TECHNICKÁ DOKUMENTACE OPRAV DB

Oprava dynamických bariér v obci Hřensko po požáru 2022 – dynamická bariéra B5

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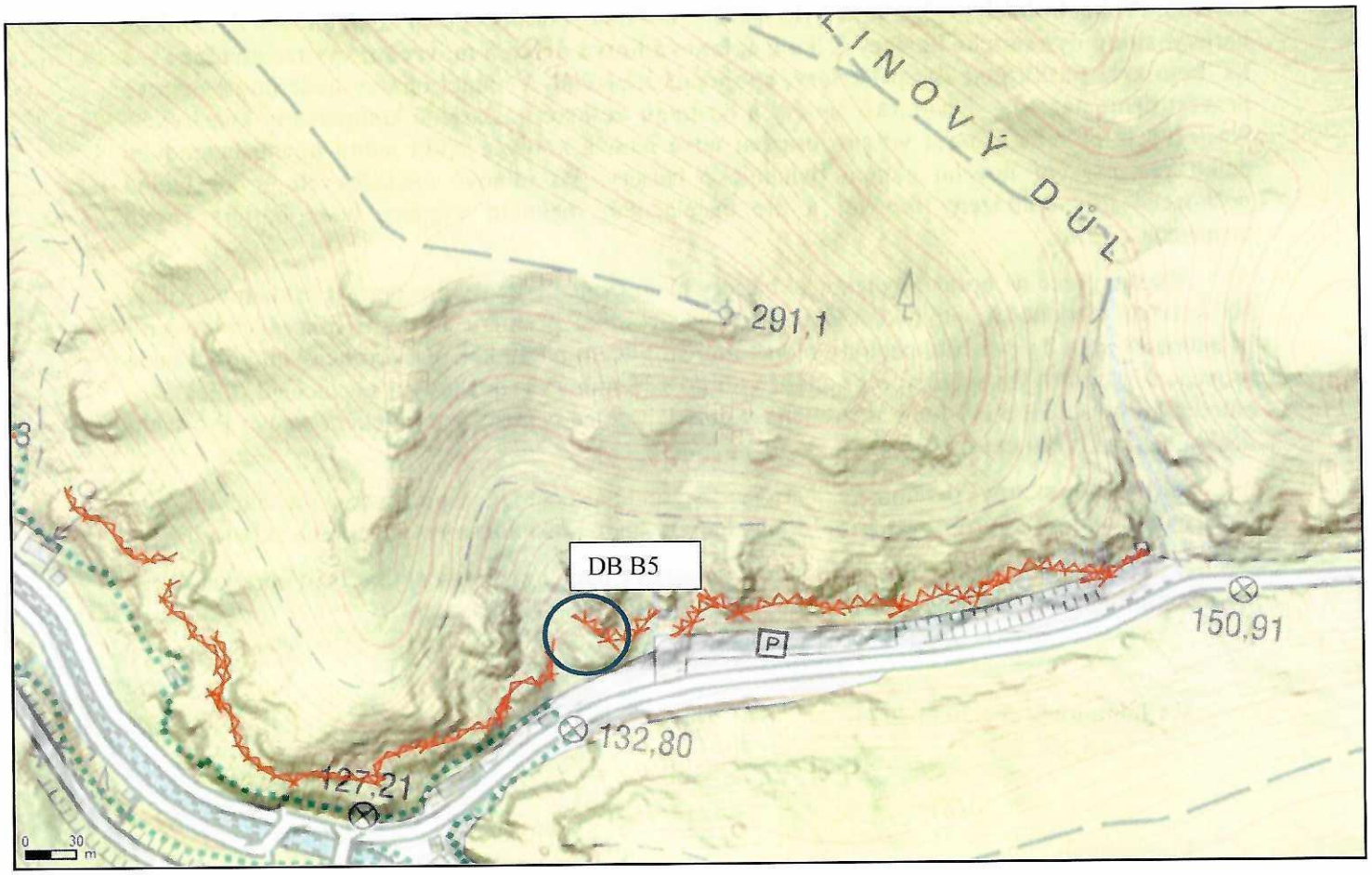
STRIX® INŽENÝRING

CHOMUTOV, srpen 2023

Příloha 01 Přehledná situace



Obr. č. 1 – Přehledná situace – umístění dynamické bariéry B5

Příloha 02 Fotodokumentace

DB B5 Celkový pohled

DB B5 – pravý krajní sloup

Lanová kotva určená k výměně

Sloup DB určený k výměně.

Poškozený sloup DB č.4 určený k výměně.

Poškozený sloup DB č.3 určený k výměně.

Příloha 03 Instalační manuál

Příloha 04 Výkaz výměr

TABLE OF CONTENT

DESCRIPTION OF USED SYMBOLS

Security advice: carry out instructions!

Remark, for easy and proper installation of the system

The colours of the brake elements, ropes, shackles etc. correspond with the colours of the system drawing

mountain side

valley side

RECOMMENDED INSTALLATION TOOLS

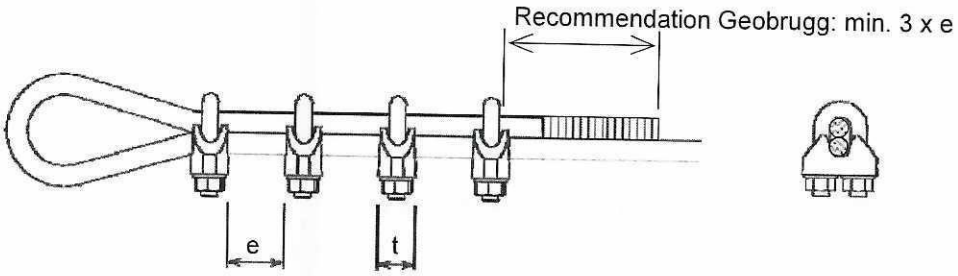
MARKING	• Tape measure 30 to 50 m • 2 meter folding rule • 5 red and white surveyor's pegs • Inclinometer • Spray paint • Small wooden or iron pegs (min. 3 pegs per field) • Hammer • Product manual
INSTALLATION	• Fork or ring wrench • Socket wrench with ratchet • Torque wrench, range 25-120 Nm (required torque) • Fork wrench for anchor nuts • Wire rope cutters Felco C16 or C112 or equivalent; cutting capacity 12 mm • Motor disc cutter or hammer wire rope cutter; cutting capacity 28 mm • Pincers, flat nose pliers • Galvanized stranded wire binding cord 2 mm or wire • Angle spirit level (water-level) • Roll of adhesive tape • Draw tongs, small 8-16 mm / large 14-26 mm (at least 2) • At least 2 tension belts / straps • Come-along/pulley, e.g. type LUGAL • Chain hoist or Habegger, at least 1.5 metric tons (15 kN) • Auxiliary ropes

USE OF WIRE ROPE CLIPS

Analog EN 13411-5 (DIN 1142)

The first wire rope clip is attached close to the loop. The wire rope clips must be spaced so that the distance **e** between them is a multiple of 1.5 to 3 times the width **t** of the wire rope clip.

The clip stirrups („u-bolts") are always applied on the unstressed rope end, the jaws („saddle") always on the stressed rope („Never saddle a dead horse").



Nominal size [mm]	Distance e [mm]	Required torque (1) [N * m]	Required number of clips	Wrench width [mm]
16	50 - 90	55	4	22
22	50 - 90	120	5	24

The torque values given apply to greased screw-nut connections.

During installation and before starting operation, tighten the hexagonal nuts to the required torque.

After installation of the barrier, the torque of the rope connections on the lateral and upslope anchors must be rechecked or readjusted if necessary.

(1) The torque values given are 10 % higher than those recommended in the standard. This is based on the deviation in common torque wrenches.

SYSTEM OVERVIEW

SYSTEM DRAWING

See appendix GS-1109

ROPE ASSEMBLY

See appendix GS-1110

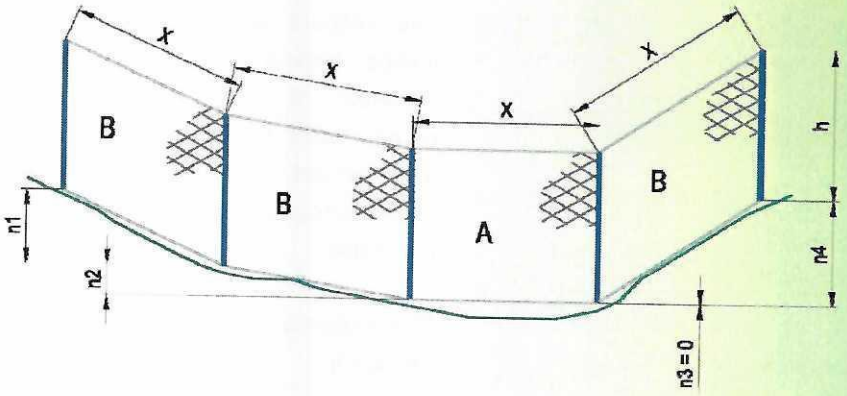
SUPPORT ROPE SEPARATION (WITH INTERMEDIATE ANCHOR ROPES)

See appendix GS-1116

A support rope separation (with intermediate anchor rope) must be built in approx. every 80m - 100m, if there is no need to do so more frequently because of topographic constraints.

MARKING

MARKING OF THE ANCHOR LOCATIONS

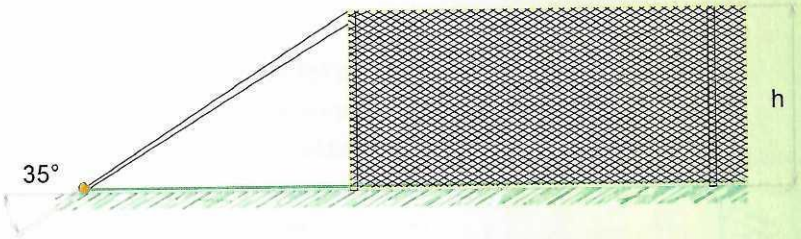


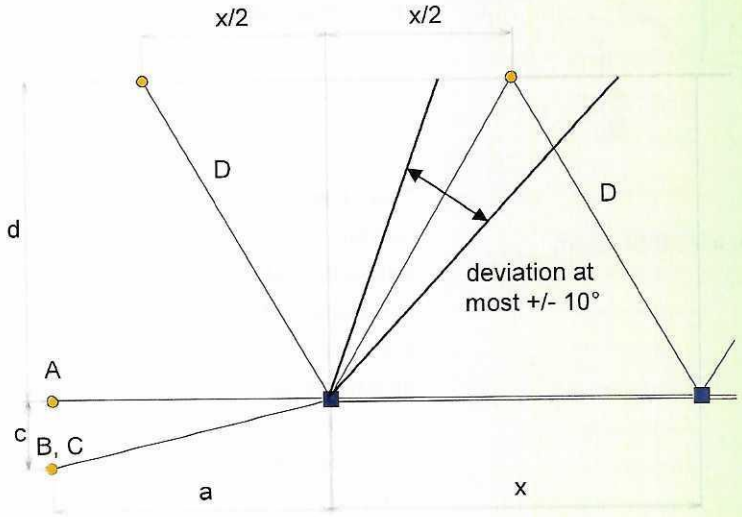
x: Post spacing measured parallel to the slope, tolerance ±5cm
n1-n4 Elevation differences
h: Barrier height
A: Standard mesh panel
B: Special mesh panel

The line followed by the barrier should be planned as straight and horizontal as possible.
Larger irregularities in the terrain must be bypassed or evened out as needed (fill up holes, flatten bumps or mark off along the contour line).

The base line is marked off and divided into the prescribed distances between posts (x) (measure parallel to the slope). The positions of the posts are then marked. In cases of deviations of more than 3° out of the horizontal, special mesh panels (B) must be used instead of standard ones (A). Therefor the elevation difference (n) of the posts must be measured and communicated to Geobrugg in an appropriate form.

ANCHORS FOR SUPPORT, RETAINING AND LATERAL ANCHOR ROPES





h: Barrier height
x: Post spacing
A: Top support rope
B: Bottom support rope
C: Lateral anchor rope
D: Retaining rope

h	a	c	d	e
3,00	4,50	1,00	5,10	1,50
4,00	6,00	1,30	6,80	2,00
5,00	7,50	1,65	8,50	2,50

Retaining ropes:
The anchors are positioned in the middle behind both posts (at a distance of x/2 from a line perpendicular to the base line). The distance between anchor and base line in a regular terrain is given by d (see table).

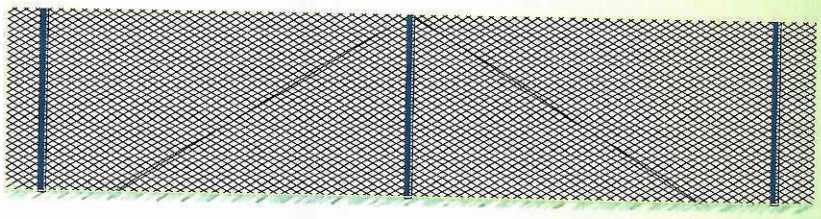
The distance can vary in irregular topography.

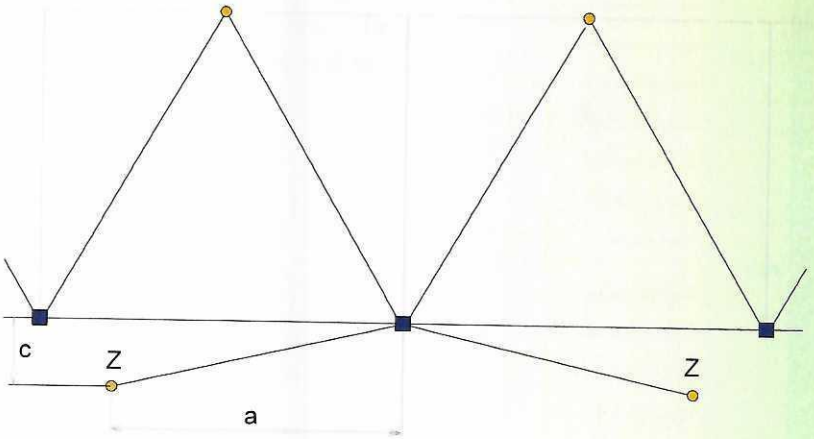
In the layout, a deviation from the prescribed retaining rope line may not exceed +/- 10°. In the case of a solid rock wall (distance between barrier and rock wall too small), each retaining rope must be anchored individually. In this case, two anchors instead of one per field will be needed.

The angle between retaining rope and posts must be between 60° and 85° in all cases (see page 16).

Support ropes and lateral anchor ropes:
The rope anchors for the support ropes and the lateral anchor ropes are located a distance a away from the last base plate. The anchor for the top support rope is in line with the barrier, while that for the bottom support rope and the lateral anchor rope lies farther downslope by a distance c. Take care that the upper anchor lies in line with the barrier or slightly in front, but not behind the barrier line.

ANCHORS FOR INTERMEDIATE ANCHOR ROPES

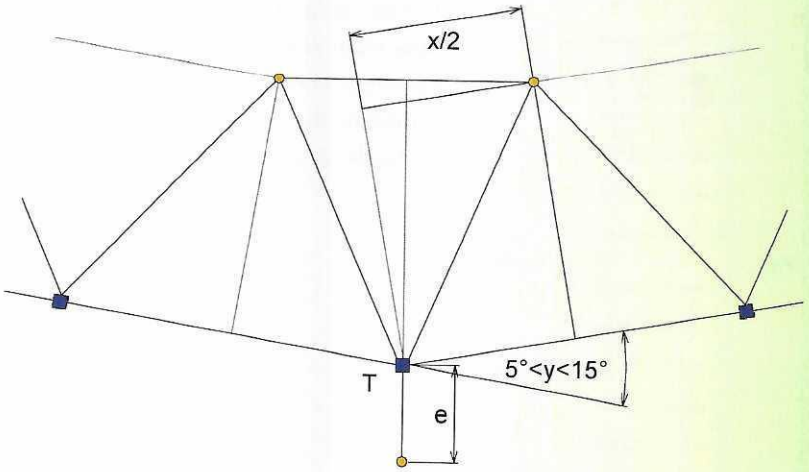




An intermediate suspension requires two anchors that are located a and c away from the respective posts. Both, the intermediate anchor ropes and (in case of a simultaneous support rope separation) the bottom support rope are guided to these anchors.

Z: Intermediate anchor rope
a: See table page 12
c: See table page 12

UPSLOPE CHANGE IN DIRECTION

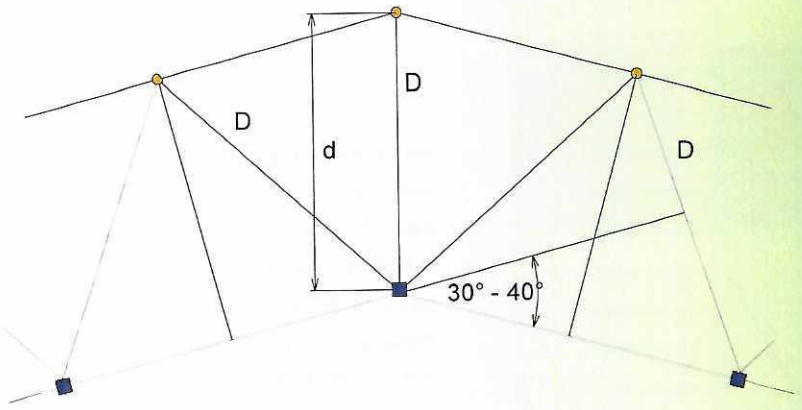


An additional downslope anchor rope (T) is required if the barrier changes its direction by an angle of 5° - 15° upslope. The rope anchor is located downslope at a distance of e from the post.

If the barrier line changes upslope more than 15° an intermediate anchor rope is required. In this case the downslope anchor rope is no longer necessary.

T: Downslope anchor rope
x: Post spacing
e: See table page 12
y: Angle of direction change

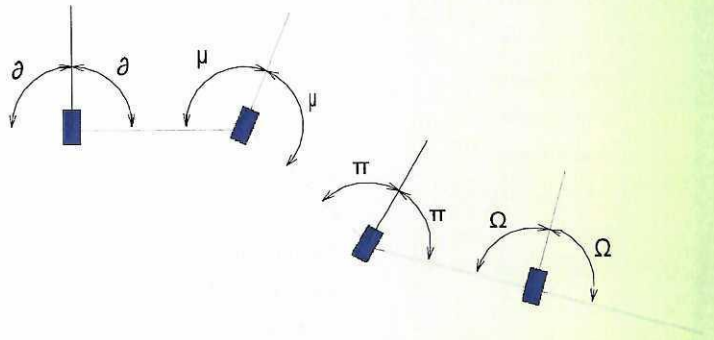
DOWNSLOPE CHANGE IN DIRECTION



For a downslope change in direction of over 30° an additional retaining rope D is installed on the post (three retaining ropes instead of two, see figure). The maximum downslope change in direction is 40°.

D: Retaining rope
d: See table page 12

ANCHORAGE OF THE BASE PLATES

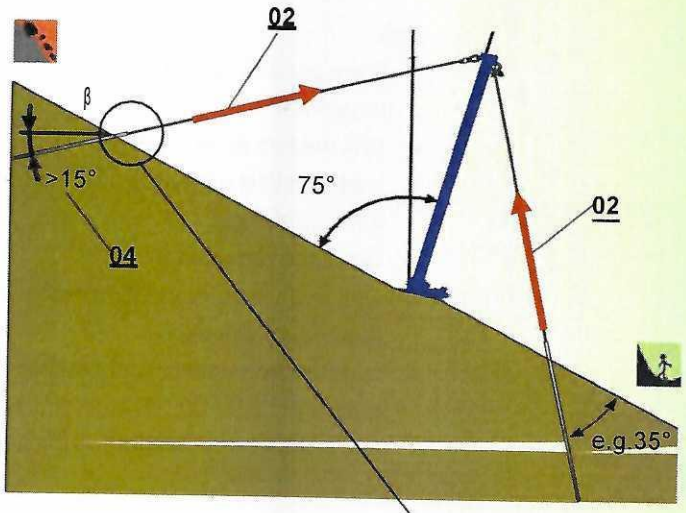


The same post base plate can be used on a concrete foundation with two parallel anchors or with a tie rod inclined 45°.

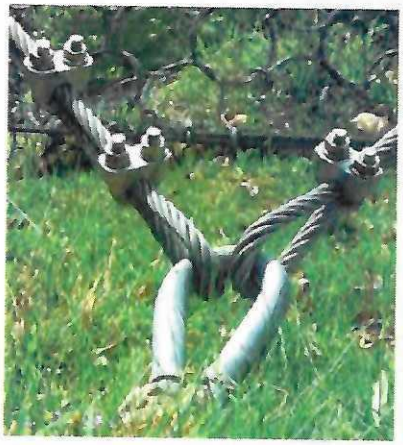
In case of a change in direction, the base plate should be positioned in the bisecting line of the angle that is formed by the two directly neighboring net fields (∂, μ, π, Ω).

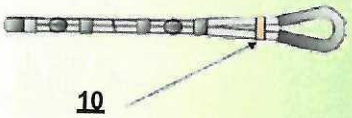
F1 – F4 = Sequential foundations
∂,μ,π,Ω = Bisecting angles

ROPE ANCHOR ASSEMBLY



The anchor holes are drilled in the pulling direction **02** with a minimum inclination of 15° to the horizontal **04**



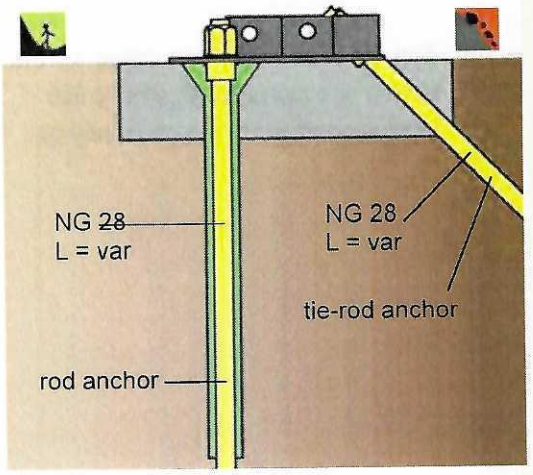


i When grouting, the anchors must be inserted lying into the bore hole up to the orange marking **10**

i When using rod anchors with flexheads, it is necessary to have reinforced head foundations to bear the shear forces.

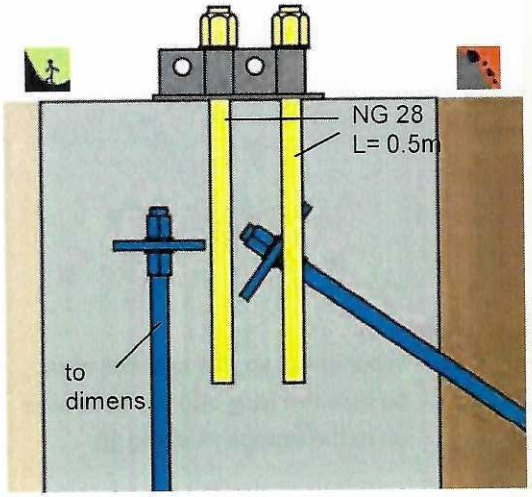
ANCHORAGE

ANCHORAGE OF THE BASE PLATES



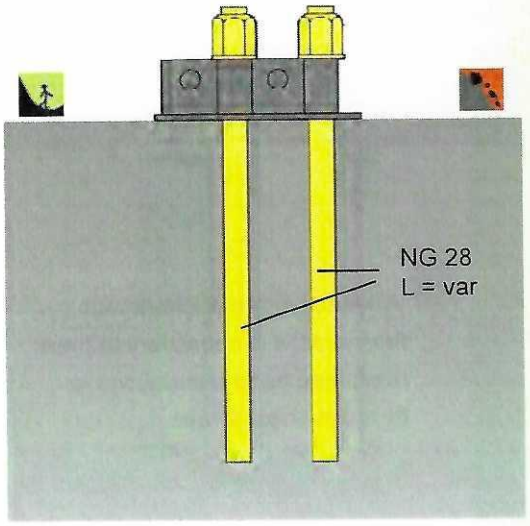
Soil:

- Base plate inclined 0-30° from horizontal
- Drill the two anchor holes
- Insert stabilization tube, rod anchor and counter nut
- Grout the rod anchor
- Optional: Head foundation made of reinforced concrete
- Insert tie-rod anchor and counter nut
- Grout the tie-rod anchor



Concrete:

- For all types of soil and rock
- Excavate foundation pit
- Optional: Drill and install soil or rock anchors for tie back
- Install appropriate reinforcement
- Insert the two anchors
- Pour the concrete foundation



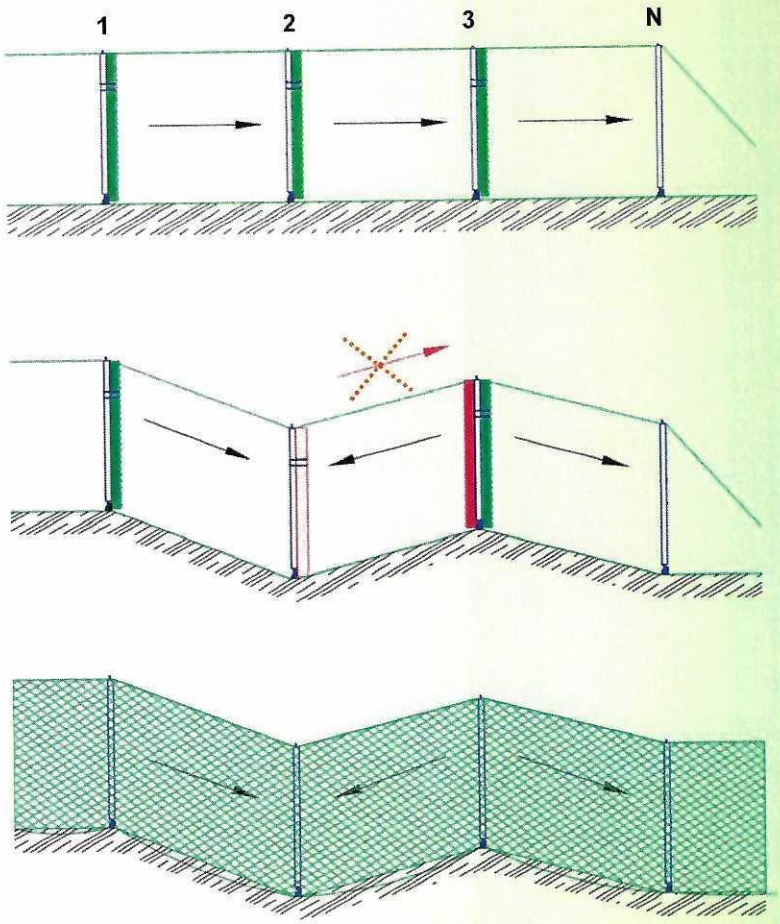
Rock:

- Level the rock 0-30° from horizontal
- Drill the two holes perpendicular to the base plate
- Grout in the anchors
- Curing of the grout
- Put the base plate and fasten with washers/nuts

Tighten the nut to approx. 30 kN pretensioning force
(for Swiss Gewi NG28 / 32 / 40 torque approx. 400 Nm)

PREPARATION OF POSTS AND NETS

ASSEMBLING IN A ROUGH TERRAIN



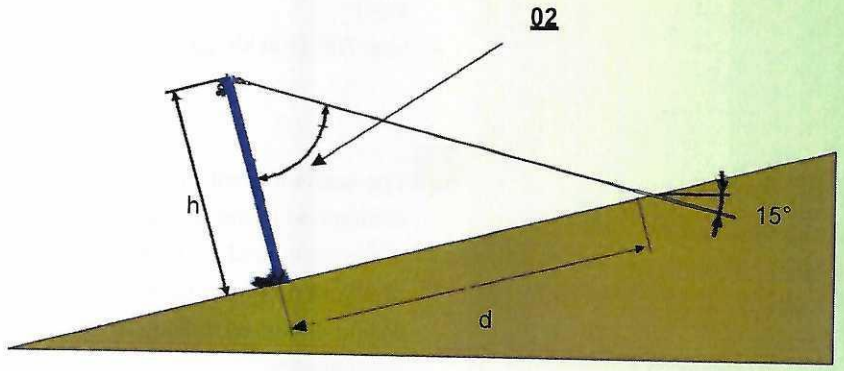
- As a standard, Geobrugg delivers the SPIDER® panels as per the first figure.
- The net panels are mounted on the right side of the posts. (seen from valley side)
- The numbering is done from the left to the right side (seen from valley side)

- With bigger height differences it's easier to pull the SPIDER® net panel from the higher to the lower post.

Pre-assemble of SPIDER® net panels on the appropriate side of the posts

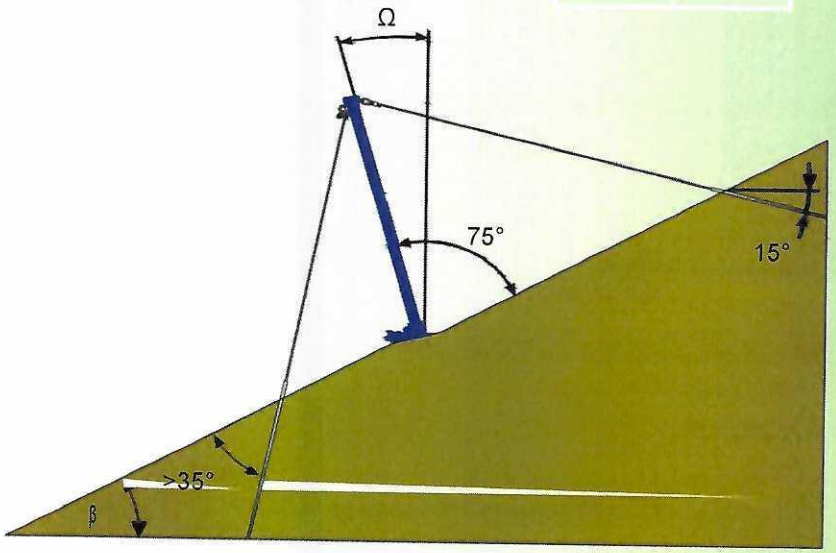
By placing your order please inform us accordingly. Geobrugg will already pre-assemble the net panels on the requested side.

POST ALIGNMENT AND ANCHORAGE OF THE RETAINING ROPES



h	d
3,00	5,10
4,00	6,80
5,00	8,50

ß	Ω
0° -30°	15°
32°	17°
34°	19°
36°	21°
38°	23°
40°	25°
42°	27°
44°	29°
45°	30°



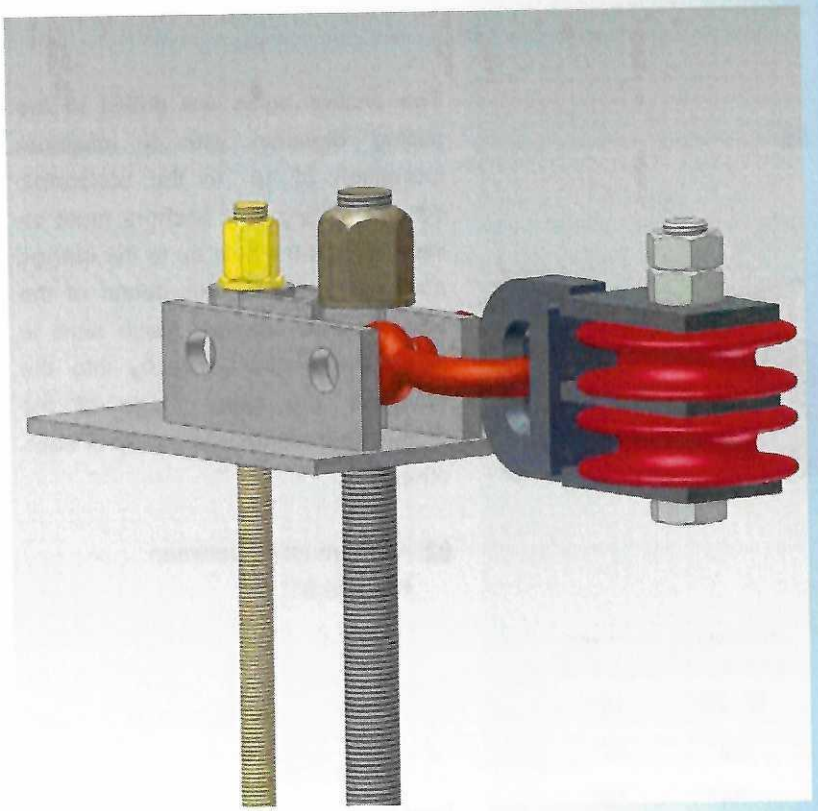
The anchor holes are drilled in the pulling direction with a minimum inclination of 15° to the horizontal. When grouting, the anchors must be inserted into the hole up to the orange marking (approximately center of the anchor head casing). Make sure to insert the anchor correctly into the borehole: the spiral ropes of the anchor lie beneath, not on top of each other.

02: Angle must be between 60° and 85°

Post alignment:

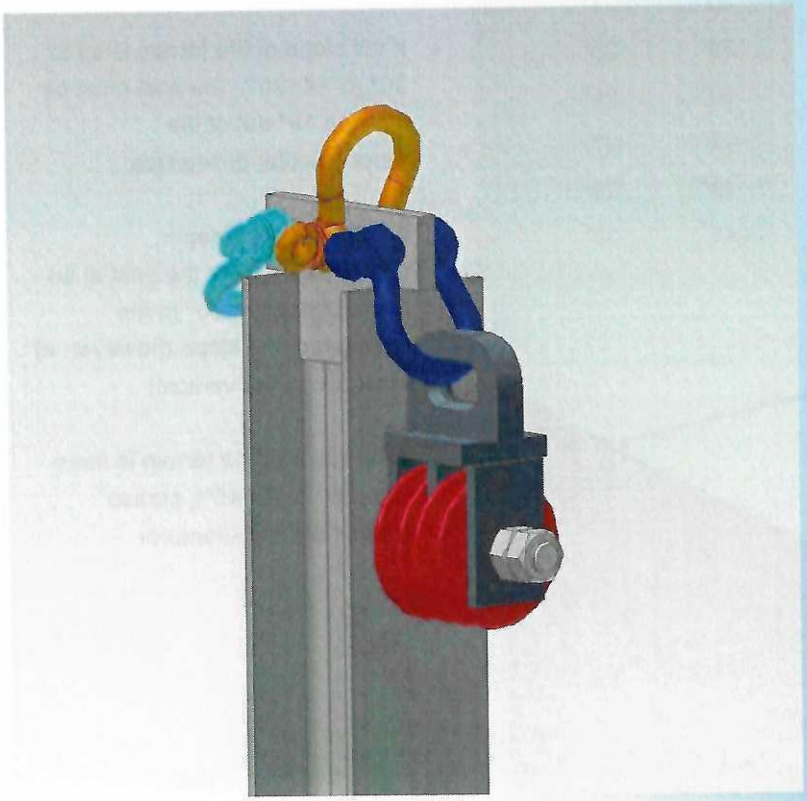
- If the slope of the terrain is up to 30° (0°<ß≤30°), the post must be inclined 15° out of the perpendicular downslope.
- If the terrain is steeper, (30°<ß≤45°) place the post at an angle of approx. 75° to the direction of the slope (however, at most 30° to the vertical).
- If the slope of the terrain is more than 100 % (ß>45°), please contact the manufacturer

INSTALLATION STEPS

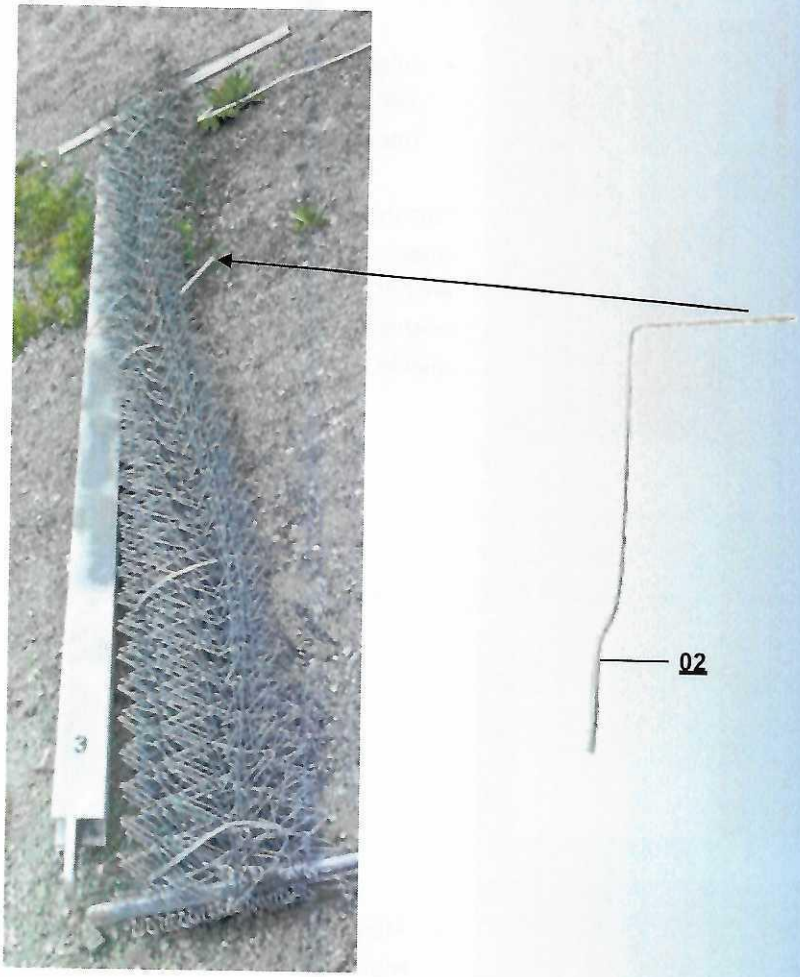


- Attach clevis **02** with both running wheels **04** to base plate (valley side)
- Use 7/8" shackle **06**

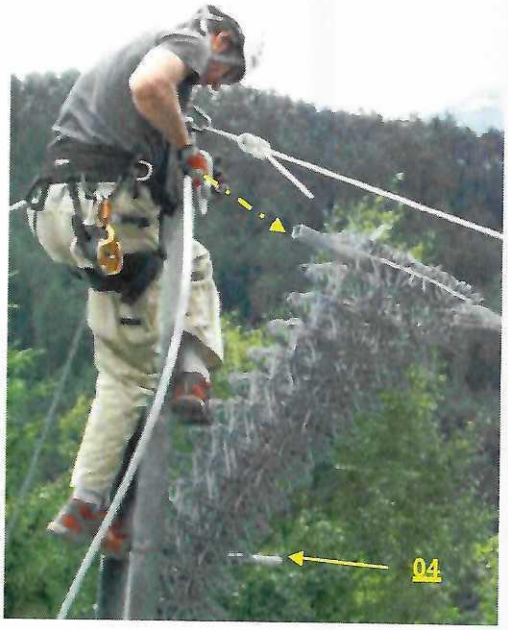
The clevis for both running wheels is attached to the eye plate close to the main anchor. Like this, the pressure on the running wheels will be deflected directly to the main anchor



- Attach clevis **08** with both running wheels **10** to the post head (valley side)
- Use a 7/8" shackle **12**



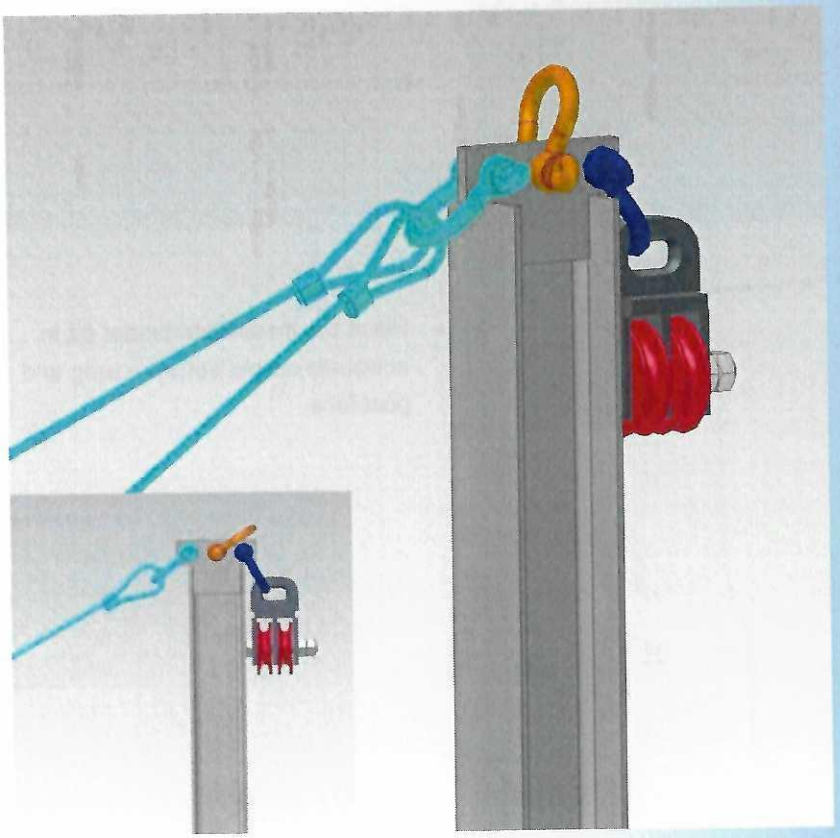
- Place the installation binder **02** in adequate height between rung and post face.



Align the SPIDER® mesh panel. The mesh opening and the upper running wheels, respectively the top support ropes have to be on the same height

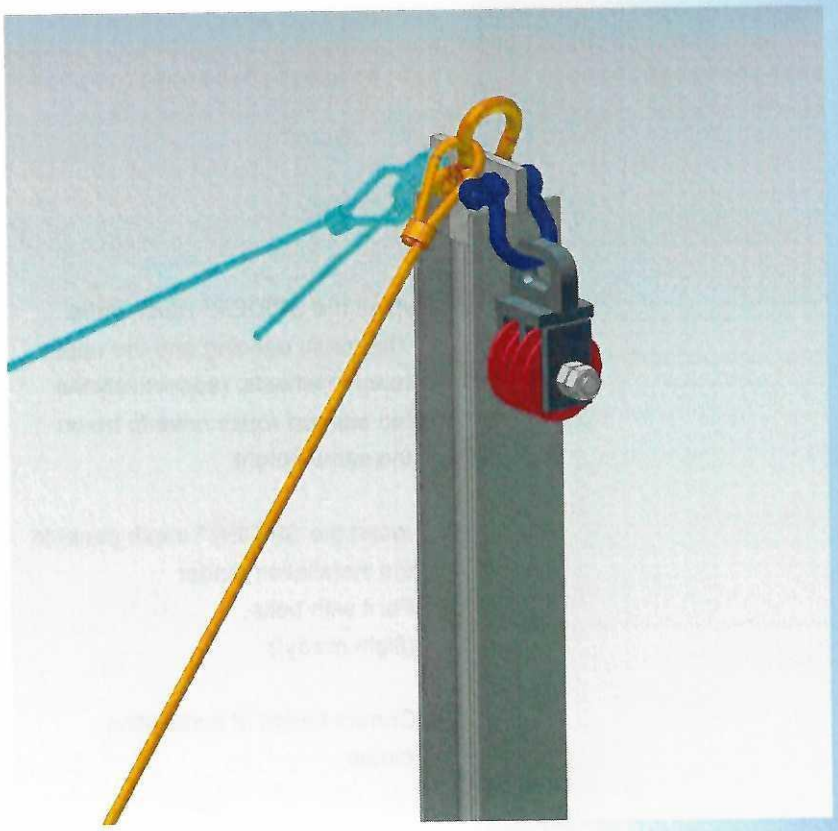
- Insert the SPIDER® mesh panel to the installation binder
- Fix it with belts. (flight ready!)

04: Correct height of installation binder



- Attach retaining ropes **02** with a 7/8“ shackle **04** to the post head (mountain side hole)

Option:
Attach the optionally valley side anchor rope or the intermediate anchor rope with a 3/4“ shackle in the middle hole



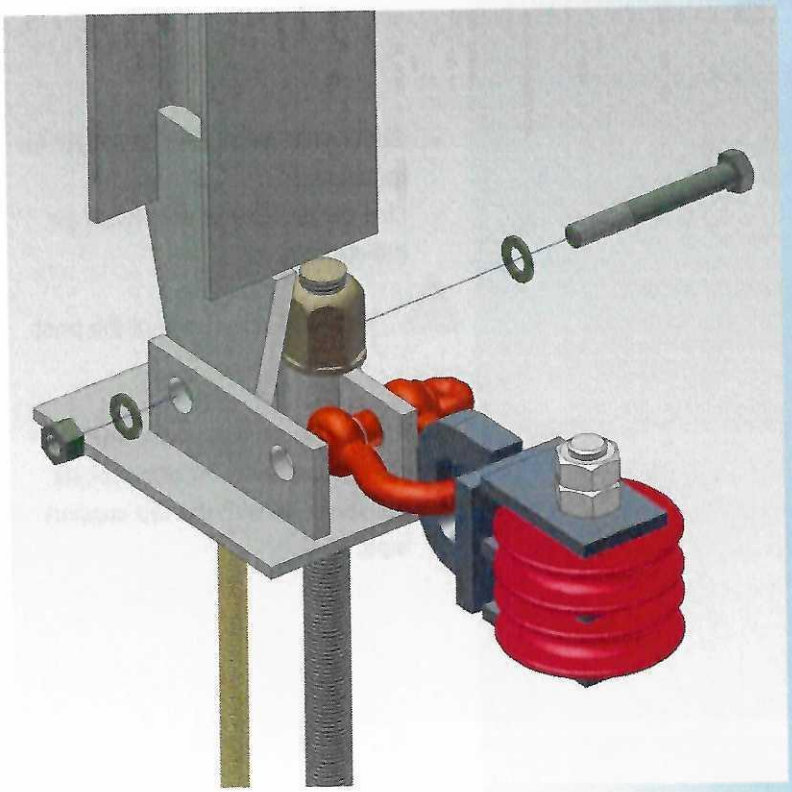
- Attach the lateral anchor rope **06** with a 3/4“ shackle **08** to the post head of the border post
- The lateral anchor rope is always towards the lateral anchors.

INSTALLATION BY CRANE OR HELICOPTER

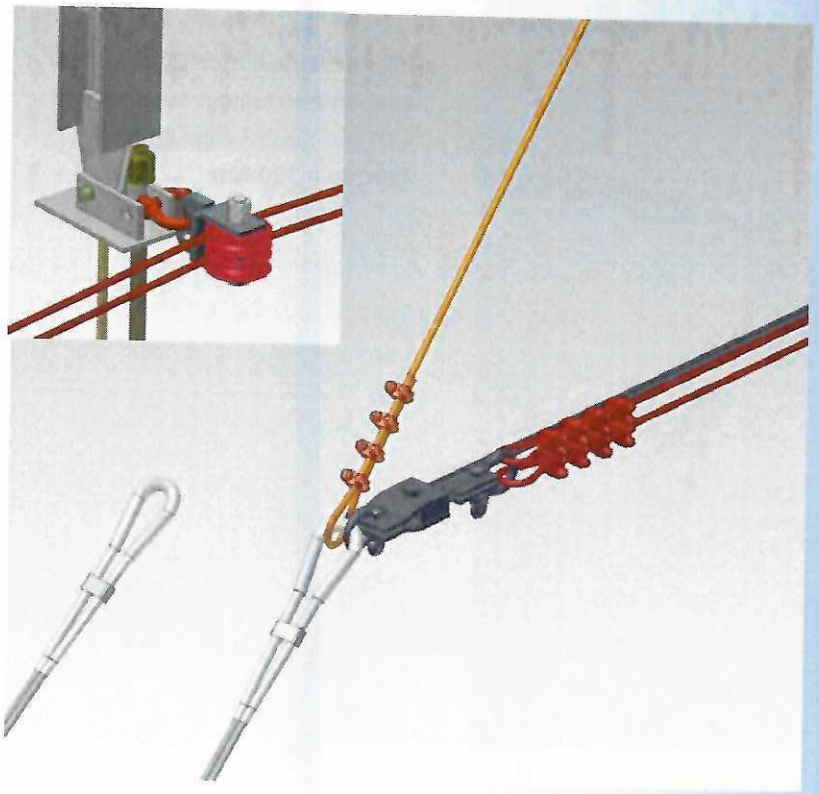
- Secure the posts with SPIDER® for installation
- Use center hole at post head for attachment

DO NOT use rungs of the post

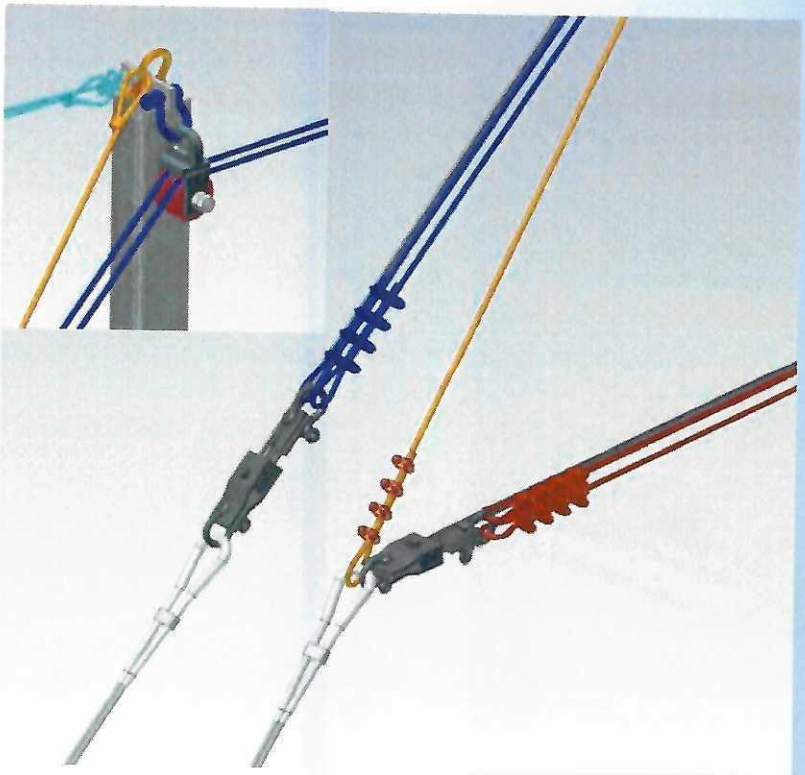
- Alternative: Install posts and put the nets in between of the posts. Pull them up with the top support rope.



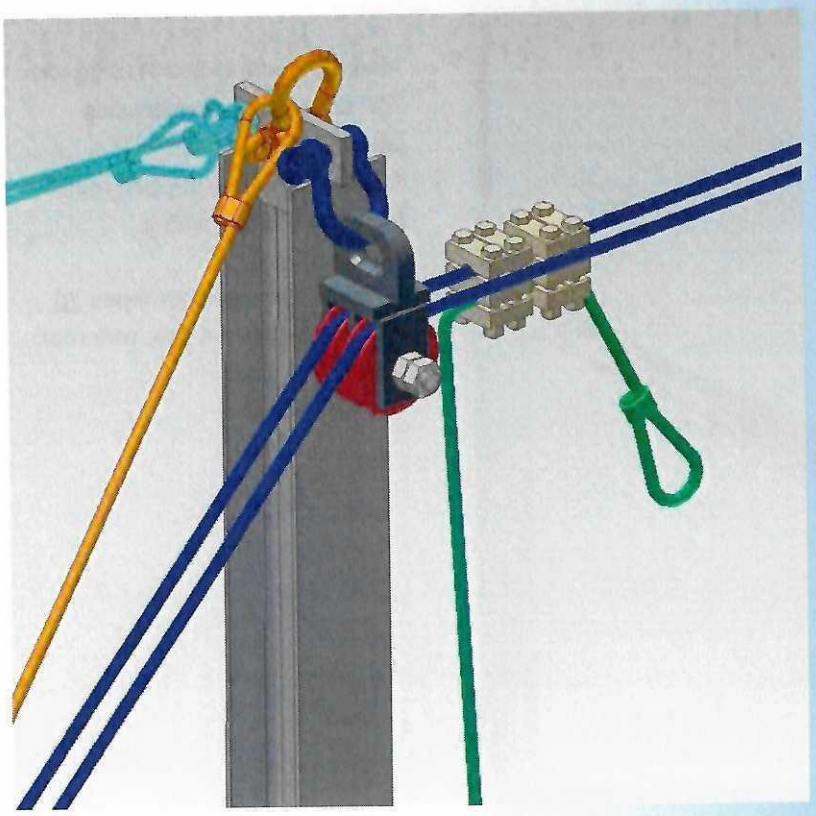
- Place the post foot into the base plate
- Fix post at base plate with hexagonal screw M20x110 **02**, 2 washers **04** and nut M20 **06**



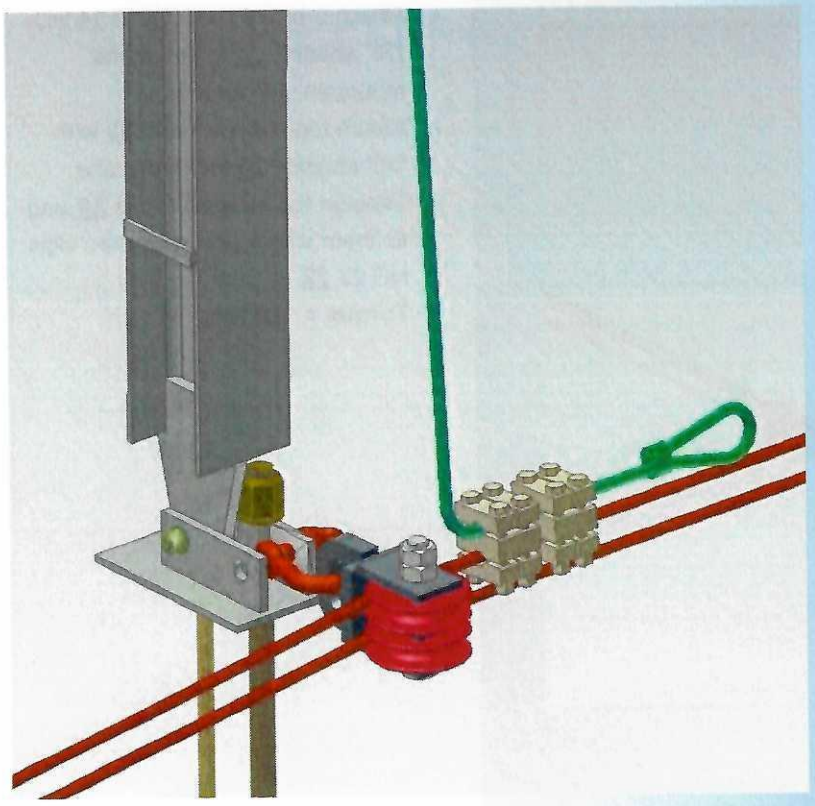
- Attach u-brake U-300-R16 **02** with 7/8" shackle **04** at valley side lateral anchor
- Attach the bottom support ropes **06** to the u-brake with a 7/8" shackle **08**
- Tension lateral anchor ropes **10** and fix them with 4 pcs. wire rope clips NG16 **12**
  Torque = 55 Nm

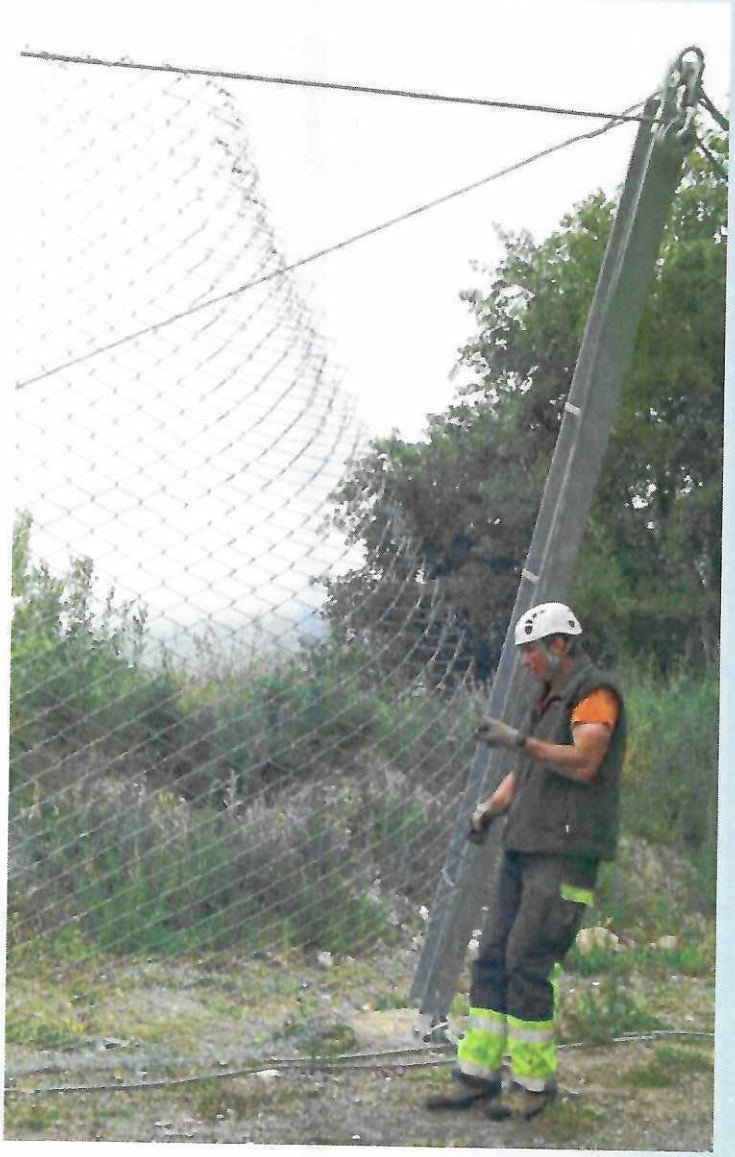


- Attach u-brake U-300-R16 **14** with 7/8" shackle **16** at the lateral mountain side anchor
- Attach top support ropes**18** with 7/8" shackle **20** to the u-brake
- Tension top support ropes **18** and fix them with 4 pcs. wire rope clips NG 22 **22**
  Torque = 120 Nm

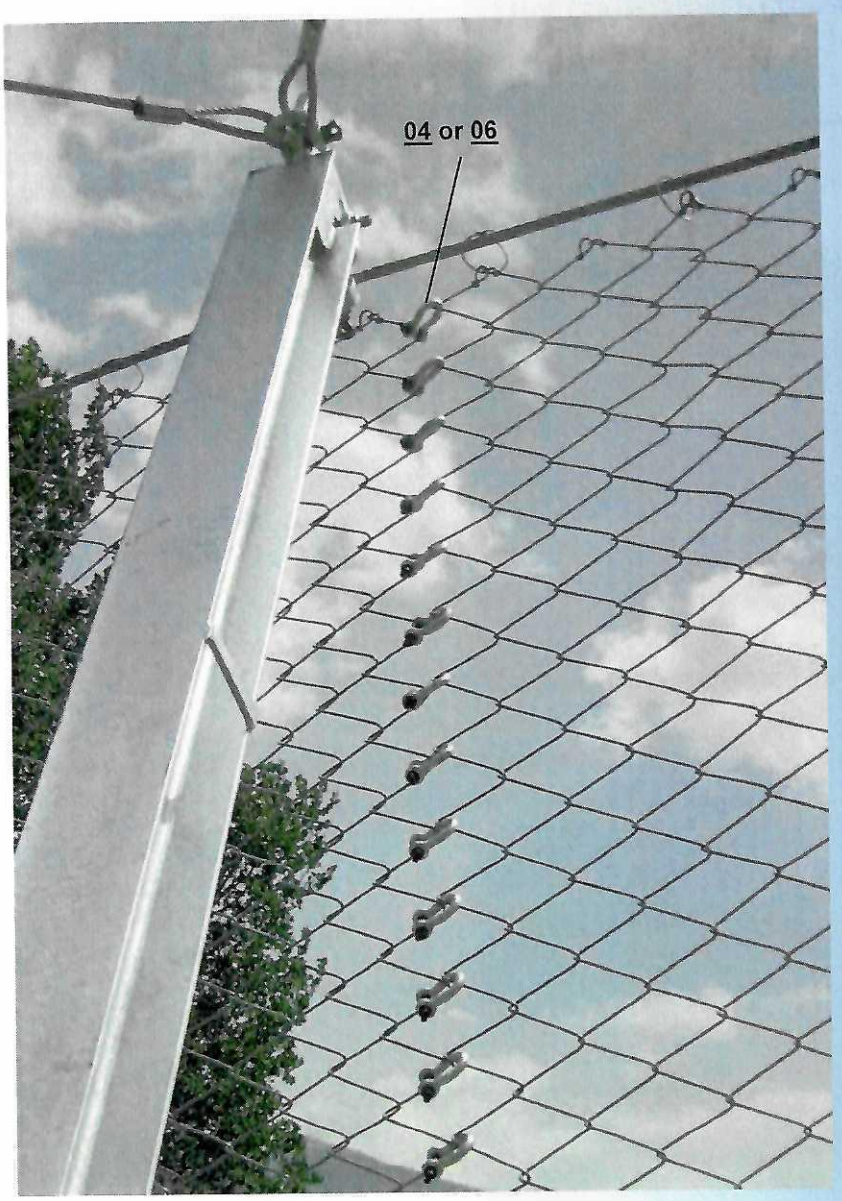


- Fix the vertical rope **02** at the top support and bottom support rope with two double clips **04** each.
  Torque = 120 Nm

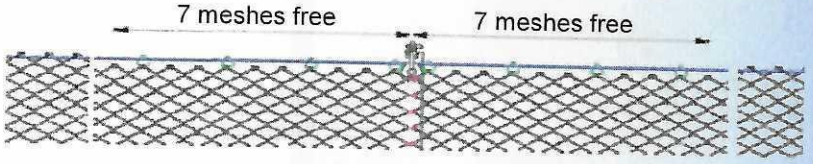




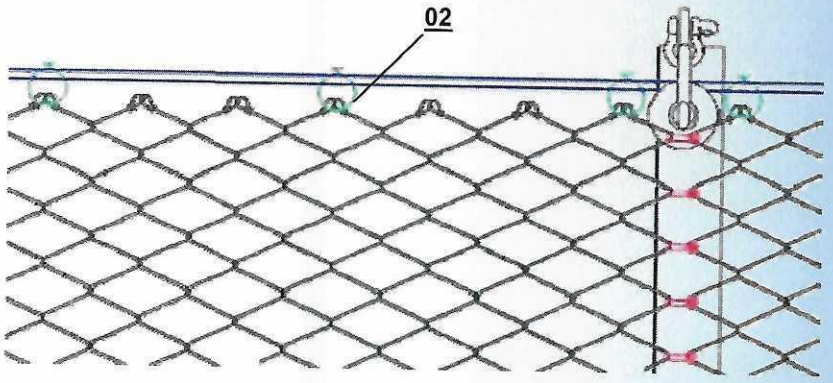
- Pull net panels apart
- Make sure that all the meshes are aligned correctly
- Tension bottom support ropes and fix it with wire rope clips to the U-brake

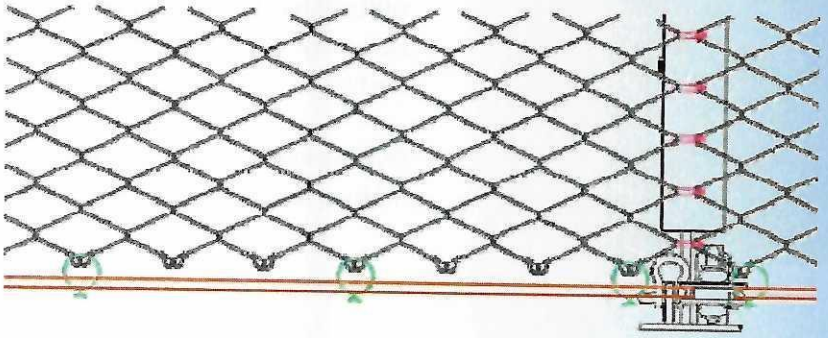


- Connect the net panels with 7/16“ shackles **04**
- Connect the border net panels with 5/8“ shackles **06** to the vertical ropes

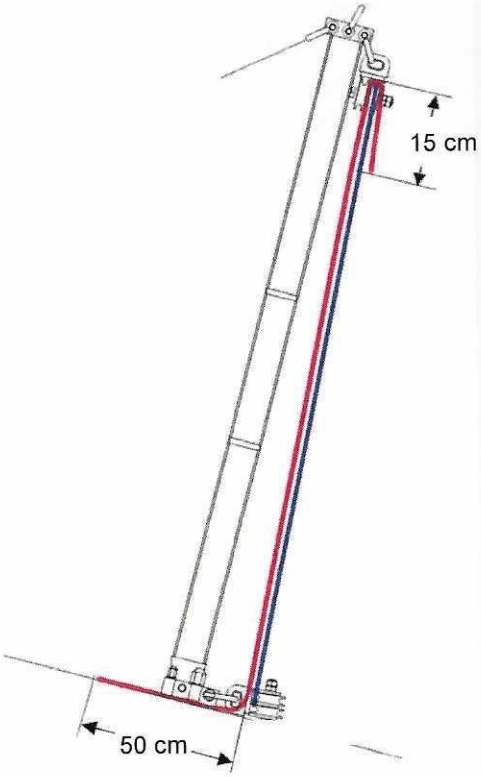


- Installation of the round clips **02** to one or both support ropes
- Leave 7 meshes free
- Install 4 pcs. round clips on the left and right side of the post (see layout), starting by the post





WIRE MESH

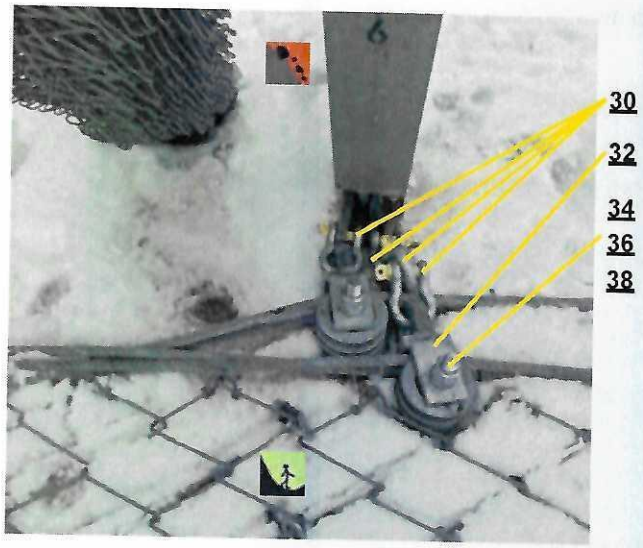


- Cut the wire mesh in the right length. It has to overlap the SPIDER net about 15 cm at the top. At the bottom it has to overlap the upslope terrain about 50 cm.

- Fix the wire mesh on the SPIDER net with double eyedwires or strand wires. Every mesh of SPIDER has to be fixed in the length and every second mesh in the height.
- Overlap every stripe of the wire mesh at least 10 cm.

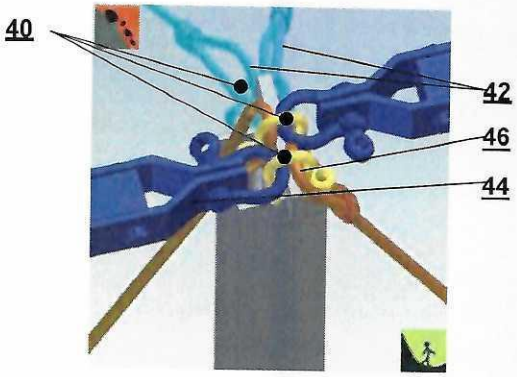
SUPPORT ROPE SEPARATION

(with intermediate anchor rope)



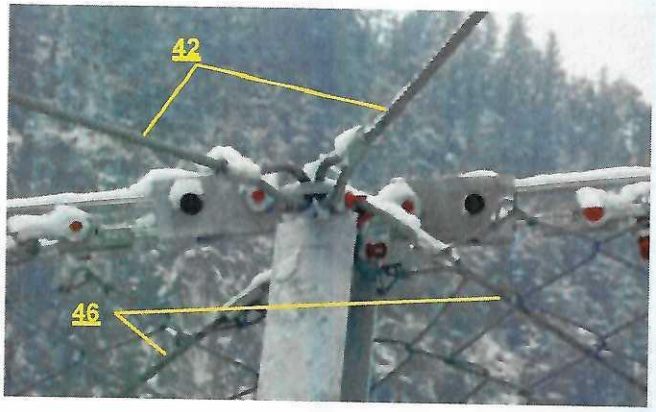
- rigging of base plates for support rope separation

4 pcs. 7/8"-shackle **30**
2 pcs. clevis **32** incl.
4 pcs. running wheels **34**
2 pcs. hexagonal screw M30x180 **36**
4 pcs. hexagonal nut M30 **38**



- rigging of posts for support rope separation

3 pcs. 7/8"-shackle **40**
2 pcs. retaining ropes **42**
2 pcs. brakes U-300-R16 **44**
2 pcs. intermediate anchor ropes **46**

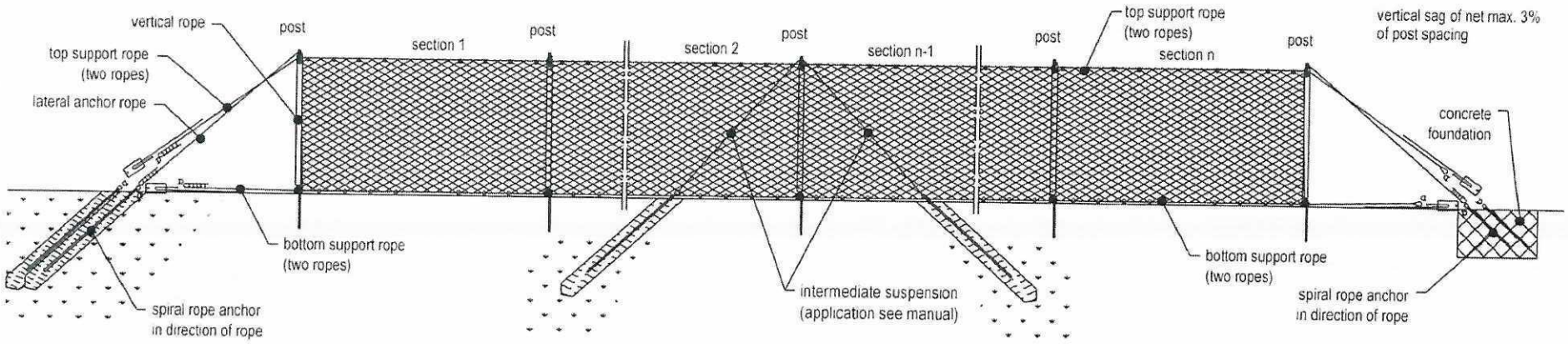


One intermediate anchor rope and one u-brake to the same shackle to avoid a torsional moment on the post.

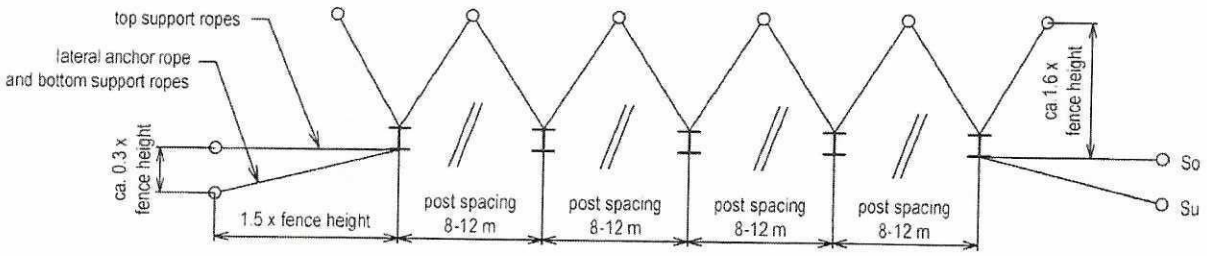
FINAL INSPECTION

After completion of the barrier the site engineer must complete a detailed final inspection

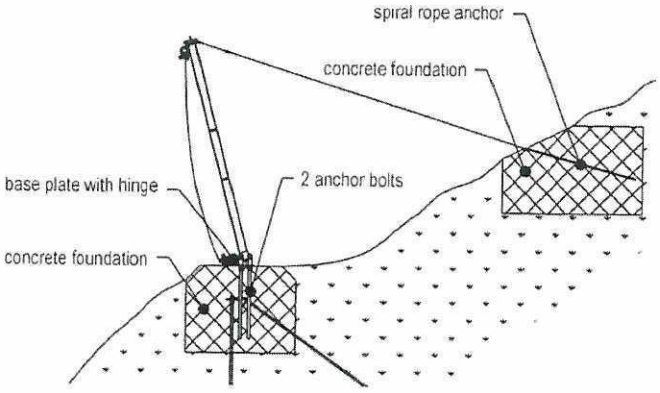
Above all, the following points must be checked	
1	Are the support ropes and lateral anchor ropes connected to the correct anchors?
2	Are the ropes guided correctly on the post head and foot?
3	Exact number of wire rope clips applied?
4	Wire rope clips mounted correctly?
5	Torque at wire rope clips correct?
6	7 meshes free on both sides of post heads and base plates? Round clips installed correctly?
7	Connection of the mesh panels correct?
8	Are the border mesh panels connected to the vertical ropes correctly?
9	Is the sag of the top support rope less than 3 % of the post spacing?



layout of anchor points
details in
product manual GBE-2000A

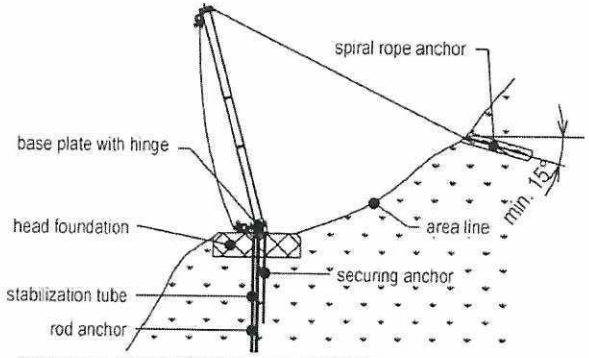


- anchoring for all types of soil: concrete foundation



- anchoring in bedrock: with two rock anchors

- anchoring in loose soil: with rod anchor and tie-rod anchor



NOTE:
Rockfall, landslides, debris flows or avalanches are sporadic and unpredictable. Causes can be e.g. human (construction, etc.) or environmental (weather, earthquakes, etc.). Due to the multiplicity of factors affecting such events it is not and cannot be an exact science that guarantees the safety of individuals and property.
However, by the application of sound engineering principles to a predictable range of parameters and by the implementation of correctly designed protection measures in identified risk areas the risks of injury and loss of property can be reduced substantially.
Inspection and maintenance of such systems are an absolute requirement to ensure the desired protection level. The system safety can also be impaired by events such as natural disasters, inadequate dimensioning parameters or failure to use the prescribed standard components, systems and original parts, and/or corrosion (caused by pollution of the environment or other man-made factors as well as other external influences).

modification:	M:%	substitute for:
-		replaced by:

Rockfall protection barrier
GBE-2000A system
EOTA Classification 5 (2000 kJ)

drawn	23.03.09	ol
checked	23.03.09	SR
approved	23.03.09	SR

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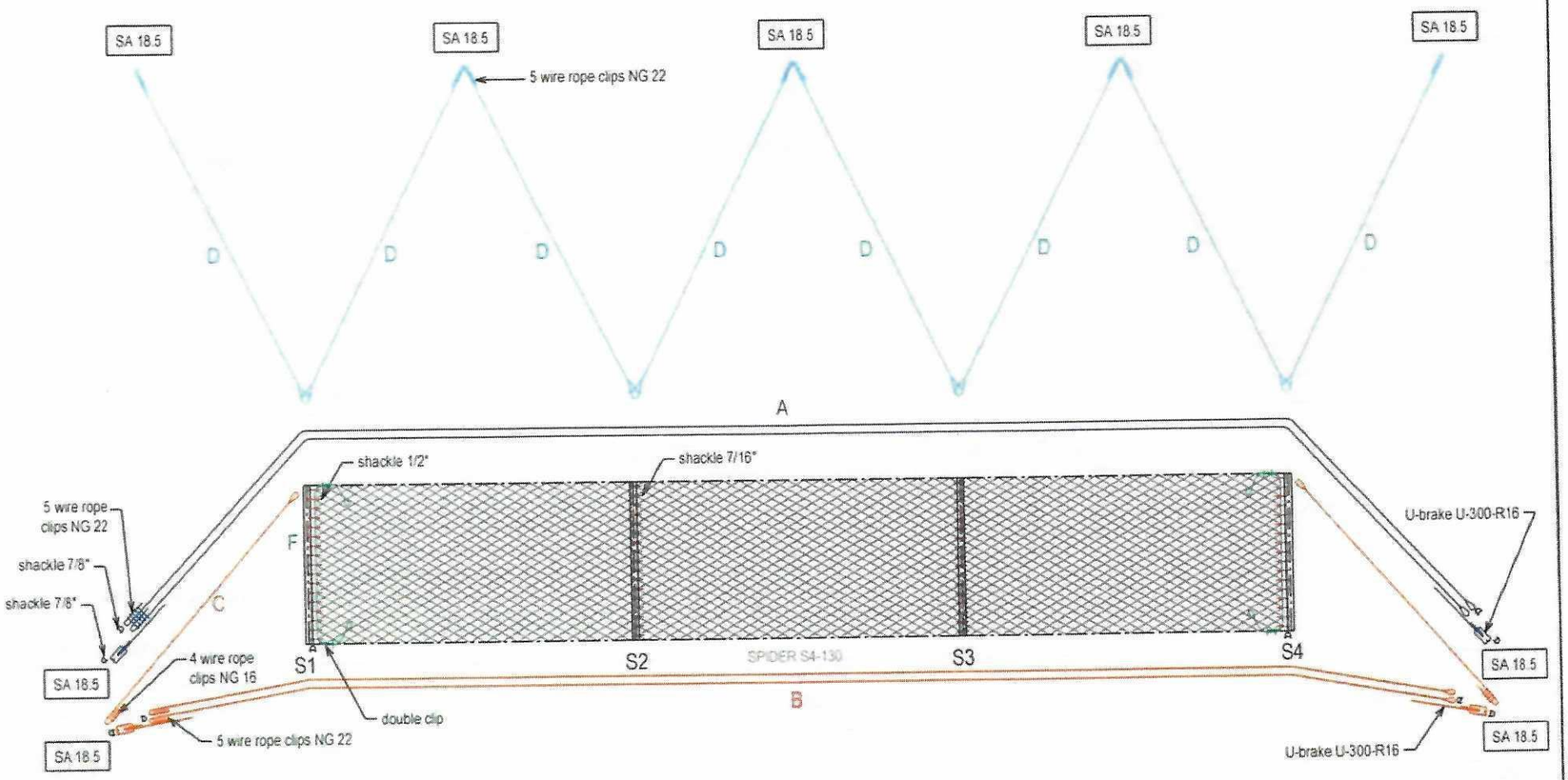
CH-8590 Romanshorn

GEOBRUGG

GS-1109 e



A Top support rope Ø22 mm
B Bottom support rope Ø22 mm
C Lateral anchor rope Ø16 mm
D Upslope anchor rope Ø20 mm
F Vertical rope Ø22 mm

modification: -	M:%	substitute for: GS-1110e ed. 15.06.09 replaced by:

GBE-2000A
Rope assembly
EOTA Classification 5 (2000 kJ)

drawn	14.12.11	hb
checked	14.12.11	hb
approved	14.12.11	SR

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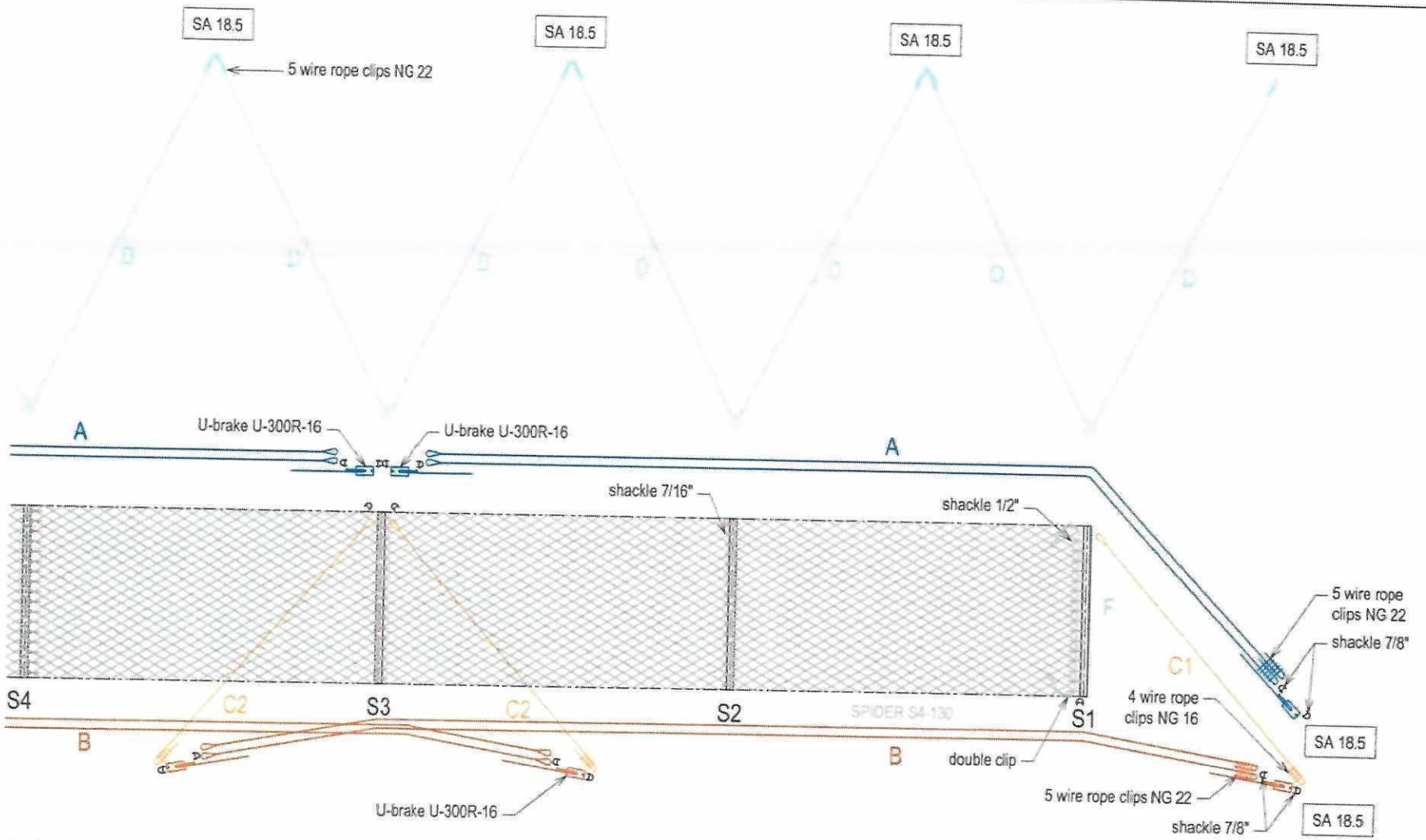
GS-1110 e



A: Top support ropes Ø22 mm

B: Bottom support ropes Ø22 mm

C1: Lateral anchor ropes Ø16 mm C2: Intermediate anchor ropes Ø16 mm

D: Retaining ropes Ø20 mm

F: Vertical ropes Ø22 mm

modification: -	M:%	substitute for: GS-1111 ed. 23.03.09 replaced by:

GBE-2000A
Support rope separation
EOTA Classification 5 (2000 kJ)

drawn	31.08.10	hb
checked	31.08.10	SR
approved	31.08.10	SR

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CH-8590 Romanshorn

GS-1111 e