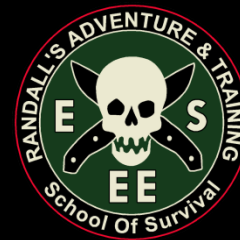




RANDALL'S ADVENTURE TRAINING®

BASIC SINGLE ROPE TECHNIQUES





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SINGLE ROPE TECHNIQUES



An introductory course in the use of single rope techniques (SRT) for rappelling and ascending in a wilderness environment. This is a basic outline for the student who has no previous experience on rope. All techniques should be practiced with a qualified instructor!
Some techniques shown are improvised and are not rated as safe practices!



WARNING: Rappelling, ascending and other aspects of high-angle rope work are extremely hazardous. It is incumbent on the user to seek qualified instruction, choose quality equipment and to understand the adequate safety procedures.



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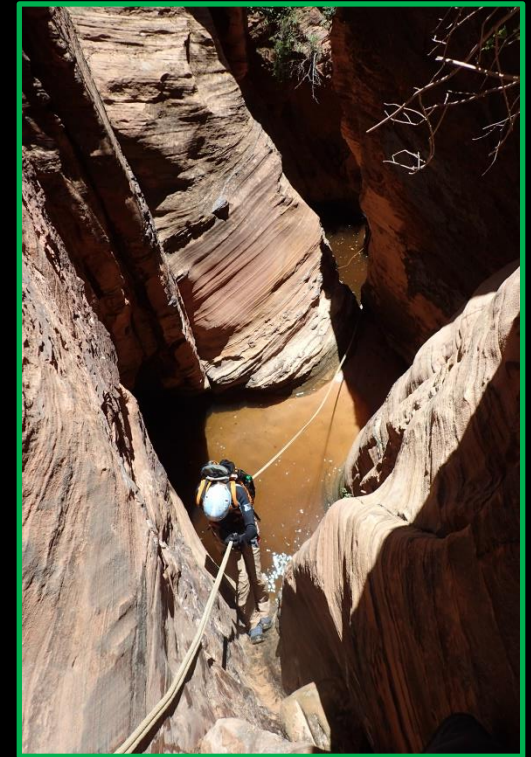


THIS BASIC OUTLINE COVERS:



**Safety
Equipment
Knots
Anchors
Descending
Ascending
Belaying
Horizontal Lines**

**Independent Belays
Simple Hauls/Lowers**





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EQUIPMENT REQUIRED:

Static Rappelling Rope
Webbing
Locking Carabiners
Descending Device(s)
Ascending Device(s)
Prusik Cords
Rappelling Harness
Helmet
Gloves



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SAFETY

Safety while using rappelling techniques can be divided into four areas:

- 1) Learning the skills (Get the basics down correctly!)**
- 2) System setup (Use the best equipment without weak links)**
- 3) Checking (Always double check to prevent mistakes)**
- 4) Belaying (Rig it properly to catch any mistakes in 1-3 above)**

For safety purposes rappelling has three main steps:

- 1) Properly anchoring the rope**
- 2) Properly rigging the descender**
- 3) Controlling the descent**



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SAFETY

- 1. Work a buddy system.**
- 2. Speak up, regardless of your skill level.**
- 3. Use the “Touch” System to verify all rigging.**
- 4. Never use questionable equipment.**
- 5. Always use a safety line when working close to the edge.**
- 6. Always consider your margin of safety. (For example, if you weigh 170 pounds and the rope you are rappelling on is only rated for 200 pounds, then your margin of safety is slightly better than 1:1. The slightest increase in load such as a sudden stop may cause the system to fail.)**

Most experts suggest a 10:1 factor for SRT and a 15:1 factor for rescue operations.

When working around a high-angle environment, every team member must wear a safety helmet, gloves and safety line.

There is ALWAYS time for safety!



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OVERCOMING FEAR

Fear is a normal response to heights, especially when trusting your life to a thin rope. Overcome this fear by:

- 1) Learning the basics properly.**
- 2) Having confidence in your equipment.**
- 3) Using a belay system.**
- 4) Concentrating on the equipment and task at hand, not the height.**
- 5) Beginning your rappelling training at lower heights.**



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GEAR

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





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ROPE & WEBBING

**3-Strand Twisted (military)
Static Kernmantle (less than 6% stretch)
Dynamic Kernmantle (above 6% stretch)
1 Inch Flat & Tubular Webbing**

The most commonly used rappelling rope is 7/16" (11mm) and 1/2" diameter Static Kernmantle certified by the National Fire Protection Association (NFPA) 1983/2012 Edition For Technical Rope Use. Technical Use is rated at no less than 20kN. General Use is rated at no less than 40kN.

Technical Use is rated for one person loads at a 15:1 safety factor. General use is rated for two person loads with a 15:1 safety factor.

Average Load Ratings Per Size:

**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.)



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ROPE CARE

Avoid shock loading.

Avoid stepping on the rope.

Avoid using Chlorine bleach or chemicals.

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.

Don't burn the rope with high friction rappels.

Always cut out any bad section or abrasion.

Protect the rope from all sharp edges.

Never buy a used rope for lifeline purposes.



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WHEN TO RETIRE A ROPE / WEBBING

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.



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HARDWARE

Carabiners (Locking and non-locking)

Descenders (Figure 8's, carabiners, etc.)

Ascenders (Prusiks and mechanical)





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PERSONAL EQUIPMENT



**Helmet
Harness
Gloves
Knife**



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



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KNOTS

The weakest part of a rope under 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 other knots in the field training exercise.



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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 with a safety knot tied off.***



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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.



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FIGURE 8 FOLLOW-THROUGH



Photo courtesy www.animatedknots.com

For tying a single rope around an anchor or object.



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FIGURE 8 ON A BIGHT



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



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DOUBLE FIGURE 8



Common knot used to attach rope to rigging points, harnesses, etc. in rescue operations.



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FIGURE 8 BEND



Photo courtesy www.animatedknots.com

For tying two ends of a rope together.



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WATER KNOT



Photo courtesy www.animatedknots.com

Preferred knot for tying two ends of webbing.



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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.**



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PRUSIK HITCH

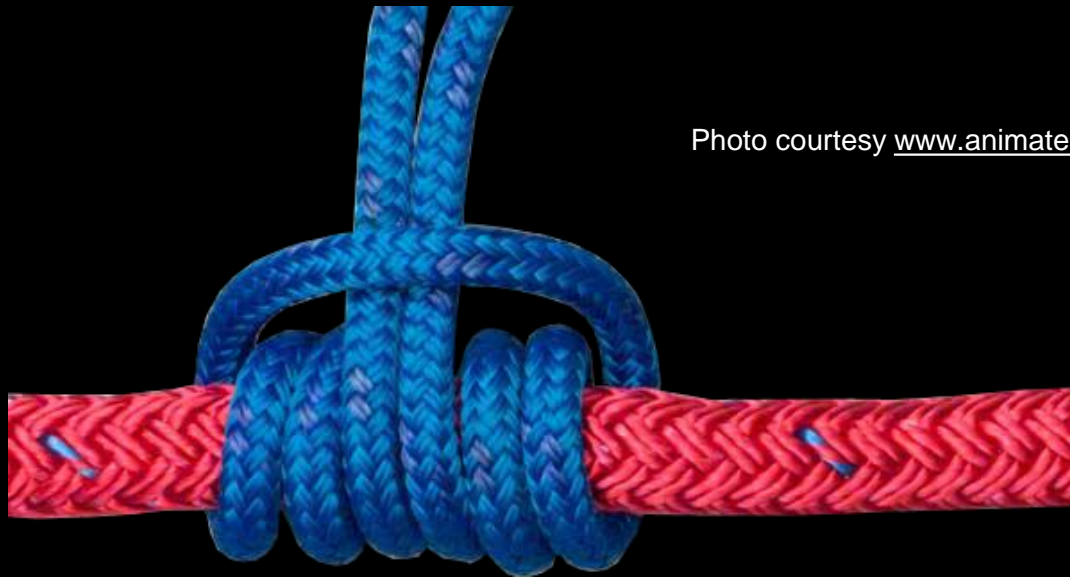


Photo courtesy www.animatedknots.com

A friction knot used as a rope grab. The preferred knot to use a self-belay for rappelling.



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ALPINE BUTTERFLY



Photo courtesy www.animatedknots.com

Used as a mid-line knot.



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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.



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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%

***Test results printed in the CMC Rope Rescue Manual**



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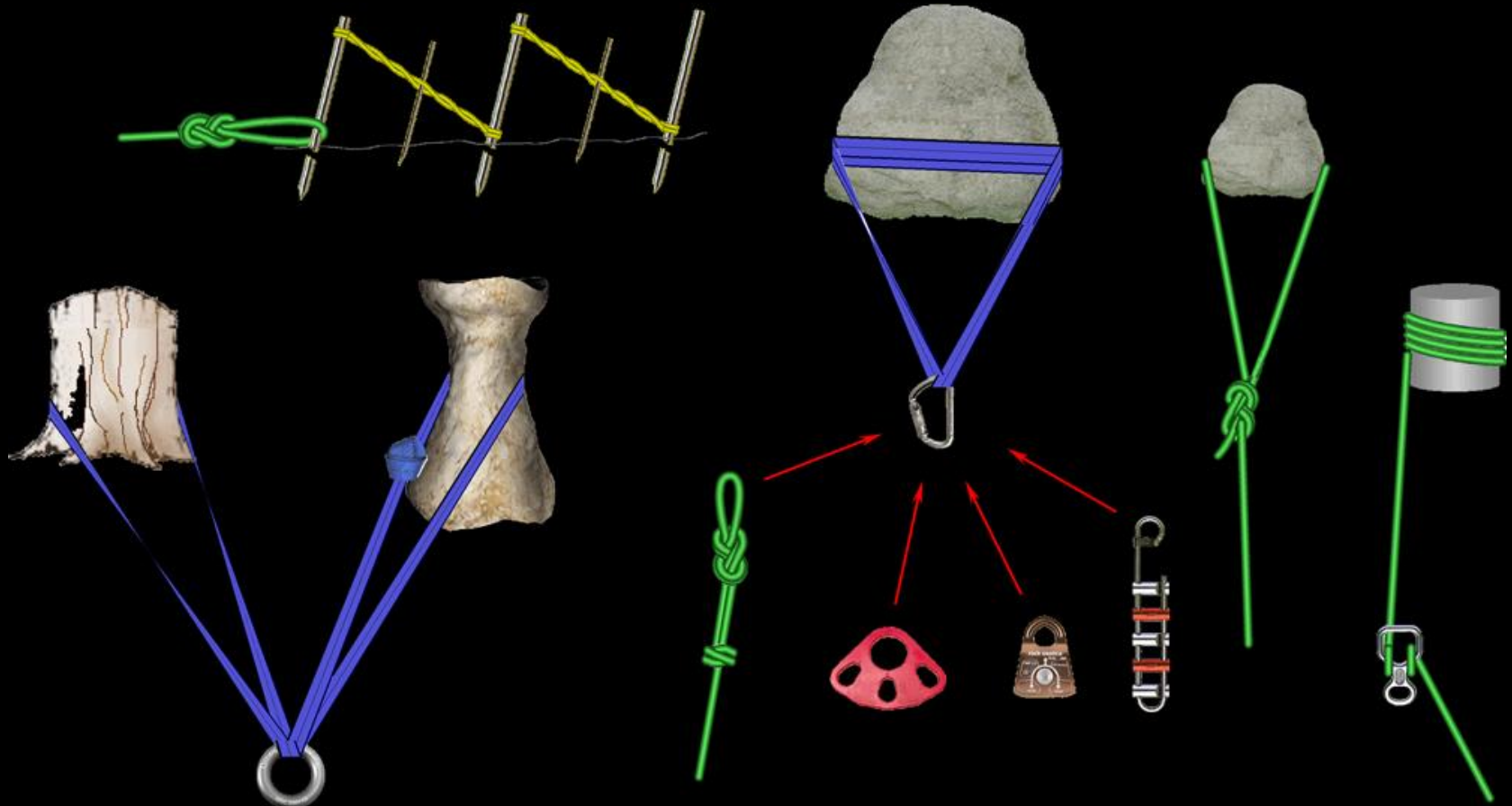


ANCHORS





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(Concept photo created in vRigger software)



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CARABINER TYPES



D

Preferred



Offset D

Preferred



Oval

Least Preferred

For rescue work, 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.

You should always assume damage, and retire from service, any aluminum carabiner that has taken a fall of more than 10 feet.

G-Rated steel locking carabiners are the preferred carabiner for main rigging and rescue.

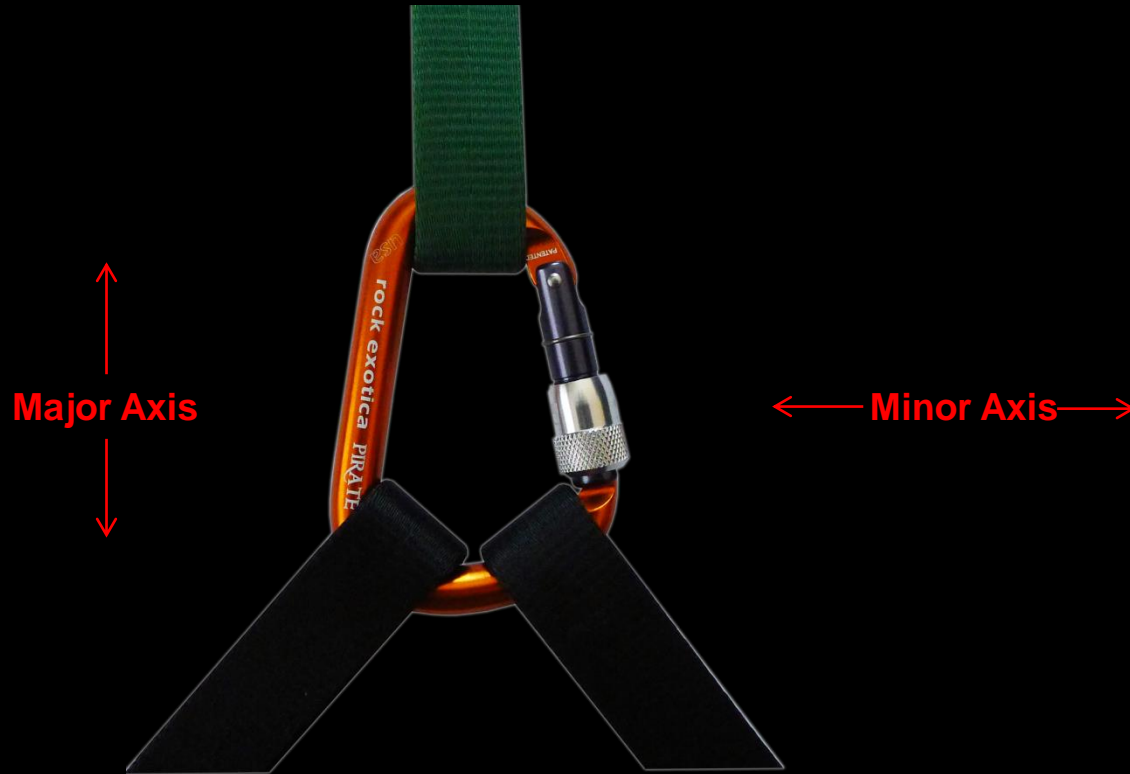


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TRI-AXIAL LOADING



Avoid tri-axial loading and never load a carabiner along its minor axis!



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TENSIONLESS HITCH

(High-Strength Tie Off, Friction Wrap)





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FIGURE 8 FOLLOW-THROUGH

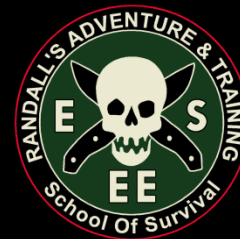


Photo courtesy www.animatedknots.com



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SIMPLE ANCHORS

Tri-Axial Loading Issues



Correct



Incorrect



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WRAP 3, PULL 2



(Note: water knot should always go against anchor)

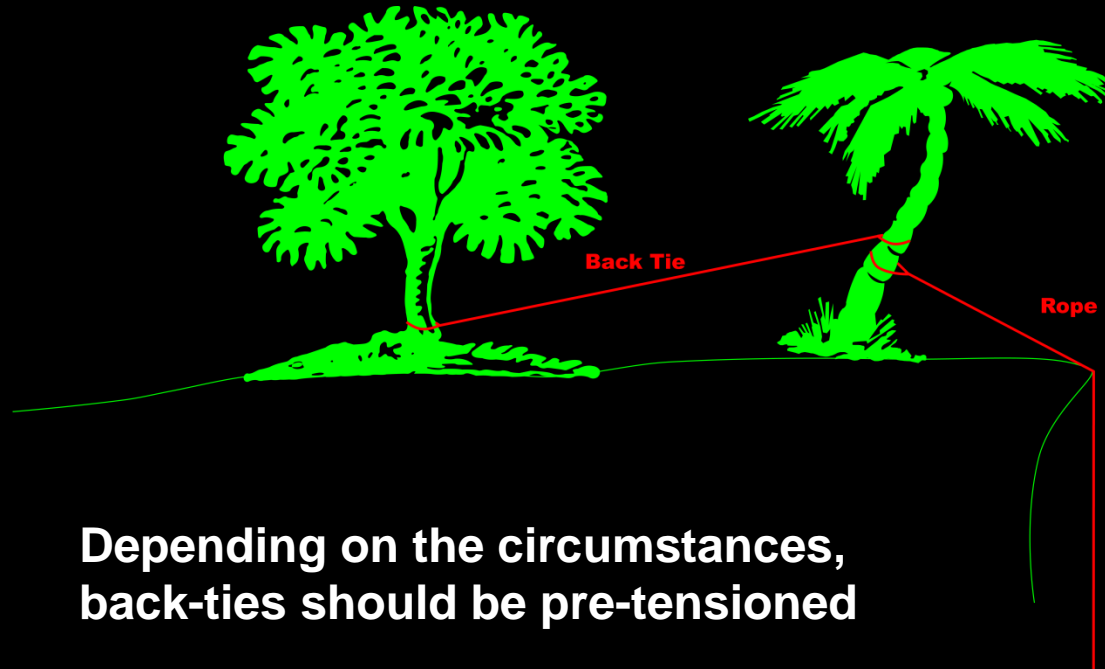


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BACK-TIES



Depending on the circumstances,
back-ties should be pre-tensioned

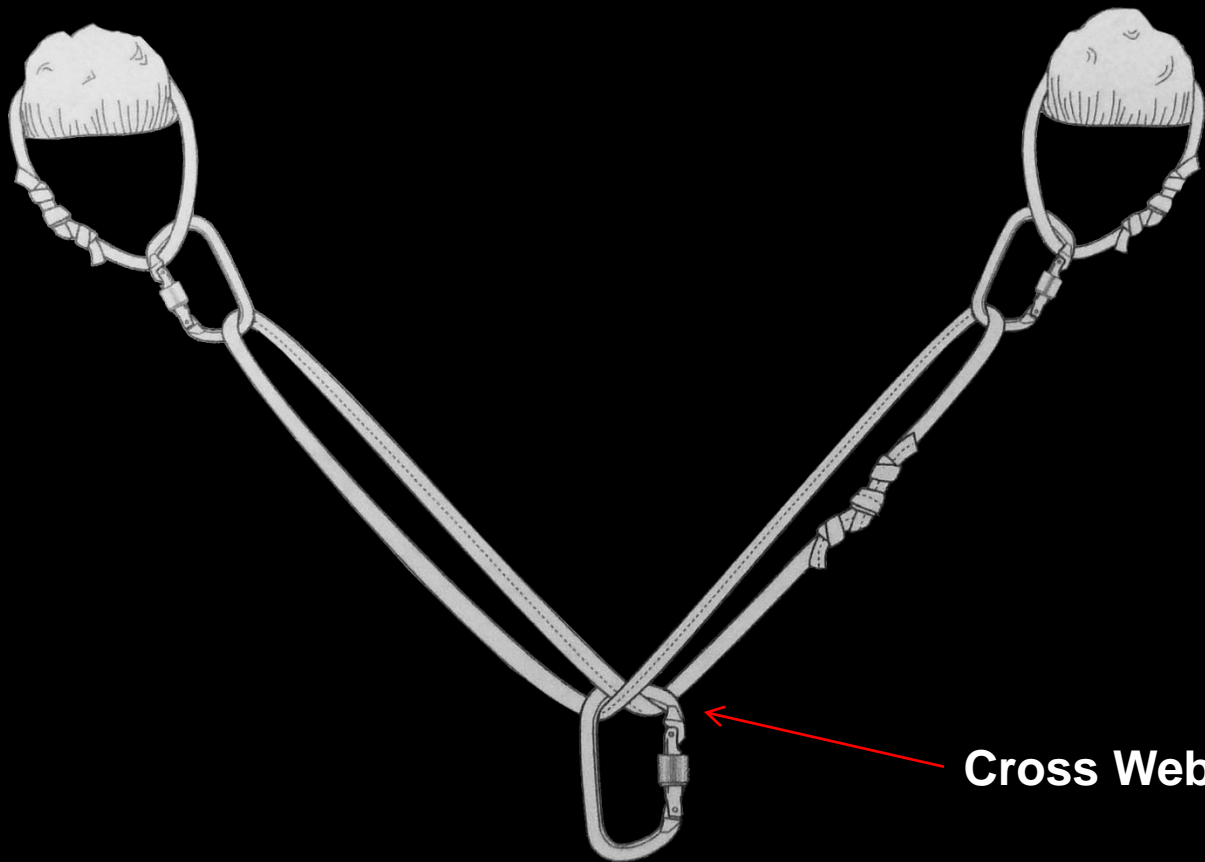


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COMPOUND ANCHORS



Cross Webbing

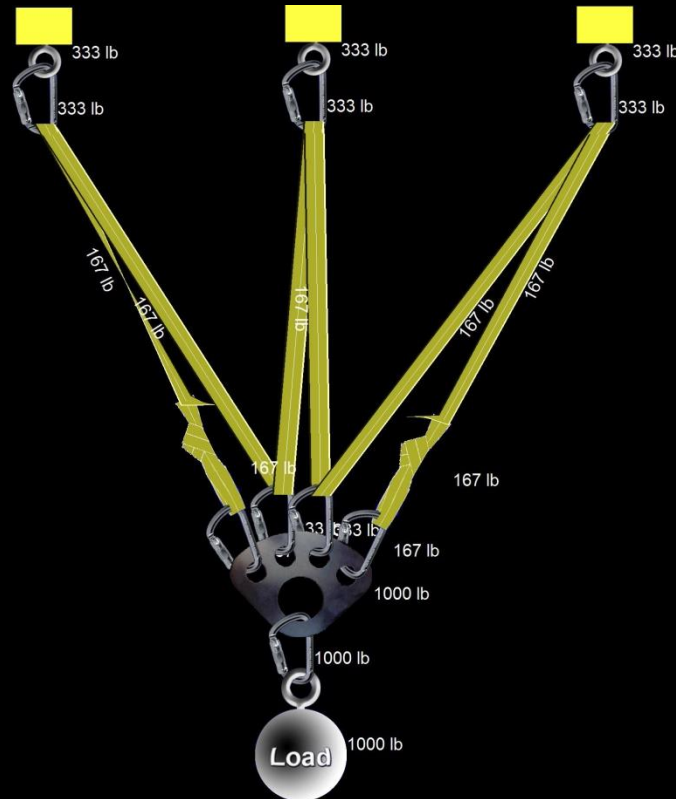


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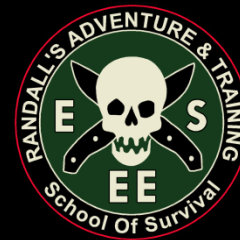
LOAD DISTRIBUTING & SELF-EQUALIZING



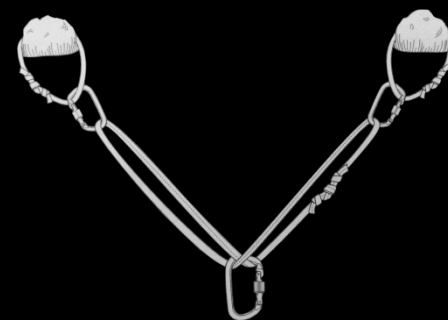
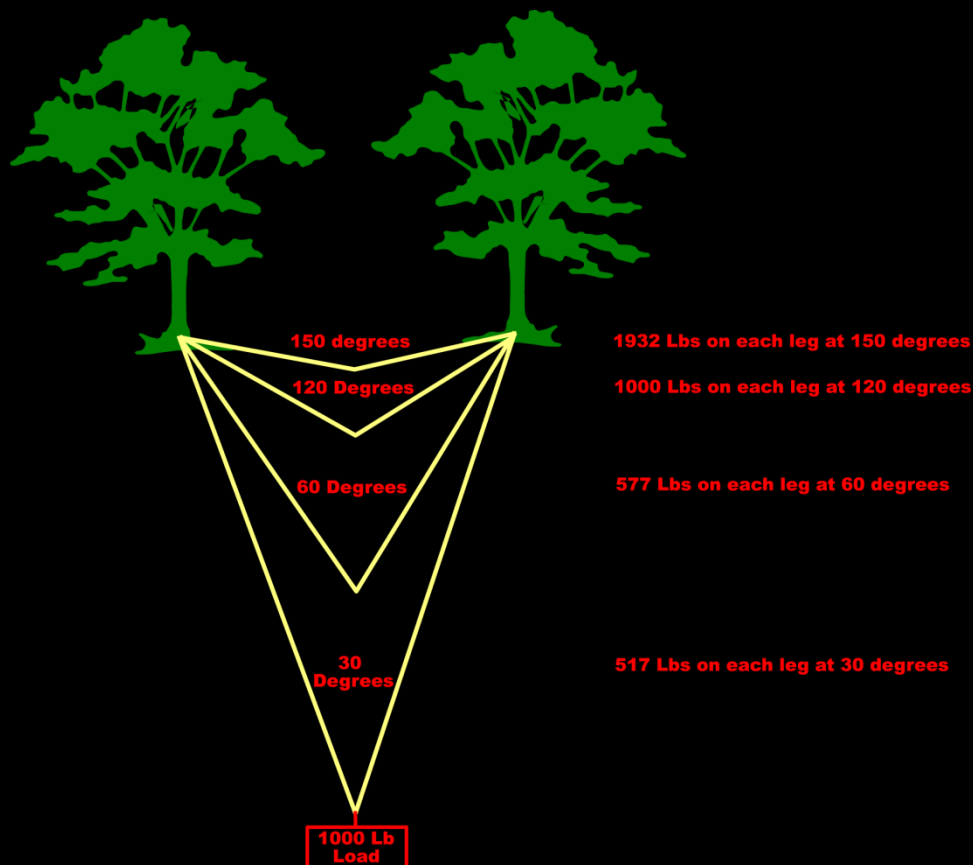


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ANCHOR LOAD RELATIONSHIP

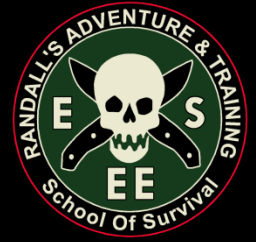


With a 1000 pound load, there is a force of 707 Lbs. on each leg at 90 degrees.

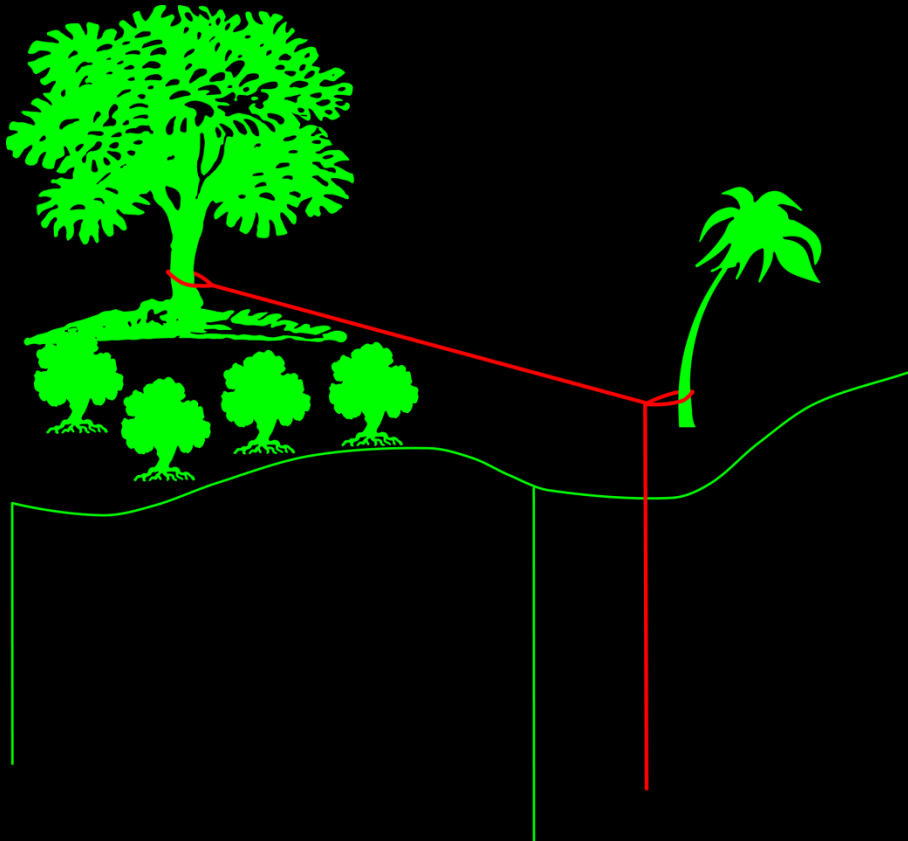


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ANCHORS WITH DIRECTION CHANGE

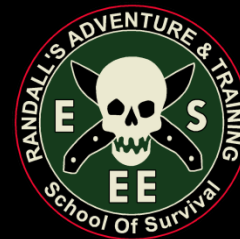


If you need need a direction change in your mainline to clear an obstruction or to make the rappel more accessible, rig the direction change the same way you would rig a main anchor. It is important to remember the anchor load relationship (previous slide) and the increased stresses that vectors may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



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TAKE-DOWN ANCHORS

Take-Down
Line



Do not use this
system on small
diameter anchors
since it may side
load the carabiner

Load
Line

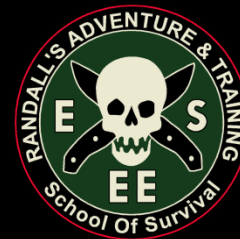
DO NOT rappel on the wrong line!

Note: This is NOT an approved system for rappelling. It is, however, a system that is used by Randall's Adventure & Training for quick take-down rappels. Use at you own risk!



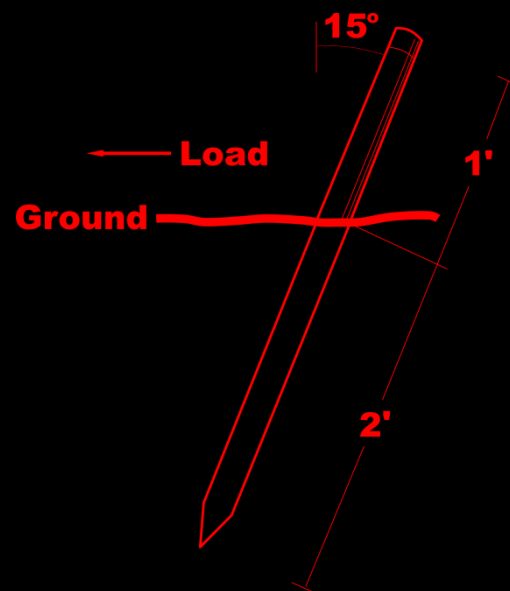
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IMPROVISED ANCHORS

Vehicles
Pickets
Bushes
Climbing Bolts



1" Diameter Picket has an average weight holding of 700 Lbs. In average loamy soil



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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 your movement up the rope.





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DESCENDERS

There are numerous descending devices on the market, including Figure 8 variations, racks, shunts, Grigris, etc. For the purposes of the rappelling section of this course we are limiting descenders to the simplicity of a Figure 8 and showing an improvised device.



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FIGURE 8

**Working End
to anchor**

**Attaches to
harness with a
locking carabiner**



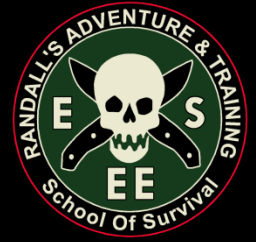
It should be noted that some users of a Figure 8 descender rig the rope with the bight going through the top of the 8 instead of the bottom. The suggested method by CMC Rescue is to start the bight through the bottom of the 8 (as shown in the photo).

**Brake
Hand**



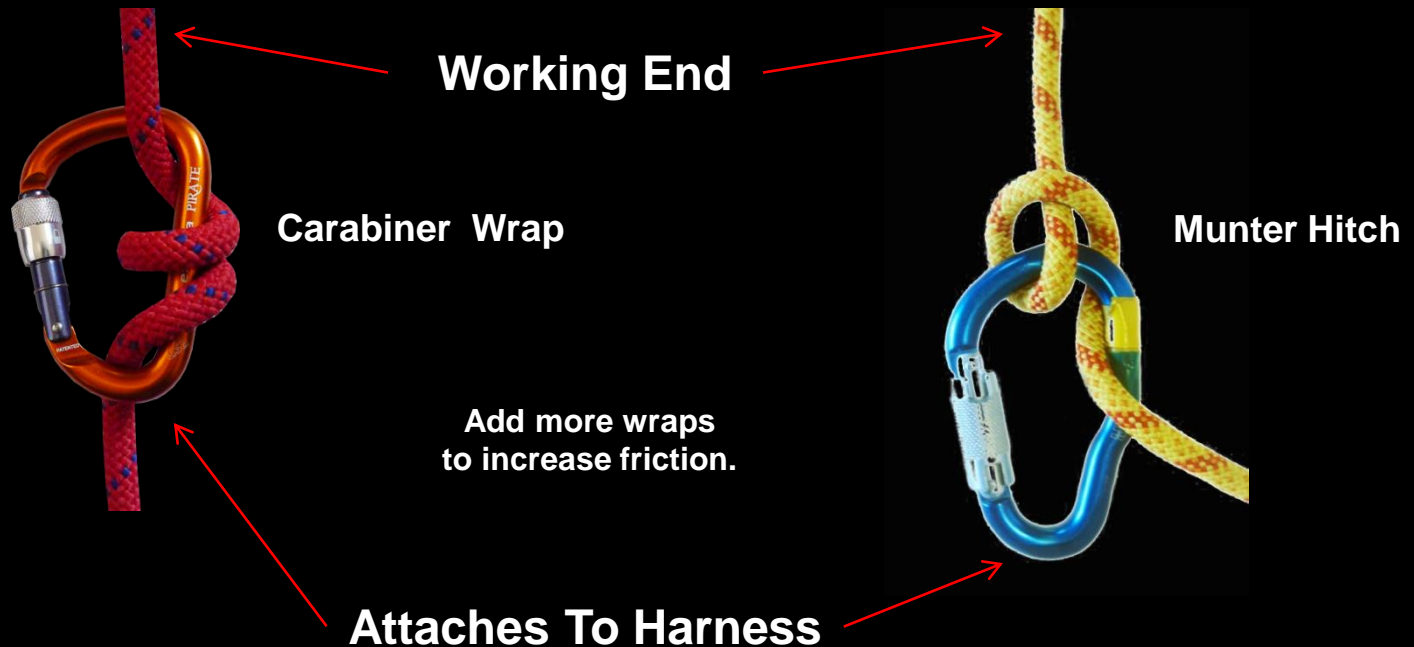
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CARABINER WRAP & MUNTER HITCH

Note: A carabiner wrap is an improvised technique and *should only* be used in an emergency rappelling situation when no other load rated descending device is available. **DO NOT** use in rescue situations! These hitches may wear an aluminum carabiner quickly.



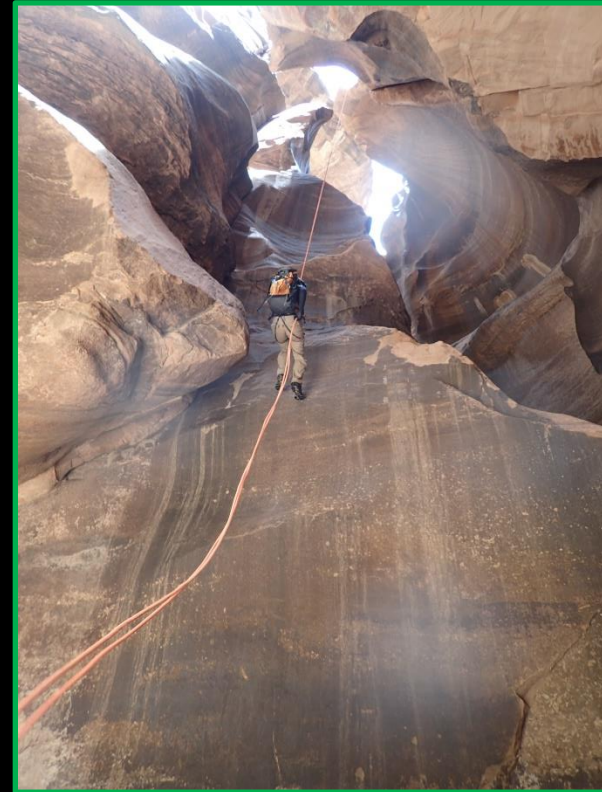


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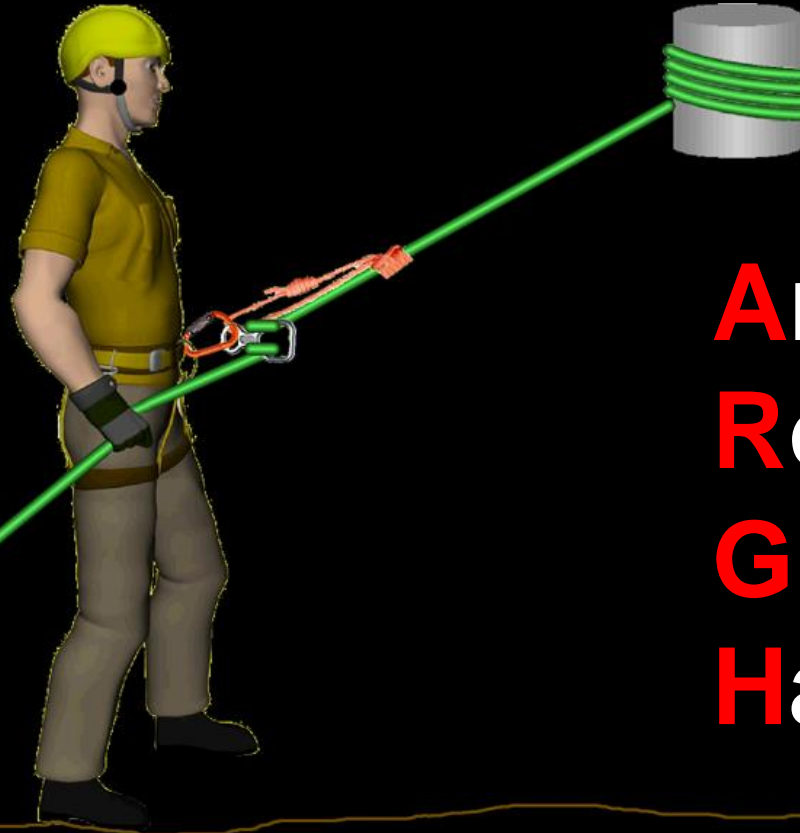
RAPPELLING





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Anchor
Rope
Grab
Hardware

(Concept photo created in vRigger software)



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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**
- Verify the rope is properly rigged into your descender**
- Verify that all carabiners are locked**

There is ALWAYS time for safety!



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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 (rope bags are suggested).

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.



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AUDIBLE COMMANDS

Rappeller shouts **“On belay”** when he/she attaches to the lifeline

Belayer responds **“Belay on”**

Rappeller shouts **“Rappelling”** as he/she moves to the edge

Belayer responds **“Rappel on”**

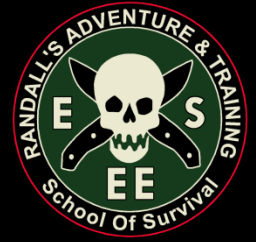
Rappeller shouts **“Off rappel”** once he/she detaches from the rope

Anyone who sees any object fall from the top shouts **“Rock!”**



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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.



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BELAYING



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SELF BELAY & AUTO-BLOCKS



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



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BOTTOM BELAY

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

(Concept photo created in vRigger software)



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INDEPENDENT BELAYS

Although independent belays are not classed as single rope techniques (SRT), they are the safest of the belay systems since they use a separate rope for the belay line. Should the mainline fail, the belay line remains intact.

When setting up independent top belays, it is advisable to use a separate anchor from the mainline and keep all slack out of the belay line so the rope is not shock loaded if the mainline fails.



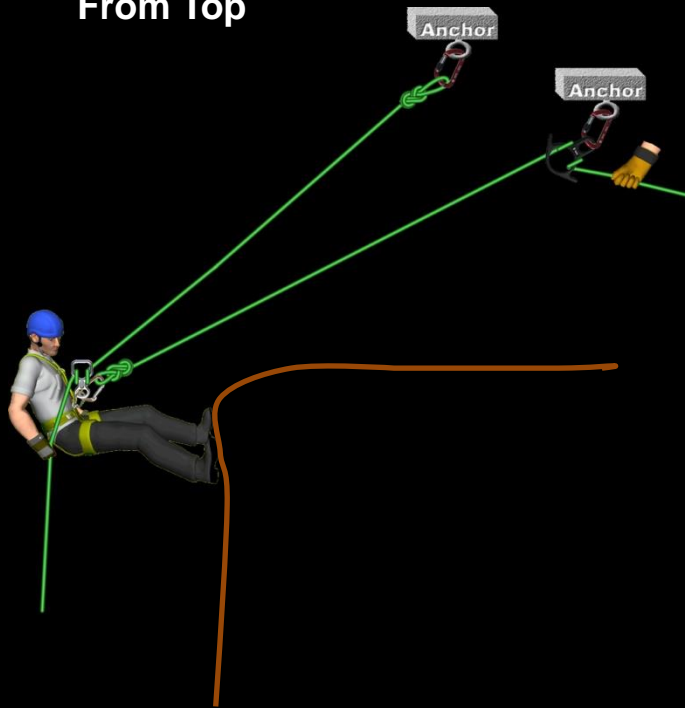
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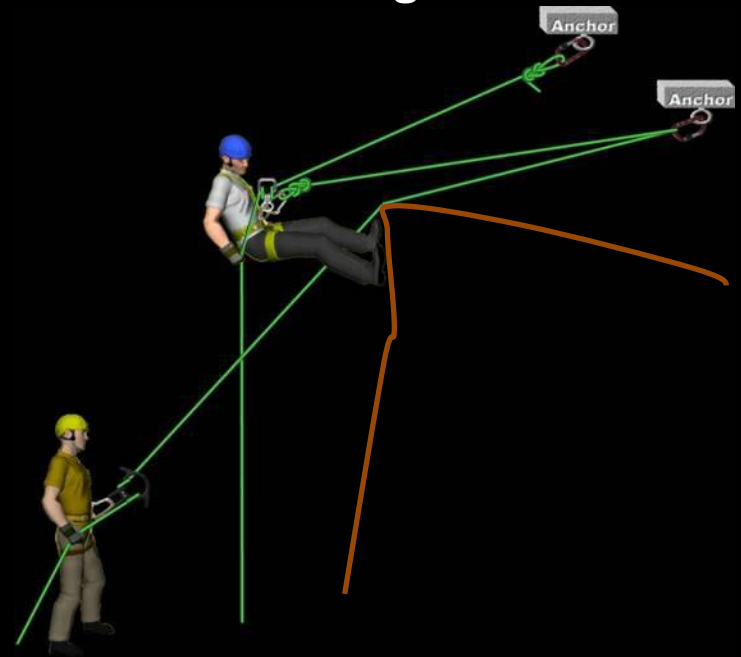


INDEPENDENT BELAYS

From Top



From Bottom With
Direction Change



(Concept photo created in vRigger software)



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SELF RESCUE

**Stuck Belay Prusik
Figure 8 Girth Hitching & Jams**



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BUDDY RESCUE



Pick Off Straps
(Static & Compound Advantage)

**Cutting An
Active Rope**





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CHANGING DIRECTIONS

What goes down may have to come up!



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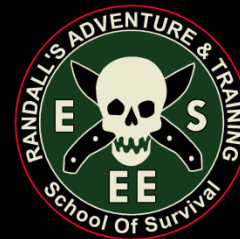
ASCENDING WITH MECHANICAL ASCENDERS





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TYING OFF A FIGURE 8



Normal Rappel



1. Grip the Figure 8 with the left hand.
2. With your brake hand bring the rope over the top and between the Figure 8 and the standing line.
3. Wrap at least 2 times.

Tied Off



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CHANGEOVER TO ASCEND

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



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CHANGEOVER TO RAPPEL

- 1. Allow harness prusik cord to hold your weight.**
- 2. Attach Figure 8 to rope below prusik. Remove as much rope slack as possible, then hold with brake hand like a normal rappel.**
- 3. With other hand, move the ascender with the foot loop up as high as possible, then push up with your leg, removing slack in the Figure 8 as you go up.**
- 4. Once all slack is removed from Figure 8, transfer the load to the Figure 8 by lowering yourself with your pushing leg.**
- 5. Tie off Figure 8.**
- 6. Remove ascender with foot loop and secure.**
- 7. Remove harness prusik (or leave on as a self-belay)**
- 8. Slowly untie Figure 8 making sure you maintain rope friction around 8.**
- 9. Rappel normally.**



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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.



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RIGGING A FIGURE 8 ON ROPE WITHOUT DROPPING IT

Store 8 on harness with carabiner clipped through large hole. Rig rope through the 8 without unclipping it.



Unclip 8 from carabiner. The rope is now holding the 8. Clip the 8 back into the small hole and start your rappel.



(Concept photo created in vRigger software)



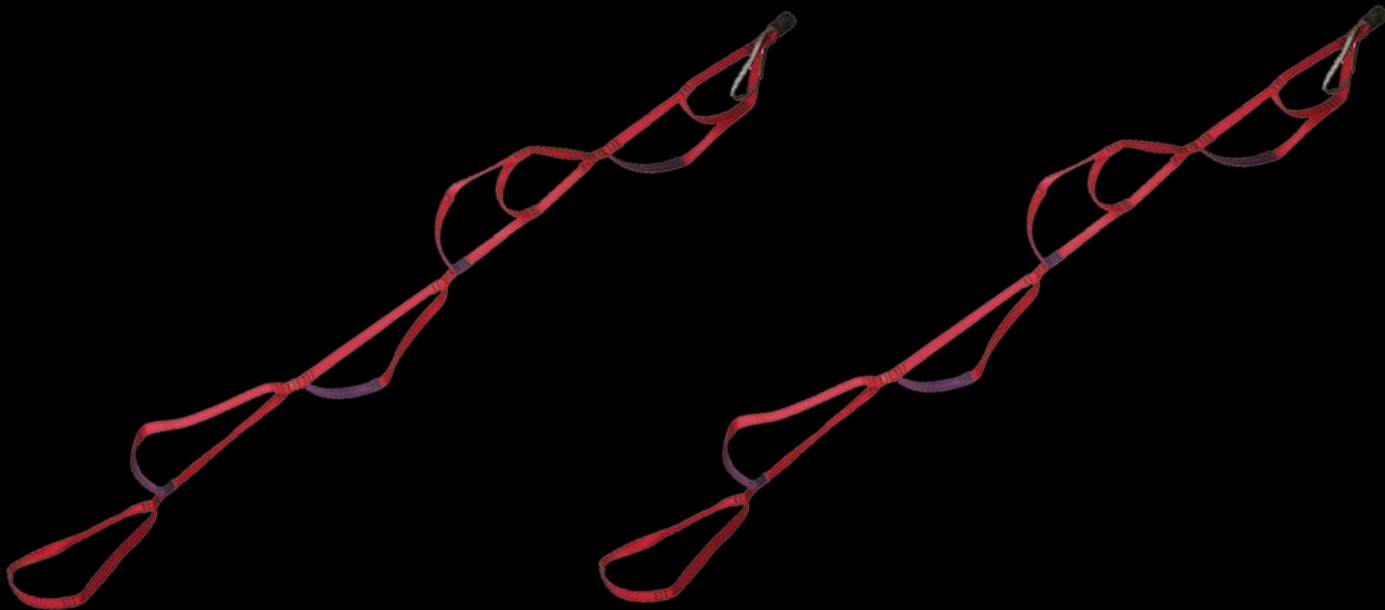
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WILDERNESS ROPE TECHNIQUES



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.





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MINIMAL WILDERNESS GEAR (For Rappelling)

Rappel Rope
Harness, Riggers Belt or Improvised Seat
Carabiner
Descending Device (or extra carabiner)

Optional:

Prusik Cords
Ascenders
Webbing



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SPECIAL CONSIDERATIONS

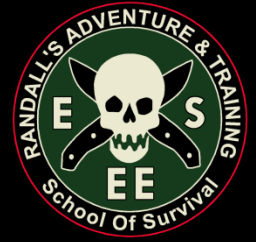
**Improvised Harness
Passing Knots
Balanced Rappels
Re-Belays & Deviations
Disconnecting While Swimming**





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HORIZONTAL TRAVERSE (Tyrolean Traverse)



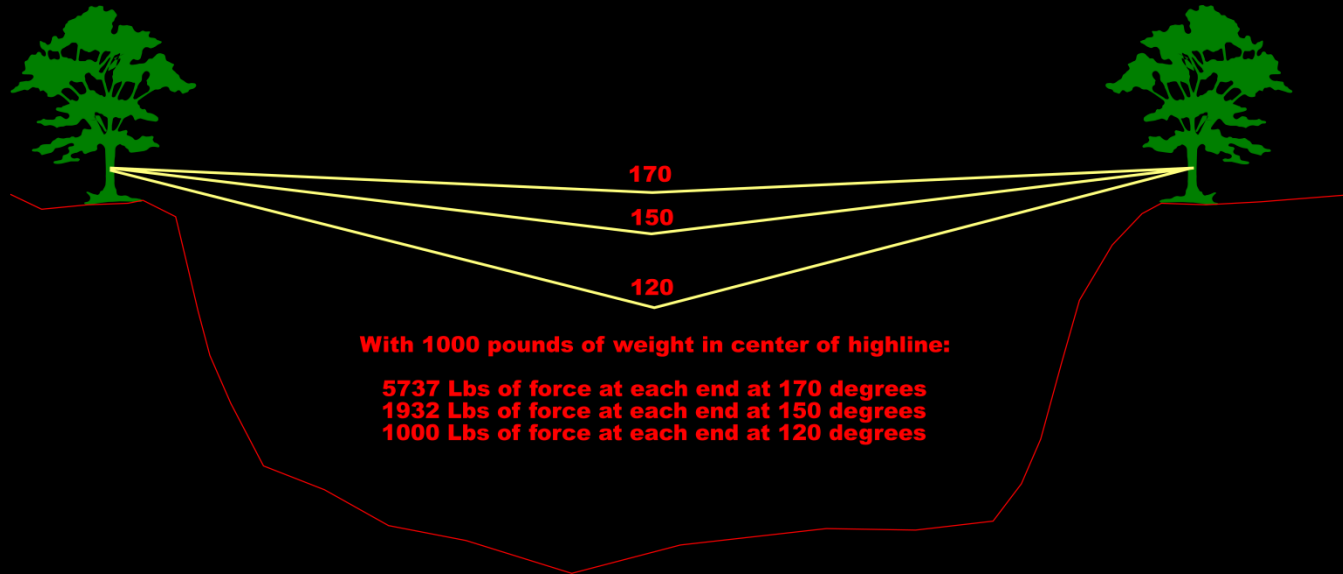


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HORIZONTAL LINES





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HORIZONTAL LINE GEAR

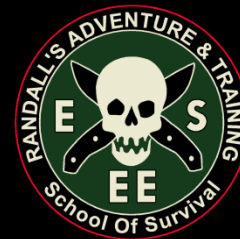
(MINIMAL)

Rope
Harness
Pulley or Carabiner to ride the line
Safety Line
Tag Lines



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SINGLE ROPE QUICK TENSIONING

Note: This is an improvised technique!



(Concept photo created in vRigger software)

Quick system to tension a horizontal line using only the line, carabiners and an opposing anchor point.

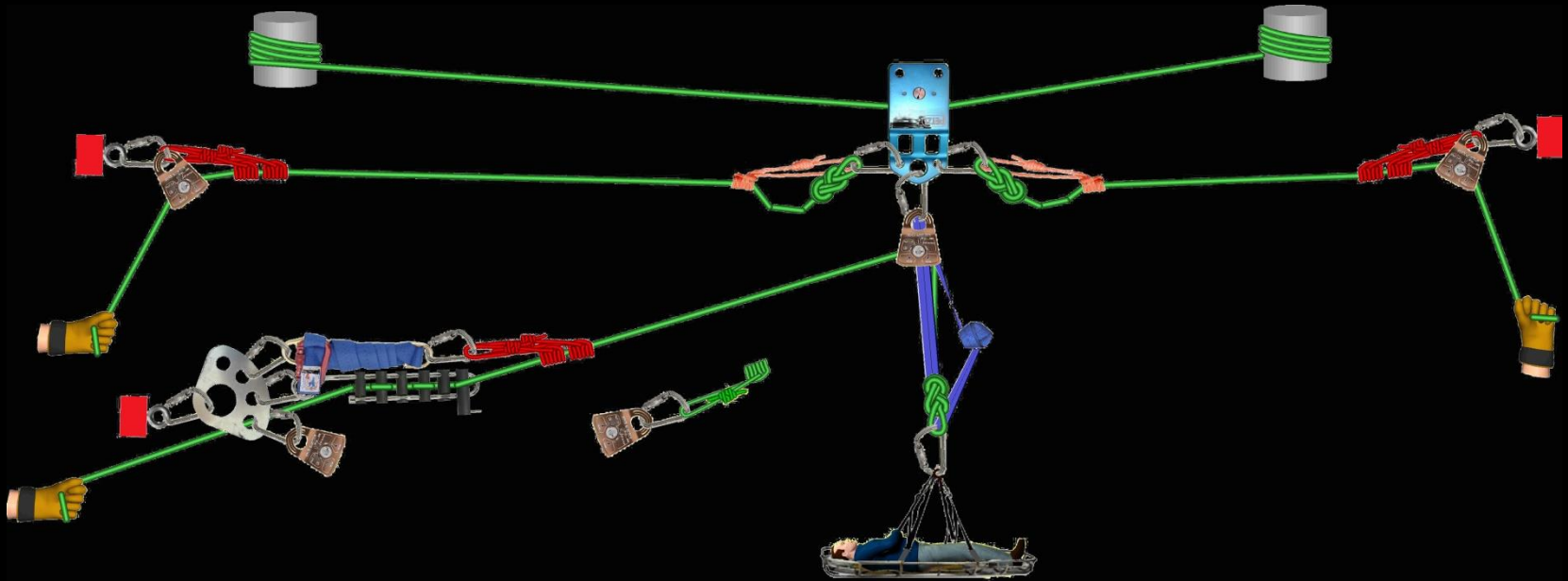


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HORIZONTAL LINE SYSTEMS



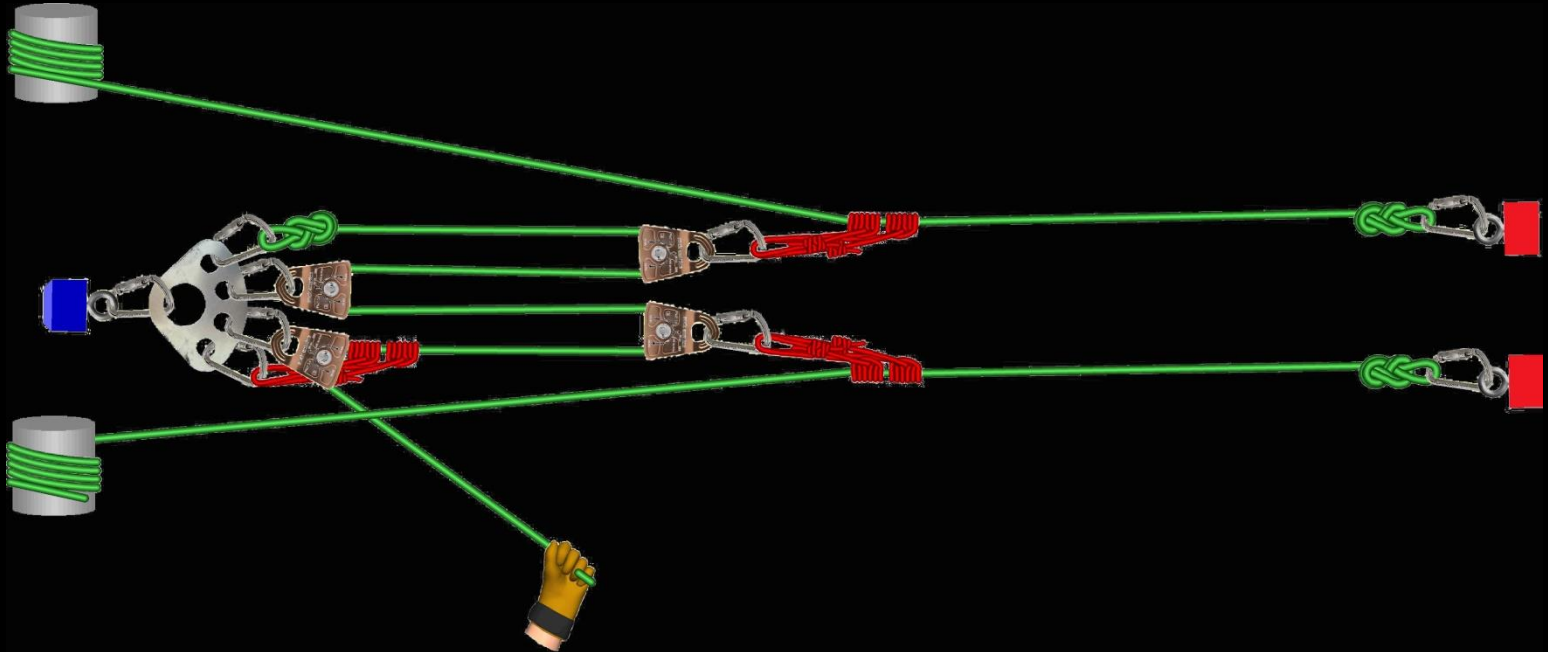


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TWIN HORIZONTAL LINE SYSTEMS





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BASIC RESCUE HAULS & LOWERS

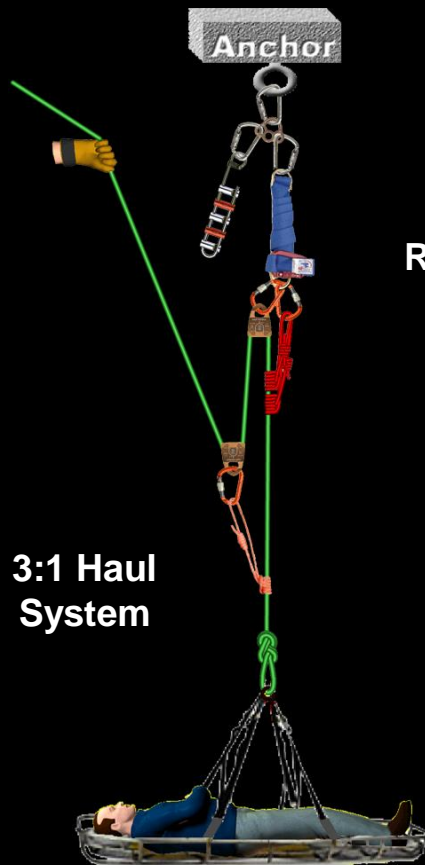


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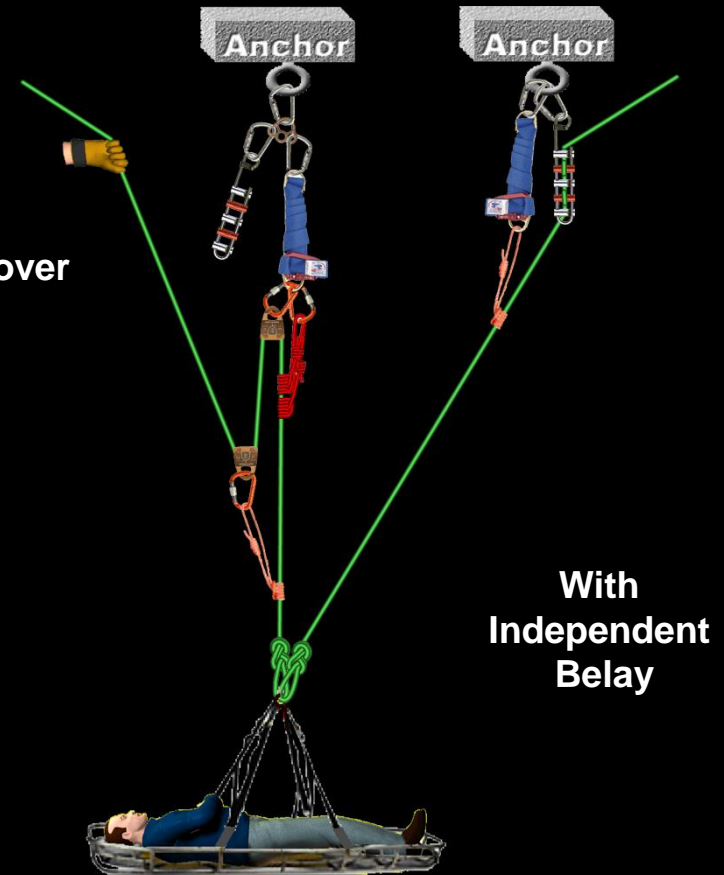
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SIMPLE 3:1 HAUL & LOWERING SYSTEMS



Racks shown for changeover
from haul to lower.

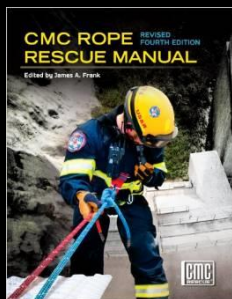
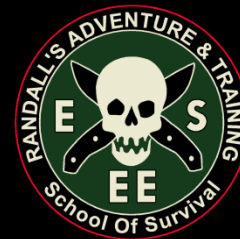


(Concept photo created in vRigger software)

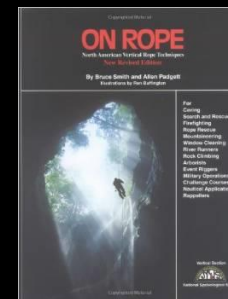


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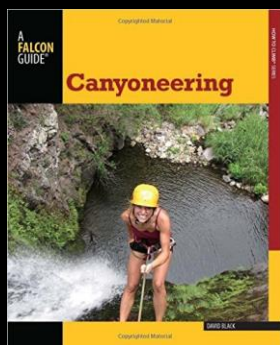
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SUGGESTED STUDY



CMC Rope Rescue Manual: ISBN 0-9618337-7-7
<http://www.cmcrecue.com/>



Vertical Academy: ISBN 1300644036

Canyoneering: ISBN 0762782730

On Rope: ISBN 978-1-879961-05-0
<http://www.caves.org>

