WILDERNESS ROPE OPERATIONS

WILDERNESS ROPE OPERATIONS

COURSE OVERVIEW

- This is an operations level course designed to merge standard rescue practices with techniques found in mountaineering, caving, canyoneering and lightweight rescue.
- Although NFPA standards are discussed, this course is not designed to be NFPA compliant.
- Minimum time requirements for this course: 40 hours (classroom and field exercises).
- Upon satisfactory completion of this course and all Job Performance Requirements, the student will receive a certificate of completion for Wilderness Rope Rescue, Operations Level.
- Suggested prerequisites: ICS-100, ICS-700, Wilderness First Aid, NASAR SARTECH II or North Carolina LSFTM (Land Search Field Team Member).

WILDERNESS ROPE OPERATIONS

THIS COURSE CONSISTS OF:

- Safety
- Equipment
- Knots
- Anchors
- Single Rope Descending
- Single Rope Ascending
- Belays / Safeties
- Pick-Off Rescues
- Lowering / Raising Systems
- Mechanical Advantage
- System Changeovers
- Knot Passes
- Litters / Patient Packaging
- High Directionals

WILDERNESS ROPE OPERATIONS

STUDENT MINIMAL EQUIPMENT REQUIREMENTS:

- Locking Carabiners (HMS Style Preferred)
- Descent Control Device
- Ascending System
- 6mm Prusik Cords (long and short)
- Class II Harness
- Helmet
- Gloves
- Helmet Light

Lifelines used in this course range from 8.5 to 9.5mm.

WILDERNESS ROPE OPERATIONS

CONCEPT OF SEARCH and RESCUE

L.A.S.T.

L - Locate
A - Assess
S - Stabilize
T - Transport

DO NO MORE HARM!

WILDERNESS ROPE OPERATIONS

LIGHTWEIGHT WILDERNESS RESCUE TEAMS

- Ability to access remote locations with no vehicle / ATV access.
- Searcher can become a rescuer, thus saving critical time.
- Each team member carries similar lightweight technical gear, so complex rescue systems can be built if required.
- Deployed to high probability areas of wilderness rescue.

WILDERNESS ROPE OPERATIONS

POTENTIAL WILDERNESS ROPE RESCUE SCENARIOS

- Injured climber / rappeler on rope (conscience or unconscious).
- Injured or non-injured person trapped in a confined space or hazardous terrain (caves, canyons, etc.).
- Falls in a vertical or steep environment.
- Short Roped (rope doesn't reach the bottom and climber can't get back up the rope).
- Climber stuck on a rope due to equipment failure or jams.
- Un-roped hiker/climber stuck on a ledge or high point.
- Injured hiker requiring evacuation in mid to steep terrain.
- Equipment problems / failures.

WILDERNESS ROPE OPERATIONS

OPERATING SAFELY

1) Learning the skills (Getting the basics down correctly)

2) System setup (Use the proper equipment without weak links)

3) Checking (Always double check to prevent mistakes)

4) Belaying / Redundancy / Safeties

WILDERNESS ROPE OPERATIONS

RESCUER SAFETY

- Work a buddy system.
- Speak up, regardless of your skill level.
- Use the “Touch” System to verify all rigging.
- Never use questionable equipment.
- Always use a safety line when working close to the edge.
- Always consider your safety factor.
- The rescuer’s safety comes first!

WILDERNESS ROPE OPERATIONS

SAFETY OFFICER and TEAM LEADER

- The Safety Officer's job is to ensure the system and individuals are safe before operations begin, during operations and during site cleanup.
- The Team Leader is responsible for operations and delegating tasks at the scene.

WILDERNESS ROPE OPERATIONS

SAFETY OFFICER DUTIES

- Survey the scene for hazards and work with the team leader to establish safe fall lines.
- Designate safe areas / zones.
- Double check rescuers' PPE before the operation begins.
- Verify the system is built properly.
- Verify edge protection (if required).
- Verify all carabiners are locked and properly oriented.
- Verify prusiks / progress captures are properly tied and placed on the lifelines.
- Verify safety lines.

WILDERNESS ROPE OPERATIONS

ZONES

- COLD ZONE: Area for incident support operations.
- WARM ZONE: Area where support of the technical rescue operation is attended to. Hauling personnel or others who may help when called upon will be located here.
- HOT ZONE: Participation in the hot zone should be by "invitation only" and be limited to those personnel whose duties and responsibilities are directly related to the safe setup, operation, and breakdown of rescue systems. The rescue group leader, hot zone safety officer, hauling boss, rigging master, and rescue group support personnel are located in the hot zone.
- If you have no business to be in a particular zone, don’t be!

WILDERNESS ROPE OPERATIONS

STANDARDS

The standard that many technical rescue organizations adhere to are created and maintained by the NFPA (National Fire Protection Association). The NFPA is not a government agency, thus it has no enforcement powers over compliance to a standard. The Authority Having Jurisdiction (AHJ) is the enforcement arm of standards and certifications.

WILDERNESS ROPE OPERATIONS

NFPA 1983

- NFPA 1983 is a manufacturing standard for ropes, auxiliary equipment and harnesses.
- The standard specifies to the manufacturer how the item is to be designed, its strength requirements, testing and labeling requirements.
- For the item to carry the 1983 certification, the manufacturer must adhere to these standards.
- Most rescue teams strive to acquire 1983 compliant rescue gear, however this standard does not require any team or individual to use gear manufactured to NFPA 1983 standards.

WILDERNESS ROPE OPERATIONS

NFPA 1006

- The purpose of this standard is to specify the minimum JPRs (Job Performance Requirements) for service as a technical rescuer.
- This standard applies to other specialties as a rescuer, including swift water rescue, wilderness rescue and ten other specialties in its current format. All specialties include two levels of qualification: Level I and Level II.
- Level I applies to “individuals who identify hazards, use equipment, and apply limited techniques specified in this standard to perform technical rescue operations.”
- Level II applies to “individuals who identify hazards, use equipment, and apply advanced techniques specified in this standard to perform technical rescue operations.”

WILDERNESS ROPE OPERATIONS

NFPA 1670

- The purpose of NFPA 1670 is to assist the Authority Having Jurisdiction (AHJ) to assess a technical search and rescue hazard within the response area, identify the level of operational capability, and establish operational criteria.

- This standard applies to agencies and not individuals, so it is the standard that an agency (AHJ) complies with. By having its individual rescuers trained to the NFPA 1006 Technical Rescuer Professional Qualifications, the AHJ is completing part of the overall requirement to comply with NFPA 1670.

WILDERNESS ROPE OPERATIONS

STANDARDS and CERTIFICATION

- The accepted standards and certification processes for a rope rescue technician are governed by the Authority Having Jurisdiction (AHJ).

The paper means nothing unless your AHJ accepts and recognizes the certification.

WILDERNESS ROPE OPERATIONS

PERSONAL PROTECTIVE EQUIPMENT

Helmet
Harness
Gloves
Cutting Tool?

When working around load bearing ropes, knives and shears should ONLY be deployed as last-ditch tools. It is imperative you verify what you are cutting so you do not accidentally cut a lifeline.

WILDERNESS ROPE OPERATIONS

HARNESS TYPES

Class 1*

Class II

Class III

* Class 1 no longer listed in 1983. Now considered escape or hasty harnesses.

WILDERNESS ROPE OPERATIONS

HARNESS TYPES

Hasty Harness

WILDERNESS ROPE OPERATIONS

EQUIPMENT

Remember, your life is supported by the weakest link in the chain. Never buy used equipment!

WILDERNESS ROPE OPERATIONS

SAFETY FACTOR

- Safety factor is the minimum breaking strength (MBS) divided by the maximum force expected to be applied. Example: a carabiner rated for 5,000 lbf (22.2 kN) MBS with a 1000-pound load suspended from it has a safety factor of 5:1.

- How a piece of equipment is used will affect the MBS it is rated at. A knot tied in a rope decreases its MBS considerably. Side loading, tri-axial loading or torque loading a carabiner lowers its minimum breaking strength.

WILDERNESS ROPE OPERATIONS

STATIC SYSTEM SAFETY FACTOR

- A rope system should be thought of as a chain that will break at its weakest link. Loads and stresses will be different on each component depending on where it's placed or how it's used in the system. Each link should be analyzed for its safety factor in relation to the job it's performing. Calculation of the weakest link will give you the theoretical Static System Safety Factor (SSSF).

WILDERNESS ROPE OPERATIONS

DYNAMIC SYSTEMS SAFETY FACTOR

- Since rope rescue systems move, the forces applied to them will change from static (sitting still) to dynamic forces.
- Dynamic forces can be much higher on the overall system.
- DSSF is much harder to calculate than SSSF due to the variable factors involved. Example: how smooth a haul team operates the system will directly effect how much dynamic force gets applied to the system as the load is raised.

WILDERNESS ROPE OPERATIONS

FALL FACTOR and SHOCK LOADING

- Fall Factor (FF) equals the distance of the fall (D) divided by the length of the rope used in the system (L). FF=D/L
- The higher the fall factor, the greater the potential force (shock load) applied to the system.
- There are numerous factors that governor potential shock load: fall factor, rope stretch (elongation), friction in the system, loads, rope lengths, etc.
- Example: A 176 Lb. load dropped 2’ on a 4’ static rope (.5 FF) generates over 1500 pounds of force on the system and the patient.

WILDERNESS ROPE OPERATIONS

SAFETY FACTOR SOGs

- Varies between agencies.
- Often misunderstood – not dictated by a standard such as NFPA.
- Will typically be lower for lightweight teams such as mountain rescue.
- Actual safety factor can be raised by eliminating the potential for shock loading and dynamic events.
- Actual safety factor can be raised by reducing the load on the system.
- To simplify safety factor calculations, consider a single person load as 1 kN.

WILDERNESS ROPE OPERATIONS

ROPE RESCUE SYSTEM ANALYSIS

- CRITICAL POINT ANALYSIS

Where / what is the weakest link in the system?

- WHISTLE TEST

What happens if everyone goes hands-off at the same time?

WILDERNESS ROPE OPERATIONS

ROPE & WEBBING

- Static Kernmantle (typically less than 6% elongation)
- Dynamic Kernmantle (typically above 6% elongation)
- 1 Inch Flat & Tubular Webbing

- The most commonly used SRT and rescue rope is 7/16” (11mm) and 1/2” (13mm) diameter Static Kernmantle certified by the National Fire Protection Association (NFPA) 1983 Standard For Technical (or General) Rope Use. NFPA Technical Use is rated at no less than 20kN. NFPA General Use is rated at no less than 40kN.

- NFPA Technical Use is rated for one person loads at a 15:1 safety factor. NFPA General use is rated for two person loads with a 15:1 safety factor (one-person loads are considered to be 300 pounds and two-person load are considered 600 pounds).

WILDERNESS ROPE OPERATIONS

ROPE & WEBBING

Average Load Ratings Per Size (depending on manufacturer and type):

8.0mm (5/16) – 15 kN or 3500 Lbs.
9.0mm (3/8) – 20 kN or 4500 Lbs.
11.1mm (7/16) – 30 kN or 7000 Lbs.
12.7mm (1/2) – 40 kN or 9000 Lbs.
25mm (1.0 Inch) (tubular webbing) – 17.8 kN or 4000 Lbs.

(1 Kilo Newton equals 224.8 Lbs.)

WILDERNESS ROPE OPERATIONS

KERNMANTLE ROPE

- Kernmantle construction uses a sheath (mantle) and a core (kern).
- Used for most all rescue, rappelling and single rope technique applications.
- The core provides most of the strength and the sheath adds a protective layer for the core (depending on the design and the manufacturer).
- Constructed with parallel strands of fibers running through the core. Twist rate of these strands determines the elongation (stretch) of the rope.
- Static ropes, such as those used for rappelling and rescue work, will have less twist in the strands than dynamic ropes that are used for sport climbing and lead climbing.

WILDERNESS ROPE OPERATIONS

ROPE CARE

- Avoid shock loading.
- Avoid excessive abrading of the rope.
- Do not use Chlorine bleach or chemicals for cleaning.
- Inspect rope before and after each use.
- Wash rope after use in dirty environments.
- Do not dry in a clothes dryer.
- Store in a rope bag.
- Avoid prolonged exposure to UV rays.
- Always cut out any bad section.
- Protect the rope from all sharp edges.
- Never buy a used rope for lifeline purposes.
- Stepping on the rope (discuss the myth)

WILDERNESS ROPE OPERATIONS

WHEN TO RETIRE A ROPE / WEBBING

Is this rope still safe?

- If the rope has taken a hard fall (shock loaded) or used for some nonstandard use (such as towing a car), it should be retired.
- Before and after every use, each rope should be inspected along its entire length. Feel the rope for changes in diameter (swelling or shrinking), cuts or extreme abrasion. Any bad spots should be cut out and discarded.

WILDERNESS ROPE OPERATIONS

HARDWARE

- Carabiners
- Descenders / Lowering Devices
- Ascenders / Rope Grabs
- Pulleys
- Rigging Plates

WILDERNESS ROPE OPERATIONS

CARABINER TYPES

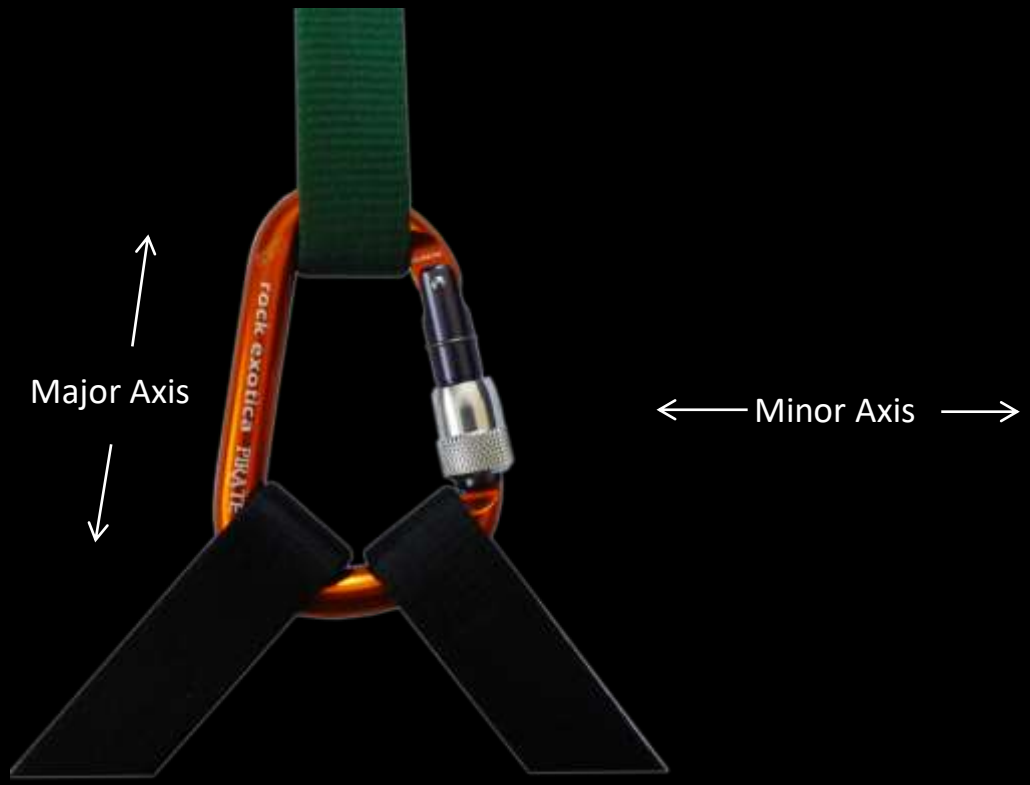
D | Offset D | Oval

Preferred

Per NFPA, Technical Use carabiners are rated at no less than 27kN on the major axis and 7 kN on the minor axis. General Use carabiners are rated at 40kN on the major axis and 11 kN on the minor axis.

WILDERNESS ROPE OPERATIONS

TRI-AXIAL LOADING



Try to avoid tri-axial loading and never load a carabiner along its minor axis!

WILDERNESS ROPE OPERATIONS

CARABINER ORIENTATION

- When horizontal, it is typically better to have the gate up so the gate can be seen, however situations may dictate otherwise.
- When vertical, most practitioners suggest gate down (discuss the myth of vibration causing the gate to unscrew).
- Front tensioning the system may help to keep horizontal anchor carabiners loaded properly against the spine.

SCREW GATES VS. AUTO-LOCKERS

- Anyone can operate a screw gate without much thought.
- Screw gates can jam easier than auto-lockers from being loaded.
- Screw gates seem to operate better in muddy or sandy conditions.

<Demonstrate how to un-jam a screw gate>

WILDERNESS ROPE OPERATIONS

DESCENDERS / LOWERING DEVICES

- There are numerous descending / lowering devices on the market, including Figure 8 variations, racks, shunts, ATCs, Grigris, IDs, MPDs, etc.
- Devices should match the rope size and application they are being used for.

NFPA 1983 (2012) requires the following for descent control devices:

- Technical Use: MBS not less than 13.5 kN (3,034 lbf)
- General Use: MBS not less than 22 kN (4,946 lbf)

WILDERNESS ROPE OPERATIONS

BRAKE BAR RACK

WILDERNESS ROPE OPERATIONS

PETZL RIG / ID / GRIGRI STYLE DEVICES

WILDERNESS ROPE OPERATIONS

MPDs / MAESTROS / CLUTCHES

- Heavy
- Not Compact
- Rope Size Specific

WILDERNESS ROPE OPERATIONS

FIGURE 8 STYLE DESCENDERS

Most manufacturers recommend a maximum lower or rappel of 100’ due to rope twist and heat buildup of Figure 8 style devices.

Working End to anchor

Attaches to harness with a locking carabiner

Brake Hand

WILDERNESS ROPE OPERATIONS

ITALIAN HITCH (MUNTER)

Working End

Attaches To Harness
Or Anchor

WILDERNESS ROPE OPERATIONS

ASCENDERS & ROPE GRABS

NFPA 1983 (2012) requires the following for rope grab and ascending devices:

Technical Use: No permanent damage to device or rope at 5 kN (1,124 lbf)
General Use: No permanent damage to device or rope at 11 kN (2,500 lbf)

WILDERNESS ROPE OPERATIONS

AUXILIARY EQUIPMENT

NFPA 1983 (2012) requires the following for auxiliary equipment:

Technical Use: MBS of not less than 22 kN (4,946 lbf)
General Use: MBS of not less than 36 kN (8,093 lbf)

WILDERNESS ROPE OPERATIONS

PROGRESS CAPTURE DEVICES

WILDERNESS ROPE OPERATIONS

KNOTS

The weakest part of a rope under a load is the knot. Always properly dress and set every knot in the system. An un-dressed knot can reduce the strength of the knot up to 50%.

There are numerous knots used in SRT and rescue operations. For the purpose of this course we are only teaching a few basic knots in these slides and will cover more advanced knot application in the field training exercises.

WILDERNESS ROPE OPERATIONS

DEFINITIONS

Hitch – A group of ties that wrap or attach to other objects or ropes.
Bend – A tie that brings together two rope ends.
Bight – A doubled section of rope that does not cross itself.
Loop –A turn of the rope that crosses itself.

Dressed – A tie with all components properly aligned.
Setting – Tightening all parts of a tie.

Working End – End of the rope used to fasten to an anchor
Standing End – All of the rope not fastened at the rigging point.
Running End – End of the rope that is not rigged.

A knot is not a knot until it is properly dressed and set.

WILDERNESS ROPE OPERATIONS

BIGHT SIZE

Try to make the bight only as large as needed to attach to the hardware. This helps to keep the bight in the spine of the carabiner and avoids cross loading.

WILDERNESS ROPE OPERATIONS

FIGURE 8

Photo courtesy www.animatedknots.com

The Figure 8 family of knots are the most commonly used in rope work due to their strength and ability to easily untie.

WILDERNESS ROPE OPERATIONS

FIGURE 8 FOLLOW-THROUGH

Photo courtesy www.animatedknots.com

For tying a single rope around an anchor or object.

WILDERNESS ROPE OPERATIONS

FIGURE 8 ON A BIGHT

Most commonly used knot to attach rope to anchor points and harness.

WILDERNESS ROPE OPERATIONS

DOUBLE FIGURE 8

Common knot used to attach rope to multiple rigging points.

WILDERNESS ROPE OPERATIONS

FIGURE 8 BEND

Photo courtesy www.animatedknots.com

For tying two ends of a rope together.

WILDERNESS ROPE OPERATIONS

WATER KNOT

Photo courtesy www.animatedknots.com

Preferred knot for tying two ends of webbing.

WILDERNESS ROPE OPERATIONS

DOUBLE FISHERMAN

Photo courtesy www.animatedknots.com

Used to tie two ends together. A secure knot with minimum size.
The main use is for tying prusik loops.

WILDERNESS ROPE OPERATIONS

POACHER's KNOT

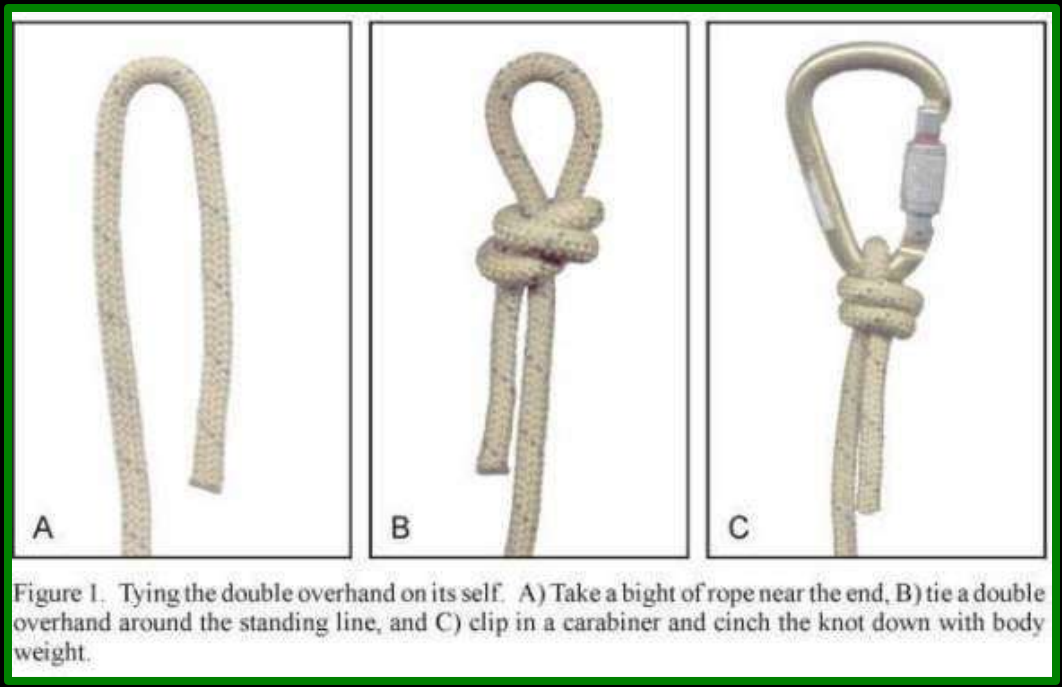


Figure 1. Tying the double overhand on its self. A) Take a bight of rope near the end, B) tie a double overhand around the standing line, and C) clip in a carabiner and cinch the knot down with body weight.

Excellent knot for typing tethers and safeties to carabiners to avoid cross loading. Hard to untie after loading.

WILDERNESS ROPE OPERATIONS

PRUSIK HITCH

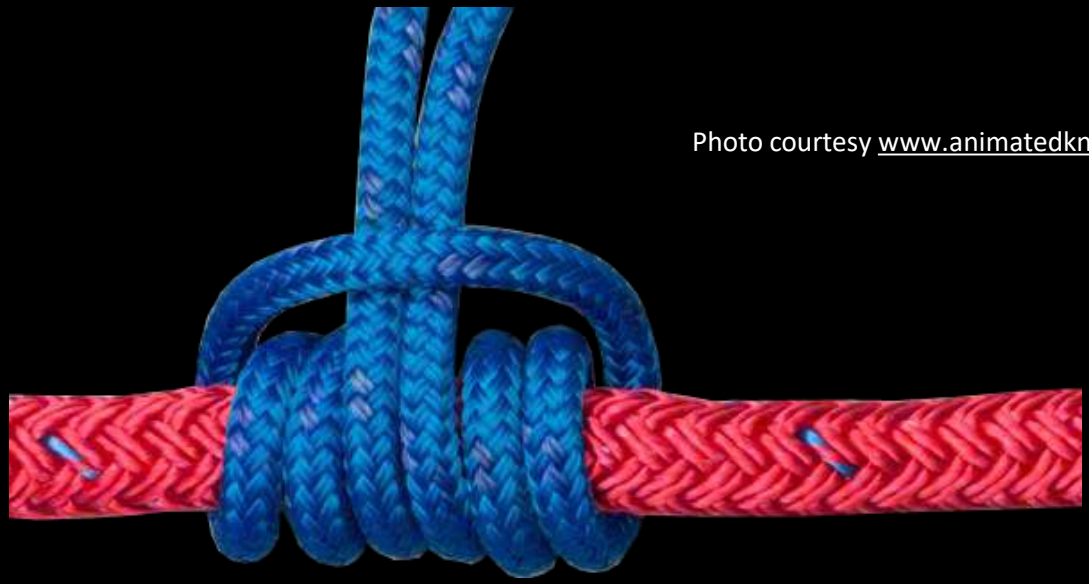
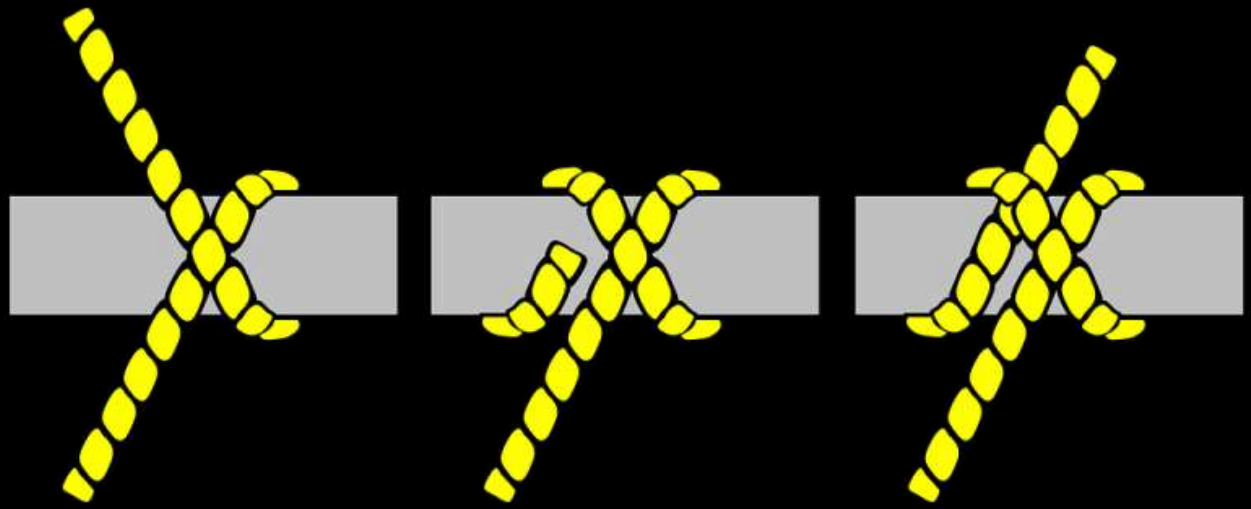


Photo courtesy www.animatedknots.com

A friction knot used as a rope grab.

WILDERNESS ROPE OPERATIONS

CLOVE HITCH



WILDERNESS ROPE OPERATIONS

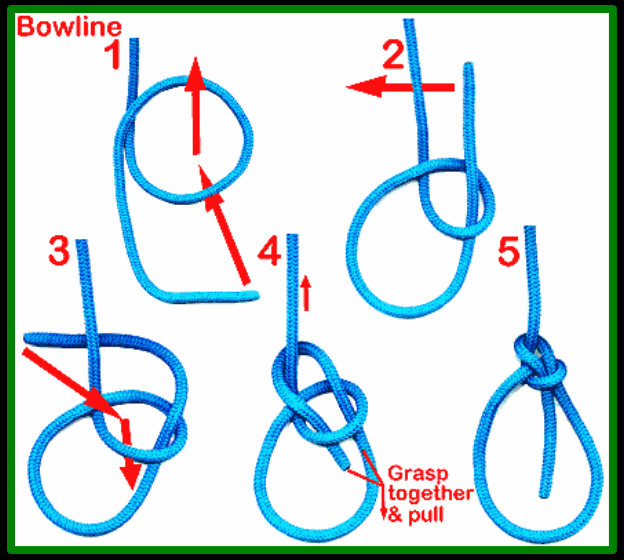
ALPINE BUTTERFLY

Photo courtesy www.animatedknots.com

Used as a mid-line knot.

WILDERNESS ROPE OPERATIONS

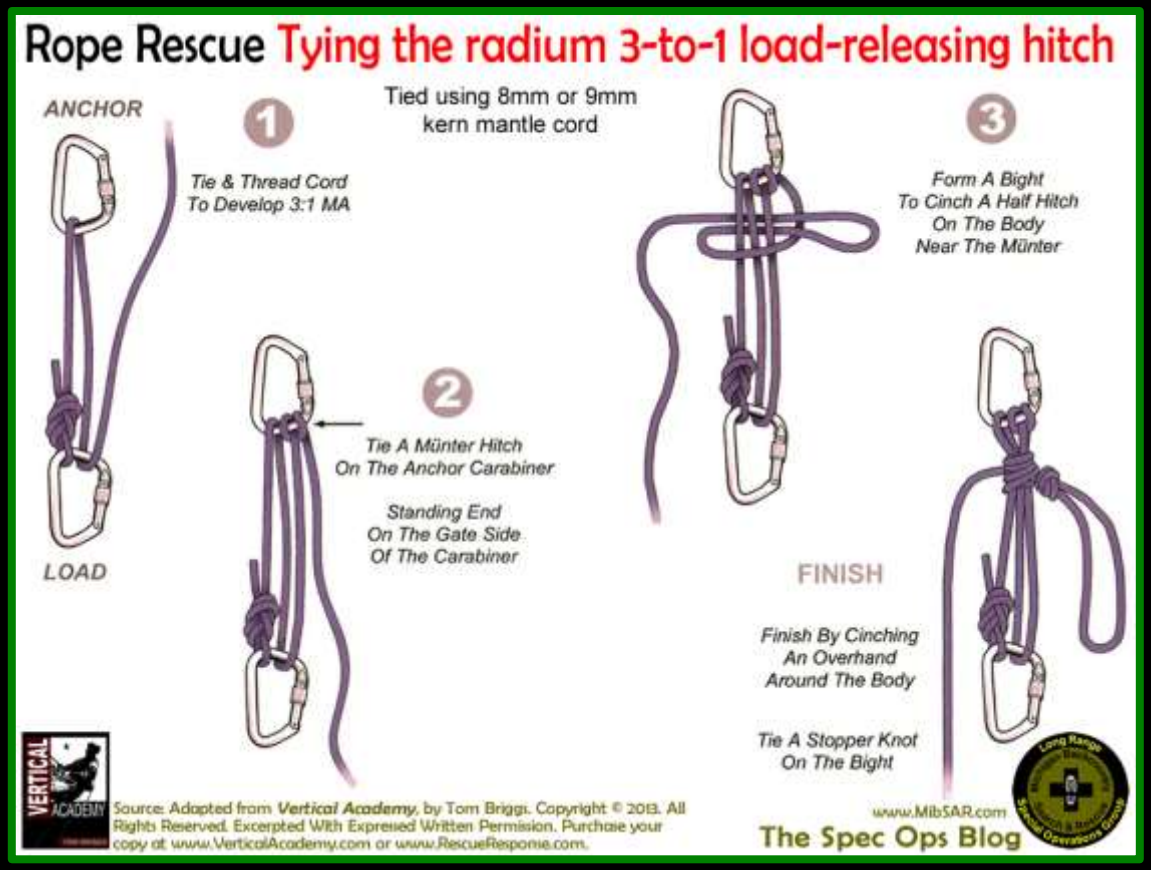
INTERLOCKING LONG-TAIL BOWLINE



Fire service method used in litter rigging to attach main line and belay line together. Not commonly seen in lightweight wilderness rigging.

WILDERNESS ROPE OPERATIONS

RADIUM RELEASE HITCH



Used as a load releasing hitch for rescue hauls and lowers.

WILDERNESS ROPE OPERATIONS

TENSIONLESS HITCH

(High-Strength Tie Off, Friction Wrap)

With the right anchor point, the Tensionless Hitch allows the rope to be tied off without sacrificing rope strength, unlike a knot.

WILDERNESS ROPE OPERATIONS

KNOT BREAKING STRENGTH

	Percentage of Rope Strength Lost*
Figure 8 On A Bight	20%
Figure 8 Bend	19%
Double Figure 8	18%
Bowline	33%
Double Fisherman	21%

Best assumption is 50% strength reduction

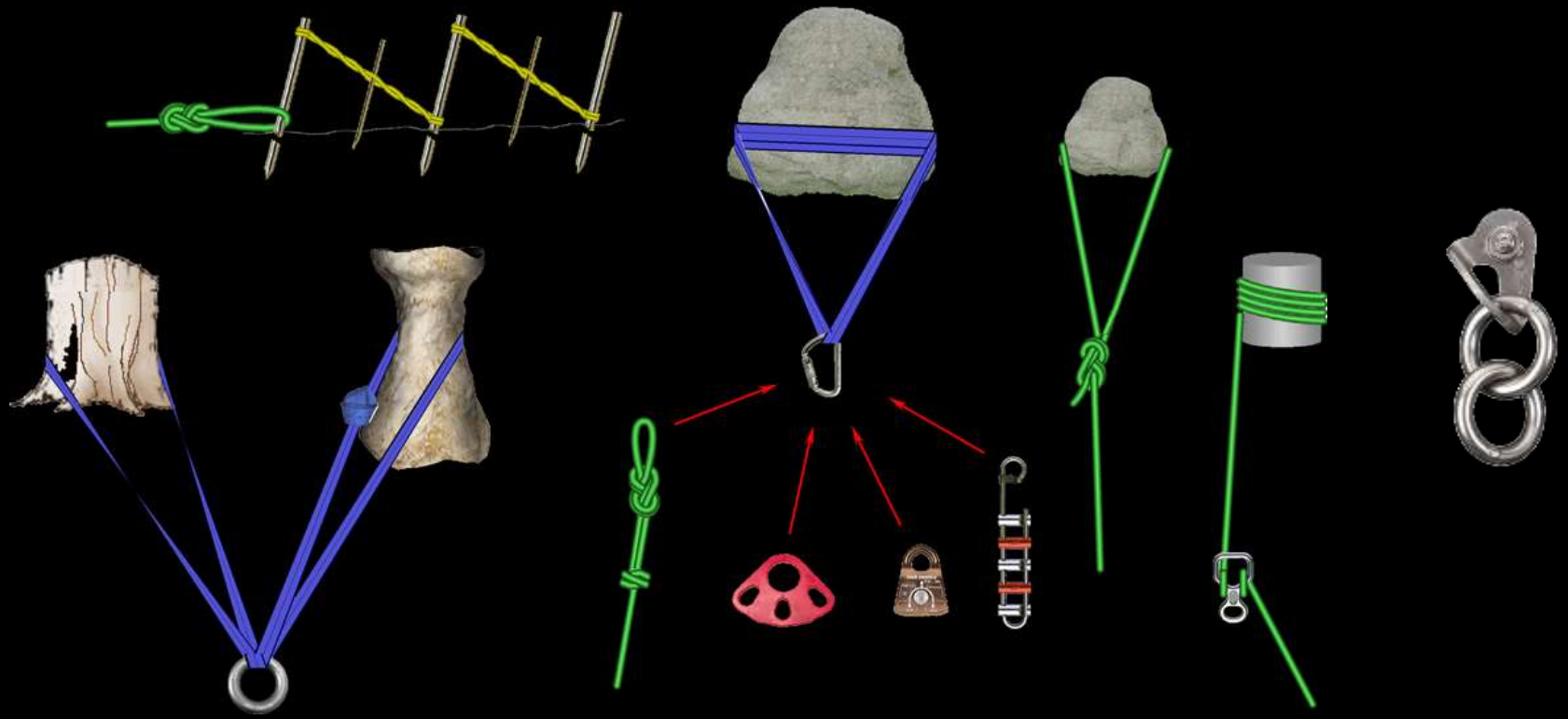
*Test results printed in the CMC Rope Rescue Manual

WILDERNESS ROPE OPERATIONS

ANCHORS

WILDERNESS ROPE OPERATIONS

Various Anchor Concepts



(Concept photo created in vRigger software)

WILDERNESS ROPE OPERATIONS

TENSIONLESS HITCH
(High-Strength Tie Off, Friction Wrap)

WILDERNESS ROPE OPERATIONS

FIGURE 8 FOLLOW-THROUGH

Photo courtesy www.animatedknots.com

WILDERNESS ROPE OPERATIONS

SIMPLE ANCHORS

Wrap 3, Pull 2

Basket Hitch
Potential tri-axial loading issues

WILDERNESS ROPE OPERATIONS

WRAP 3, PULL 2

(Note: water knot should always go against anchor)

WILDERNESS ROPE OPERATIONS

3-BIGHT (BASKET HITCH)

Simple, quick, and can be pre-made using webbing or rope.

Be aware of triaxial loading. Use an extra carabiner if needed.

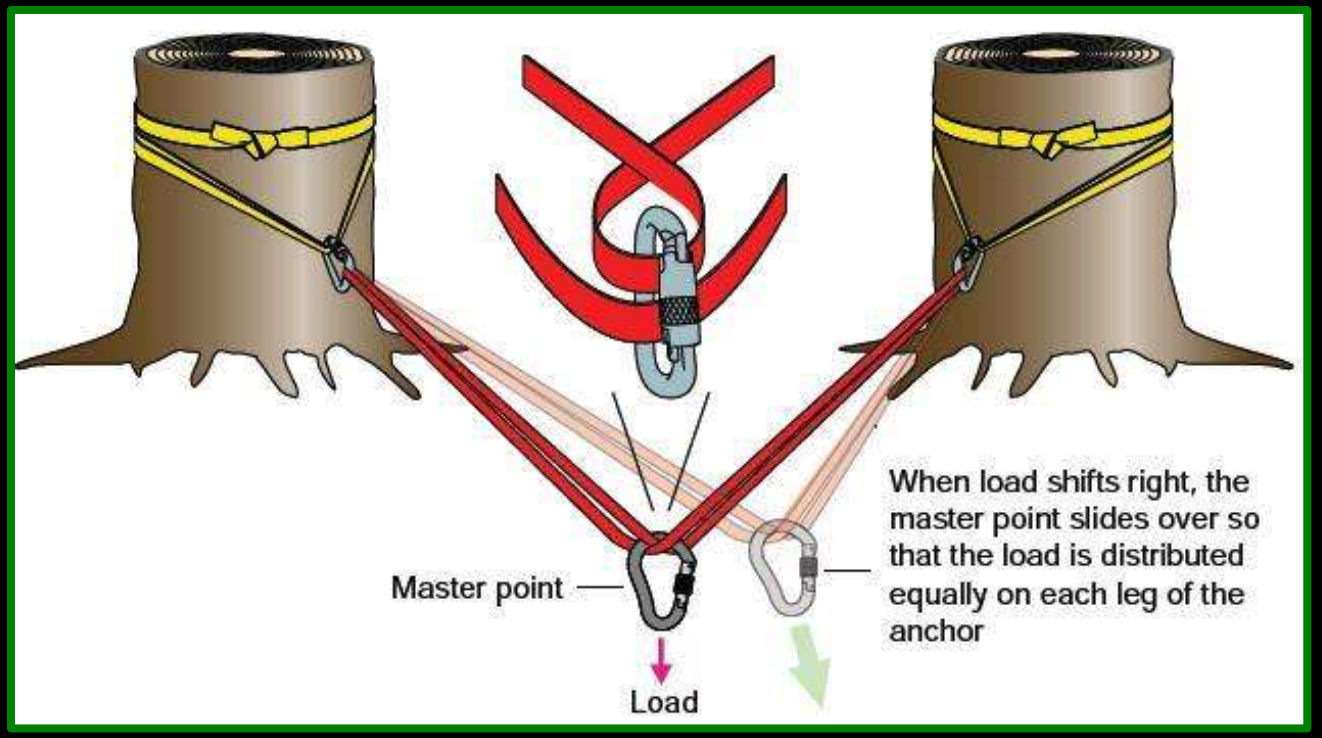
Caution should be used when using on short anchors such as short tree stumps since movement in the system could cause the webbing to creep upwards.

WILDERNESS ROPE OPERATIONS

COMPOUND ANCHORS

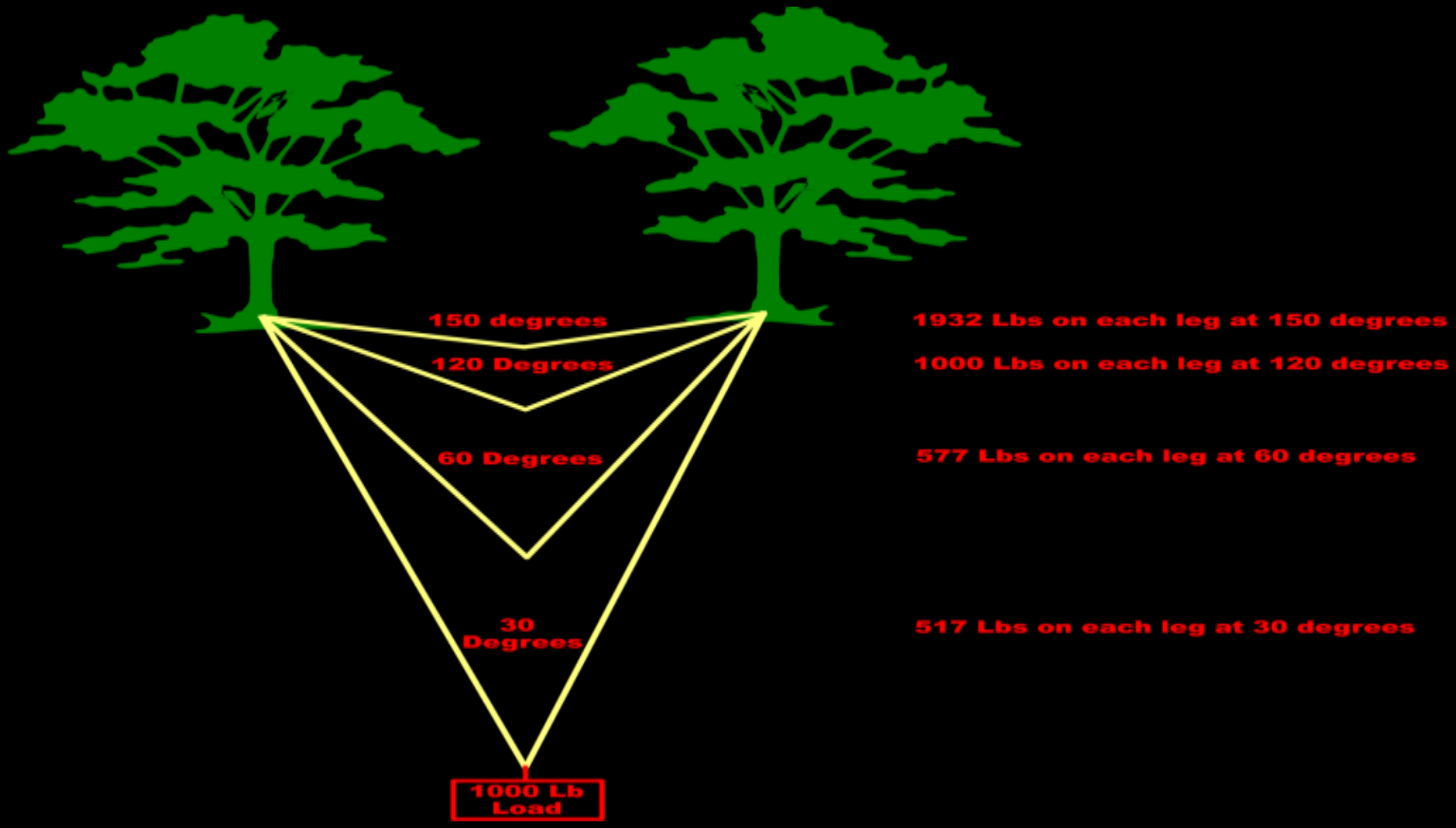
Self-Equalizing

We do NOT suggest using self-equalizing anchors such as this. It is better to tie a master point instead of being self-equalizing.



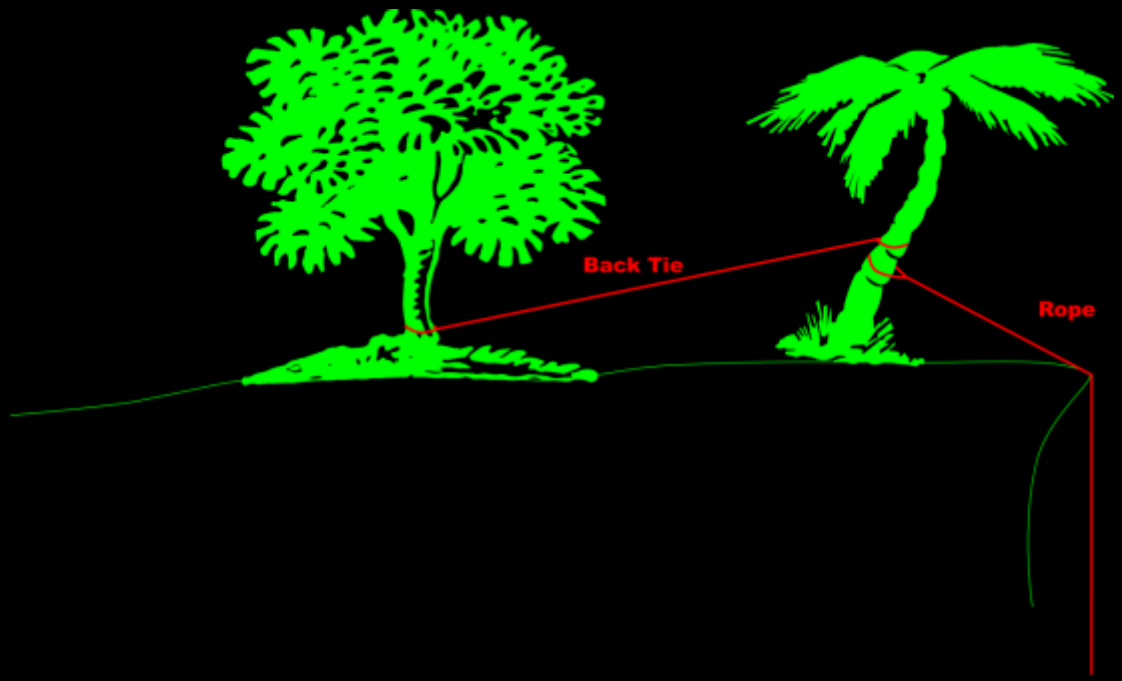
WILDERNESS ROPE OPERATIONS

ANCHOR LOAD RELATIONSHIP



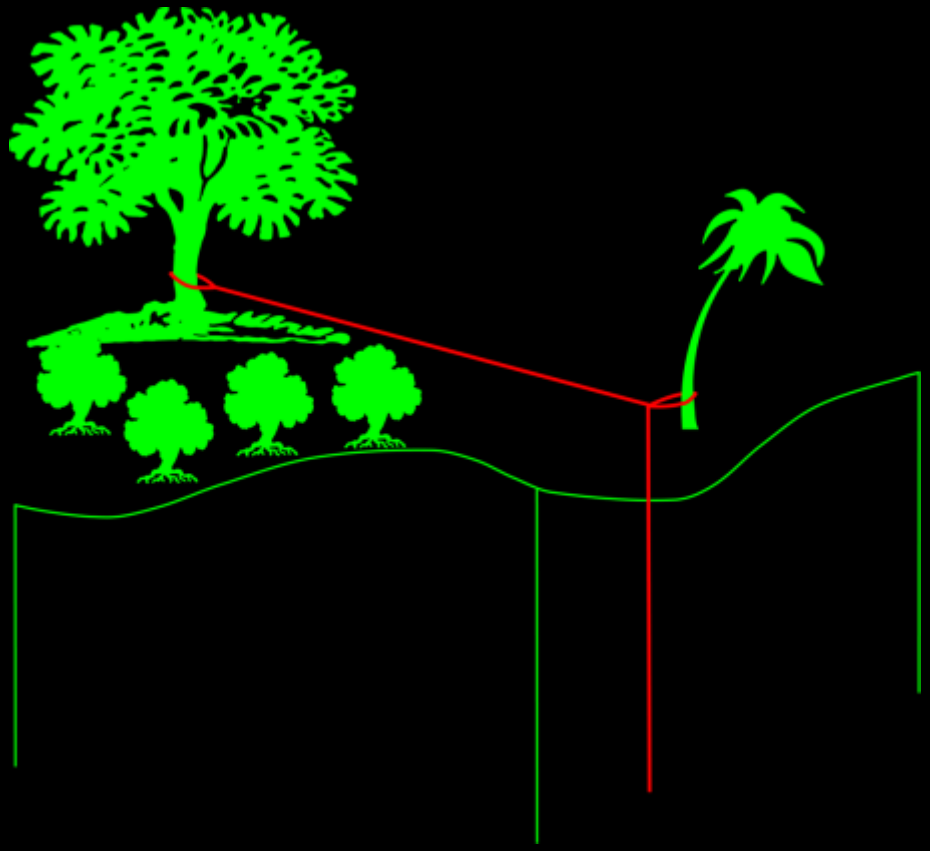
WILDERNESS ROPE OPERATIONS

PRE-TENSIONED BACK-TIES



WILDERNESS ROPE OPERATIONS

ANCHORS WITH DIRECTION CHANGE



If you need need a direction change in your mainline to clear an obstruction or to make the rappel more accessible, rig the direction change the same way you would rig a main anchor. It is important to remember the anchor load relationship (previous slide) and the increased stresses that vectors may apply to the anchor.

WILDERNESS ROPE OPERATIONS

ARTIFICAL HIGH DIRECTIONALS

<demonstrate in the field>

WILDERNESS ROPE OPERATIONS

ARTIFICAL HIGH DIRECTIONALS

<demonstrate in the field>

WILDERNESS ROPE OPERATIONS

IMPROVISED HIGH DIRECTIONALS

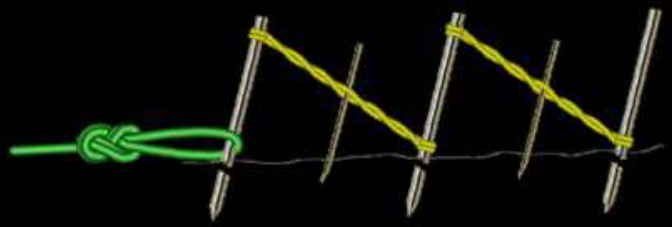
Discussion:

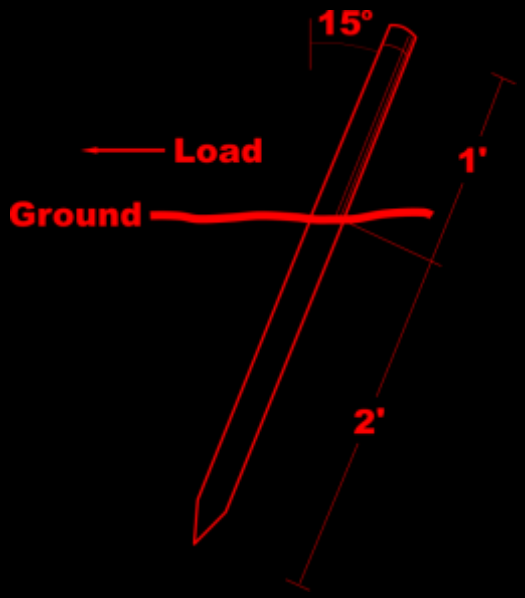
- Trees, Tripods, Gin Poles
- Resultant angle
- Independent belay or second line considerations

WILDERNESS ROPE OPERATIONS

IMPROVISED ANCHORS

- Vehicles
- Pickets
- Bushes
- Climbing Bolts
- Rock Pro





1” Diameter Picket has an average weight holding of 700 Lbs. in average loamy soil.

WILDERNESS ROPE OPERATIONS

EDGE PROTECTION

- All places where a rope or webbing touches a sharp edge should be protected with rope pads, clothes, canvas tarps or other materials.
- This is especially applicable when ascending a rope due to the up and down sawing action caused by climber's movement up the rope.
- Protect any software-on-software point that has a moving component.

WILDERNESS ROPE OPERATIONS

RAPPELLING

WILDERNESS ROPE OPERATIONS

ROPE DEPLOYMENT

- Rig your anchor and then attach rope.
- Attach yourself to the rope with a prusik hitch (or other rope grab) from your harness to the rope.
- Attach your descending device.
- Verify your belays.
- Deploy the rope over the edge.

- If you are unsure if the rope reaches the bottom, tie a stop knot in the running end of the rope so you don't accidentally rappel off the end.

WILDERNESS ROPE OPERATIONS

SAFETY CHECKOFF BEFORE RAPPEL

- Gloves and helmet on.
- Verify your anchor is properly rigged.
- Verify your rope is secured to the anchor.
- Verify your harness is secure and properly fastened.
- Verify your belay (self-belay or otherwise).
- Verify the rope is properly rigged into your descender.
- Verify that all carabiners are locked.

There is ALWAYS time for safety!

WILDERNESS ROPE OPERATIONS

AUDIBLE COMMANDS

- Rappeler shouts “On belay” when he/she attaches to the lifeline
- Belayer responds “Belay on”
- Rappeler shouts “Rappelling” as he/she moves to the edge
- Belayer responds “Rappel on”
- Rappeler shouts “Off rappel” once he/she detaches from the rope
- Anyone who sees any object fall from the top shouts “Rock!”

WILDERNESS ROPE OPERATIONS

WORKING THE EDGE

Going over the edge is the most difficult part of rappelling. The lower your anchor point is in relation to your descender, the more difficult it will be. On narrow overhangs (as shown in the photo on the right), you may have to roll off the edge. Make sure your descender is clear of the edge and you are holding brake tension before attempting this maneuver.

WILDERNESS ROPE OPERATIONS

GUIDED RAPPELS

WILDERNESS ROPE OPERATIONS

BELAYING

A belay is a secondary process or piece of equipment that protects the load from falling should the primary process or piece of equipment fail.

WILDERNESS ROPE OPERATIONS

SELF BELAYS / AUTO BLOCKS

VT Hitches are much better than 3-wrap prusiks when using hitches for self-belays.

This belay system is not a backup for a mainline failure.

WILDERNESS ROPE OPERATIONS

(Concept photo created in vRigger software)

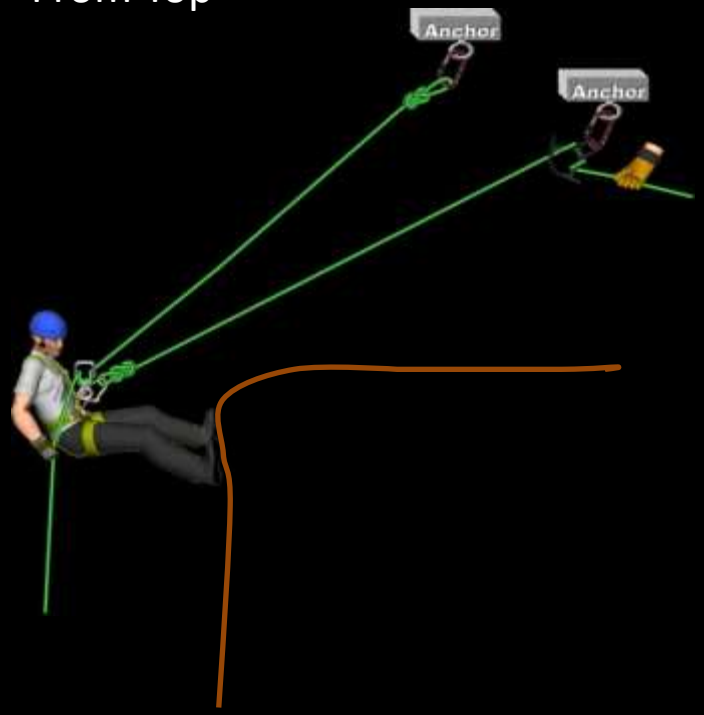
BOTTOM BELAY (SRT)
(AKA Fireman Belay)

This belay system is not a backup for a mainline failure.

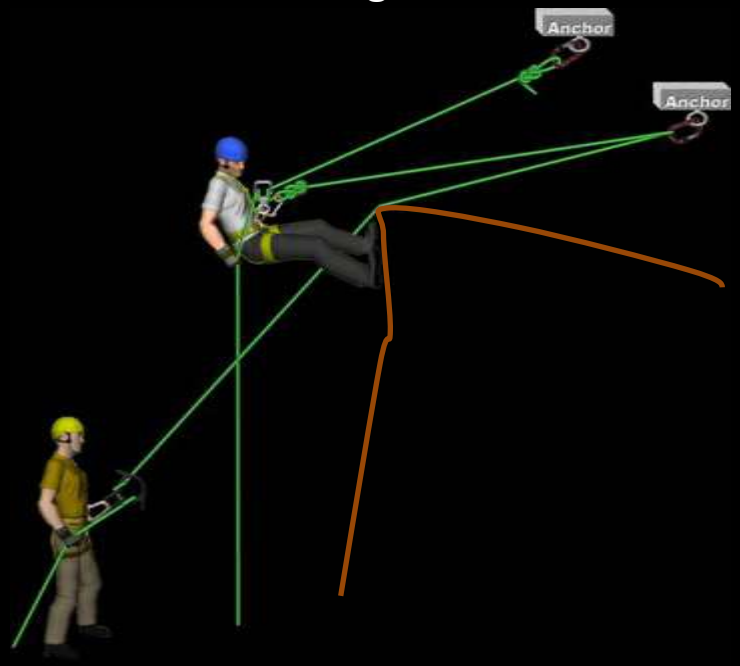
WILDERNESS ROPE OPERATIONS

INDEPENDENT BELAYS

From Top



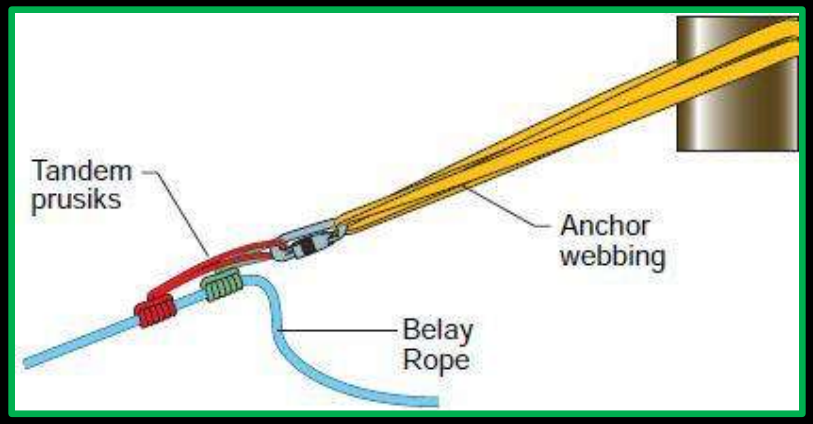
From Bottom With Direction Change



(Concept photo created in vRigger software)

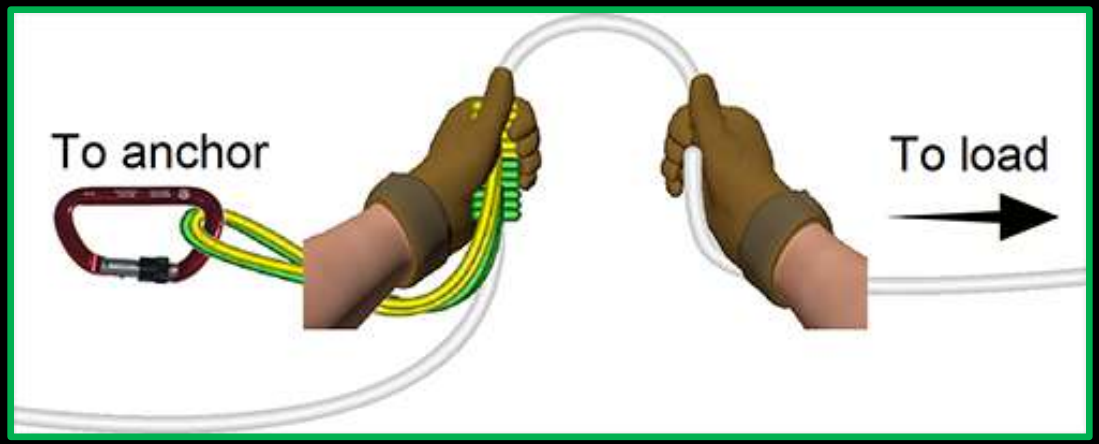
WILDERNESS ROPE OPERATIONS

TANDEM PRUSIK BELAYS



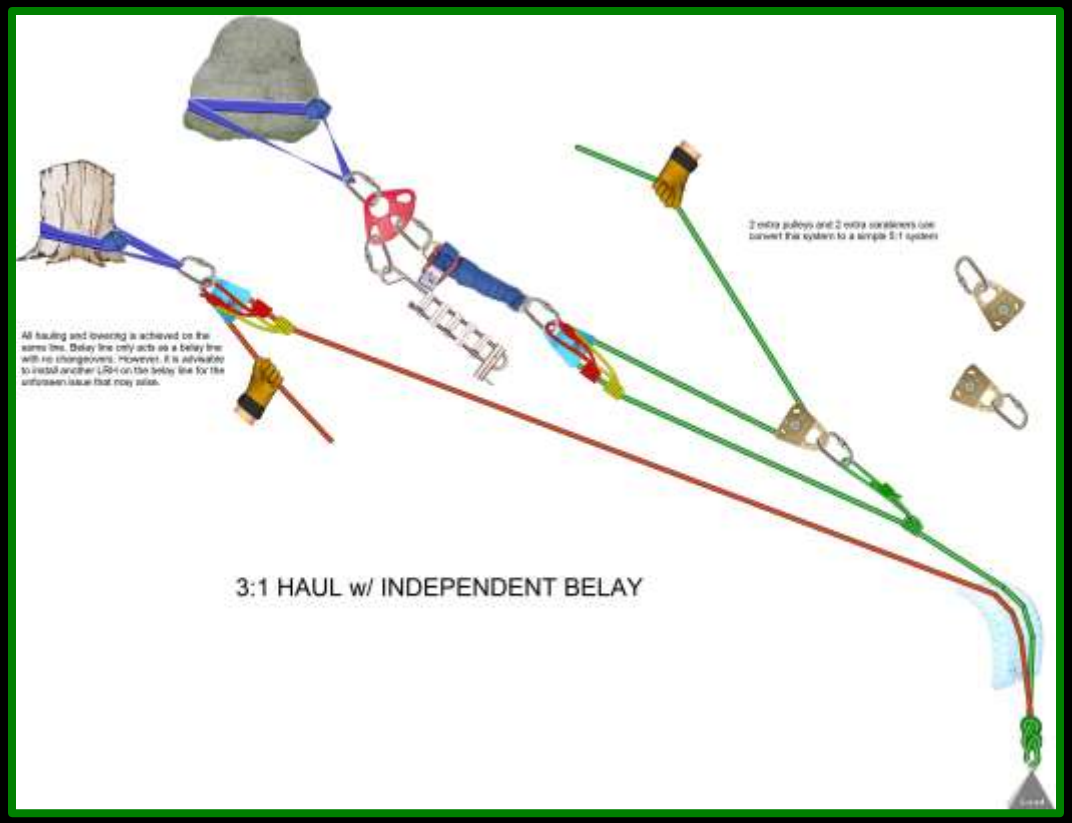
Prusiks should be about 25% smaller than the rope they are attached to.

On tandem prusik systems the short prusik always attaches between the long prusik and the anchor.



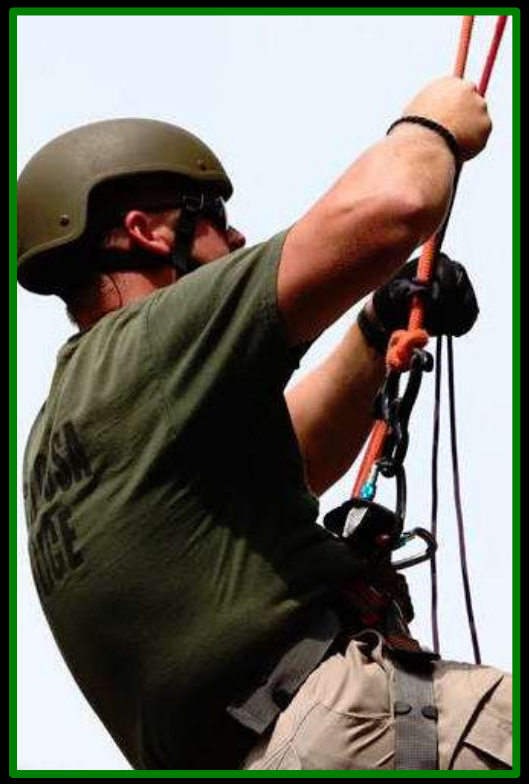
WILDERNESS ROPE OPERATIONS

TANDEM PRUSIK BELAYS



WILDERNESS ROPE OPERATIONS

SELF-RESCUE



- Stuck Self-Belays
- Figure 8 Girth Hitching
- Hair Or Clothing Caught In Device
- Equipment Jams

Discussion & Practice:

- Using Rope Grabs For Rescue
- Using Main Rope For Rescue

WILDERNESS ROPE OPERATIONS

PICK-OFF RESCUES

- Pick Off Straps –Static
- Pick-Off Straps – Dynamic (Set Of 4s, LRHs)

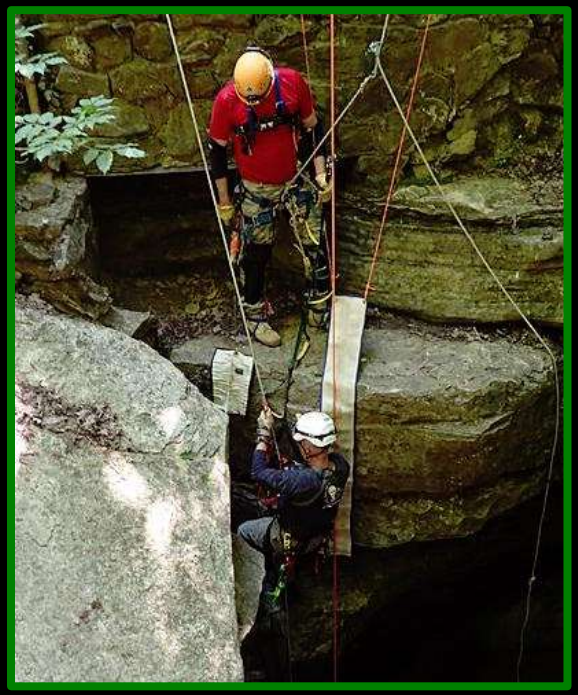
Discussion & Practice:

- Lowering Rescuer To Victim
- Rappelling To Victim (SRT)
- Rescuing On Victim's Rope
- Cutting An Active Rope

WILDERNESS ROPE OPERATIONS

ASCENDING WITH MECHANICAL ASCENDERS

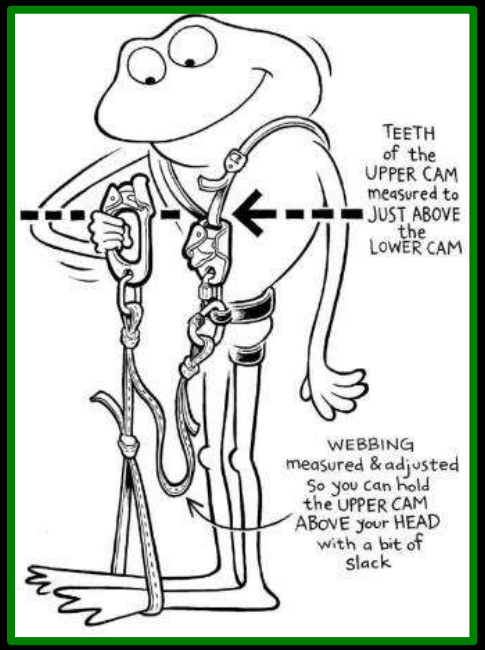
In lightweight rescue, it is essential that wilderness rescue technicians have the ability to efficiently climb a rope.



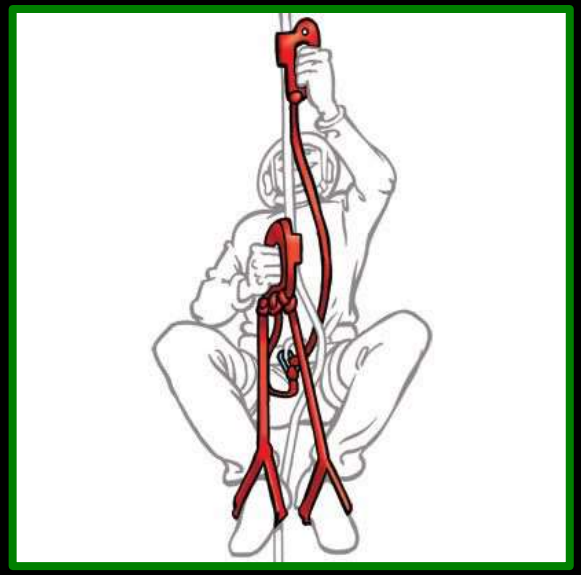
WILDERNESS ROPE OPERATIONS

ASCENDING WITH MECHANICAL ASCENDERS

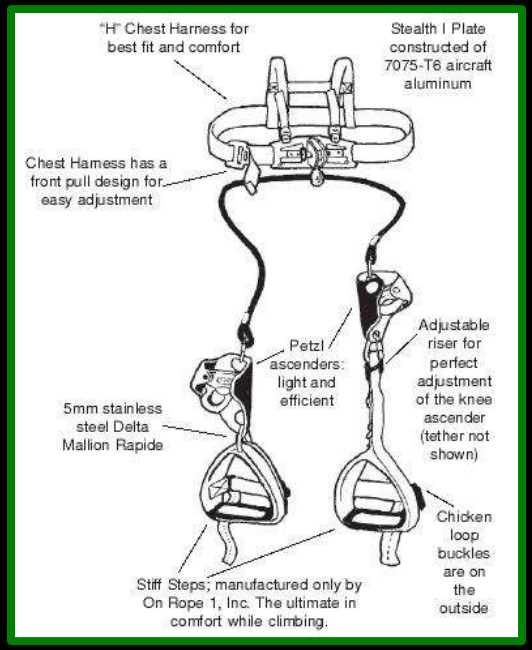
SYSTEMS



Frogging



Texas



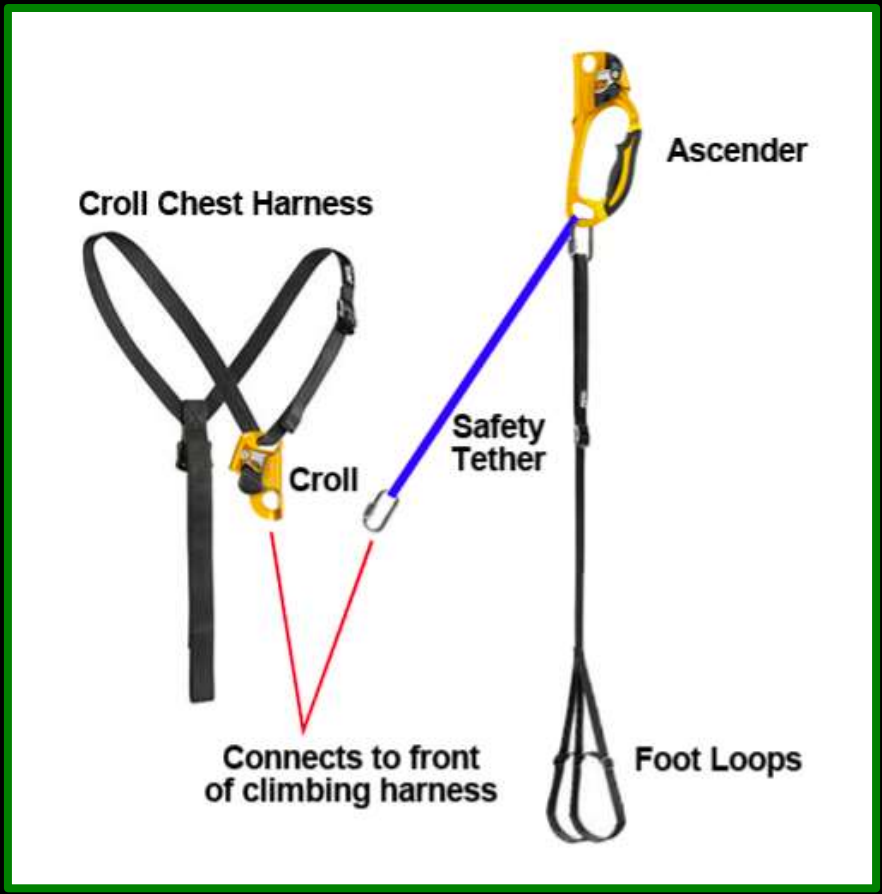
Rope Walker

WILDERNESS ROPE OPERATIONS

FROG SYSTEM

The Frog System is a preferred system in lightweight rescue.

(see printed handout for more information.)



QAS (Quick Attach Safety) not shown.

WILDERNESS ROPE OPERATIONS

CHANGEOVER FROM RAPPEL TO ASCEND

Discussion, Demonstration & Practice

1. Hard lock descender (or allow self-belay prusik to take the load).
2. Attach prusik cord or capture device just above descender and attach to harness (If you are already using a self-belay prusik cord attached above the descender then you can use this).
3. Attach ascender (with foot loop and safety tether) to the rope above the descender and place your foot into the foot loop.
4. Unlock descender and slowly allow the prusik (or progress capture) to take the load (No need to do this if you have already transferred load to the self-belay prusik).
5. Remove descender from the system and secure.
6. Push up with your leg in the foot loop. This will raise you high enough to take the load off of the harness prusik.
7. Push harness prusik (or other progress capture) up the rope and transfer your weight to it.
8. Repeat pushing up with your leg and transferring weight until you reach the top.

WILDERNESS ROPE OPERATIONS

CHANGEOVER FROM ASCEND TO RAPPEL

1. Attach QAS and allow foot loop safety or QAS to hold your weight.
2. Attach descender to the rope below the QAS or safety. Remove as much rope slack as possible.
3. Move the ascender with the foot loop up as high as possible, then push up with your leg, removing slack in the descender as you go up.
4. Once all slack is removed from descender, transfer the load to the descender by lowering yourself with your pushing leg.
5. Lock off the descender.
6. Remove ascender with foot loop and secure.
7. Remove harness prusik (or leave on as a self-belay)
8. Slowly unlock descender making sure you maintain rope friction with your brake hand.
9. Rappel normally.

WILDERNESS ROPE OPERATIONS

ASCENDING WITH PRUSIKS

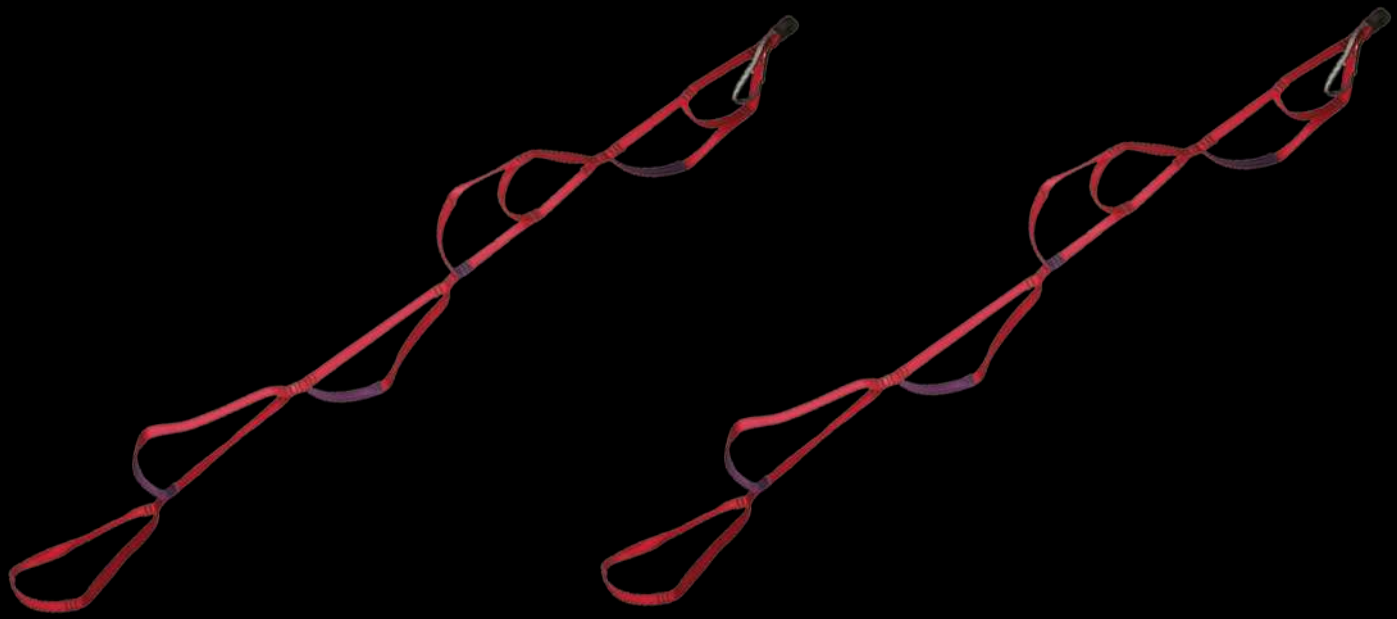
- Ascending with prusiks is the same principle as using mechanical ascenders. Be sure to carry both the harness and foot prusiks with you when you rappel, and make sure their length is adjusted to work as ascenders.

- It is always best to design and test your prusiks and ascender cords on the ground first. Test them by climbing the rope from ground up before you need them on a rappel.

WILDERNESS ROPE OPERATIONS

ETRIERS

Etriers are short manufactured or field fabricated “ladders” made from webbing. They are extremely handy for negotiating over the edge when ascending a rope with prusiks or mechanical ascenders. When attached to an ascender they can be used for ascending a rope.

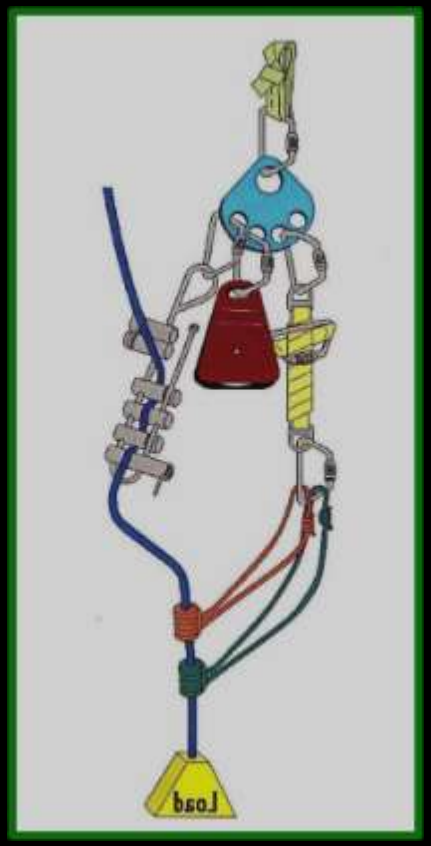


WILDERNESS ROPE OPERATIONS

BASIC RESCUE RAISES & LOWERS

WILDERNESS ROPE OPERATIONS

RPM SYSTEM



Rack (lowering Device)
Pulley (COD for Raising Mechanical Advantage)
Mariners (Load Release Hitch)

WILDERNESS ROPE OPERATIONS

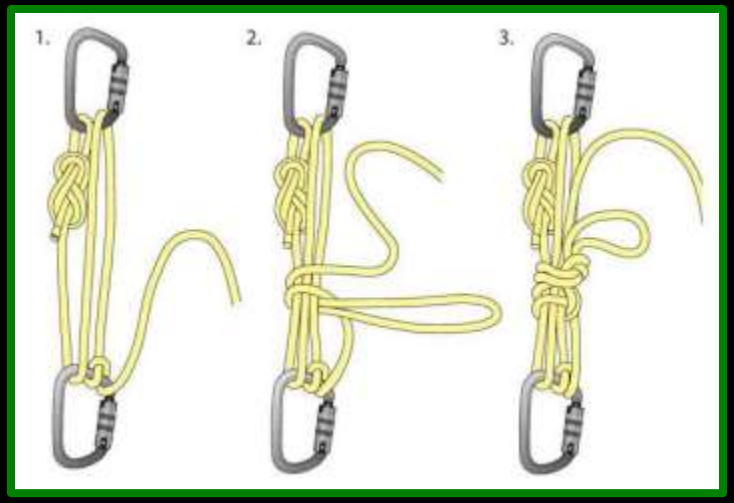
DUAL TENSION SYSTEMS

- Reduces shock load potential due to tension being shared by both lines.
- Both ropes serve as mainlines and backup lines at the same time.
- Rigging is typically the same for both lines, thus less complexity in equipment and operating techniques.
- Since both ropes are active, each line operator is more attentive to the operation.

WILDERNESS ROPE OPERATIONS

LOAD RELEASE HITCHES

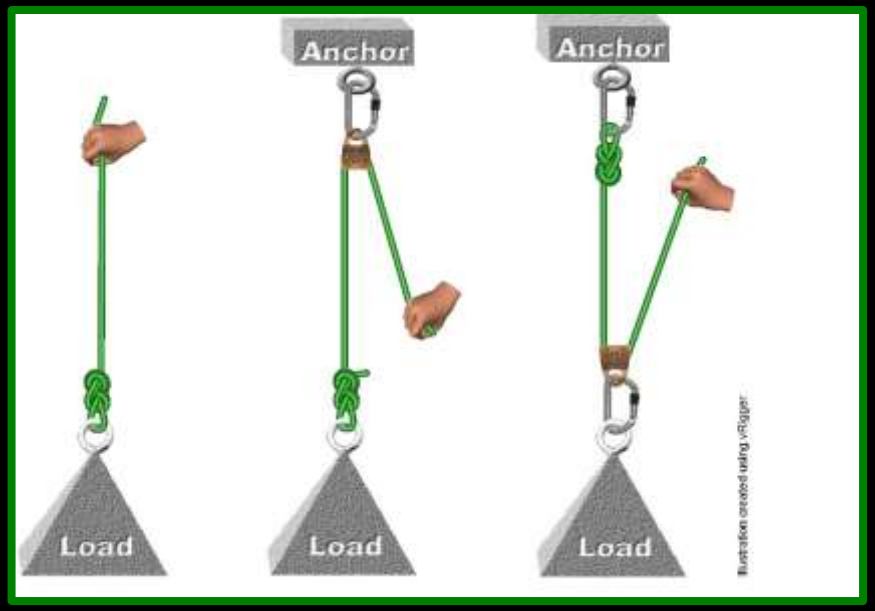
A load release hitch allows the load to be transferred from one rope to another, or transfer load during a changeover from a raising operation to a lowering operation. They can also be used to do pick-off rescues and knot passes.



- Mariners Hitch
- Radium Release Hitch
- Piggyback Rigs

WILDERNESS ROPE OPERATIONS

PRINCIPLES OF MECHANICAL ADVANTAGE (MA)



The Basics:

- End of rope starts at load = Odd
- End of rope starts at anchor = Even

- Moving pulley = MA
- Static pulley = COD

WILDERNESS ROPE OPERATIONS

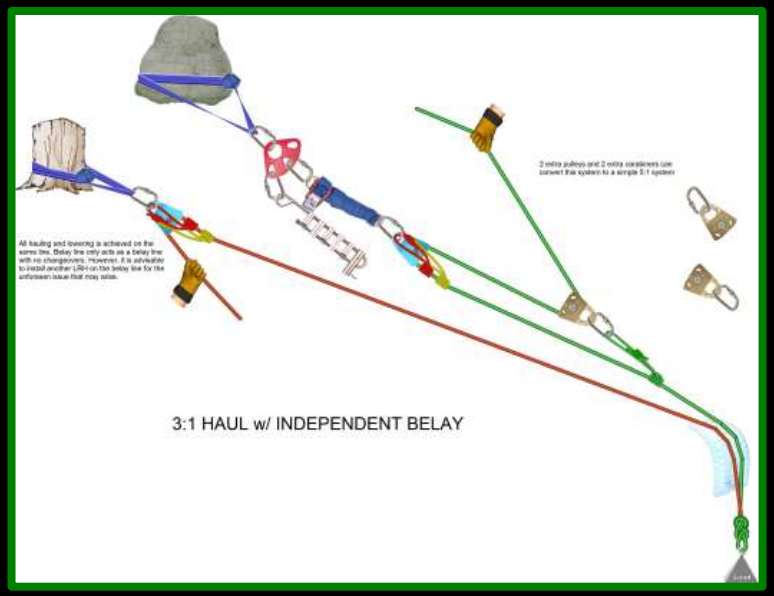
PRINCIPLES OF MECHANICAL ADVANTAGE (MA)

Discussion & Demonstrations:

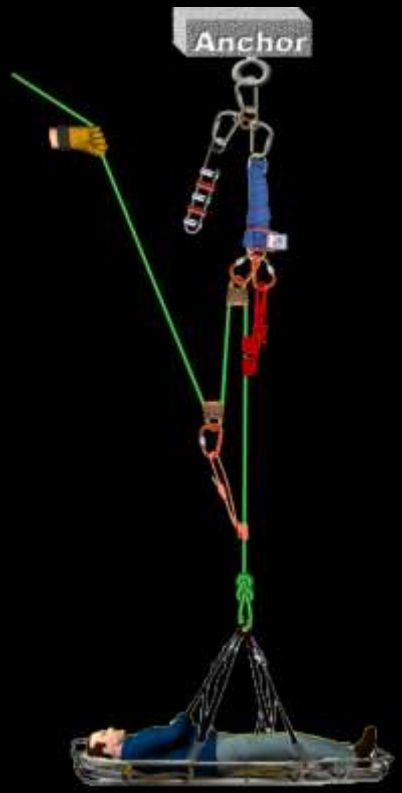
- Simple
- Compound
- Complex

WILDERNESS ROPE OPERATIONS

3:1 SIMPLE SYSTEM



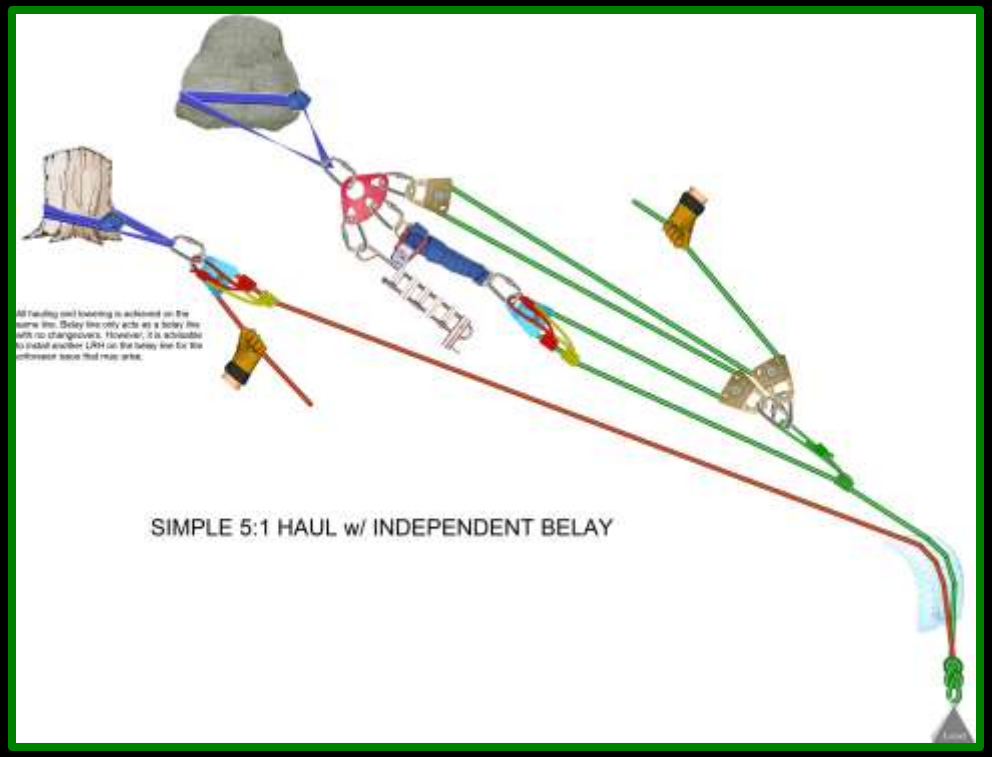
3:1 Raise System



(Concept photo created in vRigger software)

WILDERNESS ROPE OPERATIONS

5:1 SIMPLE



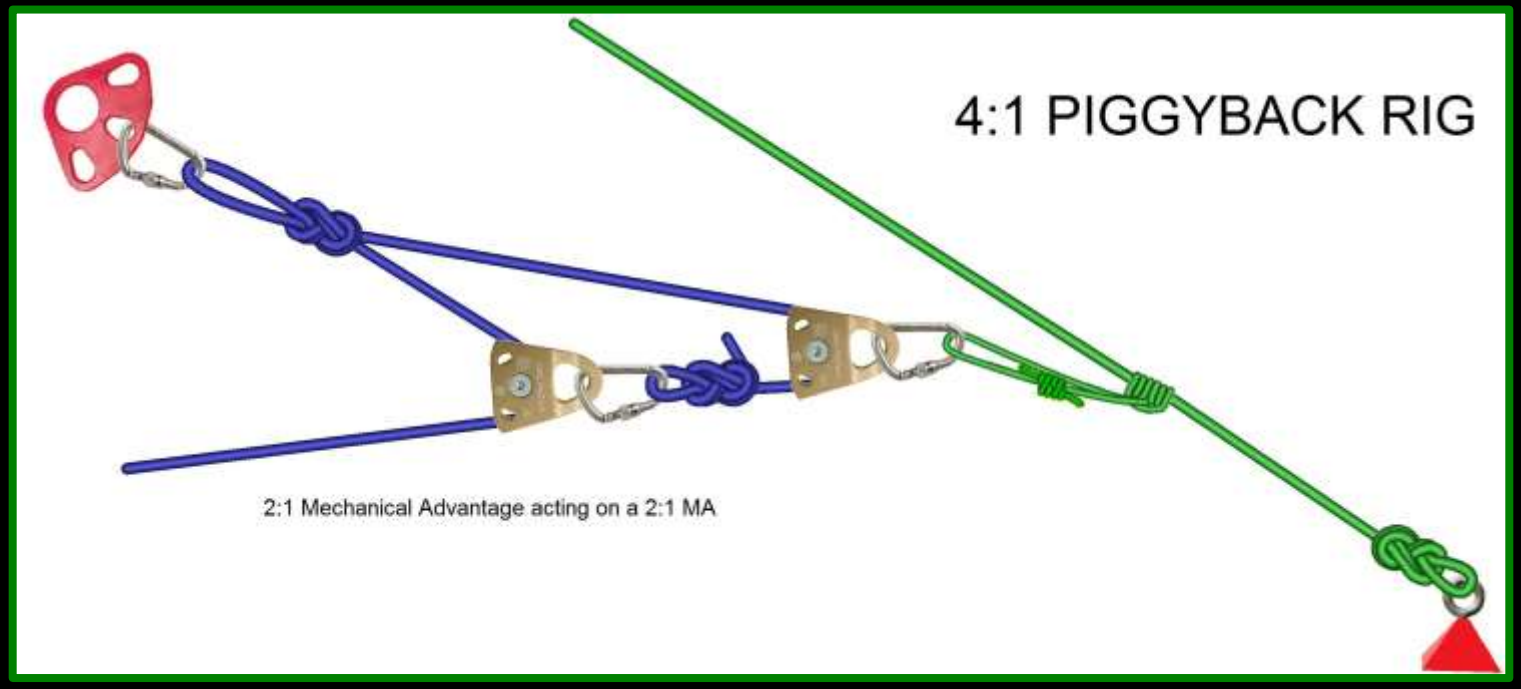
WILDERNESS ROPE OPERATIONS

PIGGYBACK SYSTEMS

A “set of 4s” can be 4:1 or 5:1 depending on how it is put in the system.

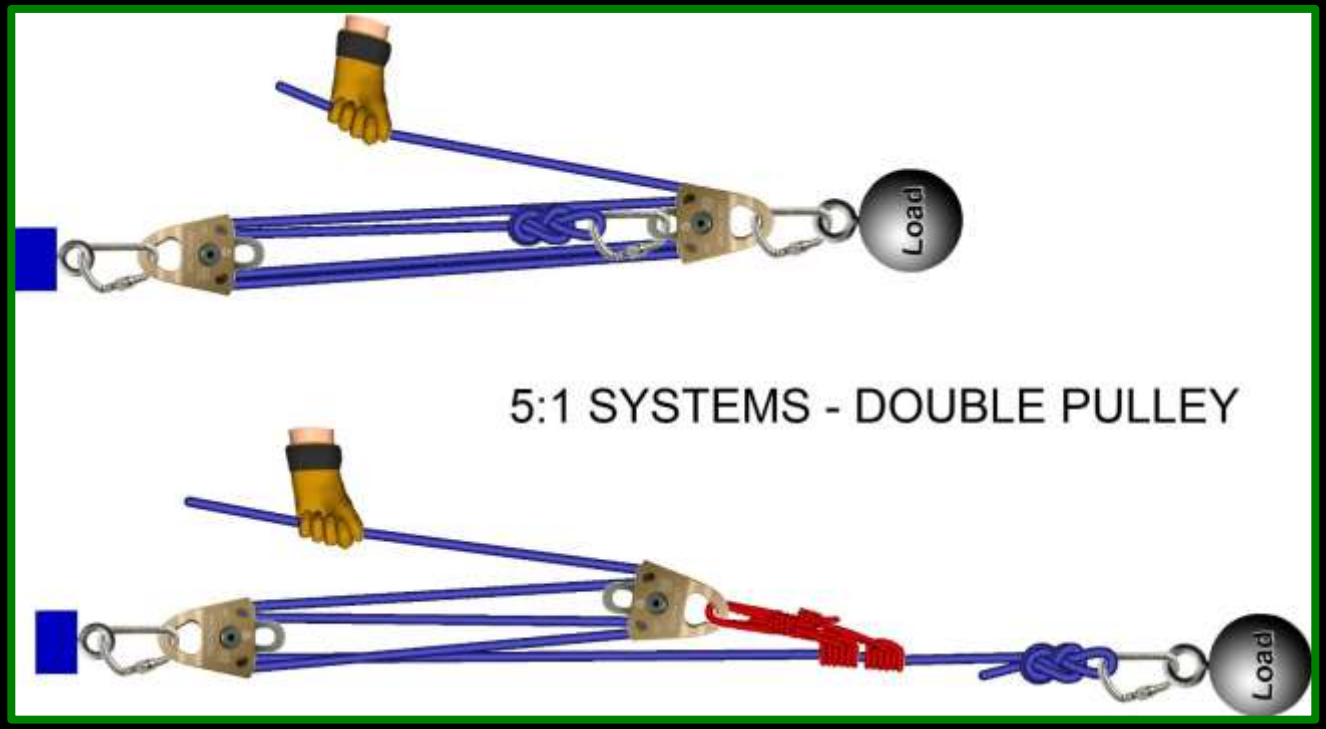
WILDERNESS ROPE OPERATIONS

4:1 PIGGYBACK



WILDERNESS ROPE OPERATIONS

DOUBLE PULLEY SYSTEMS



WILDERNESS ROPE OPERATIONS

IMPROVISED SYSTEMS

Discussion:

- Using carabiners to build mechanical advantage.
- Static / Dynamic systems?
- Counterbalance systems.
- Inside 9's.
- Breaking in to a live rope.

WILDERNESS ROPE OPERATIONS

CHANGEOVER LOWER TO RAISE

1. Lock-off descender.
2. Insert LRH into system.
3. Unlock descender and lower until load is transferred to LRH prusiks.
4. Insert haul pulleys and prusiks.
5. Proceed with raising.

WILDERNESS ROPE OPERATIONS

CHANGEOVER RAISE TO LOWER

1. Allow LRH prusiks to hold the load.
2. Remove haul pulleys.
3. Insert main rope into descender and remove as much slack as possible.
4. Lock off rope in descender.
5. Slowly release LRH until load is transferred to descender.
6. Unlock rope from descender and proceed with lowering.

WILDERNESS ROPE OPERATIONS

KNOT PASS LOWERING

1. Stop lowering before knot reaches descender (leave plenty of room between the knot and the descender).
2. Attach LRH (Radium Release Hitch) and prusiks below descender (load side).
3. Lower with descender until load is transferred to LRH.
4. Remove descender and reattach beyond the knot.
5. Lock off descender.
6. Lower the load with the LRH until load is transferred back to descender.
7. Remove the LRH and prusik.
8. Continue the lowering process with descender.

WILDERNESS ROPE OPERATIONS

KNOT PASS RAISING

Slamma Jamma Technique on a 3:1 System

1. Pass the haul prusik past the knot during a haul rest.
2. Continue to raise until the knot runs into the ratchet prusik and primary haul pulley.
3. Stop the raise and attach a new pulley and ratchet prusiks between the knot and the load.
4. Continue to raise. This will create a “dead leg” and temporarily reduce the value of your mechanical advantage. Once enough slack comes into this dead leg, attach the new pulley and prusiks into the main anchor.
5. Pull all slack through the new prusiks and allow the load to be transferred to these prusiks.
6. Remove the original primary haul pulley and ratchet prusiks.
7. Continue with the raising operation.

WILDERNESS ROPE OPERATIONS

KNOT PASS RAISING

Alternate Method on a 3:1 System

1. Pass the haul prusik past the knot during a haul rest.
2. Continue to raise until the knot reaches the ratchet prusiks.
3. Attach an LRH and prusiks well below the knot leaving enough distance to accommodate a pulley and ratchet prusiks.
4. Transfer the load to the LRH. Ratchet prusiks will have to be minded during this phase to keep them from grabbing.
5. Reattach the original pulley and ratchet prusiks below the knot (between the knot and the load).
6. Haul team can now begin to raise.
7. Once slack comes in the LRH, it can be removed.
8. Pass the knot past the second pulley (haul pulley) during a reset.

WILDERNESS ROPE OPERATIONS

OPERATION COMMANDS

“Haulers Ready” - Team should be ready to haul
“Attendant Ready” - Attendant ready to be raised
“Belay Ready?” - Belayers reply as to status
“Up – Haul Slow” - Team begins hauling (2 whistle blasts)
“Set” - Team stops and sets ratchet
“Reset” - Team resets system to prepare to haul again
“Stop” - All movement stop and tension is held (1 whistle blast)
“Down” - Lower the load (3 whistle blasts)

Single person should be giving commands

WILDERNESS ROPE OPERATIONS

LITTER TYPES

Stokes Basket

Sked

WILDERNESS ROPE OPERATIONS

PATIENT PACKAGING

- Advise patient of your rescue/evacuation plan.
- Secure patient to the lowest rail on the litter which provides more security and less chance of webbing abrading on rock during rescue.
- Secure the patient with a chest harness and seat harness.
- Pad the patient where webbing makes contact and pad all voids.
- Recheck patient's circulation after packaging.
- Prevent heat loss with insulation layers.
- Provide helmet and eye protection to the patient.

WILDERNESS ROPE OPERATIONS

LITTER RIGGING

We prefer the attendant to be on a separate system and climbing under their own power.

Rigging for the patient and attendant on the same system:

- Join mainline and belay line (or second line in dual tension system) together and connect to litter bridle.
- Litter attendant is secured into belay line with gear to adjust his position up or down the line.
- The end of the belay line is attached to attendant's harness.
- Patient harness is secured into the mainline with a prusik. The end of the mainline is attached to the patient's harness.

LITTER HARNESS (BRIDLE)

4-point litter harness with independent adjustments. Demonstrate various methods.

Tethers for edge personnel attached to each end of litter.

WILDERNESS ROPE OPERATIONS

TENDERS / EDGE PERSONNEL

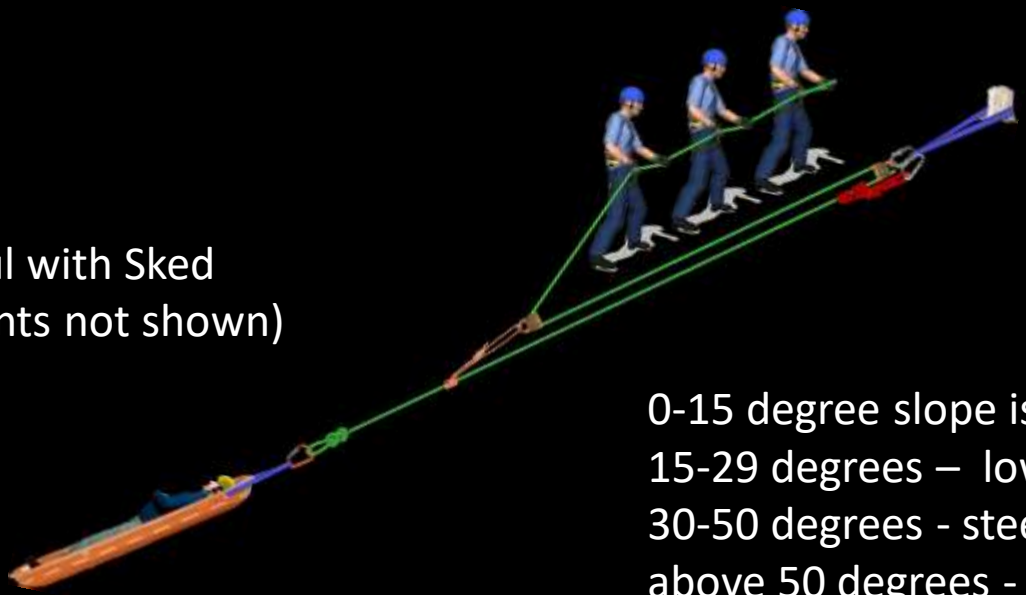
- Edge attendants assist in bringing the litter and/or rescuers over the edge, vectoring a mainline to create slack, help with communications between rescuer and top personnel, or assist the raise / lower team.

- Edge attendants must be tied into an adjustable safety. Attendants should be tied into the end of the line as well as being attached to the line with a an adjustable prusik for adjustment up and down the line.

WILDERNESS ROPE OPERATIONS

SIMPLE RAISE & LOWER SYSTEMS

Low angle haul with Sked
(litter attendants not shown)



0-15 degree slope is considered flat terrain
15-29 degrees – low angle
30-50 degrees - steep angle
above 50 degrees - high angle

(Concept photo created in vRigger software)

WILDERNESS ROPE OPERATIONS

LOW ANGLE LITTER EVACUATIONS

- Have adequate resources – minimum of 6-8 persons.
- Have a route finder to go ahead of litter team.
- Lift load with legs, not back.
- Lift and lower as a team.
- A belay may be needed depending on terrain.

WILDERNESS ROPE OPERATIONS

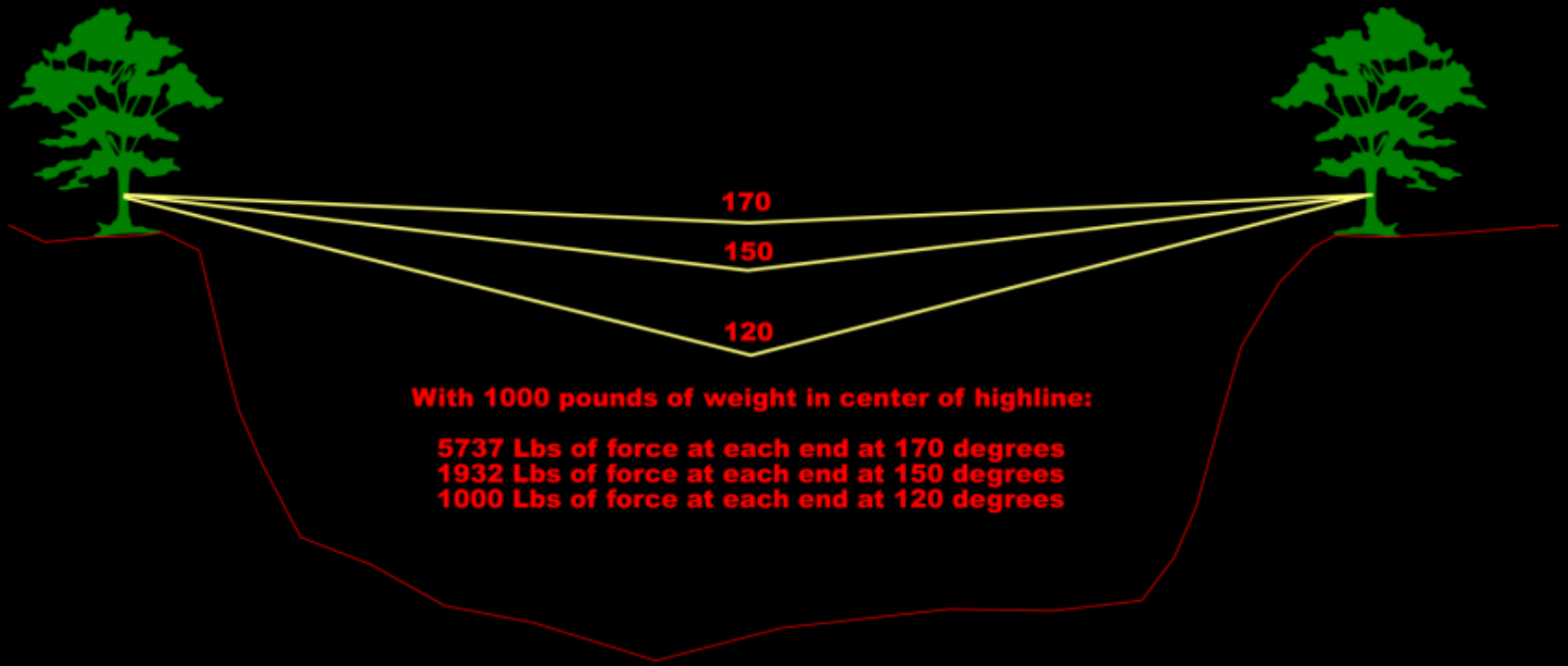
STEEP ANGLE LITTER EAVCUATIONS

- Typically require a mainline and belay (or second) line.
- Tether litter attendants to the main and belay lines if they are on the same system.
- In steep terrain, litter bearers should lean back in their harness and let the main line do most of the work.
- In steeper terrain use only three litter bearers to reduce force on the system – one on each side and one in the back.

WILDERNESS ROPE OPERATIONS

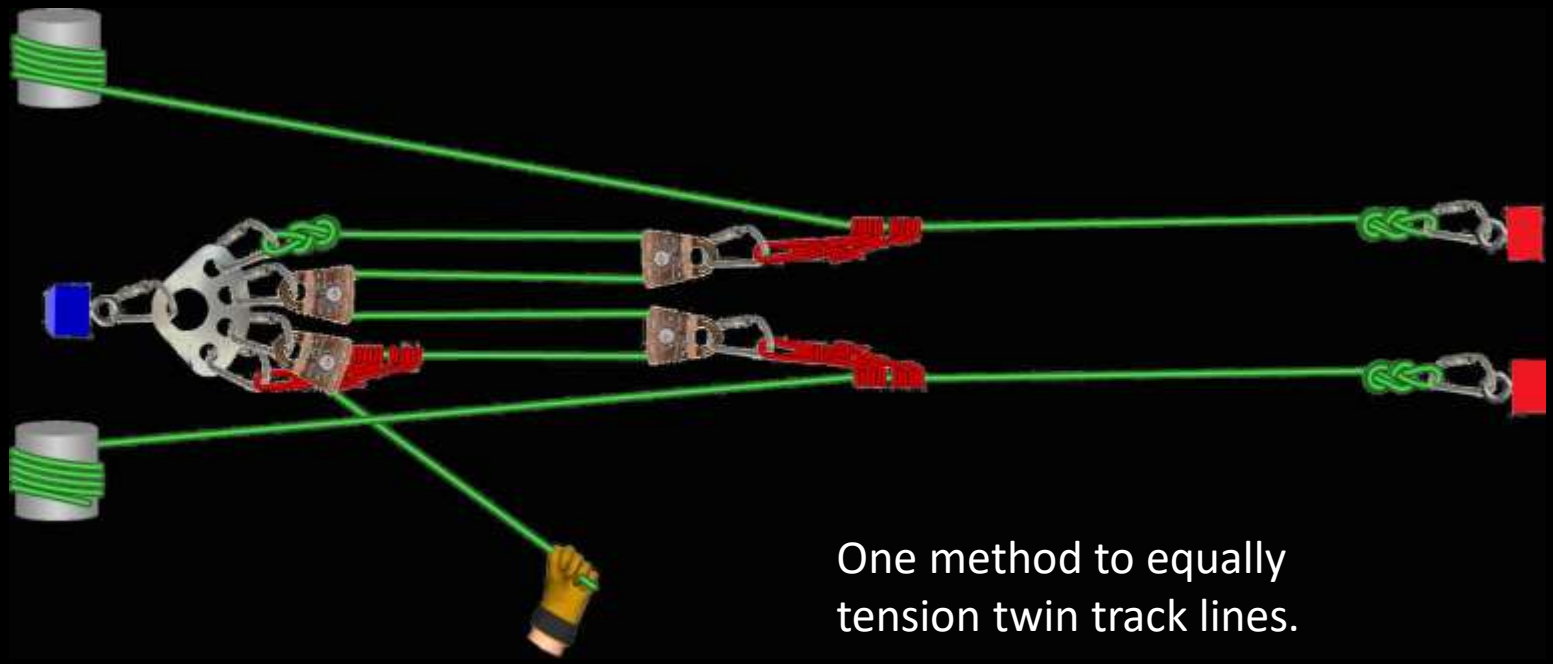
HORIZONTAL LINES

Discussion



WILDERNESS ROPE OPERATIONS

TWIN HORIZONTAL LINE SYSTEMS



One method to equally tension twin track lines.

WILDERNESS ROPE OPERATIONS

HIGHLINE TENSIONING RULE OF 12/18

For discussion and debate:

- When applying mechanical advantage to a loaded 11mm (7/16”) rope never exceed a 12:1 MA. For example, if the MA system is a 3:1, then you should not exceed 4 people hauling on the system.

- When applying mechanical advantage to a loaded 13mm (1/2”) rope never exceed an 18:1 MA. For example, if the MA system is a 3:1, then you should not exceed 6 people hauling on the system.

WILDERNESS ROPE OPERATIONS

SKATE BLOCK LOWERS

- Anchor
- Lowering Device
- COD
- Pulley

Excellent method to avoid danger areas or obstacles directly beneath the patient.

WILDERNESS ROPE OPERATIONS

TWO-ROPE OFFSET

Discussion

WILDERNESS ROPE OPERATIONS

SUGGESTED STUDY

National Park Service Technical Rescue Handbook 11th Edition
Download at:
www.randallsadventure.com
And
www.ratsar.org

On Rope: ISBN 978-1-879961-05-0
www.caves.org