Rockfall protection system

TRUMER Schutzbauten

TSC-1000-ZD Hybrid - Data Sheet

Classification

Model	TSC-1000-ZD Hybrid
Style	Hinged System
Energy Class	3
Maximum Energy Level *Tested kJ (ft-tons)*	1141 (420)
Service Energy Level *Tested kJ (ft-tons)*	373 (138)
Available Heights *m (ft)*	4.0 - 6.0 (13.1 - 19.7)
Verification	Full Scale Tested

Test Report Summary

Test Height *m (ft)*	4.0 (13.1)
Maximum Elongation *m (ft)*	N/A
Residual Height (MEL)	>80%

Test Report

Report Number	0112/01
Issuing Body	Montanuniversität Leoben
Date of Issue	May 09, 2012

Area of Application:
TRUMER hybrid rockfall fences were developed to protect infrastructure, utilities, buildings and lives from falling debris. Typical hybrid catchment fences are installed in run-out or deposition zones, close to the elements at risk that they protect.

Material:
TRUMER uses steel components and steel wire ropes made from high quality materials, following a stringent quality assurance program. The test of the structure followed the ETAG 27 guidline *[1]*. TRUMER Schutzbauten GmbH is ISO 9001:2008 certified.

Installation:
The TSC-1000-ZD Hybrid has been designed with as few components as possible to simplify installation and reduce maintenance. In addition, the systems can be installed by hand, with heavy machinery or with the use of a helicopter. Foundation design and construction is dependant on site conditions and are the responsibility of the project engineer.

Advantages:
The hybrid system is designed to reduce nearly all energy of projectiles upon impact, but allow the transition of material from the upper structure to the lower portions of the system. By doing so, maintenance is reduced and simplified since material is stored in areas more easily accessed.

References:

1. EOTA. *Guideline for European technical approval of falling rock protection kits (ETAG 27)*, February

2. Austrian Standards Institute. *ONR 24810, Technical protection against rockfall - Terms and definitions, effects of actions, design, monitoring and maintenance*, 2013.

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Primary and Tail Net

Model	Omega-Net 9.0/185
Type	Steel Wire Cable
Rope Diameter *mm (in.)*	9.0 (0.354)
Rope Construction	1 x 7 Spiral
Single Wire Diameter *mm (in.)*	3.0 (0.118)
Corrosion Protection	Zn or ZnAl (Class A)
Mesh Size *mm (in.)*	~ 185 x 185 (7.3 x 7.3)
Unit Weight kg/m² (lb/ft²)	~ 6.8 (1.39)
Mesh Tensile Strength calculated *kN/m (lbf/ft)*	465 (31862)
Connection to Main Ropes	Threaded
Connection to Adjacent Panel	7/16" Shackle

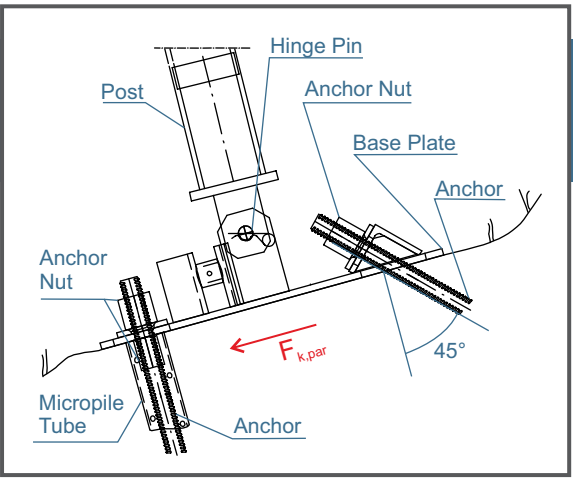
Ropes

Bearing	Quantity per fence segment	2
	Rope Diameter *mm (in.)*	20 (0.787)
	Corrosion Protection	Zn or ZnAl (Class A or B)
	Brake Elements per rope	2
	Brake Element Model	AVT phx 60/30-2.5
Middle	Quantity per fence segment	2
	Rope Diameter *mm (in.)*	18 (0.709)
	Corrosion Protection	Zn or ZnAl (Class A or B)
	Brake Elements per rope	2
	Brake Element Model	AVT phx 60/30-5.5
Retaining	Quantity per post	2
	Rope Diameter *mm (in.)*	16 (0.630)
	Corrosion Protection	Zn or ZnAl (Class A or B)
	Brake Elements per rope	1
	Brake Element Model	AVT phx 60/30-2.5

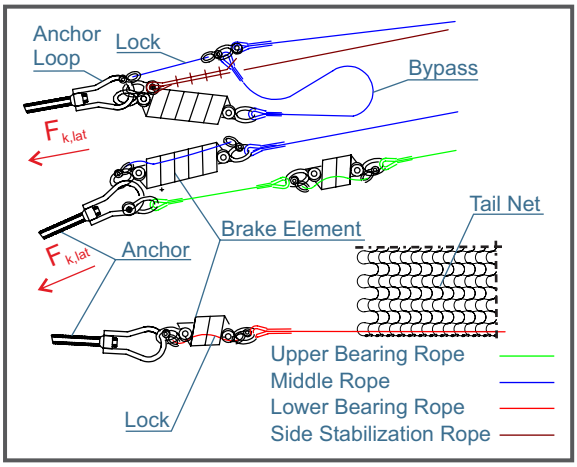
Support Structure

Post Type	HEA 180
Integrated Ladder	Rungs every 0.5 m
Rope Guides	Integrated
Post Weight 4 meter post height *kg (lbs)*	205 (451)
Base Plate Connection	Tongue and Pin
Base Plate Footprint *mm (in.)*	790 x 250 (31.1 x 9.8)
Base Plate Weight *kg (lbs)*	49 (108)
Anchors per base plate	2

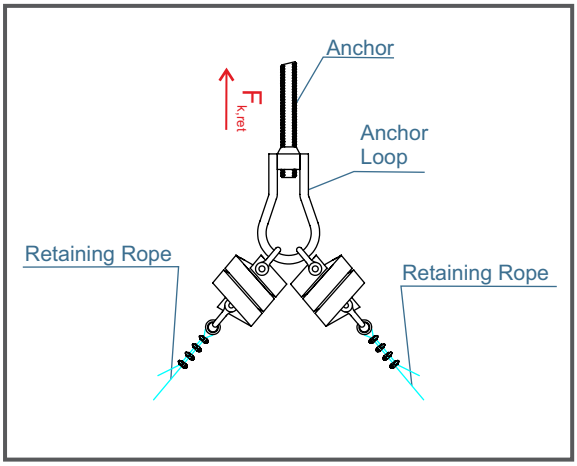
Base Plate/Foundation



Lateral Anchorage



Retaining Rope Anchorage



Anchor Forces *kN (kips)*

Base Plate ($F_{k,par}$)	198 (44.5)
Max. Lateral Anchor ($F_{k,lat}$)	188 (42.3)
Retaining Rope Anchor ($F_{k,ret}$)	146 (32.8)

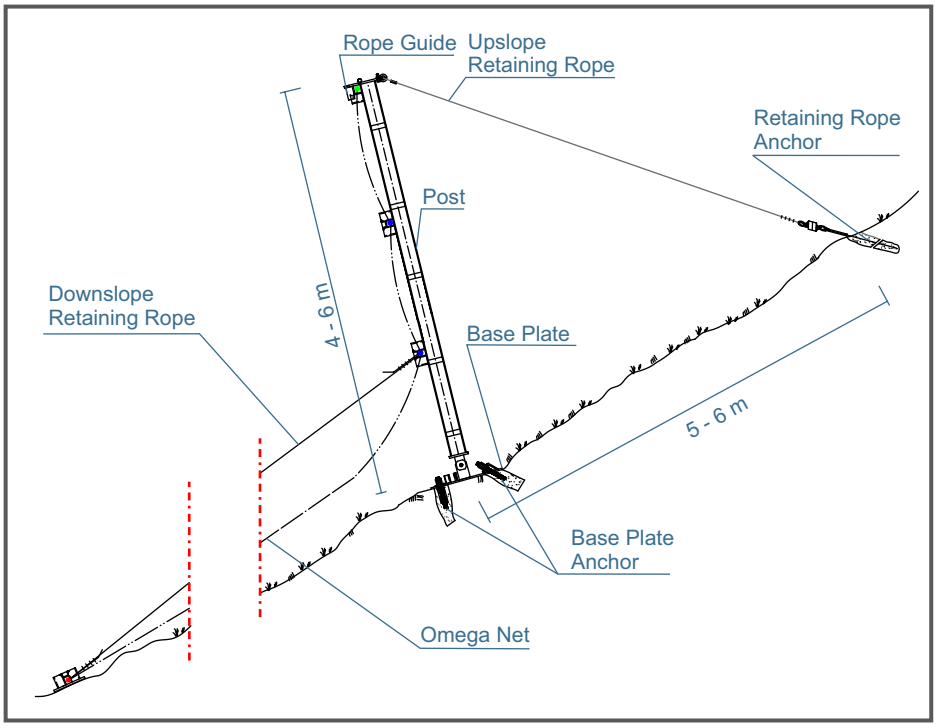
Typical Recommended Anchors Based on Steel Grade*

(per 50 m, 10 m post spacing)

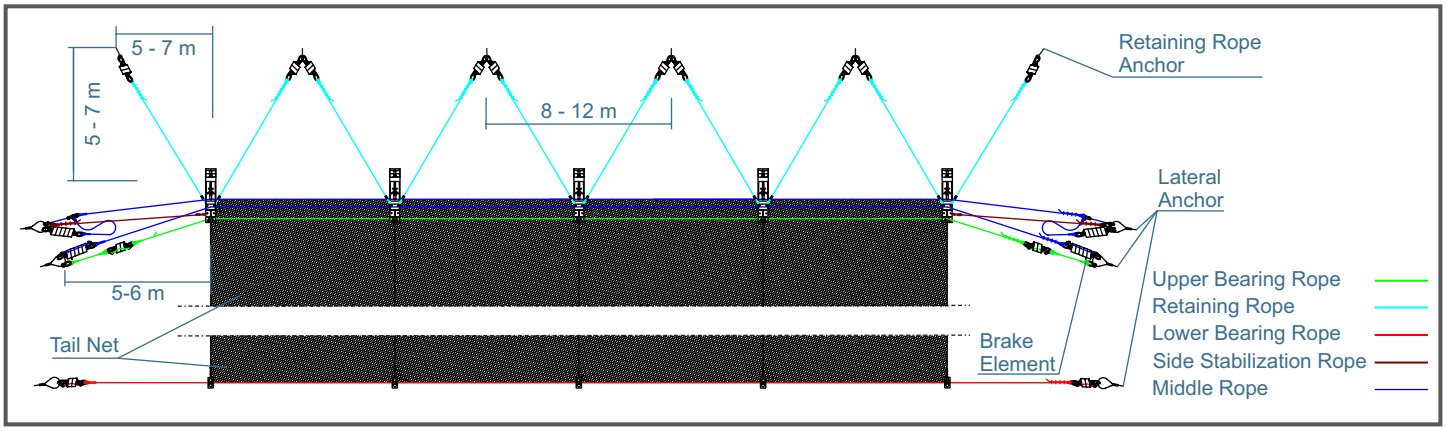
	Quantity	500/550 (MPa) (e.g. GEWI)	670/800 (MPa) (e.g. GEWI Plus)	470 min (MPa) (e.g. IBO)
Base Plate Anchor	12	32	28	site dependent
Lateral Anchor	6	32	25	R32-400
Retaining Rope Anchor	7	28	22	R32-320

* Actual anchorage to be determined by a qualified engineer in accordance with local regulations. Herein, the factors of safety were applied according to the ONR 24810 guidelines. If multiple ropes are led to one anchor, it is recommended that characteristic force values be added in a scalar manner according to ONR 24810.

Typical Cross Section



General Layout and Anchorage:
The suggested layout for the rockfall catchment fence follows the constructive rules of the ONR 24810 [2]. In general, post spacing is kept between 8 - 12 m. Posts should be positioned to create the greatest capture shadow with regards to vertical as well as lateral spread of falling debris, with the fence roughly perpendicular to the fall line. Avoid the placement of posts in areas that increase the chance of a direct post impact.

Anchor layout should follow the geometry provided in the installation manual with the anchor oriented as close as possible to the direction of the anticipated rope forces. It is acknowledged that due to site characteristics deviations from the ideal are unavoidable. In this case, the project engineer should use their best judgement to find a suitable location and orientation.

Typical Layout