



# MetroWest+

## Portishead Branch Line (MetroWest Phase 1)

**Planning Inspectorate Reference: TR040011**

**Applicant: North Somerset District Council**

### 9.3.5 ExA.SoCG-HE.D1.V1 – Statement of Common Ground

Between:

- (1) North Somerset District Council; and
- (2) Historic England

**Version: 1**

**Date: November 2020**



## DOCUMENT CONTROL

### Document Properties

**Author**

North Somerset District Council

## VERSION HISTORY

Date	Version	Status	Description/changes
26/07/2019	1	Draft	
30/01/2020	1	Draft	Updated following DCO application
07/09/2020	1	Draft	Updated following rockfall barrier work by Network Rail
30/09/2020	1	FINAL	FINAL

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## **1. ABBREVIATIONS**

2008 Act	Planning Act 2008
Applicant	North Somerset District Council
DCO	Development Consent Order
EIA	Environmental Impact Assessment
ES	Environmental Statement
NSIP	Nationally Significant Infrastructure Project
PINS	Planning Inspectorate
SoCG	Statement of Common Ground

## **2. INTRODUCTION**

- 2.1. This Statement of Common Ground ("SoCG") has been prepared by North Somerset District Council ("the Applicant") to set out the areas of agreement and disagreement with Historic England in relation to the Development Consent Order ("DCO") application for the Portishead Branch Line (MetroWest Phase 1) ("the DCO Scheme") based on consultation to date.
- 2.2. This SoCG comprises an agreement log which has been structured to reflect topics of interest to Historic England in relation to the application for the DCO Scheme. Topic specific matters agreed between Historic England and the Applicant are included.

## **3. SCHEME OVERVIEW**

- 3.1. The Applicant has applied to the Planning Inspectorate ("PINS") for a DCO to construct the Portishead Branch Line under the Planning Act 2008 ("the Application"). The Application was made on 15 November 2019 under reference TR040011 and was accepted for examination on 12 December 2019.
- 3.2. The DCO Scheme will provide an hourly (or hourly plus) railway service between Portishead and Bristol Temple Meads Railway Station, with stops at Portishead, Pill, Parson Street and Bedminster.
- 3.3. The DCO Scheme comprises the nationally significant infrastructure project ("NSIP") as defined by the Planning Act 2008 ("the 2008 Act") to construct a new railway 5.4 kilometres long between Portishead and the village of Pill, and associated works including a new station and car park at Portishead, a refurbished station and new car park at Pill and various works along the existing operational railway line between Pill and Ashton Junction where the DCO Scheme will join the existing railway. Ashton Junction is located close to the railway junction with the Bristol to Exeter Mainline at Parson Street.<sup>1</sup>

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<sup>1</sup> Please refer to Schedule 1 of the "Draft proposed DCO" (DCO application document reference 3.1) for more detail.

- 3.4. The Application has been accompanied by an Environmental Statement ("ES") because the DCO Scheme is classified as Environmental Impact Assessment ("EIA") development in the EIA Regulations 2017<sup>2</sup>.

## **4. OVERVIEW OF ENGAGEMENT**

### **4.1. Introduction**

- 4.1.1. This section briefly summarises the consultation that the Applicant has had with Historic England. For further information on the consultation process please refer to the Consultation Report (DCO Document Reference 5.1).

### **4.2. Pre-application**

- 4.2.1. The Applicant has engaged with Historic England on the DCO Scheme during the pre-application process, both in terms of informal non-statutory engagement and formal consultation carried out pursuant to Section 42 of the Planning Act 2008.

### **4.3. Overview of key issues raised at Section 42**

- 4.3.1. When formally consulted Historic England raised the following key issues:

- i. The scheme needs to consider the requirement of the Planning (Listed Buildings and Conservation Areas) Act 1990 in Section 66(1) for the local authority to “have special regard to the desirability of preserving the building or its setting or any features of architectural or historic interest which it possesses”.
- ii. Visual impacts of all aspects of the scheme both individually and cumulatively on historical assets and the surrounding areas associated with the scheme within the Avon Gorge.

- 4.3.2. The Applicant considered all issues during the further development stages which are detailed in full in the Environmental Statement ("ES") Chapter 11 "Landscape and Visual Impact Assessment" (DCO Document Reference 6.14).

### **4.4. Overview of key issues raised outside of the formal consultation process**

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<sup>2</sup> The Town and Country Planning (Environmental Impact Assessment) Regulations 2017

4.4.1. Outside of the formal consultation process Historic England raised the following key issues:

- i. Visual impacts arising from the construction phase including vegetation clearance and compounds; and
- ii. Location of equipment in relation to important historical assets, including fencing, signals, and rock stability apparatus, in particular within the vicinity of the Clifton Suspension Bridge.

## 5. ISSUES

5.1. Within the table below, the different topics and areas of agreement and disagreement between Historic England and the Applicant are set out.

Topic	Historic England Position	North Somerset District Council Position	Status
<b>Key issues raised at the Stage 1 (informal) and Stage 2 (formal) consultation stages</b>			
<b>Legislation and policy</b>	Historic England were concerned that there may be impacts on the historic environment and considers that an EIA is required	An EIA has been undertaken and the results of the assessment are set out in the ES.	<i>Agreed</i>
<b>Legislation and policy</b>	Historic England stated that the assessment methodology should follow Historic England Guidance, 'The Setting of Heritage Assets Advice Note 3' and be undertaken by a recognised heritage professional.	The Historic England guidance has been employed for the assessment of the impacts to designated assets (Section 8.6, Chapter 8 (Cultural Heritage) of the ES (DCO Document Reference 6.11) and Appendix 8.1 (Cultural Heritage Gazetteer) in the ES Volume 4 Appendices (DCO Document Reference 6.25)).  The assessment was undertaken by a	<i>Agreed</i>



Topic	Historic England Position	North Somerset District Council Position	Status
<b>Key issues raised at the Stage 1 (informal) and Stage 2 (formal) consultation stages</b>			
		recognised heritage professional.	
<b>Cultural Heritage / Landscape and visual impact</b>	Historic England identified a number of assets that may be affected by the DCO Scheme.	<p>The assets identified by Historic England have been assessed in Section 8.6, Chapter 8 (Cultural Heritage) of the ES (DCO Document Reference 6.11) and in Appendix 8.1 (Cultural Heritage Gazetteer) of the ES Volume 4 Appendices (DCO Document reference 6.25).</p> <p>The assessment on landscape, setting and views for historical assets also forms part of the landscape and visual impact assessment in Chapter 11 (Landscape and Visual Impact Assessments) of the ES (DCO Document Reference 6.14).</p> <p>The Applicant notes that Berkley Castle has not been assessed further as it lies near Stroud, Gloucestershire and that due to the distance and intervening topography it is the Applicant's view that</p>	<i>Agreed</i>

Topic	Historic England Position	North Somerset District Council Position	Status
<b>Key issues raised at the Stage 1 (informal) and Stage 2 (formal) consultation stages</b>			
		this asset will not be affected by the DCO Scheme.	
<b>Cultural Heritage / Landscape and visual impact</b>	Historic England stated that the assessment needs to consider: the impact on landscape, direct impacts on historic sites and areas; indirect impacts on setting and long views; use of photomontages; potential for buried archaeology; effects on landscape amenity; and cumulative effects.	<p>Direct and indirect impacts on the heritage assets, historic landscape and the impact on the historic setting of heritage assets are presented in Section 8.6, Chapter 8 (Cultural Heritage) of the ES (DCO Document Reference 6.11) and in Appendix 8.1 (Cultural Heritage Gazetteer) of the ES Volume 4 Appendices (DCO Document Reference 6.25).</p> <p>The assessment on landscape, setting and views for historical assets also forms part of the landscape and visual impact assessment in Chapter 11 (Landscape and Visual Impact Assessments) of the ES (DCO Document Reference 6.14).</p> <p>While photographs of the DCO Scheme and its surrounds are provided in the appendices to Chapter 8 and Chapter 11</p>	<i>Agreed</i>

Topic	Historic England Position	North Somerset District Council Position	Status
<b>Key issues raised at the Stage 1 (informal) and Stage 2 (formal) consultation stages</b>			
		of the ES, photomontages have not been prepared. There are few locations which afford views of heritage features and their setting in the context of the railway.	
<b>Landscape and visual impact</b>	Historic England raised concerns about the visual impact upon setting from the proposed security fencing on both sides of the railway. Historic England were also concerned about the cumulative impact of fencing, the proposed communications mast and new signals which could draw attention to the operating railway, together with the projected frequency of passenger trains. Historic England advised that the impact of new equipment and design/finishes of fencing should be carefully considered.	<p>The Applicant has attempted to design the DCO Scheme in such a way as to be sensitive to the issues raised by Historic England. However, the Applicant notes that fencing is required to prevent trespass which is a greater issue with the introduction of faster, more frequent passenger services.</p> <p>The visual impact of fencing has to be balanced against the benefits of fencing which include managing public access and disturbance to the SAC. With this in mind, some of the fencing requirements were scaled back at outline design to reduce the amount of vegetation clearance required and it is possible that</p>	<i>Agreed</i>

Topic	Historic England Position	North Somerset District Council Position	Status
<b>Key issues raised at the Stage 1 (informal) and Stage 2 (formal) consultation stages</b>			
		fencing may be reduced further during the detailed design of the DCO Scheme (GRIP 5).  Paladin (mesh) fencing has been chosen to lessen its visual impact.	
<b>Landscape and visual impact</b>	Historic England raised concerns over the impact of the 3-5m clearance from each of the running rails through the Avon Gorge and requested visuals so that it could appreciate the levels of impact. Historic England also requested details and locations of the proposed lighting associated with signalling etc.	The Applicant notes that Network Rail will be undertaking woodland management works, in accordance with their Site Management Statement (Network Rail, 2018) that has been approved by Natural England; the clearance from the running rail is a Network Rail standard that will be covered by this Statement for the Operational Freight Line (the existing freight only railway which runs through the Avon Gorge between Parson Street junction and Royal Portbury Dock).	<i>Agreed</i>

## Key issues raised outside of the consultation stages

### **Landscape and visual impact**

Historic England raised concerns with the designs for the Clanage Road construction compound and requested photo montages and views from key vantage points such as the Suspension Bridge and from Ashton Court Estate, particularly on the route from the mansion to Clanage Road by the deer park.

The Applicant notes the sensitivities with the site of this compound. However, this is a temporary construction compound which will not be permanently lit or contain any buildings other than a small cabin for workers during construction. Views of the compound from key vantage points such as those raised by Historic England were assessed and are not visible due to its location and vegetated surroundings.

Direct and indirect impacts on the heritage assets, historic landscape and the impact on the historic setting of heritage assets are presented in Section 8.6, Chapter 8 (Cultural Heritage) of the ES (DCO Document Reference 6.11) and in Appendix 8.1 (Cultural Heritage Gazetteer) of the ES Volume 4 Appendices (DCO Document Reference 6.25).

The assessment on landscape, setting and views for historical assets also forms part of the landscape and visual impact assessment in Chapter 11 (Landscape and Visual Impact Assessments) of the ES (DCO Document Reference 6.14).

*Agreed*

## Key issues raised outside of the consultation stages

### Landscape and visual impact

Historic England raised concerns regarding impacts to heritage assets from possible rock bolting and rock catch fencing through the Avon Gorge.

Details of rock bolting and catch fencing has been included in the Report to inform Habitats Regulations Assessment (ES Volume 4, Appendix 9.12 DCO Document Reference 6.25) and on the General Arrangement Plans Sheets 9 to 13 (DCO Document Reference 2.4).

Network Rail produced revised designs for the rock catch fencing near the Clifton Suspension Bridge in May 2020.

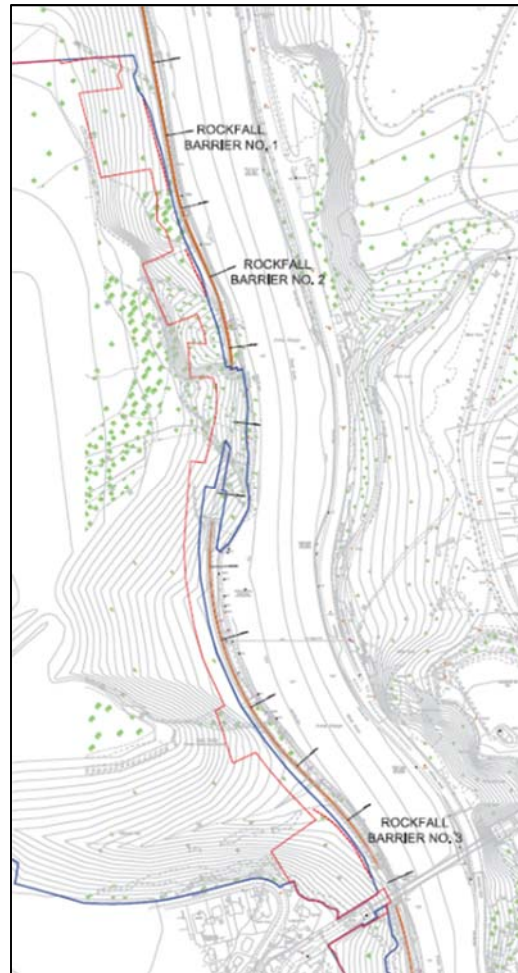
- Rockfall barrier No. 1 is located south of Quarry Underbridge number 3. It is positioned up the cliff slope from the railway line within the existing trees.
- Rockfall barrier No. 2 is located north of Quarry Underbridge number 2. It is positioned up the cliff slope from the railway line within the existing trees.
- Rockfall barrier No. 3 is located between the base of the Clifton Suspension Bridge by the tunnel and Nightingale Valley. It is positioned up the cliff slope from the railway line within the existing

*Agreed*

## Key issues raised outside of the consultation stages

trees.

### Location plan



## Key issues raised outside of the consultation stages

The three photographs show the location of the rockfall barriers. Note the locations of the barriers are shown close to scale, but please refer to the engineering drawings in the Network Rail Technical Note 'Metro West Phase I: Avon Gorge Rock Fall Barrier, 26th May 2020' at Appendix A for the exact dimensions.

Photograph 1 – Rockfall barrier 1 location (147m long)





## Key issues raised outside of the consultation stages

Photograph 2 – Rockfall barrier 2 location  
(52m long)



## Key issues raised outside of the consultation stages

Photograph 3 – Rockfall barrier 3 location  
(78m long)



It can be seen from the photographs that the rockfall barriers would be located within the existing woodland and therefore well screened from view by the planting. There would be some localised vegetation removal to allow their installation, primarily for working space and access, but this

## Key issues raised outside of the consultation stages

would not affect the major trees and the screening effect they provide.

The mesh material used for the barriers is relatively transparent and therefore even if they are visible, the vegetation and ground behind the barrier would be visible through the mesh.

It may be possible to see the barriers more easily from directly over the barrier looking down in the winter months. In the summer the tree canopy would screen the barriers. This particular view is also atypical and particular, whereas most viewers enjoy the wider view across the Avon Gorge where the barriers, if visible, would form a small part of the overall view.

Direct and indirect impacts on the heritage assets, historic landscape and the impact on the historic setting of heritage assets are presented in Section 8.6, Chapter 8 (Cultural Heritage) of the ES (DCO Document Reference 6.11) and in Appendix 8.1 (Cultural Heritage Gazetteer) of the ES Volume 4 Appendices (DCO

**Key issues raised outside of the consultation stages**

Document Reference 6.25).

**Archaeology  
and cultural  
heritage**

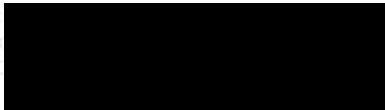
Stated that the local authorities' conservation and archaeology advisors should be closely involved throughout the preparation of the Environmental Statement.

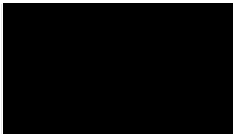
The Applicant confirms that the local authorities' archaeological and conservation advisors have been consulted. They have provided comments on the relevant sections of the ES which were incorporated (for example they requested archaeological watching briefs during construction) and have been kept regularly updated on the process of the application for the DCO Scheme.

*Agreed*

## 6. AGREEMENT ON THIS STATEMENT OF COMMON GROUND

This Statement of Common Ground has been jointly prepared and agreed by:

The Stakeholder	
<i>Name:</i>	Simon Hickman
<i>Signature:</i>	
<i>Position:</i>	Team Leader, Development Advice
<i>On behalf of:</i>	Historic England
<i>Date:</i>	09/10/2020

The Applicant	
<i>Name:</i>	James Willcock
<i>Signature:</i>	
<i>Position:</i>	MetroWest Phase 1 Programme Manager

<i>On behalf of: North Somerset District Council</i>
<i>Date: 30/09/2020</i>

## **7. APPENDIX A**

Network Rail Technical Note

‘Metro West Phase I: Avon Gorge Rock Fall Barrier, 26th May 2020’

**DESIGN  
DELIVERY**



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## **Technical Note**

### **Metro West Phase I: Avon Gorge Rock Fall Barrier**

POD 122m+0565yds to 122m+0700yds Down

POD 122m+1500yds to 122m+1550yds Down

POD 122m+1700yds to 123m+0090yds Down

26<sup>th</sup> May 2020

OP Reference: 140569

Project Manager: Emma Evans




Sponsor: Niall Spencer

**Network Rail Design Delivery**

[www.networkrail.co.uk](http://www.networkrail.co.uk)



## Document History

Version	Date	Details	Prepared by	Reviewed by	Approved by
P01	March 2020	For Information			
P02	May 2020	Amendments in line with Clients comments			
P02.1	May 2020	Amendments in line with Project Team comments			
			Patrick Staunton <i>Design Engineer</i>	Joseph Martin <i>Senior Design Engineer</i>	Joseph Martin <i>Senior Design Engineer</i>

TECHNICAL NOTE		
Issue number	P02	Page 3 of 11
Issue date	14 <sup>th</sup> May 2020	

## 1. INTRODUCTION

The Portishead Branch Line (ELR code POD) runs from Royal Portbury Docks to Parsons Street, along the west bank of the River Avon, through the Avon Gorge. The POD line is currently open to freight only. It is proposed to reopen the line to passengers as part of the Development Consent Scheme (DCO), known as MetroWest Phase 1.

As the line is currently open to freight only, the risks posed by third party rock cutting assets are considered to be acceptable to the safe operations of the railway. However, with the reintroduction of passenger services to the line, the future risks posed by third party rock cuttings are elevated. These third party rock cuttings are under the ownership of National Trust.

As part of the MetroWest Phase 1 scheme, Network Rail have been instructed to better understand the potential geotechnical risks posed to the safe operation of the railway. Amey Consulting undertook a Geotechnical Risk Assessment (COY5WESAD-GEO-REP-AVON Rev01, dated 26/10/2018) of third party rock cutting assets between 121m+1320yds and 124m+0660yds. 3No. locations were identified as high risk and the installation of Catch Fences or Rockfall Barriers were recommended to protect the railway;

- Rockfall Barrier Location No. 1: 122m+1700yds to 123m+0090yds;
- Rockfall Barrier Location No. 2: 122m+1500yds to 122m+1550yds;
- Rockfall Barrier Location No. 3: 122m+0565yds to 122m+0700yds.

Network Rail Design Delivery (NRDD) has provided rockfall barrier designs, assuming the extents identified in the Amey Report. As part of the design process NRDD has applied the following methodology;

- Site walk over;
- Survey of site geometry and rock discontinuities;
- Characterisation of rock parameters to produce design values;
- Slope geometry characterisation from Geo-RINM Lidar and site based estimation;
- Rockfall analysis using Rocscience RocFall 2019 for Rockfall Barrier locations;
- Design of Foundations and fence anchors to BS8081:2015; and,
- Production of drawings and details.

Ongoing discussion between Network Rail and the Client has highlighted a number of areas of discussion with regards to the environmental impact of the placement of Rockfall Barriers within the Avon Gorge Site of Special Scientific Interest (SSSI) and Special Area of Conservation (SAC). Amendments have been made to bring the proposed solution in line with the requirements of the DCO and the Avon Gorge Vegetation Management Plan (AGVMP - TR040011 dated November 2019).

*NRDD Management System Document Control (NOT for project use)*

Reference:	NR-IP-EN-DD-GF-273		Version:	1.03	Classification:	Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED		

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## 2. DESIGN ASSUMPTIONS

The following assumptions have been made during the design development;

- Site survey work was undertaken on foot and rope access. Measurements of geological data were taken. Due to access restrictions, vegetation cover (NRDD were instructed to that there could be no vegetation clearance) and time constraints, an exhaustive survey could not be completed. Therefore, potential rock fall volume is based on site observations and calculations of volume from discontinuity data;
- Topographic Survey has not been undertaken and is not available. Design is based on onsite observations and information available from Geo-RINM Lidar. Lidar data is not available for the entire site. Geo-RINM survey information has a buffer of 50m. For sections of slope outside of the 50m buffer, design cross sections have been developed based on site observation;
- A ground investigation has not been undertaken. Rock strength parameters have been selected from BS8081:2015 based on rock type. Rock strength should be verified prior to installation with suitability testing. A conservative rock strength for the Limestone present on site of 0.63MPa was selected;
- The soil mantle thickness at the installation locations is unknown, it is considered likely that the bedrock is shallow and that with minimal excavation rock, will be exposed. In this case the, Rock Foundation installation can be used. However, if soil mantle is found to be significant, a soil foundation will be required and will be subject to design checks;
- De-vegetation works will be required prior to the installation, including grubbing out of roots and air lancing rock slopes. Location specific ecological surveys have not been undertaken;
  - Discussion with a Rockfall Barrier manufacturer indicates that de-vegetation requirements are limited. This is further discussed in Section 3.
- As a topographic survey has not been undertaken, setting out locations are based on the proximity to the rock cuttings. Locations have a tolerance detailed to allow for variation based on actual site conditions. Rockfall barrier fence post spacing has been set to the minimum of 6m, for costing purposes. With improved topographic survey and better understanding of specific ecological constraints this spacing could be increased up to 12m. Final fence post locations to be agreed with the Client, Manufacture and Designer within the constraints of the design;
- The origin of rock blocks on site cannot be confirmed, i.e. rockfall or quarrying, therefore the rockfall barriers have been designed on worst case rock size observed onsite. Further discussion with the Client / Route to clarify residual risk could allow for the reduction in assumed rock block sizes and as a consequence, rock fall barrier specification;
- The Design assumes that a single higher energy barrier is appropriate. Depending on Client preference a series of lower energy barrier down slope could be utilised. However, this would require more barriers and as a consequence additional vegetation clearance and residual risk.
- The position of the barriers on the slope have been positioned for ease of construction (i.e proximity to track). Depending on Client preference this could be moved further from track.

Reference:	NR-IP-EN-DD-GF-273	Version:	1.03	Classification:	Official
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However, additional constraints to construction may be realised and require further design checks.

- Rockfall Barrier type and dimensions are based on the output of Rocscience RocFall 2019;
- The design is based on the installation of proprietary products from Geobrugg AG. The use of a different manufacturer is possible, subject to design checks;
- The Rockfall Barriers will be installed outside of the Network Rail land boundary in third party land. The assets will be owned and maintained by the third party land owner.

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### 3. DESIGN DEVELOPMENT

The requirement for the installation of Rockfall Barriers was identified by Amey Consulting as part of their Geotechnical Risk Assessment. The length and position of Rockfall Barriers indicated by Amey Consulting was used to inform the AGVMP and the DCO.

As part of the geotechnical assessment undertaken by NRDD, further areas of potential rockfall risk were identified beyond the original extents of the proposed Rockfall Barriers No. 2 and No. 3. It has therefore been recommended to extend the Barriers to account for the risk.

It has been highlighted that the increase in length of Rockfall Barrier No. 2 and No. 3 will result in the potential for additional habitat loss. This is based on the use of a 5m strip of removal of vegetation along the length of the Rockfall Barrier No. 2 and No. 3, and a 4m strip at Rockfall Barrier No. 1.

As part of discussions with the manufactures of the Rockfall Barriers, Geobruigg AG, it is considered that a maximum vegetation strip of 3m is sufficient for installation. If the Rockfall Barriers are installed using a 3m vegetation strip then the habitat loss at Barrier No. 2 is reduced to 198m<sup>2</sup> of ancient woodland and at Barrier No. 3 to 360m<sup>2</sup> of secondary woodland. These values are within the DCO estimates based on the Amey Consulting Geotechnical Risk Assessment. The comparison is presented in Table 1.

*Table 1: Vegetation removal comparison*

Rockfall Barrier	Barrier Type	AGVMP		NRDD	
		Barrier Length (m)	De-vegetation Area (m <sup>2</sup> )	Length (m)	De-vegetation Area (m <sup>2</sup> )
1	GBE-500A-R	147	588	126	378
2	GBE-500A-R	52	260	66	198
3	GBE-100A-R	78	390	120	360
<b>Total:</b>		<b>277</b>	<b>1238</b>	<b>312</b>	<b>936</b>

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#### 4. ROCKFALL BARRIER REQUIREMENTS

As part of the design process, Geobrugg Rockfall barrier systems have been utilised. The existing rockfall barrier installed adjacent to the POD in the Avon Gorge is a Geobrugg GBE-500A-R. Alternative rockfall barriers can be installed, however these would be subject to design checks. The Geobrugg GBE A-R system has been selected for ease of construction/installation and maintenance. The system utilises a ridged fence post with strut, installed on a foundation. This removes the need for back anchors, reduces drilling requirements and complexity of installation. Major variations in the direction of the Barrier require the installation of intermediate anchors, however these are installed in close proximity to the fence post foundation.

The rockfall barriers have been designed based on the assumption that the construction and installation of the Rockfall Barriers would be from Network Rail land. This will allow for excavator mounted drilling of foundation anchors and movement of materials which reduces the area of vegetation clearance for access. However, construction methodology is to be confirmed by the Projects Construction Managers and with agreement from the Client and other stakeholders.

The geotechnical assessment and subsequent design identified that a 3m high Rockfall Barrier at locations No. 1 and No. 2, and that a 2m high Rockfall Barrier at locations No. 3 would mitigate the potential for rockfall to reach track

However, as part of the review process the height of the Rockfall Barriers of 3m was considered to not align with the requirements of the DCO. Therefore, the heights of Rockfall Barrier No. 1 and No. 2 has been reduced from 3m to 2m. Rockfall Barrier No. 3 remains at 2m height, at the request of the Client. The reduction in height results in an increase in risk of rockfalls overtopping the barrier. A preliminary assessment of the increase in risk has been undertaken and is presented in Table 2.

200 computations were undertaken, of these, a number do not complete within the timeframe of the computation, i.e. the rock does not come to a standstill. If computation could be extended these rocks might reach the Rockfall Barrier, but are likely to have minimal energy. These rocks are classed as not having passed the barrier. Of those that reach the barrier the impact height along the barrier can be estimated.

NRDD Management System Document Control (NOT for project use)

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Table 2: Risk of rockfall overtopping barrier where height has been reduced.

Rockfall Barrier	Barrier Type	Percentage Stopped at Barrier (3m Height)	Percentage Stopped at Barrier (2m Height)
1	GBE-500A-R	100	98.0
2	GBE-500A-R	100	98.5

The modelling undertaken at this stage can be further refined upon completion of more comprehensive survey work to better understand the geometry of the slope.

Based on the reduced height the following estimate of the volumes of materials has been presented below. This is subject to agreement of the final position of the rockfall barriers and opportunity to undertaken testing.

Table 3: Outline Volume requirement for Rockfall Barriers

Rockfall Barrier	Barrier Type	Height (m)	Length (m)	No. Fence Posts	Anchor No.	Drill Depth (m)
1	GBE-500A-R	2	126	22	46	191
2	GBE-500A-R	2	66	12	26	108
3	GBE-100A-R	2	120	21	44	154
<b>Total:</b>			<b>312</b>	<b>55</b>	<b>116</b>	<b>452</b>

#### 4.1 Ecological Considerations

The GBE system utilises ridged fence posts with no requirement for installation of back anchors to restrain the barrier, reducing vegetation removal. There is flexibility within the GBE system to work around potential ecological constraints. Furthermore, depending on the slope geometry there is the potential to vary the angle between fence post locations by up to 5°. This angle can be increased up to 15° with the addition of intermediate anchors. This flexibility during construction will allow the installation of the Rockfall Barrier to be undertaken so as to mitigate the disturbance of existing protected species such as Whitebeams and Bristol Rock-Cress. The marking out should be undertaken in conjunction with the Project Ecologist, and a watching brief should be undertaken during construction.

#### 4.2 Landscape and Visual Impact

The construction on the barriers is envisaged to be undertaken from track using long reach RRVs or cranes for the drilling of foundation anchors, movement of materials and placement of fence posts. If concrete foundations are required it is considered likely that a concrete pump could be used to

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Reference:	NR-IP-EN-DD-GF-273		Version:	1.03	Classification:	Official
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED	

TECHNICAL NOTE		
Issue number	P02	Page 9 of 11
Issue date	14 <sup>th</sup> May 2020	

pour from track level to the barrier location. The intention of working from track level would reduce the necessity for disturbance of existing vegetation. Compounds and material stores would be remote from the worksite.

Rockfall Barrier No. 3 has been highlighted as posing a potential visual impact on the Avon Gorge. The woodland at this location is open, therefore the area of vegetation clearance is likely to be limited. Additional planting could be undertaken to assist in screening the Rockfall Barrier if this is in line with the Vegetation Management Plan.

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TECHNICAL NOTE		
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Issue date	14 <sup>th</sup> May 2020	

## 5. ITEMS FOR DISCUSSION

- Opportunity for investigation testing prior to the installation of rockfall barriers to verify ground conditions and provide potential savings. A conservative estimate of rock strength has been used, a higher rock strength proven with investigation testing could substantially reduce anchor requirements;
- Confirmation required that National Trust are willing to take ownership of the Rockfall Barriers, including Maintenance. This discussion is to be progressed by the Sponsor.
- Construction Managers to provide input to construction methodology.

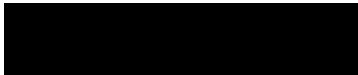
NRDD Management System Document Control (NOT for project use)


Reference:	NR-IP-EN-DD-GF-273		Version:	1.03	Classification: Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED	

# TECHNICAL NOTE

Issue number	P02	Page 11 of 11
Issue date	14 <sup>th</sup> May 2020	

## 6. FORMAL ACCEPTANCE OF PROPOSED ROCKFALL BARRIERS BY ASSET MANAGER AND DESIGNATED PROJECT ENGINEER

<b>DPE</b>	<b>Robert Buckby</b>
Comments  None	
Signed	
Date	26/05/2020

<b>Asset Manager</b>	<b>James Stockall (Route Asset Manager Geotechnical, Drainage and Off-Track)</b>
Comments  None	
Signed	
Date	23/06/2020

NRDD Management System Document Control (NOT for project use)

Reference:	NR-IP-EN-DD-GF-273	Version:	1.03	Classification: Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED

APPENDIX A: DRAWINGS

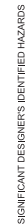
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Reference:	NR-IP-EN-DD-GF-273		Version:	1.03	Classification: Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED	



LINE REF: POD 121m 1320yds TO 124m 0660yds

SCALE: NTS


$$\overline{122m+1700vds} \quad TQ \quad 123m+0090vds$$

SCALE 1:500



122m+1500vds TO 122m 1550vds

SCALE 1:500

L1\_GS-1122E-170522-GBE-600A-R-SYSTEM-DRAWING

6. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH THE FOLLOWING DOCUMENTS:

OF 1981 TO 1982

PRODUCT-MANUAL-16\_190305  
PRODUCT MANUAL 08\_180524  
001

6. ECOLOGICAL ASSESSMENT AND ENVIRONMENTAL MANAGEMENT PLAN TO BE UNDERTAKEN BY THE CONTRACTOR, WHERE REQUIRED. AS PART OF THE WIDER SCHEME A VEGETATION MANAGEMENT PLAN HAS BEEN

TP040011-000M71-6 25 ES VOLUME 4

7. CONTRACTOR RESPONSIBLE FOR ACQUIRING AND MAINTAINING ALL NECESSARY CONSENTS AND LICENSES FOR UNDERTAKING WORKS.

8. BURIED SERVICES DATA TO BE REVIEWED PRIOR TO EXCAVATION/ BREAKING GROUND. HAND EXCAVATIONS TO CHECK FOR OBSTRUCTIONS, TO BE UNDERTAKEN WHERE NECESSARY, AS PER NR/L2/INUCP1030.

9. ALL WORKS TO BE IN GENERAL ACCORDANCE WITH MODEL CLAUSES FOR CIVIL ENGINEERING WORKS NR/L3/CIV/140 UNLESS OTHERWISE SPECIFIED ON THE DRAWING.

10. ROCKFALL BARRIER LOCATIONS ARE SHOWN INDICATIVELY. SETTING OUT LOCATIONS WILL BE FINALISED UPON AGREEMENT OF BARRIER LOCATION WITH THE CLIENT AND PRINCIPAL CONTRACTOR.

11. ROCKFALL BARRIERS TO BE INSTALLED ON THIRD PARTY LAND

P02	14.05.20	MINOR AMENDMENTS	PS	JM	JM
P01	06.03.20	FOR CLIENT INFORMATION	PS	JM	JM
REV	DATE	DESCRIPTION OF REVISIONS	DRAWN	CHECKED	APPROVED

## SAFETY HEALTH AND

## ENVIRONMENTAL INFORMATION

THE HAZARDS AND RISKS ASSOCIATED WITH THE WORKS SHOWN ON THIS DRAWING AND DESCRIBED IN THE SCHEDULE OF WORKS ARE CONSIDERED TO BE WITHIN THE REASONABLE, NORMAL AND ACCEPTABLE LIMITS FOR GENERAL BUILDING AND MAINTENANCE WORKS. PLEASE REFER TO DESIGNER

RISK ASSESSMENT  
DOCUMENT REF: 140569-NRD-RAR-ECV-2000001

STATUS	SUITABILITY CODE
--------	------------------

FOR INFORMATION S4



Bristol Temple Point, Redcliffe Way, Bristol, BS1 6NL  
Tel: 01173 720300 Web: [www.networkall.co.uk](http://www.networkall.co.uk)

---





METROWEST PLAZA

## ROCKFALL BARRIERS

**DRAWING TITLE:**

## ROCKFALL BARRIERS

1 OF 2

DESIGNED	SIGNED	DATE
P. STAUNTON		14/03/2020
DRAWN	SIGNED	DATE
P. STAUNTON		16/03/2020
CHECKED	SIGNED	DATE
J. MARTIN		14/03/2020
APPROVED	SIGNED	DATE
J. MARTIN		14/03/2020

SCALE (1:100) (SEE PLAN FOR SCALE)

ELR

POD

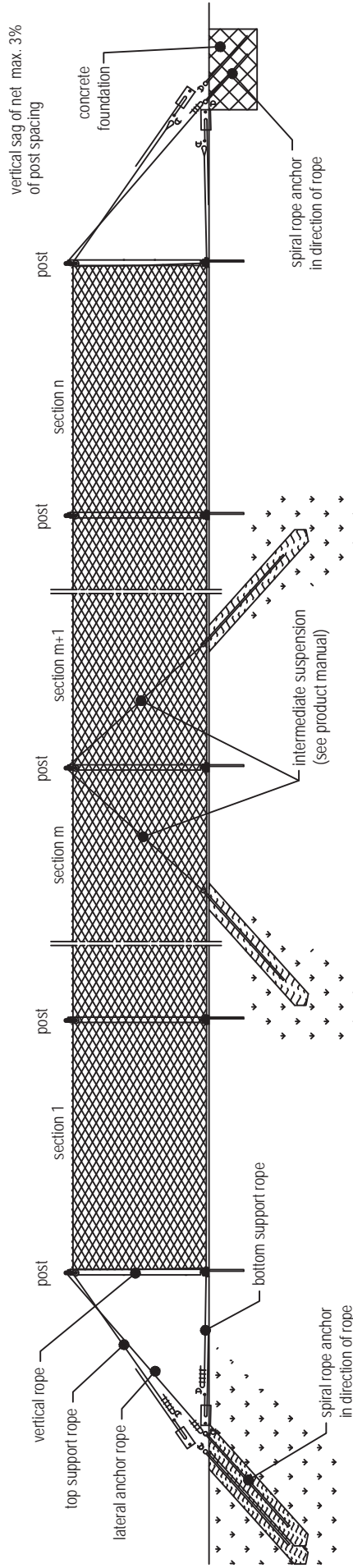
122m 0550x48 - 123m 0220x48

REVISION D02  
 DRAWING NUMBER JOE50 NIPD MW14 D0D D0C F0V 200004

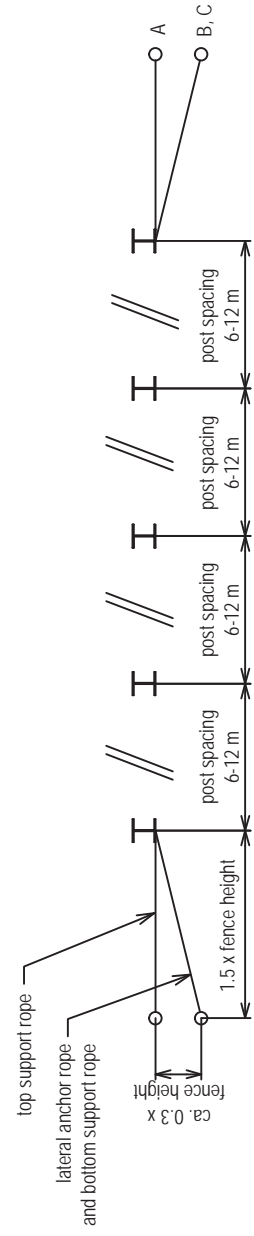
CAD TEMPLATE : NBPDPBAC-YORK-A1-w1.0.dwt



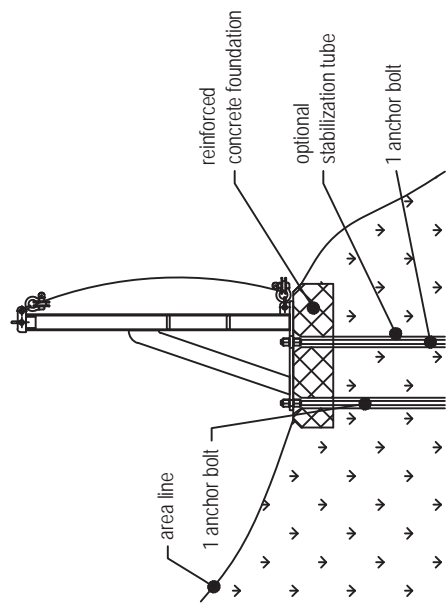




layout of anchor points  
(details see product manual GBE-500A-R)

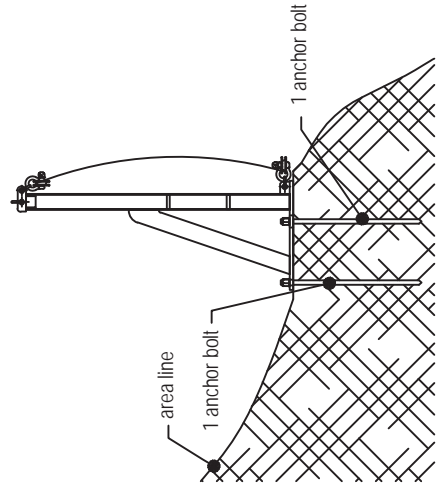


- anchoring in loose soil: with 2 anchor bolts vertical



- anchoring concrete foundation: for all types of soil

- anchoring in bedrock: with 2 anchor bolts vertical



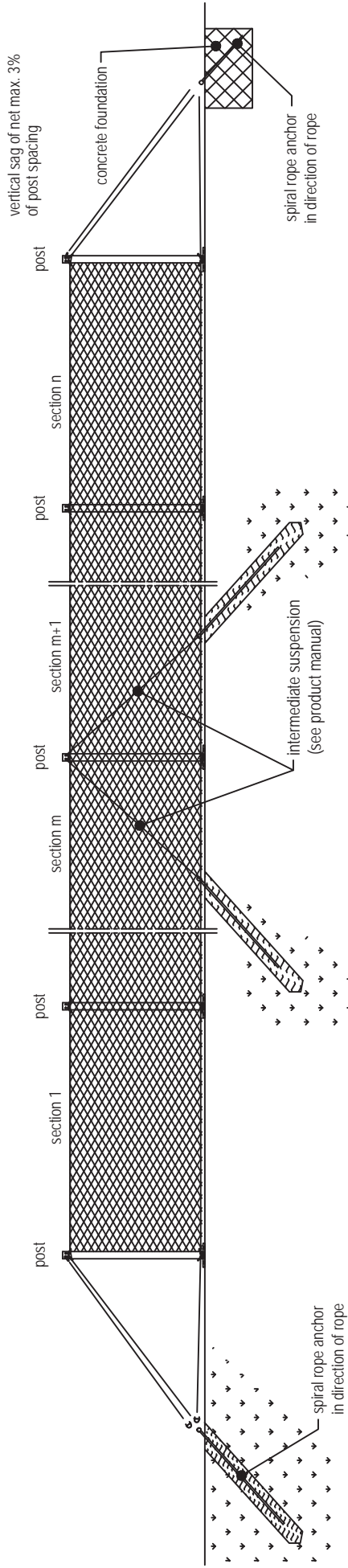
**NOTE:**  
Rockfall, landslides, debris flows or avalanches are sporadic and unpredictable. Causes can be e.g. human (construction, etc.) or environmental (weather, earthquakes, etc.). Due to the multiplicity of factors affecting such events it is not and cannot be an exact science that guarantees the 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: GS-1122e ed: 16.09.16 replaced by:				
							
<b>Rockfall protection barrier</b>							
<b>GBE-500A-R System</b>							
<b>EOTA classification 2 (500 kJ)</b>							
			drawn	22.05.17	BIH		
			checked	22.05.17	BIH		
			approved	22.05.17	LAA		
			<b>GS-1122 e</b>				

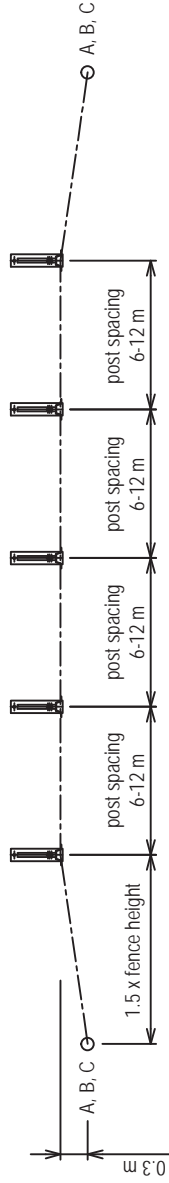
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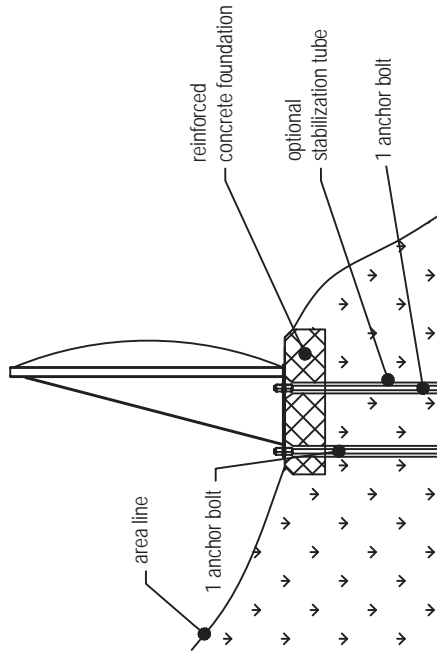
GEOBRUGG AG  
CH-8590 Romanshorn



layout of anchor points  
(details see product manual GBE-100A-R)

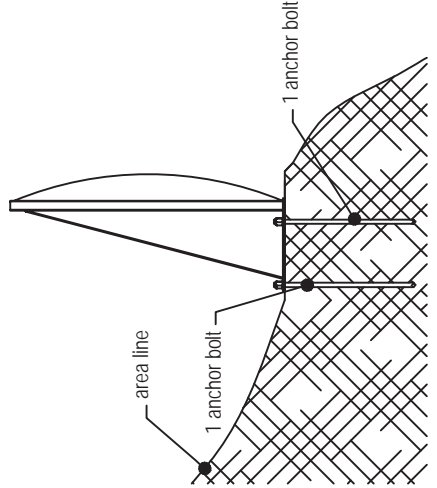


- anchoring in loose soil: with 2 anchor bolts vertical





- anchoring concrete foundation: for all types of soil

- anchoring in bedrock: with 2 anchor bolts vertical



**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: GS-1131e ed. 18.05.16 replaced by:		
					
Rockfall protection barrier					
GBE-100A-R system					
EOTA classification 0 (100 kJ)					
			drawn	22.05.17	BIH
			checked	22.05.17	BIH
			approved	22.05.17	LAA
GEOBRUGG AG CH-8590 Romanshorn			 <b>GEOBRUGG</b> arbug		GS-1131 e

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APPENDIX B: LOCATION PHOTOGRAPHS

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Site Diary

Photos

**Photo 1:** Loose rock on face of outcrop at Rockfall Barrier No. 1.



**Photo 2:** Rockfall below outcrops at Rockfall Barrier No. 1.



NRDD Management System Document Control (NOT for project use)

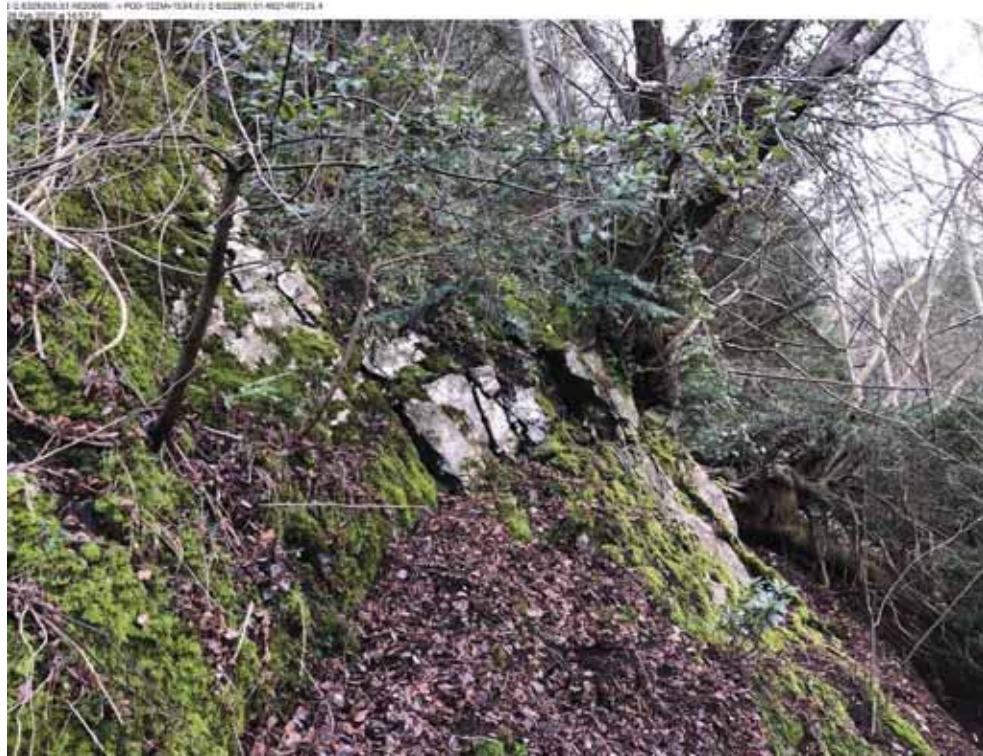
Reference:	NR-IP-EN-DD-GF-280	Version:	1.01	Classification: Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED



Site Diary

Photos

**Photo 3:** Loose rock on face of outcrop at Rockfall Barrier No. 2.



**Photo 4:** Rockfall below outcrops at Rockfall Barrier No. 2.



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Reference:	NR-IP-EN-DD-GF-280	Version:	1.01	Classification: Official	
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Site Diary

Photos

**Photo 5:** Loose rock on face of outcrop at Rockfall Barrier No. 3.



**Photo 6:** Rockfall below outcrops at Rockfall Barrier No. 3.



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APPENDIX C: DRA

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### Design Risk Assessment

Discipline(s)	Ref	Hazard description	Hazard consequence	Phase	Risk level		Mitigation measures	Residual hazard	Residual risk level		Residual risk - and - Method of communicating mitigation measures and residual risk  Inform = I	Residual Risk Drawing Reference
					Construction / Operation / Maintenance / Demolition	Likelihood			Likelihood	Severity		
								High				
G	2	Setting Out – Topographic survey unavailable.	Failure of Rockfall Barrier leading to injury/death of passengers	C	M	H	No topographic survey has been undertaken. Setting out based on proximity to rock cuttings/track. Designer/Manufacturer representative should be present during setting out to ensure design is appropriately installed. Flexibility within the system allows for variations in setting out to provide better ground.	R	L	H	This document.	2
G	3	Ecological Constraints – site designated SSSI, SAC, National Nature Reserve. Site contains protected species including Whitebeams.	Damage to protected species/designated sites. Limitations to construction/installation of Rockfall Barriers	C	H	M	There is flexibility within the designed system to accommodate protected trees. The system can be placed at the most appropriate location to avoid excessive de-vegetation works and potential damage to protected areas. Principal Contractor to employ ecologist on site during construction to provide watching brief.	R	M	M	This document.	3
G	4	Rockfall Mass – estimated based on existing rockfall material and visible potential rockfall material.	Failure of Rockfall Barrier. Damage to network rail assets. Injury/death to passengers.	C	L	H	Rock volume has been estimated based on the material observed onsite as potential fall material or material that has already failed. Design of rockfall barrier has been undertaken with redundancy for additional mass.	R	VL	H	This document.	

Design Risk Assessment

Discipline(s)	Ref	Hazard description	Hazard consequence	Phase	Risk level		Mitigation measures	Residual hazard		Residual risk level		Residual risk - and - Method of communicating mitigation measures and residual risk	Residual Risk Drawing Reference
					Construction / Operation / Maintenance / Demolition	Likelihood		Severity	Reduced or Eliminated or Not Changed,	Likelihood	Severity		
G	5	Maintenance – in the event of rockfall, inspection/ maintenance may be required, and components tested/replaced. System may be under tension in the event of rockfall.	Injury/death to workers.	M	L	H	GBE-500A-R system employs breaker rings outside the rock capture area, allowing for easy maintenance and replacement. All components of the system are replaceable, including mesh panels and fence posts.	R	VL	H	Inform = I This document.		
G	6	Demolition – cables under tension during operation, system under tension in the event of rockfall.	Injury/death to workers.	D	L	H	Tension can be released for the system from either end, reduction in tension will allow for stress release from system.	R	VL	H	This document.		
G	7	Railway Services / Buried Services.	Injury/death to workers.	C / M	L	H	Complete service searches and liaise with statutory undertakers. Permit to dig to be followed. Trough route and railway cables to be protected for the duration of the works. Principal Contractor to undertake full buried services search prior to commencement of construction.	R	VL	H	This document.	4	
G	8	Working at height / working on steep slope.	Serious or fatal injury to staff due to fall from height or fall of an object. Risk of objects falling on track.	C	L	H	Comply with the Working at Height Regulation. Contractor to use competent and trained staff. Use plant restriction zones. Where necessary use line blocks/possessions. Edge demarcation provided during works.	R	VL	H	This document.	5	



Design Risk Assessment

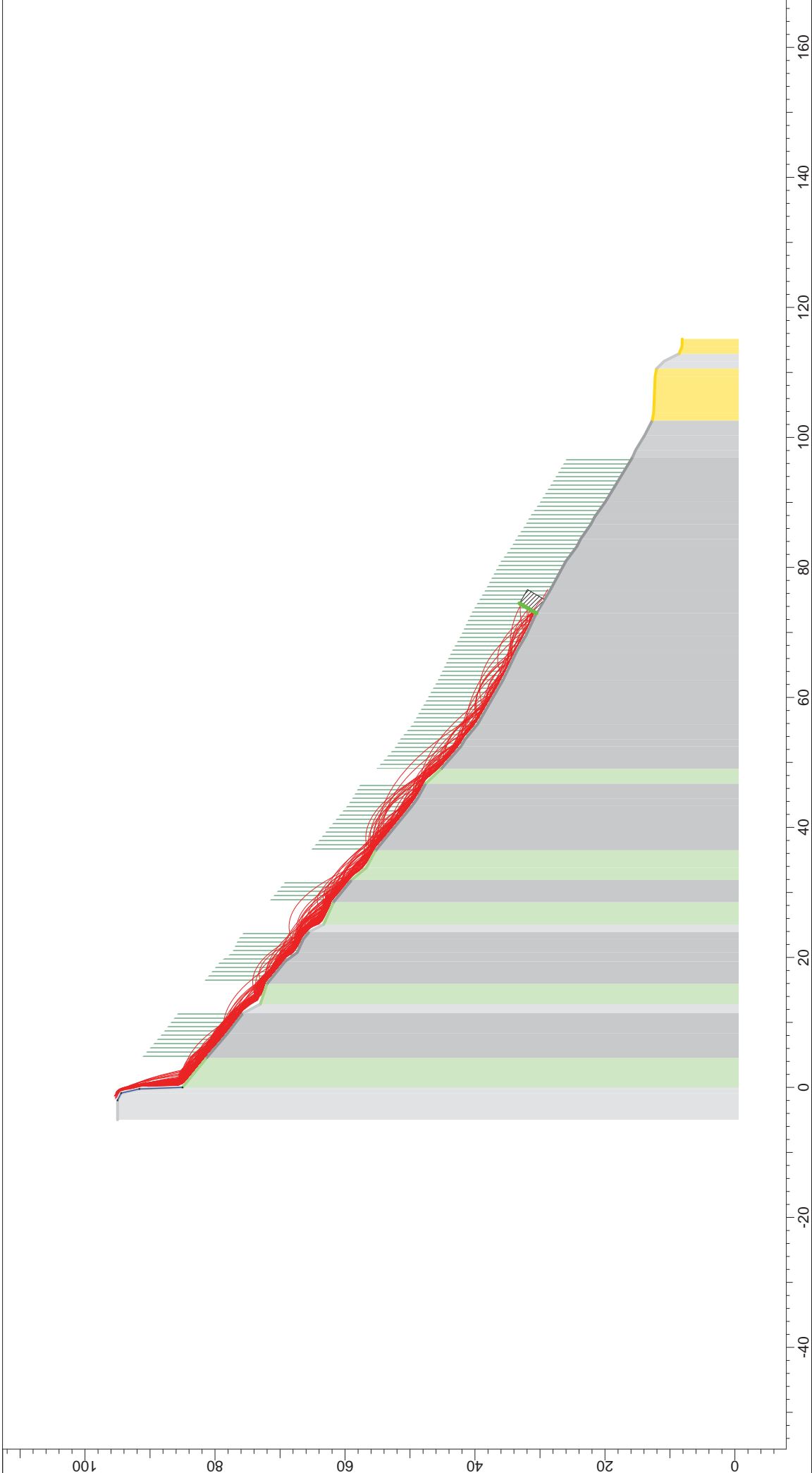
Discipline(s)	Ref	Hazard description	Hazard consequence	Phase	Risk level		Mitigation measures	Residual hazard	Residual risk level		Residual risk  - and -  Method of communicating mitigation measures and residual risk  Inform = I	Residual Risk Drawing Reference
					Construction / Operation / Mice / Demolition	High Medium Low Very Low			Likelihood	Severity		
	9	Working on or near the line.	Injury/death to workers due to impact with train. Damage to train due to plant on track.	C	L	H	Plan and undertake work during possessions or safeguarded, if required. Follow NR procedures and plan works in accordance with NR/L2/OHS/019. Competent staff with PTS and railway experience.	R	VL	H	This document.	6
G	10	Vandalism of permanent works.	Damage/failure or permanent works leading to injury/death of passengers, derailment of train.	O	M	H	Location of rockfall barriers to be removed from easy public access. Locfitte can be applied to components, however this reduces ability to maintain system.	Not changed	M	H	This document.	
G	11	Manual handling	Wrong manual handling causing injury to staff.	C	M	M	All staff to be manual handling trained. Activities requiring manual handling to be reduced to a minimum using mechanical means.  Installation of system from track allow the use of RRV's to undertake anchor installation and lift components into place, reducing manual handling requirements.	R	L	M	This Document	



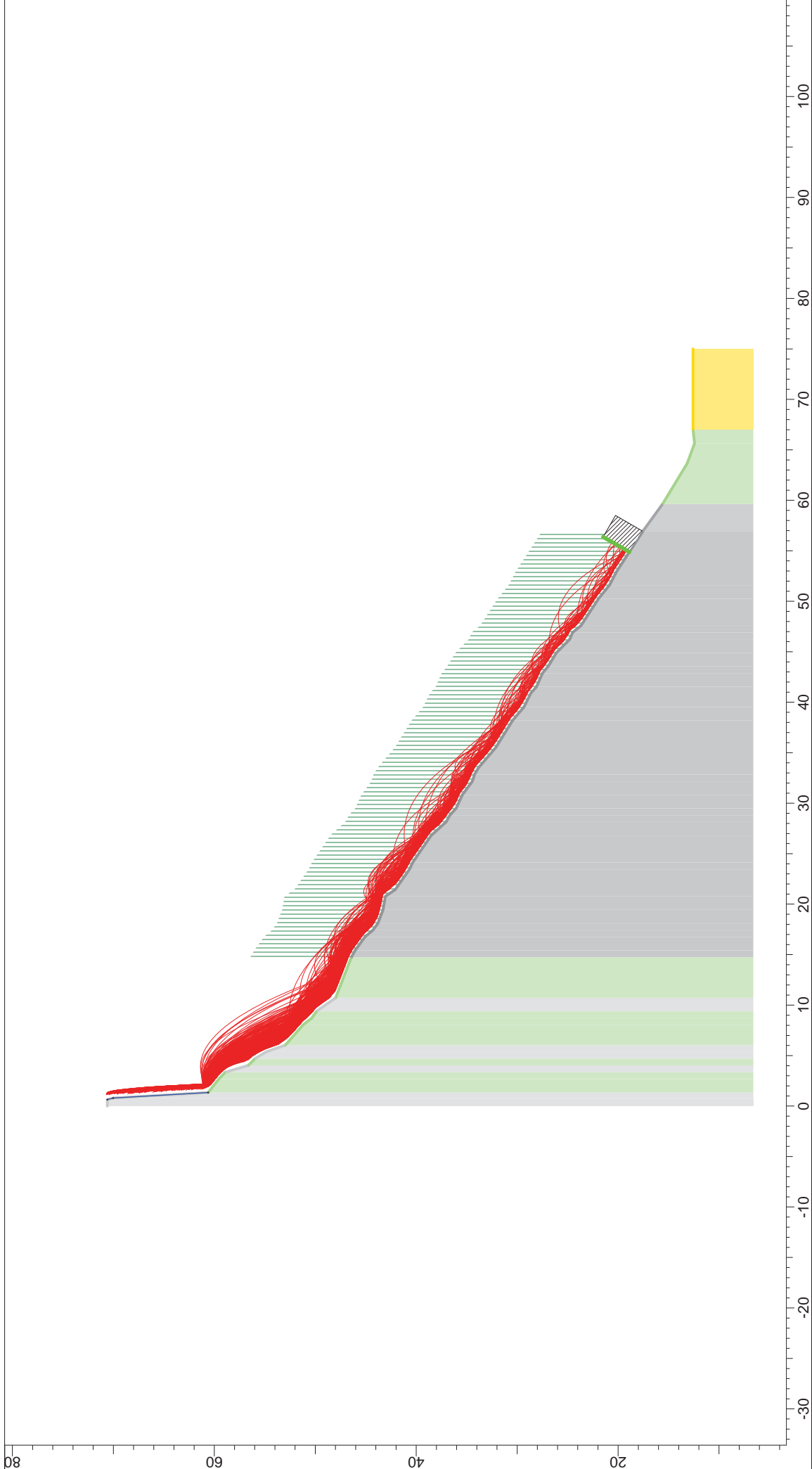
APPENDIX D: ROCSCIENCE ROCFALL 2019 OUTPUT

*NRDD Management System Document Control (NOT for project use)*

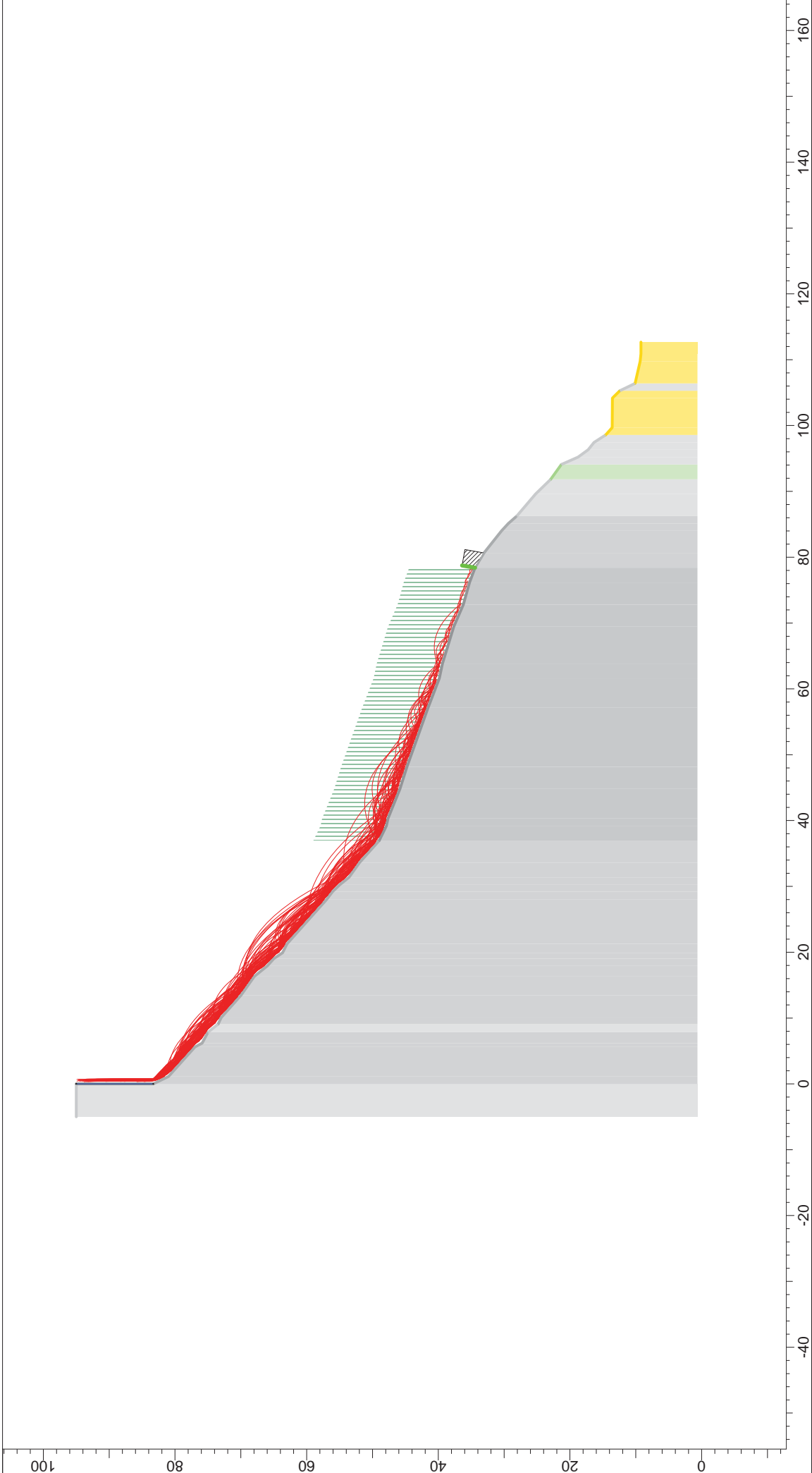
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Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED	



Project		MetroWest Phase I	
Analysis Description		Rockfall Barrier No. 1	
Drawn By		PS	NR
Date		27/02/2020, 12:07:02	Catch Fence No. 1.fal7



Project		MetroWest Phase I	
Analysis Description		Rockfall Barrier No. 2	
Drawn By		PS	NR
Date		27/02/2020, 12:07:02	Catch Fence No. 2.fal7

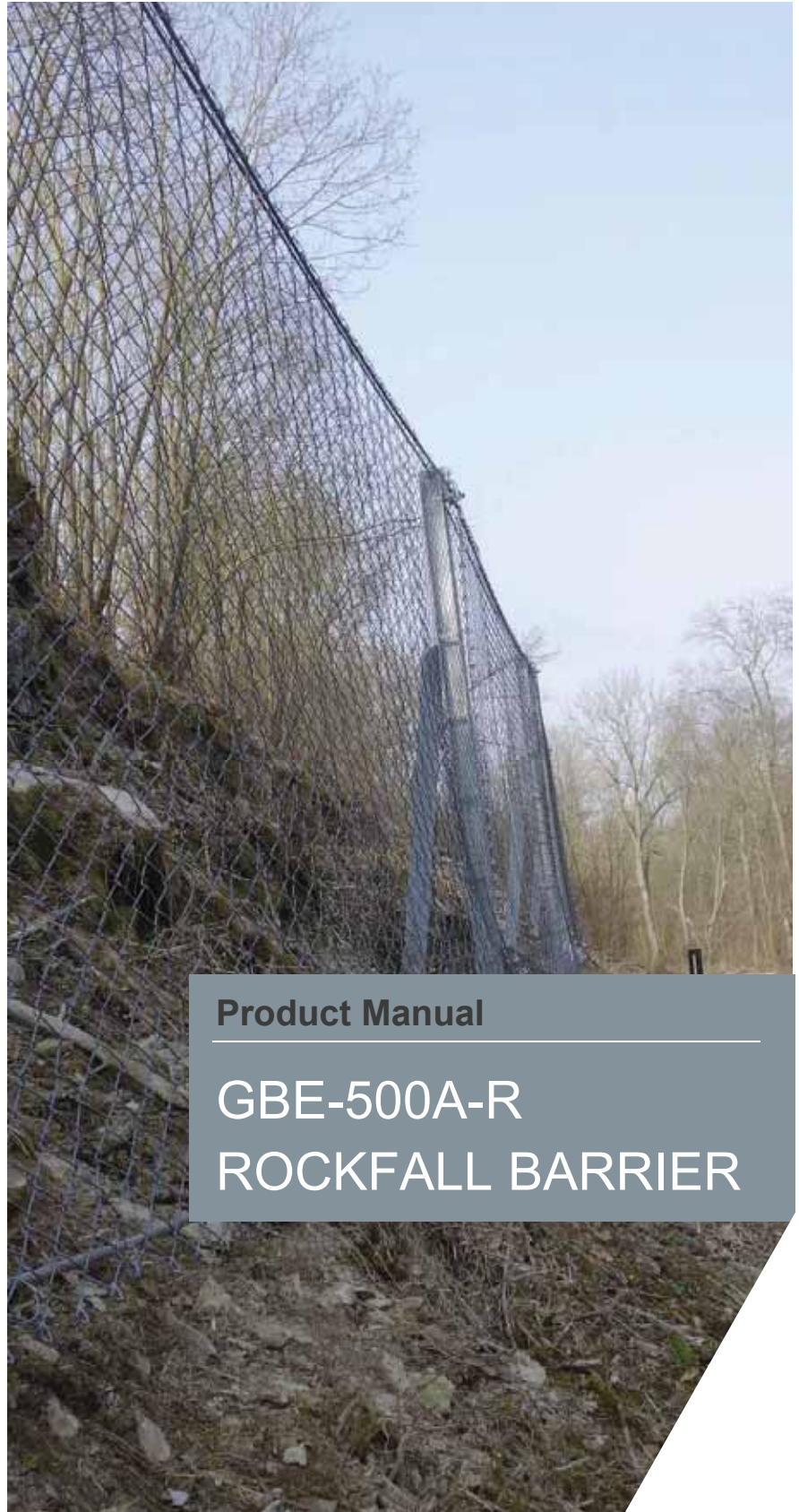


Project		MetroWest Phase I	
Analysis Description		Rockfall Barrier No. 3	
Drawn By		PS	NR
Date		27/02/2020, 12:07:02	Catch Fence No. 3 Worse Credible.fal7

**APPENDIX E: GBE-100A-R & GBE-500A-R PRODUCT MANUALS**

*NRDD Management System Document Control (NOT for project use)*

Reference:	NR-IP-EN-DD-GF-273		Version:	1.03	Classification: Official	
Applicable to:	B&C	E&P	SIGNALLING	TRACK	UNCONTROLLED when PRINTED	



## Product Manual

# GBE-500A-R ROCKFALL BARRIER

**European Technical  
Assessment ETA 16/0329**

**Date:** 05.03.2019

**Edition:** 16

© Geobrugg AG  
8590 Romanshorn  
Switzerland

## PURPOSE AND STRUCTURE OF THE MANUAL

This System Manual ensures that the Geobrugg rockfall protection systems are manufactured without any errors in accordance with the latest technical knowledge, that their area of application is defined, their functional capability specified, and their installation carried out and checked correctly.

**For an overview of the system, see the appendix at the end of this manual**

The System Manual is divided into the following parts:

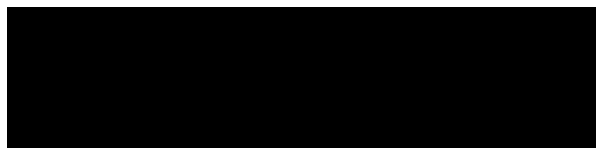
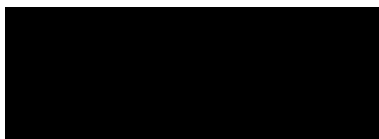
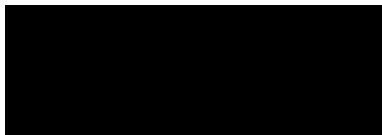
- Proof of quality assurance
- Stake-out
- Assembly details
- System overview / rope routing

This document makes no claim as to its completeness. It is designed for general standard applications and does not consider project-related parameters. Geobrugg cannot be held liable for any additional costs that may be incurred in special cases. Contact the manufacturer if anything is unclear. The General Terms and Conditions of Geobrugg AG apply.

## RESPONSIBLE FOR CONTENTS:

Geobrugg AG  
Schutzsysteme  
Aachstrasse 11  
Postfach  
8590 Romanshorn, Switzerland  
info@geobrugg.com  
www.geobrugg.com

Romanshorn, 05.03.2019



**Geobrugg AG**  
Aachstrasse 11  
CH-8590 Romanshorn  
Switzerland

(Stamp / legally valid signatures)

## **I RANGE OF APPLICATION**

The engineering of rockfall protection systems is based on detailed investigations by specialist engineering companies, which take the following geotechnical aspects in particular into account to define the range of applications:

- Previous rockfall events
- Condition of the rockfall breakout zone
- Assessment of the stability of the entire rockfall zone
- Frequency of rockfall
- Size of the rocks to be caught
- Trajectories and bounce heights of the rocks
- Calculations of the kinetic energy
- Barrier position (taking the local topography into account)
- Anchoring conditions

## **II QUALITY OF THE INDIVIDUAL SYSTEM COMPONENTS**

Geobrugg AG, previously the Geobrugg Protection Systems department of Fatzer AG, based in Romanshorn, Switzerland, has been certified to quality management system requirements (ISO 9001:2008) since August 22, 1995, registered under the number CH-34372. The certifying body is the SQS (the Swiss Association for Quality and Management Systems), to which IQNet belongs. The Quality Manual provides complete information on how individual system parts (primary material, commercial products and end products) must undergo extensive testing to rule out insufficient quality.

## **III FUNCTIONAL RELIABILITY OF THE BARRIER SYSTEMS**

The system's functional reliability is based on 1:1 rockfall tests, performed and tested in accordance with European Technical Approval Guideline ETAG 027 "Falling Rock Protection Kits" in Walenstadt, SG (Switzerland). The 1:1 rockfall tests involve performing vertical impacts into the middle field of a three-field barrier, where the posts are spaced at 10 m and an impact speed of at least 25 m/s is reached. The tests are accepted by a notified body and receive an approval, known as an ETA (European Technical Approval). The approval no. of the GBE-500A-R system is ETA – 16/0329.

## **IV QUALITY CONTROL FOR INSTALLATION**

This system manual provides a detailed description of how to design and install the barrier.



## **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).

In contrast to the one-to-one rockfall tests, which indeed test an extreme load case but still only demonstrate a standardized situation, in the field the layout and design of a protection system can vary greatly because of the topography. The influence of such alterations and adaptations cannot always be determined exactly. Critical points are, for example, post spacing, changes in direction, placement angle of the rope anchor, and the direction and velocity of impact.

Geobrugg can assist with estimating the influence of larger deviations and special situations and can offer recommendations for feasible solutions. Geobrugg cannot, however, guarantee the same behaviour as in the one-to-one rockfall tests. In critical cases, it is advisable to reinforce particular components as compared with the standard barrier.

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## EXPLANATION OF SYMBOLS USED



Safety information: Must be followed



Note/reminder that will help you to install the system easily and correctly



Consultation with Geobruigg is recommended



Upslope



Downslope

## 1 HAZARD NOTES

### QUALIFICATION OF THE GROUP LEADER



Only a qualified group leader may be put in charge of the installation.

### TENSIONED ROPES



Ropes will be tensioned. When installing and pretensioning ropes, ensure that there are no persons within in the danger area.

### RELEASING TENSIONED PARTS



Releasing or separating tensioned parts should be avoided wherever possible. If this is necessary, however, please exercise the utmost caution.

STAKING-OUT	<ul style="list-style-type: none"> <li>• 30 – 50 m measuring tape</li> <li>• Measure stick</li> <li>• 5 red and white ranging poles</li> <li>• Inclinometer</li> <li>• Spray can</li> <li>• Wooden peg or iron peg (min. 3x for each field)</li> <li>• Hammer/mallet</li> <li>• Manual</li> </ul>
INSTALLATION	<ul style="list-style-type: none"> <li>• Open-ended or ring wrench</li> <li>• Socket wrench set with ratchet</li> <li>• Torque wrench, range 25 – 400 Nm (see tightening torque required for wire rope clips and base plate fastening nuts)</li> <li>• Open-ended wrench for base plate fastening nuts</li> <li>• Felco C16 or C112 wire rope cutter or similar; 12 mm cutting capacity</li> <li>• Cutting-Off wheel or hammer wire cutter; 28 mm cutting capacity</li> <li>• pincers, flat-nose pliers</li> <li>• 2 mm galvanized wire strands or wire</li> <li>• Angle spirit level</li> <li>• Roll of adhesive tape</li> <li>• Rope clamp, small 8 – 16 mm / large 14 – 26 mm (min. 2x)</li> <li>• At least 2 tension belts</li> <li>• Cable winch hoist, e.g. LUG-ALL®</li> <li>• Chain hoist or HABEGGER wire rope hoist, min. 1.5 t (15 kN)</li> <li>• Auxiliary ropes</li> </ul>

### 3 USING THE WIRE ROPE CLIPS

Instructions below apply to all wire rope clips according FF-C-450 type 1 class 1 (similar EN 13411-5 type 2) delivered by Geobrugg AG.

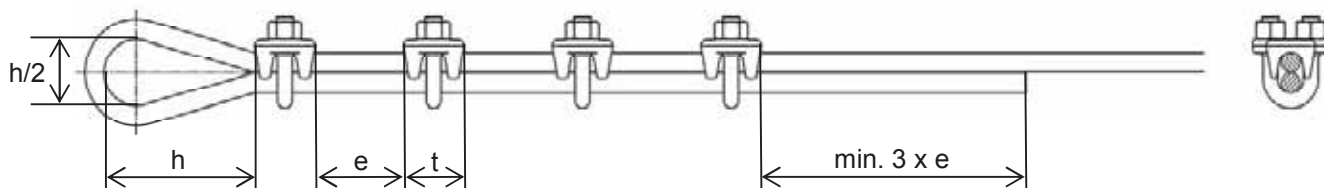
The distance  $e$  between the wire rope clips should be at least  $1 \times t$  but not exceed  $2 \times t$ , where  $t$  is the width of the clamping jaws. The loose rope end has to be  $3 \times e$  at a minimum. Geobrugg recommends looping up the remaining free section and fixing it directly behind the last wire rope clip on the tightened rope.

If you are using a thimble in the loop structure, the first wire rope clip must be attached directly next to the thimble. For loops without a thimble the length  $h$  between the first wire rope clip and the point of load incidence must minimally be 15-time the nominal diameter of the rope. In unloaded condition the length  $h$  of the loop should be not less than the double of the loop width  $h/2$ .

The clamping brackets (U-brackets) must always be fitted to the unstressed end of the rope, the clamping jaws (saddle) must always be fitted to the strained rope („never saddle a dead horse“).



FF-C-450 type 1 class 1



The required tightening torques with lubrication apply to wire rope clips whose bearing surfaces and the threads of the nuts have been greased with Panolin CL 60 multipurpose lubricant spray (or an equivalent lubricant).

During tightening the nuts have to be tensioned equally (alternately) until the required tightening torque is reached.

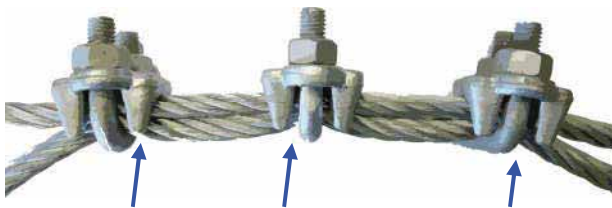
Wire rope diameter [mm]	Size of the wire rope clip	Required amount of wire rope clips	Required tightening torque lubricated [Nm]	Required tightening torque unlubricated [Nm]	Wrench size [mm]
11 - 12	7/16"	3	40	110	22
14 - 15	9/16"	3	50	150	24
18 - 20	3/4"	4	90	180	27



After the first load application the tightening torque has to be checked and if not fulfilled adjusted to the required value.



A visible contusion of the wire ropes positively indicates that the wire rope clips have been tightened to the required tightening torque.



Undamaged wire rope clips could be reused. Especially the threads and clamping jaw have to be checked.

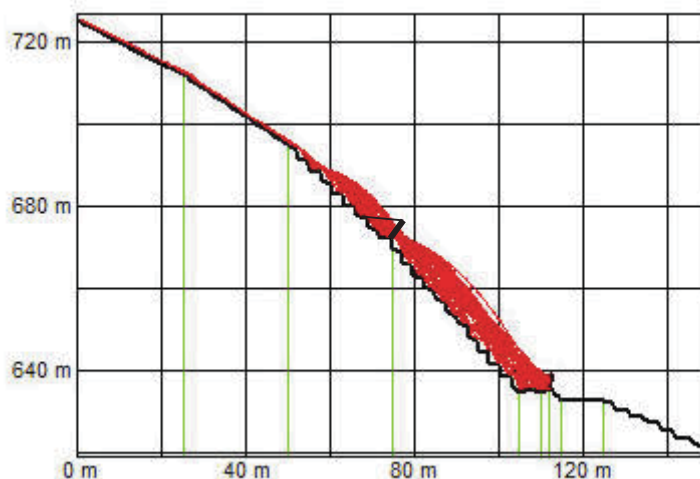


Wire rope clips always must be installed and used with the required tensioning torque.

### GENERAL PRINCIPLES FOR STAKING OUT GEOMETRY

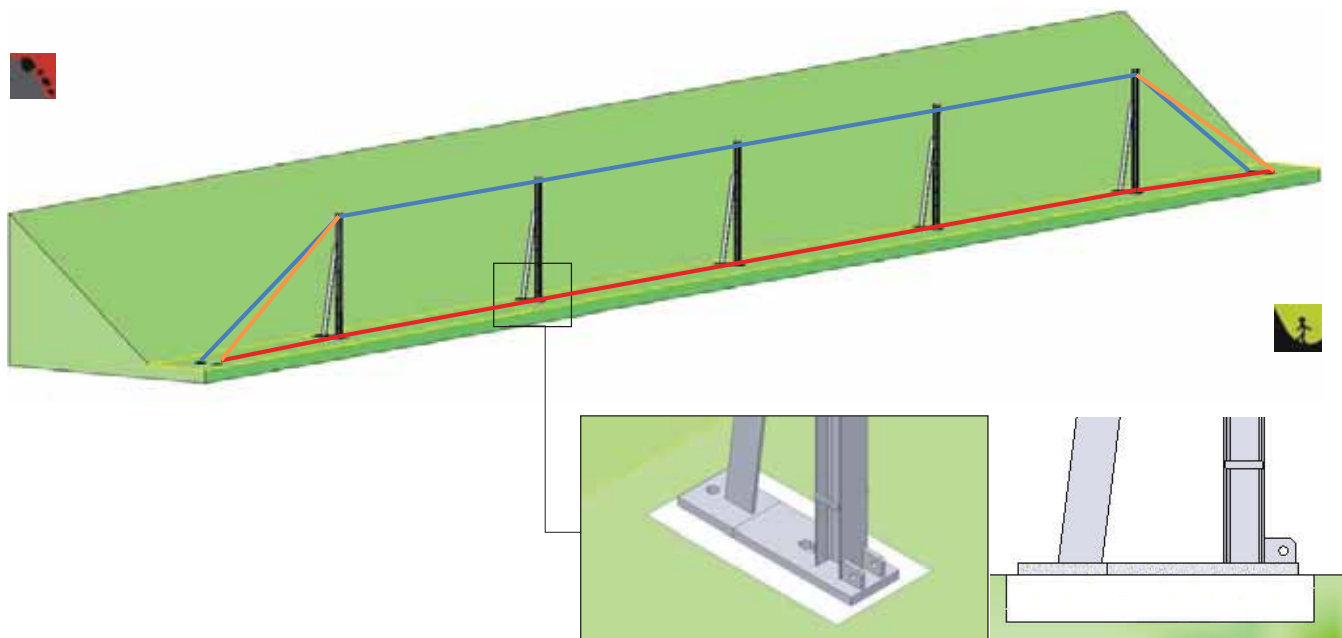
#### Position of the barrier

Tried-and-tested simulation programs are available for determining the optimum position of the barrier. Inappropriate locations with excessive displacements or terrain flaws are identified.



#### Barrier line

It is important to design the barrier line in a way that ensures it is as straight as possible and runs horizontally. Irregular lines as well as depressions and cambers in the terrain between the posts must be avoided or corrected wherever possible.

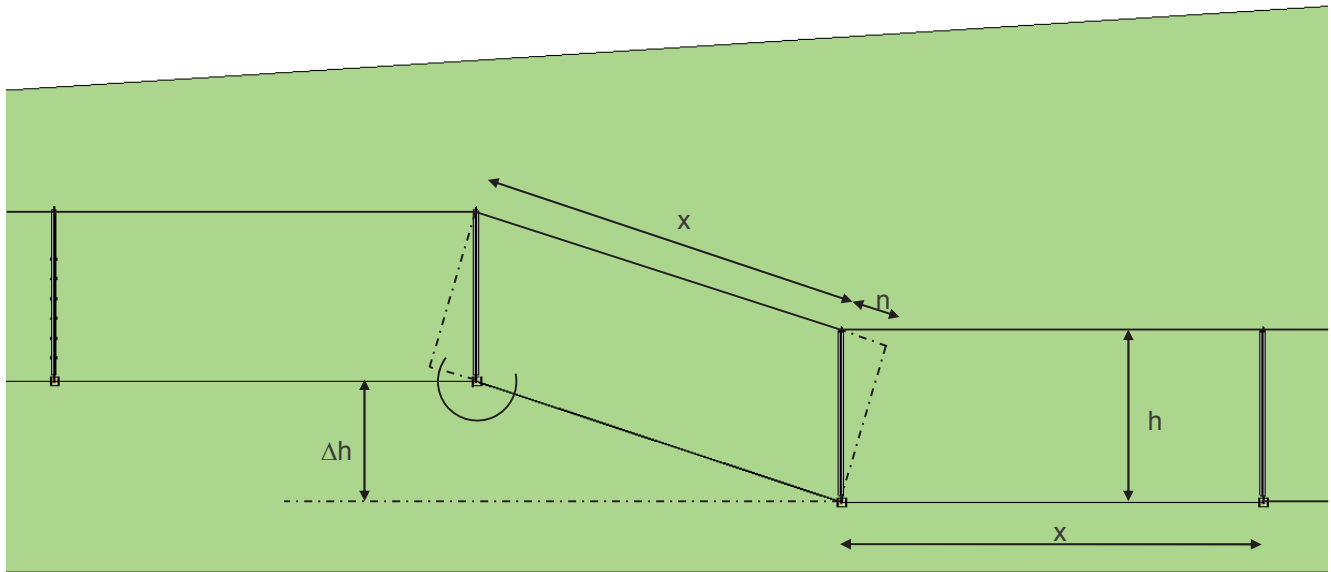


#### Placing the foundations

The base plate support of the foundation must be laid against the terrain in such a way that the lower bottom support rope remains close to the ground.

The base plate must be positioned in such a way that the bottom support rope bypasses and is not damaged by the edges of the foundation.

## Height differences in the barrier line



**h:** Barrier height

**x:** Distance between posts

**n:** Adjustment of the net lengths

**Δh:** Height difference between two adjacent posts

$\Delta h < 2 \text{ m}$  : No adjustment necessary

$\Delta h > 2 \text{ m}$  : Height difference outside standard staking-out parameters. Net must be adjusted

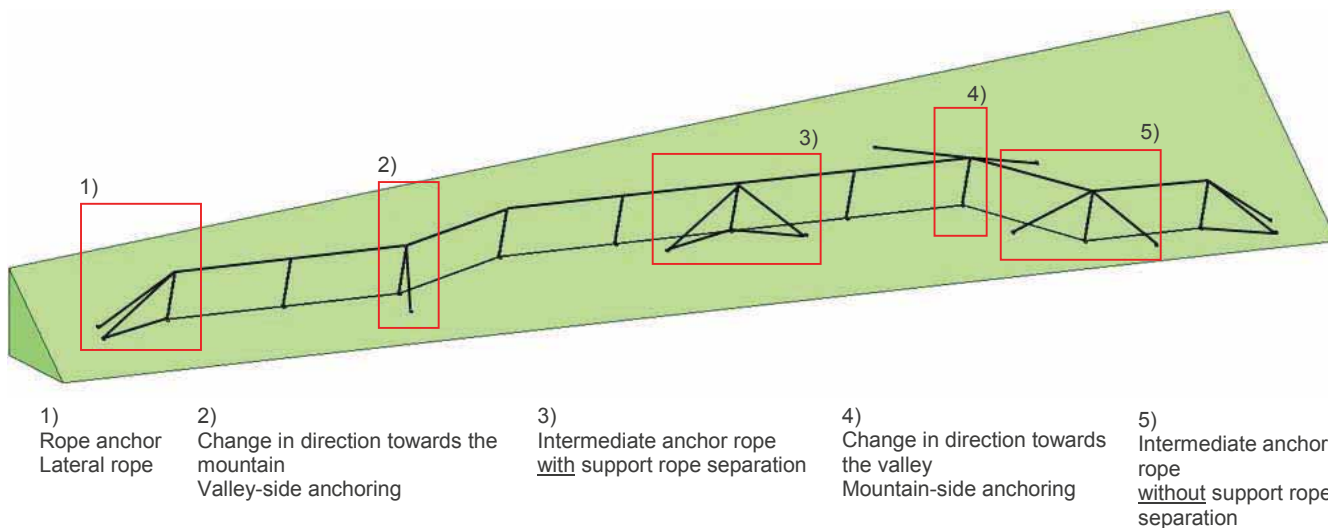
The standard net length is acceptable up to a height difference in the barrier line of 2 m and if the distance between the posts is between 6 m and 12 m.



When the height difference is greater than specified in table 2, contact Geobruigg so that the correct net length can be determined



### GENERAL PRINCIPLES FOR STAKING-OUT GEOMETRY



### Standard Staking-Out measurements

If you comply with the standard staking-out measurements and their tolerances specified on the next few pages, it will be possible to install the barrier without any problems and all components will function properly in the event of an incident.

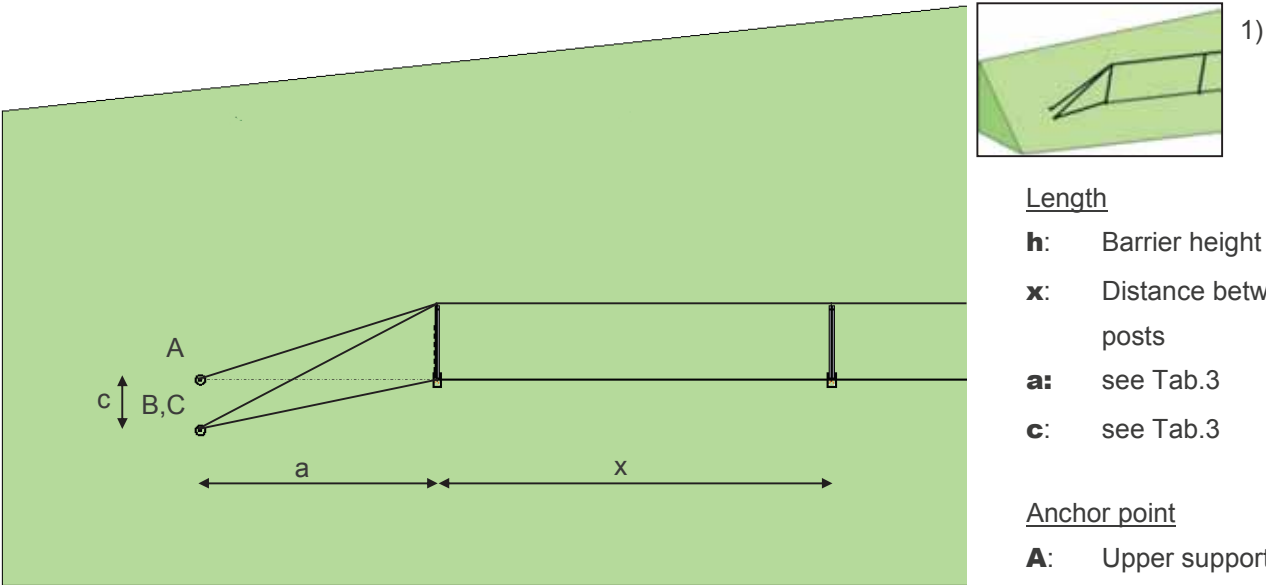
### Adjustments for the terrain

Depending on the terrain, it may not always be possible to comply with the standard staking-out measurements. To ensure that the barrier still functions properly in these cases, you may make several small adjustments to the cross-section or length of nets, ropes, posts, etc.



Informing Geobruag about the deviations enables you to work together to quickly find a solution that is adapted to your requirements.

STANDARD STAKING-OUT PARAMETERS FOR A STRAIGHT BARRIER LINE



The table below is valid for slopes of 30° - 90°.  
Dimensions in m; Dimensional tolerance ± 0.20 m

Tab. 3

h	a	c	e
2.00	3.00	0.65	1.00
3.00	4.50	1.00	1.50
3.50	5.30	1.15	1.75
4.00	6.00	1.30	2.00

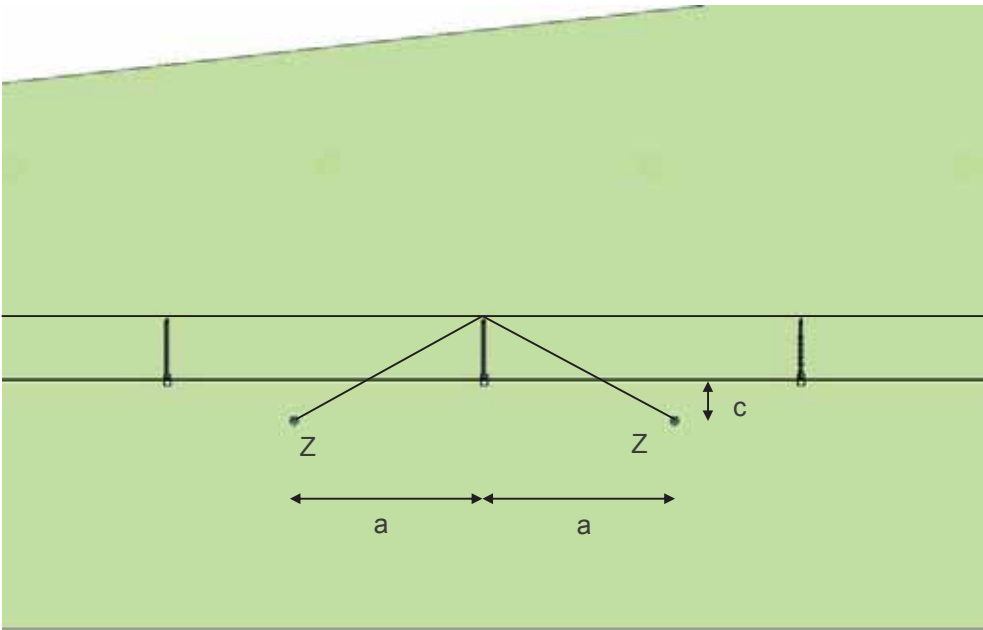
Length

- h:** Barrier height
- x:** Distance between posts
- a:** see Tab.3
- c:** see Tab.3

Anchor point

- A:** Upper support rope
- B:** Lower support rope
- C:** Lateral rope

ANCHOR POINT FOR INTERMEDIATE ANCHOR ROPE



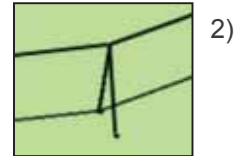
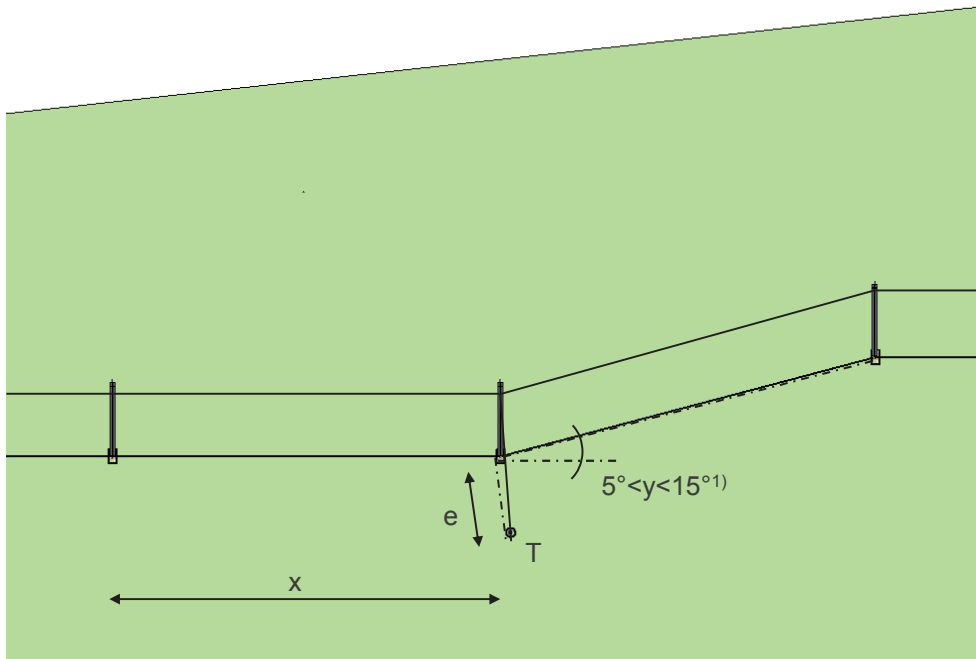
Length

- a:** see Tab.3
- c:** see Tab.3

Anchor point

- Z:** intermediate suspension

## CHANGE IN DIRECTION TOWARDS THE MOUNTAIN



### Length

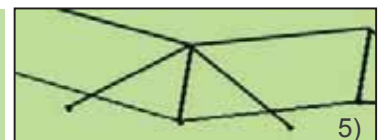
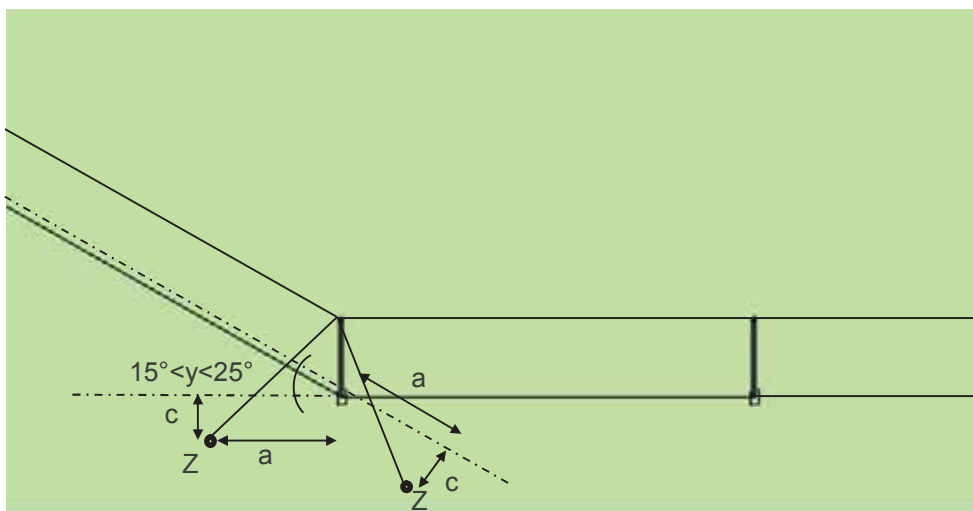
- e:** See Tab. 2
- x:** Distance between posts
- y:** Angle of change in direction

### Anchor point

- T:** Valley-side anchoring

In the case of a change in direction towards the mountain at an angle of  $5^\circ - 15^\circ$ , valley-side anchoring (T) is additionally required. The rope anchor will be positioned on the valley side at the distance (e) from the post. The valley-side anchoring has a diameter of  $d = 12 \text{ mm}$ .

## INTERMEDIATE ANCHOR ROPE



### Length

- a:** see Tab.3
- c:** see Tab.3
- y:** angle of change in direction

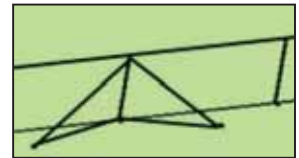
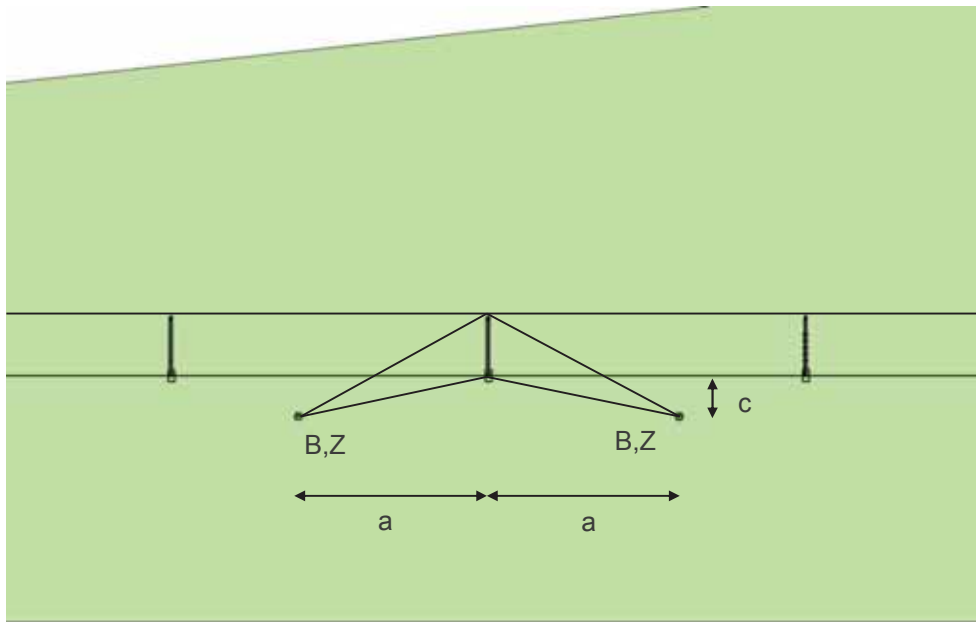
### Anchor point

- Z:** intermediate suspension



In the case of a change in direction towards the mountain of more than  $15^\circ$ , an intermediate anchor rope must be installed and the valley-side anchoring is omitted.

## ROPE ANCHORS FOR SUPPORT ROPE SEPARATION WITH INTERMEDIATE ANCHOR ROPE



3)

### Length

**a:** See Tab.3

**c:** See Tab.3

### Anchor point

**B:** Lower support rope

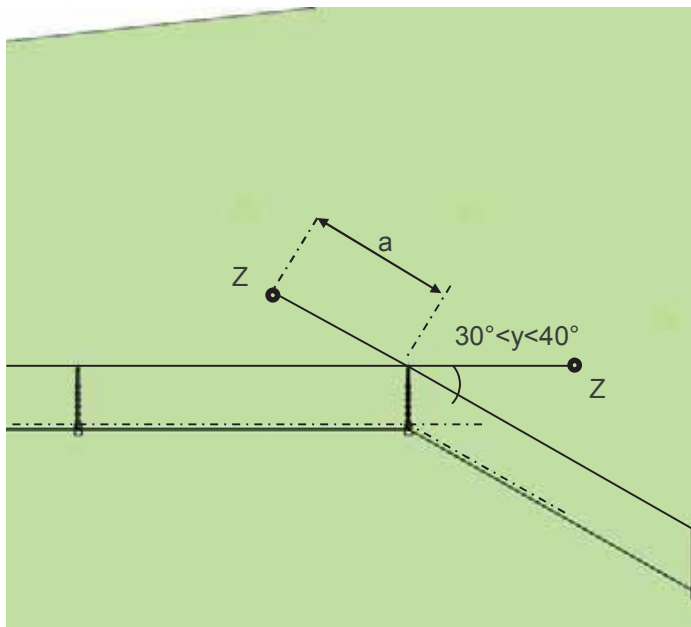
**Z:** Intermediate

A support rope separation also contains an intermediate anchor rope. In straightforward terrain conditions and when using appropriate equipment, we recommend positioning a support rope separation after approx. 60 m – 100 m.



Note: In the case of changes in direction towards the mountain of more than 25°, support rope separation must also be positioned for the intermediate anchor rope.

## CHANGE IN DIRECTION TOWARDS THE VALLEY



4)

### Length

**a:** see Tab.3

**y:** angle of change i  
direction

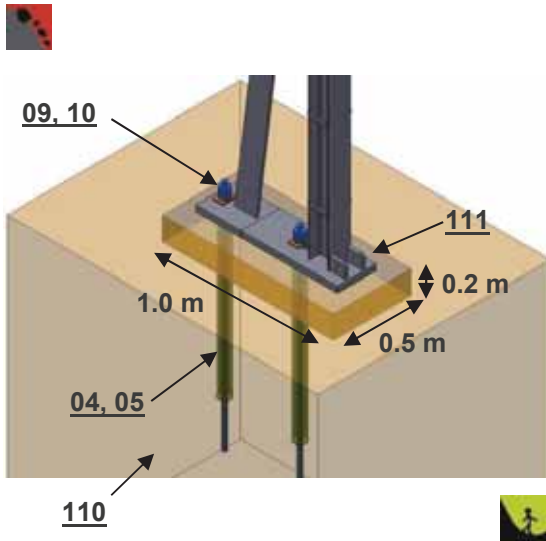
### Anchor point

**Z:** intermediate suspension

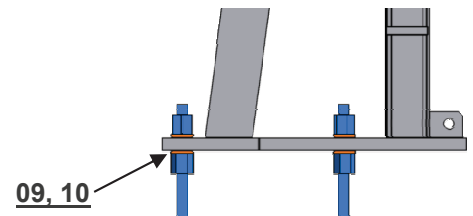
In the case of a change in direction towards the valley of more than 30°, two additional retaining ropes (D) are mounted on the post. The change in direction towards the valley must not exceed 40°.

## 6 ANCHORING THE BASEPLATE

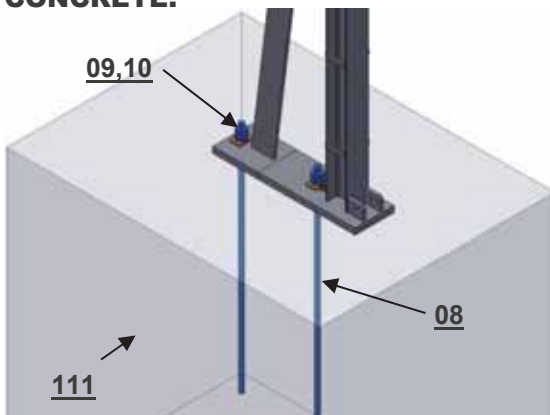
### LOOSE GROUND:



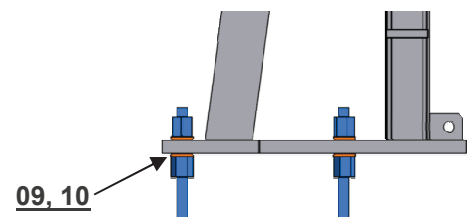
- Drill holes for anchors
- Prepare the concrete foundations 111; the concrete foundations are measured and reinforced in accordance with the specifications of the project engineer
- Insert the anchors 05, spacers 09, and fastening nuts 10; the project engineer calculates the anchor length
- Optional: Stabilization tube 04
- Using grout, fix the anchors 05 in place in loose ground 110
- Fill in the concrete foundation 111
- Tighten the fastening nuts 10 to a preload force of approx. 30 kN



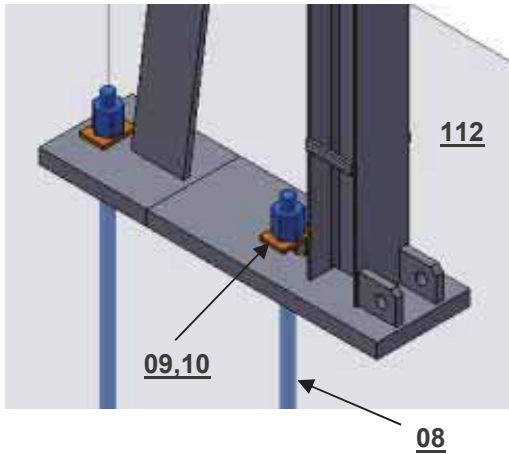
### CONCRETE:



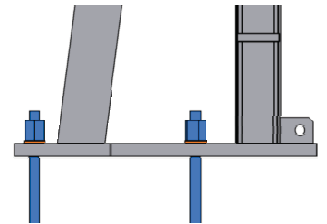
- **Applicable to all ground and rock types**
- Dig a hole for the concrete foundation 111  
The reinforcement of the concrete foundation is measured in accordance with the specifications of the project engineer
- Install both anchors 08 (using a template), **spacers 09 and fastening nuts 10 must be attached on both sides of the base plate**
- Fill in the concrete foundation 111
- Tighten the fastening nuts 10 to a preload force of approx. 30 kN



## ROCK:



- Drill holes for anchors **08** into the rock **112** at a right angle to the base plate
- Using grout, fix the anchors **08** in place; the project engineer calculates the anchor lengths
- A thin grout levelling layer is intended to guarantee that the base plate has a sturdy seat
- Position the post in grout levelling layer
- Tighten the fastening nuts **10** with spacers **09** to a preload force of approx. 30 kN once the grout has completely hardened



Fastening nut tightening torque for an anchor preload force of approx. 30 kN:

	Swiss-GEWI NG 28	Swiss-GEWI NG 32	Swiss-GEWI NG 40
Tightening torque	400 Nm	400 Nm	400 Nm



Use grout that is resistant to frost and de-icing salts.  
Reinforcement: 12 mm steel diameter at 150 mm intervals



An installation template can also be supplied on request.



Ensure that the anchors have sufficient contact with the grout and bond well. Also ensure that the anchors have a sufficient circumferential surface to the surrounding material.



You can find further information on anchoring posts on the anchor data sheet.

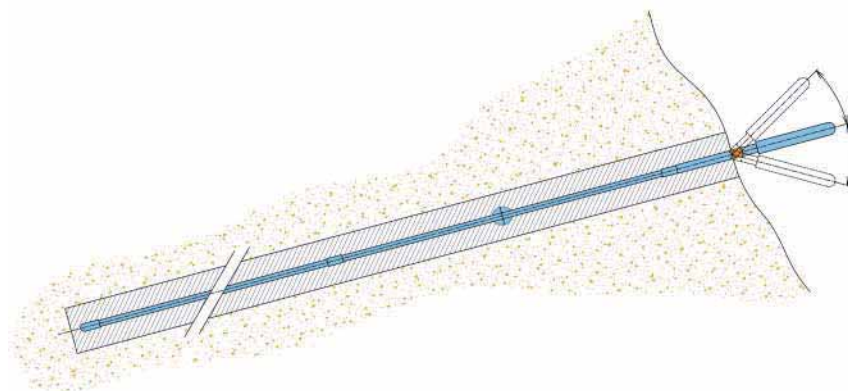


The forces that occur during a rockfall event are not to be underestimated. The civil engineering and installation work must therefore be carried out by professionals.



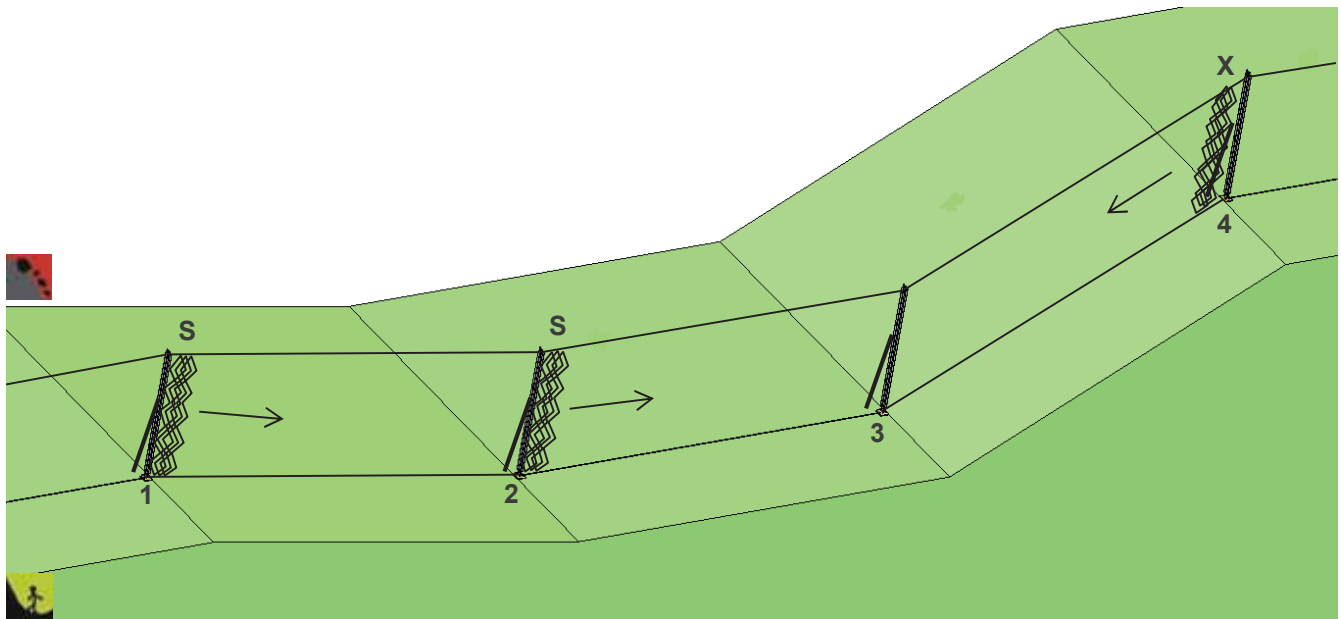
Depending on the terrain conditions but in any case, if terrain slope angle  $\beta > 45^\circ$  it is recommended to use "gap filling nets" (additional mesh between the terrain and bottom part of the mesh).

The anchor holes are drilled in the pulling direction, with a minimum angle of  $> 15^\circ$  to the horizontal.





### THE CORRECT SIDE OF THE NET BUNDLE



The posts are numbered from left to right (from the downslope)



**S:** The mesh bundles are mounted on the right of the post as standard.

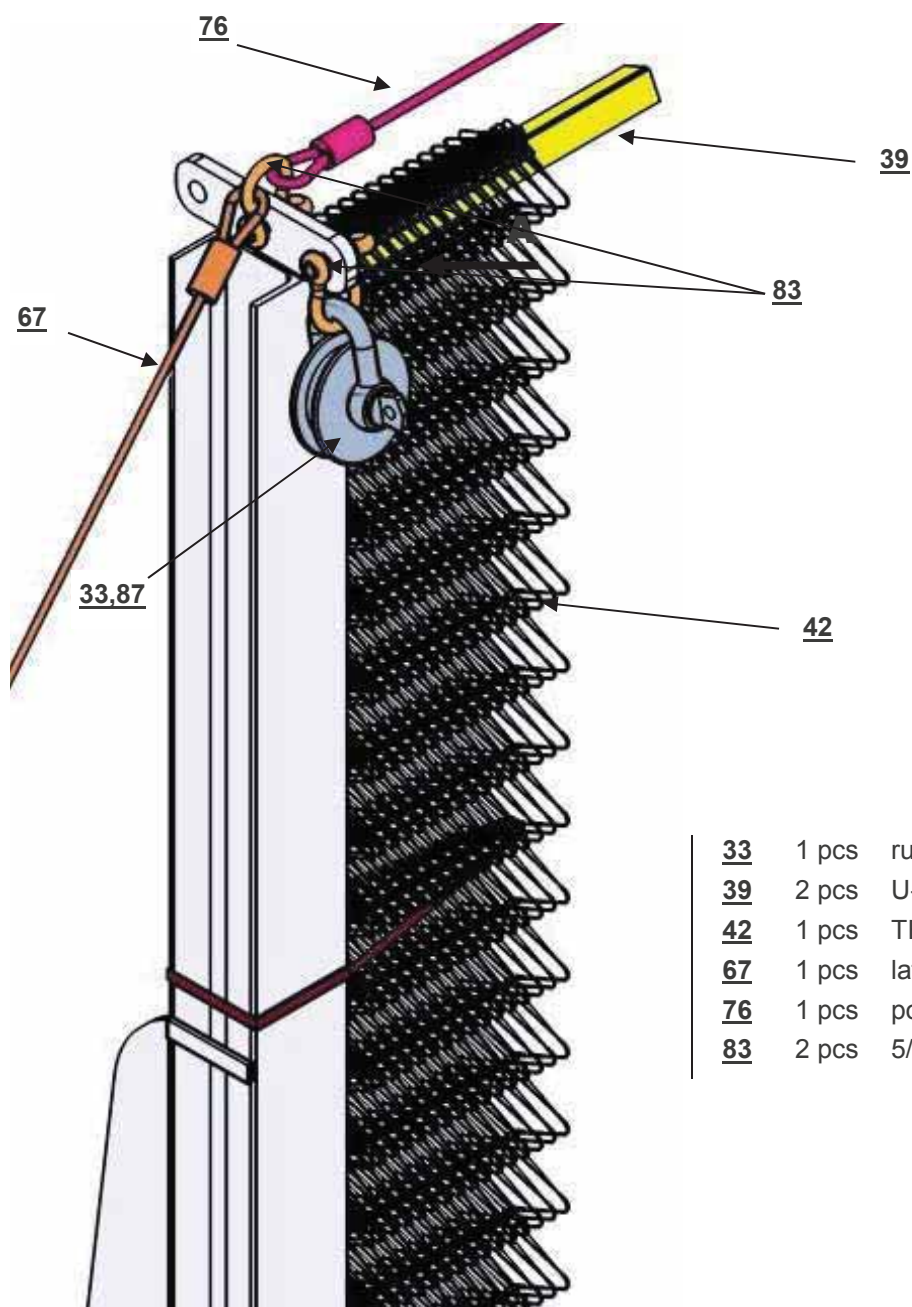
**X:** If there are large differences in height, it is easier to pull the mesh down from the higher post to the lower post.



On request, Geobrugg will also supply the bundles on the desired side of the post.

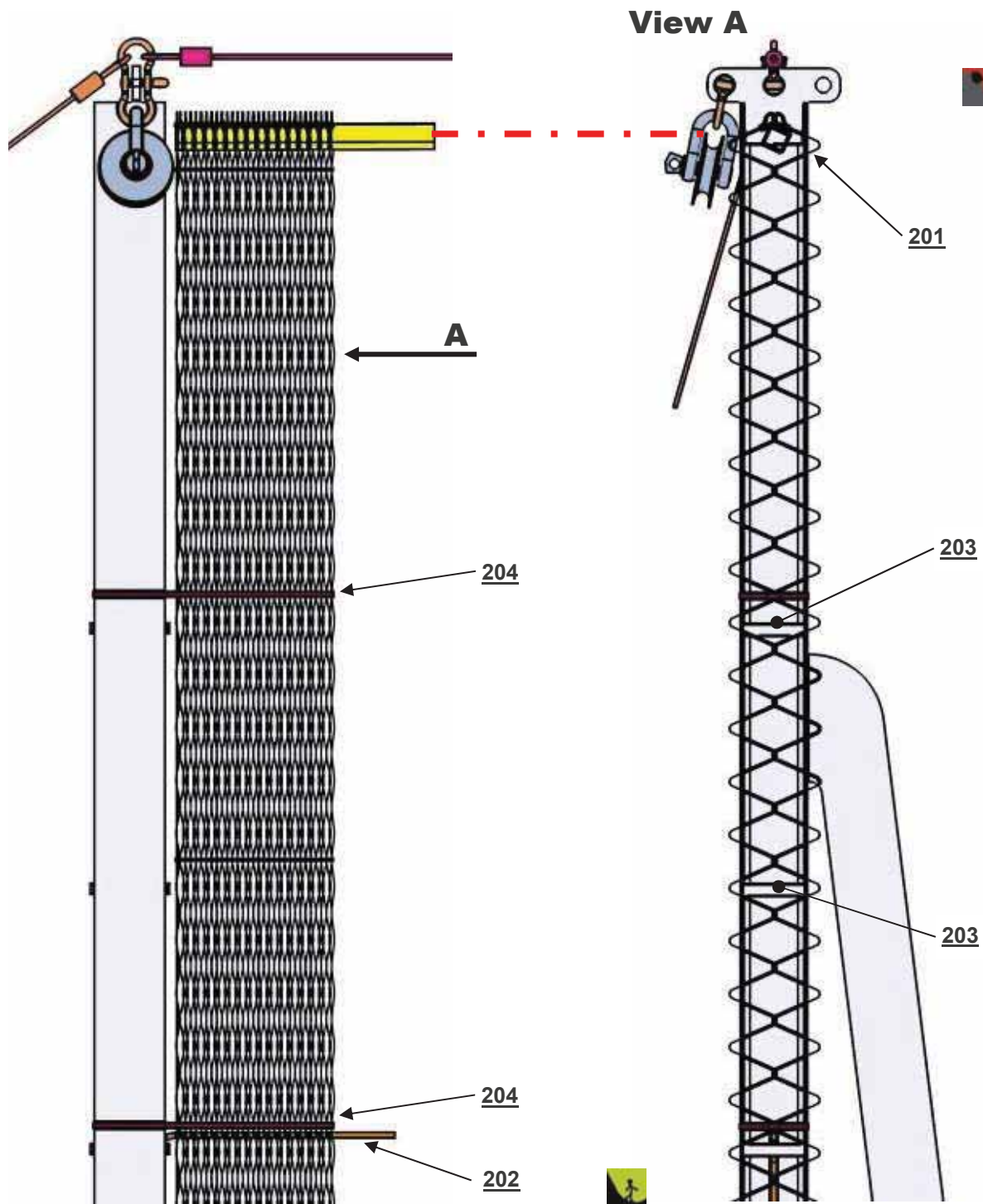


## PREPARING THE POSTS



- |           |       |                                  |
|-----------|-------|----------------------------------|
| <u>33</u> | 1 pcs | running wheel                    |
| <u>39</u> | 2 pcs | U-profiles as support rope guide |
| <u>42</u> | 1 pcs | TECCO® mesh bundle               |
| <u>67</u> | 1 pcs | lateral rope                     |
| <u>76</u> | 1 pcs | post head rope                   |
| <u>83</u> | 2 pcs | 5/8" shackles                    |

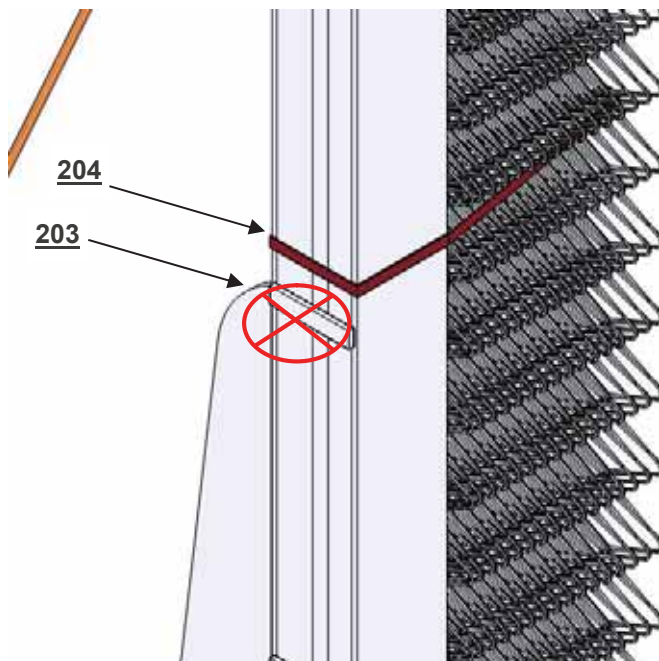
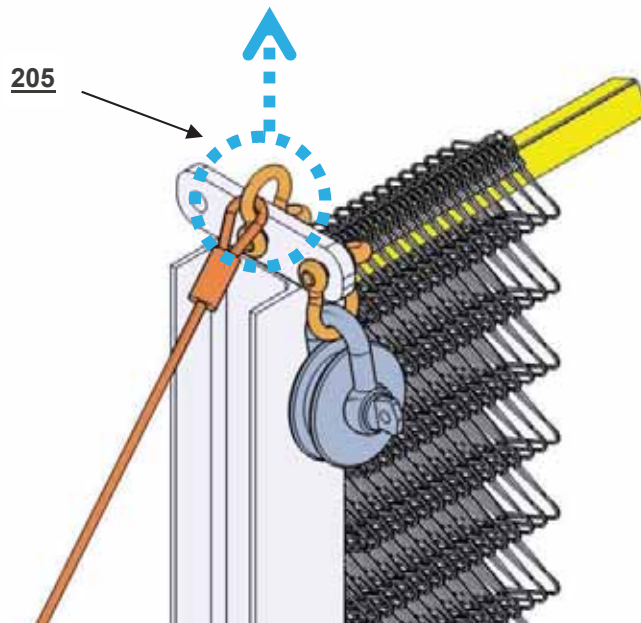
## THE CORRECT HEIGHT OF THE NE BUNDLE



The height of the uppermost row of mesh 201 is somewhat above the height of the preinstalled running wheels. The mounting bracket 202 is placed at the correct height between the rungs 203 and the post wall.



The net bundle is placed on the mounting bracket and securely fastened with 204 bands.



Fasten the mesh bundle using bands 204 and the mounting bracket so that it cannot fly away.

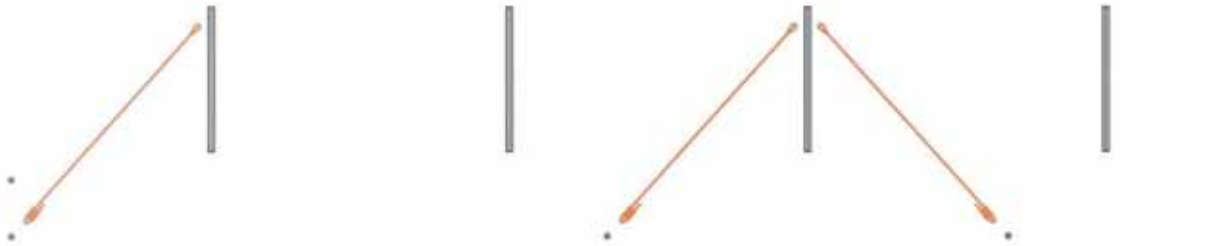


Use the centre 5/8" shackle on the top of the post 205 to lift the posts.  
Never use the rungs 203!



## 9 INSTALLING THE SUPERSTRUCTURE

- Install the lateral ropes and intermediate anchor ropes.



- Install the post head rope on the two outermost posts.



- Install the U-Brake for the top support rope on the anchors. Fasten the top support rope to the tops of the posts and tension the top support rope.



- Install the U-Brakes on the anchors, fasten the bottom support rope to the baseplates, and then tension the lower support rope.

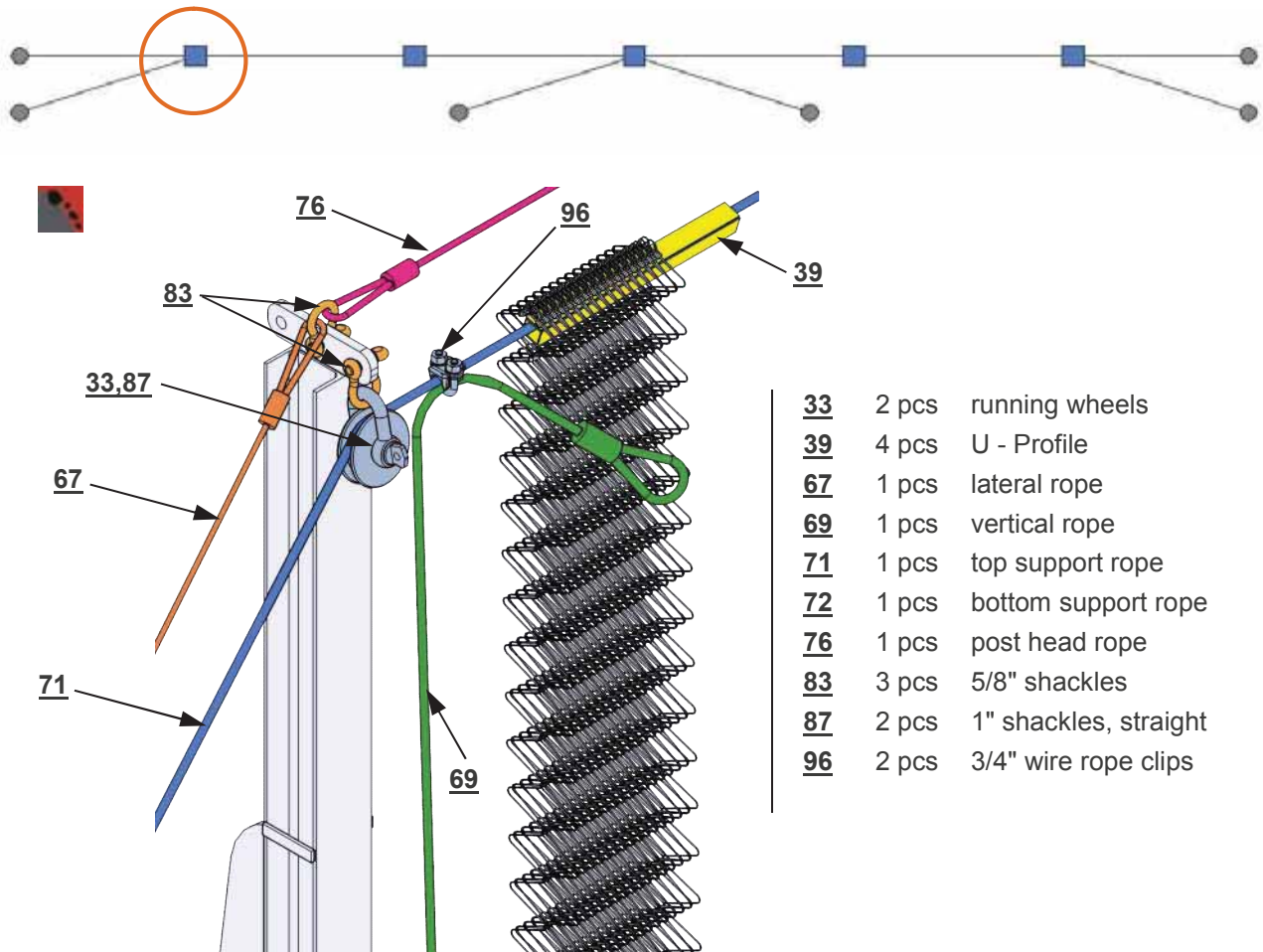


- Install the vertical ropes close to the two outermost posts.

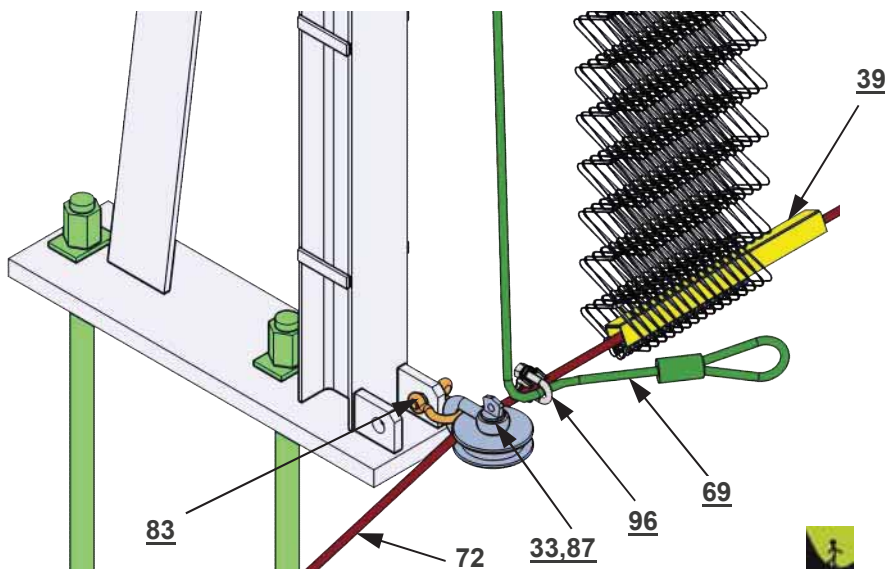


- Raise the nets on the upper and lower support rope.

# BORDER POST AND ROUTING OF THE SUPPORT ROPES THROUGH THE MESH

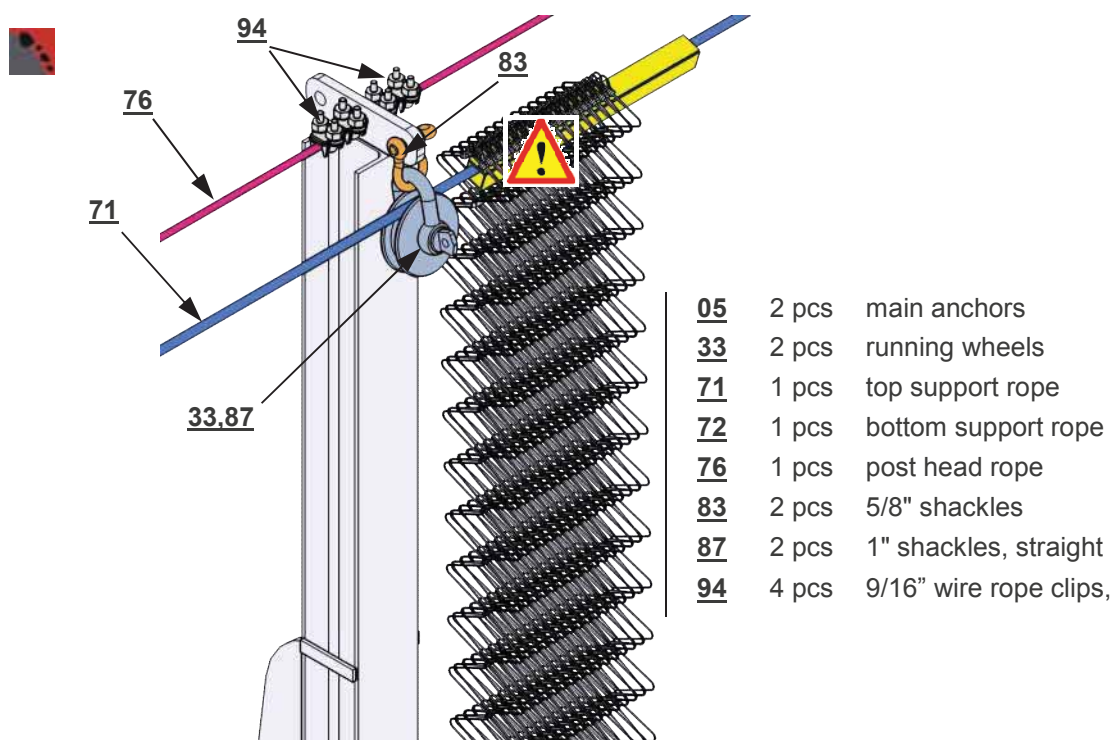
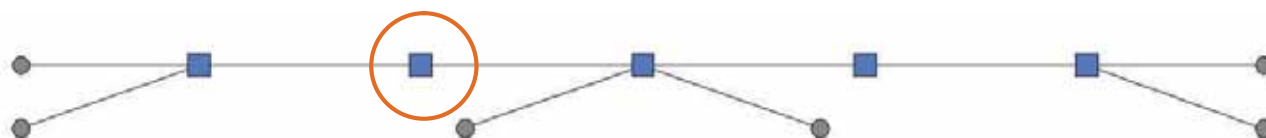


The mesh is shown in the diagram; make sure you pay attention to the number of loops that are kept free.

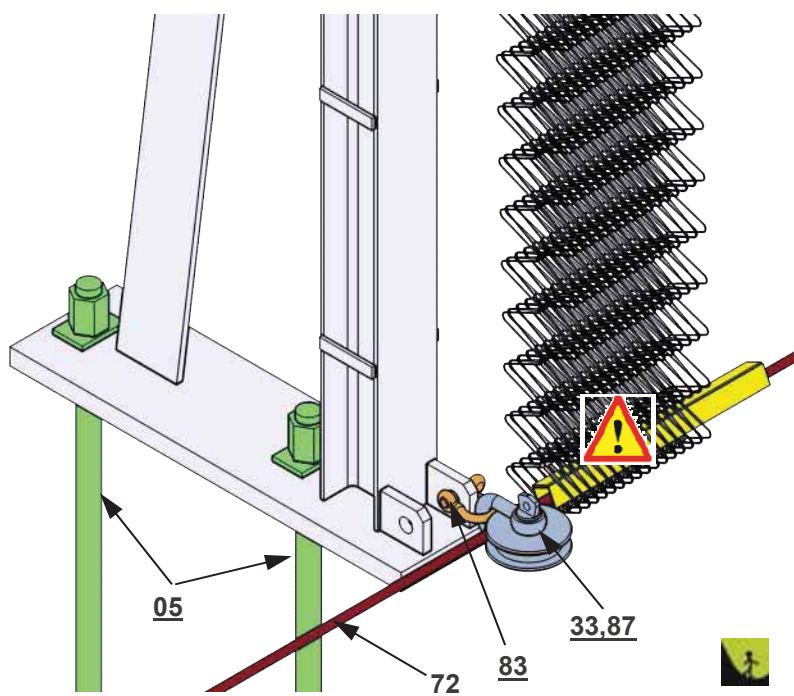




## MIDDLE POST

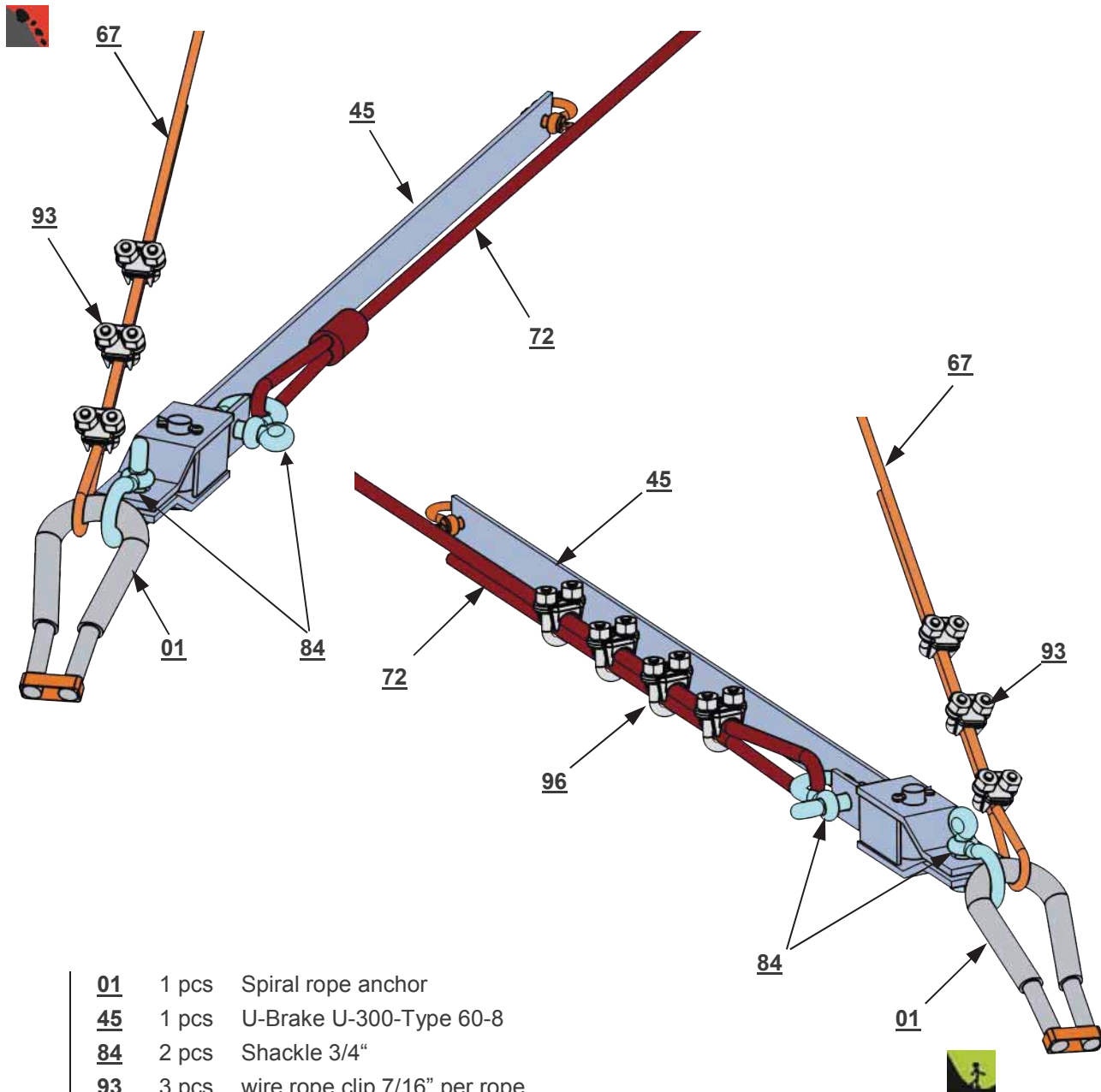
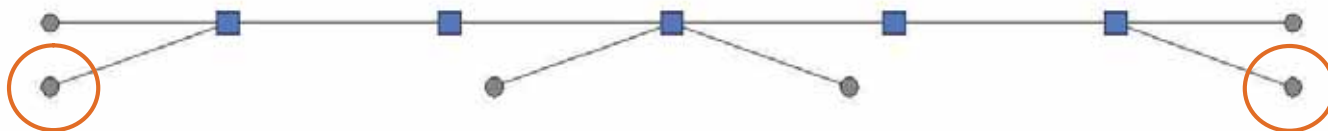


It is a schematic illustration of the net bundle, make sure that the right number of meshes rest free.



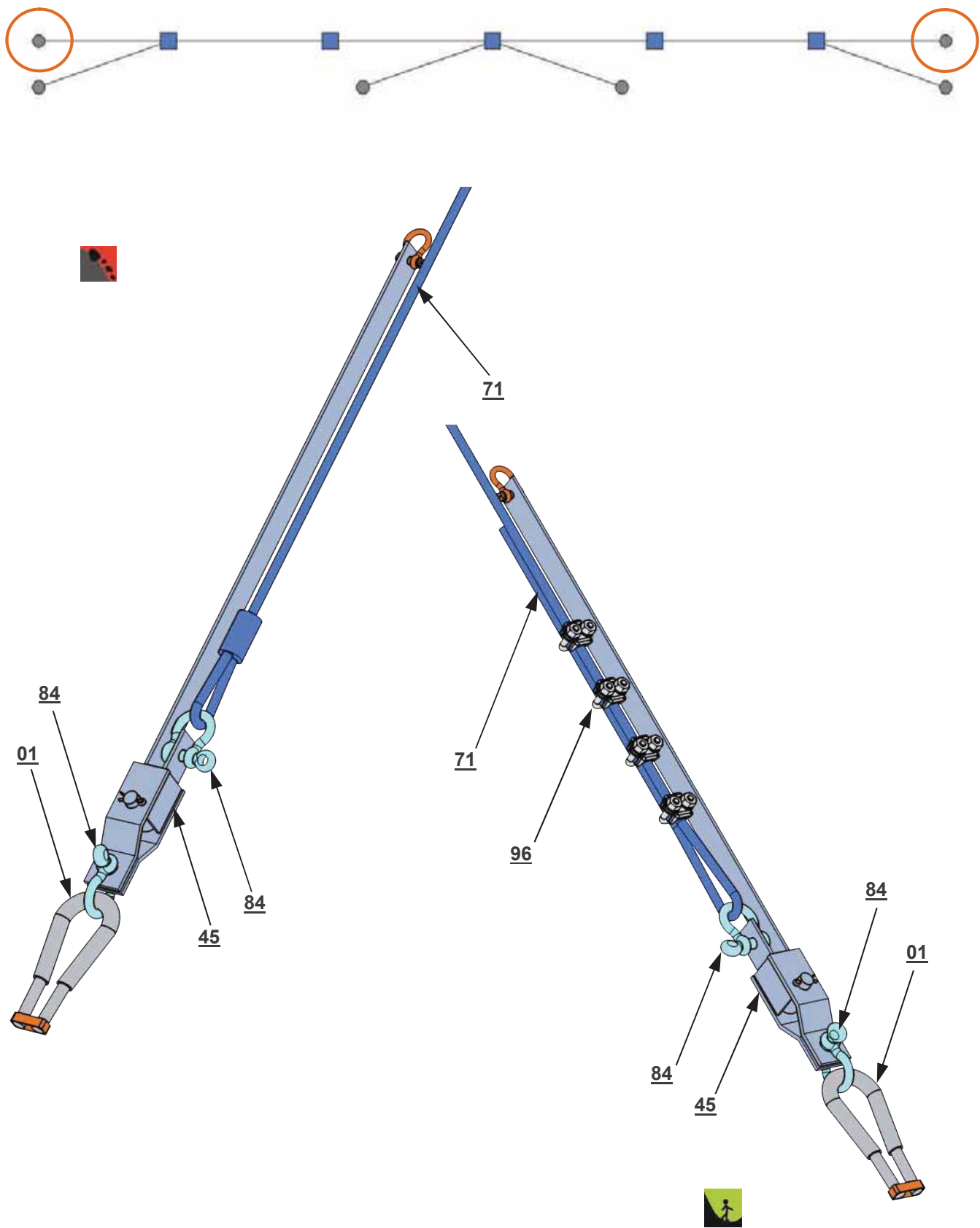


## LATERAL ROPE AND BOTTOM SUPPORT ROPE ON THE ROPE ANCHOR

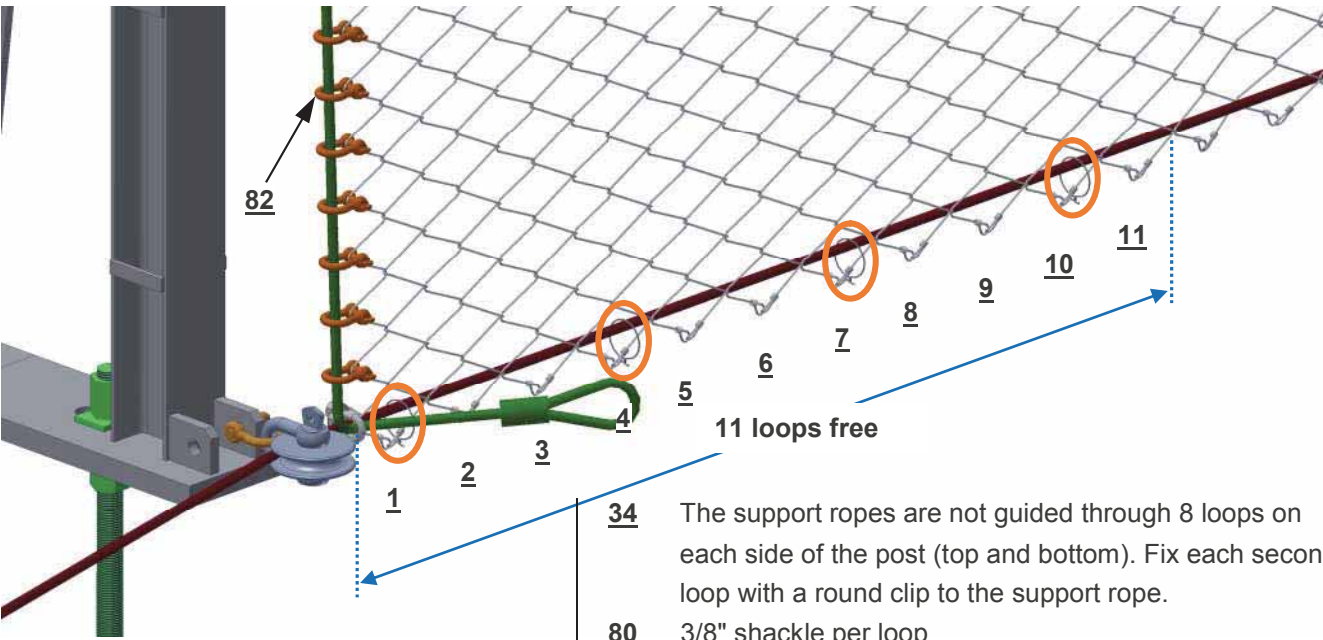
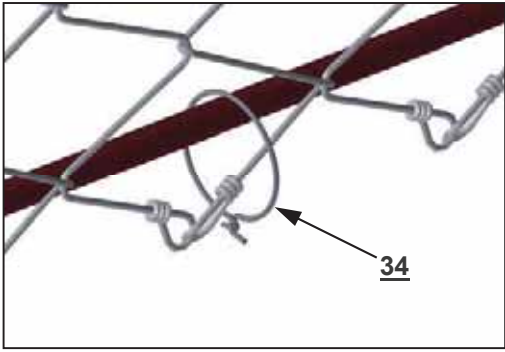
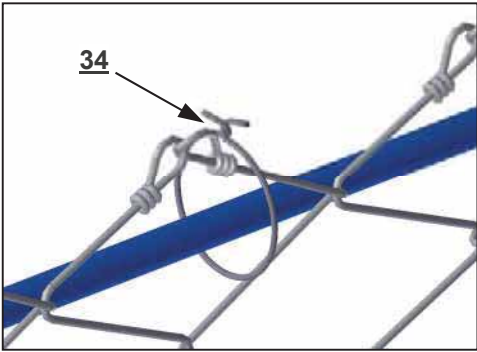
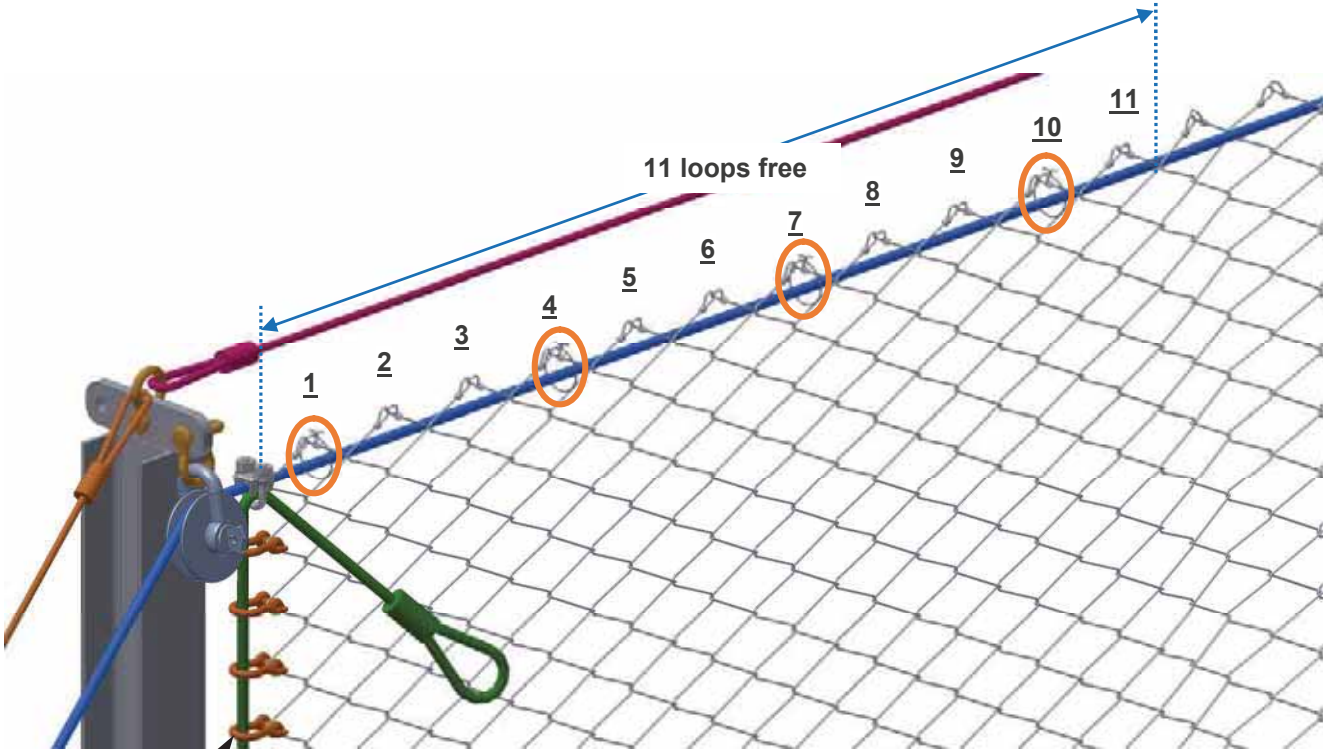


- |           |       |                               |
|-----------|-------|-------------------------------|
| <u>01</u> | 1 pcs | Spiral rope anchor            |
| <u>45</u> | 1 pcs | U-Brake U-300-Type 60-8       |
| <u>84</u> | 2 pcs | Shackle 3/4"                  |
| <u>93</u> | 3 pcs | wire rope clip 7/16" per rope |
| <u>96</u> | 4 pcs | wire rope clip 3/4" per rope  |

**TOP SUPPORT ROPE ON THE ROPE ANCHOR**



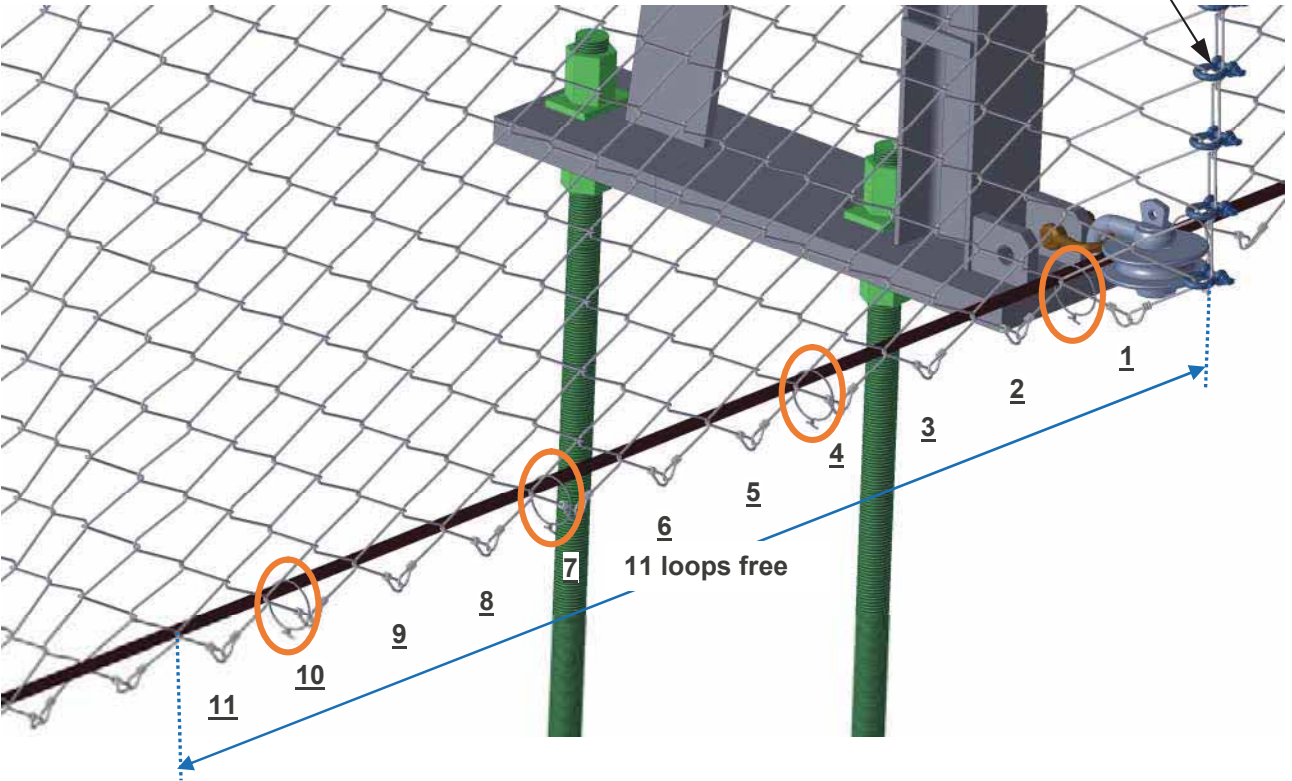
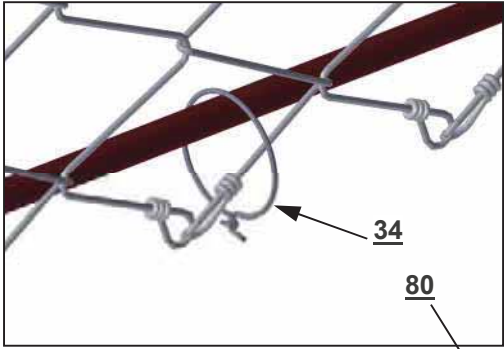
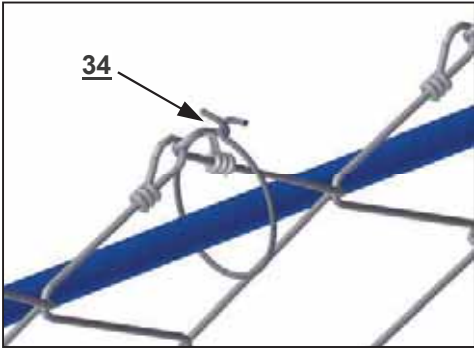
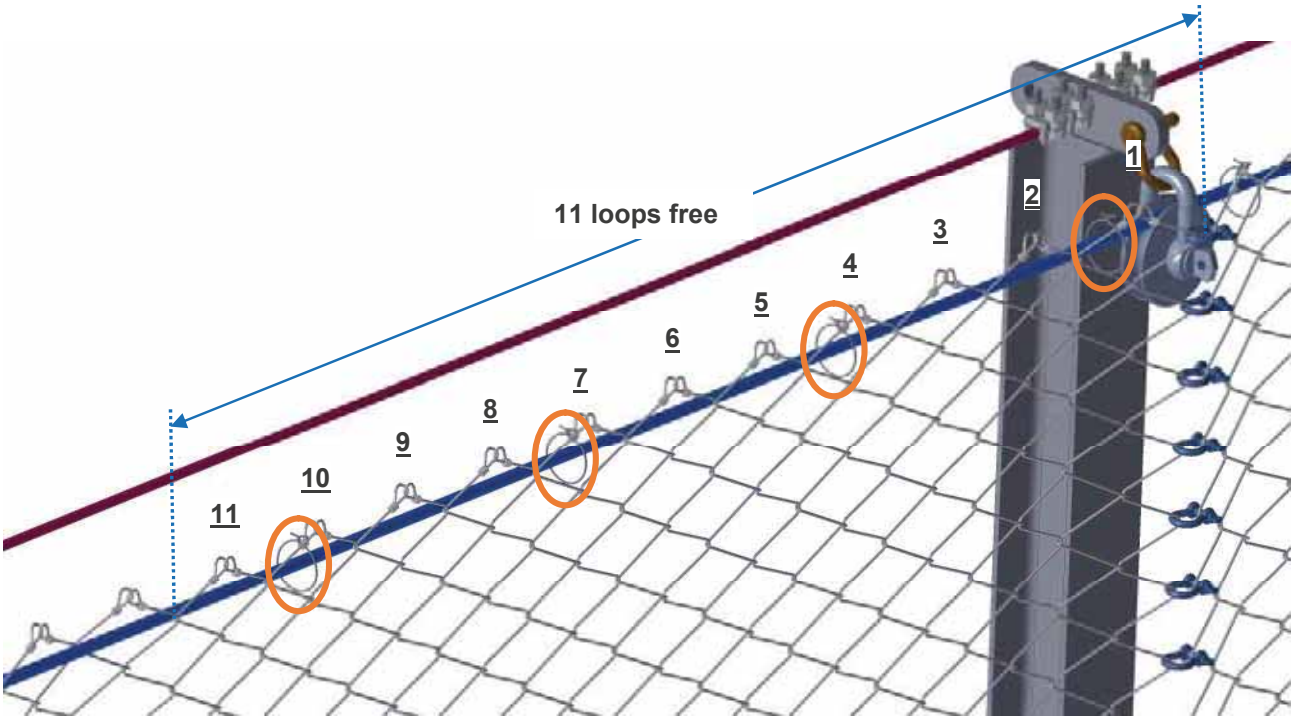
**TECCO® G80/4 ON THE SUPPORT ROPES (BORDER POST)**



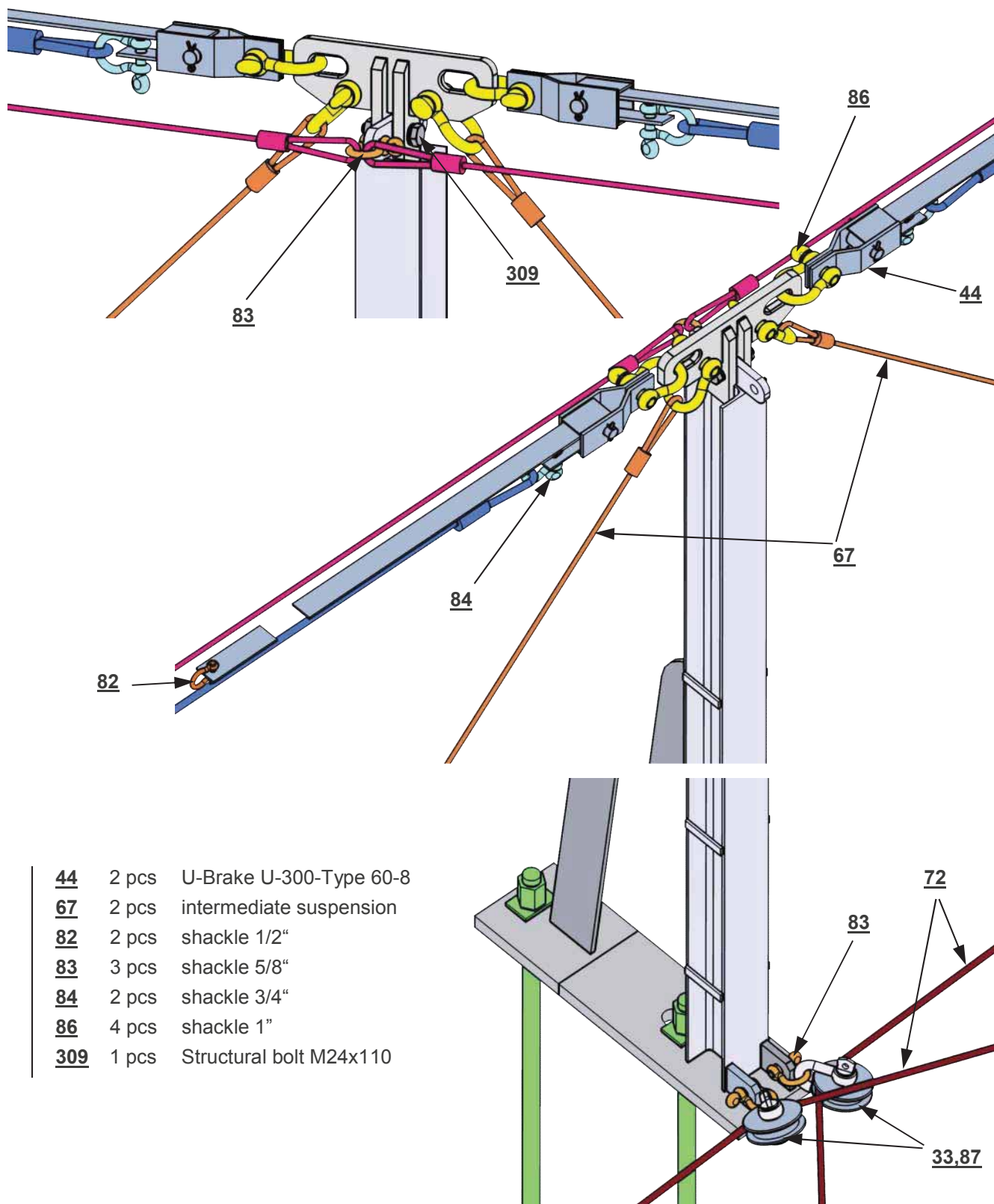
- 34** The support ropes are not guided through 8 loops on each side of the post (top and bottom). Fix each second loop with a round clip to the support rope.
- 80** 3/8" shackle per loop
- 82** 1/2" shackle per loop on vertical rope



**TECCO® G80/4 ON THE SUPPORT ROPES (MIDDLE POST)**



## SUPPORT ROPE SEPARATION

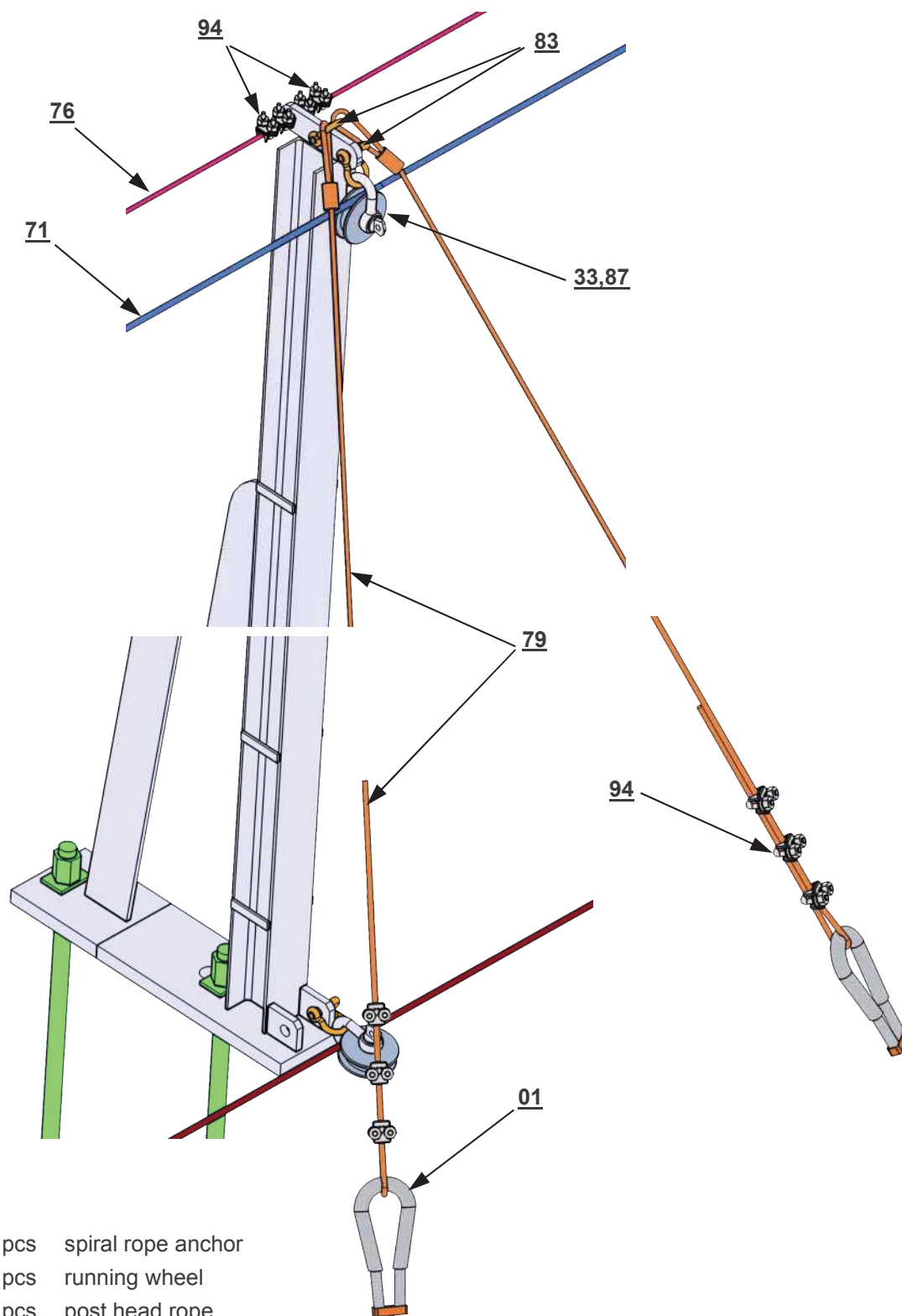


- |            |       |                         |
|------------|-------|-------------------------|
| <b>44</b>  | 2 pcs | U-Brake U-300-Type 60-8 |
| <b>67</b>  | 2 pcs | intermediate suspension |
| <b>82</b>  | 2 pcs | shackle 1/2"            |
| <b>83</b>  | 3 pcs | shackle 5/8"            |
| <b>84</b>  | 2 pcs | shackle 3/4"            |
| <b>86</b>  | 4 pcs | shackle 1"              |
| <b>309</b> | 1 pcs | Structural bolt M24x110 |



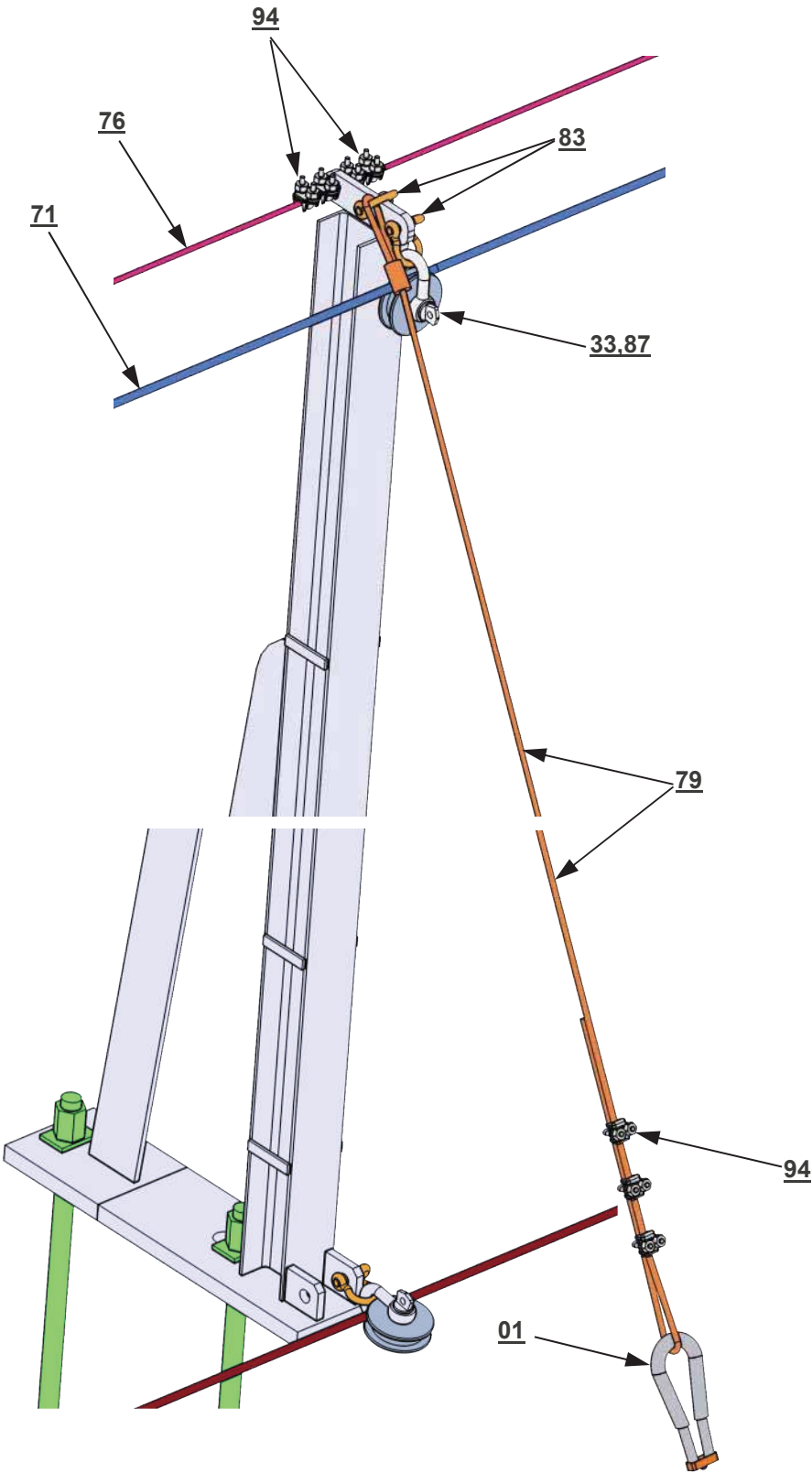
A support rope separation always contains an intermediate anchor rope.

## INTERMEDIATE ROPE SUSPENSION



- |           |       |                                 |
|-----------|-------|---------------------------------|
| <u>01</u> | 1 pcs | spiral rope anchor              |
| <u>33</u> | 2 pcs | running wheel                   |
| <u>76</u> | 1 pcs | post head rope                  |
| <u>79</u> | 1 pcs | Downslope anchor rope           |
| <u>83</u> | 3 pcs | 5/8" shackles                   |
| <u>87</u> | 2 pcs | shackle 1", straight            |
| <u>94</u> | 3 pcs | wire rope clips 7/16", per rope |

**DOWNSLOPE ANCHORING**



### BRACE ELEMENT SOLUTION



If there is not sufficient space available to stake out the lateral anchors in the standard way, a brace element solution can be developed in consultation with Geobrugg AG.

For brace element solutions in Switzerland, the specifications of the Expert Commission on Avalanches and Rockfall (EKLS) must be complied with.

### ROCK FACE CONNECTION



If it is not possible to stake out in the standard way, a rock face connection variant can be worked out in consultation with Geobrugg AG.

### GAP-FILLING SOLUTION



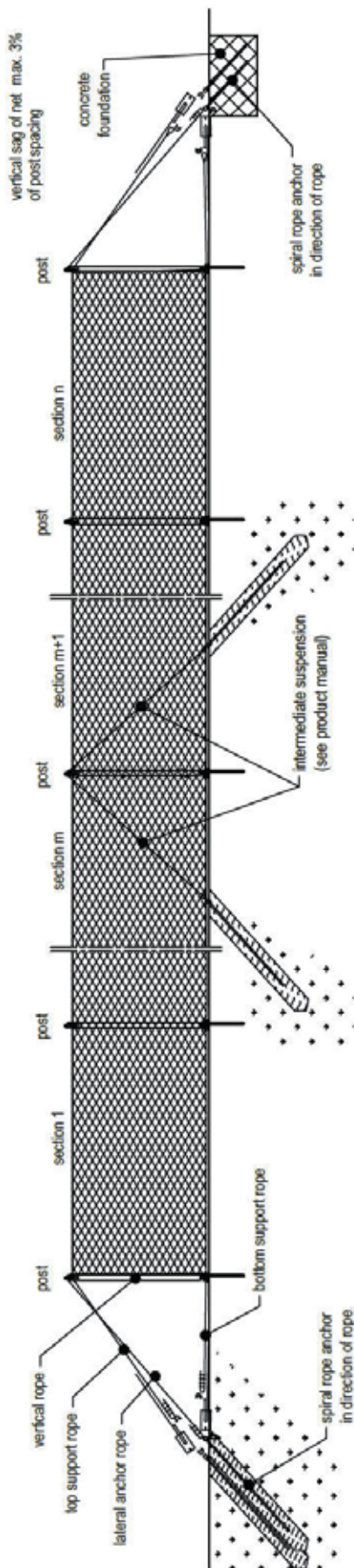
On steep slopes with torrent channels, there may be large gaps between the ground and the bottom support rope. In these cases, individual gap-filling solutions can be developed in consultation with Geobrugg AG.



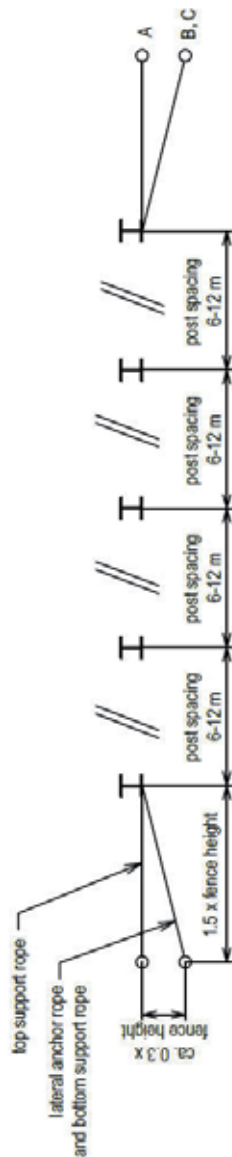
Once installation has been completed, the following aspects in particular must be inspected:

- a) Are the support and lateral ropes and the lateral rope connected to the correct anchors?
- b) Are the rope guides at the top and bottom of the posts installed correctly?
- c) Have the correct number of rings been left free on the left and right of the posts?
- d) Is the net correctly fastened to the support ropes / U-ropes?
- e) Have the correct number of wire rope clips been attached to the ends of the rope?
- f) Are the wire rope clips installed correctly?
- g) Has the correct torque been applied to the wire rope clips?
- h) Are the nets connected correctly?
- i) Are the end nets correctly fastened to the vertical ropes?
- j) Is the sag of the top support rope less than 3% of the distance between the posts?

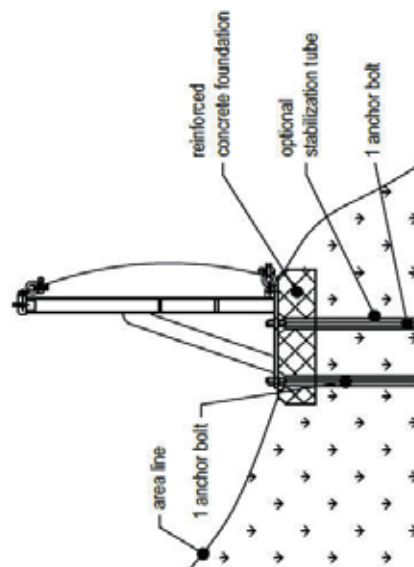




layout of anchor points  
(details see product manual GBE-500A-R)

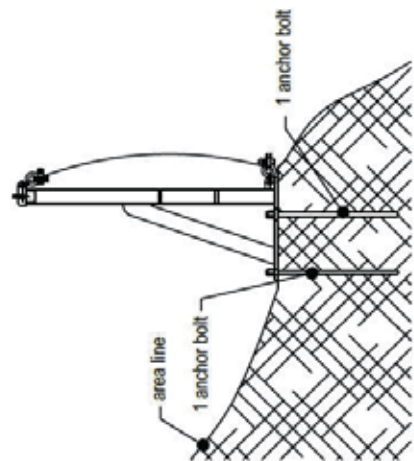


- anchoring in loose soil: with 2 anchor bolts vertical



- anchoring concrete foundation: for all types of soil

- anchoring in bedrock: with 2 anchor bolts vertical

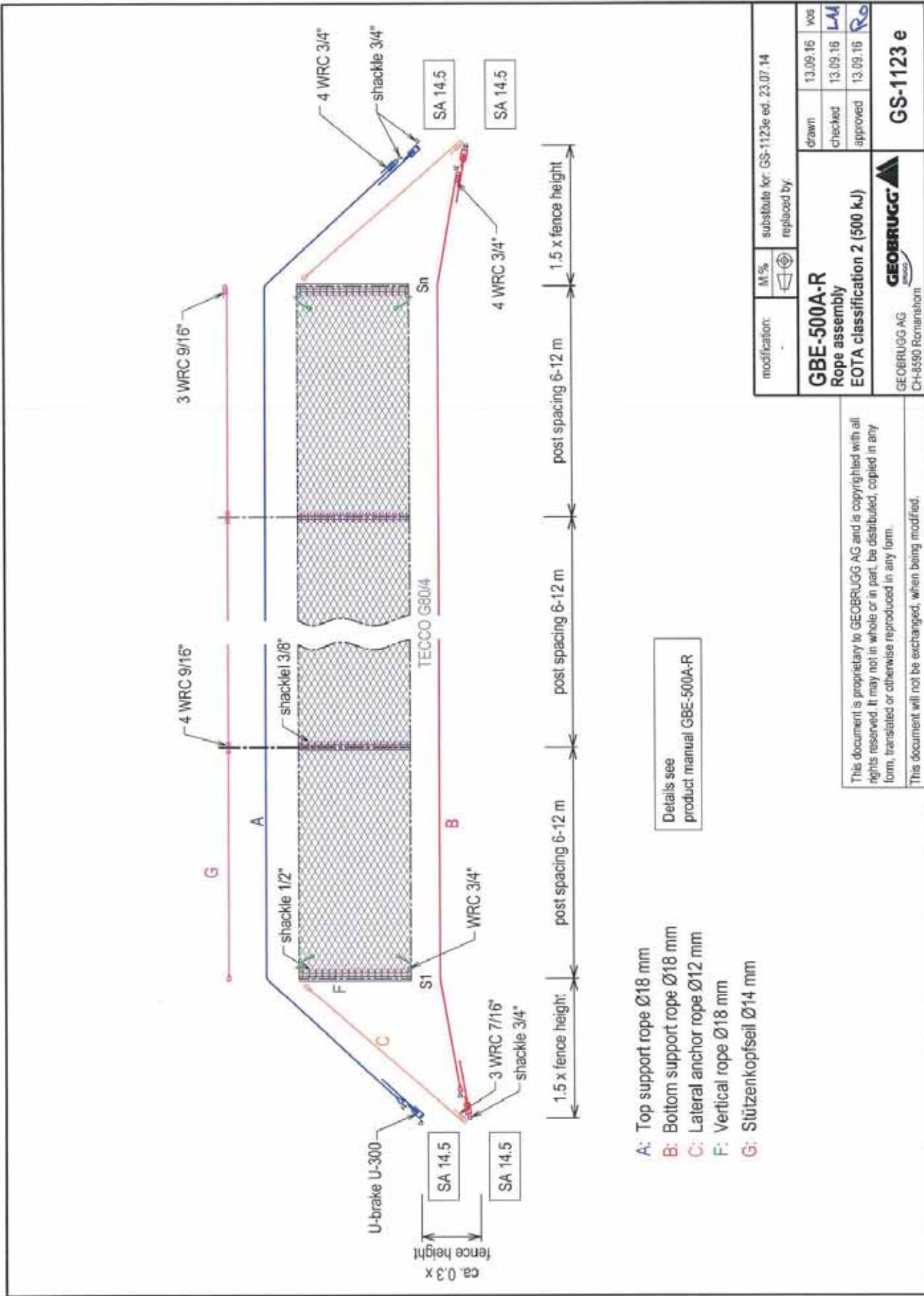


**NOTE:**  
Rockfall, landslides, debris flows or avalanches are sporadic and unpredictable. Causes can be e.g. human (construction, etc.) or environmental (weather, earthquakes, etc.). Due to the multiplicity of factors affecting such events it is not and cannot be an exact science that guarantees the 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: GS-1122e ed. 16.03.16 replaced by:	drawn	22.05.17	BIH
			checked	22.05.17	BIH
			approved	22.05.17	LAA
<b>Rockfall protection barrier</b> <b>GBE-500A-R System</b> <b>EOTA classification 2 (500 kJ)</b>			<b>GS-1122 e</b> <b>GEORUGG AG</b> <b>CH-8590 Romanshorn</b>		

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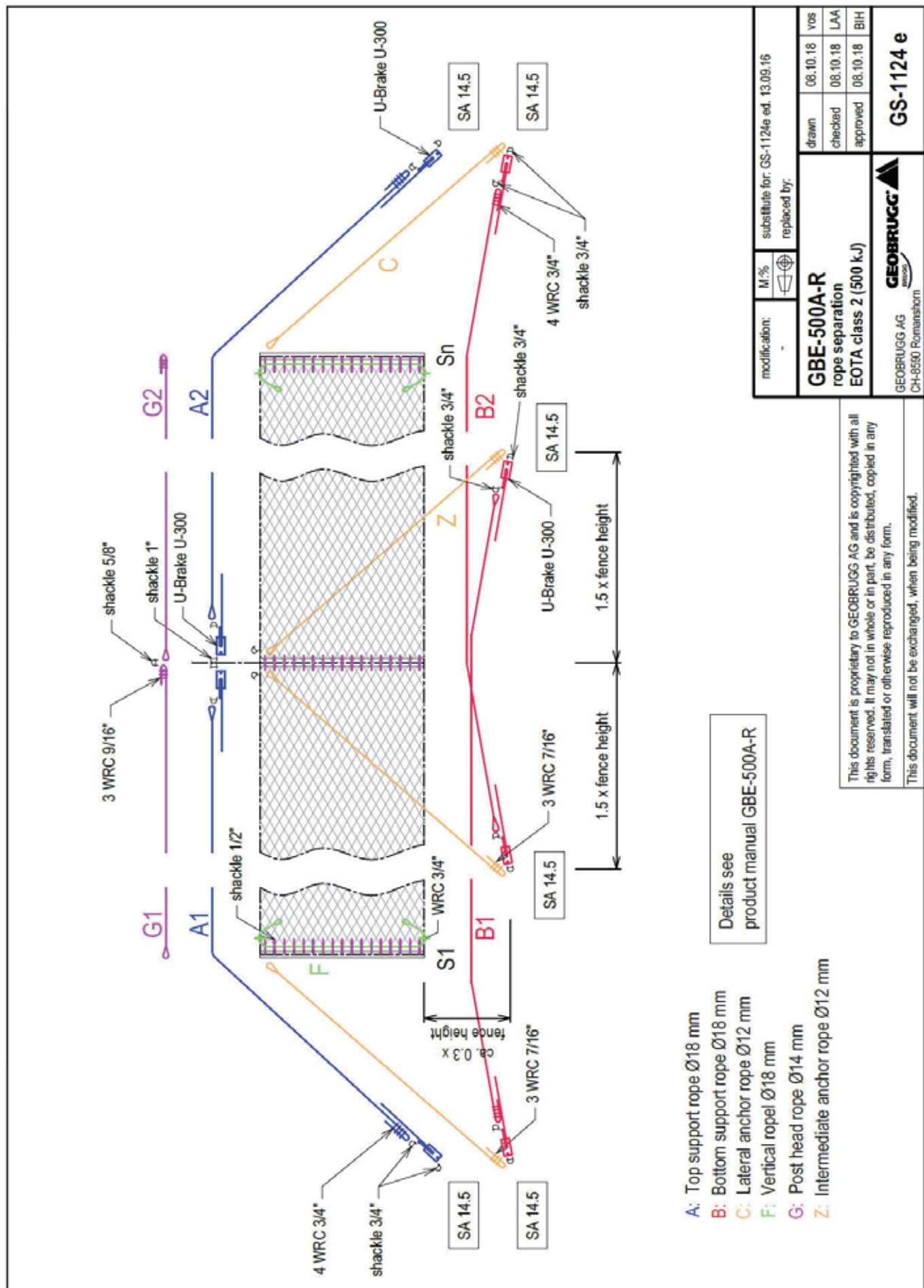


modification:	M %	substitute for: GS-1123e ed. 23.07.14	replaced by:	drawn	13.09.16	vos
				checked	13.09.16	LM
				approved	13.09.16	R <sub>0</sub>
GBE-500A-R Rope assembly EOTA classification 2 (500 kJ)				GS-1123 e		
GEOBRUGG AG CH-8590 Romanshorn				GEOBRUGG		

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**DESIGN  
DELIVERY**



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**Network Rail Design Delivery**

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