Dyneema rope use in TOPR

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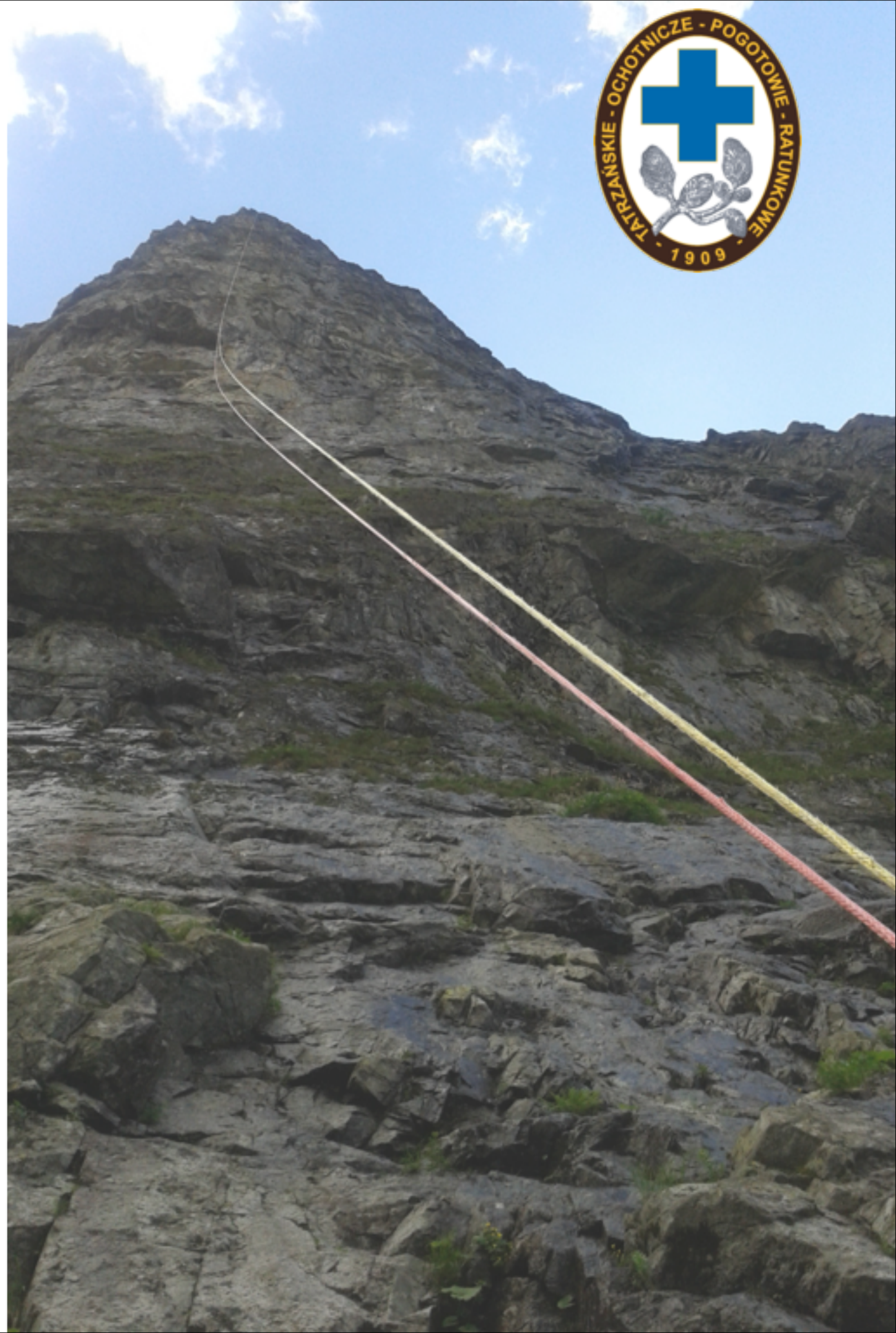

Technical characteristics of dyneema

1. **Strength** - 15 times that of steel

2. **Abrasion resistance**, UV resistance

2. **Lack of elongation** - shock absorbers are a necessity

3. **Intolerance of high temperature**

4. **Low weight** - ∅ 8mm dyneema is 3,3 kg per 100m

5. **Simplicity of use** - despite some limitations, techniques used with dyneema are fairly simple

History of dyneema rope in TOPR

1. We **learned** about dyneema rope and its applications **in 2007 at IKAR conference,** it was presented by **Bergwacht Bayern**.

2. The **first use of dyneema rope in actual rescue was in August 2010**, in the west face of Kościelec mtn.

3. In November 2010 we made the first test of **diagonal** application of dyneema.

4. The first application of **single** rope used to transport a patient in SKED stretcher in a snowy gully was in January 2011.

5. In 2011 we switched from single use, rippable shock absorber to KISA energy dissipator.

6. The **longest** abseil with dyneema during rescue was in in 2012 - **760 meters** in north face of mt. Giewont.

7. In 2012 we started to experiment with **various types of belay stations** for dyneema.

The dyneema system appeared to us as an excellent **replacement of the steel cable system** we used until then for evacuation in **rock faces exceeding 200m.**

The advantages of the new system were: **simplicity, low weight, safety.**

100m of steel cable - 12 kg

By combining different lengths of rope it is possible to perform rescues even in the tallest of Tatra rock faces.

Czołówka Mięgusza, Tatry Wysokie

Dyneema rope in the Polish Tatras.

Mnich, Dolina Rybiego Potoku

In order to avoid temperature no standard abseil devices are allowed.

Munter hitch or Super Munter are used to lower using dyneema ropes.

This method of connection of dyneema ropes is borrowed from the steel cable system.

Similarly, no knots are allowed on rope ends.

The rope is finished by splicing.
Brummel splice.

The most typical belay used with dyneema ropes is **directional** one.

Determining the optimal direction is neccessary.

The **equalising belay**, the central anchor point tends to be low

The **mixed belay** is the most efficient, demands a lot of equipment

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Partially directional, partially equalising belay station.

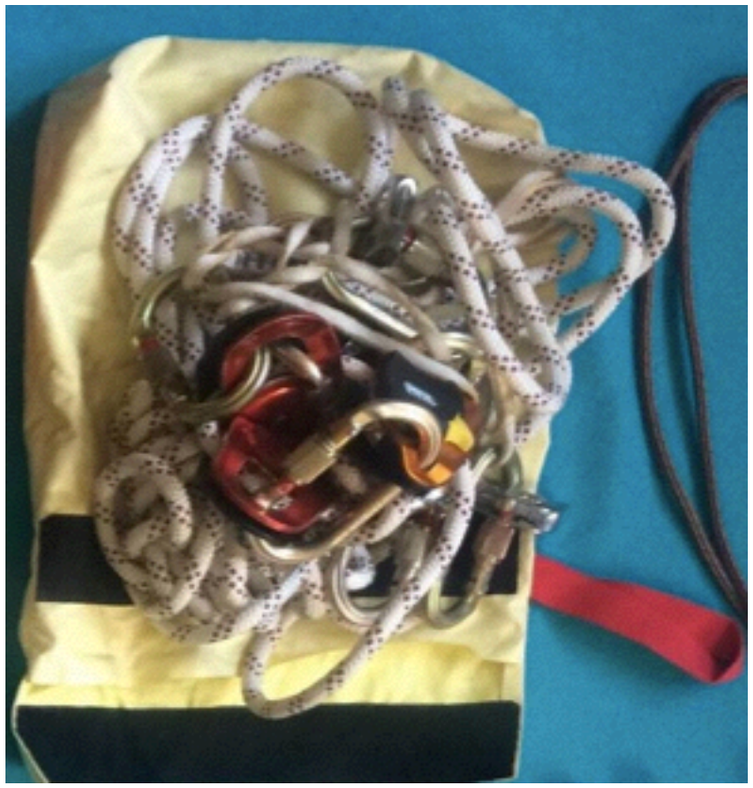
To make the system more user friendly we decided to reduce weight further.

The initial belay contents.

Certain elements of belay station are now considered optional.

Rollmodule is an example.

Lifting system can be improvised with standard rescue equipment.



Paw can be replaced with knots tied at a distance.

Lifting system, Rollmodule, and Paw - optional.

Leaner belay set, easier to carry.

The personal equipment of each rescuer.

The personal equipment serves many purposes.

Tyrolean traverse is one of the applications of dyneema rope

The diagonal positioning of the rope allows to transport the patient efficiently in difficult or time consuming terrain.

The upper belay in Tyrolean traverse configuration.

Red rope is stopped using Super Munter knot, the yellow one enables the movement of the rescuer on the traverse.

Another application of single dyneema rope is evacuation from cable car.

Myślenickie Turnie, Dolina Bystrej

Dyneema proves useful where really long ropes come in handy.

The low weight of the rope is another asset.

Single dyneema rope proves useful also in snowy terrain.

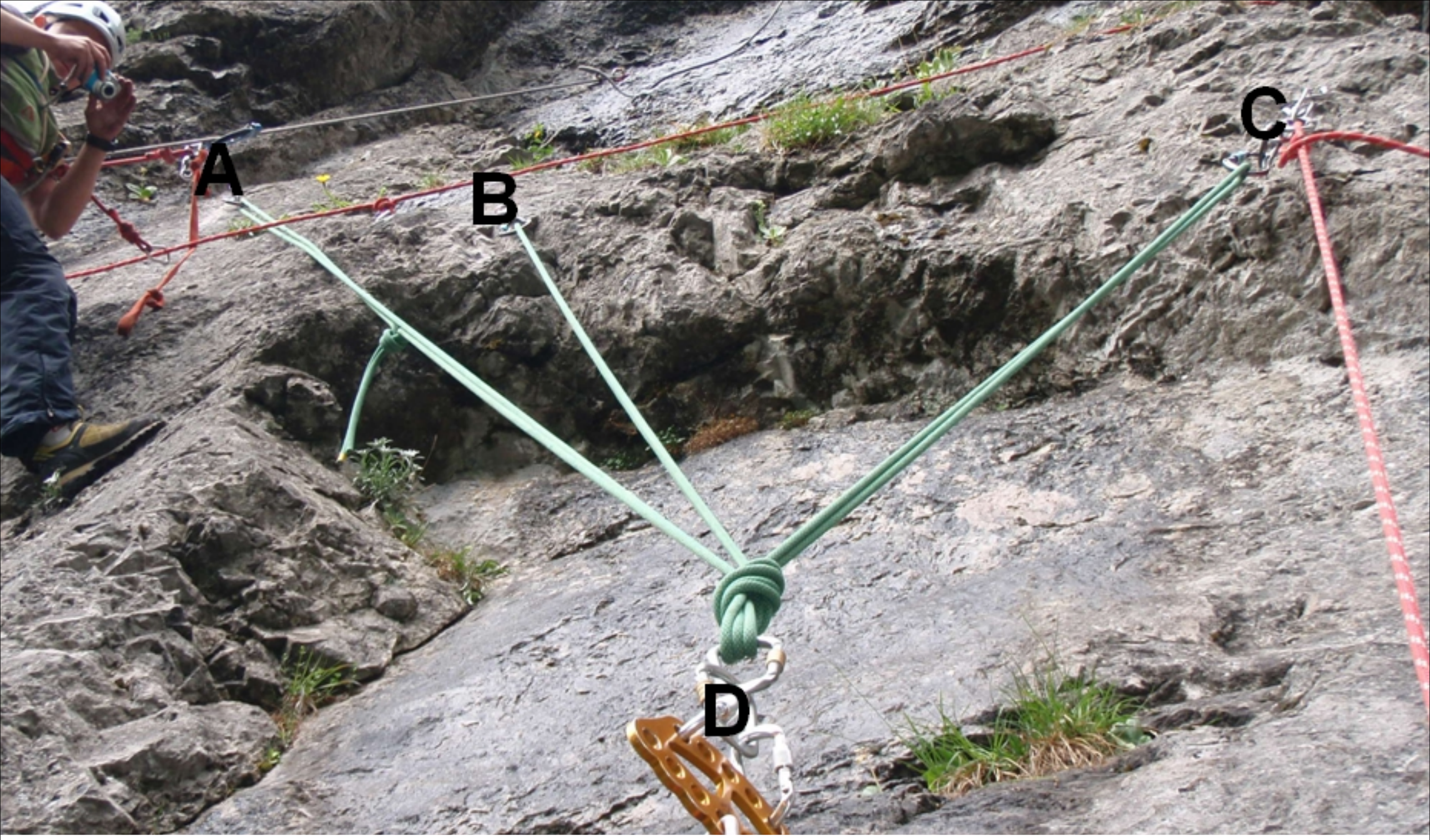
Transport of patient in a gully.

Belay tests in 2012.

Tests were organised with AMC.

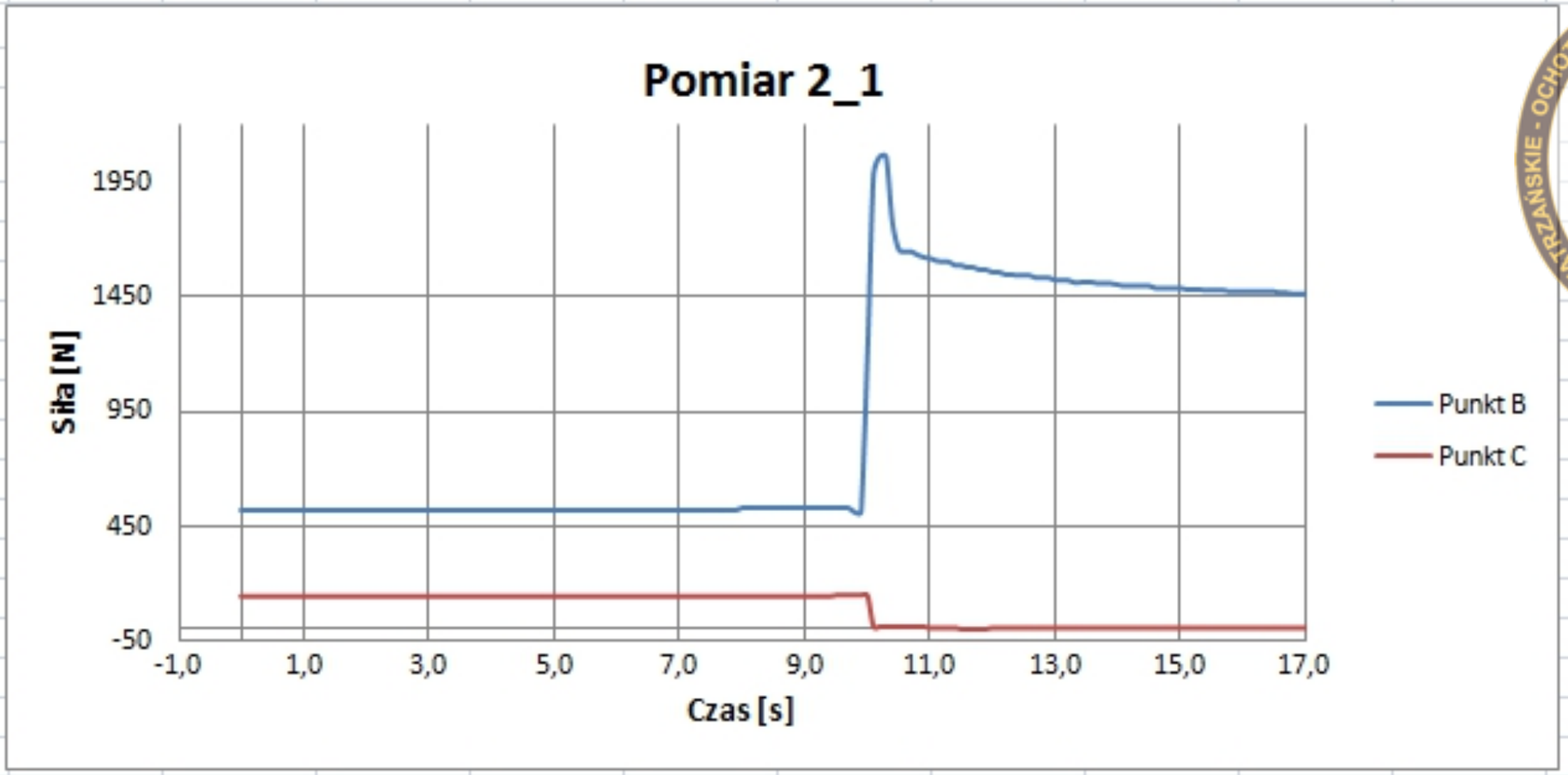
The tests of belay stations.

The shock onto remaining anchor points was measured after simulated destruction of one of the anchors.



All three types of belays were tested.

In the test dynamometers were used.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1450
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450
-50
Siła [N]
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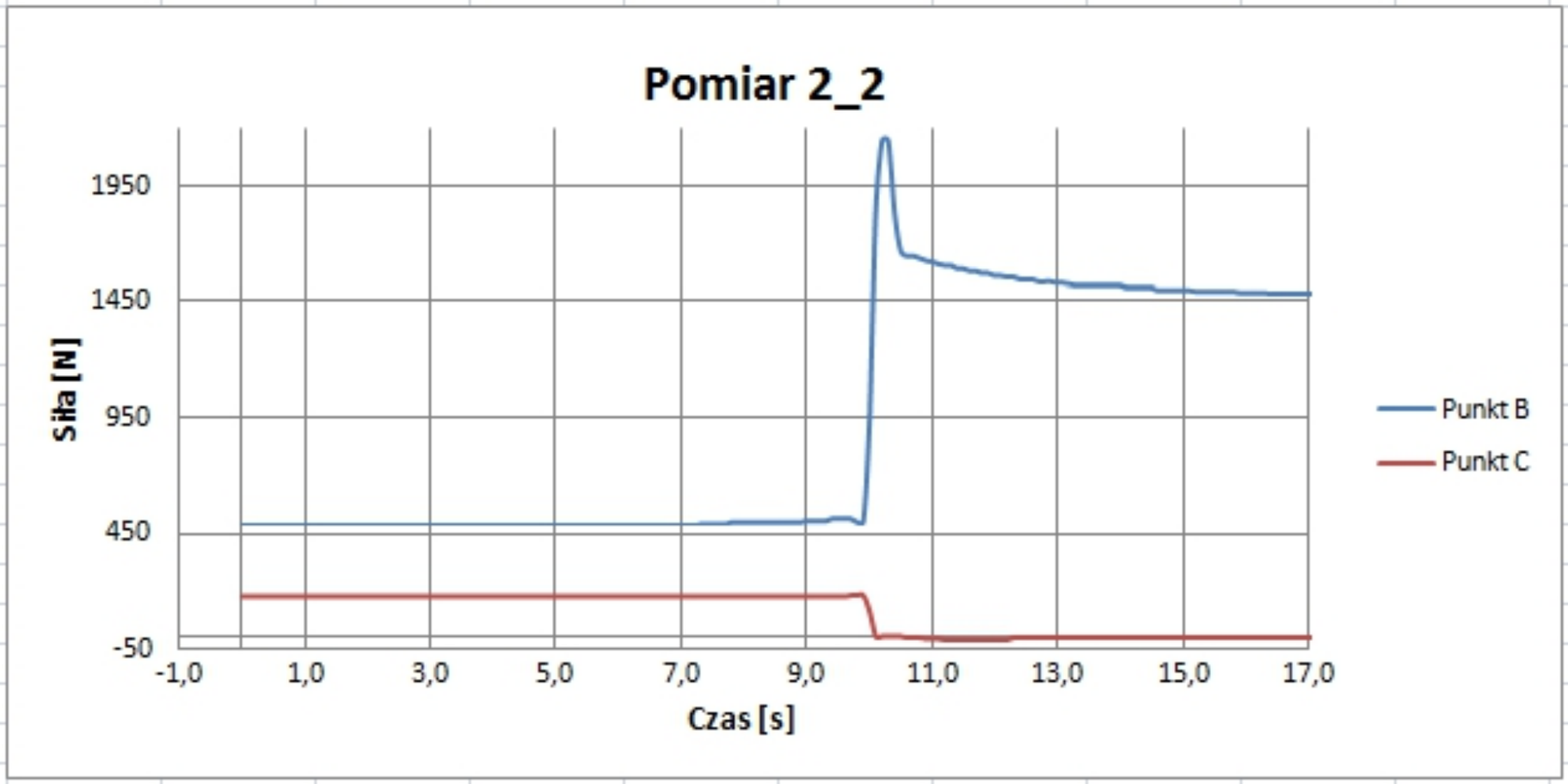
Czas [s]
Punkt B
Punkt C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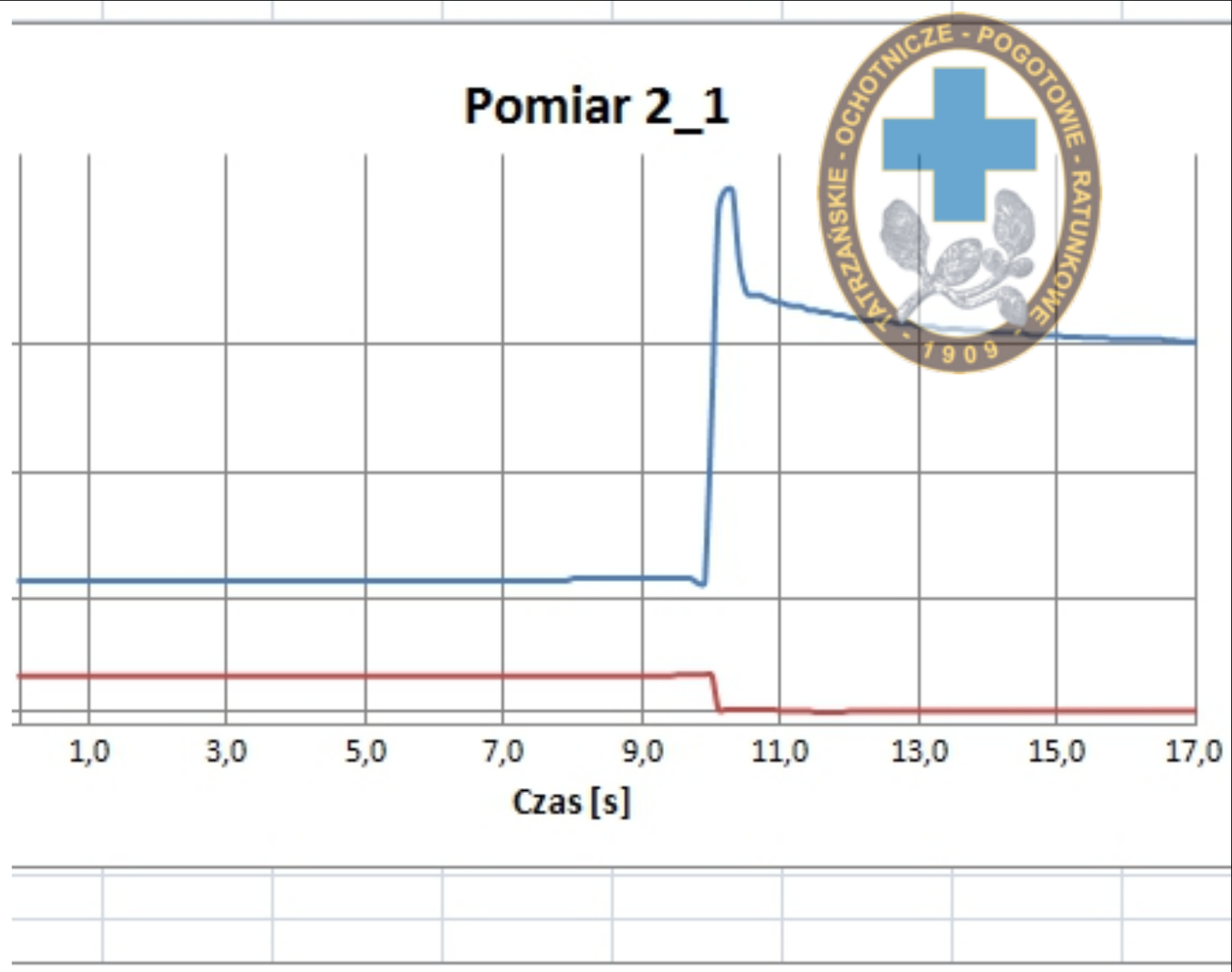
13,0
15,0
17,0
Czas [s]
Punkt B
Punkt C

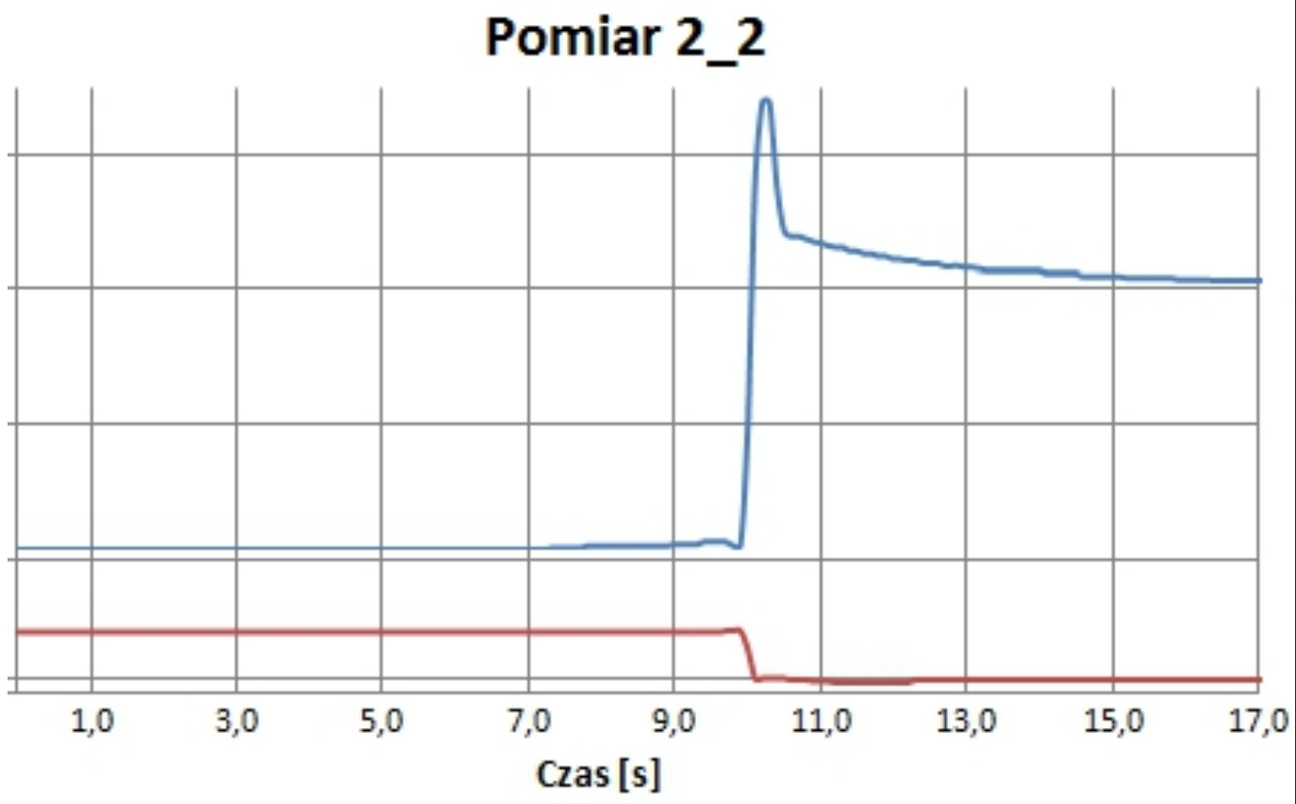
Conclusions:

-**Directional**: the postion of central point changes slightly, however the shock onto remaining points is very uneven.

-**Equalised**: the central point becomes significantly lowered, the distribution of shock to other anchors is balanced.

-The **combined** belay appears to be the optimal solution.





Dyneema tests in 2014.

Tests organised with Gleistein Ropes.

Random tests on much worn DynaOne ø 8mm rope using Gleisten Ropes testing machine in Trencin, Slovakia.

	left attachment	right attachment	damage at... kN	comments
1	wound 5 times on ø 25cm cylinder	wound 5 times on ø 25cm cylinder	25,39	equals 46% of resistance of a new rope
2	eyelet, spliced	Munter hitch with two backups	14	fracture by the knot / knot easy to untie
3	eyelet, spliced	double Munter hitch with two backups	16,44	fracture by the knot / knot easy to untie
4	eyelet, spliced	figure-of-eight knot	19,65	knot impossible to untie!
5	figure-of-nine knot	figure-of-nine knot	19,08	knot impossible to untie!
6	figure-of-nine knot	Clove hitch with overhand knot	15,74	knot impossible to untie!
7	figure-of-eight knot	Petzl Basic device	4,5 – 2,9	intially rope damage, afterwards toothed cam becomes clogged
8	figure-of-eight knot	figure-of-eight knot	17,61	on a rope damaged in previous test
9	figure-of-nine knot	Petzl ProTraxion device	6,0 – 3,0	intially slight rope damage, afterwards toothed cam becomes clogged
10	figure-of-nine knot	figure-of-nine knot	6,17	on a rope damaged in previous test

Random tests on new DynaOne ø 8mm rope using Gleisten Ropes testing machine in Trencin, Slovakia.

	left attachment	right attachment	damage at... kN	comments
11	wound 5 times on ø 25cm cylinder	wound 5 times on ø 25cm cylinder	6,05	with spliced Brummel eyelet, excentric forces - eyelet became unspliced
12	wound 5 times on ø 25cm cylinder	wound 5 times on ø 25cm cylinder	43,79	previous test continuation - fracture in eyelet splicing area

Conclusions

Super Munter is a reliable way of stopping the dyneema rope.

Figure-of-nine/eight knots will not breaking of the rope, but the knots will become impossible to untie.

The **spliced eyelet** is still the best option.

Thank you for your attention

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