creating complete redundancy. (1)Clip a strand of the cordelette into each anchor component and pull down the top segment between each anchor. (2) Join each segment with the bottom strand, ensuring that the joining knot is offset or near a high piece. (3) Pull each segment and the bottom strand together in the predicted direction of force and tie all of them together with a double double figure eight. A double-double overhand can also be used if there is not enough room for the figure eight, but may be more difficult to untie after a load has been applied. The result is a “hotpoint” or “masterpoint,” and may need to be large enough to accept multiple carabiners. There are limitations to this method. The cordelette will not equalize to load perfectly if the leg lengths vary. Special attention must also be paid to direction of force, which must be known prior to use. If the applied force is in a different direction then the “hotpoint” was tied for, it may be applied to only one of the components increasing the likelihood of failure. However due to advantages already discussed, it is preferred over self-equalizing systems.



V-Angles

Another important factor affecting equalization is the V-angles between anchor components. These are measured at the “hotpoint” and should be as small as possible, preferably less than 60 degrees. The smaller the angle, the less force each anchor will be subjected to. As the angle increases, each anchor component experiences an increasing force. With high enough angles these forces begin to multiply and can reach very dangerous levels. See the table below.

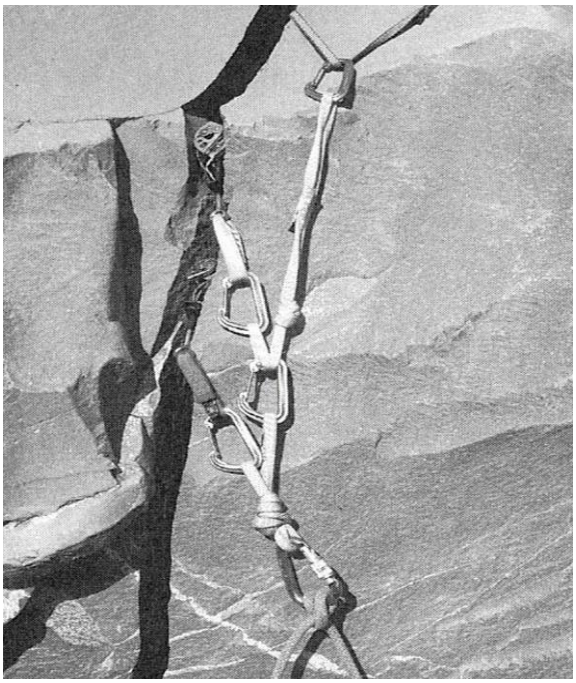


TENSION IN MULTIPLE ANCHOR RIGGING	
ANGLE	RESULTING LEG TENSION*
170°	1150%
150°	200%
120°	100%
90°	70%
0°	50%
*On each leg relative to downward force.	

The farther anchor components are apart, the more cordage or sling material is necessary to create a “hotpoint” far enough away to have appropriate angles.

NON-STANDARD MULTI-POINT ANCHORS

In some situations it may become necessary to use non-standard techniques for creating equalized anchor points. This may be when there is limited lengths of cordelette or sling material available or if anchor components are far enough apart to make standard techniques not viable for achieving appropriate V-angles. One technique is to attach a separate length of sling(s) to the anchor component farthest away from the direction of pull, thus bringing the cordelette clip-in point closer to the remaining anchor components. Another technique that may be possible when two components of a three or more piece anchor are very close together is to clip the carabiner of the higher piece to the sling or cable of the lower piece. The cordelette would then be clipped to both of these with a single carabiner and then to the remaining piece(s) before being tied together in the direction of pull. This may not allow for perfect equalization, but may still be adequate and allow for the redundancy of three or more anchor components when a limited length of cordage is available. In other cases a double overhand knot can be tied in the cord prior to clipping it into one of the higher points. This knot can then be adjusted so that a lower piece can be clipped just below this knot while still maintaining tension throughout. The remainder of the cord can then be attached to the remaining point(s) and allow for equalization using less material. In some cases, techniques may be combined in the case of anchors with 3 or more points. Self-equalization may be used between two points and then pre-equalized afterwards with the remaining points with other material.



Summary

There are many factors that influence the decision as to what technique to use for creating multi-point anchors. The soldier must have well maintained equipment, a good understanding of the principles and the potential forces, and must be able to adapt as necessary.

ADVANCED BELAY TECHNIQUES

Introduction

Belaying is a fundamental technique for climbing safely. Belaying applies friction to the rope to stop a fall and control the energy that a falling climber generates. There are several different situations where belays are required and several techniques that can be used; however all of these require training and a proper understanding of the underlying principles. While here we will focus on belaying a lead climber and belaying the second, a soldier must also understand how to properly belay when using a top rope as trained at the basic level.

HOW BELAYS ARE USED

There are two climbers, each tied into the end of a climbing rope. As one climbs, the other belays. As the climber ascends, the belayer pays out or takes in rope, ready to apply a stopping force to the rope in case of a fall. A belayer may also be called upon to hold the climber stationary under tension or to lower the climber. When considering the effects of a fall, one should get used to thinking in terms of force, rather than weight, because force expresses not only a climber's weight but also the energy that climbers and anchors are subjected to.
Static force: When holding a climber stationary under tension, gravity exerts a force on the climber, which can commonly be referred to as weight. The force that is used to hold him is Static force.
Impact force: When a lead climber climbs up beyond the anchor point or point of protection and falls, gravity will cause him to fall at a rate of 32 feet per second for every second he falls. When the rope the belayer is holding arrests the climber's fall, the sudden impact force generated will be much greater than the force of the object's weight when merely holding it against gravity. Thus the force required to stop if must also be much greater. Impact force is rated in kilonewtons (kN). One kilonewton of force is about equal to 225 pounds of static weight. (Weight is a measurement of force).
Stopping Distance: The force required to stop a fall also depends on how quickly it is arrested. It takes less resistance to stop an object if it is stopped gradually, rather than abruptly. Stopping a fall as quickly as possible may prevent a climber from falling too far and possibly hitting something, but stopping it too suddenly would subject every component of the system, including the climber, to dangerously high impact forces.
Dynamic Rope Climbing ropes are rated for "Impact force", rather than strength. The human body can only tolerate about 12 kilonewtons of force (about 2700lbs-or 15 times its own weight)-for a brief instant without risk of severe injury. Modern dynamic climbing ropes are tested to ensure that they can withstand a certain number of standardized drop tests, without exceeding an impact force of 12 kN on the first drop. Climbing ropes are only able to achieve this using stretch. They elongate under a load to absorb energy.

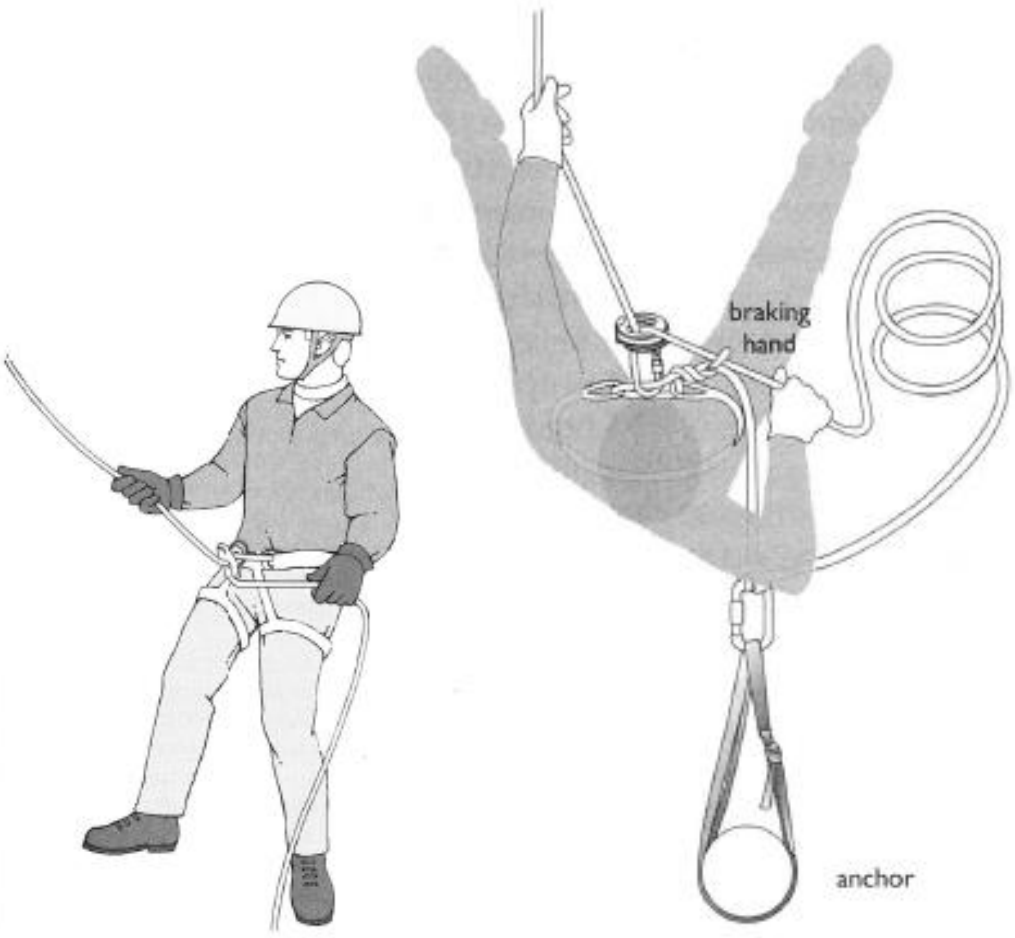
BELAYING A LEAD CLIMBER

While there are several devices that can be used for belaying a lead climber here we will focus on using a standard tube style belay/rappel device or an autolocking device in standard tube style mode. A Munter hitch can be used, but can badly twist the rope making it difficult for the leader and is therefore not recommended. Use the following steps.

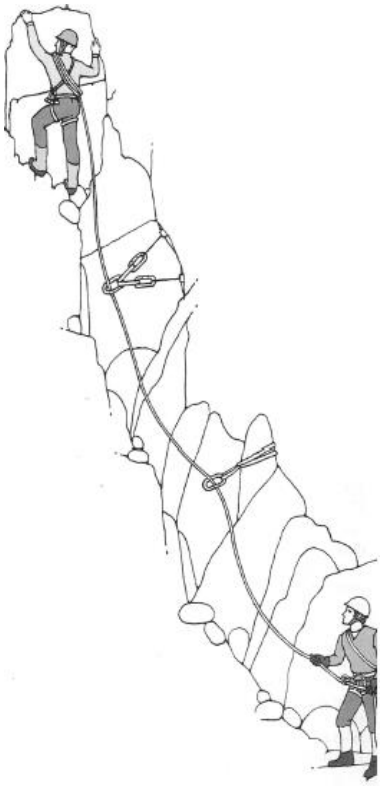
(a) The belayer must first identify a place to stand when belaying that is free from rock fall or other objective hazards that they could trip over or be pulled into. The belayer must be able to achieve an adequate "stance" or braced body position to help absorb

the energy created in a lead fall. They should also consider attaching themselves to an anchor near the ground to help prevent being pulled wildly off of their stance and possibly losing control of the belay. The climbing rope should then be back-stacked and both climber and belayer will tie into the appropriate ends of the rope.

(b) Next the belayer will feed a bight of the climbing rope near the climber's tie-in point into one side of the belay device and then into a locking carabiner so that the brake strand exits the device on the brake hand side. (This is the same as when setting up to rappel a single stand of rope or setting up to belay on a top rope.) The cable or keeper loop on the device will also be attached to the carabiner. The carabiner is then attached to either the belay loop of the harness or the tie-in portion (if no belay loop exists) and locked. The guide hand is positioned with the thumb up on the strand of rope going to the climber and the brake hand is positioned on the strand going to the rope stack and with the thumb towards the belay device.



(c) As the leader climbs, feed rope out to him ensuring that he has full freedom to move and is not hindered by the rope. Ensure that there is always a slight sag in the rope, but no more. Anticipate the climber's movements and be prepared to feed rope out quickly when protection is being clipped.



(d) To catch a fall, immediately drop the guide hand down next to the brake hand and lock the rope off in the brake position. Bend the knees slightly to help absorb the impact. Sometimes experienced belayers can attempt to pull any remaining slack in produced by the falling climber prior to locking off, thus shortening the fall. However, this may not always be possible.

BELAYING A SECOND CLIMBER

Typically one climber takes the lead while belayed from below, moves up the route to the next ledge or desired spot, and then sets up a new anchor and belay. This distance between these belays is known as a "pitch." The length of a pitch is limited to the length of available rope and convenient suitable belay positions. In most cases the leader anchors him/herself with either separate sling material or by using the climbing rope with a clove hitch and locking carabiner, and then uses the command of "Off Belay!" Once the belayer has removed the belay enabling the rope to run freely, belayer would use the command "Belay Off!" The leader then pulls in all the remaining rope until it is tight with the second. Once an appropriate belay is set up the leader uses the command "On Belay!" letting the second know that he/she can begin climbing. There are many techniques that can be used to belay the second climber depending upon the terrain, difficulty of the climbing, availability of anchors, and likelihood and consequences of a fall. The second climber is essentially on a top rope, with a snug rope being maintained throughout the climb.

Body Belays

Body belays can sometimes be used on short sections of less steep terrain where a fall is unlikely and there is a good braced belay stance to take advantage of. To create a body belay, simply run the rope around the body at the waist to create friction with your chest facing the direction of pull. The load rope is at one hip and the brake strand is in the opposite side hand. To take in rope, pull in on the load rope with the guide hand and out with the brake hand. Grab both ropes above the brake hand with the guide hand and slide the brake hand back towards the body. To brake, pull the brake hand up and across the chest. The body belay can be used in either the sitting or standing position; however the sitting position offers a lower center of gravity and is preferred. It can also be used either in conjunction with an anchor or without. The advantage of the body belay is its speed and simplicity for belaying short sections where a climber is moving quickly. However, there are disadvantages as well. Because the force of a fall is dissipated as friction against the belayer's body, serious rope burns can occur to the body and hands, possibly causing them to lose control of the belay. It also generates less braking force and causes more slippage than other techniques, causing the climber to fall farther. For this reason it is only used on low angle easy terrain. The belayer must have a good braced position and must keep the rope tight.

Indirect Belays

An indirect belay is when a leader is anchored and belays the second off of the harness with either a Munter hitch or tube style belay device. This is commonly done by recreational climbers that haven't been trained in other techniques. While this does work, it has several drawbacks. It can oftentimes be quite awkward in the event of a fall that pulls the belayer down towards the ground, or when there is a climber who is struggling and hanging excessively on the rope. The belayer is forced to hold the rope in the brake position with much or all of the climber's weight pulling in a downward direction on their harness. In addition to this, should the belayer need to tie off the climber and escape the belay for any reason, several steps would be required to get him/her un-trapped from the system. For these reasons this technique is only preferred when using an anchor that is suspected to be weak. With a weak or bad anchor, the belayer's body in this case acts as the primary anchor with the other simply backing them up. Once again, a good braced position is necessary. The preferred technique otherwise is to always use direct belays.

Direct Belays

Belaying directly off the anchor allows any forces to be transmitted solely to the anchor so that the belayer does not get pulled in any direction and cannot become trapped in the system should problems arise. Direct belays are also generally more comfortable and give the belayer freedom to move about while maintaining control of the brake rope. This can be done either using a Munter hitch or using an autolocking style belay device in autolocking mode. In either case, the first step is to attach yourself to the anchor and shout "Off Belay!" Pull the remainder of the rope up until the second shouts "That's me!" Then use one of the following methods:

Munter hitch: Attach a pear-shaped locking carabiner to the anchor "hotpoint." Tie a Munter hitch in the climbing rope and attach it to the pearabiner so that the brake strand is between you and the load rope. Stand with your body facing the anchor and slightly sideways and take in rope while looking over your shoulder. You can then shout "On Belay!" letting the second know that it is safe to begin climbing. To take in rope, reach down and place your guide hand on the load strand and place your brake hand on the brake strand a few inches away from the Munter hitch. Both thumbs should be pointing towards the anchor. Holding firmly onto the rope, slide your hands towards each other until they meet. With the guide hand grab both strands of rope just beneath the brake hand then slide your brake hand back up to within a few inches of the Munter hitch. Slide your guide hand back down and repeat. This often takes a little bit of practice to get the hang of. One should be comfortable setting up for and using the technique facing in either direction. Belay the second up and have them attach to the anchor or move to safe location well away from the edge. An advantage of using a Munter hitch for this is that it is very quick and easy to tie and can also be used to easily lower the second back down if necessary. Care should be taken to ensure that the brake hand does not get so close to the Munter hitch that a thumb or finger could be sucked in and pinched during a fall.

Direct Belay with Munter Hitch

Autolocking Device: There are several different tube style belay/rappel devices that also have a separate autolocking mode that can be used when using a second locking carabiner. Two of these are the Black Diamond ATC Guide and the Petzl Reverso. With each of these, one locking carabiner is used to attach the device itself to the anchor and a second is used as a braking carabiner after the rope is fed through the device. The shape and orientation of the device allows rope to pass smoothly through it one direction, but lock off in the opposite direction, being pinched around the stock of the braking carabiner. To use the device attach it to the anchor with a locking carabiner in the appropriate spot. Then feed a bight of rope into the device paying close attention to the diagram on its side. Clip an additional locking carabiner around both the rope and the keeper, ensuring again that the brake strand is between your body and the load rope. Pull down on the load rope to make sure it is rigged correctly and locks off in the correct direction before shouting "On Belay!" NEVER USE A STANDARD MODE TUBE STYLE DEVICE TO BELAY DIRECTLY OFF THE ANCHOR! It is too difficult to maintain an appropriate braking angle when taking in rope with an anchor that is above you. To take in rope with a device in autolocking mode use the same technique described above for the Munter hitch. One advantage of these devices over the Munter hitch is that they do not require holding power on the part of the belayer because they lock off automatically, oftentimes allowing the belayer to multi-task at the anchor. They can also be used when using double rope technique or to belay two seconds simultaneously on two separate ropes. They are particularly useful in these situations or if the climbing is difficult and you expect the second to be hanging a lot. A disadvantage is that since it only allows rope to pass through in one direction it can be quite difficult to give "slack" or to lower a climber back down. See Belay Transitions.

Direct Belay with Autolocking Device

Extending from the anchor: With any direct belay it is also possible to belay out away from the anchor. This is particularly useful when the anchor is a ways back from the cliff edge, but you wish to be able to see the second as he/she climbs the route.

(1) One technique is to anchor yourself using the climbing rope and a clove hitch but extend this to where you can see over the edge, then simply operate the belay from a distance away.
(2) A second technique is to anchor yourself as described above, then tie a double figure eight in the strand of the rope coming from the backside of your clove hitch. The belay can then be established in this new extension of the anchor point.

Climbing Commands

All commands must be preceded by *other* soldier's first or last name.

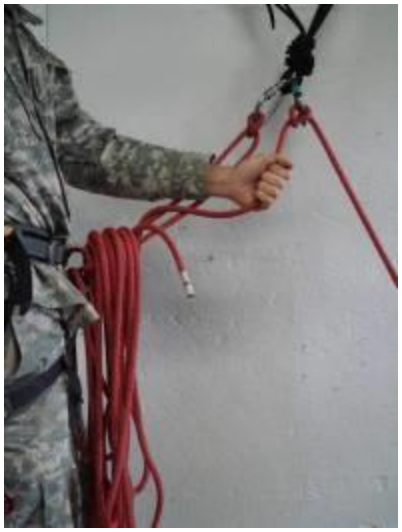
Leader	Second	Meaning
	"On Belay"	Everything has been inspected. I have established the belay. You can begin climbing.
"Climbing"		I'm beginning the climb.
"Slack!"		Feed out more rope.
"Take!" or "Up Rope"		Take in rope.
"Rock!"		Falling Object.
"Watch Me!"		I'm at a difficult section and may fall.
"Falling!"		Go immediately to the brake position.
"Off Belay!"		I've established a new anchor and have attached myself to it. Remove the belay.
	"Belays Off!"	I have removed the rope from the belay. It is free for you to pull up.
	"That's Me!"	The rope is tight with my anchor or tie-in point. You can establish the belay
"On Belay!"		You're on belay at the new anchor. You can begin climbing.
	"Climbing!"	I have begun climbing.

Rope management

Careful attention must be paid to ensure that rope taken in when belaying the second is stacked or coiled neatly to make the belay transition easy and to ensure that is does not fall down the cliff and get tangled or caught.

On Ledges: On small or large ledges it is usually possible to stack the rope in a neat pile as it's pulled through the belay. This allows for an easy transition and for smooth rope feeding.
At hanging stances: At hanging belay stances it may be necessary to stack the rope back and forth over your tie-in strand as you pull rope through the belay. If this is done, the rope should be looped back and forth in large bights (not so long as to becoming caught on things below you). If the second will become the new leader for the next pitch, these bights should start big and gradually get smaller. This allows the rope to feed out without becoming tangled during the next lead. If you are continuing to lead the next pitch you may have to restack the rope over the

seconds tie-in strand when he reaches the anchor. Another option is to stack the rope back and forth over a leg or foot. However, feet tend to get shifty when belaying during a long lead, which can lead to dropping the rope where it could possibly become stuck or jammed below you.



BELAY TRANSITION TECHNIQUES WITH AUTO-LOCKING DEVICE

It is very important that if a soldier chooses to carry and use an autolocking style belay device, he/she fully understands its inherent disadvantages and is trained on how to deal with these limitations.

Because autolocking devices only allow rope travel in one direction certain steps must be taken to give slack to the second, or to lower the second on the climbing rope.

Giving Slack on an unweighted device: Pull up and out on the braking carabiner with one hand while feeding rope out with the other.

Lowering the second a short distance on a weighted device: Use the braking carabiner to ratchet the second down by simply moving it in an up and down motion that pushes rope back through the device slowly. This often requires a larger stock carabiner and can only lower inches at a time; however works well if only a short lower is required.

Lowering the second a long distance on a weighted device:

(a) Girth-hitch a pre-joined sling or cordelette to the braking carabiner and redirect both strands of this material through a carabiner further back (oftentimes the shelf). Attach this sling to your harness with a carabiner. (b) Next, take the brake strand of the climbing rope and redirect it for the lower. (This could be using the same carabiner at the shelf or elsewhere). While holding onto the brake rope, apply full body weight in a down and outward direction to un-pinch the rope from against the braking carabiner. Begin the lower. Stop the lower at any point by stepping forward and taking your body weight off the system. The brake strand MUST be redirected as described! Watch for any hazards such as rope running over nylon slings or carabiner gates.

(a)

(b)

An alternate technique is to do the above procedure, but place a foot in and step down on the cord or sling material rather than clipping it into the harness. This may be necessary when you have limited space at your belay station and need to apply the force straight down.

*(A hands free back-up is NOT required with either of these).

Second Assist: To assist a climber through a difficult section, attach a friction hitch to the load rope. Redirect the brake strand into a carabiner in the friction hitch creating a simple 3:1 hauling system. (See advanced hauling systems) No ratchet hitch is necessary because progress is captured with the autolocking device. Haul as needed. If the climber is within the top 1/3 of the rope, a bight can be passed down directly to the climber. Have the climber clip the bight into his harness and pull himself up on the original brake rope while you pull on the hauling strand. In this way, both you and the climber work to get him through the difficult section or move.

Summary

Level II Mountaineers must be confident in the use of the various belay techniques for belaying both the leader and the second and should be very familiar with the specific characteristics of their chosen device.

ADVANCED CLIMBING TECHNIQUES

Intoduction

The soldier wishing to gain access to key terrain in the mountains may require movement through sections of steep 4th or 5th class rock. Here we will discuss both the use of ropes for safety as well as the fundamental movement skills required. Training and good overall physical fitness is paramount, especially for the soldier moving with a rucksack, weapon, or other equipment.

TYPES OF CLIMBING

There are several different terms used for types of climbing. A climbing route may involve more than one of these types, as some of these categories overlap. And some of these refer to types only used by civilian recreational climbers and are beyond the scope of this course. One must only be familiar with the various terms.

Technical climbing: When anchored belays are needed for the team's safety.

Free climbing: Climbing using your own physical ability to move over the rock via handholds and footholds, with the rope and protection used only for safety.

Aid climbing: Climbing with the use of protection as foot/hand holds.

Solo climbing: Climbing by oneself; either unroped or using rope-solo techniques for safety.

Traditional climbing: Climbing using only "clean" or "removable" anchors as protection. Usually cracks.

Sport climbing: Face climbing routes equipped with fixed bolts for protection and belay/rappel anchors.

Face climbing: Climbing using surface features of rock to move up, as opposed to cracks.

Slab climbing: Climbing usually lower angled face climbs with relatively few holds or features.

Crack climbing: Climbing natural lines of cracks on a rock face.

Cragging: Climbing short, usually one pitch, routes at developed areas with detailed guidebook information.

Multi-pitch climbing: Climbing routes that involve more than one "pitch," or a series of intermediate anchored belay points.

Big Wall climbing: Climbing large, sheer walls that often require extensive aid climbing, use of fixed ropes, haul bags, hanging bivi ledges, and one to several days to complete.

Alpine rock climbing: Rock climbing routes that are farther from civilization and require alpine route finding or glacier climbing skills and equipment.

SPECIAL EQUIPMENT

Footwear: On climbs of easy to moderate difficulty, the same mountain or combat boots worn on the approach will generally work for the actual climbing. When the climbing becomes more difficult, specialized footwear – rock shoes – give a significant advantage. Most rock shoes have flexible uppers, plus smooth, flexible soles and rands of sticky rubber. These soles create excellent friction when weighted on rock, allowing easy purchase on small holds or features. There are shoes designed with stiff-soles for edging; flexible shoes designed for smearing; and shoes with higher tops that cover your anklebones offering protection in cracks. However, none of these negate the need for good technique and it is best to find a pair with good all-around characteristics. Rock shoes should fit snugly, but should not cause any pain and should be able to be worn over a thin sock.

Clothing: Clothing should be comfortable and capable of handling changing weather conditions. Any load carrying equipment and personal combat gear worn over clothing should not restrict range of motion. Rings, bracelets, and watches should be removed so they don't get scratched or caught in a crack and damage your hands.

Tape: Athletic tape can be used to protect the back of your hands and knuckles from abrasive rock when crack climbing. This is advised for new soldiers learning crack climbing technique.

Chalk: Gymnastic chalk can improve your grip, especially in hot weather, by absorbing sweat. These are available as loose powder or in a mesh ball and are most often carried inside a chalk bag that can be clipped to the climbing harness.


ROCK CLIMBING TECHNIQUES

For efficient movement over rock, there is no substitute for good technique, which can only be developed through practice and experience. Good technique combines balance, footwork, and handwork with the minimum expense of strength necessary. Arm strength alone may get you up a certain section, but you will become fatigued quickly. The best option is a combination of strength, endurance, and proper technique. Whether it's long sections of technical scrambling or short sections of vertical terrain, a wide variety will give the climber a distinct advantage over the untrained soldier

General:

Climb with your eyes. Observe the rock. See where the holds are before attempting to use them. Look to the sides as well as up and down, to continually check where the holds are in relation to your hands and feet. Move in a smooth, deliberate manner. Avoid jumping and lunging for holds unless absolutely necessary.
Use footwork. Footwork is the foundation of climbing, giving you balanced positions and requiring less exertion than handwork. Leg muscles are stronger than arm muscles and should provide the majority of the power. Climb with your feet and legs. Look for footholds that are comfortably spaced. Shorter steps take less energy than higher steps and allow for better balance. Try to keep your body weight centered over your feet, as the resulting down pressure helps keep your feet on the holds. Avoid "hugging" or leaning into the rock. When possible move from foothold to foothold as if you were going up a ladder, using your hands for only balance. Use your hips to shift your balance from one foothold to the next.
Maintain three points of contact whenever possible. This is especially important for beginners. This can be two hands and one foot or one hand and two feet. Keep your balance over your feet until you release a hold to move to the next one.
Check for Loose holds. Loose holds are common in the mountains and can cause a climber to fall or seriously injure your belayer or other soldiers below you. Be alert for fracture lines and gently nudge or test a suspect hold before applying full body weight and be sure your testing does not actually dislodge the rock. A hollow sounding rock is usually loose.

Face climbing:

Handholds: Beginning climbers-and experienced climbers when they are scared- have a tendency to over grip. Over gripping can bring on a "pump" that can be difficult to recover from. Once your strength is drained your technique follows. Use the lightest possible grip to stay on the rock and make progress. With a handhold you may have the choice between pulling down, sideways(*side pull*), or pulling up (*undercling*). Pulling down feels natural and is often the best choice, however sometimes a hold will be oriented for a sideways or upward pull and you may be forced to use it this way to reach a faraway hold. On steep sections, keep your arms as straight as possible especially when stationary so you are hanging from your skeletal system

rather than your rapidly tiring bicep muscles. Holds can be many different sizes. Large holds with incut edges that allow your entire hand to be cupped over the hold are known as "j*ugs*" or "*buckets*." Other holds may allow only room for your fingers or finger tips and require better strength and/or footholds to use them. Smaller holds may be used with a "*crimp*" grip, putting your fingertips on the edge with your first knuckles higher than the tips and then tucking your thumb over the index finger. On sloping holds the "*open*" grip may be required, which relies on skin to rock friction. A "*pinch*" grip can be used on small knobs by pinching it with your thumb working in opposition to your fingers. In small pockets or holes it may be possible to use only one or two fingers to hang on with.

Downpull

Crimpgrip

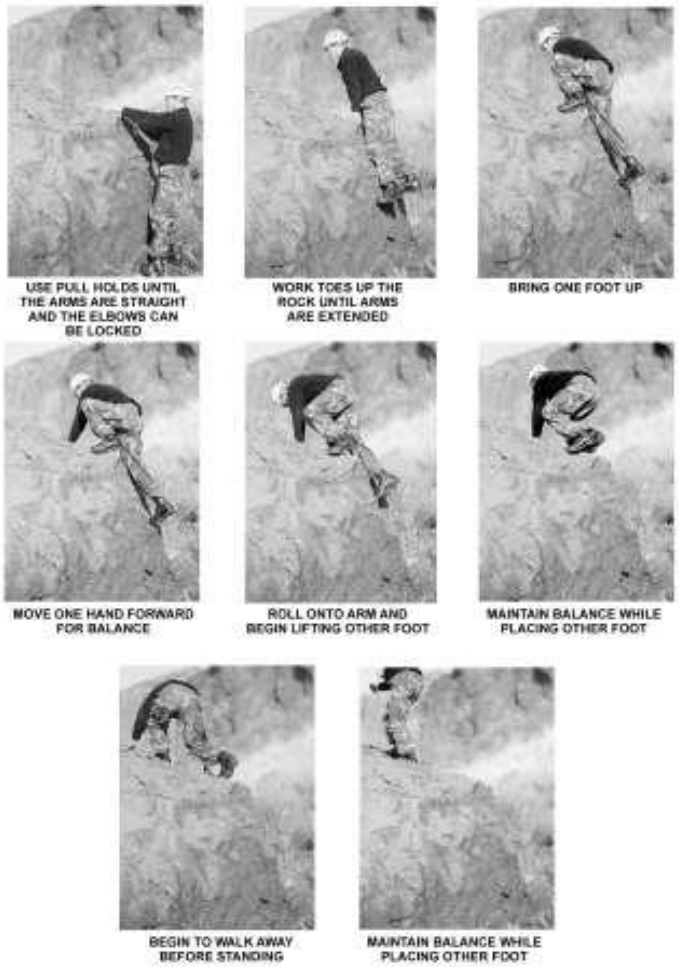
Bucket or jug

Sidepull

Footholds: Climbers use most footholds by either "*edging*" or "*smearing.*" To "*edge*" weight the edge of the shoe sole over the hold. Either the inside or outside of the edge can be used but the inside is preferred for greater ease and security. The ideal point of contact is between the ball of your foot and the end of your big toe. To "*smear*" paste the sole of your boot or shoe over the hold. On lower angle rock you may not even need a hold to smear. When using footholds make the best possible use of direction of force. Flexing you ankle can increase surface area in contact with the rock. Sometimes leaning away from the rock creates inward as well as downward pressure on the hold, increasing security; however is sometimes more tiring. On bigger holds place only as much of your foot on the hold as is necessary to maintain balance. Avoid using knees, which are unstable and prone to injury.

Downpressure: For downpressure, place your fingertips or the palm, side, or heel of your hand on a hold below you and push down. Holds are often used by pulling down on them and then as you move above them push down on them. These can be used by themselves or in combination with other holds.

Mantel: The mantel uses downpressure to allow you to get your feet up onto the same holds your hands are using when no good hand holds are available higher. Walk your feet up the rock until you can place both feet on the holds and push down then raise your body up on stiff arms. With one foot up on a hold, stand and reach for the next hand hold.



Stemming: Stemming is a valuable technique that lets you support yourself between two spots with your feet reducing the force necessary to hold yourself up with your arms. This uses the counterforce of your feet pressing outward to your sides and opposite each other and can often be used when very small or no footholds are present.

Hopstep: If you need to move one foot onto a small hold already occupied by the other foot place both hands on holds that provide a balanced position and use the hopstep to switch feet.

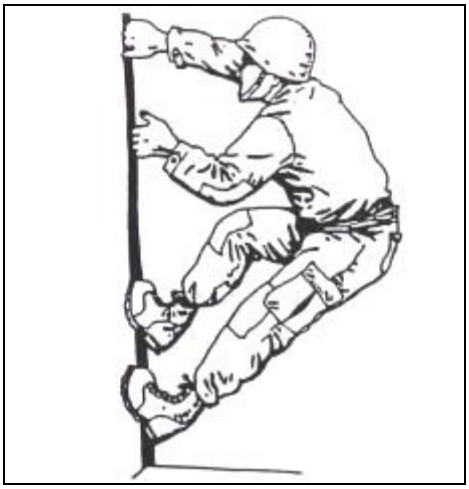
Crack climbing:

Jamming: Jamming is the best technique for crack climbing. To jam place a hand or foot into a crack, then turn your foot or flex your hand so that it is snugly in contact with both sides of the crack. Cracks may be climbed with pure jamming technique with both hands and feet, or in combination with other types of holds.
Hand cracks: Insert your entire hand, cupping it and pressing downward with the thumb as needed to provide adequate expansion against the walls of the crack. The hand jam can be done either thumb up or thumb down. Thumb up is often easiest and most comfortable for vertical cracks and works well when your hands are low. The thumb down technique allows for secure reach in a high jam because your hand can be twisted for better adhesion and you can lean in any direction. It is best to use a combination of both. Keep your forearm generally parallel with the crack and keep direction of force in a downward direction, rather than outward. Hand cracks are also great for foot jamming. Slightly wider cracks may require you to use a "*fist jam"* by first making a fist before placing it in the crack.



Finger cracks: In very narrow cracks it is often possible to create a finger jam with however many fingers will fit. These are usually done with the thumb down. Once again keep your forearm(s) as close to parallel with the crack as possible. Finger cracks are rarely big enough to accept your foot, but there is often room for your toes. You can turn your foot sideways and insert your toes then twist your foot to jam it. Smearing and friction also work well for your feet when climbing finger cracks.

Liebacking: Liebacking uses hands pulling and feet pushing in opposition as you move upward in shuffling movements. This is often used in crack climbing and is a strenuous technique. Grasp one edge of the crack with both hands and lean back and to the side, away from the crack, on straightened arms. At the same time, push your feet against the opposite wall of the crack. Walk your hands and feet slowly up the crack.

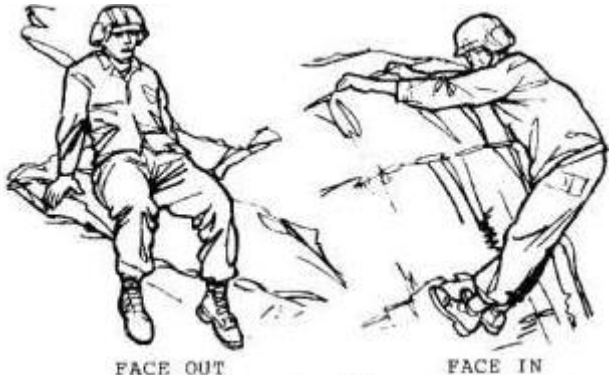


Chimneys: A chimney is any crack big enough to climb inside. The technique is to span the chimney with your body using counterforce against its walls to keep from falling. The position and technique will vary depending upon your size, the size of the crack, and whether or not you are wearing a pack. There are many techniques that can be used to climb chimneys, and all of them are strenuous.

Other:

Overhangs and Roofs: When negotiating overhangs or roofs stay in balance and conserve energy. Identify handholds early and make the most use of footholds by keeping your feet high and your hips low and in. Move quickly to minimize time spent in strenuous positions.
Traversing: Going sideways across the rock calls for a wide variety of techniques. Good balance

and being aware of your center of gravity are especially important.
Downclimbing: Downclimbing is useful in many situations, especially in the mountains, where it is sometimes faster, safer, and easier than establishing anchors and rappel points. However, holds are generally more difficult to see and it can be difficult to test holds before committing to them. Keep your hands low and use downpressure whenever possible. Keep your weight over your feet. On lower angle rock, face outward for best visibility.



LEAD CLIMBING TECHNIQUES

The lead climber accepts the responsibility of determining the best route and also accepts the higher risk associated with bigger fall potential. The lead climber must be well trained, confident, and must stay within their limits.

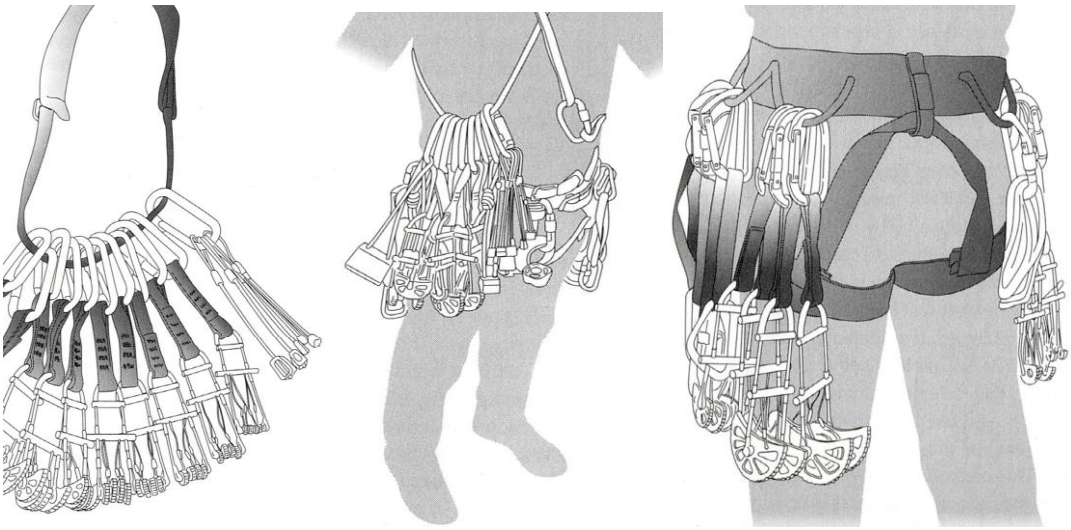
Racking Equipment for a Lead Climb

The amount of protection the lead climber brings will depend upon personal preference, skill level, and the route itself. Highly skilled climbers may get by with only a few pieces of gear while a less skilled leader may carry a much bigger, fuller rack of protection. Once on the climb, what you have is all you've got. Bringing too much gear can weigh you down and make the climbing more difficult; bringing too little can make the climbing dangerous with skimpy, spread out protection or belay anchors. It is best to always study the route in advance if possible to determine how much may be necessary and/or any special gear requirements. Experienced climbers organize their racks meticulously so they can find the right gear quickly. Cams are typically grouped by size and carried on a few carabiners or carried by size in order, each on its own separate carabiner. Chocks are usually carried all on a single carabiner or, if more than 10 or so are carried, can be grouped small and large on two carabiners. Which method is used will depend upon the situation and on personal preference. In addition to the protection, the climber will need several "*runners,*" or slings with two carabiners on them used to extend the protection for clipping the rope. Some runners are extendable, typically over-the-shoulder length, and are made of pre-sewn thin tubular webbing. These are set up by attaching two carabiners to the sling. One carabiner is then passed completely through the other carabiner and then clipped back into the newly formed loop and straightened. This allows it to be used as is, or extended out when more extension is needed. To extend the runner out, simply unclip one of the carabiners and clip it back onto only one strand of the loop and pull it all the way out.
"Quickdraws" are short, non-extendable pre-sewn runners that are typically less bulky than other types. Often a combination of quickdraws and extendable runners are used.

Runner

Quickdraw

Cams, chocks, and runners can be carried on an over-the-shoulder sling, on the harness gear loops, or on both. Small racks can be carried entirely on the harness, whereas larger racks may require the use of both. One advantage of using a gear sling is that it can be switched or moved from side to side to keep it out of the way when necessary or to access gear with either hand. The ideal racking method permits the leader to place protection efficiently and climb without awkwardness. However, the method used will depend upon personal preference and also on the method in which personal combat equipment is carried. Climbing equipment used in conjunction with personal combat equipment can be bulky, awkward, and cumbersome at best. One or both of these may need to be modified if necessary.



Leading and Protecting a Climb

Placing protection: When beginning a lead, climb up as high above the ground as you feel comfortable and then place your first piece of protection. This may be six feet up if there's a hard move near the ground or 15 feet up if the climbing is easy. Or it may depend on availability of suitable places to place protection. If the belayer is positioned away from the base of the climb the first piece should be multi-directional anchor, such as a cam or a chock placed so that it can resist both a downward and an outward force. This is to prevent the piece from being pulled out in the event of a fall on a higher piece due to the angle of the rope coming from the belayer. When placing a cam first look at the crack and decide which cam will fit. Then reach

down and grab the carabiner with the cam and place it into the crack. If hanging on with one hand due to lack of a good stance it may be necessary to set the piece in your mouth momentarily in order to readjust your hand position on the trigger. To place a chock, grab the carabiner with the chocks and select the appropriate size. Place this chock in your mouth and then reposition your hand on the cable. Place the chock then remove the carabiner with the remaining chocks and place it back on your rack or harness, taking care not to drop any of them while the carabiner gate is open.

How often to place protection: Good judgment is important. Placing lots of protection keeps the climbing safer, however placing too much depletes time and energy, and can use up your whole rack before the end of the pitch. You must be constantly aware of the hazards of falling and place each piece where it counts. "Running it out", or climbing long distances between points of protection, is dangerous.

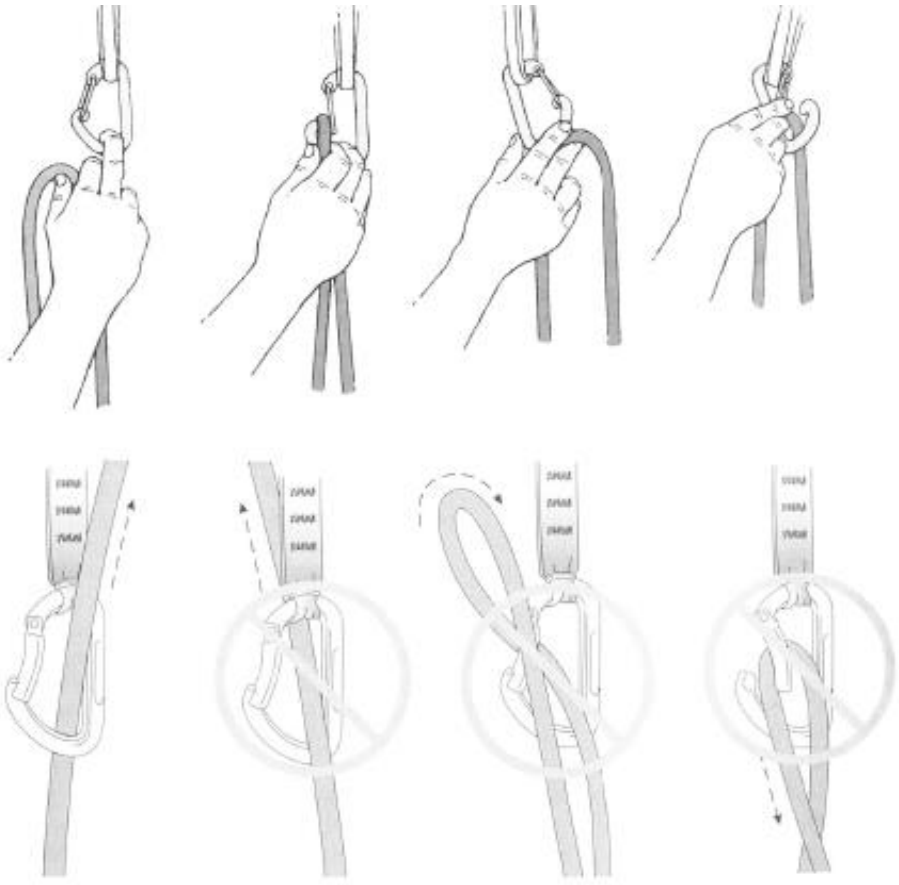
What are the chances of falling? If the chances of falling is almost zero because the climbing is easy and the rock is solid, you can often justify climbing farther between pieces of protection. If the chances of falling are high because the climbing is difficult or the rock quality is poor, install protection more often.
What are the consequences of falling? If the rock is so steep that there's nothing to hit in a fall, then you may be able to run it out a bit more. However, if there is a possibility of bouncing off of or hitting rock/objects during a fall you must place protection to help prevent or avoid this.
How far is it to the last piece? It is generally dangerous to routinely climb more than 15 feet above your protection, even on easy terrain, and should be avoided when possible.
How solid or secure is the last piece? If pieces below are poor or suspect, place something better as soon as possible.
Is good protection readily available? Some climbs will just have less suitable spots to place protection than others.
How urgent is speed to the mission? Some situations where speed/efficiency is important may not afford the time to place lots of protection.
Is the pitch safe for the second climber? While in most cases the leader assumes much more risk than the second, dangerous situations can be created for the second during traversing pitches if not protected adequately.
How big is the rack? There are times when it may be necessary to conserve gear while climbing, especially during long pitches, or on cracks that are the same width for long stretches. You may need to vary the sizes of protection you use to preserve pieces for higher on the pitch.
What is your confidence level? Fear while climbing can drain a lot of energy and cause awkward movement. A good piece of protection can give you the confidence to make a hard move.

Protecting Moves

Set good protection just before starting a difficult move if possible. Getting into a section of difficult climbing with protection far below you, then trying to fiddle with gear, wastes strength and confidence. Try to set protection from good stances or holds. Move quickly through the difficult section and then place better protection once you get to easier ground. If it's a long section of difficulty, you will need to protect in the middle of it. In this case, try to protect from the least pumpy holds or from places where you can place gear quickly. You can also ask for "tension" from your belayer when pumped to hang from a point of protection and rest on the rope before proceeding further.

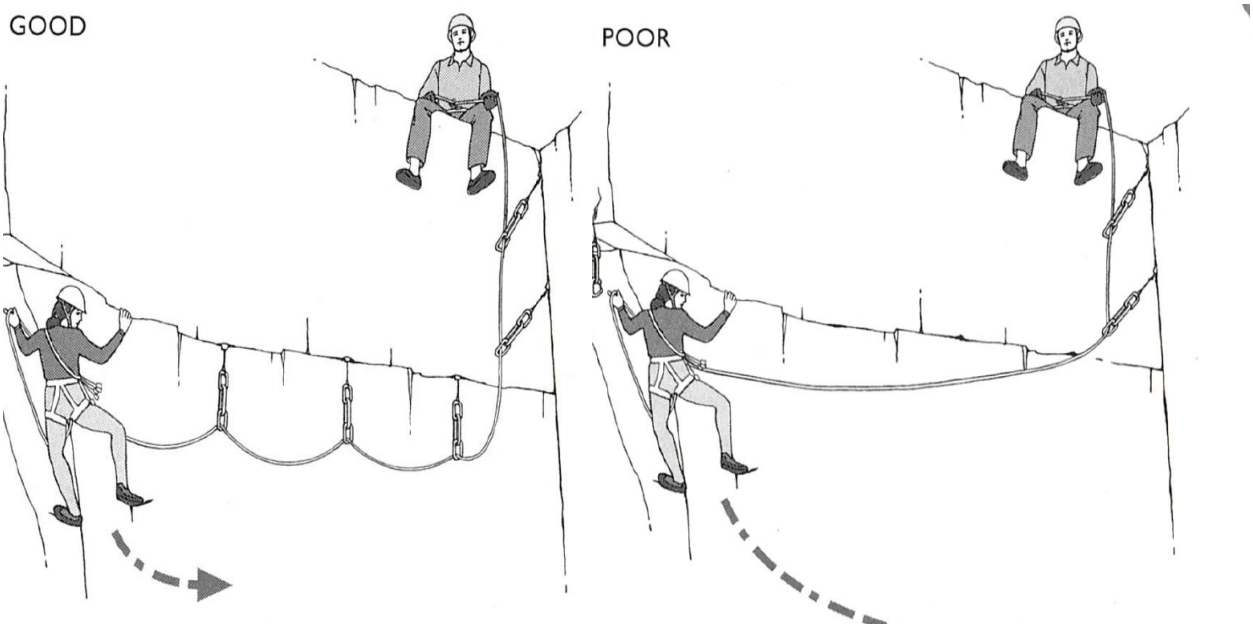
Clipping the Rope

To clip the climbing rope into a point of protection reach down and grab the rope between your thumb and index finger. Use you middle finger to stabilize the carabiner at the protection or runner and your thumb and index finger to clip the rope in. Alternately, the rope can be held between the middle and index finger and clipped in as shown below. Care must be taken to ensure that the gate of the carabiner faces out (not towards the rock) and that the rope is clipped in the direction of travel to prevent the rope from potentially becoming unclipped in a fall. Many pieces, depending on the pitch, and all chocks should have a runner or quickdraw attached to it. The rope will, therefore, be clipped into the bottom carabiner of the runner or draw. Recreational climbers will typically do all their clipping while hanging onto rock holds as much as they can, however, as a soldier not worried about preserving the "free climbing" style, you can often simply grab the point of protection and hang onto it while you clip the rope and/or runner into it. This may give you a better hold momentarily, or provide a much needed rest.



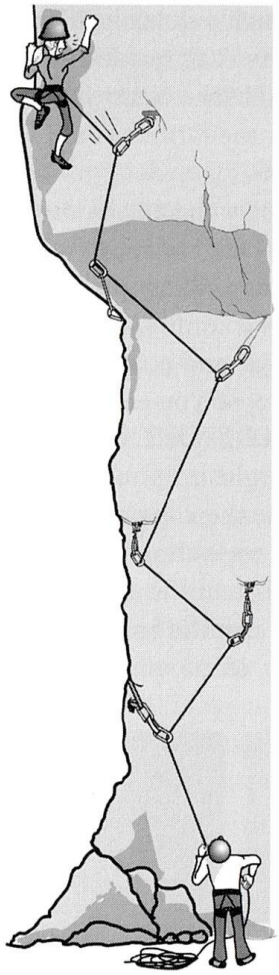
Protecting the second

It is very dangerous to run it out sideways on a climb without placing protection, especially on difficult sections. If the second falls at the tricky spot he'll take a pendulum fall. This sideways swing can cause him to smash into the rock or damage the rope as it slices across. Protect often during a traverse, especially before and after difficult moves.

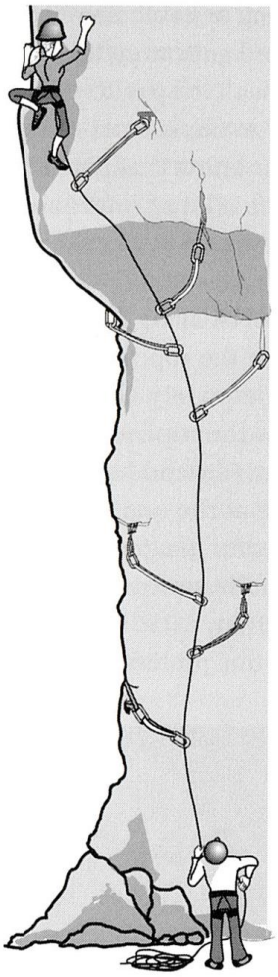


Extending the protection

Each bend in the rope adds rope drag, or increased friction of the rope running across the carabiner gate on its way to the next protection point. If you don't adequately extend your protection to allow the rope to run straighter, the drag gets heavier and heavier until you can barely move at the end of a pitch. Or worse, if you fall, the sideways and outward pulling of the rope can dislodge protection. And the longer the pitch, the worse this hazard can be. Extend the protection by using slings or quickdraws to keep the rope running in as straight a line as possible. The advantage of the shoulder length slings is that they can be used doubled when only a little extension is necessary or single when more is needed. Sometimes it may be possible to down-climb a move or two to unclip and lengthen out a sling when needed. It is important to note that the increase in length of slings does result in a longer fall. On straight-up pitches with continuous cracks it is often possible to clip the rope directly to the nylon slings of the cams or into short quickdraws on chocks because there is little chance for rope drag. Extending protection may also be necessary to prevent the rope from being pulled tight over a sharp edge, such as when climbing up and through a roof or sharp bulge.



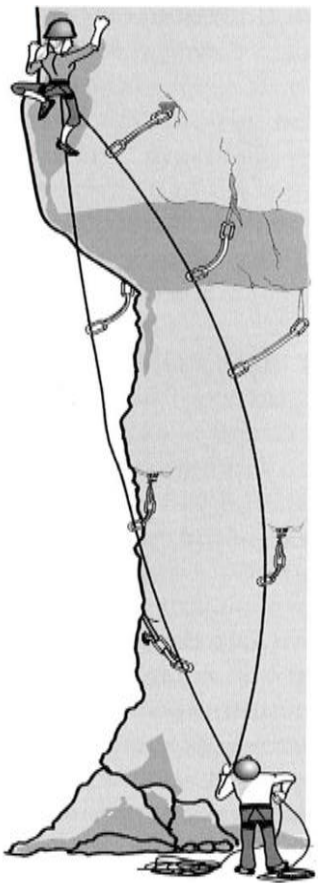
Bad rope drag



Good extension

Double/Half Rope Technique

Climbers commonly use a single rope for leading because it's the easiest rope system to manage. Double/half rope technique uses two ropes that serve as independent belay lines. Each rope (two different colors) is referred to as a "half rope," and is marked by a "1/2" symbol on the end, and is usually between eight and nine millimeters in diameter. The leader clips each rope into its own protection on the way up and the belayer manages the ropes separately. Although this technique is more complicated than using a single rope, it does offer some advantages. With a series of zigzagging protection placements the rope can be clipped into protection alternately or separated left and right, allowing the ropes to remain relatively straight and reduce rope drag without needing long slings for extension. It also has the advantage that two strands of rope are more difficult to cut over a sharp edge than one. The system also gives you two strands of rope for rappelling, possible negating the need for a multi-pitch rappel or use of a tagline. On the downside, the belayer's job is more complex, handling the separate movements of two ropes at the same time, and climber must pay more attention to how the ropes lay.



Double/Half Ropes

Hauling Lines

In cases where heavy rucks or equipment are carried, another option is to use a separate haul line to pull additional equipment up once at the top of the pitch. This could be lighter-weight and thinner in diameter than the climbing rope. It should be dragged up by the leader with the opposite end attached to the load to be hauled. Special attention must be paid to the way in which the load is attached to the rope and to any drag or friction that could damage the load during the hauling process. In most situations it is best for the leader to first haul up the load prior to belaying the second. In this way, should the load become stuck for any reason, the second may be able to pry it loose.

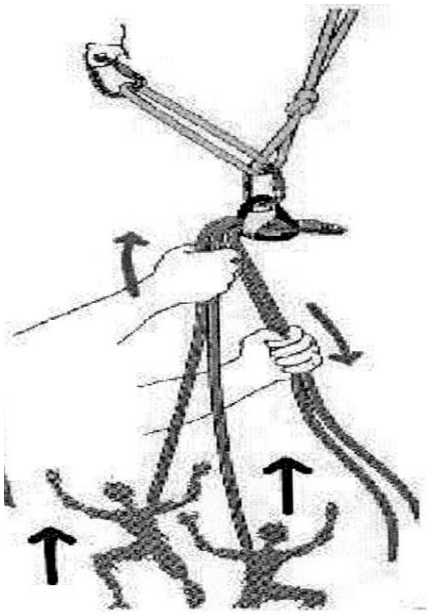
Climbing in a three person team

Climbing in a three person team is generally more awkward and less efficient than in pairs, however it has the advantage of having an extra man for hauling, rescue, pulling security, etc..Two ropes are required unless pitches are less than half the length of a single rope.

(a) *Using ropes sequentially:* In a team of three the leader would lead the pitch, establish a belay anchor, and belay the second person up. The second climber would have the second rope tied or clipped into his harness. Upon reaching the top of the pitch the third climber could then be belayed on the second rope. In this case, while climbing, the second would unclip his rope from the protection and re-clip the third person's rope into it. It is important

for the second rope to remain in the protection unless the rope runs straight up and there is no traversing or pendulum possibility.

(b) *Using two ropes simultaneously:* With this technique the leader ties into both ropes while the second and third climbers each tie in to one of the other ends. The leader climbs the pitch, belayed on one or both ropes (both if using half ropes). At the top of the pitch the leader can then belay each climber up one at a time or both simultaneously with an auto-locking device. This technique takes more rope management, but in this way three climbers can ascend nearly as fast as two.



Backing off

There are times when due to the difficulty of the climbing, the availability of adequate protection, or both, the leader may make the decision to discontinue the ascent and return to the ground and look for other possibilities or safer routes to the top. This is known as “backing off.” Sometimes it may be possible on easy terrain to down climb while the belayer takes rope back in and remove the protection as you go. Other times, if the down climbing is very difficult and the climber has used less than half of the available rope, it may be necessary to have the belayer lower the leader off of his/her last(highest) good piece of protection and remove the remaining pieces on the way down. The climber, in this case, may choose to leave two top pieces or create an equalized anchor point to prevent the potential of groundball if a single piece were to fail. Whatever is lowered off of will remain in place unless the team is able to rappel down from above and retrieve it later on. If the climber has already used more than half the available rope and cannot down climb it may be necessary to construct an anchor, attach to it, have the belayer remove the belay, then set up to rappel down. Climbers must be familiar with various techniques for retreating from a climb.

Attaching to the Anchor Point

Upon establishing the belay anchor the leader must first attach him/herself to this anchor point before pulling the rope(s) up and setting up the belay. The following are the two most common techniques:

(a) Long sling or daisy chain: A long sling or daisy chain can be girth-hitched to the harness and then attached to the anchor hotpoint with a locking carabiner.
(b) Clove hitch: A clove hitch can be tied in the climbing rope coming from your harness and clipped into the anchor with a locking carabiner. The advantage of using this technique is that it allows you to quickly and easily adjust your distance away from the anchor. This is especially useful when extending out towards the edge of the cliff for better communication with the second climber.

Seconding a Climb and Cleaning Protection

In the case of difficult climbing it is often easier and faster for the second to climb the rope itself rather than be belayed from above by the leader (See Adv.Fixed Ropes). Here we will assume that the climbing is easy to moderate and is faster than rope ascending. The second climber should climb as quickly and efficiently as possible. While ascending, this second climber cleans the protection and organizes it for efficient transfer at the end of the pitch.

(1) First remove the protection from the rock.
(2) Unclip the carabiner from the rope and carefully transfer it to the gear sling making sure not to drop it.
(3) If runners or quickdraws were used for extension, hold the carabiner that's connected to the protection and clip this carabiner and protection/sling combination directly to your gear sling or harness. Then unclip the bottom carabiner of the runner from the rope. This allows the gear to not hang down too low as you proceed.
(4) If the climbing is difficult or pumpy the second can simply remove the protection from the rock and let it hang on the rope as he moves quickly through a section. Then organize it when in a better stance.
(5) Upon reaching the top of the pitch, safety into the anchor point.

MULTI-PITCH CLIMBING

Multi-pitch climbing is any climbing that, due to the length of the climb, requires multiple leads with one or more intermediate belay positions. While advanced fixed rope techniques can be used in a multi-pitch setting, here we will again assume that both the leader and the second are using standard techniques for climbing and belaying.

When using intermediate belay/anchor points during a climb, the climbing team must use efficient organized techniques to manage the rope and transition from one belayed lead to the next while ensuring that both or all members of the team are safe at all times. The difficulty of the pitches, and the experience and ability of the climbers will determine who will lead which pitches. Sometimes the more experienced or stronger climber assumes all of the risk by leading every pitch. Other times, two climbers of roughly equal abilities may swap leads, with one climber leading odd pitches and the other leading even pitches.

Belay Station Transitions

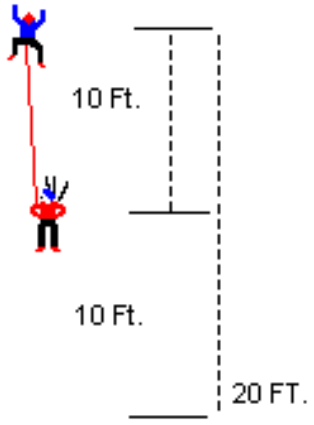
As the second climber arrives at the belay station he will attach himself to the anchor and say "Off belay." The leader can then remove the belay. At this point several things need to take place, but the order in which they are done may depend upon the leader's personal preference or on the situation. The rope must be back- stacked so that the leader's end feeds smoothly off the top of the stack. On bigger ledges, if care was taken when taking rope in during the

previous belay, it may be possible to simply flop the entire pile like a pancake. When in doubt, back- stack. Next, the protection cleaned by the second must be transferred back to the leader. This handoff must be done very carefully, especially as both climbers are working quickly, to ensure that nothing is dropped. One option is for the second to clip all gear onto the leader's anchor strand of rope, between his tie-in and clove hitch and allow the leader to unclip them and organize them at his own pace. This is also the time when both members can eat/drink etc...It is typically possible to carefully remove packs or other equipment and clip them into the anchor point during this process. Once these tasks are done, the belayer can then put the leader back on belay. The leader then removes his attachment to the anchor and begins the next lead.

If the team is *swapping* leads the first leader simply hands over the gear sling to the second, who becomes the new leader. Here the rope may not need to be back- stacked because his end should already be feeding off the top of the pile. Once the climber begins the lead, the belayer remains attached to the anchor until the leader has established the higher belay, pulled the rope tight, and said "On Belay!" Only at this point can he dismantle the anchor and begin climbing.

Fall factor

During a lead fall, you gain kinetic energy as gravity accelerates you body toward the earth. Ideally, your dynamic rope absorbs that energy rather than your bones. The amount of energy produced in a fall depends upon the climber's weight, the elasticity of the rope, rope drag, and the fall factor. This energy is referred to as impact force. Fall factor is determined by dividing the length of the fall by the amount of rope out (between the climber and belayer). In theory, a very short fall and a very long fall with the same fall factor will create the same amount of impact force, regardless of the length, because the longer fall has much more rope to absorb the energy than the short fall. (This assumes equal weights, belays, and rope properties.) Obviously, the longer fall may be more dangerous because there's a greater chance of hitting things, but the impact force generated is no worse. When leading off of flat ground you begin with a fall factor of 1. Each time you place protection and clip the rope into it, you reduce the length of the fall, thereby reducing the fall factor and potential impact force. Also as you climb higher you get more rope into the system, which further reduces fall factor and impact force. Rope drag also reduces fall factor by increased friction, however, is not a reasonable technique for doing so; It is better to extend protection. The worst case scenario is a fall factor of 2.



Fall Factor = 2

Avoid the Factor 2

As the leader leaves the belay on multi-pitch climb, he is in a situation where it's possible to create a *factor 2* fall. This is when the climber falls twice the distance as the amount of rope that it is in the system (between the climber and belayer's belay device), in this case coming to a stop below the belay anchor point. This is the worst case fall, and with a very short amount of dynamic rope to absorb this energy, the belayer and belay anchor are forced to take the majority of the impact force. Therefore, the climber must place a good, solid piece of protection as soon as possible when leaving the belay. Equally important is that if there is any chance at all of falling before getting that first solid piece, the climber should clip the lead rope into the anchor itself. This reduces fall factor slightly, but more importantly changes the direction of pull on his belayer to upwards and towards the anchor. Without this, a factor 2 fall would twist the belayer's body around and pull his harness and belay device down and towards the falling climber, probably causing loss of control of the belay.

Clipping an immediate first piece of protection

AID CLIMBING TECHNIQUES

Aid climbing is the technique of using artificial protection to support your weight as you climb. It can be as simple as pulling on a piece or as complex as climbing an entire route with your weight suspended from artificial protection. Aid climbing is a valuable skill for the trained soldier to overcome difficult sections of climbing or easier sections in bad weather or with heavy equipment.

Improvised Aid Climbing Techniques

While there are many complex techniques and special equipment that can be used when aid climbing long routes, here we will focus on simple and improvised techniques using a standard rack and equipment that can be used to get quickly through short sections.

Pulling on Gear: Simply placing artificial protection and pulling on it with one or both hands can be used as a quick way of gaining some distance. It may be used to reach the next higher hand

hold. Some pieces may only be solid enough to apply body weight to but incapable of holding the forces of a fall and may be used as a temporary hold and removed once a higher hold or better point of protection is reached; others may be solid for both and can be also clipped with the climbing rope. The climber may choose not to leave every solid piece in place as protection if it is necessary to conserve gear for higher up. This will be determined by the situation, the size of the rack, and the type of equipment carried. If a piece is placed overhead, it is very important to first test it by weighting or bouncing on it before clipping the rope into it so that there is not additional unnecessary rope slack in the system if the piece pulls out.

Standing on Gear: Standing on gear is often a reasonable way to gain height or to reach better holds or placements that were previously out of reach. Some types of protection can be stood directly on, or a more common technique is to attach a long sling or cordelette to a piece with a carabiner and stand in this loop. This loop and carabiner should be chained to the carabiner of the gear whenever it is a piece that will remain in place and used as protection for the lead.

Etriers: Etriers are ladder-like slings with several steps that can be clipped into gear and stepped into. These can be purchased commercially or made from 1" webbing. A common technique for building an improvised etrier is to use a cordelette. Next to the joining knot tie a double overhand knot big enough for a carabiner. Then tie a series of double overhand knots beneath this with slack pulled up from a single strand to form each loop big enough to step in. Pull up the slack on the opposite strand each time so that the foot loops formed oppose each other. Four or five steps are usually created. Place a carabiner in the top small loop. This is then clipped into the gear before being stood on. If the gear is to be left in place as a piece of protection for the lead, the etrier carabiner should be chained directly to the carabiner in the protection. This prevents carabiners from becoming pinched or trapped. Aid climbers often use two etriers (one for each foot) when aiding long sections or climbs. Use the highest step possible to achieve the most gain in height.

Etrier

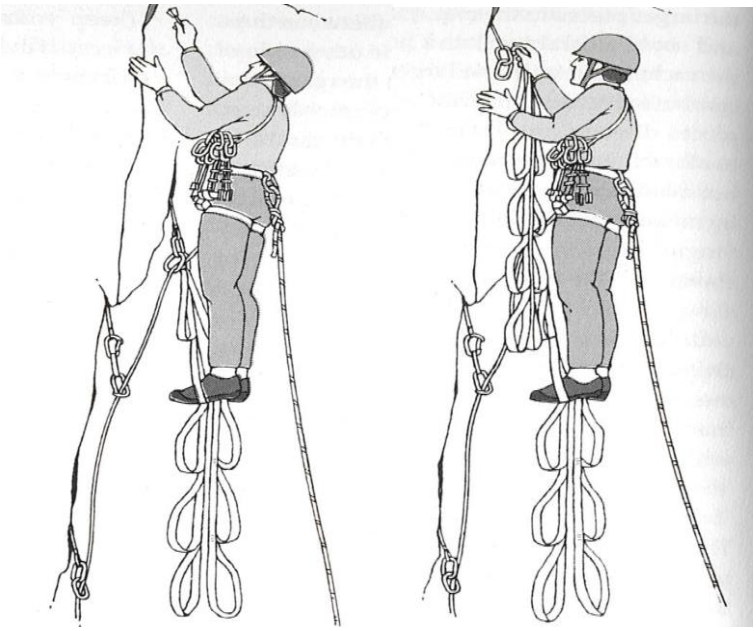
Daisy Chains: Daisy chains are sewn slings with multiple loops formed by stitching every 3-6 inches. These are typically 45 to 55 inches long and are used both to clip into and hang from gear placements and to keep placements and etriers attached to the climber. They can also be used to adjust ones hanging position from a piece when used in conjunction with a fifi hook. Daisy chains can be improvised using long slings or cordelettes.

Daisy Chain

Fifi hook: A fifi hook is a small hook attached directly to the harness that can be set directly into an aid piece or into one of the sewn loops of a daisy chain, allowing you to rest on your harness. A nonlocking carabiner can be used in place of a fifi hook, preferable the “keylock” type that have no pin and notch that can get hung up on the loops of a daisy chain.

Fifi Hook

General: Aid Climbing can be very strenuous and exhausting work and mentally taxing as well, constantly standing and pulling and evaluating the strength of placements. Good aid climbers use a combination of balance, organization, and good placement skills to work as efficiently as possible. Aid climbing is generally much slower than “free” climbing whenever it involves more than simply pulling on a piece. Therefore it’s best to switch back to “free” techniques as soon as possible. When switching to free techniques clip any etriers, daisychains, etc…to the back of your harness where it is out of the way but accessible it it’s needed later.



Traditional aid climbing technique

Seconding: It may be possible for the second to aid through as well, but may be quicker for the leader to fix the rope and for the second to use rope ascending techniques and clean the protection along the way.(See advanced Fixed Ropes)

ADVANCED FIXED ROPES

Introduction

The installation of fixed ropes is one of the most essential skills of the advanced mountaineer or assault climber, allowing for the movement of soldiers through complex or dangerous terrain that may otherwise be unusable. Depending upon the terrain and the situation, fixed ropes can be climbed using rope ascending techniques, clipped into for safety, or simply used as hand lines to make movement quicker and easier. They can be simple fixed ropes only tied off at the top of the dangerous section, or complex fixed ropes using multiple rope sections and anchor points. While basic military mountaineers can be used for the construction of fixed ropes on short sections of 3rd class terrain, the advanced military mountaineer is responsible for the installation of both simple and complex fixed ropes on 4th and 5th class terrain. These can be established from the top down, or from the bottom up as a two man team using lead climbing techniques. While each of the techniques discussed is different in procedure, the resulting product is essentially the same.

FIXING A ROPE ON RAPPELL

Fixing a rope from the top is often the easiest and safest method to use when establishing complex fixed ropes on steep terrain and allows an individual to work alone. However, safe and easy access to the top is required. To fix a rope on rappel, anchor the rope at the top of the route, and set up for an extended rappel with an autoblock. Ensure you have adequate anchor building material and that the rope reaches the ground at the bottom. Add an additional girth hitched sling to the harness to clip into intermediate anchor points during the descent. Rappel down and establish an intermediate anchor point where necessary. If there is not good footing at the anchor point, use the additional sling to attach yourself to the anchor point. This will allow you to un-weight the rappel device and gain enough slack above it to secure the rope to the anchor point. Secure the rope using a clove hitch or double figure of eight. Unclip the additional sling and continue rappelling to the next anchor point. Each section of the fixed rope should have enough slack to be completely independent of the section below it when weighted. The number of intermediate anchors used and the distance between them will be determined by transition stances, training, available equipment, and ascent technique to be used by follow on troops. Standard non-locking carabiners are acceptable to use here because each anchor point, while redundant and solid, is also backed up by other anchors above or by the top anchor.

LEADING AND FIXING A ROPE ON RAPPELL

In this scenario, the installation team will use a single dynamic rope to lead the climb and then fix the route on rappel. This requires a two man team consisting of a lead climber/fixer and a belayer. The lead climber must lead the route to gain the top, clip into the anchor point with a girth-hitched sling and locking carabiner and say “Off Belay!” He will then anchor the end of the rope, transition to a rappel with autoblock back-up, and fix the rope as discussed above.

LEADING AND FIXING USING TWO-ROPE TECHNIQUE

In this scenario, one dynamic climbing rope is used to safely gain the top of the pitch, while separate installation rope(s) is fixed in place. Fixing using a separate installation rope is an appropriate technique for fixing multiple pitches, or when both members of the team must end up on top. This technique also saves the dynamic lead line for use elsewhere. In this case there will be a leader and belayer/fixer. The leader will attach one end of the separate

installation rope to himself prior to beginning the lead. This rope will simply be dragged to the top and will only be clipped into protection at major direction changes to keep it within reach for the fixer. Upon reaching the top the leader will establish the anchor point, attach himself to it and say "Off belay!" He will then pull up any excess slack in the installation rope and attach it to the anchor point using a munter hitch. The munter hitch will prevent the excess installation rope from falling down the cliff, but will allow the belayer/fixer to easily pull down on the rope when more slack is needed. To fix the installation rope, the second can either use rope ascending techniques to ascend the lead line, or can climb the route while being belayed from above by the leader. Whichever method is faster given the difficulty of the terrain should be used, but in either case, prior planning and proper communication is important. The second will fix the installation rope while recovering any protection placed by the leader that wasn't needed for installation and upon reaching the top will remove the munter hitch and secure the last, uppermost section of rope. The team could continue on in this manner with an additional installation rope if necessary.
*NOTE: If creating a "simple" fixed rope using either of the above procedures, the belayer/second need only remove the leader's protection during the ascent.

ROPE ASCENDING TECHNIQUES

The advanced military mountaineer must have the skills to ascend rope in all types of steep terrain using a variety of techniques and equipment.

Low-Angle

Use the following techniques when ascending low angle terrain or terrain where there are large steps or foot holds. These are typically trained on by basic military mountaineers.

Single prusik or friction hitch*:* Attach a prusik to the fixed rope. Clip the friction hitch to the harness with a locking carabiner. If a long cordelette is used, tie a double-double figure of eight and clip it to the harness with a locking carabiner. The optimum distance is one outstretched arm length away. This technique is recommended only on simple fixed ropes without intermediate anchor points.

Mechanical ascender*:* Attach a mechanical ascender to the fixed rope. Girth-hitch a sling to the harness and connect it to the ascender using a locking carabiner. If using a handled ascender on a simple fixed rope, attach a standard non-locking carabiner around the rope and through the top hole of the ascender to prevent it from levering off the rope. It is a good idea to also tie a stopper knot in the rope below the ascender every 10 to 15 feet and clip it to the harness. This prevents falling a long distance and becoming seriously injured in the event of an ascenders failure to grab. If using a mechanical ascender on fixed ropes with multiple anchor points this is unnecessary; however a separate sling should be girth-hitched to the harness and clipped on the fixed rope below the ascender with a carabiner, allowing for the transition from one section to the next. To transition, simply transfer the additional sling to the next higher section. Then remove the ascender and place it back above the sling on the above section of rope.

High-Angle

Use the following techniques for ascending ropes on high angle terrain. Each technique consists of a knot or device used to gain upward distance or progress, and a device used to capture that progress prior to continuing. We will refer to these as the “progress” and the “progress capture” respectively.

Two friction hitches*:* Two friction hitches (prusik, klemheist, autoblock,etc…) can be used to ascend rope. This can be done the same as learned at the basic mountaineer level, or modified using alternate friction knots and cord/sling material. The uppermost friction hitch is secured to the harness with a locking carabiner and serves as the “progress capture”, while the lower friction hitch serves as the “progress” or a makeshift foot hold. The lower hitch is slid as high as possible while hanging from the upper hitch. The soldier then stands up on the lower hitch pushing down and behind him with his leg while at the same time sliding the upper hitch as high as possible. He then rests in the harness from the upper hitch and continues. It is important to tie a stopper knot below the lower hitch and attach it to the harness with a locking carabiner every 10-15 feet to protect against failure of the friction hitch(s) to grab. The lower hitch can also be attached to the harness if necessary.

Mechanical rope grabs or ascenders*:* Mechanical rope grabs or ascenders can be substituted for one or both hitches in the above techniques to serve as either the “progress,” “progress capture,” or both. There are dozens of devices for this on the civilian market. Ensure the rope type and diameter is appropriate for the device used, as most mechanical devices have a specified range of acceptable use. Read all manufacturer’s instructions!

Tibloc

Advantage System*:* The advantage system consists of using a mechanical rope grab such as a *Petzl Gri-Gri* or M*ini-traxion pulley* attached directly to the harness as a "progress capture" and then a friction hitch or ascender and foot loop on the rope above this for the "progress." To build the advantage system, insert a bite of rope to the Gri-Gri or other device according to the instructions and attach the device directly to the harness. Attach a friction hitch or mechanical ascender to the rope above the device and a full arm's length away. Create a foot stirrup with a cordelette or other sling material equal to the highest point your foot can be raised when lifting your leg. (If using a long cordelette, create a small fixed loop in that strands directly below the friction hitch). Attach a standard non-locking carabiner to this fixed loop or clip it directly into the ascender if one is used. Redirect the strand of rope coming out of the progress capture device at the harness and clip it into this carabiner. You have now essentially created a small 3:1 system of mechanical advantage. To use the system place one hand on the "progress" device and one on the free strand of rope. Place one foot into the foot stirrup. (The foot used should be the same side as the hand on the "progress" device). Pull down with both hands while simultaneously stepping down in the foot stirrup. Rope is allowed to easily slide through the device at the harness; however once body weight is reapplied it clamps down onto or grabs the rope Capturing your progress and preventing slippage. Slide the "progress" back up to full arm's length away and repeat. It is important push both down and back with the leg when using the foot stirrup to keep your body weight forward. This technique requires some special equipment and more training to master, but is faster than others mentioned.

Advantage System (Climber and harness omitted for clarity)

ADVANCED RAPPELL TECHNIQUES

Introduction

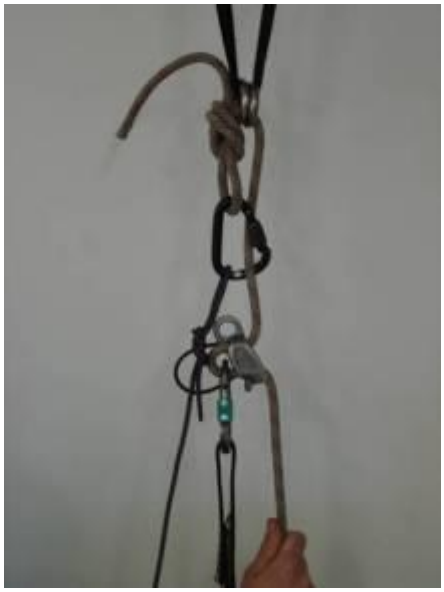
Historically, more bad accidents in the mountains occur during descents than do during ascents, and more deaths occur while rappelling than while climbing. This can be due to critical errors or simple oversight combined with decreased awareness or judgment from end-of-the day fatigue. It is often times much safer to walk off or down climb an easier section when possible. However rappelling can sometimes be the only option. In this lesson we will discuss topics beyond those covered in the Basic Military Mountaineer Course. You are already familiar with basic rigging of rappel anchors and rappel techniques including rappelling with a no-hands backup, hasty rappels, the fireman's belay, and the use of stopper knots.

RETREIVABLE RAPPELL SYSTEMS

Outside of specific rappel training situations, it is necessary to be able to recover the rappel rope(s) from the bottom after rappelling before driving on with the mission. You are already familiar with using a single rope as well as using the flat overhand knot to join two ropes together for rappelling longer distances. Always remember to protect against sharp edges and use rappel back-ups and belays when necessary. Here are some other problem solving skills.

Tag Lines

For soldiers operating in small teams with combat loads, ropes can be heavy and bulky items to bring along. Often only a single shorter length rope may be carried among the team. In this case to rappel the full length of the available rope, a tagline will be required. A tagline is simply a thin, lightweight section of cordage or rope equal in length to that of the available rappel rope. Some climbing teams may have one rope that serves as both an equipment hauling line for climbing and also as a tagline for the descent. For short rappels a tagline may also be something as simple as 550cord. To use a tagline, back-stack both the rappel rope and the tagline material. Tie a double figure eight knot in the end of each. Route the rappel rope around or through the anchor point and clip the double figure eight back onto itself with a locking carabiner. Attach the double figure eight of the tagline material to the locking carabiner as well. Throw or lower the ropes down, ensuring they reach a safe area. If it is unknown whether or not they reach a safe area tie a stopper knot in the rappel rope and have extra anchoring equipment available before beginning the rappel. Next hook up and rappel on the single strand of the rappel rope. Once all soldiers are at the bottom, pull on the tagline. This will pull the locking carabiner down. The rappel rope will slide up through the carabiner, then around the anchor and fall to the ground. Keep in mind that with this system there is more bulk to get hung up or stuck when pulling the rope. Additionally, the thinner the tagline material, the more difficult it will be to pull. Therefore, in most cases a minimum of 7 or 8mm diameter rope should be used for full 60meter or longer rappels. If improvised materials such as 550 cord are used, distances must be kept shorter. If in doubt whether or not the rope will pull, the first rappeller down can do a short test pull. If it pulls ok, the next rappeller can even the ropes back up, or if it doesn't pull ok, can reconfigure the set-up.



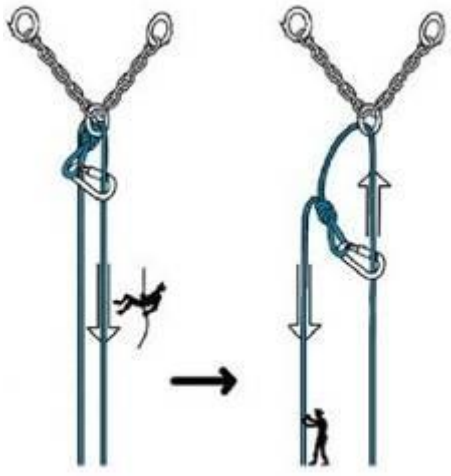
Rappel rigged w/Tagline

Rope being pulled from below

In situations where the rappel rope doubled is just shy of reaching the ground, a similar system can be used. Route the rappel rope around the anchor and pull down on one strand until you can see it touch the ground. This leaves one end short. Next tie a double figure eight in the opposite strand near the anchor and clip it to the strand that touches down. This isolates this rope for a single strand rappel just as before. Last, join enough cordage or material to the short side so that it can be reached when standing on the ground to pull the rope with.

Rappelling on Damaged Ropes

In the case of a damaged spot on a rappel rope that otherwise reaches the ground, one can use the procedure described above to isolate the non-damaged half of the rope for a single strand rappel. The damaged strand, unless barely attached, can safely be used to pull down and recover the rope. If two separate ropes are used, use the non-damaged rope as the rappel rope and the damaged rope as the tagline.



Dealing with Stuck Ropes

Ropes can at times become stuck, either jammed at the anchor due to friction, or jammed somewhere below during the process of pulling them down. It is best to avoid this by keeping the rope out of cracks or by using shorter rappels if the terrain is highly featured. Despite this, you will occasionally still have to deal with stuck ropes. If the rope or ropes are difficult to pull from the beginning try flipping them away from any obstacles that may be causing the rope drag. Make sure the ropes are not twisted around each other. Pull them apart and watch to see that they separate all the way to the anchor. If this does not solve it, try pulling the other side of the rope. If rappelling on joined ropes it's possible that you are pulling on the wrong rope and the knot is jammed at the anchor, or if using a single rope that one strand is being pinched under the other. Another technique used if you are on the ground is to walk out away from the cliff to pull the rope(s). This sometimes decreases rope drag enabling it to come down. Last, pull harder. This can either free it, or potentially jam it worse. If the rope(s) stay jammed despite all efforts there are a couple options. One option is to return at a later time with a separate rope(s) and attempt to retrieve it. Another is to use rope ascending techniques to ascend the two strands of rope together all the way back to the anchor and free it. If the rope became jammed lower down and not at the anchor the first step is usually to try various methods of flipping the rope and changing the angle of pull to free it. If this fails to work pulling harder once again may work it loose or may get it even more stuck. In some cases there may be enough rope on the ground to use to lead climb with a belay up to the point where it is jammed to free it. This, of course, is only possible you had rappelled over reasonable climbing terrain or rappelled back down the route of ascent. Another more dangerous option would be to ascend the rope itself to free it, although this would likely cause serious injury or worse if it became un-stuck during the ascent. A final and perhaps better option may be to return later and retrieve it from above on a separate rope, or simply cut whatever length of it can be reached from the ground and continue on with a shortened rope.

TIME EFFICIENT RAPPEL TECHNIQUES

The following techniques can be used to reduce the amount of time required for an element to conduct a rappel in hasty conditions.

Stacking Rappel Devices

To stack rappel devices, begin as close to the anchor point as possible and attach each device to the rope(s), one immediately beneath the next, and each with an "unlocked" locking carabiner. As each soldier arrives at the anchor they need simply to attach to the locking carabiner either directly to the harness or with an extension sling, lock it, and rappel. As soon as the first soldier reaches the bottom the next can begin. This allows one individual, preferably the most experienced, to rig the rappel devices and inspect each rappeller, leaving all others free to prepare equipment, pull security, or other tasks.

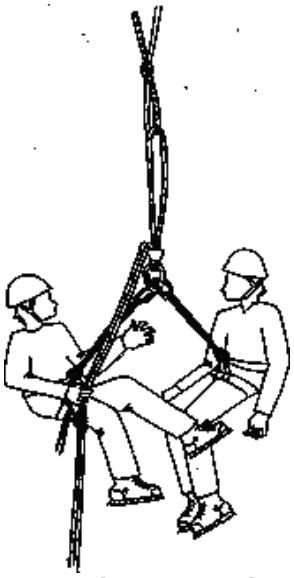
Stacked Rappel Devices

Conducting Single Strand Rappells

In some situations it may be advantageous to have rappellers proceed simultaneously on each single strand of the rappel rope(s) to greatly reduce time. This is particularly useful with larger elements. Because one strand of rope pulling the other strand through or around the anchor could be fatal, the two strands must first be effectively blocked. This can be done by tying a large bulky double-double figure of eight with both strands of the rappel rope as close to the anchor point as possible and then attaching the two rappel strands to this knot with a locking carabiner. In order to retrieve the rope from below the very last rappeller must unclip and untie this knot and attach his/her device to “both” strands before rappelling. Another option with some style belay devices is to attach the last rappeller’s device with a locking carabiner on both ropes nearest the anchor. The device, when weighted, effectively isolates each strand, allowing the other soldiers to proceed on the single independent strands. Be cautious, however, as some types may allow rope to still slip through while one strand is weighted and the other is not. Be prepared for the decreased friction and faster descent if rappelling single strand.

Tandem Rappelling

Rappelling can be done with two soldiers on one rappel device. This is both cumbersome and awkward at best, and oftentimes even slower than if the two had rappelled separately. However, tandem rappelling is a useful tool for descending with an injured soldier. To rig for a tandem rappel use the standard technique for extending the device out with an autoblock or friction hitch backup. Then attach sling material to the injured soldier’s harness and attach this to the same locking carabiner of your rappel device. It is often easier if the injured soldier hangs slightly above or slightly below you during the descent. Adjust the length of the slings used to achieve this. With leg injuries it may be best to set the length so that they are slightly below you. This way you can get them up onto your back. An unconscious soldier may need an improvised chest harness to keep them upright.



Tandem Rappel

MULTI-PITCH RAPPELLING

Descent routes often involve a series of rappels to reach the bottom or safe ground. Certain considerations must be taken and specific techniques used.

When conducting multiple rappels the standard technique of extending the device should be used and the first soldier down should use an autoblock or friction hitch backup. Additionally, a second locking carabiner should be placed in each rappeller's extension sling. They will use this to attach themselves via the sling to the next anchor point down prior to coming off rappel. In this way they remain safely attached to an anchor point at all times. Once the first rappeller is safely anchored below, preferably out of the way of possible rock/ice fall, he belays the remaining rappeller(s) one at a time down to this point. Once the last soldier is secured, the rope or ropes are pulled and the next pitch is rigged at the new anchor. All soldiers may stack devices rigged for the rappel prior to the first one leaving, or each can hook up independently upon their turn. If the most experienced member is rappelling first, stacking has the advantage of enabling him to inspect all hookups prior to leaving, reducing the chance of error. The most difficult aspect of multi-pitch rappelling is when descending into unknown or unfamiliar terrain. The first soldier down must effectively manage the ropes during the descent and have the necessary equipment for establishing the next anchor point. If adequate anchor points are found before nearing the ends of the rope(s) the decision must be made whether to use it or continue lower in hopes of finding something further down. Although it is efficient to gain the maximum distance from each rappel, if a safe anchor point cannot be found lower it will become necessary to ascend back up the ropes, taking much more time.

RAPPEL DEVICES

Different type/style rappel devices have advantages and disadvantages for various applications. Improvised techniques should be practiced in case of dropped or forgotten equipment.

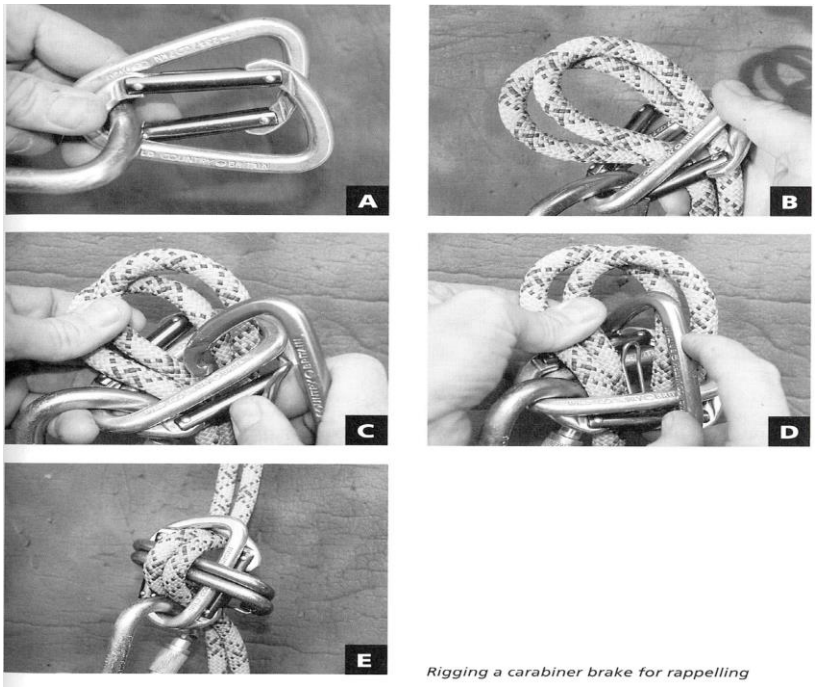
Tube style: Most climbing teams use these. The advantages are that they can be used for both belaying and rappelling with one or two ropes. Some serve as autolocking belay devices as well. They are compact and lightweight. They do not twist the ropes as much as figure 8

descenders. The disadvantages are that they do not work smoothly when used with static or low-stretch ropes due to the more tightly woven rope sheath and stiffer feel. They also do not typically work well on ropes larger than 11mm in diameter.

Figure 8 descenders: The advantages of these are that they work well with both larger diameter ropes and static or low-stretch ropes. The disadvantages are that they are heavier and bulkier. They are less versatile than tube style devices. And they tend to twist the rope when used for rappelling.

Munter Hitch: A Munter hitch tied in both strands of the rappel rope and placed in a locking pear-shaped carabiner provides adequate friction and control and is the simplest and easiest method of rappelling on steep terrain when without a standard rappel device. However the munter hitch does greatly twist the rope. An experienced soldier can separate the strands with the brake hands and counter the twist of the rope as it feeds through the hitch to lessen this effect. It is not recommended to have several soldiers rappel on the same rope using this method.

Carabiner Brake: The carabiner brake is seldom used for rappelling. It can be rigged using four standard carabiners and one locking carabiner. It does not twist the rope as does the munter hitch; however, it requires more equipment and more time to build. This can be used in specific situations, but is not recommended for common use.



Rigging a carabiner brake for rappelling

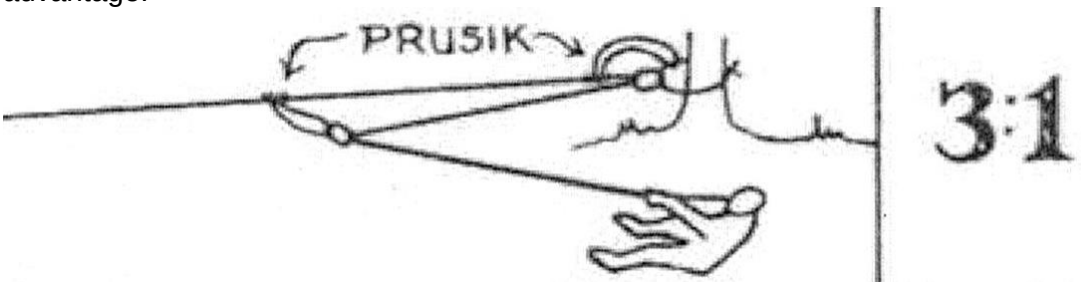
*The standard military rappel used for bounding off of towers or exiting aircraft by wrapping the rope around the spine of a carabiner does not provide adequate friction for a slower, controlled descent on vertical terrain and should not be used for military mountaineering.

ADVANCED HAULING AND LOWERING TECHNIQUES

ADVANCED HAULING SYSTEMS

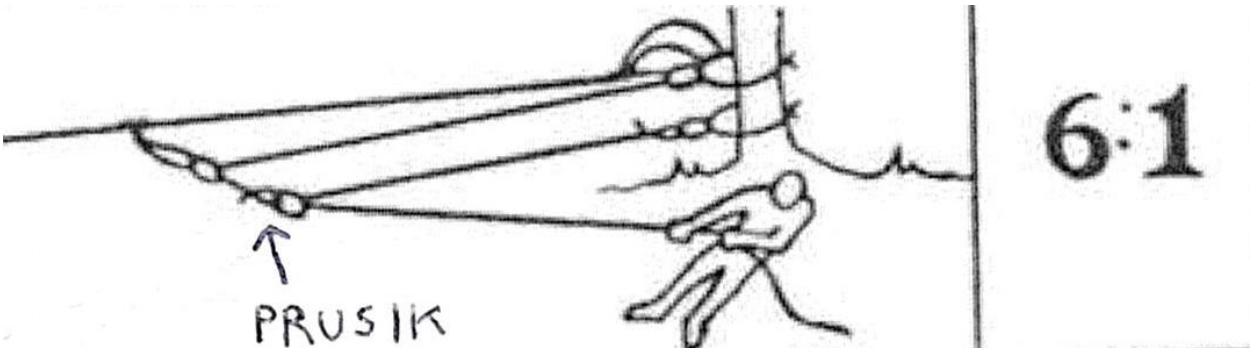
Introduction

Hauling systems are used to raise loads up a vertical obstacle, and to aid in rescue situations. While there are many versions with complicated designs, lower mechanical advantage is preferred to maintain load sensitivity and efficiency. Efficiency is lost throughout the system any time the rope touches a surface, including the edge of the cliff, carabiners or pulleys, and twists in the system where the rope rubs itself. Always use pulleys if possible to maintain maximum efficiency instead of carabiners. The simple 3:1 hauling system is sometimes not enough, and advanced mountaineers should know how to transition to systems that gain more mechanical advantage.



Compound 6:1 Hauling System

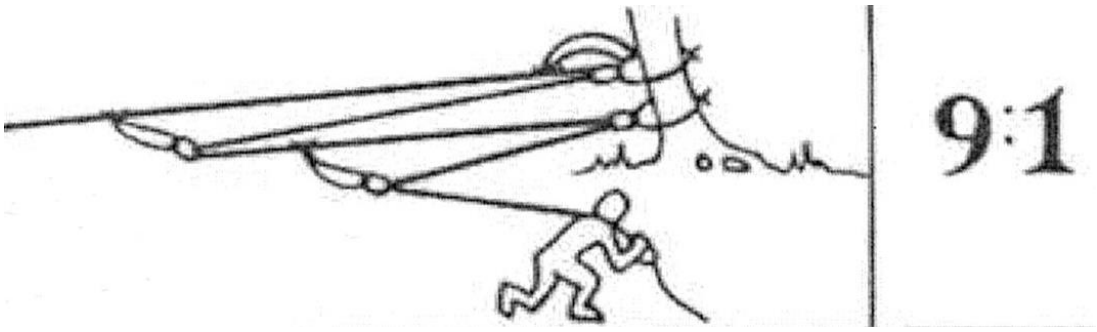
The compound 6:1 can be built upon a simple 3:1 raising system to double the mechanical advantage. To build the system, begin with a 3:1 hauling system. The moveable prusik with carabiner and/or pulley we will refer to as the "tractor." The progress capture prusik at the anchor we will refer to as the "ratchet." Extend the tractor out as far as possible. From this point, on the pull strand, attach another friction hitch with carabiner/pulley as close as possible to the original tractor. Next, route a fixed strand of rope coming from the anchor through this to create a 2:1 hauling system acting on the original 3:1 hauling system. This fixed strand of rope could either be the end of the same rope or a different rope all together. When hauling, the 2:1 tractor may need to be reset several times before each reset of the 3:1 tractor. Remember to close the system once the load has been raised an unsafe distance above the ground by tying a figure eight on the hauling strand and clipping that back to the anchor. Closing the system should be done with the tractor at full extension.



To increase efficiency when hauling, a separate anchor can be created for the 2:1 behind the original anchor. Because the 2:1 tractor is moving at a faster pace than the 3:1 tractor, this will enable both systems to collapse closer to the same time and require less resetting during the haul. Ideally, the distance between the two anchors should be approximately twice the distance of the throw in the 3:1 part of the system.

Compound 9:1 Hauling System

The compound 9:1 denotes the upper limit of what's reasonable for mechanical advantage given what's lost in efficiency and sensitivity to the load. To build the system, begin with a 3:1 hauling system The compound 9:1 denotes the upper limit of what's reasonable for mechanical advantage,. From this point, simply treat the pull strand as a load rope and create a second 3:1 hauling system to act of the original 3:1. When hauling, the second 3:1 tractor may need to be reset several times before each reset of the original 3:1 tractor. Remember to close the system once the load has been raised an unsafe distance above the ground by tying a figure eight on the hauling strand and clipping that back to the anchor. Closing the system should be done with the tractor at full extension.



To increase efficiency when hauling, a separate anchor can be created for the new 3:1 behind that of the original anchor. Because the two tractors are moving at different speeds, this will enable both systems to collapse closer to the same time and require less resetting during the haul. Ideally, the distance between the two anchors will be approximately three times the distance of the throw in the original 3:1.

ADVANCED LOWERING SYSTEMS

Lowering systems are used to control the speed of descent for personnel or equipment using a rope or ropes and are an integral part of both high and low angle rescue. Lowering a victim or a load is always preferred over hauling, if the terrain and situation allows. There are many devices and techniques available depending on the weight of the load. The bottom line for any lowering system is that there must be enough friction to control the load, and there must be a "no-hands" backup for the system

The Munter hitch provides enough friction for a one person load. The no-hands backup for this system is an autoblock on the brake strand, clipped to the harness. The Munter hitch can be easily converted to a Super Munter if more friction is desired.

Munter Hitch

Super Munter

A redirected belay device provides enough friction for up to two people. Ensure the point of redirection is far enough behind the belay device to provide enough braking power. The no-hands backup is also an autoblock on the brake strand, clipped to the harness. The redirected strand can be converted to a Munter hitch if more friction is desired or a second redirected device can be used.

Redirected Belay Device

Stacked Redirected Belay Devices

For long, heavy lowers (over 50m); care should be taken not to overheat the lowering device. Either lower very slowly or use a device with more mass such as a brake bar.

Passing a Knot through a Lowering System

If joining two ropes together will make the lowering operation faster and easier, it will be necessary to pass the joining knot through the system. Setting up for this prior to beginning will make the knot pass smooth and seamless. Note: This can also be done if a knot is used to isolate a damaged spot in the rope.

(a) Begin by establishing a lower appropriate to the load. The no-hands backup should be tied on the load side of the rope instead of the brake side. This should be a friction hitch with a cordelette, tied to the anchor with a releasable knot (Munter/mule). (b) Lower the load until there is about 8-12 inches before the joining knot hits the lower. Set the no-hands backup, then continue lowering to transfer the load onto it. (c,d) While keeping the original lower in, establish a new lower behind the joining knot and a new no-hands backup on the brake strand. (e) Remove the original lower. (f) Release the Munter/mule from the original no-hands backup and slowly lower to load the new lower and backup. Remove the original friction hitch and continue lowering. Some steps may be done in different orders so long as the load is never suspended by only a single friction hitch or lowering device by itself.

(a) 

(b) 

(c) 

(d) 

(e) 

(f) 

If a second joining knot is encountered, tie a friction hitch on the load side with a releasable Munter/mule, and repeat the process.

NOTE: The above scenario assumes that the first rope is under the weight of the load throughout the process. If it is possible to unweight the rope at the time the joining knot nears the anchor, the process can be greatly simplified.

HIGH ANGLE RESCUE

High angle rescue refers to any technical rescue conducted over vertical or near vertical terrain, usually requiring an increase in time, equipment, and training.

Rigging a Litter for High Angle Evacuation

Whether a SKED stretcher or a rigid metal basket is used for a high angle evacuation, the rigging is similar. The litter should be rigged for horizontal orientation, similar to helicopter hoist configuration. The SKED stretcher comes with two straps specifically for this use. In the case of the Stokes or similar metal basket litter, cordage or one-inch tubular webbing can be rigged to connect the four corners to a single midline attachment point. Ensure the head end of the litter is slightly higher than the foot end, about 6" when unloaded. Use locking carabiners, and ensure that all carabiners used in the rigging are oriented correctly; it is easy and dangerous to crossload carabiners if the webbing is too short. The main and belay lines are attached to the litter bridle using two interlocking bowlines, with 2-3 meter pigtails. The pigtails can be tied into the attendant and the patient to act as back up attachments.

Sked with straps shown with bowline attachment and casualty tied into bowline pigtail as a back-up. (Belay line omitted for clarity).

Rigid basket litter shown with bridal built with cordellettes and locking carabiners.

Interlocking bowlines representing Main and Belay line attachment to the litter bridal. Pigtails run to casualty and litter attendant.

Components of a High Angle Rescue

A technical high angle rescue requires two separate rope systems, known as the main line and the belay line. Each rope system requires its own separate anchor. The main line is used to haul or lower the litter, and the belay line is there in case of main line failure. Both ropes should be static (low-stretch), and must have a tensile strength of 30 kN (6750 lbs.). Usually the ropes are the weakest link in the system – after tying a knot in the rope, the tensile strength is reduced by 1/3, equaling 20kN (4500 lbs.). 20kN is the minimum strength needed in all components of the system to maintain a 10:1 safety factor when there are 2 personnel attached (one attendant and one patient, 1 kN (225 lbs.) each).

The main line is always routed through a high directional or A-frame at the top edge to reduce friction at the edge, and make the transition over the edge easier. The main line uses a high friction lowering system. While the main line and its anchor system should not fail, there is potential for a severe shock to the system if the attendant slips going over the edge. If such a slip occurs, the shockload will be significant due to the short amount of rope available to absorb the force, and the static nature of all the system components. This is the reason for the second belay line.

Use of a High Directional

The belay line is NOT routed through the high directional at the edge. This reduces the amount of rope out if either the main line or the high directional fails. While there are manufactured devices available that meet the criteria for a technical rescue belay, the easiest and most field expedient method is called the tandem prusik belay. Two prusiks, preferably made from 8mm static utility cord, are tied two inches apart on the belay line. These prusiks are then clipped to a carabiner on the belay anchor. There must be either a releasable anchor system, or a Munter mule on each prusik. To use the belay, feed rope through the prusiks, ensuring there is only a few inches of slack to the litter, while also ensuring the prusiks don't catch prematurely. Tandem prusiks and the belay line are also helpful when transitioning from a lower to a raise, or when passing a knot through the lowering system.

Tandem Prusik Belay

A high angle rescue requires a skilled team to conduct. The following positions are mandatory for a safe evacuation.

Team leader: This person has overall responsibility for the operation. The team leader should not be handling the mainline or the belay, but is often found at the edge in short manpower situation.
Belay: This person manages the belay line.
Mainline: The mainline will consist of either one person lowering, or a haul team raising. In the case of a haul team, only one person should be the spokesperson to keep communications clear.
Edge: The edge person keeps the edge area clean of debris, places edge protection, and assists the load over the edge. Edge also relays commands between the attendant and the personnel above.
Attendant: This person manages the handling of the patient (with/without litter) during the technical portion of the rescue and cleans/protects route if necessary.

Command and Control Considerations

Precise commands and singular control is necessary for safe operations. All commands should originate with the team leader, or in some cases the edge. Commands must be short, simple, and clear. Always include the name of the position in the command, such as "slack on main", or "tension on belay." Before any lowering or raising operations take place, a roll call is necessary to ensure everyone is ready. Start the roll call at the edge, and work backwards to the main. Once all personnel are ready and checked, begin the operation by calling "up slow" or "down slow". Once the litter is moving, the speed can be adjusted by calling for "up up/down down" which doubles the speed, or "up slow/down slow" to halve the speed. To halt all movement, call

for “all stop”.

Radios are almost always necessary to maintain contact with the attendant on the litter; once the attendant is over the edge, in high winds, yelling is not reliable and produces a sound signature that can travel unpredictable distances in mountain terrain.

Summary

High angle rescue is a skill that demands flexibility and a very solid understanding of concepts, equipment strengths, anchors, along with good task organization, communication, and leadership. High angle rescue skills are very perishable and must be trained on frequently.

SUPERVISING MOUNTAIN TRAINING

Introduction

Soldiers receiving advanced training in military mountaineering may be called upon to conduct and/or supervise the training of basic military mountaineering tasks. These soldiers must be able to serve as the subject matter expert, instructor, leader, and mentor. They may be required to advise the commander on training requirements, priorities, and equipment needs, as well as plan, organize, and conduct training. It is critical for soldiers in this role to stay within their own limitations and not conduct training beyond their current skill level.

RISK MANAGEMENT IN MOUNTAIN TRAINING

The standard model for Composite Risk Management can effectively be used for mountain training. Here we will discuss a few examples. These examples may not pertain to all situations.

Identify Hazards

Objective hazards: These are natural hazards that you cannot control. Examples: Rock fall, lightning strike.
Subjective hazards: These are hazards that you can control. Examples: Anchor failure, belay failure, equipment failure, rock fall caused by a soldier, hot weather injuries.
Cumulative hazards: Subjective hazards + Objective hazards = Cumulative hazards. Small errors combined with natural hazards can lead to cumulative hazards. Examples: The trainers did not conduct a thorough site recon. Training was hurried and a soldier was hit in the head from a large falling rock that could have been avoided or knocked down from above prior to training.

Assess Hazards

Assess the probability of the event or occurrence. Then estimate the expected result or severity. Determine the specified level of risk using the risk assessment matrix.

Risk Assessment Matrix						
		Probability				
Severity		Frequent	Likely	Occasional	Seldom	Unlikely
Catastrophic		E	E	H	H	M
Critical		E	H	H	M	L
Marginal		H	M	M	L	L
Negligible		M	L	L	L	L
E=Extremely High		H=High		M=Moderate		L=Low

Develop Controls

Effective control measures address WHO, WHAT, WHEN, WHERE, and HOW.
Examples: Wear helmets, identify safe areas where helmets can be removed, use correct mountaineering techniques, use solid anchors, use only serviceable equipment, hydrate, have

medical personnel and equipment available, establishing emergency procedures, etc…

Implement Controls

These should be simple and understood by all. Examples: Conduct training site recon prior to the training date, provide a safety brief, provide demonstrations, supervise, inspect all equipment prior to training, inspect all personnel prior to them leaving the ground or safe area, have all key personnel have radio communication, conduct breaks or rest periods, etc…

Supervise and Evaluate

It should be determined in advance (by name) who has which responsibilities for the supervision. These are typically the duties of the instructor or unit leader. Continually evaluate and make adjustments as necessary.

CONSIDERATIONS FOR PLANNING MOUNTAIN TRAINING

Site Reconnaissance: When possible, visit the training area in advance of the scheduled training date and conduct a rehearsal or walkthrough with key personnel if appropriate. This may help with the overall plan and with identifying hazards and developing controls. It also may be an opportunity to save time with site set up by identifying anchor points and/or cleaning the area of loose rock or other hazards ahead of time.
Time Management: Make sure you have enough time in your training plan to cover movement, set-up, demonstrations, and training time.
Communication: Ensure all key personnel have adequate means of communication with you and with each other. This is especially important in the event of emergencies or any unforeseen circumstances.
Participant to Instructor ratio: Ensure that there is an adequate number of trained personnel or subject matter experts to effectively supervise the given number of participants. In cases where there are only one or two SMEs working with a much larger group it may be necessary to limit the number of soldiers being trained at one time.
Organization/placement of key personnel: Ensure that key personnel or any individuals with instructor or trainer duties are properly positioned for the event so that proper inspection and supervision is taking place at all times. It may be necessary to create separate groups or rotation cycles allowing soldiers to train on different tasks at given times. In some cases, previously trained basic mountaineers may be used as trainers.
Acclimatization/Conditioning: It is essential that leaders evaluate the individual abilities and fitness level of their soldiers. Physical condition, changes in climate, and acclimatization levels need to be considered. If training above 2500 meters soldiers will begin displaying the effects of altitude. Proper acclimatization must be conducted.
Anchors: In training situations, any anchors used must be completely redundant. While an anchor used for leading or for multi-pitch climbing is typically used only for a short period of time and is inspected almost immediately prior to its use, a training site anchor is often used for much longer durations of time and is often out of sight of the user. For these reasons, training area anchors must be generally bigger, beefier, and stronger.
Equipment: Equipment used for training must be properly inspected and should have a known history. Generally it's good practice to use larger diameter ropes when conducting training because they are bulkier and less likely to be cut over an edge.
Weather: Mountain weather is highly unstable. The training plan must remain flexible and account for contingencies in the weather.
Emergency/Medevac Plan: Create a detailed emergency plan, ensuring vehicles and medical

personnel and equipment are positioned accordingly.

TOP ROPE CLIMBING TRAINING

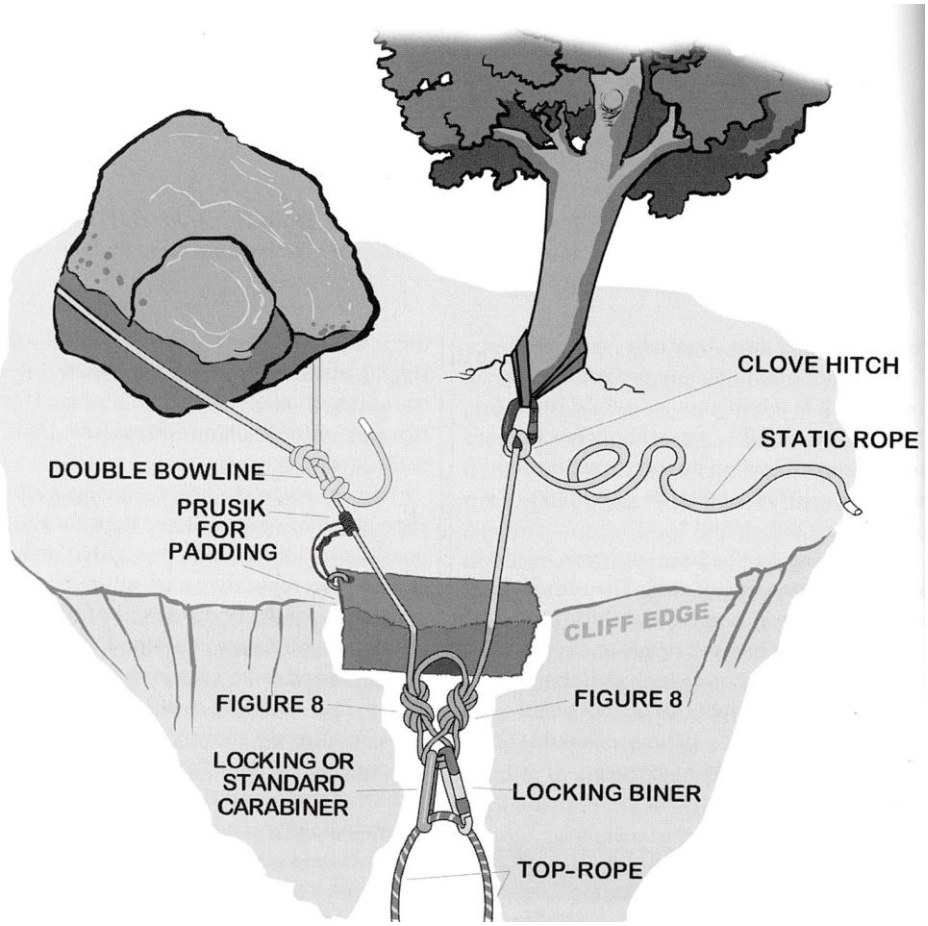
Top rope climbing is typically the first stage of climbing training for beginners. This is where they learn the basics of tying in to the harness, belaying techniques, verbal commands, and the basic techniques used for climbing cracks or rock faces. It is a valuable training tool enabling them to learn the fundamentals and practice their skills without the risks associated with lead climbing. The soldier with advanced mountain training should be capable of safely setting up climbs and supervising small groups.

Considerations for Top Rope Climbing

Ease of access: The top of the cliff must be accessible to safely establish the anchor points and hang ropes. Otherwise, a climb may have to be lead prior to rigging. The bottom of the cliff must be easily accessible for the group and have adequate space to move around and store equipment.
Availability of anchors: Anchors must be strong and redundant. Because anchors aren't always available at the cliff edge, it is helpful to carry a shorter length section of static or low-stretch rope (30-50 ft). This is helpful for extending anchors out over the edge of the cliff to run smoothly and should be at least 10mm in diameter.
Length of the climbs: The length of the climbs must be less than half the length of the available ropes. Longer climbs can be used by joining two ropes together but is more complex and should be avoided if possible when working with beginners.
Difficulty: Make sure the level of climbing is appropriate for the soldiers. A common mistake is to use climbs that are too difficult, making it nearly impossible to learn the basic movement skills and establish confidence. It is best to have a variety of difficulty levels available.
Distance between climbs: Climbs should be far enough apart so that climbers are not falling on or swinging into other climbers, however, should not be so far apart that supervision and control are hindered. With climbs in close proximity, the instructor can often maintain adequate supervision of more than one climb.
Belayers: Instructors may belay participants; however, belaying is an important and useful skill and should be learned and used by participants as well. New belayers must be watched closely to ensure proper technique, both when taking rope in and when lowering. When dynamic ropes are used on longer climbs, one must be especially attentive to the additional length of falls due to rope stretch. This can be dangerous when climbers are near the ledges or near the ground. Tight belays must be maintained.
Anchoring of belayers: Belayers should be anchored down at the bottom it they are significantly lighter weight than a heavier climber, if they are belaying from back away from the cliff, or if there are other obstructions/hazards they could get pulled into and potentially lose control of the belay. In some cases it's simpler to establish the SOP that all belayers anchor themselves down and adds a further element of safety. The anchor point can be provided by you.
Use of back-up belayers: It can sometimes be useful with very new beginners to use back-up belayers. Simply have an additional soldier stand next to and slightly behind the belayer on the brake hand side. Have them keep a hand on the brake strand of rope a few feet behind the primary belayer's brake hand, making sure not to interfere. They serve simply as a back-up during the taking in of rope and lowering. This does a few things. It gets more soldiers involved when larger groups have a limited number of ropes or climbing lanes, frees up the instructor to be able to maintain control of more than a single lane, and puts a heavier emphasis on safety and the importance of the belay. At other times this may be overkill and unnecessary.
Pendulums: Pendulums are created when the anchored rope is not directly above the route of

ascent, or when a climber is climbing too far to the right or left of the intended route. When or if the climber falls, he/she swings widely to the opposite side potentially slamming into or hitting things and becoming injured. Very small pendulums are acceptable, however, one must ensure climbers stay on route and that the anchor and rope attachment point are located as directly above the climb as possible to avoid large ones.
Communication: When top roping, climbers and belayers should use a standardized system of communication for safety. These commands can be the same as learned at the basic military mountaineer level or other.

Establishing Top Rope Climbs



There are many ways to safely establish top ropes for training. The following technique is a common method that is versatile enough to be used in a variety of anchoring situations. The technique assumes that there are no fixed anchors for top roping in place, and is described with the use of a short static rope for anchoring. We will refer to this as the anchor rope. Identify two anchor points be used. These could each be trees, equalized artificial anchor points, or other. We will refer to each as anchor #1 and anchor #2.

(1) Anchor one end of the anchor rope to anchor #1.
(2) Flake out enough rope to reach down over the edge and back to anchor #2 (include the necessary rope that will be taken up by the hotpoint knot(s)). Attach the rope to anchor #2 using a clove hitch.

(3) Attach a friction hitch to the remaining free side of the anchor rope and attach it to your harness with a locking carabiner to use as a self-belay when approaching the cliff edge. This strand of rope should be attached to the harness with a fixed loop as well to prevent it from sliding through the friction hitch.
(4) Move to the edge. Working from anchor #1, tie two double figure eights or a big "double double" figure 8 for use as a redundant hotpoint at the preferred location below the edge.
(5) Back-stack the climbing rope and clip it into the hotpoint with two carabiners reversed and opposed, at least one of these being a locker. Send the rope over the edge and recheck its position.
(6) Pad the edge if necessary.
(7) Move back to anchor #2 and adjust any slack through the clove hitch so that both anchor strands are under equal tension.
(8) Alternatively, if during the set-up the remaining free side of the rope is not long enough to reach the edge, a friction hitch can be attached directly to the anchor rope strand coming from anchor #2 to approach the edge with.

RAPPEL TRAINING

Accidents and injuries are common during rappel training due to errors caused by negligence and/or lack of correct techniques and safety precautions. These can be eliminated with proper use of fundamentals and an organized safe training site.

Considerations for Rappel Training

Ease of access: The top and bottom of the cliff must be easily accessible and have room for rigging rappels and belaying.
Availability of anchors: Strong anchors must be available far enough back from the cliff edge for safe hook up of soldiers.
Length of rappels: The length of the rappel(s) must be less than half the length of available rope if only one rope is being used.
Ropes: Vertical rappel training should have the redundancy of using two fixed independent strands of rope for safety. This provides an added measure of safety. In this way single rope failure will not be catastrophic. Rappel training can cause the back and forth sawing of ropes and can easily wear them down at edges and transition points. Thicker diameter ropes should be used and padding should be placed at these points. Static ropes are generally more abrasion resistant than dynamics for training.
Belays: Belays should be used for rappel training. There are several types of belays that can be utilized depending upon the situation.
Fireman's belay: Soldiers must be trained and supervised for the use of the fireman's belay. This is not the preferred technique if there is a chance of being hit with rockfall.
Self-belay: The standard technique of using an autoblock or friction hitch for a hand's free belay can be used, but requires more time.
Belay from above: This is an often over-looked technique. Rappellers can rappel on a single strand of rope, but tie into or clip into the end of the second rope strand and be belayed by another soldier above using a Munter Hitch or other belay technique. This second rope must be pulled back up in order to be attached to the next rappeller.
Stuck rappellers: At times, rappellers can get clothing or other material stuck in a rappel device, jamming it and preventing it from sliding on the rope. In other cases, rappellers can become

scared and “lock-up” where they are unable to move. A plan should be in place with the extra rope and equipment needed to rescue rappellers from this situation or haul them up, etc…

Establishing Training Site Rappel Points

Rappels less than half the length of a single rope:
Attach the middle of the rappel rope to the anchor point and throw or lower the ends down to the ground.
Rappels requiring two ropes:
Attach the end of each rope to the anchor point and throw or lower the remaining ends down to the ground.

*NOTE: Many of the principles discussed above can be used when planning or conducting other military mountaineering tasks, whether it be Fixed Rope, High Lines, or others.

INSTRUCTOR SKILLS FOR MOUNTAIN TRAINING

A soldier need not be a professional instructor/educator or have experience working at a military mountaineering school to be an effective trainer. He/she must, however, be able to effectively utilize the following skills.

Demonstration

The use of effective demonstration is an important aspect of teaching any skill and often goes much further than verbal explanations in the case of some learning styles. Demonstrate the desired technique slowly and make sure all participants can clearly see any and all components. Provide an opportunity to ask questions. Sometimes, a second demonstration can clear things up and prevent frustration later.

Inspection

Inspection is one of the most critical components of any technical mountain training event. Many accidents can be attributed to lack of inspection or instructor error during the inspection process. All participants should be absolutely clear on when and where it is required to be inspected. The site should be organized in such a way that participants are unable to climb or proceed towards edges or dangerous terrain without first being inspected. New soldiers should NOT accept the responsibility of rigging things correctly themselves. Instructors must have a clear, logical sequence to follow when conducting inspections, whether its anchor points, harnesses, tie-ins, rappel hook ups, or other. These should be conducted hands on – NOT viewed from a distance. These procedures must be followed in sequence each and every time.

Coaching

A frequently overlooked skill is the simple ability to articulate the desired action to the soldier. The goal is to provide understanding and confidence. It is easy to forget that if a soldier truly understood the desired action he/she would already be doing it. Yelling and frustration on the part of the trainer often leads to the further confusion and frustration. Speaking clearly and correctly articulating will more quickly achieve the desired outcome.

Knowledge

The trainer should not only be competent at the skill being learned, but should also understand other similar techniques or options and know their advantages and disadvantages. The trainer should be knowledgeable about any special equipment being used including properties, breaking strengths, etc…

Self-Assessment

It is important to conduct a quick self-assessment after conducting a training event. This can be part of a normal AAR, or be done separately; however, it should involve a more detailed look at critical safety components and identify things that could be improved, whether it has to do with the overall organization, the instruction, or a specific event. Instead of just patting yourself on the back at the end of each day, make the goal of this exercise to improve the training you provide next time.

ROUTE PLANNING

Introduction

Route planning is a fundamental skill to the Level 2 mountaineer. The ability to effectively utilize maps and other materials and/or reconnaissance to analyze terrain and plan technically and tactically sound movements is critical to mission success.

CLASSIFICATIONS OF TERRAIN

Operational Terrain Classifications: Mountain operations are generally carried out at three different operation terrain levels.

Level I: The bottoms of valleys and main lines of communications. At this level, heavy forces can operate, but maneuver space is often restricted. Light and heavy forces are normally combined, since vital lines of communication usually follow the valley highways, roads, and trails.

Level II: The ridges, slopes, and passes that overlook valleys. Generally, narrow roads and trails, which serve as secondary lines of communication, cross this ridge system. Ground mobility is difficult and light forces will expend great effort on these ridges, since they can easily influence operations at Level I. Similarly, enemy positions at the next level can threaten operations on these ridges.

Level III: The dominant terrain of the summit region. Although summit regions may contain relatively gentle terrain, mobility in Level III is usually the most difficult to achieve and maintain. Level III terrain, however, can provide opportunities for well-trained units to attack the enemy from the flanks and the rear. At this terrain level, acclimatized troops with advanced mountaineering training can infiltrate to attack lines of communication, logistic bases, air defense sites, and command infrastructures.

Dismounted Mobility Classifications: Mountain terrain may be categorized into five classes based on the type of individual movement skill required.

Class 1**.** Class 1 terrain is defined as gentle slope or easy trails. This terrain is negotiated with simple walking techniques. Classified as easy.

Class 2**.** Class 2 terrain involves off-trail scrambling in steeper, more rugged terrain. Rarely, use of hands may be needed to negotiate Class 2 terrain. Type 2 terrain is classified as easy.

Class 3**.** Class 3 terrain usually necessitates moderate scrambling, with use of hands needed for balance. Use of fixed ropes or belay techniques may be required for beginners. Basic mountaineers may be useful to negotiate this terrain. Classified as moderate terrain.

Class 4**.** Class 4 terrain is steeper terrain that involves belayed climbing or fixed ropes. There is moderate to difficult scrambling which may have some exposure. Significant injury can occur if an un-roped fall occurs. Basic mountaineers are needed to negotiate this terrain. Class 4 terrain can be classified as moderate to hard depending on the exposure and the consequences of a fall.

Class 5**.** Class 5 terrain is vertical terrain involving hands and feet at all times while moving. This terrain is complex, dangerous ground where significant injury or death can occur from an un-roped fall. Class 5 terrain requires Soldiers to be roped up, use belay techniques, and place intermediate protection. Assault climbers are required to negotiate this terrain. Class 5 terrain should always be considered hard terrain when planning

USE GUIDEBOOKS AND TOPOS IN TRAINING

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When training on individual climbing and mountaineering skills it is often wise to climb routes previously climbed by others and for which detailed information is available. Guidebooks are often written for popular climbing areas and can contain a wealth of information including an introduction and history of the area, information about the approaches and easiest descents of the climbs, specific and detailed route information and descriptions, rock type and quality, difficulty ratings, pictures, and lots of other useful information. Guidebooks can be used both when planning and preparing for a climb and as a reference during a climb. They are particularly useful for time planning, determining the proper equipment necessary, and selecting routes that are at ones desired level of difficulty. Topos are detailed drawings of a particular climbing route (usually multi-pitch) and contain symbols and hand drawn features. Symbols are typically somewhat standardized. The quality and accuracy of topos and guidebook route descriptions can vary from excellent to pathetic.

Rating Systems for 5th Class Terrain

A rating system is a tool used to describe the difficulty level of the climbing on established routes. This helps climbers choose a climb that is challenging and within his or her limits of ability. These are opinions and are, therefore, very subjective. Climbs are typically rated by the first ascent team and are often changed by consensus of others that have climbed it since. There are many rating systems established worldwide. Here we will discuss a few American systems. Some of the ratings in each system are beyond the scope of military mountaineering and are purely for advanced recreation.

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5th class Rock Climbing:

5th class rock climbing is rated on a scale of 5.0 to 5.15 depending on the most difficult move of the climb, regardless of length or number of pitches. Ratings from 5.0-5.9 often contain a + or – to help distinguish those that are in between levels. Ratings from 5.10-5.15 are broken down into a,b,c,and d to further delineate difficulty. It should be noted that these ratings are of the hardest climbing move alone, NOT on the difficulty of leading and placing protection, the strenuousness, or of how sustained.

5.0-5.7: Where most novices begin. Relatively straight forward for experienced climbers.
5.8-5.9: Moderately difficult; employs specific techniques such as jamming, liebacks, and mantels.
5.10-5.11: Advanced. Dedicated climbers can achieve this with training.
5.12-5.15: The realm of true experts; demands training, natural ability, and often, the repeated working and practicing a route.

Protection Ratings:

These highlight the protection potential for leading a route in terms of ease of placement, quality, and abundance. They vary from area to area and guidebook to guidebook and are not always included. Below is an example.
G or E: Good or Excellent. Can be lead safely by a competent climber with an adequate rack of protection.
PG or PG 13: Pretty good. Protection is adequate, but not as close together or requires good placement skills.
R: Protection is considered inadequate; there is potential for a long fall with injury possibilities.
X: Inadequate or no protection. A fall would be very long with serious, and perhaps fatal, consequences.

Quality:
Ratings of the quality of routes are common, but of course very subjective. They often have to do with the aesthetics of the climb, the solidity or looseness of the rock, and the overall enjoyment or challenge. These are often denoted by stars next to the route name. The more stars included, the higher the quality or popularity.

Aid Climbing:
Aid climbing ratings indicate the difficulty and frequency of quality placements. These run from A0 to A5 and C0-C5. The C stands for clean aid/protection, as opposed to using pitons and malleable pound in gear. These are typically only given on routes that would be extremely difficult to climb free.
A0 or C0: Fixed protection is in place.
A1 or C1: Easy aid placements, where virtually every one is capable of holding a fall. These can often be climbed by simply grabbing the gear.
A2 or C2: Placements are fairly good, but may be tricky to place. There may be a couple of bad placements(body weight only) between good ones.
A3 or C3: Hard aid. Frequently using hook placements. Can take several hours to lead a pitch, with long fall potential.
A4 or C4: Serious aid. Fall potential of 80 to 100 feet. Few placements that would hold a fall.
A 5 or C5: Only body weight placements. A fall would likely result in death.

Alpine Climbing:
Multi-pitch alpine climbs are often rated in terms of time and technical difficulty, taking the following factors into account: length, number of hard pitches, difficulty of the hardest pitch, commitment, difficulty of route finding, and time needed for the ascent. Often times the approach, remoteness, or level of exposure to hazards such as rock fall, crevasses, or avalanches may affect the given grade.
Grade I: Normally requires several hours; can be of any technical difficulty.
Grade II: Requires half a day; any technical difficulty.
Grade III: Requires a day to do the technical portion; any technical difficulty.
Grad IV: Requires a full day for the technical portion; the hardest pitch is usually no less than 5.7(see YDS below).
Grade V: Requires a day and a half; the hardest pitch is usually 5.8 or harder.
Grade VI: A multiday excursion with difficult free and/or aid climbing

TECHNICAL ROUTE PLANNING TECHNIQUES

Gather information: Route planning for any technical climb begins with information gathering. One must gather as much information specific to the area as possible. This could include maps, photographs, satellite imagery, or could be as simple as knowledge gathered from locals of routes, hazards, or conditions. It is important to establish an overall picture of what to expect.
Determine Non technical movement times: If estimating from a map, map distance plus one-third is a good estimate of actual ground distance to be covered. Understand that when moving in the mountains there is a high likelihood of encountering natural obstacles that are not on the map. These obstacles, although smaller, can greatly affect movement times and require technical work to get through or around. These could include small cliffs, rivers or mtn. streams, crevasses, etc…
Use the Time/Distance formula: Foot marches in the mountains are measured in time and elevation, not just distance. For dismounted movement in non technical terrain plan for about 2-3km per hour and add 1 hour for every 1000ft of ascent or 2000ft of descent. Adjust based on

loads, fitness level, training, and altitude. If deep snow is encountered, reduce estimated movement rates significantly. Include time for rest halts.
Glacial areas: In glacial areas, the principal dangers and obstacles to movement are crevasses, snow, and ice avalanches. Movement should be limited to platoon and lower levels. An advanced element should be used to identify the best route, mark the trail, and provide directions and distances. A marked trail is especially important during inclement weather and poor visibility.
Determine the time required for the technical portion: The time for the ascent will be determined by the skill/experience and ability level of the mountaineers, the type of operation, size of the element, whether or not ropes must be fixed in place, the load, and the tactical situation, and many other factors. This can be the most difficult part to accurately assess.
Determine special equipment: Determine the type and amount of equipment necessary to conduct the climb, including clothing, rope, footwear, anchors, protection, etc.. Carrying too little can compromise safety; carrying too much can weigh you down and compromise the mission. Look for the right balance.
Determine where the route goes: The skill required for this depends on the location and nature of the climb. Study the route on the approach or from afar if possible. Look for major features that the best line of ascent might follow. Look for and identify crack systems, steps, areas of broken rock, etc…Note areas of small trees or bushes that could indicate belay ledges and/or possible rappel anchors. Identify landmarks that, when you reach them, will help you to determine your position on the route. For this kind of small-detailed planning, your eyes will tell you what the topographic map cannot. Watch out for deceptively tempting lines that lead to broad roofs, blank walls, or false summits. These may not be visible once you are on the climb and, if you climb them in error, may dead-end after a couple pitches. Develop a plan for the line of ascent, but keep likely alternatives in mind. Look for places where retreat could be possible if the climbing becomes too difficult or dangerous. It is sometimes advantageous to make a technical route card containing any notes, distances, or other information that may be useful once you are on the climb.
Plan during the ascent: Continue planning the route finding as the actual climb begins, looking for more local features and landmarks. Seek out natural lines to follow as you climb. Form a tentative plan for each section or pitch, including protection locations and/or the next belay/anchor station. Look around for easier alternatives that may not be visible from below. Keep track of anchor stations and rope lengths along the way. Always have a plan for the descent and for retreat if the mission is aborted.

TACTICAL ROUTE PLANNING TECHNIQUES

Overview: When planning tactical routes, all the previous information are still considered. Special attention must be paid to the following:
Reconnaissance: When planning routes, close attention should be paid to this. At a minimum, a thorough map reconnaissance should be conducted to evaluate terrain and to determine appropriate routes for unit capabilities and mission success. Whenever possible, other reconnaissance assets should be utilized. The use of satellite imagery, photographs, UAV can greatly increase route planning when used in conjunction with each other. However, when pre mission planning is conducted, it important to try to receive area information from prior units operating within that area or through reconnaissance assets on the ground. This can confirm or deny routes that were picked from other sources due to the inability to see micro terrain. These assets can also provide information on route hazards pertaining to soil composition, vegetation and hydrology.
Weather: Weather patterns and history should be carefully evaluated for impact on routes. Terrain that may normally be passable can be affected by precipitation levels increasing

hazards to Soldiers on the selected routes. Adverse weather can provide added concealment allowing units to move along routes (but also preventing units from observing surrounding terrain).

Task Organization: During route planning, careful consideration must be paid to the skill level of personnel, equipment and weapon systems utilized during a mission. Personnel and equipment must be task organized to better react to terrain and enemy during movements, maintaining continuity. Depending on the selected routes, rope installation teams need to be identified and given time to rehearse.

Enemy situation: A thorough enemy analysis needs to be conducted to determine the potential for enemy contact along selected routes and the identification of potential contact areas. These contact areas will determine movement techniques, security and even route suitability.

Scheme of Maneuver: During the planning process, movement formations and types will be determined. Close attention should be given to specific areas along routes that may change movement types and how this will affect movement times. The transition between traveling, traveling overwatch and bounding overwatch will be determined by potential contact areas and levels of cover and concealment. Some areas may need to be approached as vertical danger areas with the necessary security and installation teams. Rest Halts should be incorporated into the movement plan.

Communications: Selected routes may significantly affect the ability of units to communicate with each other. Planning should incorporate a P.A.C.E. plan to account for identified areas of diminished communications. This will allow units better flexibility when choosing routes.

Summary

Your ability to classify and analyze terrain, coupled with your knowledge and understanding of both technical and tactical planning and movement considerations is critical to success on the mountain battlefield.

SMALL UNIT BIVOUAC TECHNIQUES

Introduction

Proper bivouac routine is critical for unit survival. At the basic mountaineer level you learned tactical, sanitary, and safety considerations for mountain bivouac, such as cover and concealment, wind protection, ground condition, availability of water, fuel, and construction materials. In this lesson you will use special equipment specific to small team bivouac.

Manufactured Shelters

When selecting a tent, the mission must be defined to determine the number of people each tent must accommodate. The climate the tents will be used in is also of concern. A tent used for warmer temperatures will greatly differ from tents used in a colder, harsher environment. Mountaineering tents are made out of a breathable or weatherproof material. A single-wall tent allows for moisture inside the tent to escape through the tent's material. A double wall tent has a second layer of material (referred to as a fly) that covers the tent. The fly protects against rain and snow and the space between the fly and tent helps moisture to escape from inside. 4 season tents typically have guy lines attached to the fly that are used to aid in anchoring the tent down for high winds. Before using a new tent, the seams should be treated with seam sealer to prevent moisture from entering through the stitching.

The frame of a tent is usually made up of aluminum or carbon fiber poles. The poles are connected with an elastic cord that allows them to extend, connect, and become long and rigid. When the tent poles are secured into the tent body, they create the shape of the tent. Tents are rated by a "relative strength factor", the speed of wind a tent can withstand before the frame deforms. This usually marks the difference between a 2, 3, or 4 season tent. Temperature and expected weather for the mission should be determined before choosing a tent.

Mountain Stoves

When selecting a stove one must define its purpose-will the stove be used for heating, cooking or both? Stoves for small elements are typically just used for cooking and making water, and are simple and lightweight. Stoves are a necessity in mountaineering for cooking and making water from snow and ice. When choosing a stove, factors that should be considered are altitude and temperature where it will be used, weight, fuel availability, and its

reliability.

There are many choices in stove design and in fuel types. White gas, kerosene, and butane are the common fuels used. All stoves require a means of pressurization to force the fuel to the burner. Stoves that burn white gas or kerosene have a hand pump to generate the pressurization and butane stoves have pressurized cartridges. All stoves need to vaporize the liquid fuel before it is burned. This can be accomplished by burning a small amount of fuel in the burner cup assembly, which will vaporize the fuel in the fuel line.

Stoves should be tested and maintained prior to a mountaineering mission. They should be easy to clean and repair during an operation. The reliability of the stove has a huge impact on the success of the mission and the morale of personnel.



Summary

Bivouac equipment should be carefully selected to meet the demands of the mission. Shelters and stoves must be meticulously maintained to ensure proper operation when needed. Know your equipment.

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