BELAYING WITH DYNAMIC ROPE

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BELAYING A CLIMBER WITH DYNAMIC ROPE

This presentation is a summary of testing performed by students of the University of Lyon (France) together with Petzl at Petzl France, with a focus on belaying with dynamic ropes. Several myths and misconceptions are addressed, including analysis of system forces and force absorption, loads on the anchor and on the belayer, static versus dynamic belaying, and comparisons between connecting the belay system to the anchor versus to the belayer.

ABOUT THE PRESENTER:

Peter Popall has served as Director of Technical Information at Petzl France for 18 years. His degree and experience in Physics and Engineering are foundational to the quality research, testing and product information produced by Petzl.

THE FALL

The fall in a climbing situation with a dynamic rope

By Peter Popall,
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THE FALL

The fall in a climbing situation with a dynamic rope

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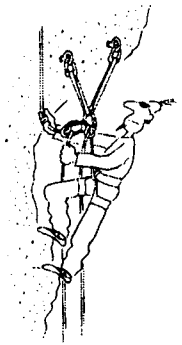
- Braking in static use
- Braking in dynamic use
- The shock-load
- Comparison of tests - and theoretic results

The different ways of belaying

- On the anchor

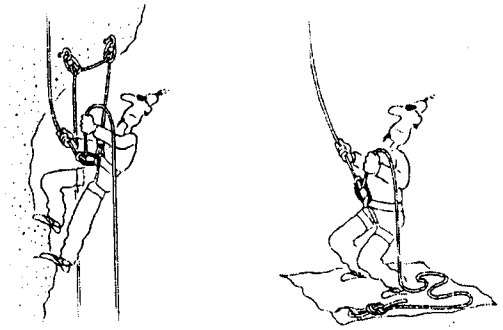
The different ways of belaying

- Between the anchor and the body



The different ways of belaying

- On the body



The question:

- What helps us to hold a fall?
  - Gloves
  - The braking system
  - The lifting of the belayer

The braking system

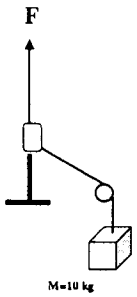
- Braking in static use:
  - Holding a load
  - Rappelling
- Braking in dynamic use:
  - Holding a fall

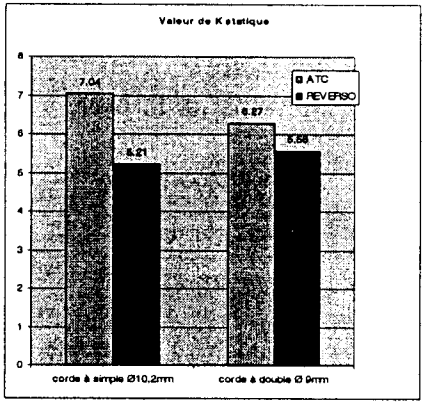
Braking in static use - rappelling

- Difference between (using the same set-up)
  - Reverso
    - Longer slot due to its DOUBLE function
  - ATC
    - Shorter slot due to its SINGLE function
- **Result: easier holding with ATC**
- Possible explanation:
  - Smaller available volume = more friction

Static load comparison

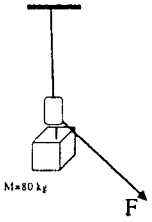
K=F/M

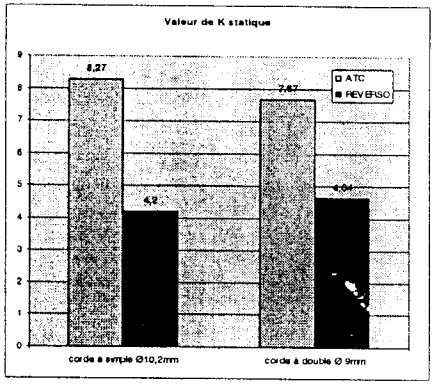




Static load comparison

K=1+ M/F

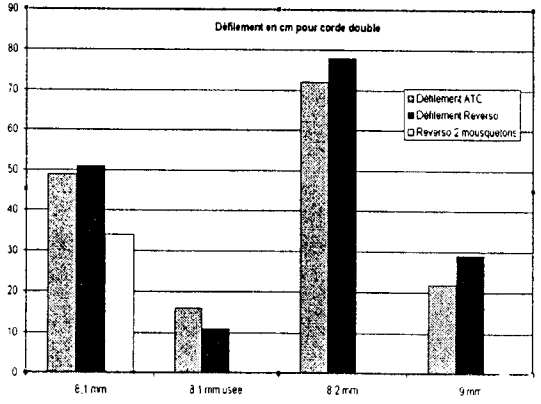




Braking in dynamic use:

- Difference between (using the same set-up)
  - Reverso
    - Longer slot due to its DOUBLE function
  - ATC
    - Shorter slot due to its SINGLE function
- Result: similar holding
- Possible explanation:
  - Movement in the rope due to dynamic use = more friction. - « The swallowing snake »

Comparison: REVERSO / ATC



The shock-load

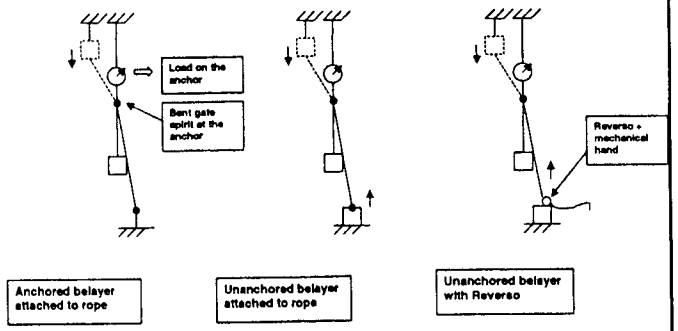
- What creates the shock-load ?
  - The falling mass (climber)
    - Potential energy is transformed into kinetic energy
    - $M \times g \times h = mv^2 / 2$

- What can lower the shock-load
  - The elasticity of the rope
    - See the rope information
  - The sliding of the rope in the device
    - Risk of burning the hand
  - The knots
    - 3%
  - The harness
    - 5%
  - The body of the falling climber
    - 5%

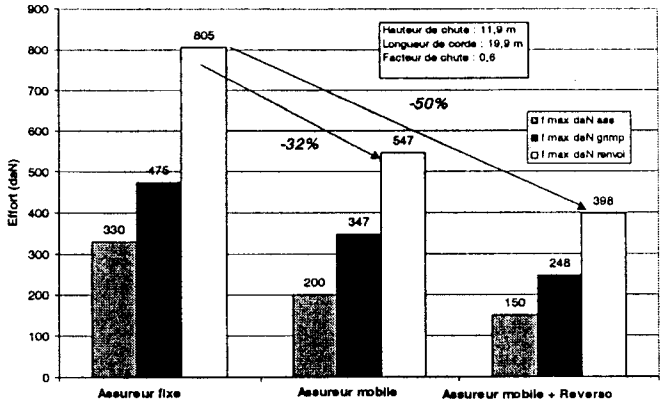
What else can lower the shock-load?

- The lifting of the belayer

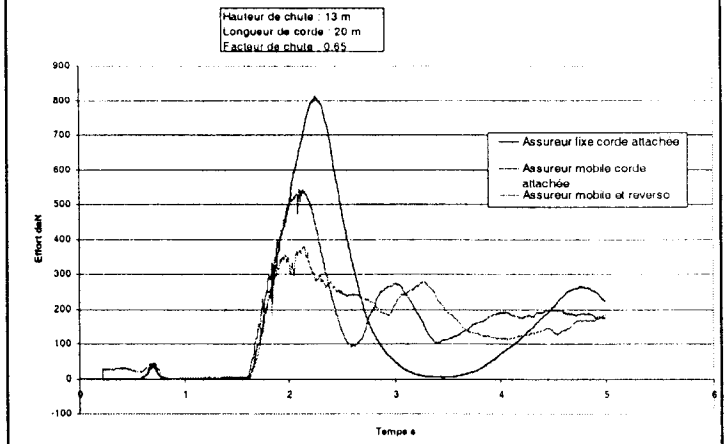
Set-up for comparing different belay methods



influence of the belay method



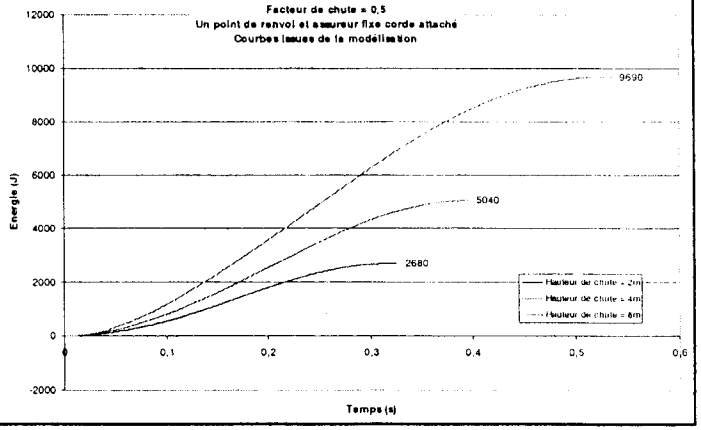
Load at the anchor



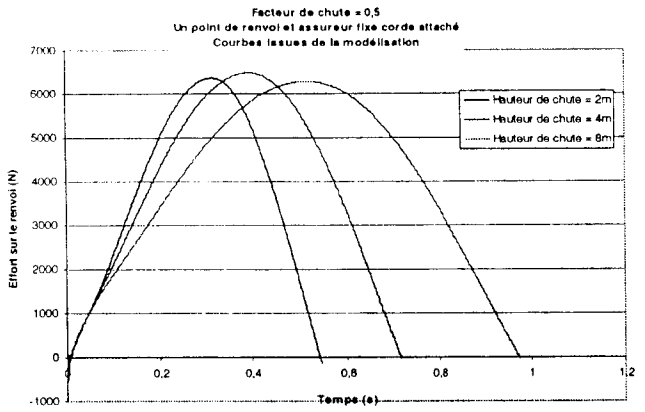
Development of a model for calculation

- Theoretic calculation and comparison to real testing
- Real testing on different heights of falls (short and long falls)

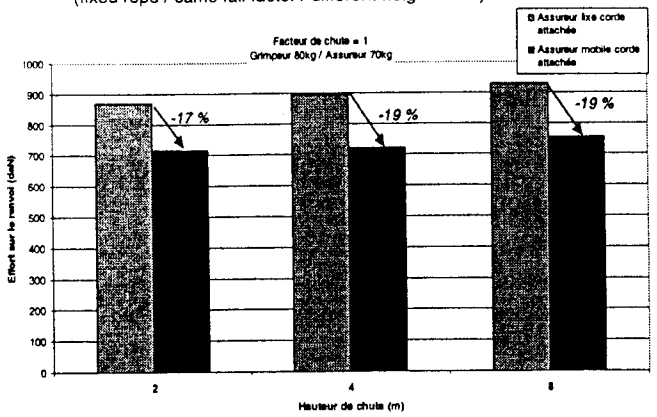
Toral energy (respecting elasticity and friction in the anchor-biner)
fall factor 0,5 / fixed rope / different heights



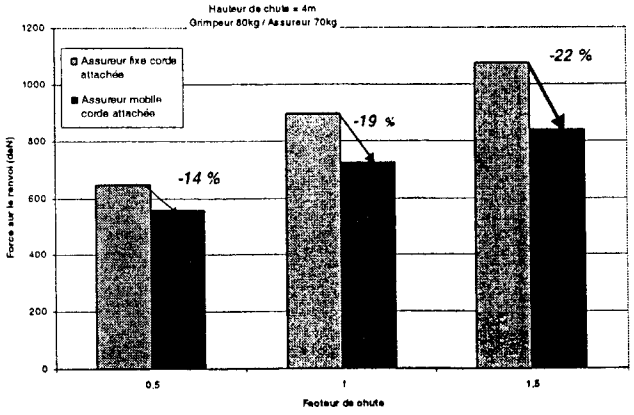
Load on anchor
same fallfactor / different height



Load on anchor
comparison between belay on anchor and belay on body
(fixed rope / same fall-factor / different height of fall)



Calculated comparison:
belay on anchor/belay on body
same height / different fallfactor



Advantage of the lifting

Lowering the shock-load

Creating the reflex of holding

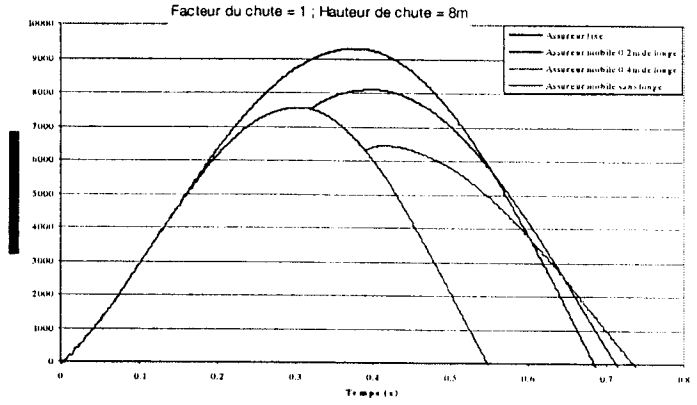
Delaying the main force

Attention: be careful for the belayers head if there is an overhang

Another story

- The belayer-body-move-effect
  - Is it constant ?
- The influence of the length of the self-belay line

Lifting of the belayer and length of the selfbelay



The future

Study in progress: the sliding of the rope in the belay device

Lifting of the belayer and the braking system