

## General information

Energy class:	1.000kJ
Manufacturer:	Trumer Schutzbauten GmbH Maria Bühel Strasse 7 A-5110 Oberndorf bei Salzburg
System name:	TS-1000-ZD
Test report number:	0607
Report creation date:	19.11.2007

## Specification of rock-fall protection kit TS-1000-ZD

The tested rock-fall protection kit TS-1000-ZD of TRUMER SCHUTZBAUTEN GMBH was a flexible rock-fall protection system for energy impacts up to 1000kJ. The rock-fall protection kit TS-1000-ZD was characterised by ground plates which were fixed to the underground by two anchors per plate. The posts were connected to the ground plates by tumbler bearings and they were held in position by uphill retaining cables at their top. The interception structure of the tested rock-fall protection kit comprised an OMEGA-net. An additional layer was not implemented at the test. The upper and lower longitudinal bearing ropes were arranged as single ropes and connected to the side foundations using energy dissipating devices. The system was supported by two integrated longitudinal ropes, which were connected to the side foundations using one energy dissipating device per connection. The uphill retaining cables were also connected to their foundations by energy dissipating devices.

## Main components of rock-fall protection kit TS-1000-ZD

### Interception structure

#### PRIMARY NET

Type:	OMEGA/9,0mm/MW185
Number of net packages:	6
Dimensions of single net package:	3,35m x 5,00m
Connection to bearing ropes:	threaded
Connection to side posts:	rope 12 vz 6x19 DIN 3060 FE sZ 1.770 N/mm <sup>2</sup> (RBL: 106kN) (cp. DIN EN 12385-4)
Connection between net packages:	by 7/16 inch shackles (28 per face)

The system was tested without additional layer.

### Support structure

#### POSTS WITH WELDED TOPPLATE

Type:	I-Profil DIN 1025 – IPBL 160 – S235JRG2 (HE 160 A according to EURONORM 53-62)
Material:	S235JRG2
Surface conditioning:	blank
Length:	3.140mm

#### GROUNDPLATE

Material:	S235JRG2
Dimensions:	790mmx250mmx15mm
Dimensions of shims:	100mmx100mmx10mm
Drill diameter of shims:	42mm
Surface conditioning:	blank
Joint pin:	Rd 30 EN10025-S355J2G3

The posts are connected to the ground plates by tumbler bearings.

### Connecting components

#### BEARING ROPES

Upper bearing rope:	rope 20 vz 6x19 DIN 3060 SE sZ 1.770 N/mm <sup>2</sup> (RBL: 293kN) (cp. DIN EN 12385-4)
Lower bearing rope:	rope 20 vz 6x19 DIN 3060 SE sZ 1.770 N/mm <sup>2</sup> (RBL: 293kN) (cp. DIN EN 12385-4)

SUPPORTING ROPES

Supporting ropes (2times):	rope 18 vz 6x19 DIN 3060 SE sZ 1.770 N/mm <sup>2</sup> (RBL: 238kN)	(cp. DIN EN 12385-4)
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RETAINING AND SIDE ROPES

Side cables:	rope 16 vz 6x19 DIN 3060 SE sZ 1.770 N/mm <sup>2</sup> (RBL: 188kN)	(cp. DIN EN 12385-4)
Uphill retaining cables:	rope 16 vz 6x19 DIN 3060 SE sZ 1.770 N/mm <sup>2</sup> (RBL: 188kN)	(cp. DIN EN 12385-4)

Energy dissipating devices

ENERGY DISSIPATING DEVICES IN BEARING ROPES

Type:	AVT phx/FLA30x60/2,5W
Material:	St 37-2 (S235JR)
Diameter:	200 mm
Position:	at the right and left foundations
Connection to rope:	7/8 inch shackle
Connection to anchor:	7/8 inch shackle
Number:	1 element per connection
Surface conditioning:	blank

ENERGY DISSIPATING DEVICES IN SUPPORTING ROPES

Type:	AVT phx/FLA25x60/5,5W
Material:	St 37-2 (S235JR)
Diameter:	200 mm
Position:	at the right and left foundations
Connection to rope:	¾ inch shackle
Connection to anchor:	¾ inch shackle
Number:	1 element per connection
Surface conditioning:	blank

ENERGY DISSIPATING DEVICES IN UPHILL RETAINING CABLES

Type:	AVT phx/FLA25x60/1,5W
Material:	St 37-2 (S235JR)
Diameter:	200 mm
Position:	at the uphill anchors
Connection to rope:	¾ inch shackle
Connection to anchor:	¾ inch shackle
Number:	1 element per connection
Surface conditioning:	blank

Summary of test results

The tested rock-fall protection kit TS-1000-ZD of TRUMER SCHUTZBAUTEN GMBH was hit by a block of reinforced concrete with a mass of 3.164kg and a velocity of 27,37m/s. The impact was placed in a height of 1,624m. The angle of block trajectory was determined with 33,52°. The impact energy was determined with 1.186kJ. The maximum horizontal system elongation was 5,502m. The block was stopped and caught by the rock-fall protection kit and did not touch the ground during the test until the system reached the maximum elongation. The whole impact energy was absorbed by the tested rock-fall protection kit. The energy impact caused an irreversible deformation of the interception structure in the place of the impact. A few wires of the bearing and supporting ropes were shopworn at the guiding devices of the inner posts. The energy dissipating devices in the longitudinal bearing ropes and supporting ropes were stretched but still had about 38% of their deformation capacity after the test. The energy dissipating devices of the retaining cables in the middle module of the rock-fall protection were stretched up to 60% of their deformation capacities. As a consequence of the impact the nominal height of the rock-fall protection kit was reduced from 3,033m to 2,029m, which means a residual height of the tested system of 66,90% of its nominal height.

Affirmation of test report no. 0607

The chair of Mining Engineering and Mineral Economics at the University of Leoben confirms that test report no. 0607 about the testing of rock-fall protection kit TS-1000-ZD is correct in respect of content and matter of fact.

**The rock-fall protection kit TS-1000-ZD of Trumer Schutzbauten GmbH was tested according to the future "Guideline For European Technical Approval of Falling Rock Protection Kits" and has passed the Maximum Energy Level (MEL) test.**

According to the test criterion "residual height" the system is classified as **System of Category A** (residual height > 50% nominal height).

Leoben, the 21/11/2007

*Christian Heiss*

(Dipl.-Ing. Christian Heiss)

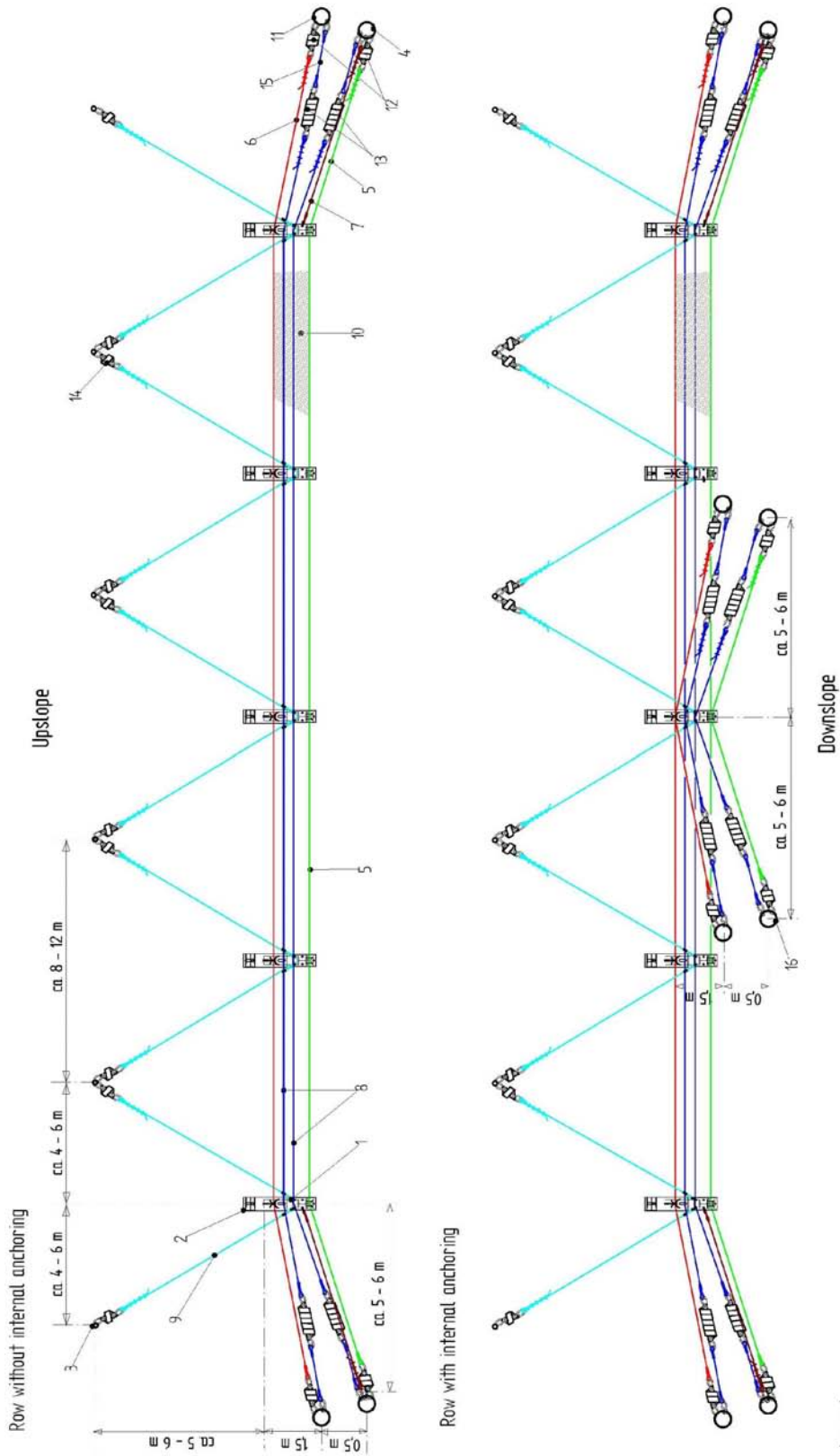


*Peter Moser*

(Ao.Univ.-Prof. Dipl.-Ing. Dr.mont. Peter Moser)



# Rockfall Protection System TS-1000 - Plan View



- Legend**
- 1. Post
  - 2. Base plate
  - 3. Upslope anchor
  - 4. Lateral anchor for upper bearing, upper middle and side stabilisation rope
  - 5. Upper bearing rope for post head
  - 6. Lower bearing rope (along ground)
  - 7. Side stabilisation rope
  - 8. Middle rope
  - 9. Upslope retaining rope
  - 10. Omega-Net
  - 11. Lateral anchor for lower bearing and lower middle ropes
  - 12. Brake element AVT phx 60/30-25
  - 13. Brake element AVT phx 60/25-55
  - 14. Brake element AVT phx 60/25-15
  - 15. Extension rope
  - 16. Internal lateral anchor