Installation Manual

TS-2000-ZD

Subject to technical change

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SAFETY BY COMPETENCE

03/2024

Rockfall Protection Kit TS-2000-ZD
Helicopter or Crane Installation

1. Mark position of base plates and anchors.

2. Drill and set all anchors for bearing and retaining ropes. In doing so, it is extremely important to set the orientation of the anchor in accordance with the expected forces.

3. Gauge, drill and set anchors and micro piles (with micro pile tubes if used), making sure the proper orientation of the base plates (e.g. valley-side of base plate is oriented accordingly). Prepare the substructure for base plates in accordance with details for each post. Each base plate must have full contact with a firm subsurface.

4. If mono bar anchors are used, attach anchor eyelets.

5. For lateral anchors and upslope anchors, install the brake elements and the rope extensions as shown in the accompanying detailed drawings, keeping the bearing ropes on one side.

6. Mount base plates with post couplings and install anchor nuts with washers.

7. Layout posts beside one another at a preparation site with the valley-side facing down and leaving at least 1 – 2 m space between them.

8. Mount retaining ropes and side stabilisation ropes (only for end posts) to post head using the proper shackle. The shackle pin should always be mounted so that the eye of the pin is at the top of the post.

9. Place net packages next to post. Insert a mounting bar (not supplied) into tube fixed to the post head and thread net packages onto the bar. Caution: The correct orientation of the net package is crucial, as indicated by the coloured marking. Fix the net packages to the post 2 – 3 times by wire. Attach two mounting chains per post by leading the chains through the loop of the retaining ropes or shackle and fixing it to itself using a carabiner. Never mount the chains directly with a carabiner. Mounting chains and carabiners not supplied.

10. Transport the post and net packages (steps 6 – 8) by helicopter/crane to the base plates. The ideal team consists of four people. Two people, each with one mounting chain, go to the upslope anchors and secure the post while simultaneously two people guide the post into the base plate and insert the pin

11. that connects the post. The helicopter/crane then turns toward the valley, causing the post with net packages to hang in the mounting chains. Disconnect the suspension tackle so that the helicopter/crane may return to the preparation site to retrieve the next post.

12. Following the initial installation of the posts, all of the posts must be adjusted to the proper inclination. Install all upslope retaining ropes and side stabilisation ropes to the appropriate anchors.

13. Install all ropes and clips as per the appended standard table, remembering the saying “Never saddle a dead horse!” This also applies to all bearing and middle ropes installed in the next following steps.

14. The upper bearing rope is now led from the brake elements at the lateral anchor to the post, through the rope guide and the net packages. Repeat from post to post until reaching the opposite lateral anchor or internal retention anchor. At the other end, the bearing rope should be secured to the brake element and subsequently the anchor, put under tension and clamped down with wire rope clips.

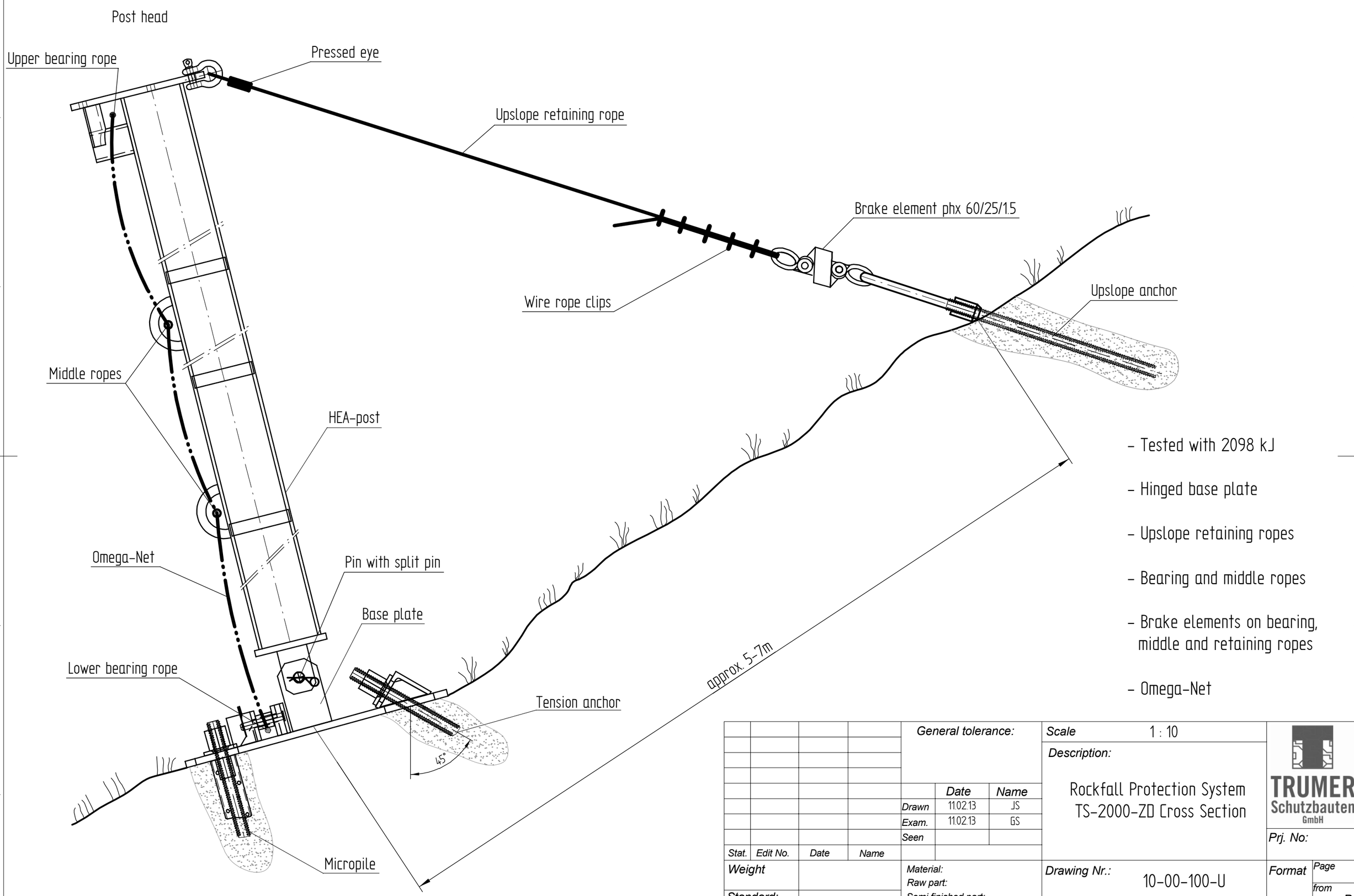
15. The lower bearing rope is also attached in the same manner except there should be no tension applied so that the rope lies on the ground and the net packages can be opened. Do not stretch the rope at this time but secure using a wire rope clip.

16. Next, mount the four middle bearing ropes in the same manner as the upper bearing rope, putting the ropes under tension and clamping it down with wire rope clips.

17. Free the net packages and stretch the nets open like a curtain. Adjacent panels are connected using either shackles or a sewing rope. Nets at either edge of the fence line are secured to the posts using a border rope. For more detailed instructions concerning the closing of the nets, see mounting instructions for net installation.

18. Re-stretch lower bearing rope and clamp down with wire rope clips.

19. Mount mesh layer, if required, using six connection points per square metre.



- Tested with 2098 kJ
- Hinged base plate
- Upslope retaining ropes
- Bearing and middle ropes
- Brake elements on bearing, middle and retaining ropes
- Omega-Net

				General tolerance:			Scale 1 : 10
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				Exam.	11.02.13	GS	
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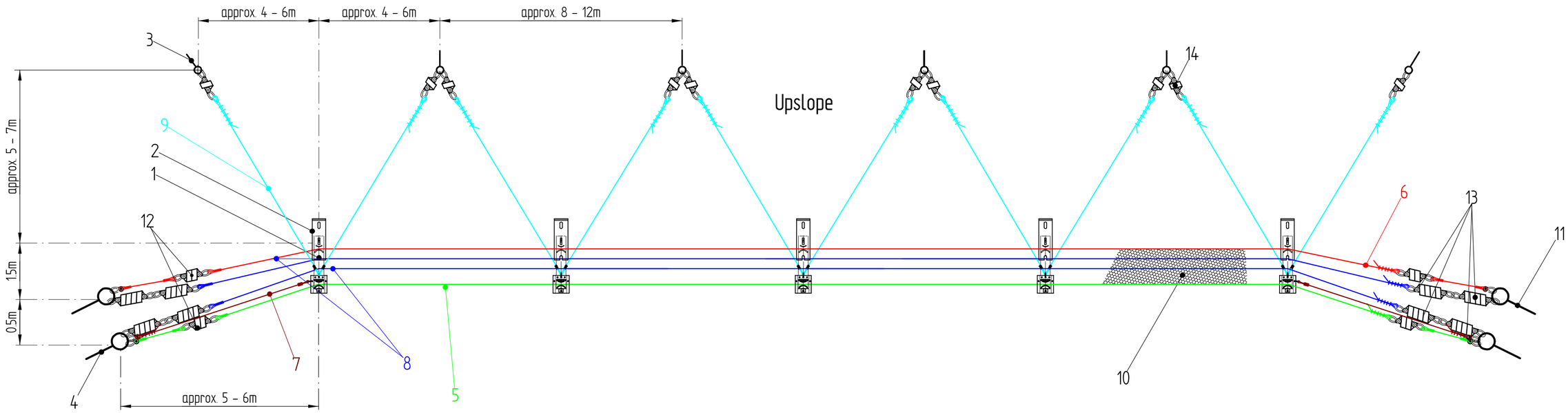
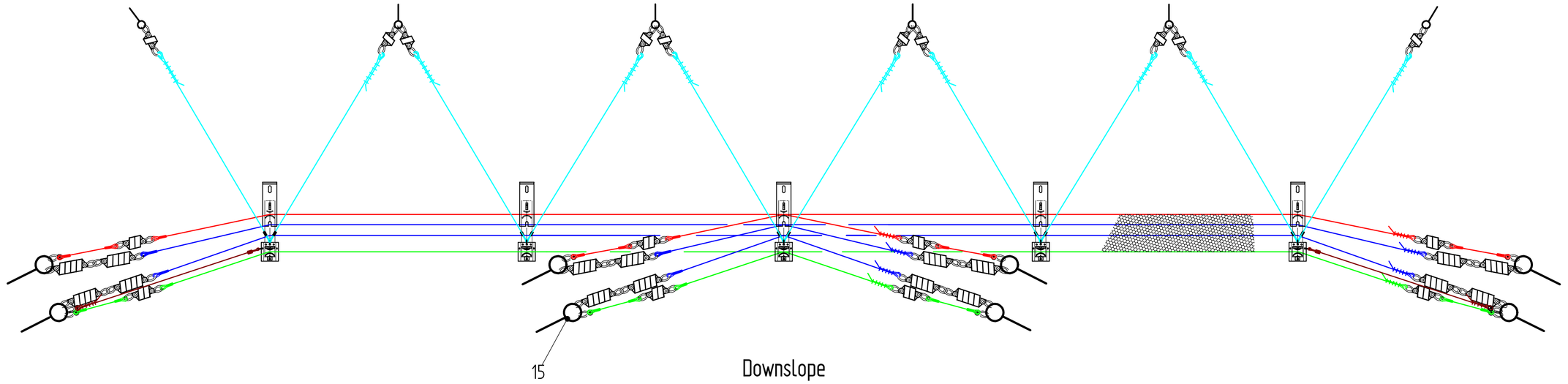
Row without internal anchoring



Row with internal anchoring



Legend

1. Post
2. Base plate
3. Upslope anchor
4. Lateral anchor for upper bearing rope, upper middle rope and side stabilisation rope
5. Upper bearing rope (post head)
6. Lower bearing rope (base plate)
7. Side stabilisation rope
8. Middle ropes
9. Upslope retaining rope (post head)
10. Omega Net 9.0
11. Lateral anchor for lower bearing rope and middle rope
12. Brake element AVT phx 80/30–2.5 for bearing ropes (with rope extension)
13. Brake element AVT phx 2x 60/30–4.5 for middle ropes
14. Brake element AVT phx 60/25–1.5 for upslope retaining ropes
15. Internal anchoring

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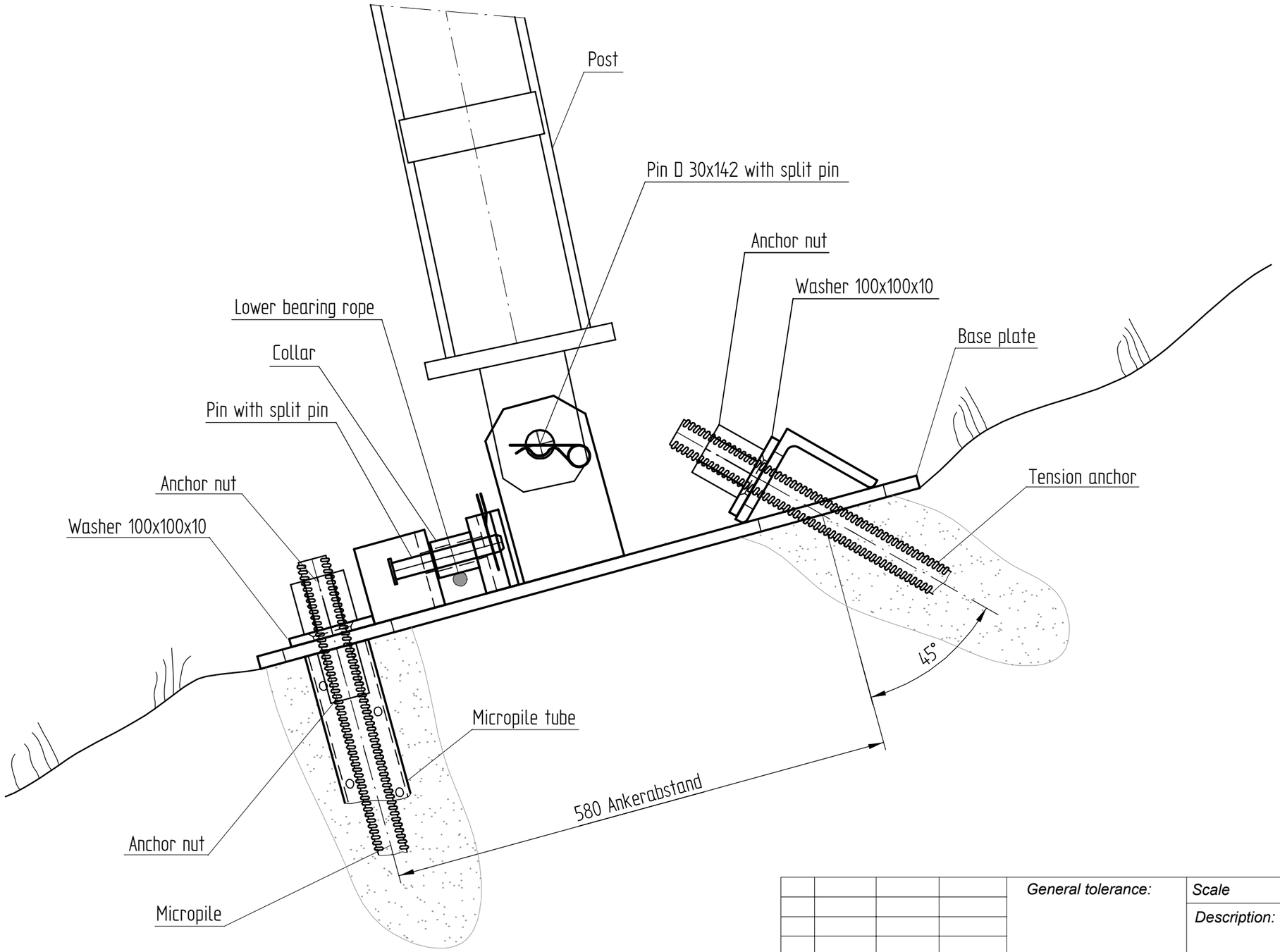

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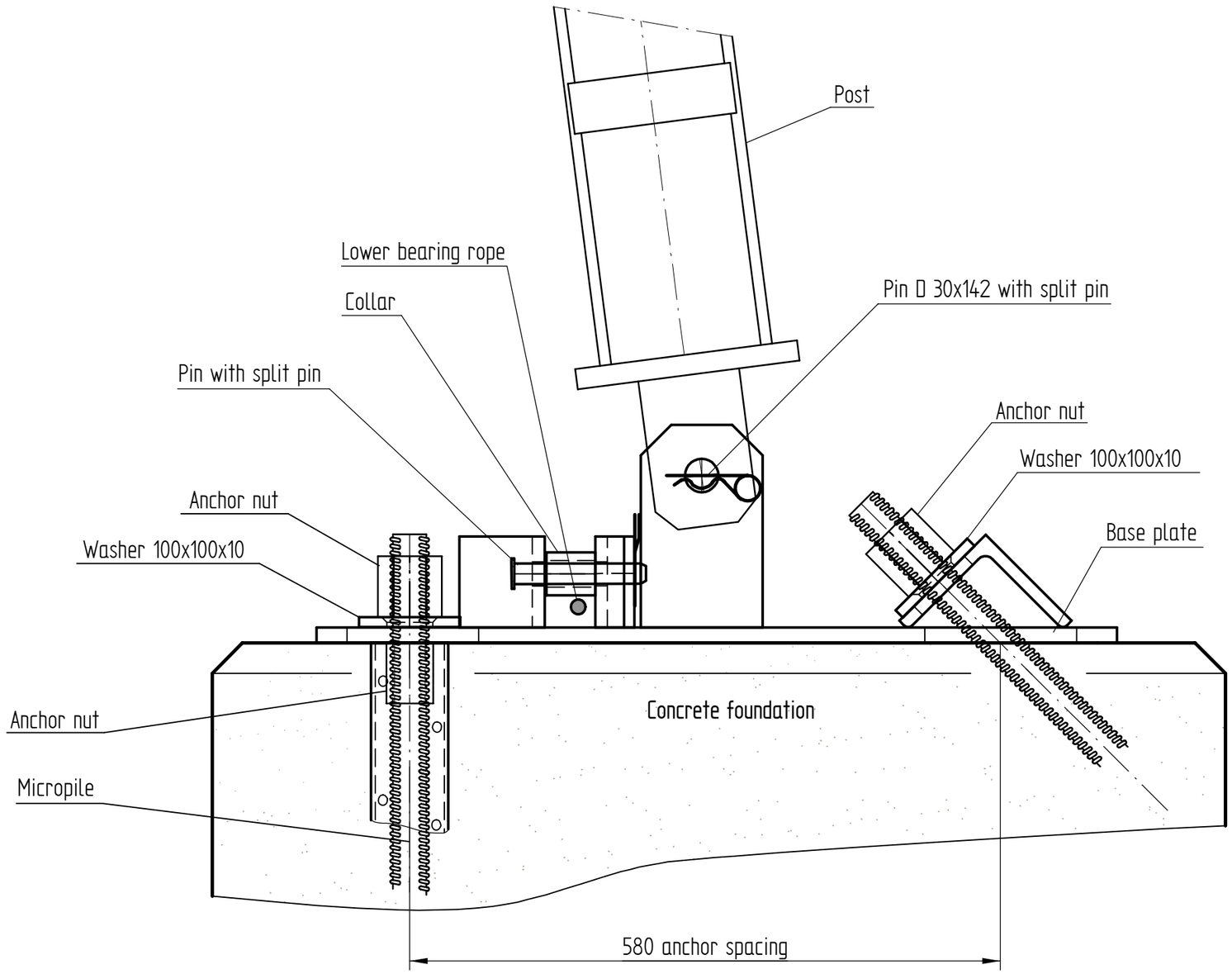

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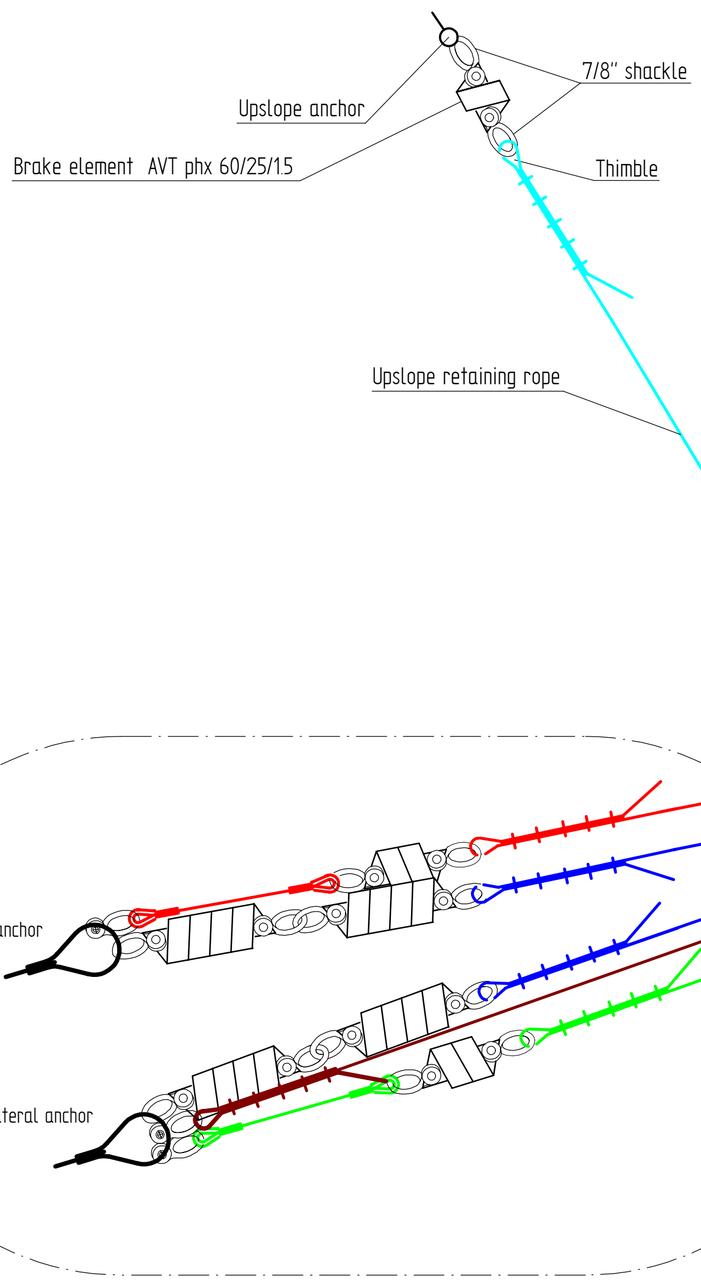
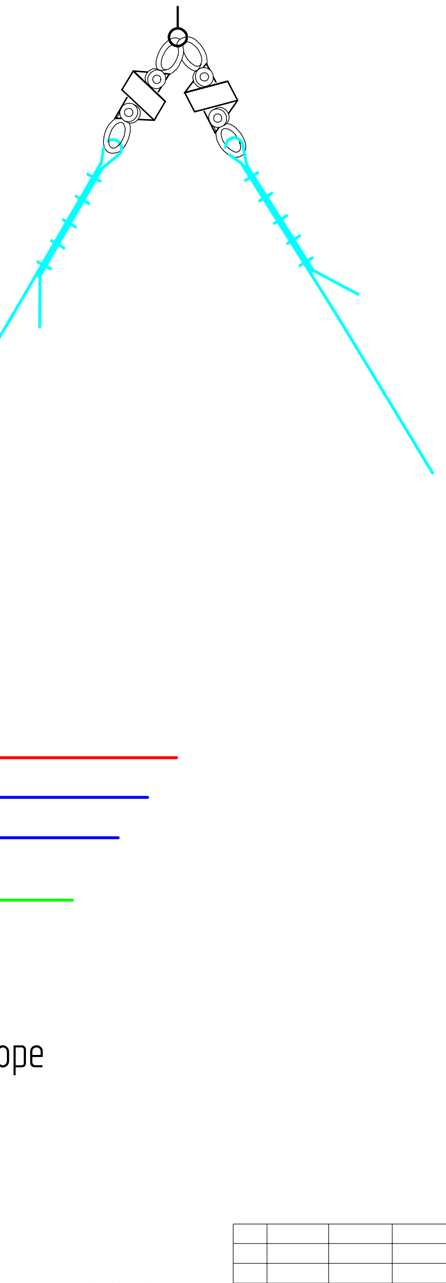
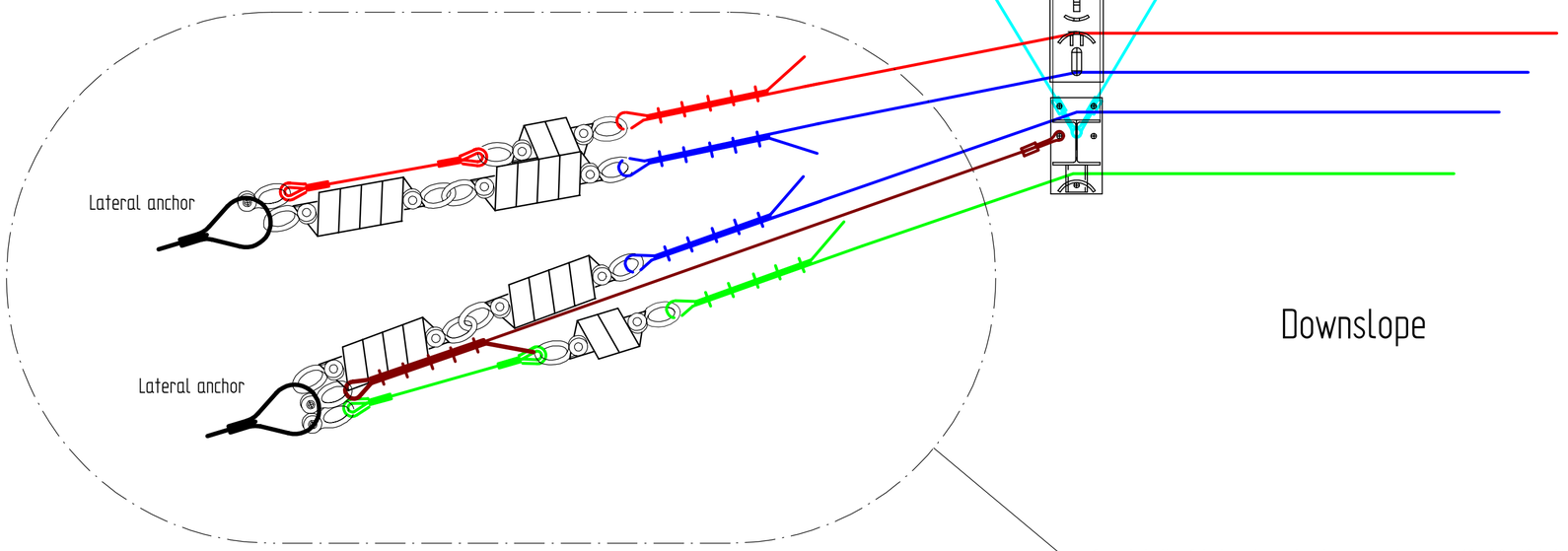
Upslope







Downslope

for detail of lateral anchoring, see dwg. no. 10-00-106-U

Note:
The correct number of wire rope clips is detailed in the provided table and is defined by the diameter of the rope.
In general, thimbles are always used at connection points.

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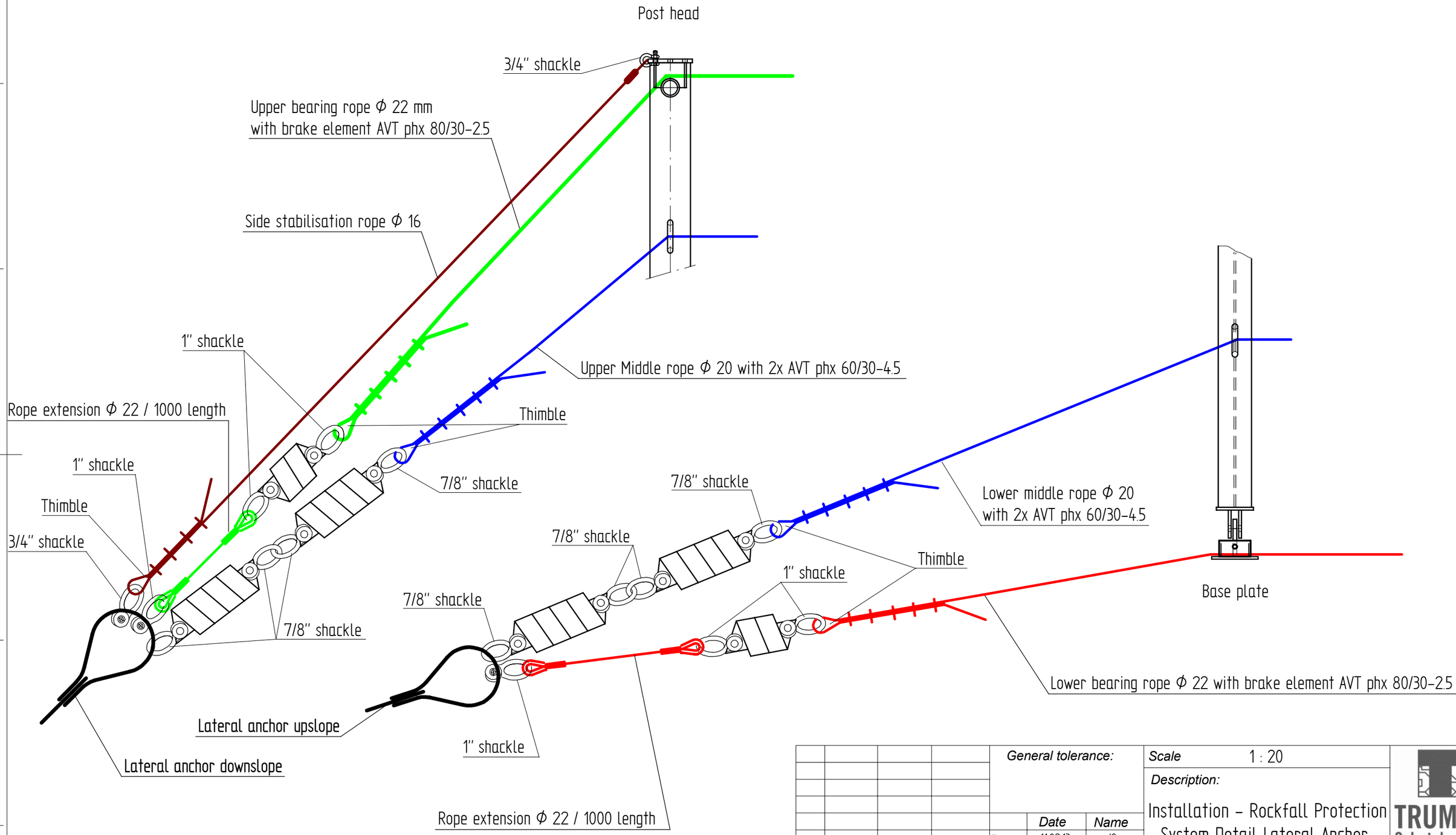

Note:
The correct number of wire rope clips is detailed in the provided table and is defined by the diameter of the rope.
In general, thimbles are always used at connection points.

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General tolerance:

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Raw part:
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Repl. by:

Scale 1 : 20

Description:
Installation - Rockfall Protection System Detail Lateral Anchor TS-2000-ZD

Drawing Nr.:
10-00-106-U

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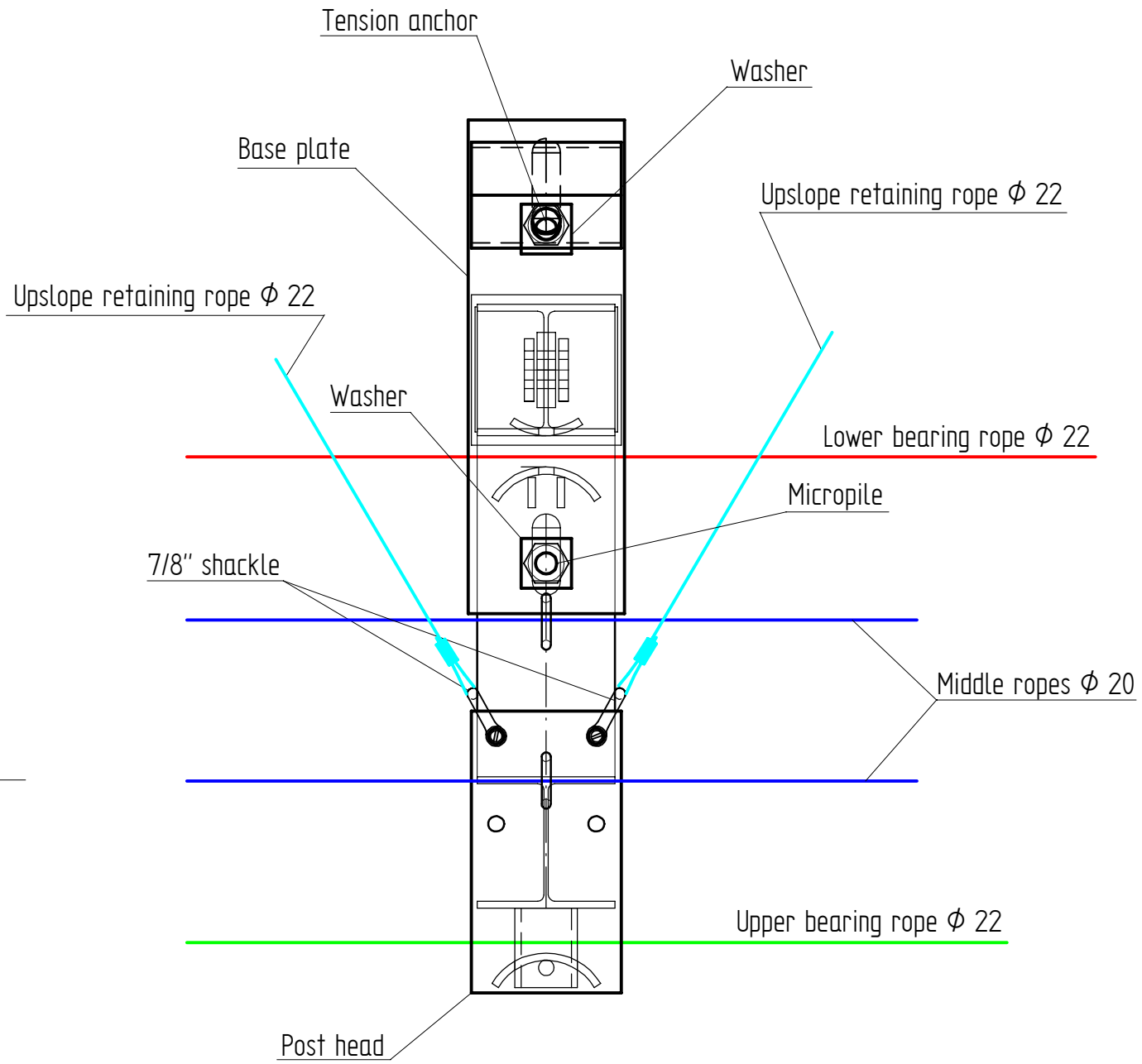

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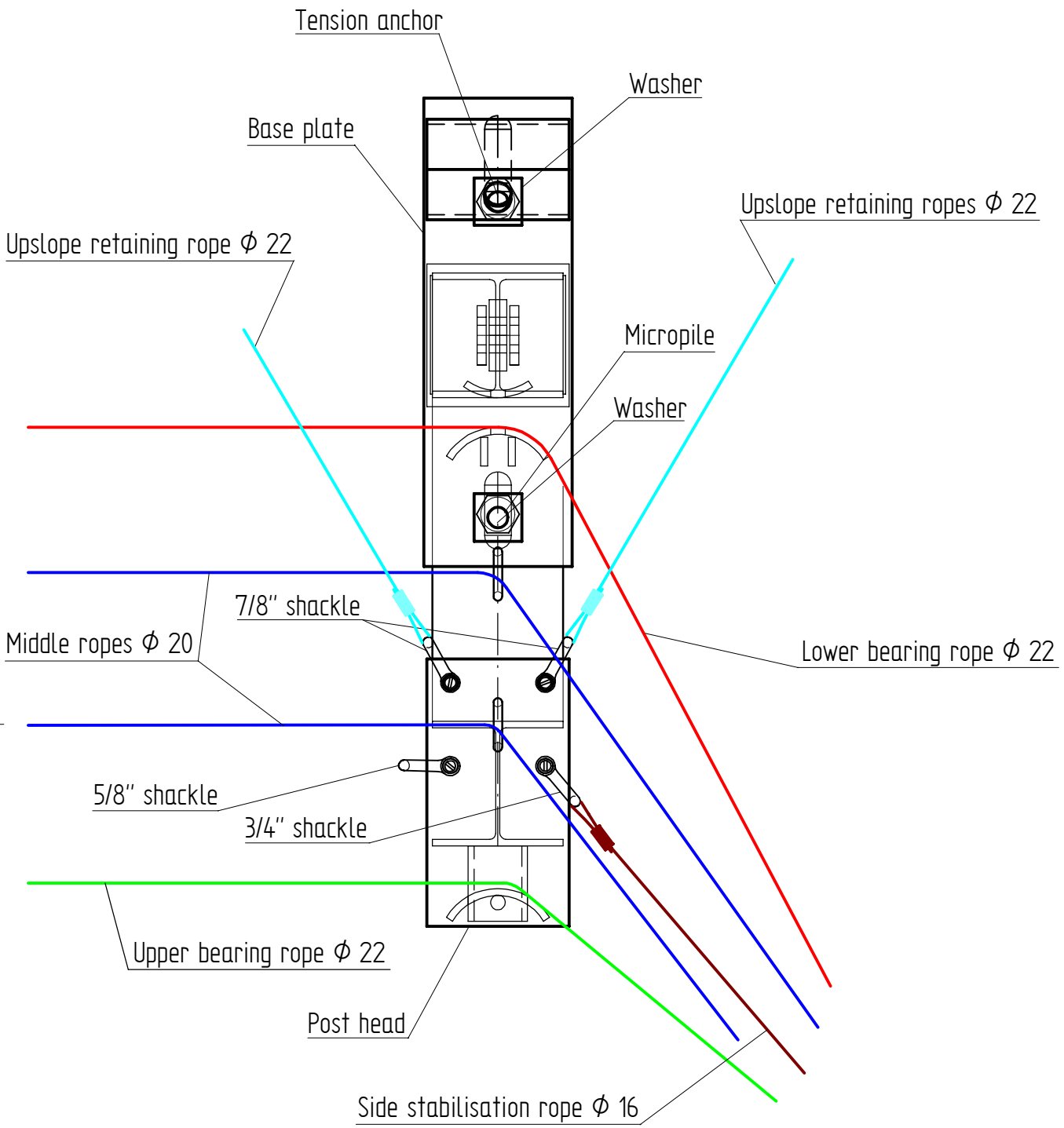

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				Seen			
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Weight				Material:			Drawing Nr.: 10-00-202-U
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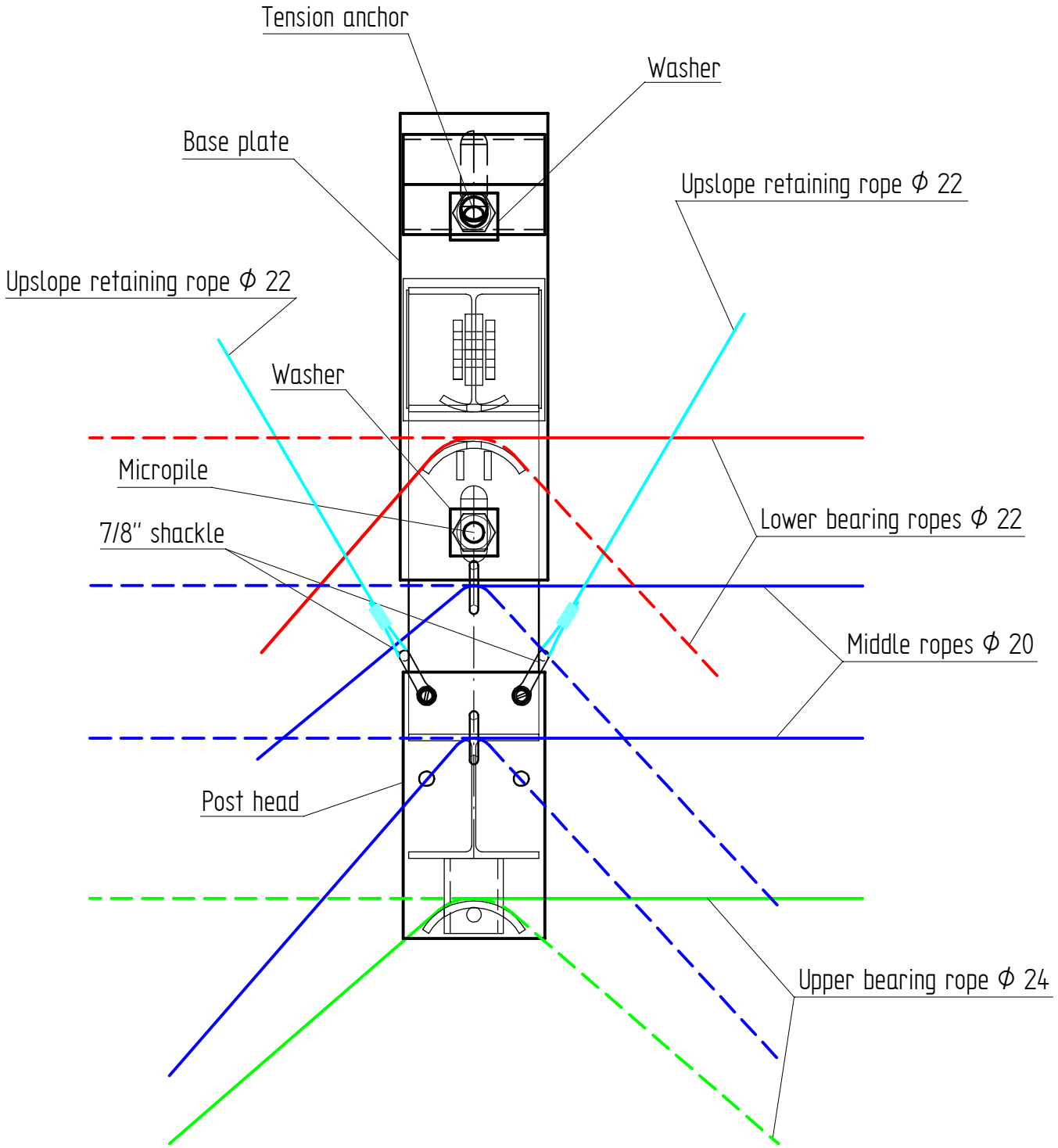

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Prj. No:

Rockfall Protection – Installation of Omega-Net 9.0mm

Each net is marked with coloured paint at one corner. During installation, this marking must have the same orientation with respect to the fence line for each net in order to ensure that they are properly aligned. For example, whether the coloured mark is found at the bottom right of the net as it hangs from the ropes or the top left is unimportant. What does matter is that all of the nets match one another (e.g. they all have the mark at the bottom right or they all have the mark at the top left).

Connecting nets at the end posts

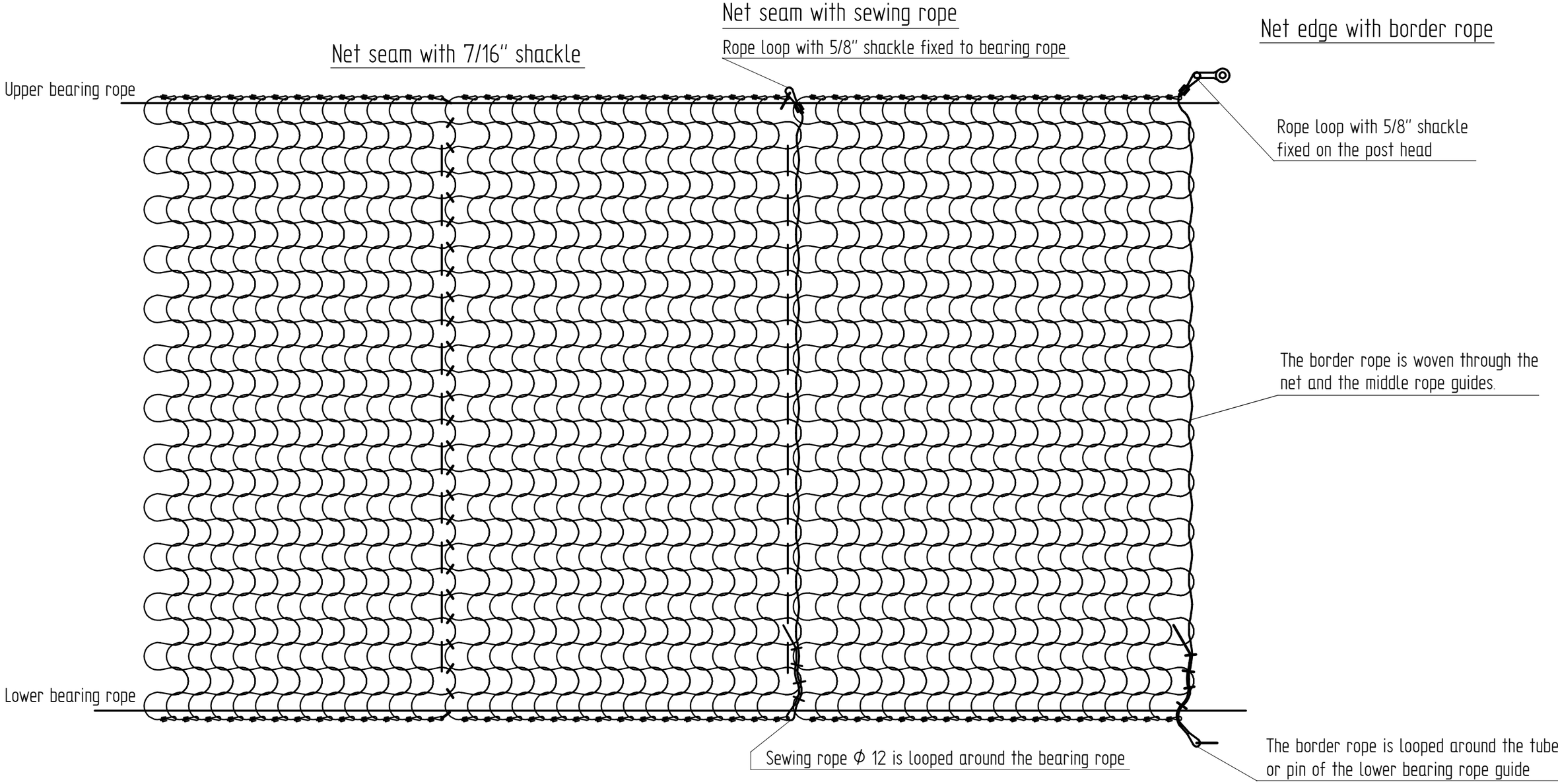
At the outer edges of each row, feed a one-sided pressed sewing/border rope through the Omega-Net and the guides for the middle ropes. At the top, the pressed loop must be fixed at the post head using a 5/8” shackle. At the bottom, the end of the sewing rope must be threaded through the guide of the lower bearing ropes and must be clamped down with wire rope clips.

Connecting adjacent panels

Depending on the type of connection selected for adjacent panels, one of the following methods will apply:

Alternativ A:
Feed a one-sided pressed sewing rope from the top down through both nets. At the top, hang the pressed loop into the upper bearing rope using a 5/8” shackle. At the bottom, the rope must be strapped to the lower bearing rope following the exact same path backwards and then must be clamped down with wire rope clips. It should be loosely mounted with approximately 10 cm leeway.

Alternativ B:
Connect both nets using the appropriate shackle as per attached figure. Two shackles should be used for each rope arc.



Note
The correct number of wire rope clips is detailed in the provided table and is defined by the diameter of the rope connection points.

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				General tolerance:		
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				Raw part:		
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Description:

Installation
Omega-Net 9.0 mm

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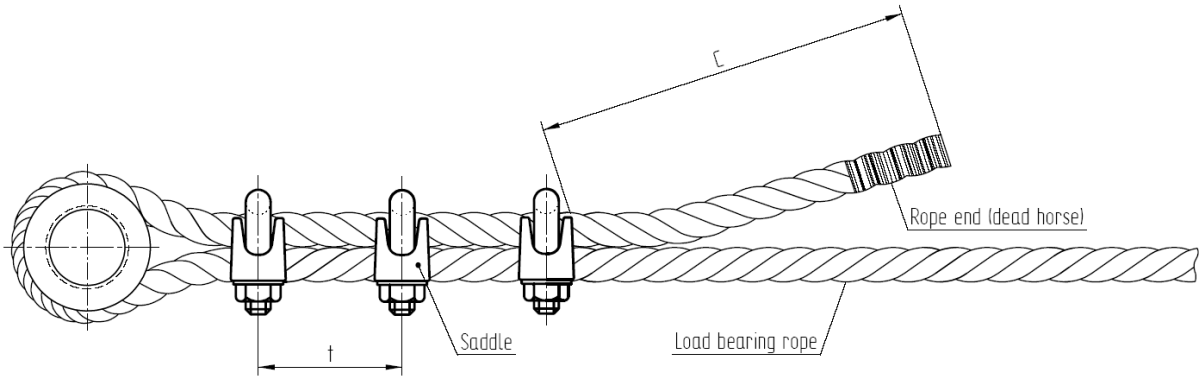
Installation of Wire Rope Clips

All wire rope clips must be visually inspected for defects prior to their use. Any defective clips should be discarded.

The given tightening moments are only valid if the threads and the surface making contact with the nut are greased!

The U-bolts must always be put on over the end of the rope that is not subject to stress (“Never saddle a dead horse “).



Rope Ø mm	Clip Size	Number of Clips	t[1] mm	C mm	Spanner Opening mm	Tightening Moment[2] Nm
3	NG 5	3	20 - 40	40	8	2
4	NG 5	3	20 - 40	40	8	2
6	NG 6,5	3	24 - 48	55	10	3,5
8	NG 8	4	30 – 60	70	13	6
10	NG 10	4	30 - 60	85	13	9
11	NG 12	4	36 - 72	100	16	20
12	NG 12	4	36 - 72	100	16	20
14	NG 16	4	48 - 96	150	21	49
16	NG 16	4	48 - 96	150	21	49
18	NG 19	4	48 - 96	150	21	68
20	NG 22	5	51 - 102	180	24	107
22	NG 22	5	51 - 102	200	24	107
24	NG 26	5	57 - 114	230	30	147

[1] t = Distance between wire rope clips = approx. 1 clip length
[2] Tightening moment is only valid for wire rope clips whose threads and surface making contact with the nut have been greased.

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DBA 300 white
DBA 400 blue
DBA 500 yellow
DBA 600 green
DBA 700 black
DBA 800 orange

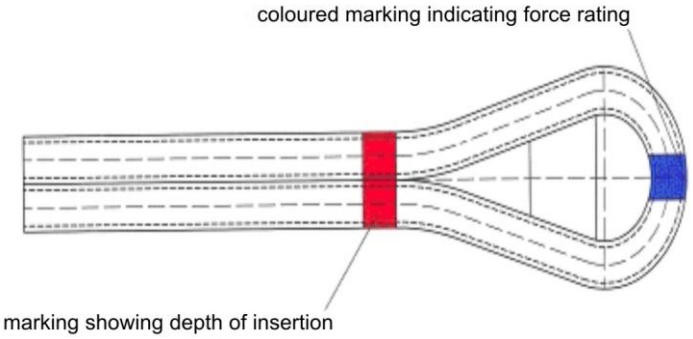

Table of forces

Type	Number of wires Ø 6mm	Cross Section As [mm²]	Mass G [kg/m]	Yield Load Fsk [kN]	Bearing Capacity [1] Rd = Fsk/1.35 [kN]	Break Load Fpk [kN]	Working Load [2] Fpk/2 [kN]
DBA 300	6	170	1,35	258	191	300	150
DBA 400	8	226	1,80	344	254	400	200
DBA 500	10	283	2,20	430	319	500	250
DBA 600	12	340	2,75	517	383	600	300
DBA 700	14	396	3,10	602	446	700	350
DBA 800	16	453	3,55	689	510	800	400

1) Measurement of the bearing capacity for an un-tensioned anchor as according to SIA 267 2003 Geotechnik
2) Working load = half of the braking load as per the “Richtlinien für den Lawinenverbau BUWAL/WSL (1990)“

Mass table

Mass [kg]	Length						
	2 m	**3 m**	**4 m**	**5 m**	**6 m**	**7 m**	**8 m**
DBA 300	8.0	9.5	11.0	12.5	14.0	15.5	17.0
DBA 400	9.0	11.0	13.0	15.0	17.0	19.0	21.0
DBA 500	10.0	12.5	15.0	17.5	20.0	22.5	25.0
DBA 600	11.0	14.0	17.0	20.0	23.0	26.0	29.0
DBA 700	12.0	15.5	19.0	22.5	26.0	29.5	33.0
DBA 800	13.0	17.0	21.0	25.0	29.0	33.0	37.0

Maintenance and Repairs

After the installation of a rockfall protection system, periodic inspection is required to ensure that it is in proper working order. A full visual inspection should be carried on a yearly basis, most appropriately shortly after the freeze-thaw season, at the very minimum. In addition, inspections are recommended following large natural events such as storms, debris flows and avalanches. The following points should be noted during the inspection:

- Net and Mesh:
  - Sag
  - Frayed cables
  - Broken cables
  - Debris build-up in nets requiring clearing
  - Damage to net seams
  - Corrosion

- Bearing, Middle, Retaining and Side Stabilisation Ropes:
  - Rope damage (frayed cables, completely broken, corrosion)
  - Wire rope clips (missing, displaced, cracked, completely broken, corrosion)
  - Shackle (missing, deformed, completely broken, corrosion)
  - Thimble (missing, deformed, completely broken, corrosion)

- Posts and Base Plates:
  - Deformation
  - Damage to rope guides
  - Corrosion

- Brake elements:
  - Stretched
  - Cracked
  - Broken
  - Corrosion

- Anchoring of the Base Plates and Ropes
  - Deformation
  - Failed (completely broken, pulled free)
  - Cracked
  - Corrosion
  - Verformung

Cleaning of the system should be carried out when material such as rock, boulders, windthrow, etc. are in the nets. Damaged components should be replaced with original parts from the manufacturer, Trumer Schutzbauten GmbH.

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Inspection Protocol:

Place/Row:
System:

Date:

Inspected by:

Net and Mesh:

Bearing, Middle, Retaining and Side Stabilisation Ropes:

Posts and Base Plates:

Brake Elements:

Anchors: