

Table of Contents

- 1 Clothing+Harness
- 2 Helmet+Rope+Carabiners
- 3 Ascender+Descender
- 4 Cowstail+Climbing aiders
- 5 Tape+Slings+Daisy Chain+Cord+Rope
- 6 Equipment Donning
- 7 Basic techniques+Prohibited actions+2 points rules
- 8 Pulley+Rigging Plates+ Rope Bags+Seats
- 9 Knots
- 10 Rigging+Share anchors



Basically use equipment that has passed standards such as CE, EN, UIAA, etc.

Clothing

Basically wear long sleeves and long pants suitable for work.

Since it is often difficult to immediately evacuate from the rope, consider it similar to mountaineering and select clothing made of materials that are suitable for the climates and weather conditions. Ideally, use synthetic fiber materials for both under and outer garments or windproof breathable materials.

Harness

Sit Harness

A safety harness that supports body weight with the waist and thighs. Ideally, the harness must be suitable for Single Rope Technique and European standard EN813.

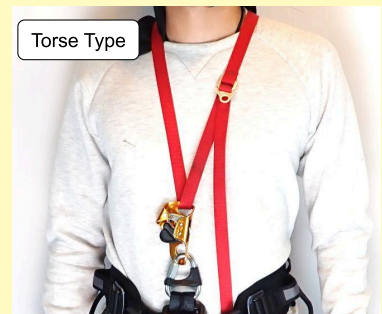
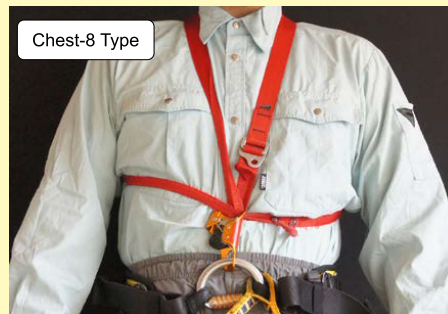


Alternatively, rock climbing sit harnesses can also be used.

Chest Harness

A belt that supports the upper body through the neck, chest, and underarms by passing through the top hole of the chest ascender. Simple chest harnesses mainly include the Torse type and Chest-8 type.

- The Torse type only supports the neck and back but allows easy length adjustment.
- The Chest-8 type crosses under the arm pits for support, providing a larger support area compared to the Torse types.



Significantly larger and easier to use.

Work chest harnesses are mainly torso-type with thick padding. While they are suitable for long-duration rope work, they are heavy and bulky, making them unsuitable for mountain work sites where transport requires considerable effort or situations where equipment weight reduction is desired.

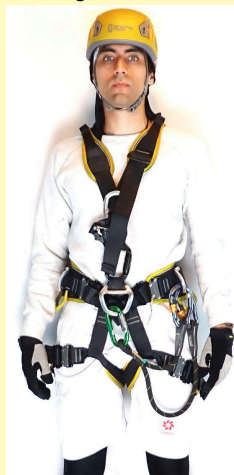
Rock Climbing Harnesses

Have an appropriately large upper body support area and are easy to use.



Fall Arrest Harness

Work fall arrest harnesses are designed with attachment points positioned on the chest and back to evenly distribute impact forces in the event of a fall. They feature thick padding and wide belts, making them suitable for long-duration rope work and free hanging. However, they are heavy and bulky, making them unsuitable for mountain work sites where transport requires considerable effort or situations where equipment weight reduction is desired.



Helmet

Use helmets that comply with European standards EN397 and EN12492. Long hair should be tied up and secured as it may get caught between the descender and rope.



Rope

Generally, a static rope (in the broad sense) with a kernmantle construction is used, having a load capacity of 18kN or more, a diameter of 9mm to 11mm, and an elongation rate of 5% or less.

Rope External Structure

Generally, a static rope (in the broad sense) with a kernmantle construction is used, having a load capacity of 18kN or more, a diameter of 9mm to 11mm, and an elongation rate of 5% or less.



Rope Internal Structure

In the case of a polyamide core, the rope structure consists of a "core" made of approximately 10 bundles of twisted rope, each approximately 3mm thick, covered by a tubularly braided "sheath."

The rope is characterized by its resistance to kinking (twisting) and low elongation.

Once sufficiently proficient in rope access and able to reliably avoid rope abrasion, 8mm diameter rope may also be considered as an option.



Connectors

There are mainly two types: carabiner type and maillons type, with materials primarily being aluminum (lightweight) and steel (heavier than aluminum but stronger). The shape and strength vary depending on the application, and the appropriate equipment should be used in the appropriate place.

1 Carabiners

Classification by Carabiners' shapes

Oval Type

Elliptical carabiner.
Symmetrical, suitable for connecting to FIXE pulleys or hand ascender top holes. Most versatile.



Asymmetric D Type

Asymmetrical. Easy to clip.
This shape allows for high strength and large gate opening width. Since high strength is easily achieved, most carabiners specialized for weight reduction are of this type. Widely used in rock climbing. Not popular in SRT due to low versatility.



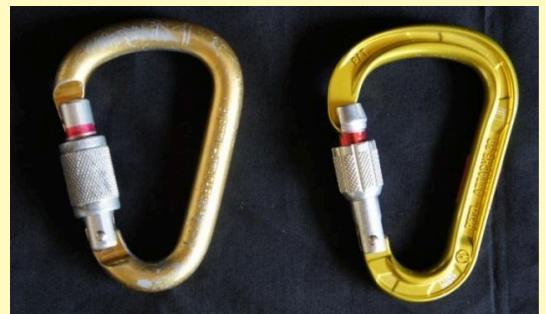
HMS Type

Pear-shaped and symmetrical. Wide gate opening, suitable for Munter hitches knot or carrying multiple gear. Since the tip is symmetrical. It is also suitable for FIXE pulley or hand ascender top hole connections.



Delta Type

Symmetrical, small triangular shape. Suitable for reducing distance between connected objects or weight reduction.



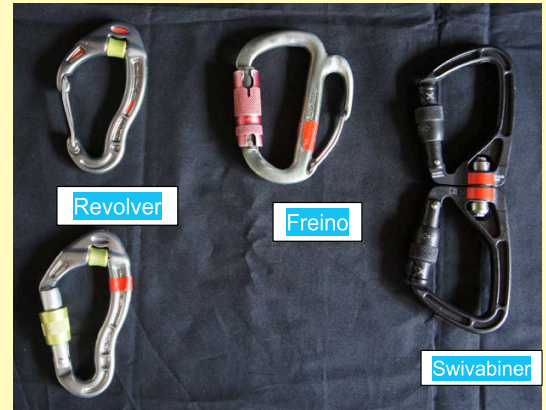
Demi-Round Type

Semi-circular carabiner. Used as the main attachment for seat harnesses.



Specialized Type

From left to right, there are carabiners with an integrated pulley at the tip (DMM Revolver), those equipped with an additional braking bar designed for use in conjunction with a descender (PETZL Freino), and carabiners with a built-in swivel (Rock Exotica Swivabiner). The Revolver is convenient when attached to a hand ascender, as it allows for immediate construction of a Z-rig (3:1 mechanical advantage).



Classification by Safety Gate Type

No lock

Type without safety lock. Used for load suspension or at zero-point belay locations when using hooks.



Manual Locking Gates

Manually twists the gate covering the gate to lock it. Used where accidental gate opening must be prevented. Mainly used for rigging (anchor construction, re-belays, etc.)



Automatic Locking Gates

A spring is built into the sleeve that covers the gate, and when the hand is released from the gate-open position, it automatically transitions to the locked state.



Tri-Action Locking Gates

Malfunction-prevention safety gates with one additional twist beyond auto lock. Used at locations requiring reliable locking that are rarely opened once set. Used for harness main attachments or connections between descenders and main attachments.



2 Maillons

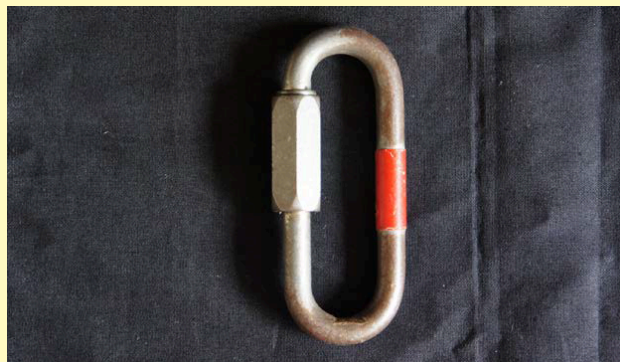
Speedy Type

Gate opens/closes with 3-4 turns and slides to full opening. Allows rapid installation and removal. Available in both aluminum and steel.



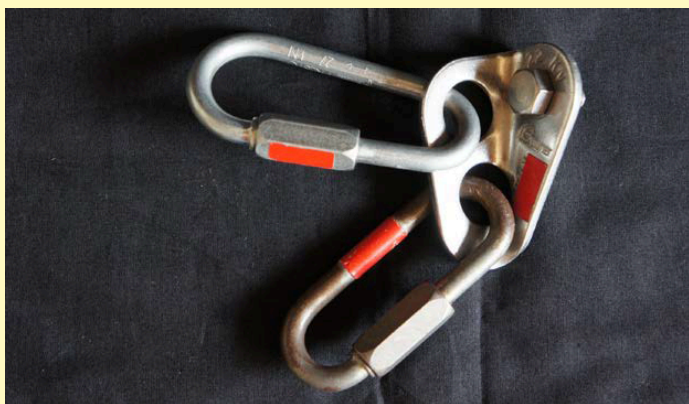
Rapid Type

The gate section is fully threaded, requiring rotation of gate threads corresponding to opening amount for gate opening/closing.



3 Combination of Shape and Materials

When Using Stainless Steel Hangers

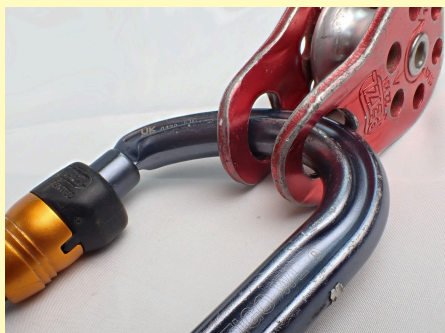


Use steel connectors with stainless steel hangers.

If aluminum connectors are used under load, the difference in hardness will cause the aluminum side to be sharply abraded.

When Connecting to Pulleys or Hand Ascender Top Holes

When connecting to wide pulleys such as FIXE pulleys or to the top hole of a hand ascender, use HMS-type or oval-type carabiners. When connecting to attachment holes positioned on two separate parallel plates, if the shape is not symmetrical, the load will not be evenly distributed across the two plates.



Ascender

Gear that can be fixed to rope by gripping or biting the rope. Shape varies according to application. Mainly used during rope ascent and lifting heavy objects.

Basic Ascender

A cam with unidirectional spikes bites into the rope surface and can lock at any position on the rope. Basic form with high versatility for ascent and hauling.

Cut through rope sheath at around 600Kg.

Therefore cannot be used as the main device for Tyrolean bridges tensioned using mechanical advantage systems.



Chest Ascender

Specialized as an ascender for chest attachment. Cam section plate is minimally sized for easy rope attachment/detachment.

The bottom hole is angled so the chest ascender remains parallel to the body. They have the same strength as basic types.



Hand Ascender

Basic ascender with handle attached. Shape specialized for handheld use. Used together with foot loops. Can be attached/detached with one hand. Strength is the same as basic types.



Foot Ascender

Auxiliary ascender for ankle attachment. Not necessary but make the climbing much easier when mastered. Strictly auxiliary gear and must not be recognized as a self-belay equipment.

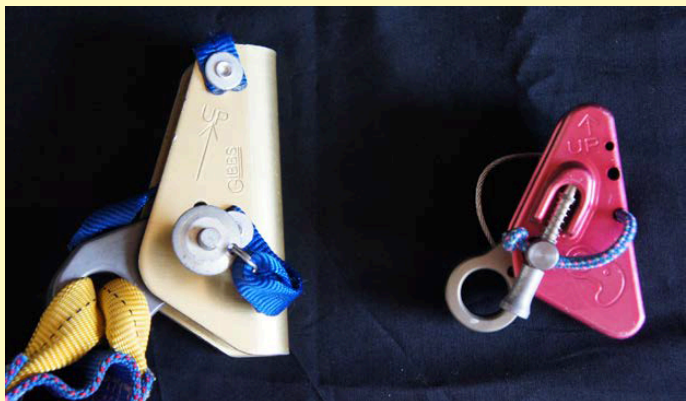


Gibbs-type Clamp

A cam with unidirectional spikes bites into the rope surface and can lock at any position on the rope. Basic form with high versatility for ascent and hauling.

Cut through rope sheath at around 600Kg.

Therefore cannot be used as the main device for Tyrolean bridges tensioned using mechanical advantage systems.



Shunt

This is an ascender with a unique mechanism in which a metal bar presses and grips the rope when load is applied to the attachment point.

Attachment to and removal from the rope is cumbersome, and response time under load is slow. It can be used in conjunction with an ATC to add an auto-stop function. Like the ATC, it can be used with either single or double ropes.

When using double ropes, do not use ropes of different diameters. Only the thicker rope will be locked, and there is a possibility that the thinner rope may slip through.



Descender

There are many types of descenders, all of which control descent speed by creating friction between metal components and ropes. In this document we will focus on the most used device in SRT PETZL's RIG and ATC.

Rig

This is a single-bobbin descender developed for work solutions. It can be hard-locked using only the lever operation. The attachment hole on the front plate is clip-style, allowing the descender to be attached to the rope without removing it from the carabiner.

When the rope is thin or the bobbin is worn, adding a hard lock similar to that of the Stop can be effective.



ATC

Used in combination with a carabiner, they function as a belay device or descender. They do not have an auto-stop function, but can be used in conjunction with a prusik or Shunt to add an auto-stop function. Can be used with double ropes.



4

Cowstail+Climbing aiders

Cowstail

A self-belay lanyard consisting of two lines (long and short) with carabiners attached at the tips.

Used for self-belaying when passing intermediate anchor points and when using hand ascenders.

Product equivalents include PETZL's Spelegyca and Progress.



Always use anti-rotation rubber (captive bar) in conjunction!

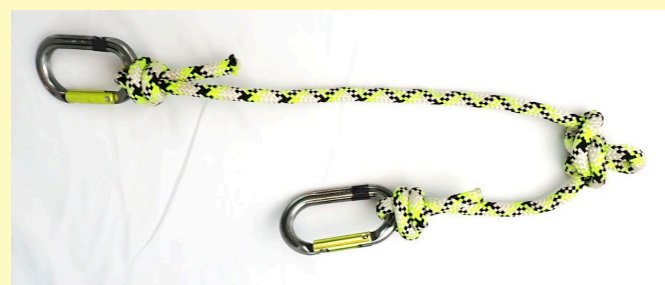
Always use a captive bar (anti-rotation rubber) to prevent the carabiner at the tip from rotating. (Not necessary for barrel knots) If a captive bar is not used and the cow's tail is free to move within the carabiner, there is a danger that if the tip of the cow's tail catches on the gate section when unweighted, the cow's tail may push the carabiner gate open and detach when re-tensioned.



Can also be self-made

Can be self-made using dynamic rope with a diameter of 9mm or more.

The terminal end should be tied with either a double figure-eight knot, barrel knot, or overhand knot, and the intermediate point should be tied with either a double figure-eight knot or alpine butterfly knot.



Climbing Aiders

Foot Loop (Etriers)

Connected to hand ascenders for pushing up with feet. The end forms a loop for inserting feet, with adjustable length.



Etrier

An etrier typically has 4 to 5 steps and is available in webbing material or metal plate material. Webbing material has excellent packability but is less comfortable when standing in it. Metal plate material is bulky but suitable for extended standing work.

In rope access, it is conveniently used during bolt traverses.



5

Tape+Slings+ Daisy Chain+Cord+Rope guard

Tapes

Wide fiber tape mainly with width of approximately 10mm to 30mm.

Tied with water knots and used auxiliarily during rigging.



Sewn Sling

Pre-sewn tape products made into a ring shape. Mostly have the strength of approximately 22kN

Extremely convenient and frequently used, but caution is required in its use.



Daisy Chain

Sewn sling with intermediate section sewn at approximately ten locations to create loadable points at arbitrary positions.

While sewn sling (end-to-end) the load capacity is 22kN, intermediate pocket load capacity is approximately 300kg.



Different materials will cause breakage!

Do not connect slings or daisy chains made of different materials. (Example: nylon and Dyneema, etc.) It is known that materials with different elasticity will melt and sever due to friction under load. When connecting them, use a carabiner for the connection.



Connecting with a girth hitch will cause breakage!

Do not connect with a girth hitch.

Use a square knot or connect using a carabiner.



Cord

Rope with kernmantle construction and circular cross-section, mainly 5mm to 8mm diameter, Used auxilarily during rigging. Kevlar and Dyneema materials may have strength equivalent to the main rope. Frequently used when sewn or tied into sling form.

Regarding Kevlar material, self-polishing properties have been noted with reports of low fatigue characteristics. Kevlar should be discarded earlier compared to other materials.



Sewn products

Sewn products are neat, compact, and convenient.



Tying with a fisherman's knot

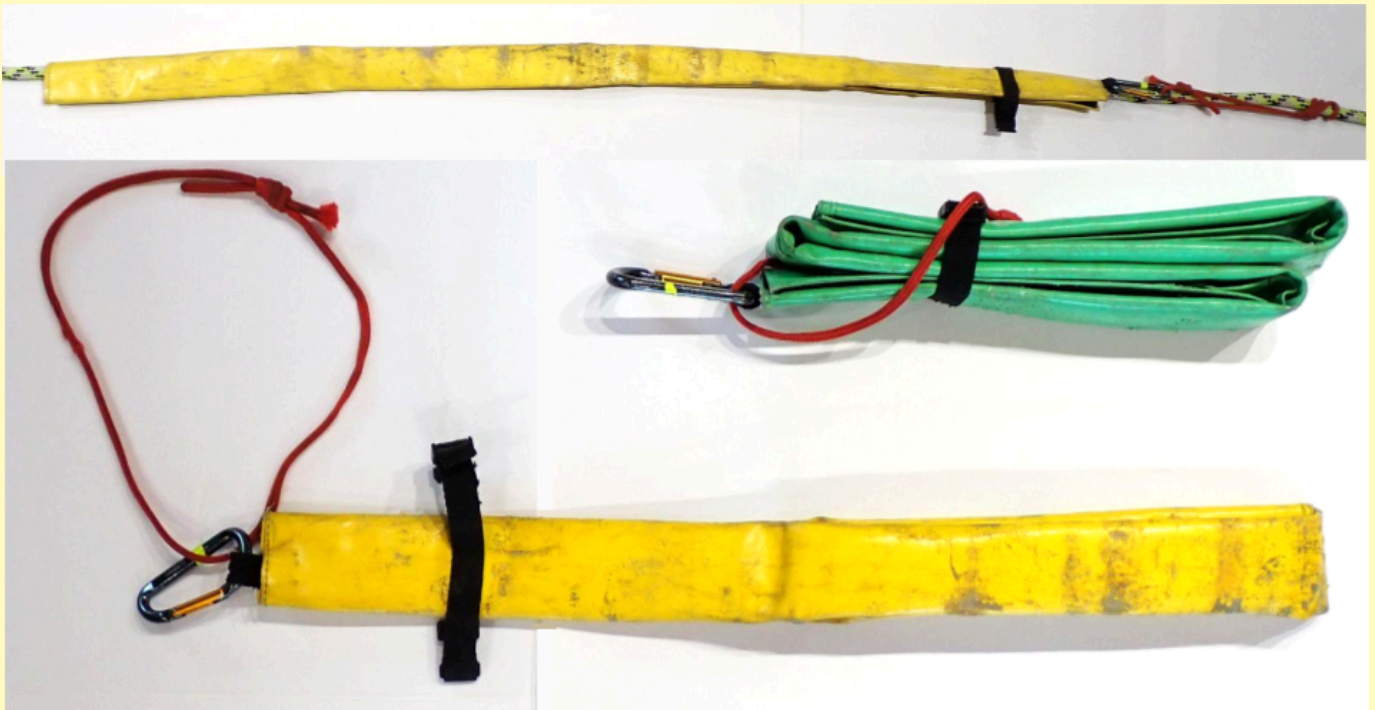
Can be tied into a sling shape using a fisherman's knot. Inexpensive.



Rope Protector (Rope Guard)

Rope Protector (Rope Guard)

Rope protection component made from abrasion-resistant fabric such as PVC. Carried together with approximately 3mm diameter cord and a small carabiner.



6

Equipment Donning

Donning General Rope Access Personal Equipment

1 Put on helmet

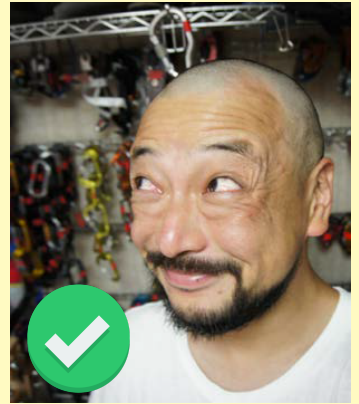


Bundle and secure long hair. Always keep it away from the area in contact with the descender.

(There is a danger of hair getting caught in the rope intake section of the descender during use. Short hair is recommended.)

Long Hair Problem

If hair gets caught in the descender, your own body weight will pull your own hair. If the load cannot be released, the only option is to cut it!



2 Put on sit harness



At this time, attach to the main carabiner, from the wearer's perspective from right to left, in the order of: chest ascender, cow's tail.

3 Put on chest harness



Use the top hole of the chest ascender to tie around the neck, shoulders, and underarms, securing the chest ascender against the body.

4 Equip hand ascender



Connect the foot loop to the hand ascender using a Speedy maillon. Clip a carabiner to the Speedy, and when not in use, fold the foot loop short and hang it on the gear rack.

If you use a Revolver (made by DMM) with a built-in pulley as the carabiner, it's convenient as you can quickly construct a 3:1 mechanical advantage.

5 Connect descender



Connect an auto-stop descender to the main attachment point with a locking carabiner.

The chest ascender and cow's tail are already connected to the main attachment point from the wearer's perspective from right to left, and the descender is attached on the far left.

6 Attach backup equipment



Not normally used, but as backup equipment in case rescue is activated or gear shortage occurs, carry a pulley, spare cord approximately 4m long and $\phi 6\text{mm}$ diameter (preferably made of Dyneema or Kevlar with 1800kN load capacity), three locking oval carabiners, ATC, knife, and 6mm prusik cord.

7 Other equipment



Not necessarily required, but a foot ascender makes ascending much easier, and a small pulley cam has high versatility for hauling, rescue, backup ascender, etc.

Also, if you attach a small rigging plate to the lower side of the main attachment point, you can distribute and hang your carried equipment, making attachment and removal convenient.

Basic Ascending and Descending

The following shows operation methods for each device during ascent and descent

1

How to Use a Descender

There are numerous gears for descending rope, each with various characteristics.

In rope access, an inline-type descender with an auto-stop function is required that does not cause kinking (twisting) in the rope being used.

This manual adopts PETZL's "RIG."



❶ Connect both the short and long cow's tails to the anchor point (carabiner, sling, or loop) at the descent starting point to establish security.



❷ Connect the descender to the main attachment point, open the front plate, and thread the rope through. For the RIG, set the lever to belay mode beforehand. (Are you attaching the rope while the descender is still on your gear rack?)



❸ Release the handle to let the Rig goes into the hard-locked mode.

(The older RIG models need to be manually locked.)



④ Gradually transfer your weight to the descender, and if there are no problems once your weight is fully transferred to the descender, remove the short cow's tail. (This confirms that there is no breakage of the descender body or carabiner, and that the descender connection is normal.)



⑤ Firmly grip the brake-side rope, release the hard-lock, and descend just a few centimeters. Hard-lock again and remove the long cow's tail. (This confirms that the rope is properly threaded through the descender.)



⑥ Again firmly grip the brake-side rope, release the hard-lock, and begin descent. Always keep your hand on the brake-side rope. Never release your hand from the brake-side rope without hard-locking the descender.



⑦ If you need to release your hand from the brake-side rope while on the rope during descent, always hard-lock before releasing your hand.

Caution!

- If you set the descender lever to descent mode without gripping the brake-side rope, it will result in an uncontrolled state and you will fall.
- If the descent speed is too fast, high heat will be generated from friction between the descender's bobbin and the rope, potentially melting the rope sheath. (Take approximately 2 seconds per meter of descent)
- The braking force obtained varies greatly depending on the rope's thickness, age, dry/wet condition, and the degree of wear on the descender. If the braking force appears insufficient, connect a new carabiner next to the descender on the main attachment point to obtain additional braking. There are also carabiners equipped with an additional braking bar called Freino.

2

How to Use a Ascender

There are several rope ascending styles using ascenders, mainly including the Frog System used in European-style caving, Gibbs Rope Walk System used in American-style caving, and Texas System used in alpine climbing.

This manual adopts the Frog System, which is more suitable for vertical or aerial movement and staying.

Therefore, adopted gear includes handled ascenders (such as PETZL's Ascension) and chest ascenders (such as PETZL's Croll). Adding foot auxiliary ascenders to the Frog System is called the Frog Walk System.

It is very convenient as you can choose from three ascending methods according to physical strength.

1

Frog System



① Use a maillon to connect a foot loop to the smaller bottom hole of the hand ascender. Put your foot in the foot loop and adjust the length of the foot loop so that the underside of the hand ascender cam and the upper side of the chest ascender cam are positioned to overlap precisely.



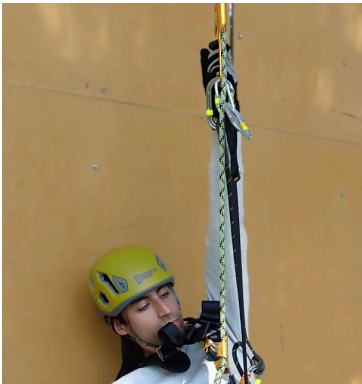
② Attach hand ascender and chest ascender to rope. Also attach the long cowstail to the bottom hole of the ascender. (Be careful that the rope and the long cowstail do not cross)



③ Pull the rope under the chest ascender downwards and stretch your body several times until tension is applied to the chest ascender.



④ While pulling the rope below the attached chest ascender downward, stretch up and entrust your body weight to the chest ascender for takeoff.



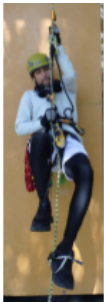
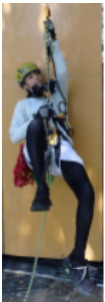
⑤ Push the hand ascender upward until the long cowstail becomes taut, then put your foot into the foot loop.



⑥ Push the foot in the foot loop down then stand up.



⑦ If the rope sags between hand ascender and chest ascender, pull the rope below chest ascender downward.



⑧ Entrust body weight to chest ascender then sit and repeat from step 5 until reach the desired level.

Tips

For the first few meters from the start of ascent, the rope has little self-weight, so the rope will not flow smoothly through the chest ascender by simply standing up—this requires technique.

① When standing up with the foot loop, pull the rope below the chest ascender downward with free hand.

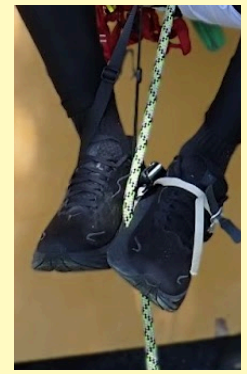


② Place the rope on your foot before threading your foot through the footloop. Then pinch the rope between your foot and foot loop before standing up.

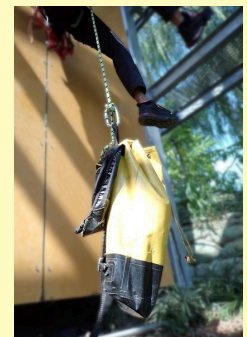
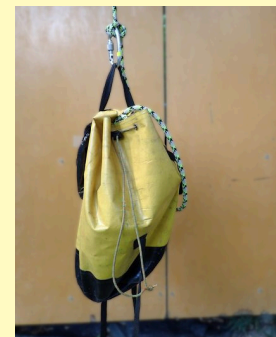
Stand up and pinch the rope on your feet downward at the same time. Repeating this process until there is enough rope weight for smooth ascending.



③ Insert both feet into the footloop, pinch the rope between feet then stand up. Repeating this process until there is enough rope weight for smooth ascending. (This solution is effective in completely suspended state with no place for hands and feet)



④ Using an object such as rope bags at the end of the rope to increase the rope weight.

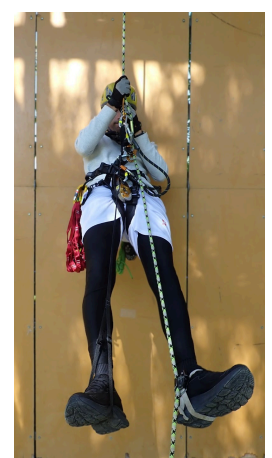
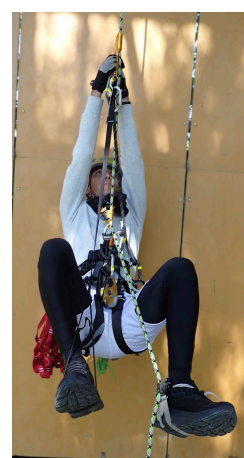
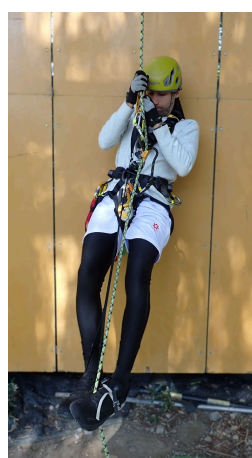


2 Frog Walk System

The Frog Walk System enables three climbing methods (Basic Step, Asymmetric Step, Symmetric Step). Climbing speed is proportional to required physical strength.

Basic Steps

Climb with sit-and-stand motion same as Frog System. Adding a foot ascender allows left and right feet to kick in different directions for stable climbing.



① Raise hand ascender to full length of long cow's tail. Raise the foot ascender to the same height as the foot loop.

② Kick up using both foot loop and foot ascender.

③ Entrust body weight to chest ascender.

④ Repeat from ①.

⑤ Can climb stably by standing with both feet.

Asymmetric Steps

Lift your body by standing in a foot loop. Standing in the foot ascender is not for lifting the body but for moving the hand ascender upward.



❶ Insert foot in foot loop, attach rope to foot ascender.



❷ Raise foot ascender to height between opposite knee and heel.



❸ While kicking up with foot ascender, raise hand ascender to full length of long cow's tail.



❹ While kicking up with foot loop, simultaneously raise foot ascender to height between opposite knee and heel.



❺ Repeat.

Symmetric Steps

Lift body with standing motions of both foot loop and foot ascender. Achieves unbeatable speed on 70°-80° inclined walls where toes touch a wall.



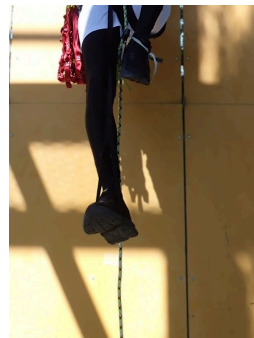
❶ Insert foot in foot loop, attach rope to foot ascender.



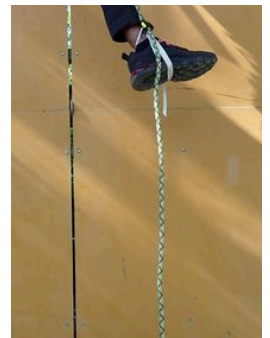
❷ Raise foot ascender to opposite knee height.



❸ While kicking up with foot ascender, raise hand ascender to full length of long cow's tail.



❹ While kicking up with foot loop, simultaneously raise foot ascender to opposite knee height.



❺ Repeat.

3

Descending with Chest Ascenders



① Hand ascender and chest ascender are connected to the rope, with body weight resting on the chest ascender.



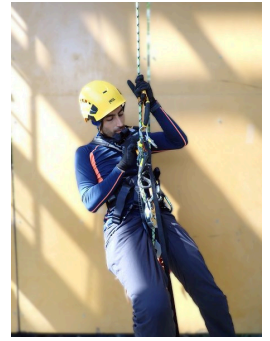
② Stand up on the foot loop, gradually push open the chest ascender cam while slowly sitting down to slide the chest ascender down the rope (do not completely remove the chest ascender from the rope).



③ Lower the chest ascender cam just before the long cow's tail is tight.

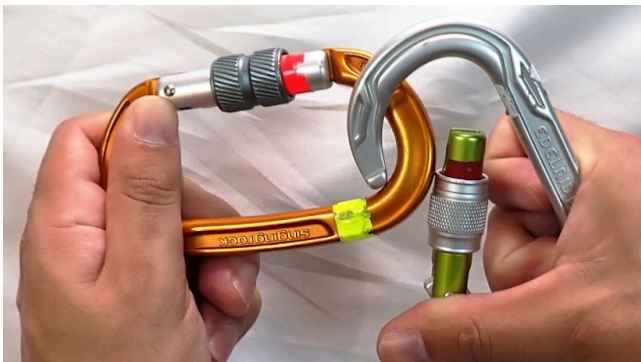


④ As body weight transfers to the chest ascender, pushing the hand ascender's cam to open it (do not completely remove the hand ascender from the rope) then slide the hand ascender down.



⑤ Repeat the step ①. Until reaching the desired level.

When connecting descenders, ascenders, cowstails, etc. to the harnesses (also during rigging), do not link carabiners together. Twisted carabiners under load could cause accidents where gates are forcibly opened unintended.



Exception: Connection between descender and main attachment point, or demi-rond carabiner.

When connecting a descender to an ascent harness (one that connects the main attachment of a sit harness with a semi-circular demi-rond carabiner) or other work solution harness (one with a ring pre-sewn into the main attachment point), you will be connecting

carabiner to carabiner, or carabiner to metal main attachment point.

While this is unavoidable in such cases, make the descender-side carabiner as small as possible. Large-diameter HMS and similar carabiners can easily come off when twisted. Of course, use carabiners with safety gates.

For connections that unavoidably use carabiner-to-carabiner connections, watch the loading carefully without taking your eyes off it until loading is complete to ensure it is loading without twisting during re-tensioning.

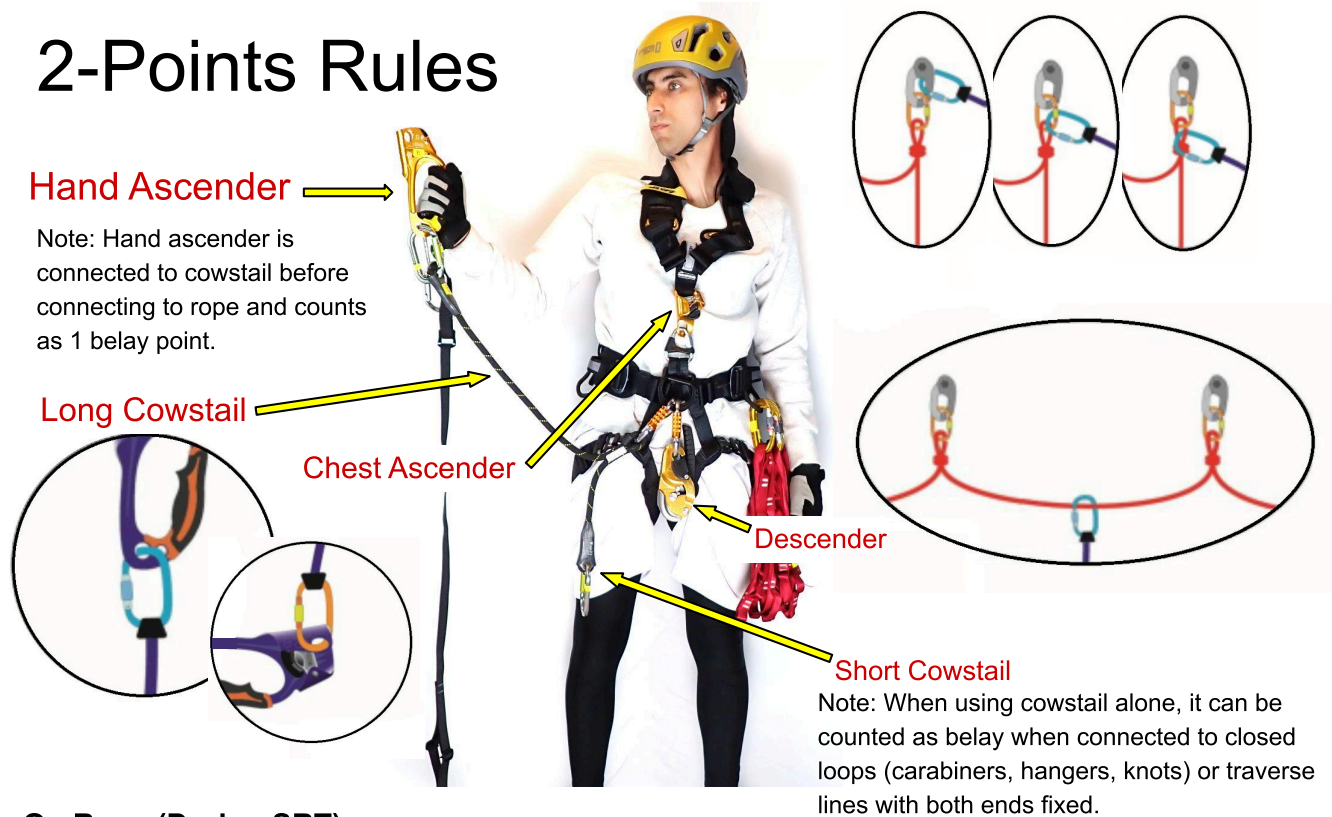


2-Point Rules

Always maintain a state where 2 points among the 5 self-belay equipment worn by the rope users (hand ascender, chest ascender, long cowstail, short cowstail, and descender) are always functioning as self-belay. (2-point rules)

As an exception, only 1 point with descender is acceptable during descent. When wanting to remove 1 point from 2-point belay state during changeover, secure a 3rd point first before changing over .

Foot ascenders are auxiliary ascenders and must not be counted as belay.



On Rope (During SRT)

Among the above 5 pieces of gear that can provide belay to rope, a minimum of 2 belay points must always be secured. The only exception is during descent with descender, where 1 point is acceptable.

A shout out to our model Mr. Jose. Jose is one of a foreign workers in Keystone who came all the way from Argentina with a big dream and a golden heart.



At our training facility in Gojo Nara, we have a modest guesthouse with a chicken and duck farm, vegetable farm and rice field.



If you have a plan to visit Nara, why not give our guest house a visit? We have fun activities for families here like indoor climbing, real Japanese traditional farming, and even professional rope access training service.

8

Pulley + Rigging Plates + Rope Bags + Seats

Used for changing pull direction and constructing mechanical advantage systems.

Swing/Slide Type

Both plates rotate on the pulley axis for rope attachment.
Many have high pulley efficiency.



Among swing-slide pulleys, the Prusik-minding pulley, which has squared edges on the plate adjacent to the sheave that provide the effect of pushing down the prusik, can be used in conjunction with prusik cord to construct a pulley cam.



It can be combined with an ascender to form an assembly, enabling the construction of a pulley cam or the leading end of a Z-rig.

FIXE Type

Body plates are fixed in place.

Can be combined with ascenders to form assemblies and construct pulley cams or Z-rig terminal sections.



Tandem Pulley

A pulley with bobbins arranged side by side, primarily used to stabilize direction when traversing a Tyrolean bridge.



Cam Pulley

A device that integrates a pulley (sheave) and a cam. Primarily used for hauling (raising), rescue, and movement on Tyrolean bridges. **Must not be used for rope tensioning!** Can be used as either a pulley only or as a cam only.



Rigging Plates

A strong metal plate or cube with multiple attachment points. Primarily used for rescue or hauling heavy objects. When carrying a lot of equipment, it is convenient to attach a small rigging plate to the lower side of your attachment point for distributing loads.



Rope Bags

A bag for rope transport, primarily made of smooth, non-absorbent fabric such as PVC. Designed to minimize protrusions as much as possible to prevent snagging during hauling on wall surfaces or passage through confined spaces.



Work Seats

A suspension seat that assists during prolonged aerial suspension. Connects to the main attachment point of the harness from both left and right sides using adjustable buckles.



SRT primarily uses 16 knots. The following shows knotting methods along with usage locations, purposes, and prohibited actions. Note that creating knots causes loss of approximately 30% of rope strength. No problem for single rope users loading vertically, but simple strength calculations are necessary when creating tensioned lines like Tyrolean bridges with multiple users loading.

① Figure Eight Knot

Basic knot in SRT. This knot itself is not frequently used, but various modified figure eight knots are commonly used.



② Double Figure Eight Knot

Mainly used when connecting to anchor carabiners. Relatively high strength.



③ Rabbit Knot

Variation of double figure eight knot that can create two connectable loops. Knot for Y-shaped connection of two adjacent anchor carabiners. Relatively high strength but consumes much rope.



④ Bowline

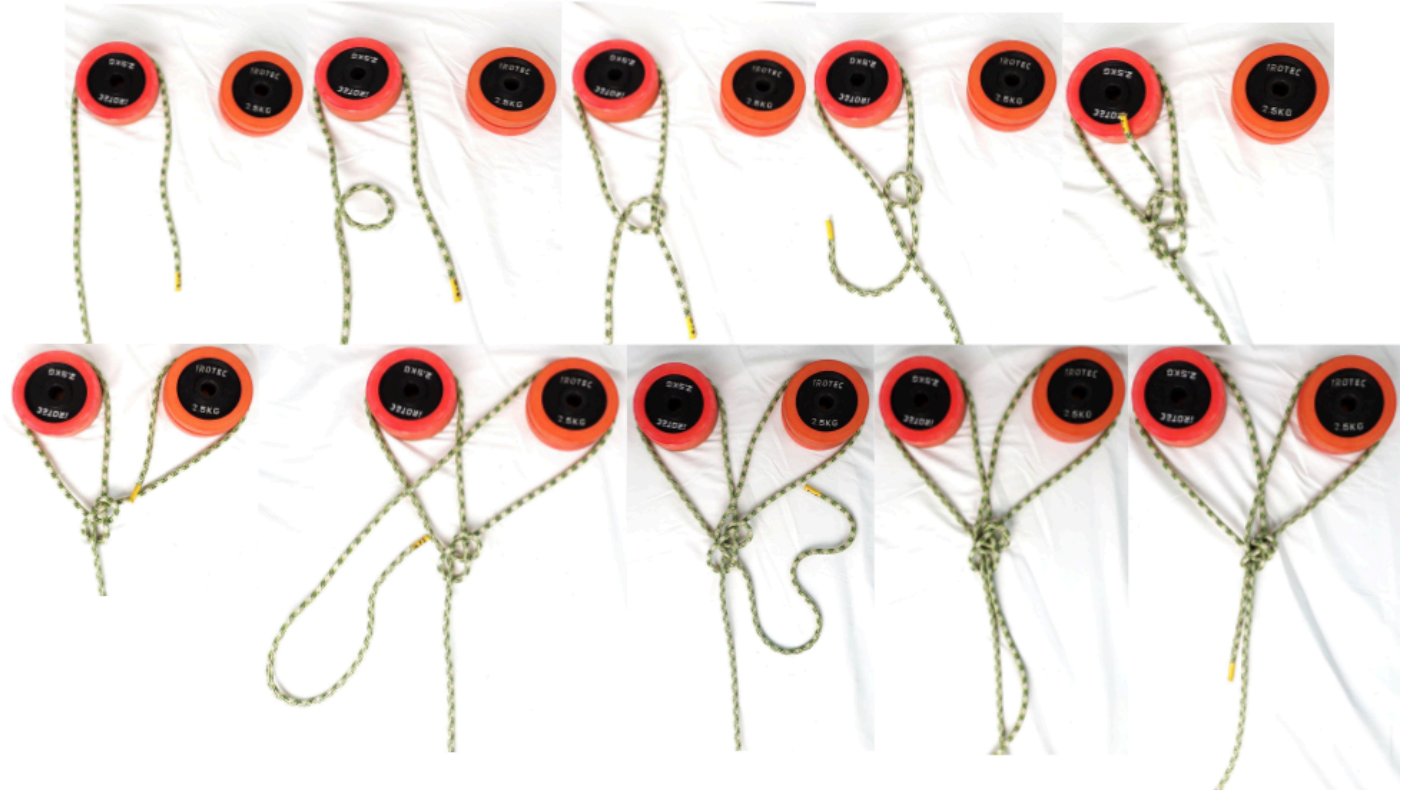
Frequently used for connecting to natural anchors at rope ends in combination with clove hitch described later. Consumes little rope and is easy to untie after loading. Will untie under ring loading (load in direction expanding the loop formed by knot), so never apply tension such as self-belay inside the bowline loop. Always use a modified bowline with end treatment.



⑤ Bowline on a Bight

1 When tying at the rope end

When connecting at rope end, it can directly Y-connect two adjacent natural anchors with rope, eliminating auxiliary equipment like carabiners and slings. May shift to the equilibrium side under excessive unequal distribution.



2 When tying in the middle of the rope

When connecting at rope middle Used for Y-connecting two adjacent anchor carabiners when wanting to reduce rope consumption compared to rabbit knot, or when directly connecting rope to ring hangers for re-belays.



⑥ Alpine Butterfly

Knot for creating Y-shaped load distribution rigging (classical Y-belay) at rope middle.



⑦ Clove Hitch

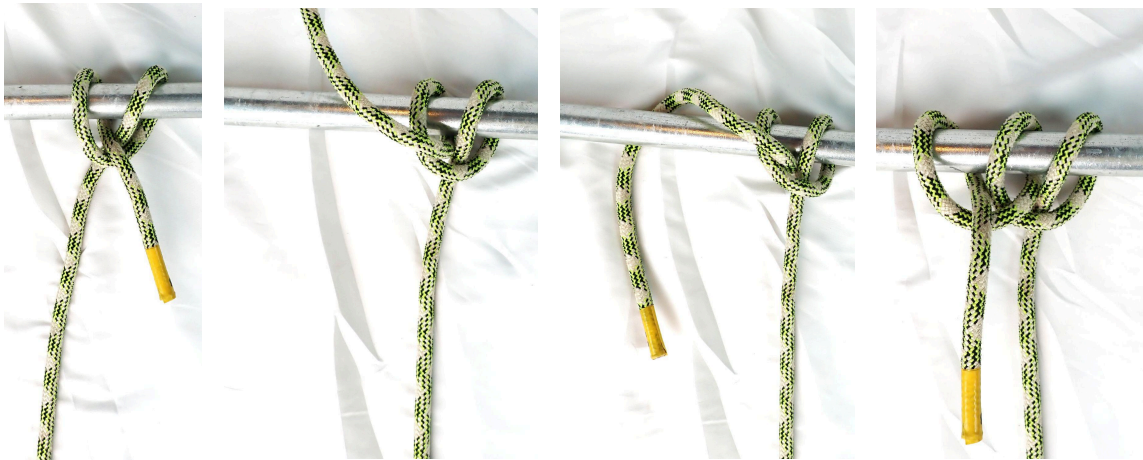
Used for connecting to natural anchors combined with bowline at rope start, or frequently used as temporary fixing knot through carabiners at rope middle.

1 When connecting at rope end

Created by wrapping around a natural anchor and weaving.



When the anchor surface has low friction, increase wraps to obtain sufficient friction.



2 When connecting at rope middle

Created by overlapping rope twisted twice, through carabiner.
Effective for temporarily fixing rope bags to rope ends.
Resembles Italian hitch, so be careful not to confuse.



⑧ Italian Hitch (Half Clove Hitch)

A Knot capable of braking rope. Used for emergency escape when descender is lost mid-pitch, or when rescue occurs requiring many fixed brakeable anchor points and descenders are insufficient. It resembles the clove hitch, so be careful not to confuse.



⑨ Triple Figure Eight Knot

Used for rope joints on-rope. Create a double figure eight knot at the bottom end of the upper rope, then create by follow-through (weaving alongside) with new rope from below.

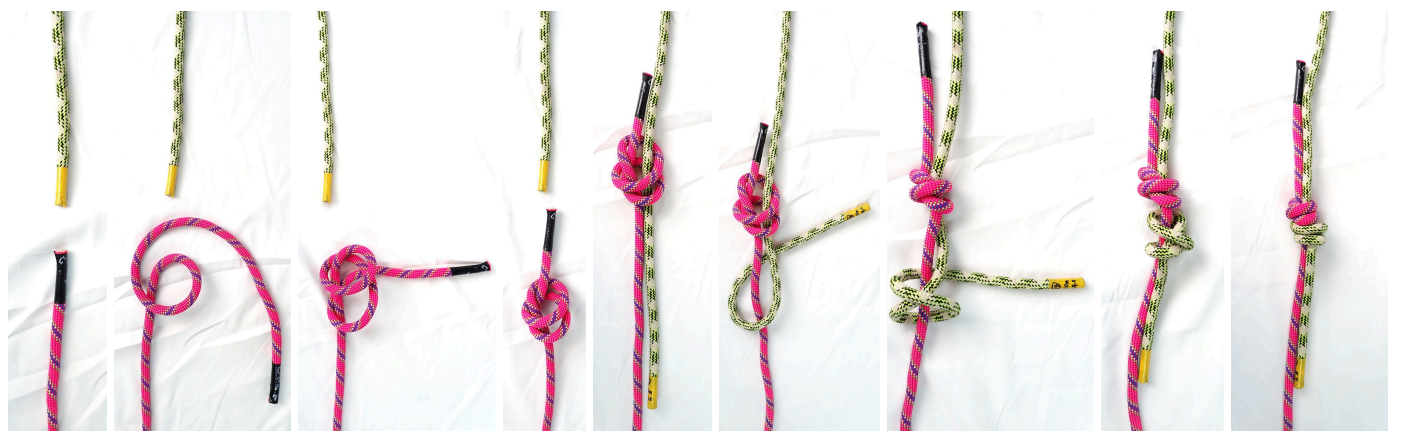


Following the rigging two-point rule, add knots. Connect triple figure eight knot ends with double fisherman's knot as backup.



⑩ Double Fisherman's Knot

Used for linear connection of ropes, cords, and other circular cross-section materials. Mainly used for creating rope slings or as backup knots during rope joints. Very difficult to untie once the knot tightens under tension.



⑪ Double Fisherman's Loop

Rope folded back with a connector and connected with one side of a double fisherman's knot (barrel knot). Used when self-making cow's tails from dynamic rope or creating variable cow's tails.



⑫ Prusik

Representative friction hitch capable of gripping rope. Basically made with a rope loop of smaller diameter than the main rope. Appropriately increase/decrease friction by number of wraps. Used for emergency escape when ascender is lost mid-pitch, fixing protectors on rope, tensioning Tyrolean bridges. A 8mm diameter prusik cord can withstand approximately 1200kg load.



⑬ Blake's Hitch

Like the prusik, this is a type of friction hitch. Unlike the prusik, it can be slid by pulling the knot section while under tension. Used for creating a foot loop with spare rope or for adding a braking function during emergency escape descent.



⑭ Tape Bend (Water Knot)

Knot for joining tapes together. Created by follow-through (weaving alongside). Danger of untying if a specific part within the knot catches and is loaded. Position so the knot section is completely in catch-free location, or create another tape bend with the remaining connected portion as backup.



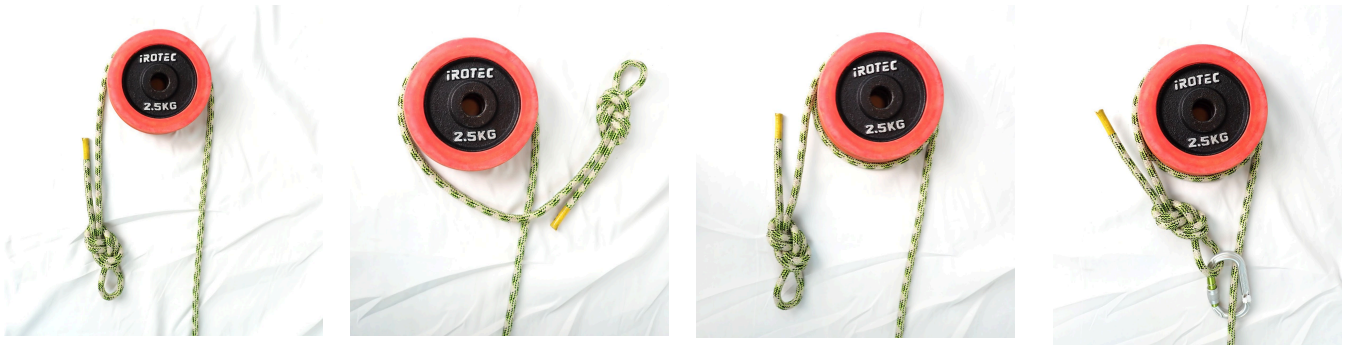
⑮ Girth Hitch

Frequently used for connecting loop slings like tape slings or daisy chains to natural anchors. Note that strength is significantly lost (60% or more) when the loaded sling is folded back. When connecting slings together, do not connect different materials and use square knots instead of girth hitch.



⑩ Tensionless Hitch

Used when connecting to natural anchors at rope ends, especially when rope strength is required. Can extract rope strength with almost no loss. Used for anchors of tensioned lines like Tyrolean bridges.



The following are the main types of natural anchors. Their tying methods are also introduced below.

Standing Trees

For thick trees with diameter at breast height of approximately 20cm or more, establish anchor points as high as possible on the trunk within strength limits. If beginning main rope use, use rope end to directly weave clove hitch into standing tree for connection, then create bowline with remaining portion. (Use clove hitch in combination considering knot tying errors).



When connecting at rope middle, wrap loop slings or daisy chains around the trunk with girth hitch and connect to rope through carabiners. (Anchor height is secured since it won't slide down even when tension is released)



When obtaining anchor from shrubs where a single trunk lacks sufficient strength, bundle multiple trunks with girth hitch.



Or distributing load by using knots shown as below across multiple branches.



When there is a middle branch and no need for a girth hitch, using it double provides higher strength. When particularly high strength is required, tie a tensionless hitch around the main trunk.



Pay attention to the angle!

When using a girth hitch, be aware that the greater the angle of the pulling section, the greater the strength loss.



Boulders and Bedrock

Large boulders that stop stably or large protrusions of bedrock can be used as anchor points.

Consider load direction and confirm shape prevents slipping out toward the open side. If beginning rope use, rope may be directly connected with bowline or similar.



When connecting to rock, wide tape slings are effective.

(Compared to rope where abrasion with edges is point contact, tape has increased contact area with edges, resulting in less fiber damage)



The following can also be applied to large tree trunks.

When connecting with open slings wrap around the anchor 2-3 times then connect with a tape knot and load only one strand.

This tightens around the anchor making it less likely to slide down even when tension is released.

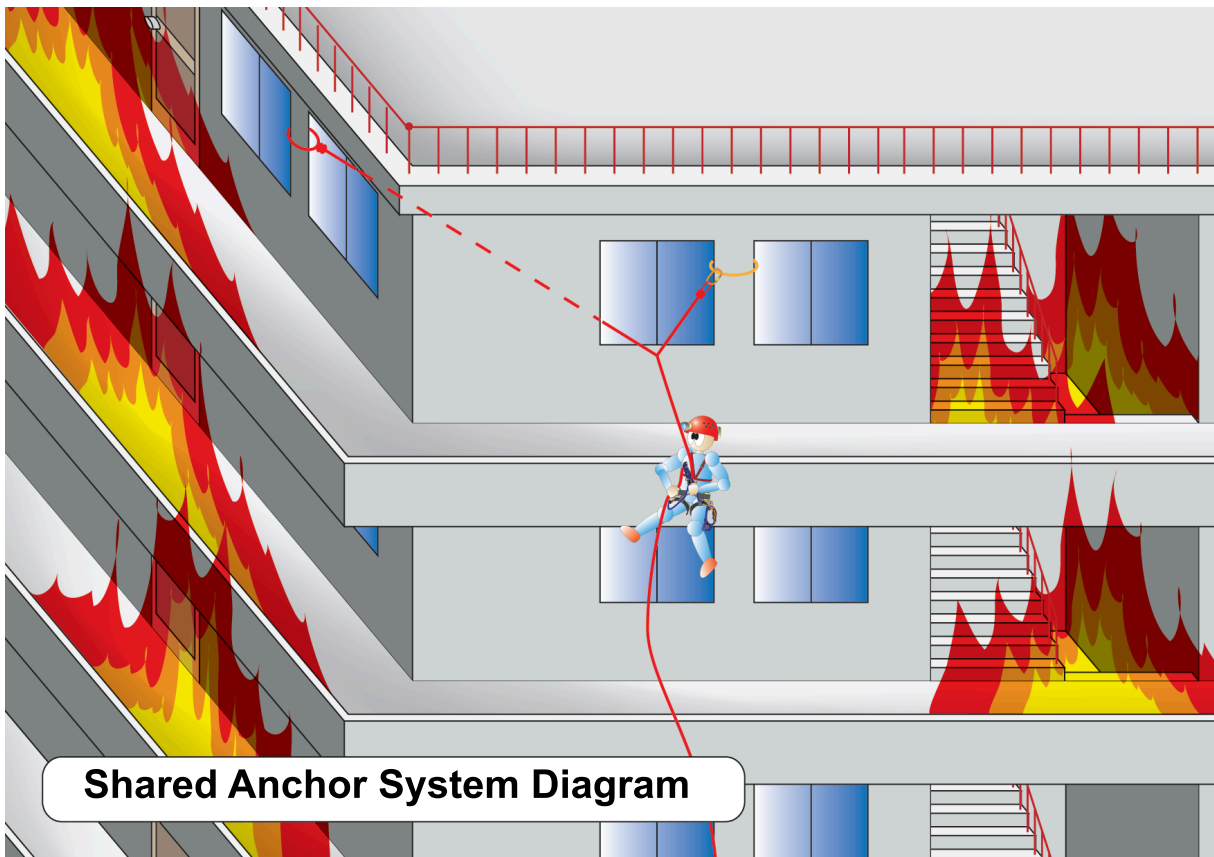
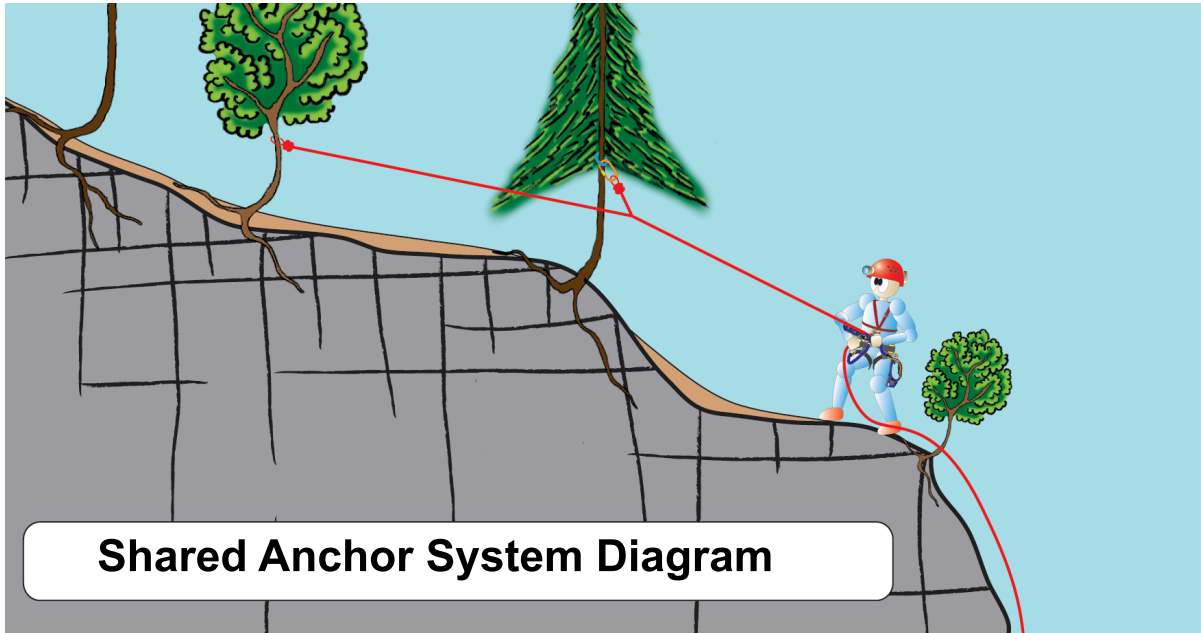


Pre-made into loop and girth hitch is also possible or if auxiliary sling strength is sufficient, single girth hitch may be created.



Shared Anchors System

A system that distributes and applies load across multiple anchors. Also called a Y-belay because of its Y-shape.



There are two types of Y-belays: the independent distribution Y-belay, which fixes the load distribution ratio, and the sliding distribution Y-belay, in which the rope or sling flows so that the load ratio remains constant at all times.

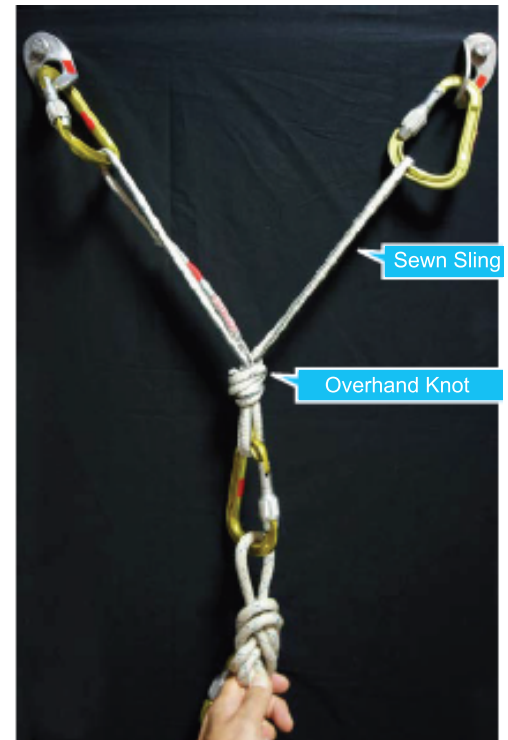
① Independent Distribution Y-Belay

A method that independently fixes the length of each arm of the Y-belay, also fixing the load distribution ratio.

Can be constructed with minimal consumption of rope or sling, and if one rope within the Y-belay breaks, it is backed up by the other. In general SRT, there are few cases where loads need to be completely evenly distributed, so unless there is a specific reason, use an independent distribution Y-belay.

An anchor that uses a Y-belay created by connecting a rabbit knot and sewn sling with an overhand knot.

Since only one knot is being used, if that is incorrect it would be fatal.



When anchors are adjacent, connection methods using rabbit knots or bowline on a bight are possible, but backup connections should be used to avoid single knot dependency.

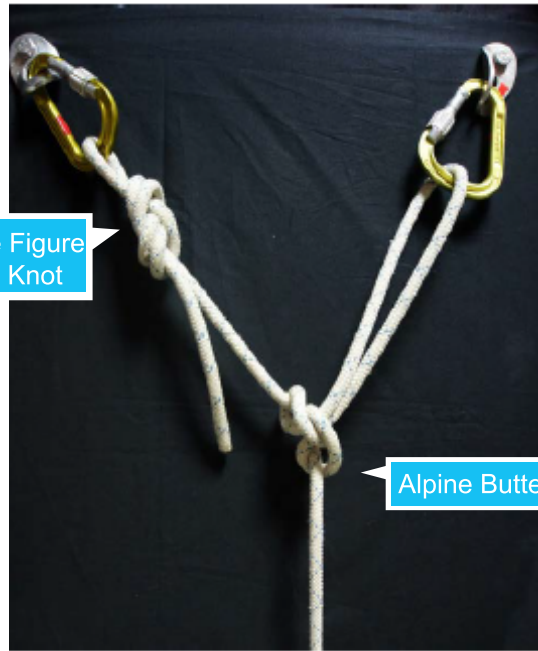


After installing the backup anchor, the method of tying the middle of the rope to the main anchor using an alpine butterfly is called the "classical Y-belay,"

This is the most frequently used method as it is the most rational tying method that minimizes the consumption of rope and auxiliary equipment.

Double Figure Eight Knot

Alpine Butterfly

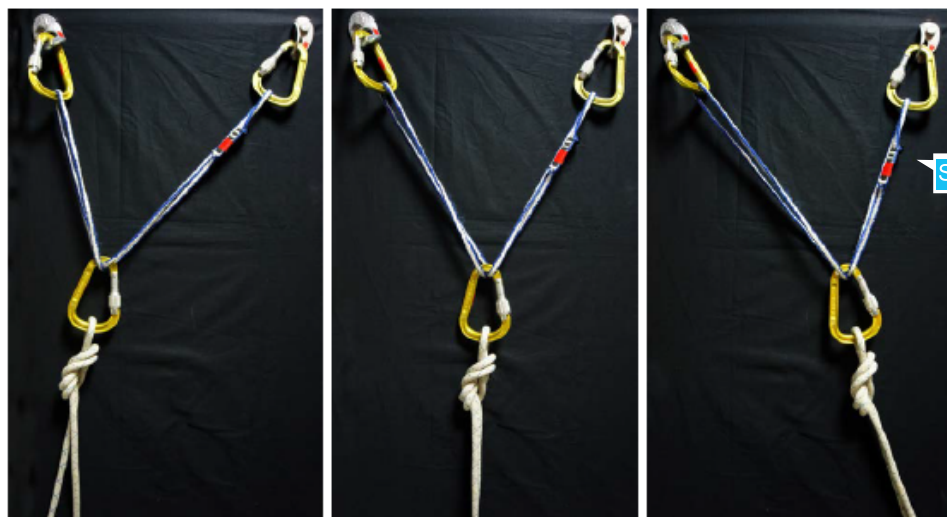


② Fluid Distribution Y-Belay

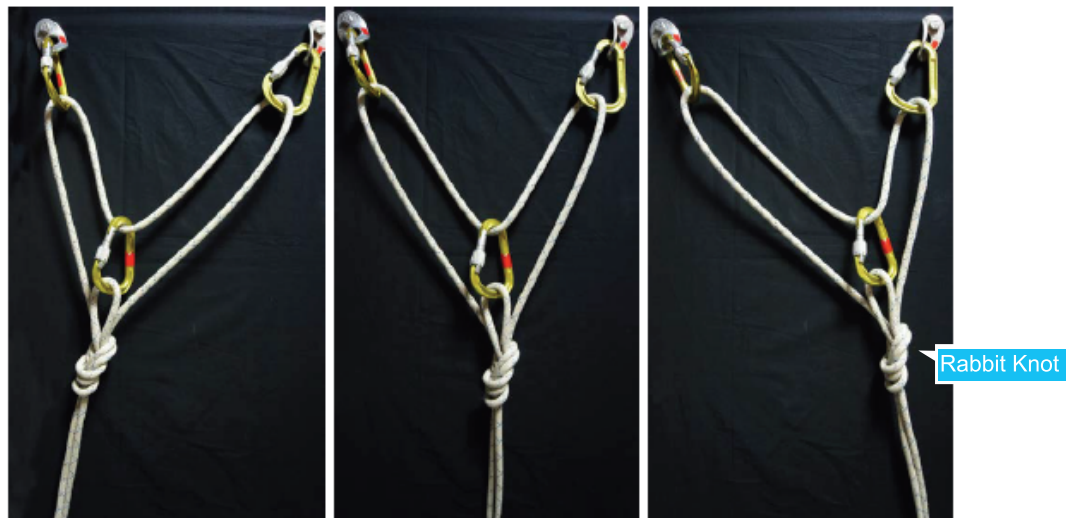
A method that constantly distributes load evenly to the anchors by connecting multiple anchors with movable rope or slings. For construction, methods include using loop-style slings or using rabbit knots or bowline-on-a-bight in unconventional ways.

When fabricating the sliding section with slings, twist the section between anchors of the loop sling once to prevent complete failure in case of anchor detachment. With fluid distribution, the load automatically equalizes even when the direction of descent changes.

Example of a fluid distribution Y-belay using a sewn sling.

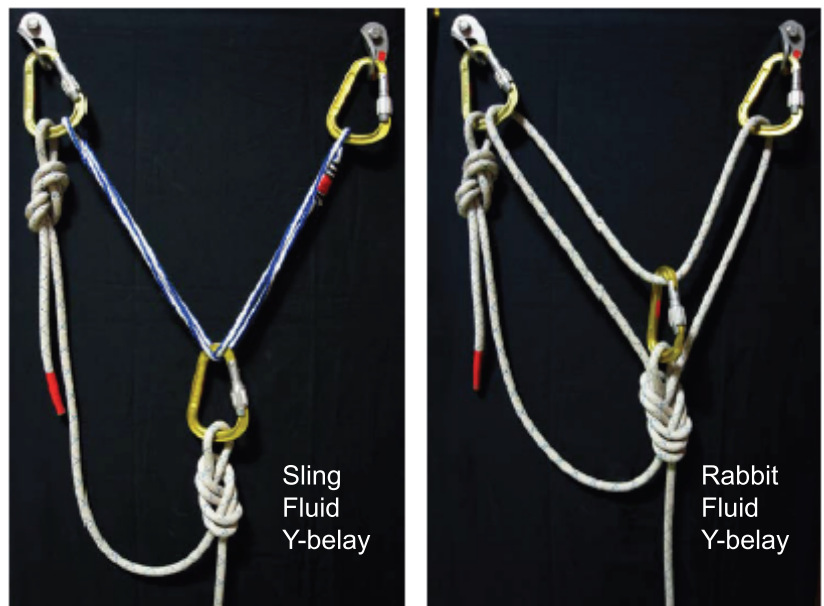


Example of a fluid distribution Y-belay using a bowline-on-a-bight.



The disadvantages of fluid distribution include the fact that if the sliding section breaks, all compound anchor points will fail, and rope or sling consumption is high.

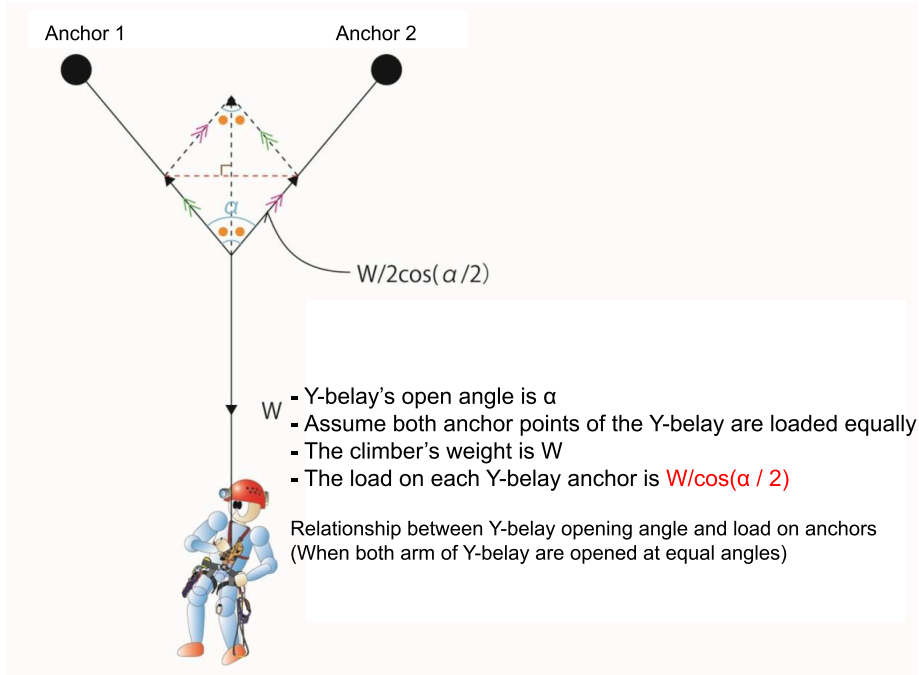
As a countermeasure, it should not be used alone, but rather should be used in conjunction with backup ties.



Y-belay (Load Distribution System)

① Opening Angle

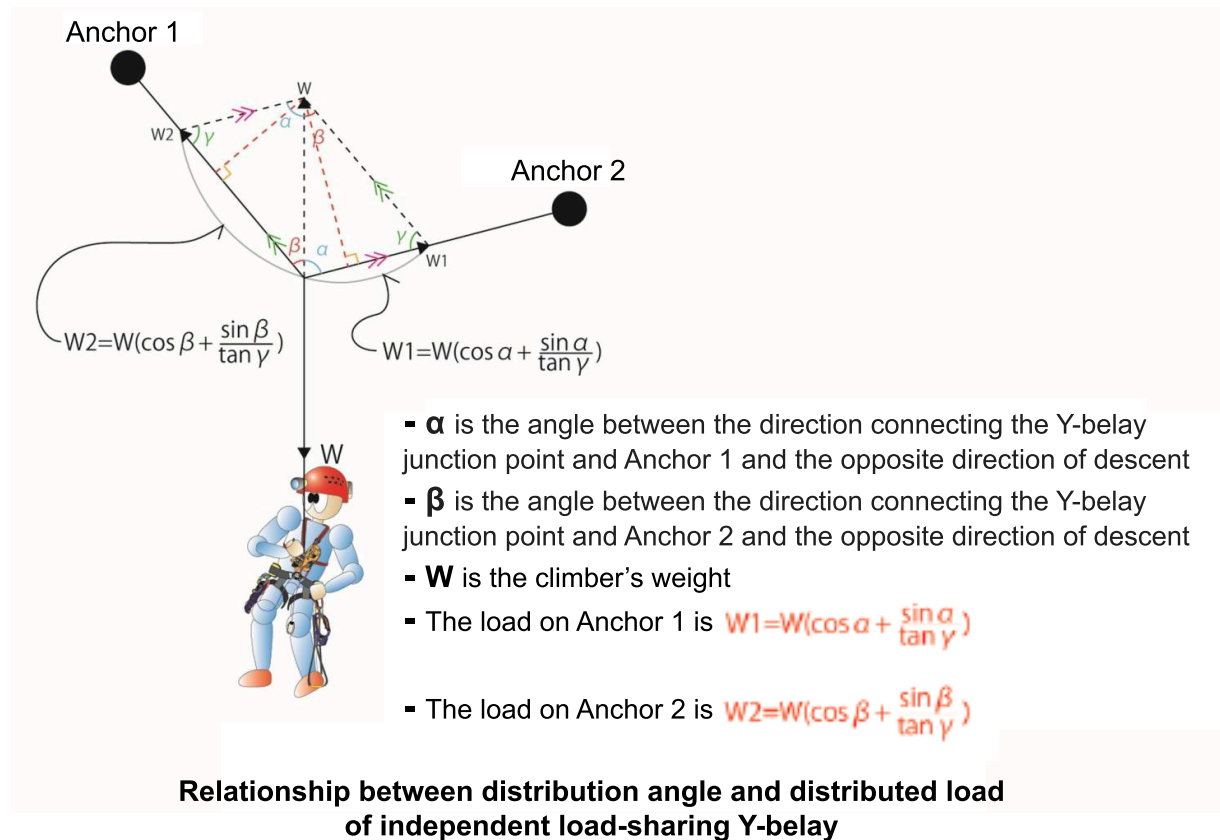
Regardless of fluid or independent type, in Y-belays, larger opening angles (α) between anchors result in greater loads on anchors. For fluid distribution and equal-angle independent distribution, when Y-belay opening angle exceeds 120° , anchor loads exceed rope user's body weight.



Angle of Y-belay α	Distributed load on each anchors (Climber's weight = 0.1)
0	0.5
10	0.501909919
20	0.507713306
30	0.51763809
40	0.532088886
50	0.551688959
60	0.577350269
70	0.610387294
80	0.652703645
90	0.707106781
100	0.777861913
110	0.871723398
120	1
130	1.183100792
140	1.4619022
150	1.931851653
160	2.879385242
170	5.736856623
180	∞

② For independent distribution Y-belays with unequal load distribution

Anchor loads may exceed the rope user's body weight when Y-belay opening angle exceeds 90°.



In independent distribution Y-belays, descent direction may change during descent, potentially altering Y-belay distribution ratios. Therefore, independent distribution opening angles should be within 90°.

To distribute loads to both anchors, predict descent range beforehand and construct Y-belay so this range falls within the angle formed by independent distribution Y-belay arm extension lines.

Two conditions when constructing independent distribution Y-belays:

- Is the Y-belay opening angle within 90°?
- Does descent activity range fall within the angle formed by Y-belay arm extension lines?