GEOBRUGG

TECCO® Avalanche

Product Manual AV-030

Dk = 3.0 / N= 2.5

- Proof of quality assurance / verification of conformity
- Installation guide
- System drawings / stake-out drawings
- ISO 9001 certificate

The Product Manual describes avalanche prevention structures that are in full compliance with the GUIDELINES FOR AVALANCHE PREVENTION IN THE AVALANCHE STARTING AREA, ISSUE 1990, SUPPLEMENTED 2000, produced by the Swiss Federal Institute for Forest, Snow and Landscape (WSL), Birmensdorf, Switzerland; the Swiss Federal Institute for Snow and Avalanche Research (SFISAR), Davos, Switzerland; and SAEFL, Federal Directorate of Forests, Bern, Switzerland.

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FUNCTION AND ORGANIZATION OF THE MANUAL

This product manual ensures that the GEOBRUGG TECCO® Avalanche system for avalanche prevention is installed free from defects in accordance with the latest technology and that the range of applications is clearly defined, the functional efficiency is given, and the installation of the system is professionally carried out and controlled.

THE PRODUCT MANUAL IS DIVIDED INTO THE FOLLOWING SECTIONS:

- Proof of quality assurance / verification of conformity
- Installation guide
- System drawings / stake-out drawings
- ISO 9001 certificate

No claims are made that this document is complete. The manual describes standard applications and does not take into account project-specific parameters. Geobrugg cannot be held liable for any extra costs that may be incurred for special cases. In case of uncertainties, please contact the manufacturer. The General Sales Conditions of Fatzer AG and all its subsidiaries are applicable.

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Romanshorn, February 13, 2006

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(stamp / authorized signatures)

I RANGE OF APPLICATION

The system complies fully with the **GUIDELINES FOR AVALANCHE PREVENTION IN THE AVALANCHE STARTING AREA, ISSUE 1990, supplemented 2000**, from the Swiss Federal Institute for Forest, Snow and Landscape (WSL), the Swiss Federal Institute for Snow and Avalanche Research (SFISAR), 7260 Davos, and SAEFL, Federal Directorate of Forests, 3003 Bern. The release decision documents are attached in the appendix. With respect to the range of application, the guidelines prescribe the following, among other things:

- general conditions
- prevention zones
- types of prevention structures
- configuration of prevention structures

II QUALITY OF THE SYSTEM COMPONENTS

The Geobrugg division of Fatzer AG has been certified since August 22, 1995, in accordance with the **Quality Management System Requirements (ISO 9001: 2000, Rev. 2004), registration no. 11774**. The certifying body is the Swiss Association for Quality and Management Systems (SQS), which belongs to EQ-Net 9000. The quality manual completely specifies how to test the system components (raw material, commercial and end products) comprehensively in order to exclude deficiencies in quality. The relevant certificates are attached as appendices.

III FUNCTIONAL EFFICIENCY OF THE PREVENTION SYSTEMS

The functional efficiency of the system is based on the static calculations specified in the **GUIDELINES FOR AVALANCHE PREVENTION IN THE AVALANCHE STARTING AREA, ISSUE 1990, supplemented 2000** of the Swiss Federal Institute for Forest, Snow and Landscape (WSL), Swiss Federal Institute for Snow and Avalanche Research (SFISAR), 7260 Davos and SAEFL, the Swiss Federal Directorate of Forests, 3003 Bern.

IV QUALITY CONTROL FOR THE INSTALLATION

The product manual describes in detail the different steps for installation of the snow net structures. Local building contractors must faithfully follow these steps. The installation guide is based on the **GUIDELINES FOR AVALANCHE PREVENTION IN THE AVALANCHE STARTING AREA, ISSUE 1990, supplemented 2000** of the Swiss Federal Institute for Forest, Snow and Landscape (WSL), Swiss Federal Institute for Snow and Avalanche Research (SFISAR), 7260 Davos and SAEFL, the Swiss Federal Directorate of Forests, 3003 Bern.

V PRODUCT LIABILITY

Rockfall, landslides, debris flows or avalanches are sporadic and unpredictable. The cause is human (buildings, etc.), for example, or forces beyond human control (weather, earthquakes, etc.). The multiplicity of factors that may trigger such events means that guaranteeing the safety of persons and property is not an exact science.

However, the risks of injury and loss of property can be substantially reduced by appropriate calculations that apply good engineering practices, and by using predictable parameters along with the corresponding implementation of flawless protective measures in identified risk areas.

Monitoring and maintenance of such systems are an absolute requirement to ensure the desired safety level. System safety can also be diminished through events, natural disasters, inadequate dimensioning or failure to use standard components, systems and original parts, but also through corrosion (caused by environmental pollution or other man-made factors as well as other external influences).

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Design

The system is designed in accordance with the guidelines of the SFISAR concerning permanent supporting structures, using the following standard parameters:

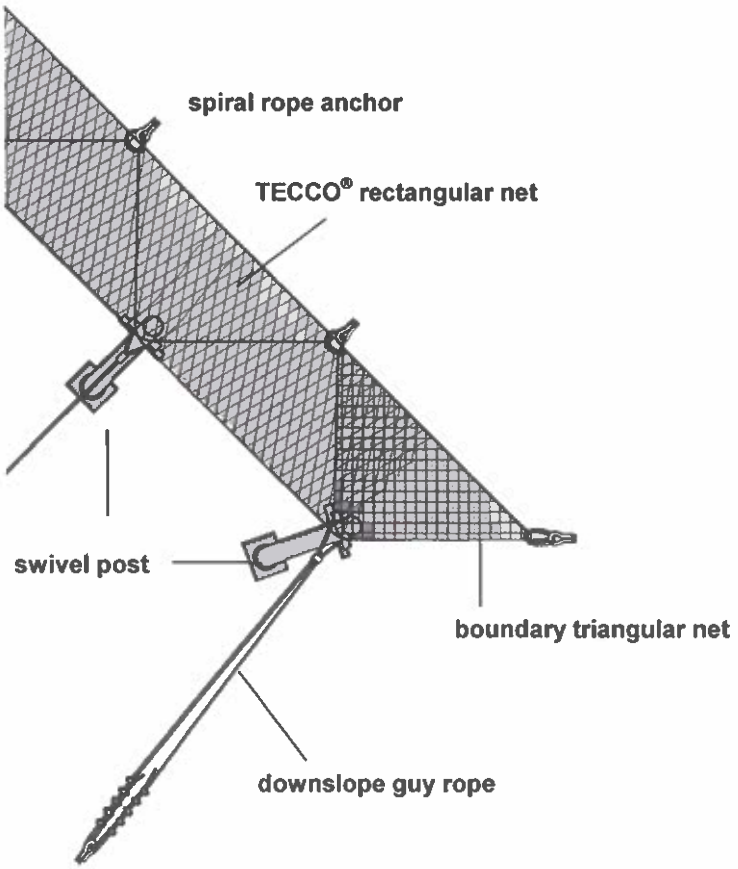
- N = 2.5 glide factor
- fc = 1.1 height factor
- ψ = 45° slope angle

The design is based on a modular system. Any number of units (sections) can be arranged in a row to suit the structure of the terrain. Essentially two sections consist of:

- 2 swivel posts
- 1 TECCO® rectangular net
- 1 boundary triangular net

Each additional appended section requires:

- 1 swivel post
- 1 TECCO® rectangular net



The nets suspended on the posts form the support surface against the snow.

1.2 Size

We differentiate the systems according to snow thickness Dk and glide factor N.

Snow thickness Dk	Glide factor N	System drawing
3.0 m	2.5	GL-1021

The appropriate stake-out kit for this system must be used.

1.3 Forces

The forces on a fully loaded snow net are very great. This requires that the anchoring and installation work be carried out carefully.

Attention: For slope angles > 45° it is absolutely mandatory to first contact Fatzer AG GEOBRUGG!

The forces in detail are found in the system drawings (see appendix).

2 RECOMMENDED INSTALLATION TOOLS

stake-out

- tape measure 20 to 50 m
- 2 meter folding rule
- 5 red-white surveyor's pegs
- inclinometer
- spray paint
- small wooden or iron pegs (min. 3 pegs per section)
- hammer
- stake-out rope kit for corresponding Dk system of wire ropes
- manual

installation

- fork or ring wrench (US)/spanner (UK) SW 17-24
- socket wrench set with ratchet (Knarre)
- torque wrench SW 17-24
  range 40-120 Nm (required torque)
- fork wrenches of appropriate SW for anchor nuts:
  GEWI 28 --> SW 46
  GEWI 32 --> SW 50
  GEWI 40 --> SW 60
  anchor head -->SW 70
- wire rope cutters Felco C16 or C112;
  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
- roll of adhesive tape

Manual installation	Installation with helicopter
• 10 fiber ropes Ø 10 mm, ca. L = 10 m for securing posts against sliding off	• 1 flying kit per flying unit in accordance with drawing GL-8008 consisting of - GL-8008.01/.02 helicopter suspension gear - GL-8003 suspension gear, pluggable - GL-8004 suspension gear, fixed - GL-8007 suspension rope - GL-8006 safety rope
• 4 - 8 wooden supports	• timber beams (1 per post)

3 STAKE-OUT

3.1 Coarse stake-out

The **Guidelines for Avalanche Prevention in the Avalanche Starting Area, Issue 1990, supplemented 2000, from SAEFL and WSL, Form. 310.021** must be adhered to for the arrangement of the lines of structures, their lengths and their spacing in the fall line. The guidelines are available from the Swiss Federal Printing and Supplies Office (EDMZ), CH-3000 Bern.

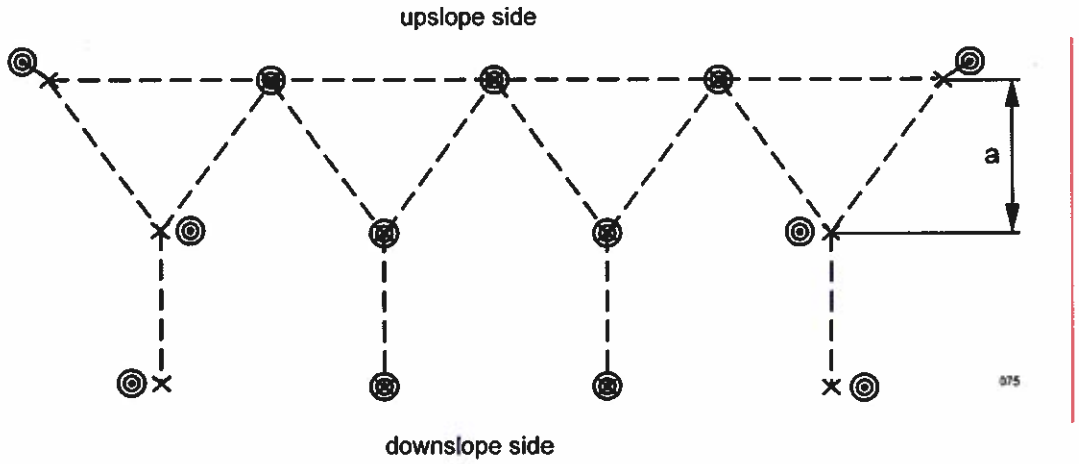
The coarse stake-out serves to finalize the positions and dimensions of all snow nets, taking into consideration the shape of the terrain and the design fundamentals. It is best to mark the beginning and end of every structure with stakes or paint, whereby the length of the structure is a multiple of the distance between posts. It is advantageous to mark the line of the post foundations. This line must be a contour line.
It is recommended to prepare a narrow track along the contour line of the post foundations to facilitate the stake-out, drilling and installation work.

An uninterrupted and straight line of structures with as few bends as possible should be chosen. In principle the length of the structure is identical with the basic length and a multiple of the net width.

Rugged terrain results in structures with bends. In case of sharp bends (as a rule more than 15°) the line of structures should be interrupted.

3.2 Detailed stake-out

The detailed stake-out is done with the stake-out rope kits and the stake-out drawing GL-3009.



If the post foundations are on crooked or curved lines, the points from the stake-out drawing are corrected on the basis of the correction drawings GL-3007/3008 and their enclosures.

X = theoretical points

◎ = actual drilling points; mark with stakes or paint

Distance a must be understood as a minimum distance. As a rule, it is recommended to shift the anchor points upwards by **20 to 30 cm**.

3.3 Stake-out ropes and stake-out drawing

The appropriate stake-out rope (part of the scope of supply) must be used, and the appropriate stake-out drawing as well as correction drawings GL-3007/3008 (see appendix), if applicable, with the related enclosures, must be used.

The stake-out ropes are marked at the press sleeves with the snow thickness Dk and if necessary the glide factor N.

Type	Stake-out drawing	Correction tables for correction drawings GL-3007/3008
Dk = 3.0 / N=2.5	GL-3009	GL-3005

⚠ Other stake-out and correction measurements apply for slope angles greater than 45°. In such cases a stake-out should only be carried out after consultation with GEOBRUGG. In some situations it may be necessary to use longer posts .

3.4 Stake-out procedure

Starting from the root line of the structure's posts (coarse stake-out line), the prescribed distances between base plates are measured exactly and each marked with a wooden stake (or a spot of paint on rocky ground). Measuring from these points with the stake-out rope, the positions of the upslope anchors are each also marked with a wooden stake/spot of paint. The downslope anchor points are then staked out.

In accordance with the appropriate stake-out drawing, the boundary posts and upslope and downslope boundary anchors are corrected inwards or outwards, respectively, in the direction of the structure line.

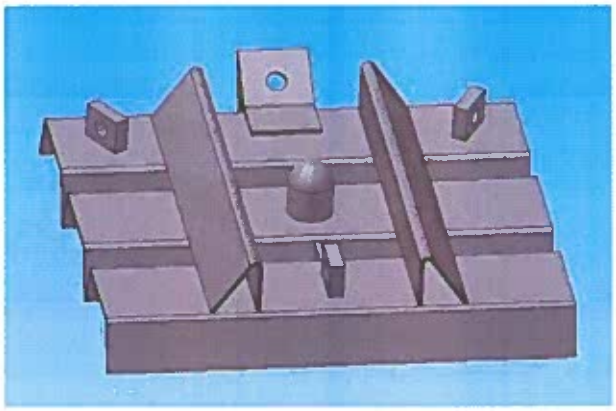
4 DRILLING AND FOUNDATION WORK

4.1 Preparatory work

Unless already done before staking out, clearing is necessary to remove scree and rubble from the rocky area.

4.2 Base plate for swivel posts

Using a specially developed base plate it is possible to transfer the forces from the post into the ground without an anchor. This method is suitable for the most varied subsoil conditions, such as permafrost, for example. The post can be repositioned later by means of the fixing ropes.



Base plate for swivel post

Installed base plate for swivel post with fixing ropes and post

The base plate is placed on as even a surface as possible with an inclination of ca. 15° to the slope. It is fixed with two upslope guy ropes to the upslope rope anchors (see figure A).

The base plate at the boundary post must be aligned at an angle of 12° - 15° outwards (in the direction of the forces).

Note that the post must be perpendicular to the base plate as nearly as possible. The angle between post and perpendicular axis may be at most 10 ° in all directions (see figure A).

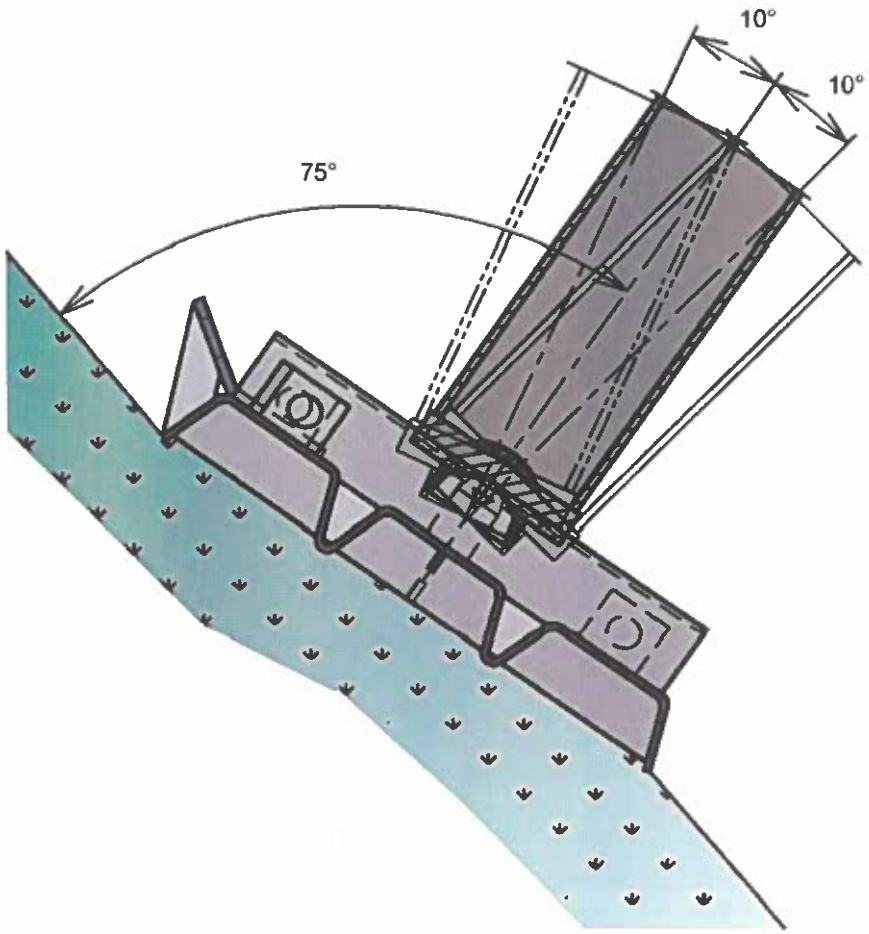


Figure A

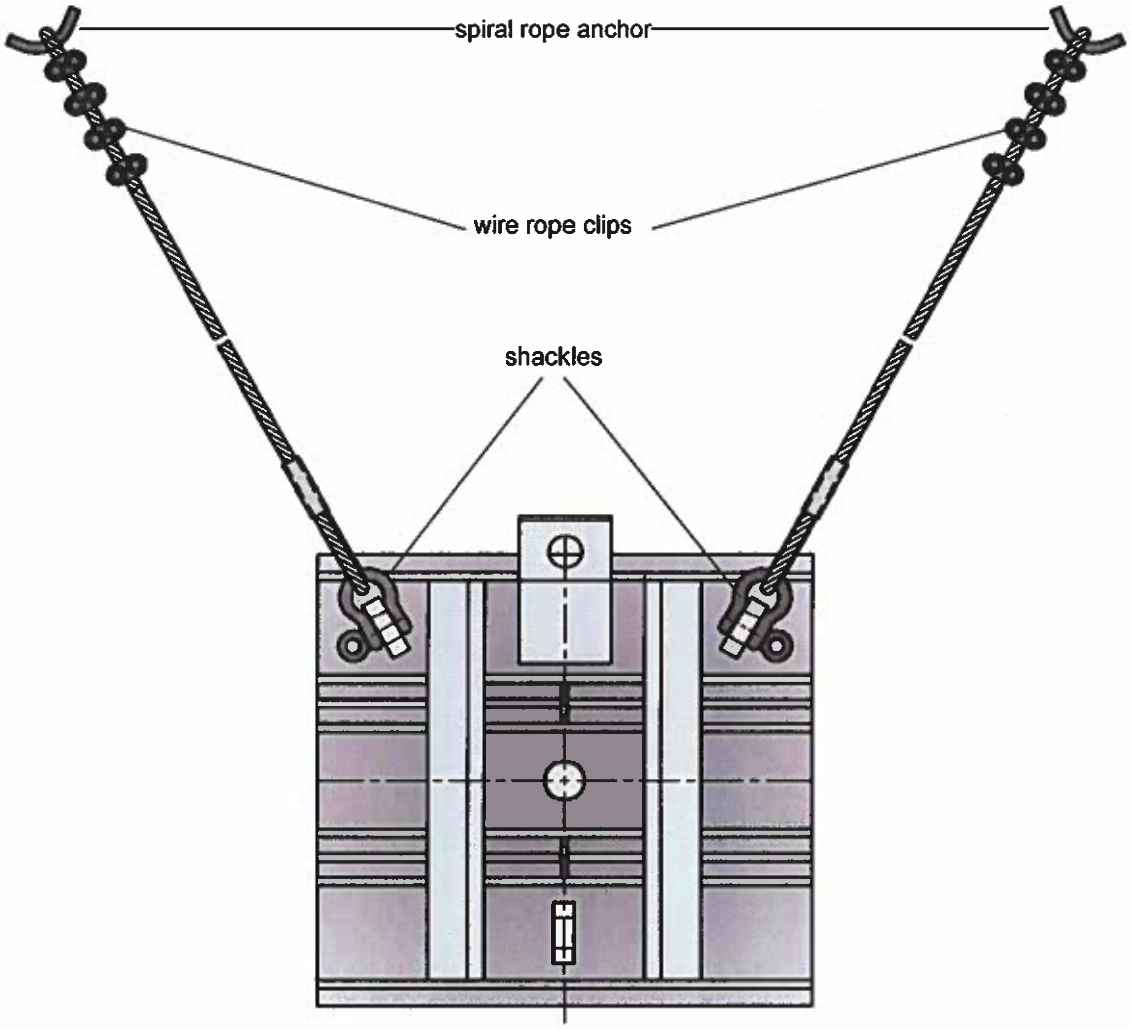
4.2.1 Base plate dimensions

Two sizes of base plate will be needed to fit the different sections.

Designation	Size	Ultimate load for ground pressure of 500 kN/m²
Base plate medium	750 x 800 mm	F < 300 kN
Base plate large	900 x 900 mm	F < 405 kN

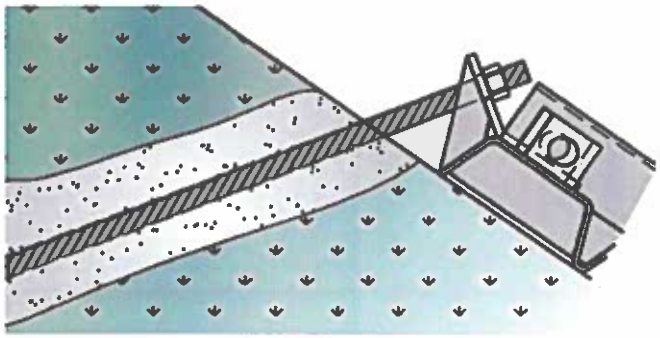
4.2.2 Suspension/fastening dimensions

In most cases the base plate will be fixed to the upslope rope anchors with two ropes in a V-shape.

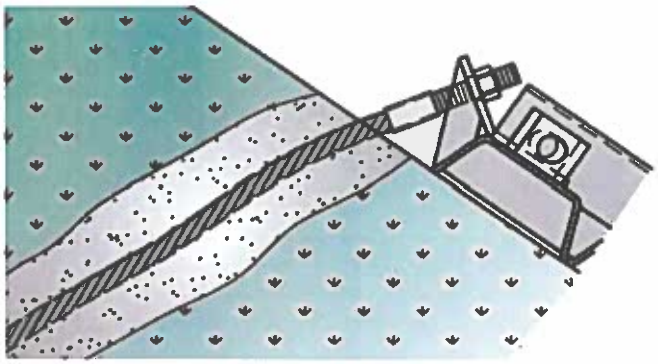


Variant A: base plate with guy rope

If necessary the base plates can be fixed with GEWI or rope anchors instead of guy ropes.



Variant B: GEWI- anchor



Variant C: rope anchor

Designation	Variant guy rope	Variant GEWI anchor	Variant rope anchor
Base plate medium	rope Ø 12 mm, L = 6.50 m, 4 DSK NG 13, shackle 5/8"	Ø 25	Ø 16
Base plate large	rope Ø 14 mm, L = 7.00 m, 4 DSK NG 16, shackle 3/4"	Ø 28	Ø 20

4.2.3 Base plates range of application

Only one size of base plate are needed for the structure type Dk=3.0 N=2.5. The following table gives an overview of the plates to be used:

Base plate for swivel post	
Dk = 3.0	
N = 2.5	
Base plate medium	MF/RF/WF

RF = boundary section

WF = end section

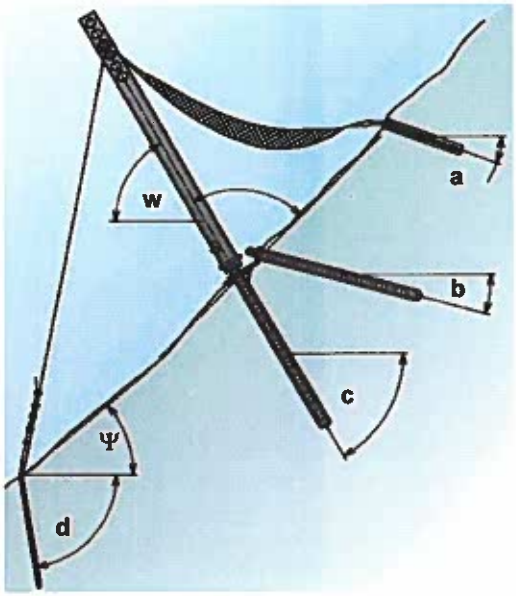
MF = intermediate section

4.3 Post anchorages with drilling

It is advantageous to install the post anchorages first.

The minimum borehole diameters must be taken from the system drawings.
The minimum diameters are governed by the guidelines.

⚠ For slope angles ψ to 45° angle s = 75°.
For slope angles ψ greater than 45° angle s = 70°.

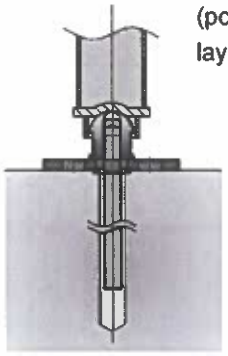


Slope angle	Struct. angle	Anchor a	Anchor b	Anchor c	Anchor d
ψ	w	a	b	c	d
30 °	75 °	15 ° - 30 °	30 °	75 °	75 ° - 80 °
31 °	74 °	15 ° - 29 °	29 °	74 °	76 ° - 81 °
32 °	73 °	15 ° - 28 °	28 °	73 °	77 ° - 82 °
33 °	72 °	15 ° - 27 °	27 °	72 °	78 ° - 83 °
34 °	71 °	15 ° - 26 °	26 °	71 °	79 ° - 84 °
35 °	70 °	15 ° - 25 °	25 °	70 °	80 ° - 85 °
36 °	69 °	15 ° - 24 °	24 °	69 °	81 ° - 86 °
37 °	68 °	15 ° - 23 °	23 °	68 °	82 ° - 87 °
38 °	67 °	15 ° - 22 °	22 °	67 °	83 ° - 88 °
39 °	66 °	15 ° - 21 °	21 °	66 °	84 ° - 89 °
40 °	65 °	15 ° - 20 °	20 °	65 °	85 ° - 90 °
41 °	64 °	15 ° - 19 °	19 °	64 °	85 ° - 90 °
42 °	63 °	15 ° - 18 °	18 °	63 °	85 ° - 90 °
43 °	62 °	15 ° - 17 °	17 °	62 °	85 ° - 90 °
44 °	61 °	15 ° - 16 °	16 °	61 °	85 ° - 90 °
45 °	60 °	15 °	15 °	60 °	85 ° - 90 °
46 °	64 °	15 °	19 °	64 °	85 ° - 90 °
47 °	63 °	15 °	18 °	63 °	85 ° - 90 °
48 °	62 °	15 °	17 °	62 °	85 ° - 90 °
49 °	61 °	15 °	16 °	61 °	85 ° - 90 °
50 °	60 °	15 °	15 °	60 °	85 ° - 90 °
51 °	59 °	15 °	14 °	59 °	85 ° - 90 °
52 °	58 °	15 °	13 °	58 °	85 ° - 90 °
53 °	57 °	15 °	12 °	57 °	85 ° - 90 °
54 °	56 °	15 °	11 °	56 °	85 ° - 90 °
55 °	55 °	15 °	10 °	55 °	85 ° - 90 °

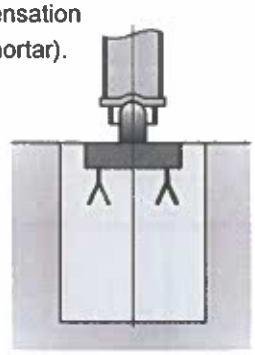
⚠

4.3.1 Anchorage type matched to soil condition

Plate must lie flush with rock (possible compensation layer of high quality mortar).

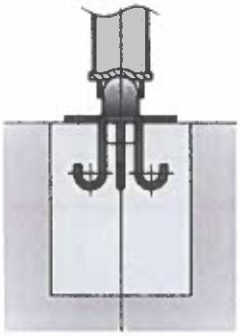


Var. 1
Anchorage in rock



base plates type
Dk = 2.0 - 2.5

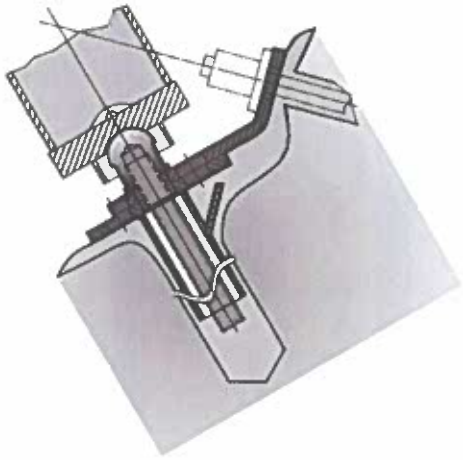
Var. 2a
Anchorage in concrete



base plates type
Dk = 3.0 - 4.5

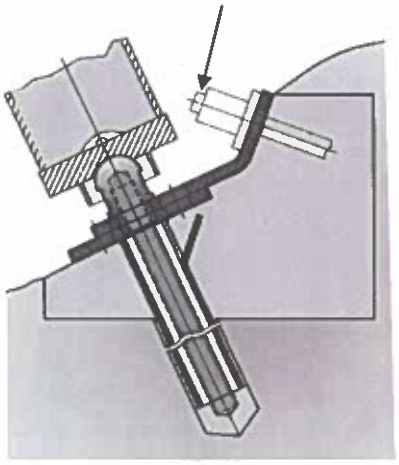
Var. 2b
Anchorage in concrete

Important before installation: cut off excess anchor end.



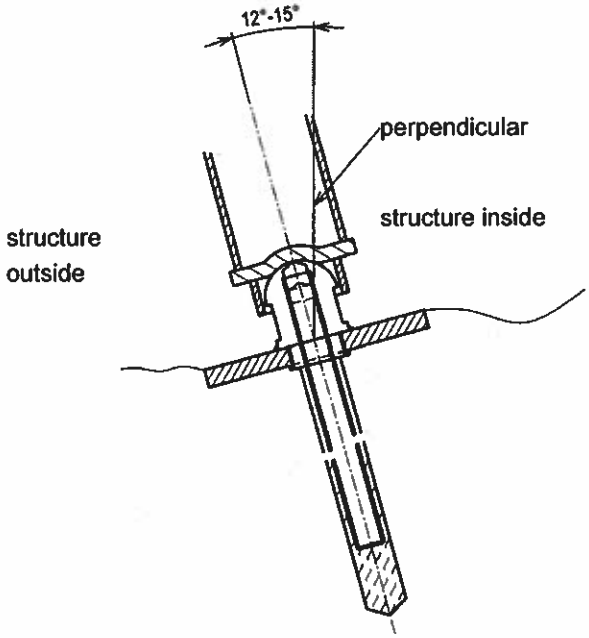
Var. 3a
Anchoring in loose rock with anchor forces up to 350 kN with micro pile, supporting tube and tie rod

Important before installation: cut off excess anchor end.



Var. 3b
Anchoring in loose rock with anchor forces over 350 kN with micro pile, supporting tube and tie rod and concrete foundation

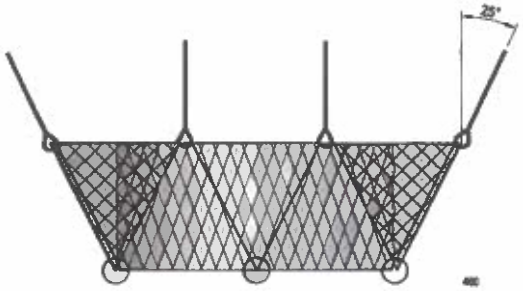
4.3.2 Drill axis of the boundary posts



The boundary post base plates must be inclined an additional 12° - 15° **outwards**. Valid for all types of anchorage

Important: The anchor head must be screwed fast to the GEWI anchor (fork wrench SW 70). The anchor mortar must first be cured for at least 3 days.

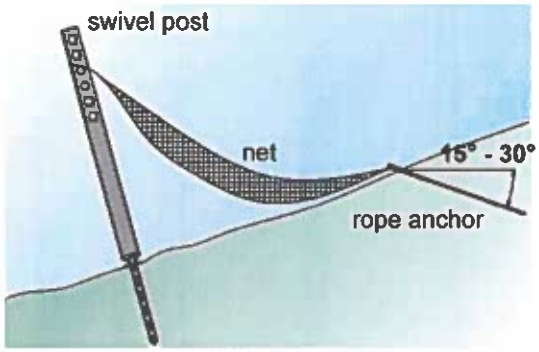
Upslope anchorages



It is compulsory to use the flexible GEOBRUGG spiral rope anchors for the upslope anchorages.

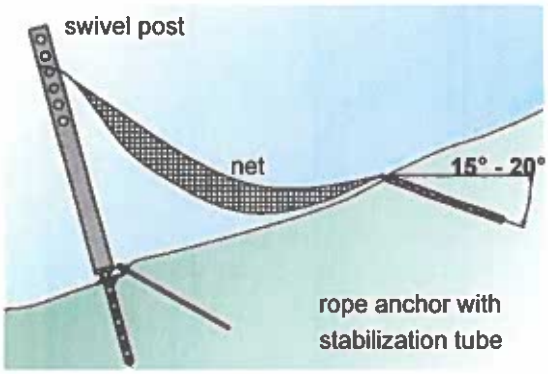
Drill axis for the boundary anchors

The boundary anchors should be drilled at an angle of 25° to the outside with respect to the fall line.



Drill axis in rock

In rock the anchors must be positioned at a 15°-30° incline in relation to the horizontal plane.
(as per table on page 15, but at least 15°)

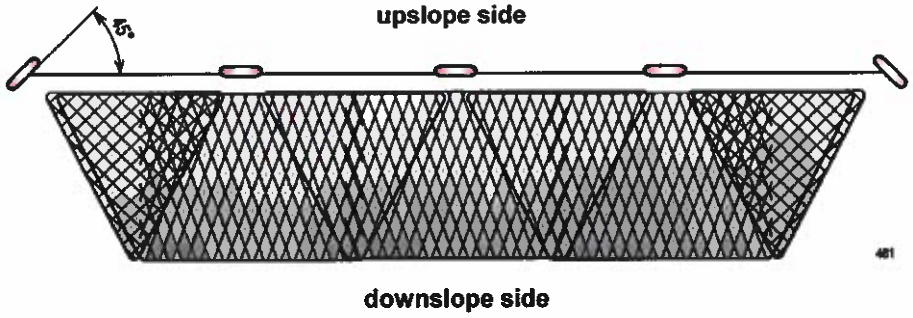


Drill axis in loose rock

In loose rock a stabilization tube is also needed. The anchors must be positioned at a 15°-20° incline in relation to the horizontal plane.
(as per table on page 15, but at least 15°)

4.3.3 Installation of the rope anchors

The loops of the rope anchors must be aligned horizontally!
The anchor loop of the boundary anchor is offset 45° to the contour line (exception: horizontal position for twin anchors).



4.3.4 Loose rock

After installing the stabilization tube, insert the spiral rope anchor and the injection lance together into the borehole and then fill it with mortar.

4.3.5 Rock

All boreholes must be well blown out with compressed air (rainwater, dirt) before introducing the anchor mortar. Only then can the anchor be inserted.

See page 18

4.4 Downslope anchorages

For the downslope anchorages also use only spiral rope anchors.

Note system drawing and page 15

Drill axis in rock: vertical or 5° upslope (not at a right angle to the slope!)
Drill axis in loose rock: in pulling direction of the rope fastening or at a right angle to the slope. By also installing a stabilization tube (expanded metal) the transverse forces parallel to the slope will be absorbed.

Installation of rope anchors (downslope)

5 INSTALLATION WORK

5.1 Preparatory work

At the building site, the anchor loops and base plate heads must be cleared of any material or stones, and the mortar must be cured. The differentiation and identification of the swivel posts and nets occur in accordance with the table on page 20. Wire rope clips and needed tools must be available at the building site. **A helmet must be worn** on the building site as well as the preparation area during installation with the helicopter.

5.2 Differentiation between swivel posts and nets

(classification as per the system drawings)

Dimensions		Tube outer diameter	Length mm incl. base plate	Marking at head of post	Marking of the nets
Dk 3.0	WF	Ø 168.3 mm	3684	blue / yellow	R
N = 2.5	MF/RF	Ø 159.0 mm	3684	red / yellow	Z

R = boundary triangular net **Z** = TECCO® rectangular net

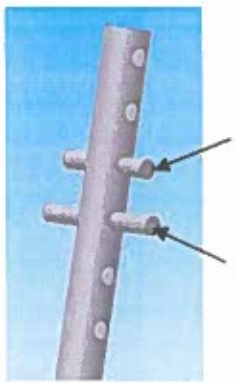
The **stake-out rope** is marked on the press sleeve with the snow thickness Dk.

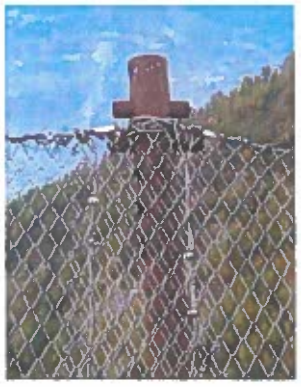
5.3 Manual installation

5.3.1 Position of the pegs

As a rule the pegs are to be inserted into the two middle holes. The longer peg (bottom) serves for bearing, while the shorter one (top) secures the nets and the guy ropes.
The shorter (top) tube is only inserted after completion of the installation.

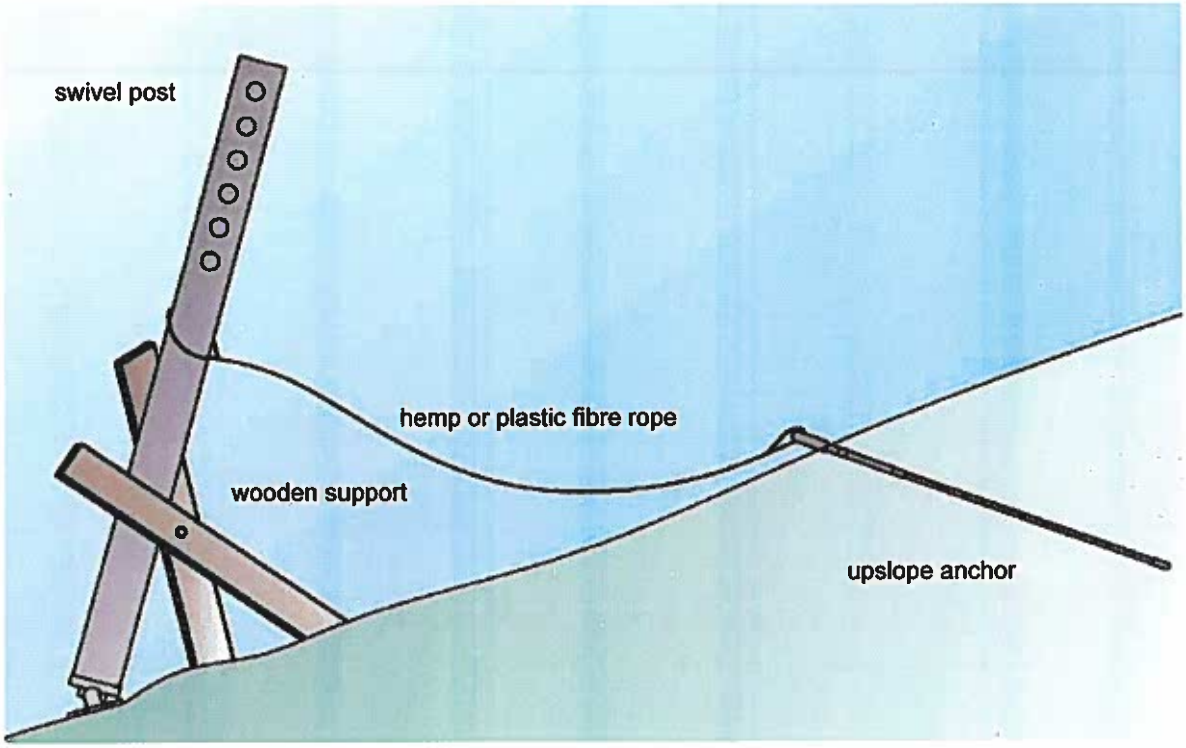
middle position



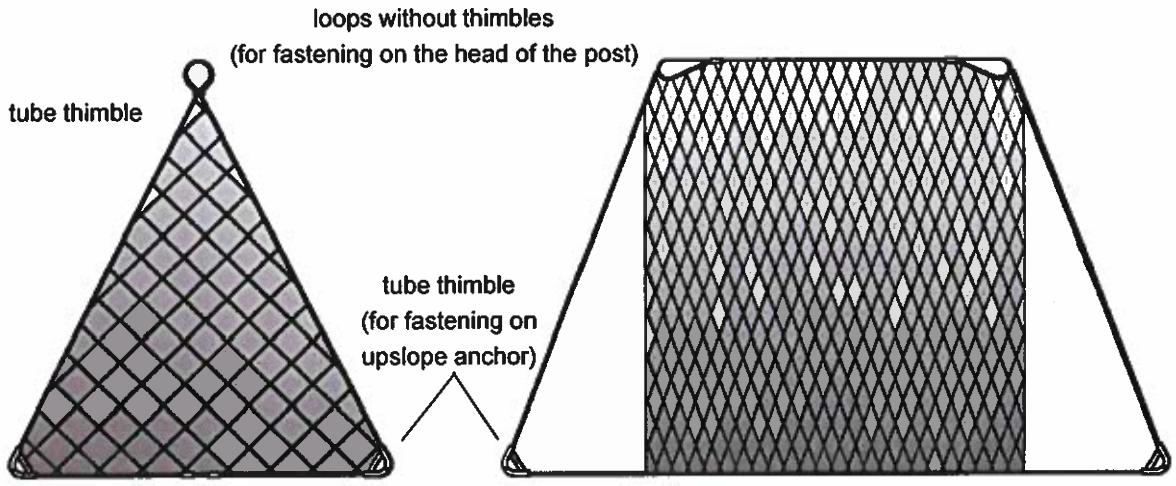


5.3.2 Installing the posts

Deposit the swivel posts upslope of the base plate. Then place the foot of the post on the anchor head and prop the post on the upslope side with a wooden support, so that the foot of the post remains on the anchor head.
To protect the posts against sliding off, secure them with a hemp or synthetic fiber rope to the upslope anchors.

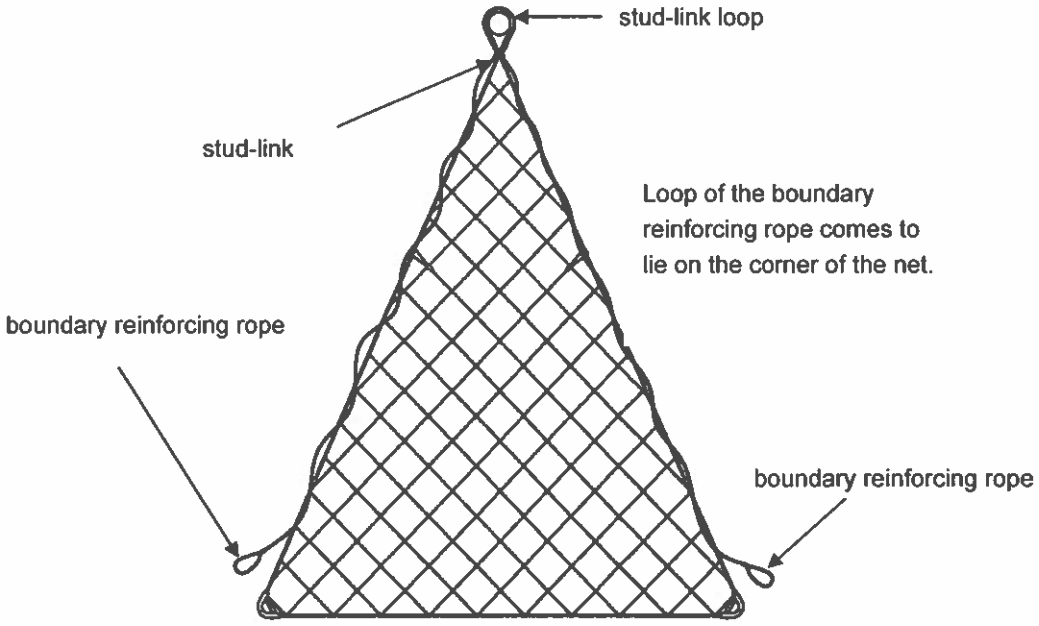


5.3.3 Laying out the boundary and intermediate nets



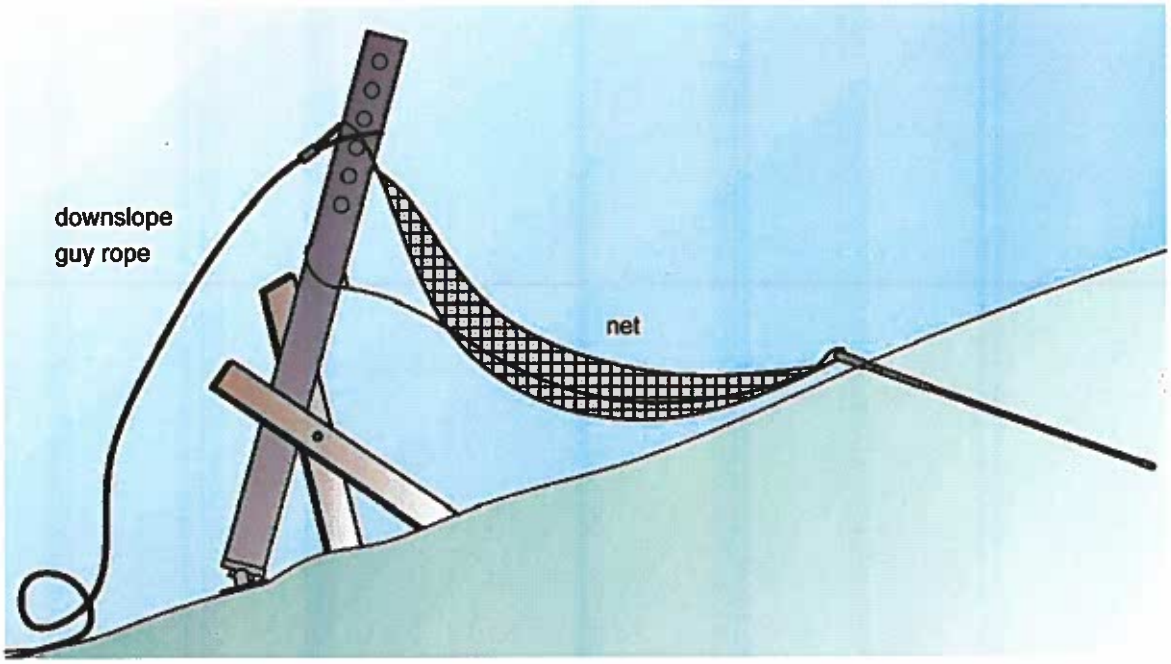
5.3.4 Boundary reinforcing rope

If necessary, intertwine the boundary reinforcing ropes for the nets with the nets at the end of the structure. The boundary reinforcing ropes are delivered in loose form (provided with loops) as part of the scope of supply. They will be intertwined at the assembly area.



Procedure: Lay the boundary reinforcing ropes with the stud-link loop onto the net loop with stud-link. Place each length of boundary reinforcing rope (equal lengths) parallel to the net's edge ropes. The loops of each boundary reinforcing rope are then intertwined 3 times with the net edge rope as shown in the drawing.

5.3.5 Suspending the nets



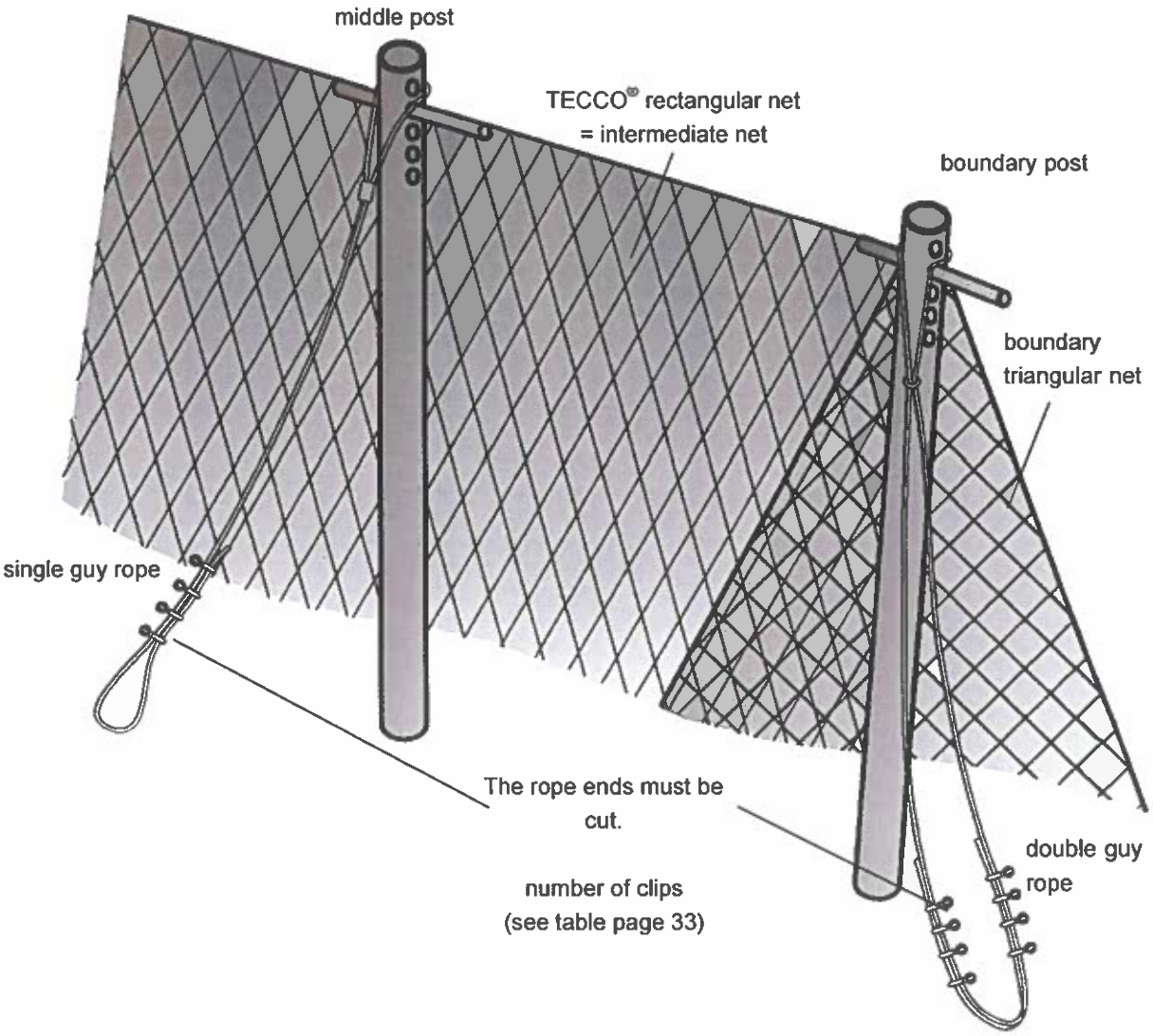
Hang the stud-link loop of the boundary triangular net and the boundary reinforcing rope over the pegs of the swivel post in a middle position. Do the same with the loops of the TECCO® rectangular nets. Suspend from the top or bottom pegs if a height adjustment is needed because of a base plate being too high or too low.

The tube thimbles on the corners of the net and the thimbles on the boundary reinforcing ropes must be brought together and fastened with a hemp rope of the theoretical length to the upslope spiral rope anchors.

.

5.3.6 Hanging the downslope guy ropes

Hang the loop of the guy rope towards the nets and boundary reinforcing rope (if any) downslope over the peg in the post head.



5.3.7 Setting up the structure

The nets are set up by pulling on the guy ropes in the direction of the valley. It is necessary to pull on every guy rope simultaneously in order to prevent the adjacent post from tipping over. The guy ropes are temporarily fastened to the downslope spiral rope anchors with a wire rope clip.

5.4 Installation with a helicopter

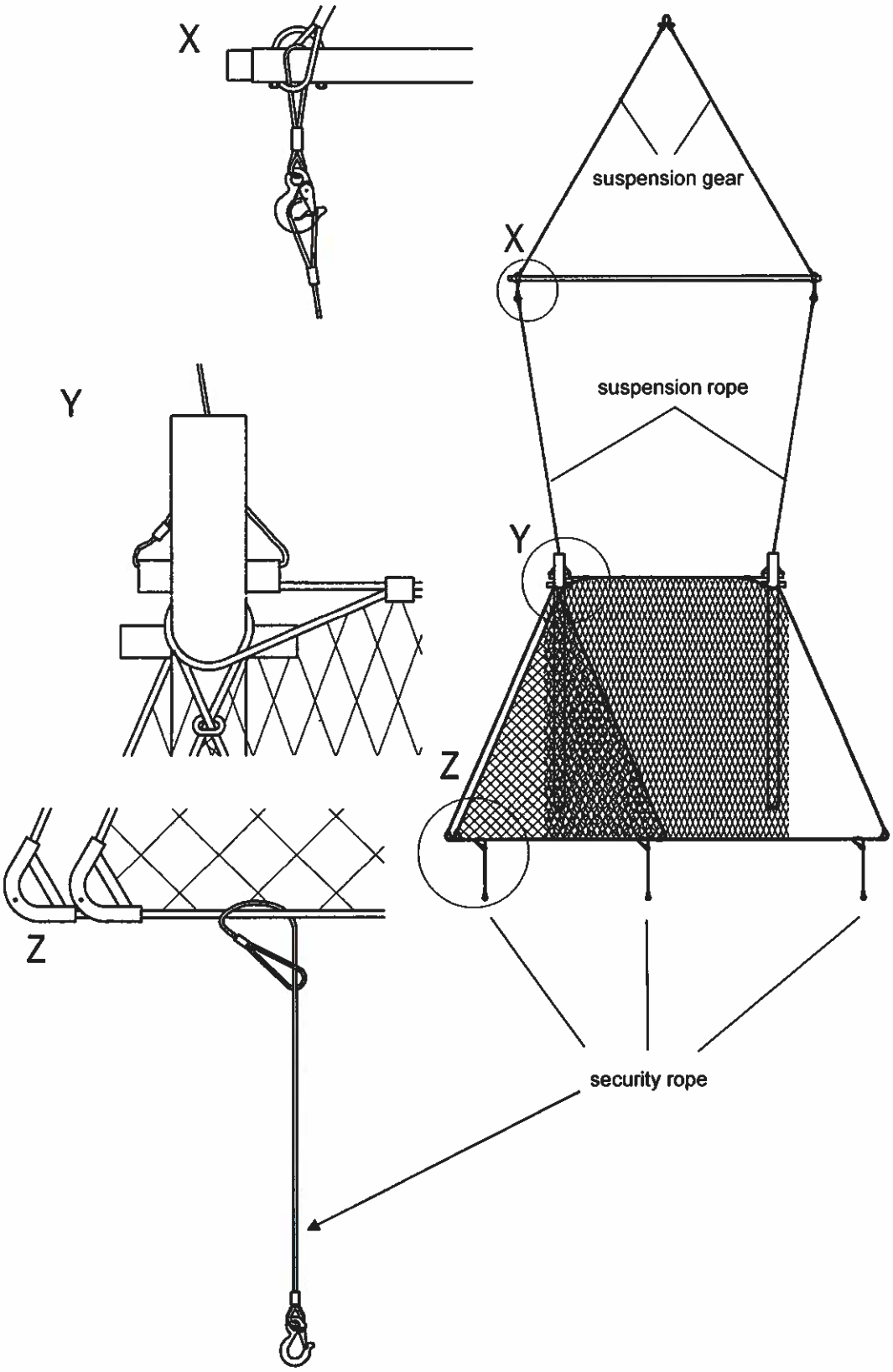
5.4.1 Preparatory work

Before flying in the units, all projecting GEWI tie-rods must be cut off in order to be able to place the posts.

5.4.2 Pre-assembly and preparation for flying

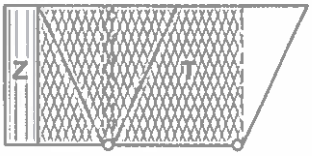
- First determine exactly how the structure will be divided into "flying units".
- To prepare the individual net sections for flying units, an even surface of terrain is recommended so that the pre-assembly can be carried out easily and the helicopter can approach easily.
- First lay the posts parallel on the ground spaced at the intended distances. To facilitate the preparatory work, place a timber beam underneath each post head below the pegs.
- Next lay the boundary triangular net (boundary section) over the post head and above the bearing peg in the middle position. In case of different foundation heights, choose the corrected position of the pegs.
- If a boundary reinforcing rope is planned for the boundary section, this must now also be placed over the post head. Both legs must be the same length and must be intertwined three times around the net edge rope of the boundary triangular net underneath (see drawing on page 22).
- Fasten the end loops of this boundary reinforcing rope to the net corners with a piece of tying strand. Hook a "security rope" into the first mesh of each net corner.
- Next hook the loops of the TECCO® rectangular net (intermediate net) over both adjacent post heads. Now the overlapping of the next suspended net is intertwined ("sewn") vertically at the pre-assembly area.
- Now hook a "security rope" into the first net mesh of each net corner.
- Finally the guy ropes must be hooked in and deposited above the posts.
- Safety pegs and bearing pegs must be fastened with iron wire to prevent them from falling out.

Helicopter suspension gear

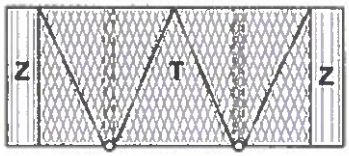


Approximate weight (kg) of the flying units (incl. helicopter suspension gear):
(It is recommended to figure in ca. 10% reserve.)

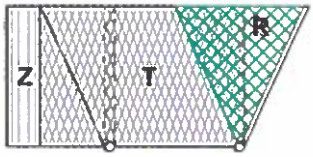
variant A



variant B

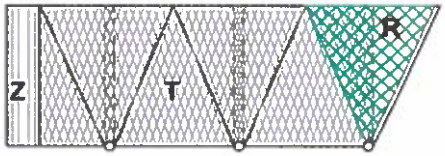


variant C



variant D

R = boundary triangular net
T = TECCO® rectangular net
Z = TECCO® rolled



variant E

Reinforced posts are used for some of the end sections (WF), which results in greater weights.

	A		B		C		D		E	
	RF	WF	MF	WF	MF	WF	RF	WF	MF, RF	WF
Dk = 3.0 N = 2.5	290	305	315	--	380	--	355	370	510	525
	All data in kg.									

5.4.3 Flying

- One flying unit is attached to the helicopter. The helicopter must approach the building site from the valley side and high enough for the corners of the net to correspond with the anchor height.
- Two installation workers turn the incoming flying unit at the dangling guy ropes so that the nets hang upslope of the posts.
- Three additional installation workers wait upslope under the dangling nets and hook the net corners with the security ropes into the spiral rope anchors. The same installation workers then go to the base plates for the posts and guide the posts onto the anchor heads of the base plates as the helicopter descends slightly.
- Once the posts are standing on the anchor heads, the guy ropes must be pulled slightly by hand to keep the posts from tipping sideways. A slightly open wire rope clip is slid onto the guy rope, the end is pulled through the spiral rope anchor on the valley side and passed back through the wire rope clip. Tightly tension the guy rope manually and tighten wire rope clips firmly with the wrench (ratchet).

- Only now may the net be climbed into and the ropes of the helicopter suspension gear detached. The helicopter then starts its return flight with the empty suspension gear.
- During the above-described process, the worker at the preparation site down in the valley has attached the second flying unit to the second helicopter suspension gear. He now removes the first helicopter suspension gear from the incoming helicopter and hangs the second flying unit on it. The first helicopter suspension gear can now be used for the third flying unit and so forth.

It is important to note that the structures installed in this way are standing only provisionally at first, i.e., that their lateral stability is limited.

If only one single section (post and main net) is being flown, it is advisable to attach a second auxiliary rope as an auxiliary guy rope. This is to be fastened to the adjacent downslope single hole anchor.

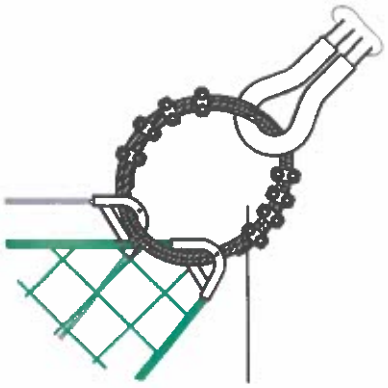
5.5 Adjusting the structure

Adjustment takes place with the aid of the upslope fastening ropes and by means of intertwining or "sewing" the TECCO® rectangular nets where they overlap. Vertically and horizontally in the area of the post head (see drawing) as well as upslope onto the support rope.

5.5.1 Upslope fastening

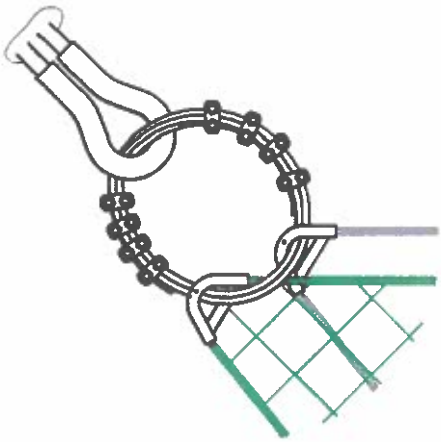
The fastening ropes are supplied cut to length. The number of rope wrap-arounds must comply with the system drawings.

The rope lengths result as follows:

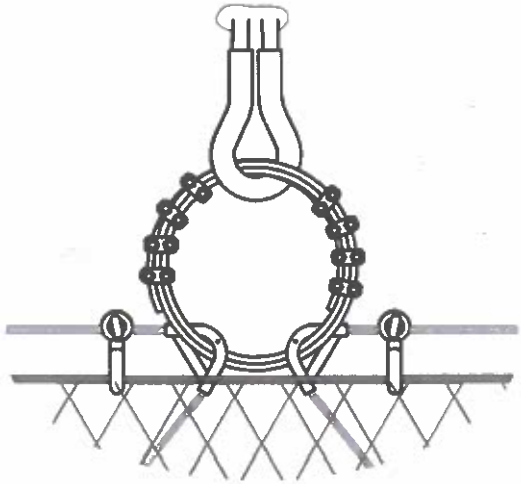


2 wrap-arounds = 6x distance

The ropes must be tensioned manually so tightly and the wire rope clips tightened until tension is released in the security rope, and it can be removed.



end of the structure



middle of the structure

5.5.2 Alignment

The structure is aligned in the following way:

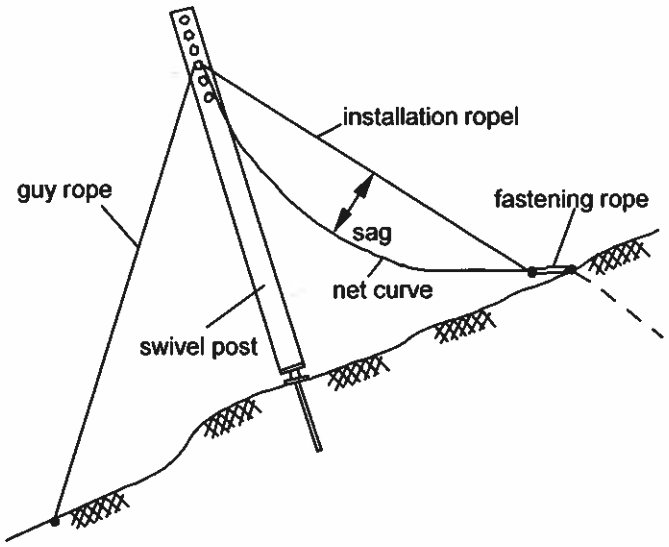
- Intertwine ("sew up") TECCO® rectangular net in post head area horizontally onto the support rope with a flexible 7 mm wire rope.
- Intertwine TECCO® net vertically.
- Intertwine TECCO® net onto the support rope at the overlap upslope.

Now lengthen or shorten the upslope fastening ropes and the downslope guy ropes so that:

- the swivel posts lie in one plane
- the swivel posts form the correct angle to the slope (see table p.15)
- the boundary/end posts incline outwards at an angle of ca. 12-15°
- the intermediate posts are standing vertical when viewed up the mountain.

After this the downslope guy ropes are tensioned with a rope hoist/cable winch.

Finally, tension the upslope fastening ropes.



5.5.3 Wire rope clips

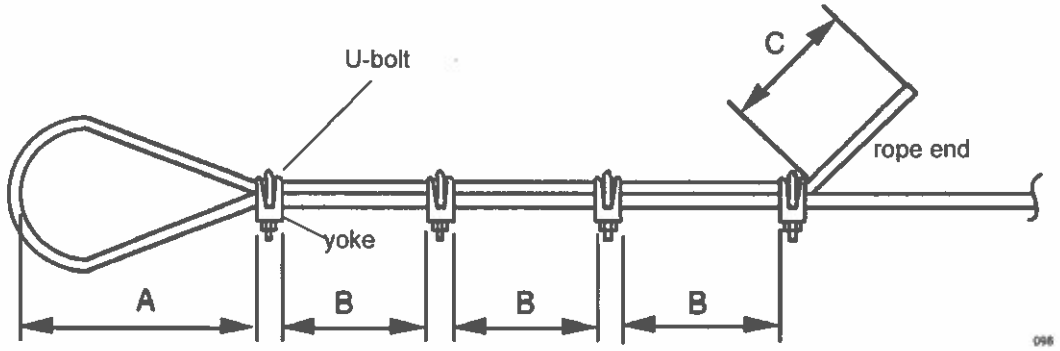
Wire rope clips according to DIN EN 13411-5 (DIN 1142) are required for all fastenings.
They must be uniformly spaced and tightened with a torque wrench. The yoke of the wire rope clip always presses on the tensioned rope that is going through, and the U-bolt on the end of the rope. The rope connections must be inspected after the winter season and retightened if loose. The table below specifies the sizes and number of wire rope clips:

Table
a = simple guy rope
b = double guy rope, also upslope fastening rope

Rope Ø	Clip size	Number of clips		A	B	C	Wrench width	Torque
		a	b	mm	mm	mm	mm	Nm
6	6.5	3	6	100	32	50	10	3.5
8	8	4	8	120	40	70	13	6
9, 5, 10	10	4	8	150	40	70	13	9
12	13	4	8	180	48	100	19	33
14,16	16	4	8	240	64	150	22	49
18	19	4	8	270	64	150	22	68
20, 22	22	5	10	300	68	180	24	107
24, 26	26	5	10	330	76	200	32	147
28	30	5	10	330	82	200	32	212

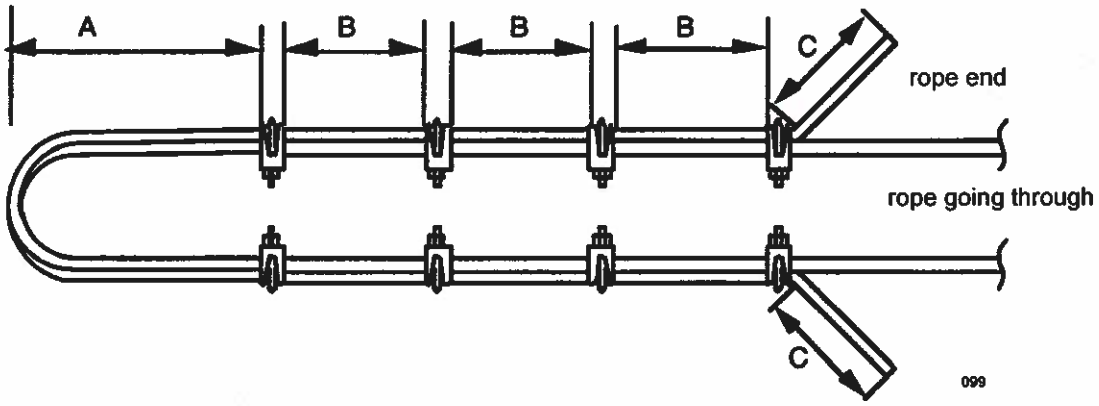
B and C are to be considered as standard gage and become accordingly smaller in the case of the fastening ropes. The given torque values apply to greased screw-nut connections.

5.5.4 Clip arrangement for simple guy rope



The yoke is always installed on the rope that is going through!

5.5.5 Clip arrangement for double guy rope



5.5.6 Clip arrangement for fastening rope

See page 30

6 FINAL INSPECTION

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

7 WEIGHTS AND NUMBERS OF COMPONENTS

7.1 Individual weights of the components in kg

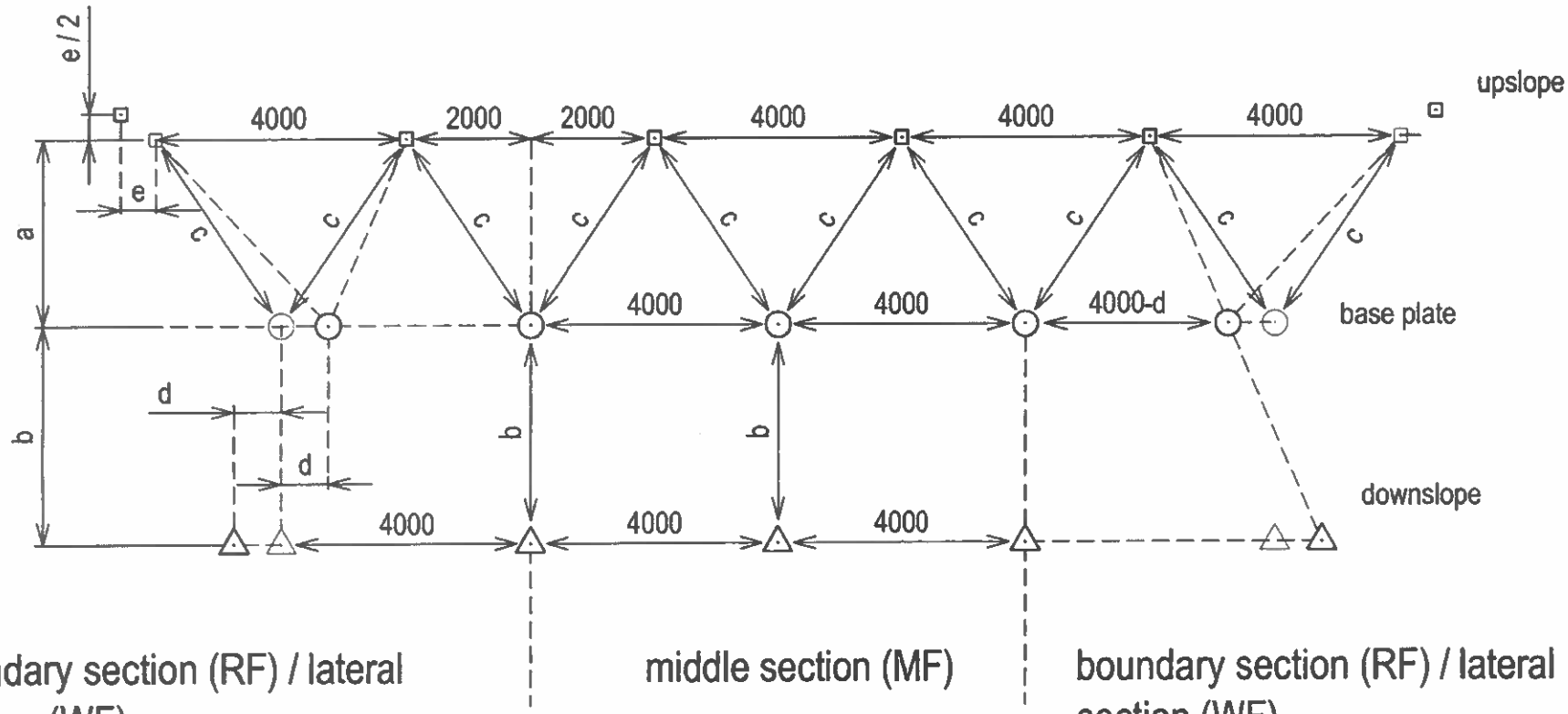
Designation	Dk = 3.0
Swivel post Ø 159.0	91
Swivel post Ø 168.3	106
Base plate	16
Base plate medium	72
Anchor head	4
SWISS-GEWI NG28 L = 1.5	7.2
SWISS-GEWI NG32 L = 1.5	9.5
SWISS-GEWI NG40 L = 1.5	15
Boundary triangular net	29
TECCO® rectangular net	65
Boundary reinforcing rope	9
Downslope guy rope	
1 x Ø 16 mm	7
2 x Ø 16 mm	14
Upslope fastening rope	
4 x Ø 16 mm	5
Downslope spiral rope anchor L = min. 1.5 m	
Ø 10.5	2
Upslope spiral rope anchor L = min. 1.5 m	
Ø 18.5	10
Wire rope clips DIN 1142	
100 pc. NG 16	43

8 OTHER APPLICABLE DOCUMENTS

- Guidelines for avalanche prevention in the avalanche starting area, issue 1990, supplemented 2000, WSL
- System drawing Dk 3.0 / N = 2.5
- Stake-out drawing GL-3009
- Correction drawings to stake-out drawings GL-3007, GL-3008
- Correction table Dk 3.0 GL-3005

9 APPENDIX

- 1 approval base plate
- 1 system drawing
- 1 certificate ISO 9001:2000
- 1 certificate EQ-Net 9001:2000



Dk	N	a	b	c	d	e
3.0	2.5	2560	3600	3250	700	350

modification	M:%	identical with: / replaced with:
-		

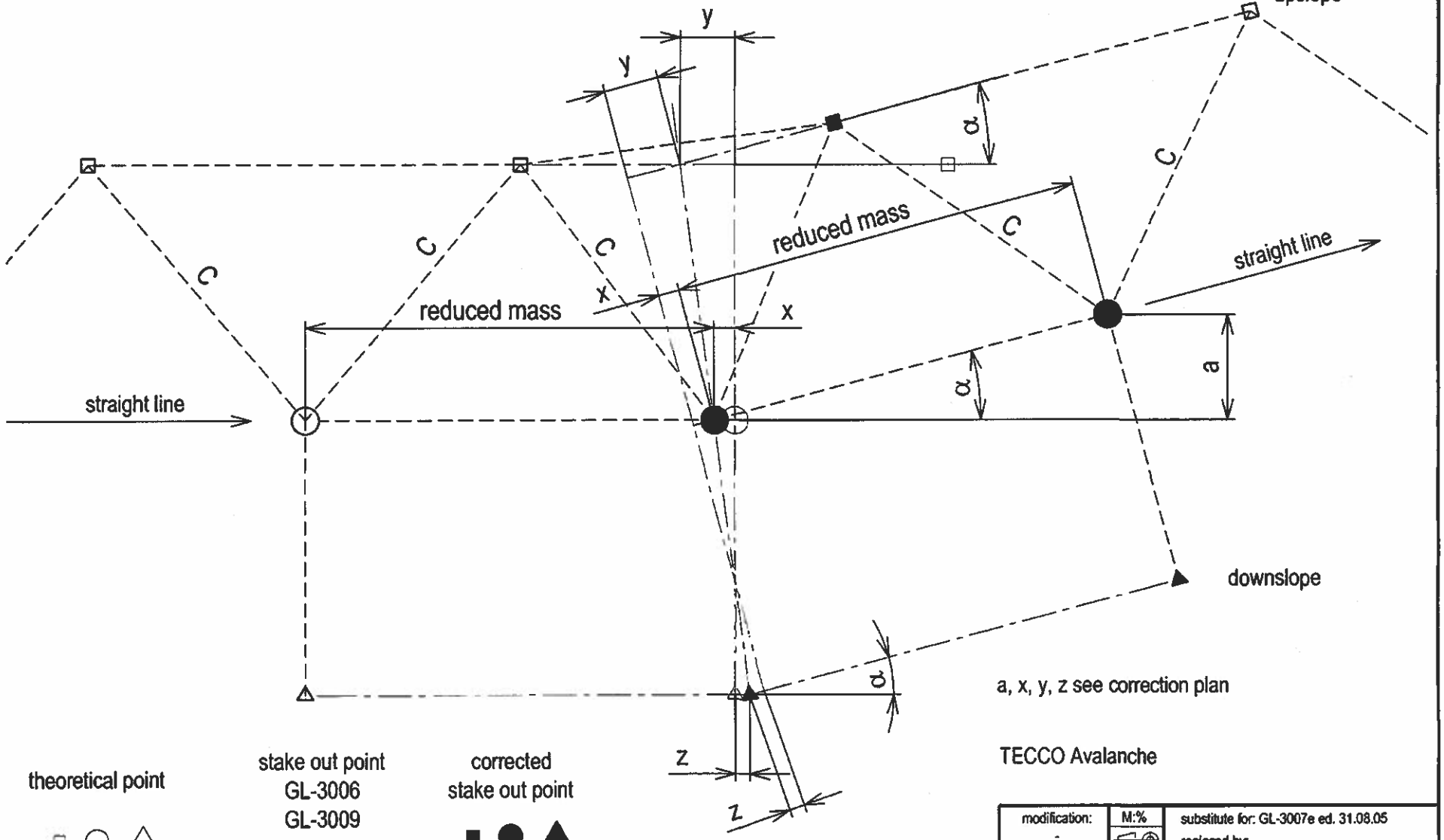
Plan of stake out on a straight line
TECCO Avalanche
Dk=3.0 N=2.5

drawn	13.02.06	ol
checked	13.02.06	ze
edition	13.02.06	AE

FATZER AG
CH-8590 Romanshorn

GEOBRUGG

GL-3009e

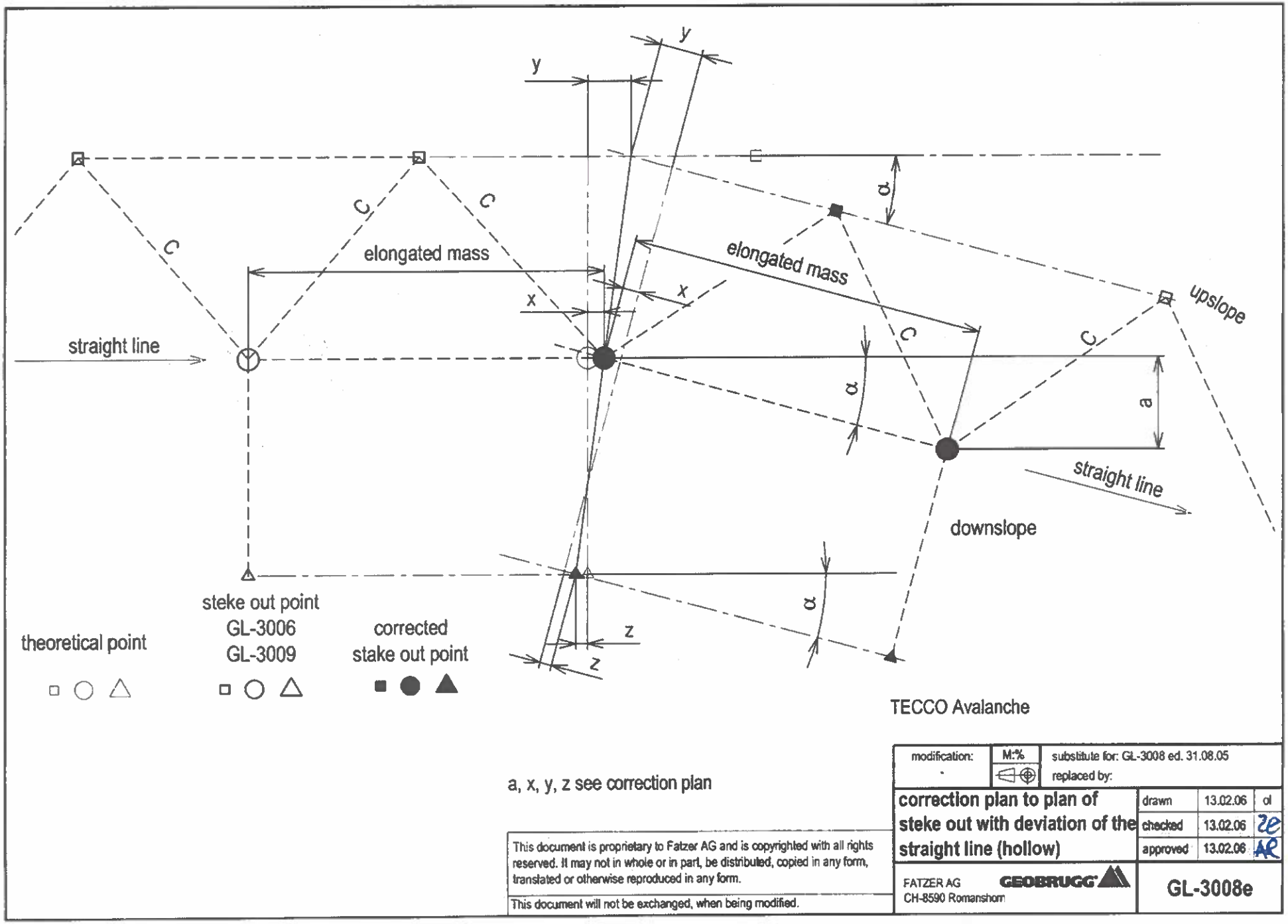


modification:	M:%	substitute for: GL-3007e ed. 31.08.05
-		replaced by:

correction plan to plan of stake out with deviation of the straight line (hilltop)	drawn	13.02.06	ol
	checked	13.02.06	ze
	approved	13.02.06	AR

FATZER AG GEOBRUGG
CH-8590 Romanshorn

GL-3007e



a, x, y, z see correction plan

modification:	M:%	substitute for: GL-3008 ed. 31.08.05
-		replaced by:

correction plan to plan of steke out with deviation of the straight line (hollow)

drawn	13.02.06	ol
checked	13.02.06	ze
approved	13.02.06	AR

FATZER AG
CH-8590 Romanshorn

GEOBRUGG

GL-3008e

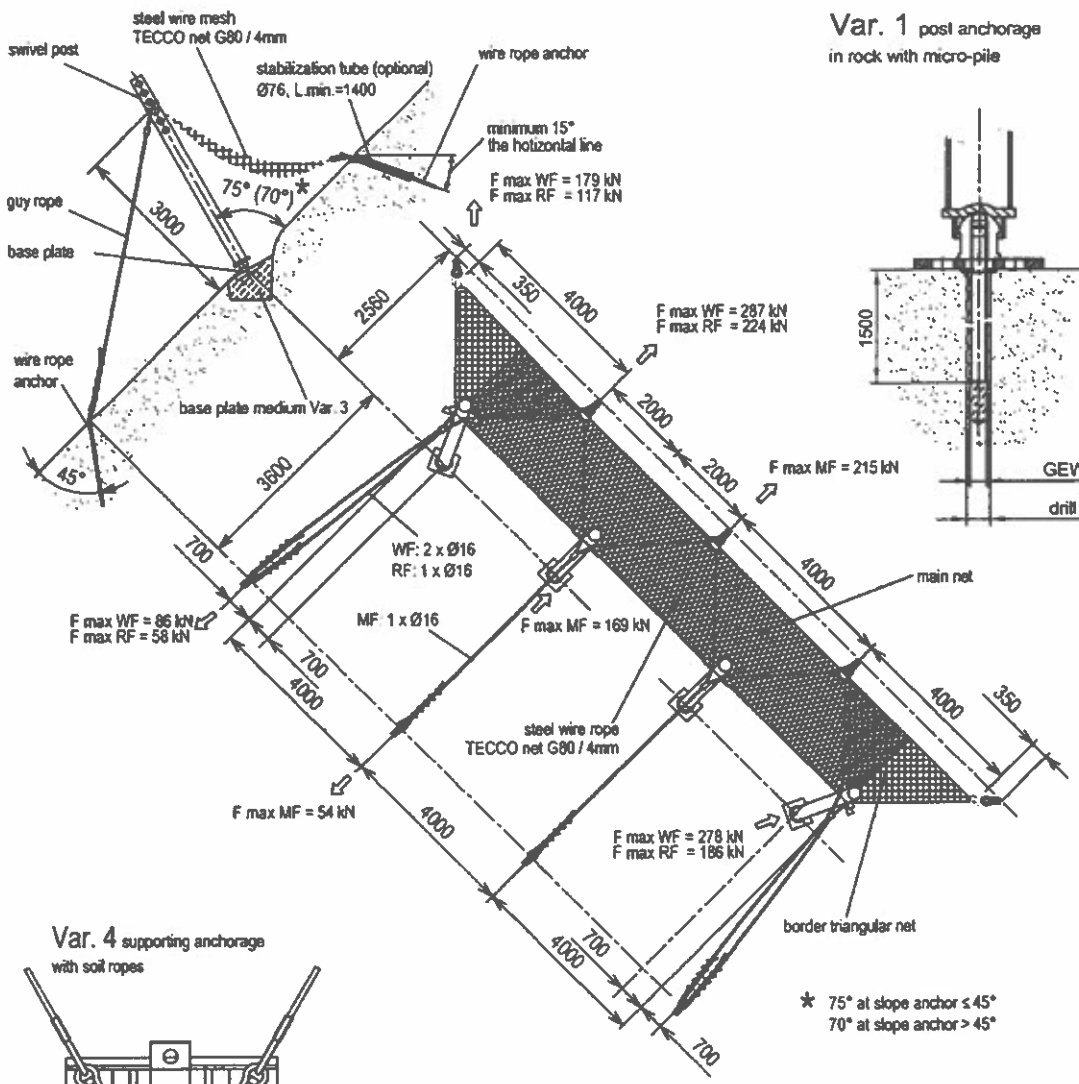
stake-out chart; TECCO Avalanche Dk = 3,0 N =2,5 GL-3005/2

deviation on the straight line		Slope angle inclination ψ																			
		30°			35°			40°			45°			50°			55°			60°		
α =	a =	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z	x	y	z
2°	14	1	5	4	2	6	3	2	6	3	3	6	2	3	6	1	3	6	0	4	6	-1
4°	28	3	11	8	4	11	7	5	11	5	6	12	3	6	12	2	7	12	0	8	12	-1
6°	42	4	16	12	6	17	10	7	17	8	8	18	5	9	18	3	10	18	0	11	18	-2
8°	56	6	21	16	8	22	13	9	23	10	11	23	7	12	24	4	13	24	0	15	24	-3
10°	69	7	26	20	9	28	16	12	29	13	14	29	9	14	30	5	17	30	1	19	30	-3
12°	83	9	32	24	11	33	20	14	34	15	17	35	10	17	36	6	20	36	1	23	36	-4
14°	97	10	37	28	13	39	23	17	40	18	20	41	12	20	42	6	24	42	1	27	42	-5

Deviations above 15° require the approval of GEOBRUGG.

The changed statical configuration needs a new dimensioning of anchors and posts.

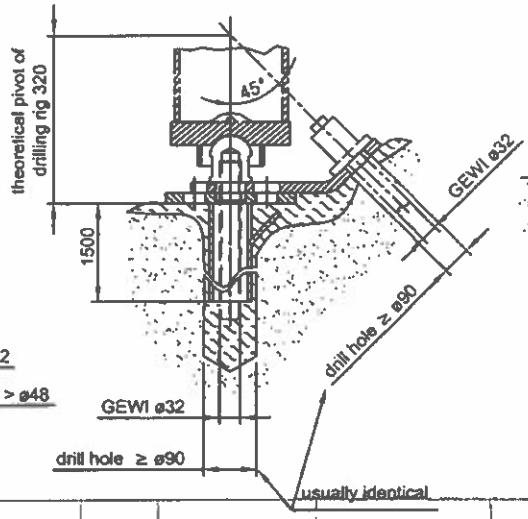
all measurements in cm



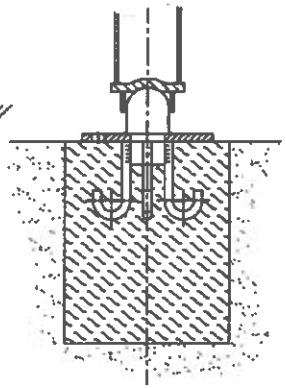
* 75° at slope anchor ≤ 45°
70° at slope anchor > 45°

Var. 1 post anchorage
in rock with micro-pile

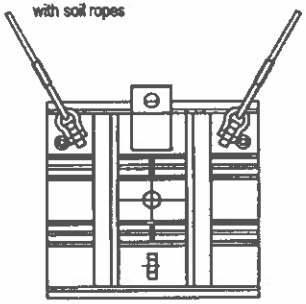
Var. 2a post anchorage
in loose material, using
micro-pile, stabilization tube and tie rod



Var. 3 post anchorage
on concrete foundation
(min. 400 x 400 x 500)
with base plate



Var. 4 supporting anchorage
with soil ropes



draw.nr.	art.nr.	item	utlisation	dimensions [mm]	mass [kg]
GL-6000	152300	swivel post	WF / RF	ø168.3, L = 3684	106.0
GL-6000	152301	swivel post	MF	ø159.0, L = 3684	91.0
GL-7037	155230	base plate middle	MF / RF / WF	750 x 800	72.0
GL-7022	155032	base plate	variant 1	rock, GEWI ø32	9.0
GL-7024	155034	base plate	variant 2	loose material, GEWI ø32	27.5
GL-7020	155039	base plate	variant 3	concrete foundation	13.5
GL-7026	155036	extra plate	variant 2	loose material	10.0
GL-7001	155006	anchor head	variant 1 & 2	loose material	3.9
GL-4024	113300	border triangular net	border net	mesh size 250	29.0
GL-4041	--	TECCO wire mesh rectangular	middle net	G80 / 4 mm mesh size 103 x 180 mm	65.0
GL-5000	130300	boundary reinforc.rope	RF/WF	ø16, L = 2 x 4150	8.7
GA-7006	142109	stabilization tube	with plate	ø80, L = 1500	4.2
GL-5001	130306	guy rope	MF / RF	ø16 x 7000	6.8
GL-5001	130308	guy rope	WF	2 x ø16 x 7000	13.6
	180012	fixation rope	MF / RF	ø16, 4-times, L = 5000	4.9
	180012	fixation rope	WF	ø16, 4-times, L = 5000	4.9
GA-7001	144101	wire rope anchor	downslope	ø10.5, L min = 1000	1.9
GA-7001	144203	wire rope anchor	upslope	ø18.5, L min = 2000	10.2

Nomenclatur
WF = lateral section
RF = boundary section
MF = middle section

concrete, mortar

ground material

modification: AeM 00-562 | M:% | substitute for: | replaced by:

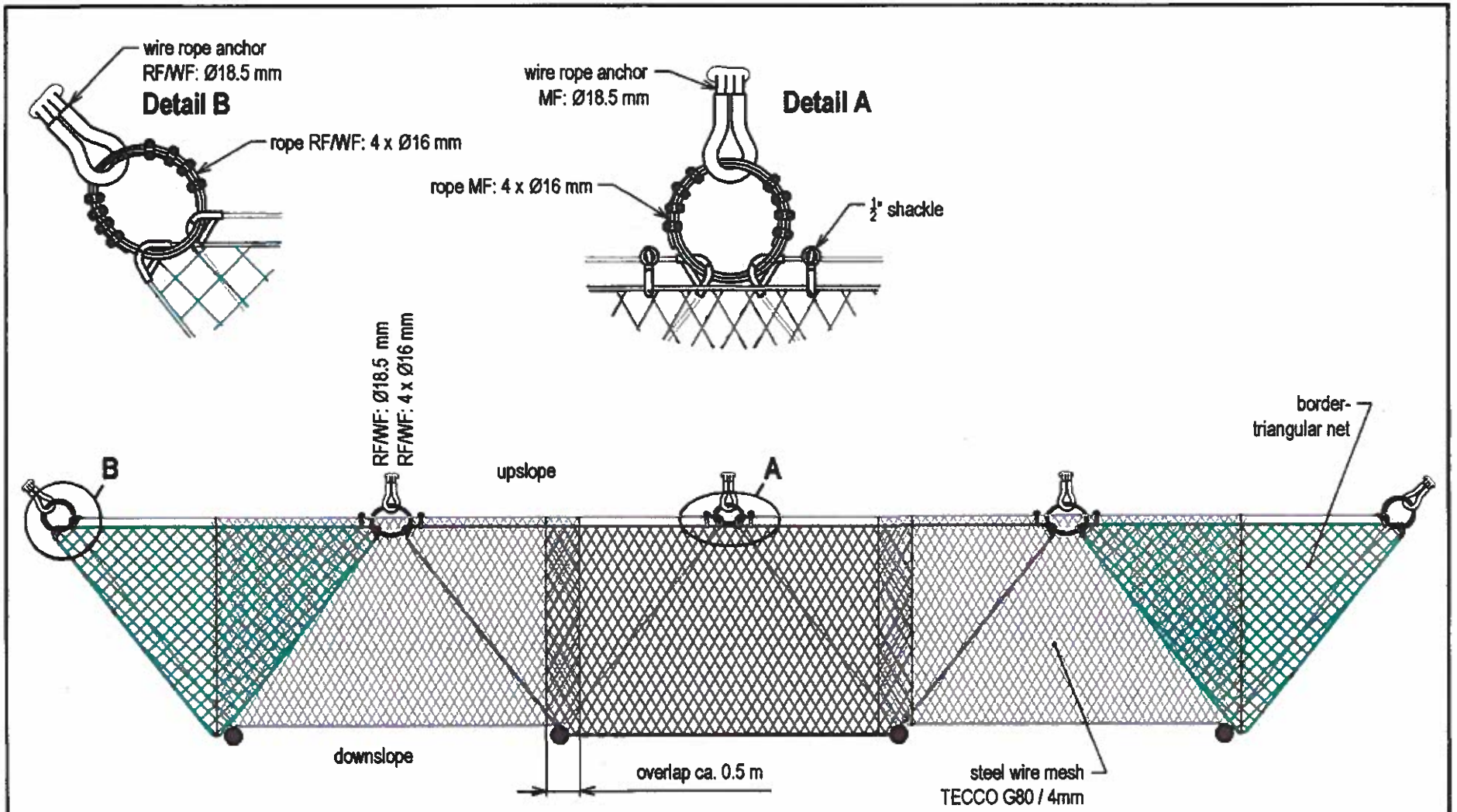
TECCO Avalanche
System drawing
Dk=3.0 N=2.5 fc=1.1 Psi=45°

drawn	13.02.06	ol
checked	13.02.06	ie
edition	13.02.06	AeR

FATZER AG
CH-8590 Romanshorn

GEOBRUGG

GL-1021.1e



modification: -	M:%	substitute for: replaced by:	
TECCO Avalanche Dk=3.0 steel wire mesh TECCO G80 / 4 mm and border- triangular net		drawn	13.02.06 ol
		checked	13.02.06 Ze
		approved	13.02.06 AR
FATZER AG GEOBRUGG CH-8590 Romanshorn			GL-1020.2 e

Bundesamt für Umwelt, Wald und Landschaft
EIDG. FORSTDIREKTION, 3003 Bern

PRÜFUNG VON WERKTYPEN UND IHREN FUNDATIONEN IM VOM BUND SUBVENTIONIERTEN LAWINENVERBAU

Prüfungsverfahren

Adresse:

Fatzer AG/GEOBRUGG

CH 8590 Romanshorn

Prüfungsobjekt (~~Mörteltyp~~/Werktyp):

Druckplatten für Schneenetze
Druckplatte klein, mittel und gross
Plan Nr. GL-7036/ 7037/ 7038/ 7536-P/7537-P/7538-P; 31.01.2003
Statische Berechnungen vom 17.12.2002 u. 30.1.2003

Prüfungsbericht des Eidg. Instituts für Schnee- und Lawinenforschung

Der Werktyp ~~/ Ankermörtel~~ entspricht den Richtlinien und Normen
(SLF-Prüfungsbericht Nr. 2003.02/1 _____ vom 3.2.2003)

ja ☒ nein ☐

Datum der Prüfung: 3. Februar 2003 **Unterschrift:**

Eidg. Institut für Schnee- und Lawinenforschung
7260 Davos Dorf

Prüfungsentscheid der Eidg. Expertenkommission Lawinenverbau

Die Eidg. Expertenkommission Lawinenverbau stellt an die Eidg. Forstdirektion den Antrag, den Werktyp / ~~Ankermörtel~~ für den subventionierten Lawinenverbau freizugeben. ja ☒ nein ☐

Datum der Prüfung: 11.2.2003 **Unterschrift:** R. Baan

Freigabeentscheid der Eidg. Forstdirektion

Der Werktyp / ~~Ankermörtel~~ kann für den subventionierten Lawinenverbau freigegeben werden. Die Typenliste wird demnächst mit dem geprüften Werktyp / ~~Ankermörtel~~ ergänzt. ja ☒ nein ☐

Datum der Prüfung: 6.3.2003 **Unterschrift:** R. Bader

Bundesamt für Umwelt, Wald und Landschaft
Eidg. Forstdirektion
3003 Bern

The Swiss Association for Quality and Management Systems

SQS herewith certifies that the company named below has a management system which meets the requirements of the normative bases specified below and issues the company

Fatzer Inc.

CH-8590 Romanshorn

certified areas

FATZER Steel Wire Ropes

GEOBRUGG Protection Systems

BRUGG ROPE STRUCTURES Rope Structures

Field of activity

Rope and Netting Technologies

on the basis of the audit result the

SQS Certificate ISO 9001:2000

CH-3052 Zollikofen, August 4, 2004
This SQS Certificate is valid up to and including August 3, 2007
Scope number 17
Registration number 11774

President SQS

X. Edelmann

Managing Director SQS

T. Zahner

SQS-ISO 012, 023

IQNet

THE INTERNATIONAL CERTIFICATION NETWORK

CERTIFICATE

IQNet and SQS
hereby certify that the organization

Fatzer Inc.

CH-8590 Romanshorn

certified areas

Steel Wire Ropes, Protection Systems, Rope Structures

Field of activity

Rope and Netting Technologies

has implemented and maintains a
Management System
which fulfills the requirements of the following standard

ISO 9001:2000

Scope No: 17
Issued on: 2004-08-04
Validity date: 2007-08-03
Registration Number: ***CH-11774***

Dr. Fabio Roversi
President of IQNet

Theodor Zahner
Managing Director SQS

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