Fixed-Point Belaying

Derek DeBruin

Thanks to Jesse Williams, Chris Burk, Petzl America

Austin Schmitz on “Lost in Space” in Linville Gorge, North Carolina.
Photo: Tate Peterson.
The Problem

• “Fall Factor 2”

• i.e. Difficult climbing on steep terrain immediately above the belay anchor, increasing the probability of a fall directly onto the belay prior to placing the first piece of protection on the pitch
Solutions?

1. Relocate anchor
2. Chariot belay
3. Pre-clip first piece
4. Redirect on the anchor
5. Fixed-point belay
1. Relocate the Belay

• Must have the gear to do so
• Probably more useful if not onsighting
• Not always possible on steep routes with fixed anchors
2. Chariot Belay

Leader

Belayer

3+ meters from anchor

Additional rope in the system
2. Chariot Belay

• Belayer displacement?
• Belayer security at start of their turn to climb
  • Can belayer secure themselves?
  • Security from above requires lots of rope
3. Pre-Clip First Piece

- Additional rope in the system
- First protection on next pitch
- Leader
- Belayer
3. Pre-Clip First Piece

- Need sufficient rope on preceding pitch
- Need right gear for first piece and a solid anchor
- Leader must downclimb or lower back to anchor
- Potentially long distance from belayer w/difficult moves
- Belayer displacement?
- Swapping leads more complex (untie, etc.)
4. Redirect on the Anchor

Leader

Belayer

Additional rope in the system
4. Redirect on the Anchor

• Familiar to most climbers
• Belayer displacement!
• Pulley effect!!!
4. Redirect on the Anchor: Pulley Effect

- Let’s go top roping...
4. Redirect on the Anchor: Pulley Effect

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4. Redirect on the Anchor: Pulley Effect

- How much does a climber weigh?
4. Redirect on the Anchor: Pulley Effect

- 1kN ~ 224.5 lbf
4. Redirect on the Anchor: Pulley Effect

- What about acceleration?
4. Redirect on the Anchor: Pulley Effect

- Rope translates force from one end to the other
4. Redirect on the Anchor: Pulley Effect

- Rope translates force from one end to the other

![Diagram showing the pulley effect with Belayer and Climber at the anchor points and force annotations of 2kN]
4. Redirect on the Anchor: Pulley Effect

- Force on the anchor is...?
4. Redirect on the Anchor: Pulley Effect

- Force on the anchor is...?
- \(2 + 2 = \ldots\)
4. Redirect on the Anchor: Pulley Effect

Belayer

Climber

Climber Falls!!!

2kN

4kN
4. Redirect on the Anchor: Pulley Effect

• Caveats:
  • Climbers might be >225lb
  • Rope might not be taut
  • Friction means force on anchor is 1.6 times (NOT 2 times) force on climber
4. Redirect on the Anchor: Pulley Effect

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  - Friction means force on anchor is 1.6 times (NOT 2 times) force on climber
4. Redirect on the Anchor: Pulley Effect

• Punchline: force gets doubled, give or take
4. Redirect on the Anchor

- How much force in this leader fall...?
4. Redirect on the Anchor

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Practically speaking, at this distance the leaders feet are even with the anchor components.
4. Redirect on the Anchor

• How much force in this leader fall...?
4. Redirect on the Anchor

• Assumes an ABD
• <6kN on leader, so “acceptable” per EN standards at this fall height
• The higher the leader climbs, the greater the force and the less “acceptable” this becomes
• 3.25kN on belayer → sucked into first piece
• Will belayer catch the fall?!
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- Will belayer catch the fall?!?
- Belayer moved violently, ABD might jam
4. Redirect on the Anchor

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- <6kN on leader, so “acceptable” per EN standards *at this fall height*
- 3.25kN on belayer → sucked into first piece
- Will belayer catch the fall?!

This is A LOT of force. Like “snap your wires, break you microcams, rip your screw out of the ice” a lot.
5. Fixed-Point Belay
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- MUST use an MBD, i.e. something that lets rope slip
  - Munter or tube
5. Fixed-Point Belay

• How much force in this leader fall...?
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• How much force in this leader fall...?
5. Fixed-Point Belay

• Assumes an MBD—**CANNOT** use ABD
• **Belayer needs gloves** (probably a good idea in general)
• Lower force on anchor—pulley effect eliminated
• NO (or very little) force on belayer
• Greater force on climber, but “acceptable”
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• Greater force on climber, but “acceptable”

This is A LOT of force on a human. Like “I am suddenly very aware of the existence of both my kidneys” a lot.
Fixed-Point Belay Rigging
Fixed-Point Belay Rigging: Banshee Belay
Fixed-Point Belay Rigging: Banshee Belay

- Double bight knot (overhand, fig 8, bowline)
- Clove hitch w/ captured tail
- Belayer clove hitch
- Vertical configuration of components offers some load distribution.
- Locking carabiner at fixed point attachment
- The “fixed point”
- Munter hitch to leader
Fixed-Point Belay Rigging: Banshee Belay

Horizontal configuration of components offers redundancy but not load distribution.
Fixed-Point Belay Rigging: Banshee Belay

Construction with the rope offers simplicity and minimal equipment. Most convenient when swapping leaders.
Fixed-Point Belay Rigging

• What about distribution/equalization?!
Fixed-Point Belay Rigging: Distribution

• True distribution is not attainable in the field.

• “Static” systems: 75/25 or 3:1 is realistic
  • Ponytail
  • Cordelette
  • Wishbone aka swamp

• “Dynamic” systems: 60/40 or 1.5:1 (best case)
  • Quad
  • Equalette
  • Sliding-x
Fixed-Point Belay Rigging: Distribution

• Real-world example:
Well placed #2 and #3 Camalots in a crack in the planet tied together with a sling at a 60° angle
Fixed-Point Belay Rigging: Distribution

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Fixed-Point Belay Rigging: Distribution

• Real-world example:

Take a 3m fall with a redirect on the masterpoint.

F = 8kN
Fixed-Point Belay Rigging: Distribution

• Real-world example:
  \[ F = 8 \text{kN} \implies F' = 8 \text{kN} \]
Fixed-Point Belay Rigging: Distribution

- Real-world example:
  
  \[ F = 8\text{kN} \rightarrow F' = 8\text{kN} \]
  
  \[ F_{cam} = \frac{2F'}{\sqrt{3}} \]
Fixed-Point Belay Rigging: Distribution

- Real-world example:
  \[ F = 8 \text{kN} \rightarrow F' = 8 \text{kN} \]

\[ F_{\text{cam}} = \frac{2F'}{\sqrt{3}} \]

\[ \frac{3}{1} = \frac{F'_1}{F'_2} \]
Fixed-Point Belay Rigging: Distribution

• Real-world example:

$F = 8\text{kN} \rightarrow F' = 8\text{kN}$

$F_{\text{cam}} = \frac{2F'}{\sqrt{3}}$

$\frac{3}{1} = \frac{F'}{F''}$

$F' = F$ & $F'' = 0.75F'$
Fixed-Point Belay Rigging: Distribution

• Real-world example:

\[ F = 8\, \text{kN} \rightarrow F' = 8\, \text{kN} \]

\[ F_{\text{cam}} = \frac{2F'}{\sqrt{3}} \]

\[ \frac{3}{1} = \frac{F'_{1}}{F'_{2}} \]

\[ F' = F \& F'_{1} = 0.75F' \]

\[ \therefore F_{\text{cam}} = \frac{1.5F'}{\sqrt{3}} \]
Fixed-Point Belay Rigging: Distribution

• Real-world example:

\[ F_{\text{cam}} = \frac{1.5F'}{\sqrt{3}} \]

If \( F = 8\text{kN} \), \( F_{\text{cam}} \approx 7\text{kN} \)
Fixed-Point Belay Rigging: Distribution

• Real-world example:
In other words, distribution doesn’t buy you much (about 1kN).
Fixed-Point Belay Rigging: Distribution

• Real-world example:
• Working backwards...
• 14kN cam breaks with 16kN on the masterpoint.
• A 10kN ice screw breaks with 11.5kN.
Fixed-Point Belay Rigging: Distribution

• Real-world example:
• Working backwards...
• 14kN cam breaks with 16kN on the masterpoint.
• A 10kN ice screw breaks with 11.5kN.
• The placement/rock/ice could fail at lower loads.
Fixed-Point Belay Rigging: Distribution

- What about dynamic rigging systems?
Fixed-Point Belay Rigging: Distribution

• Assume one anchor twice as strong

5kN

10kN

Masterpoint
Theoretical 0° angle
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?  
  
  \[ \begin{align*}
  & \text{5kN} \\
  & \text{10kN} \\
  \end{align*} \]

  Masterpoint Theoretical 0° angle
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
• 15kN? (additive rule)
Fixed-Point Belay Rigging: Distribution

- How strong is this anchor?
  - 15kN? (additive rule)
  - 7.5kN?

5kN  10kN

Masterpoint
Theoretical 0° angle
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
  • 15kN? (additive rule)
  • 7.5kN?
Fixed-Point Belay Rigging: Distribution

- How strong is this anchor?

Theoretical 0° angle

Masterpoint

5kN 10kN

10.1kN
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
• 5.05kN each leg
Fixed-Point Belay Rigging: Distribution

- How strong is this anchor?
- 5.05kN each leg
- First leg fails!

Diagram:
- 5kN to 5.05kN
- 10kN to 5.05kN
- Masterpoint
  - Theoretical 0° angle
  - 10.1kN
Fixed-Point Belay Rigging: Distribution

- How strong is this anchor?
- 5.05 kN each leg
- First leg fails!
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
• 5.05kN each leg
• First leg fails!
• Second leg fails!

Poof!

Masterpoint
Theoretical 0° angle

10.1kN

10kN

10.1kN
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
• 5.05kN each leg
• First leg fails!
• Second leg fails!

Poof! Poof!

Masterpoint Theoretical 0° angle

10.1KN
Fixed-Point Belay Rigging: Distribution

• How strong is this anchor?
• 5.05kN each leg
• First leg fails!
• Second leg fails!
• Climbing career is over

It’s not the fall, it’s the sudden stop...
Fixed-Point Belay Rigging: Distribution

• Therefore, dynamic rigging makes sense (from strength standpoint) if the anchor components are roughly equal in strength AND neither component strong enough on its own (in which case simply use static rigging or banshee system).
Fixed-Point Belay Rigging: Distribution

- Extension as a result of component failure can cause not-insignificant increases in the load on the remaining component.
- Since dynamic rigging is best applied with comparable strength components, failure of one component implies strong chance of failure for remaining component.
Fixed-Point Belay Rigging: Distribution

• If single piece could take the load, focus on redundancy (i.e. fixed-point/banshee or static rigging)
Fixed-Point Belay Rigging: Distribution

• If single piece could take the load, focus on redundancy (i.e. fixed-point/banshee or static rigging)

• (Of course, with two good bolts, you can probably do just about whatever you want...
Fixed-Point Belay Rigging

• Back to rigging options...
Fixed-Point Belay Rigging: Banshee Belay

The general case. Works well for two bolts (vertical preferred to horizontal) or ice screws. “Fixed point” should allow no more than 20cm of travel.
Fixed-Point Belay Rigging: Locker Draw

Requires bomber, trustworthy hardware. Sacrifices redundancy. May sacrifice distribution (depending on bolt spacing and length of draw). Can be built to size with ice screws and/or cams. VERY efficient for time and materials.
Fixed-Point Belay Rigging: Locker Draw

Redundant variation. Requires bomber, trustworthy hardware. May sacrifice distribution (depending on bolt spacing and length of draw). Can be built to size with ice screws and/or cams. Also VERY efficient for time and materials.
Fixed-Point Belay Rigging: Quickdraw

Redundant variation. Requires bomber, trustworthy hardware. May sacrifice distribution (depending on bolt spacing and length of draw). Can be built to size with ice screws and/or cams. Sacrifices security of locker draw. Also VERY efficient for time and materials.
Fixed-Point Belay Rigging: One Bolt

Requires bomber, trustworthy hardware. Sacrifices redundancy at the fixed point. Very quick to rig with a typical masterpoint or a quad.
Fixed-Point Belay Rigging: Power Triangle
Fixed-Point Belay Rigging: Power Triangle

Two point masterpoint anchor. Fixed point created by securing masterpoint with upward pull piece. Often creates very comfortable belay position.
Fixed-Point Belay Rigging: Power Triangle Var.

Two point masterpoint anchor. Fixed point created by securing masterpoint with upward pull piece. If such a piece is not convenient, backside of belayer clove hitch can be fixed to upward pull piece.

To upward-pull piece
Fixed-Point Belay Rigging: Cam Slings

Two cam slings. Works for horizontal anchor configurations where other options may not. Can rig with a typical masterpoint anchor.
Fixed-Point Belay Rigging: Double Ropes
Fixed-Point Belay Rigging: Double Ropes

For double rope systems, a tube device can be used. The tube must have a redirect carabiner at least until the leader clips the first piece. Using a non-locking carabiner can minimize confusion for the belayer.

Redirect carabiner
Fixed-Point Belay Rigging: DO NOT!!!
Fixed-Point Belay Rigging: DO NOT!!!

The fixed point must be “fixed” with a maximum 8 inches of travel (ideally less). DO NOT use it on a traditional masterpoint.
Fixed-Point Belay Rigging: DO NOT!!!
Fixed-Point Belay Rigging: DO NOT!!!

A manual braking device must be used. Assisted braking device can cause catastrophic damage to the lead climber and/or the anchor.
Fixed-Point Belay: Anchor Failure?

• If this is a serious problem, why aren’t more anchor failures showing up in *Accidents in North American Climbing*?
Fixed-Point Belay: Anchor Failure?!

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• Anchors rarely get tested. Many climbers have *experience* but not *expertise*. i.e. our skills don’t get tested. Akin to skiing a bullseye slope on a considerable hazard day and thinking you made the right call because it didn’t avalanche.
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• Modern bolted anchors largely eliminate the risk of anchor failure.

• It’s a good idea not to lead fall directly onto the anchor regardless.
Fixed-Point Belay: Application

• CANNOT relocate anchor, chariot belay, pre-clip first piece
• High probability of falling
• Run-out terrain
• Steep/difficult climbing
• “Low friction” rope system—little rope drag/rope on rock
• Overhead hazard to belayer (roof, ice cave, etc.)
• Lightweight belayer
Fixed-Point Belay: Example Routes

- “Risky Business” Red Rock, NV
- “Escape Artist” Black Canyon, CO
- “Slippery When Wet” Ouray, CO
- “Thin Air” Cathedral Ledge, NH
- “Cascading Crystal Kaleidoscope” Gunks, NY
- “Lost in Space” Linville Gorge, NC
- Black Velvet Wall, Red Rock, NV
Fixed-Point Belay: Application

• Hybrid system:
  • Pre-rig belay device on harness (can be ABD)
  • Dump out slack, tie back up knot if appropriate
  • Fixed-point belay
  • Establish a few solid pieces of protection
  • Remove fixed-point belay
  • Belay from harness
Fixed-Point Belay Rigging: Final Notes

- Position fixed point between waist and eye level of belayer (chest level very comfortable to operate).
- Can use second client to back-up the belay/manage ropes.
- Can also use second client as redirect belayer when employing hybrid system.
Derek DeBruin belayed by Sam Latone on “Glass Menagerie” at Looking Glass Rock, North Carolina.
Photo: Samantha Henry