

# ICAR 2015

KILLARNEY, IRELAND

## HUMAN FACTORS AND SYSTEMS ANALYSIS FOR ROPE RESCUE

- A CASE STUDY



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Parks  
Canada

Parcs  
Canada

- Level of skills or training
- Command & Communication Structure
- Mindset
- Physical Limitations

**Human**

- Sharp edges
- Rock Fall/Avalanche
- Chemical
- Lightning

**Environmental**

**Material**

**Method/  
Technique**

- Strength
- Abused
- Worn/Defective
- Durability/resilience

- Competence
- Capability
- Equipment suitability

# ROPE RESCUE SYSTEMS ANALYSIS



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# **Two Rope Systems**

## **Dual Capability, or Mirrored Systems:**

**Each rope system must  
be fully *capable* and  
*competent* as both a  
mainline and a  
back-up line,  
at the same time.**





# Environmental Factor: Sharp Abrupt Edges



## HOW IS THE RISK BEING MANAGED?



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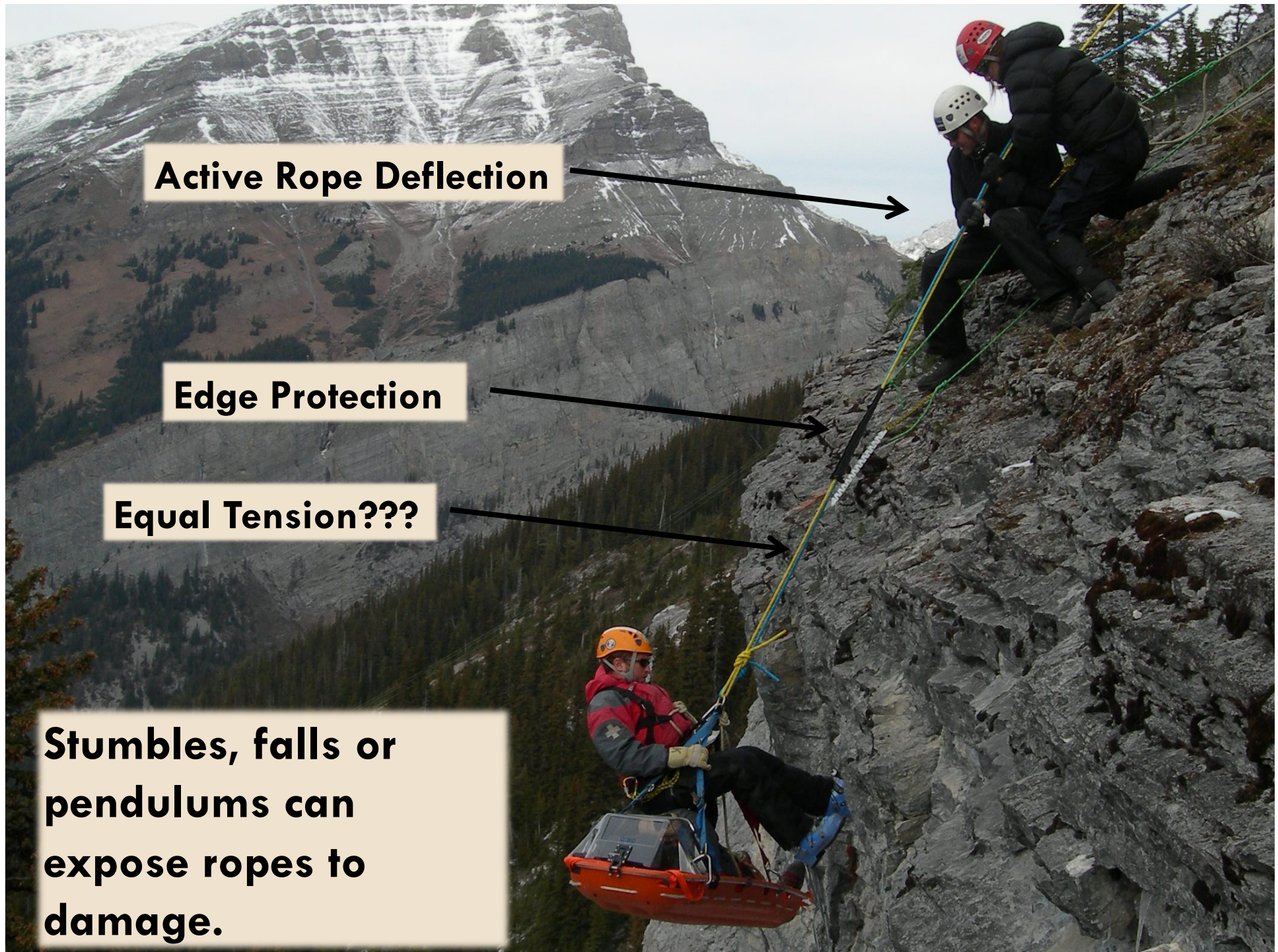


**Active Rope Deflection**

**Edge Protection**

**Equal Tension???**

**Stumbles, falls or pendulums can expose ropes to damage.**



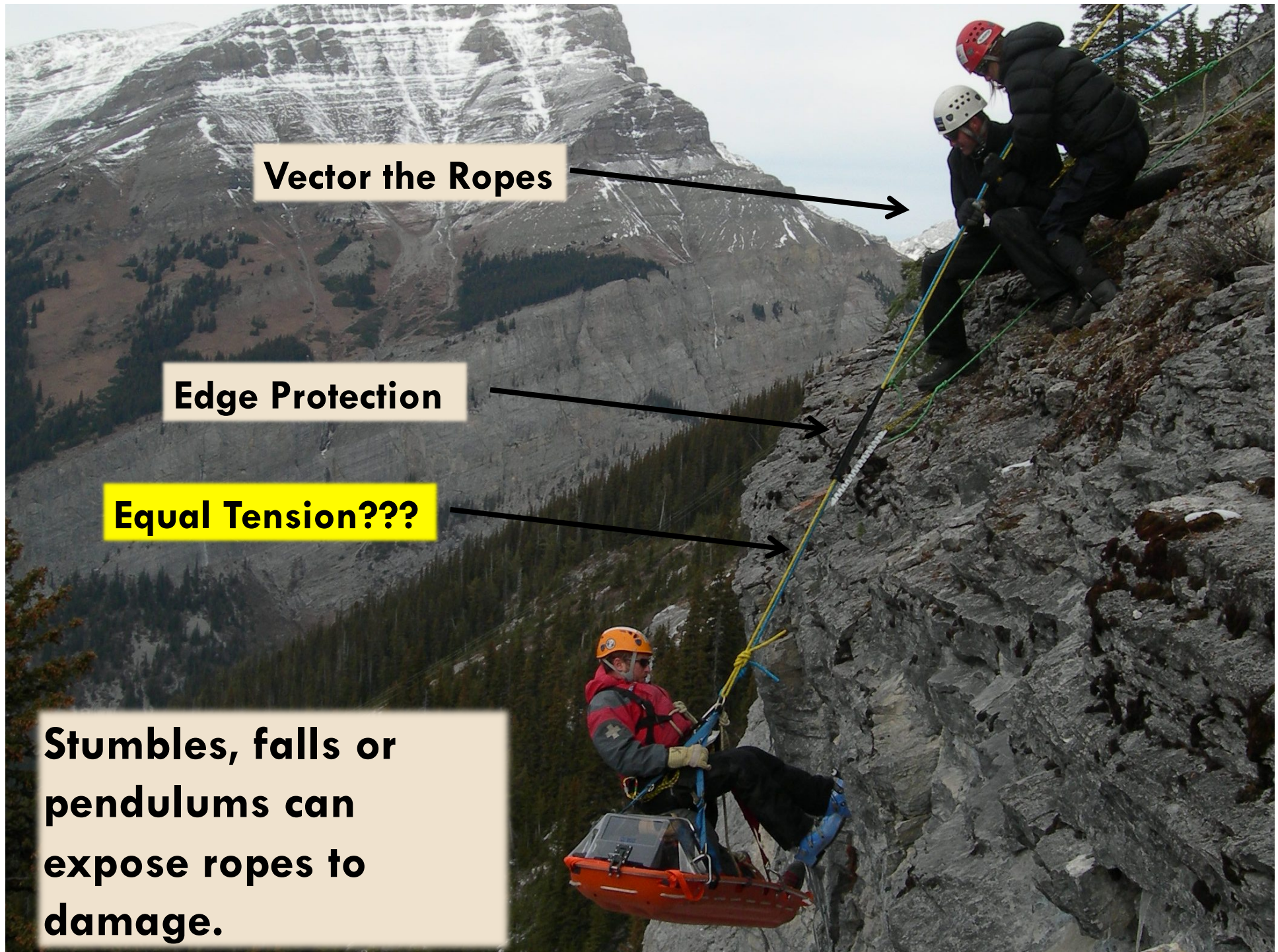


**Vector the Ropes**

**Edge Protection**

**Equal Tension???**

**Stumbles, falls or pendulums can expose ropes to damage.**





## Risk:

A *tensioned* rope is more likely to get damaged from a *sharp edge* than an *un-tensioned* rope.

## Strategy:

Keep one rope hand-tight during edge transitions. This limits risk to mostly the tensioned line.



# Critical Evaluation – Systems Analysis:

How do we know which is a better strategy for managing sharp edges?

A) Dedicated Mainline with Un-tensioned Back-Up Rope

or

B) Both ropes equally share the load



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Risk management must be based on the best data. To that end we should take an informative look at the evidence<sup>1</sup>.

<sup>1</sup>Helmet Use for Ski Guiding – Further Analysis; Dr. Jeff Boyd 2014



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# SHARP EDGE TESTING



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# COMPARE HAND-TIGHT BACK-UP TO TWO-TENSIONED ROPE SYSTEM

- drops over unprotected level sharp edge
- drops over protected non-level sharp edge
- drops over protected non-level sharp edge

VIDEO



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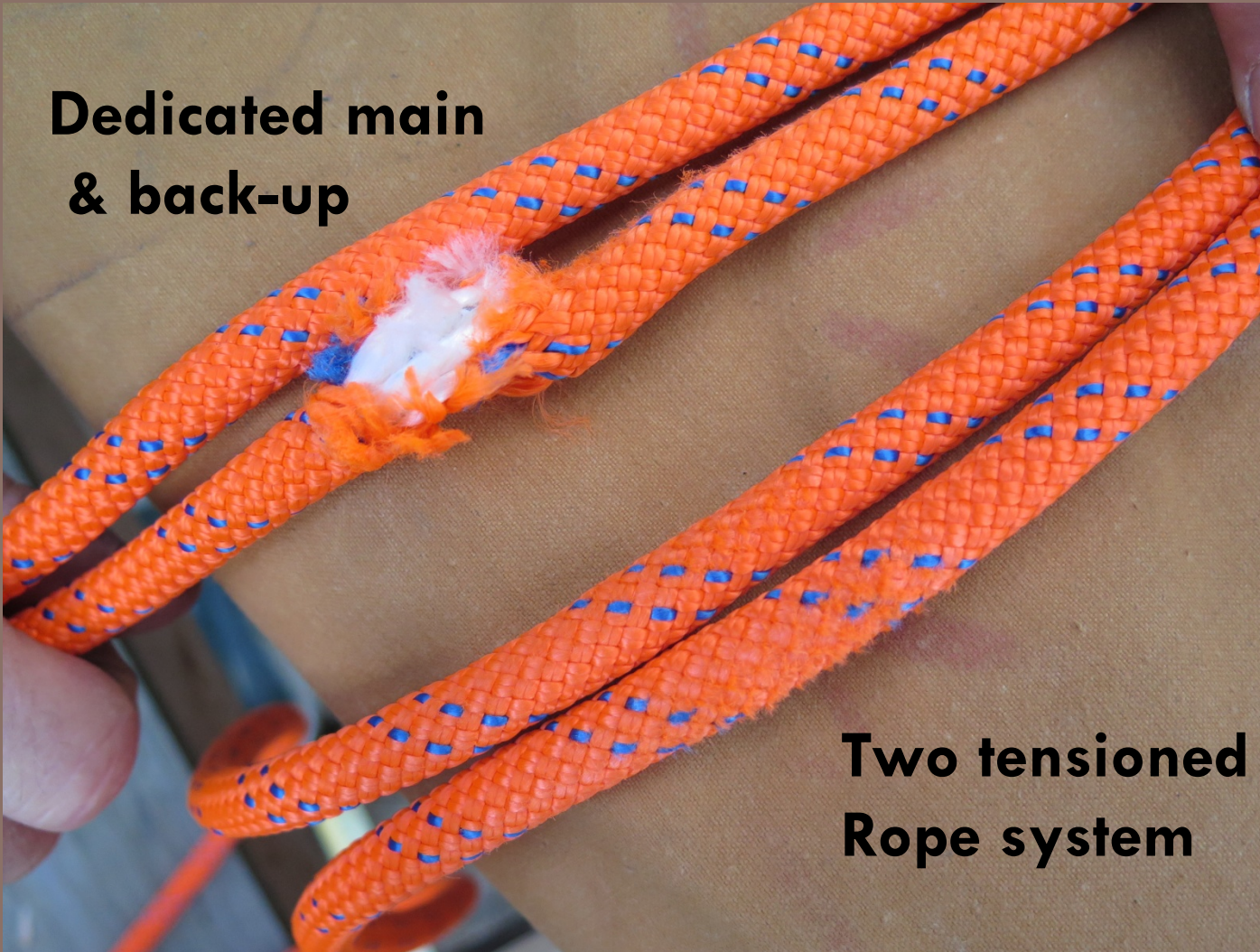
# HAND-TIGHT BACK-UP, OR TWO TENSIONED ROPE SYSTEM?

There was no evidence in any of the tests that a hand-tight back-up rope offered any obvious risk benefit advantages over two-tensioned rope techniques for transitioning over sharp edges.



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**Dedicated main  
& back-up**



**Two tensioned  
Rope system**

**EDGE PROTECTION IS MANDATORY**



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Two-tensioned ropes performed better than dedicated main & back-up rope systems.



**LESS TENSIONED ROPES ARE LESS LIKELY TO BE DAMAGED/  
CUT FROM SHARP EDGES**



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# Environmental Factor: Sharp, Abrupt Edges



**METHOD/TECHNIQUE FACTOR: TWO TENSIONED ROPE SYSTEMS**



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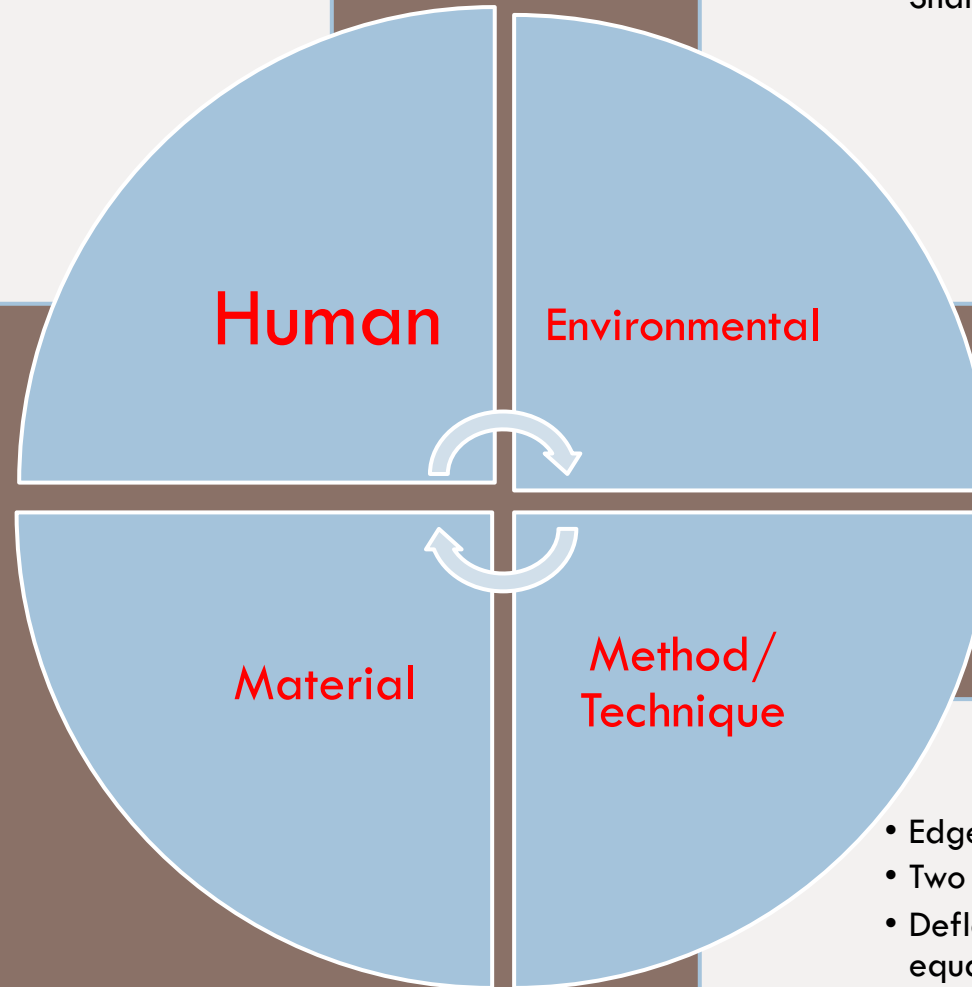
# Deflect Both Ropes - Equally



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• ?????

• Sharp edges



- Edge Protection
- Two Tensioned Ropes
- Deflect both ropes equally

# ROPE RESCUE SYSTEMS ANALYSIS



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## Two Tensioned Rope Systems: (dual capability)

**Human Factor Problem!**

**The Devices auto-locks  
are being defeated while  
lowering.**







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- Edge Transition Briefing
- Dry Run Test
- Mindset of Backing up Loads (not lowering)

- Sharp edges

**Human**

**Environmental**

**Material**

**Method/  
Technique**

- Edge Protection
- Two Tensioned Ropes
- Tail the Ropes

# ROPE RESCUE SYSTEMS ANALYSIS



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# THANK YOU

**HUMAN FACTORS**  
AND  
SYSTEMS ANALYSIS  
FOR ROPE RESCUE



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