Information sheet
to
ROCKFOR
Rock Fall Events Assessment Procedure

The aim of this assessment procedure is to create a standardized documentation for rock fall events. The procedure can be used either directly after an event or to assess past events. The assessment forms allow intuitive fill-in. Therefore they can be easily used immediately before important marks, e.g. silent witnesses, are removed.
The assessment and documentation procedure belongs to people with different experience in the field of rock fall:

- People involved in event management, local authorities
- Practicians from private and governmental agencies
- Hazard experts
- Scientists

The assessment procedure is divided in different levels of detail:

Module A – General Rock Fall Event Assessment

Module A provides general information (Where, when, damages, affected people, eyewitnesses,…) on an event, focusing more or less on the damage/deposition area. It is determined to give an overview on the event. It should be useful primary for local authority. Module A contains all general data needed for a proper documentation of a rock fall event.

Module B - Simple Rock Fall Event Assessment

The module B is a semi-detailed assessment of a rock fall event. The whole process area is assessed.

Module C - Detailed Rock Fall Event Assessment

Module C provides assessment forms for in-depth study on the process area. It is aimed to provide data for experienced rock fall models, such as CRSP 4.0 and Rockfall 6.1. It is intended to be used mainly by engineers and scientists.

If damages, either personal or of infrastructure, have occurred "Module B – Simple rock fall assessment" has to be filled in.

For further information and in case of a rock fall event please contact:

Institute for Forest and Mountain Risk Engineering
Department of Natural Hazards
University for Agricultural Sciences, Vienna
Tel.: 01/47654 - 4380 or - 4354.
URL: http://www.boku.ac.at/anfi

Contents

Info sheet A

Ad A5)

Definition of the directions of measurements:

Lenght	Measurements in slope direction, retention dams and deflection dams are measured in dam direction
Width	Measurements perpendicular to slope

Info sheet B

Ad B1)

The device list serves for the documentation of the measured unities.

Ad B3)

Soil depth

Table 1: Soil depth

Definition	Class
0 - 30cm, shallow soil depth	1
> 30cm, middle- and deep soil depth	2
Other The effective through-root able soil depth is larger than ascertainable by ditch with the spade, because of block corridors, strongly stony, weathered background or very high skeleton proportion.	3

Soil type

Table 2: Soil type

Definition	Class	Definition	Class
Silicate rock		*Limestone*	
Leptosols derived from noncalcareous material (Lithic Leptosols, Umbric Leptosols and Arenosols)	1	Leptosols derived from calcareous material (Rendzic Leptosols and Lithic Leptosols)	17
Dystric Cambisols, Ferralic Cambisols and colluvial soils derived from dystric silicate material	2	Colluvial soils showing properties of both Rendzic Leptosols and Chromic Cambisols (Terra Fusca)	18
Eutric Cambisols, colluvial soils derived from eutric silicate material and Calcareous Cambisols	3	Chromic Cambisols on calcareous bedrock (Terra Fusca)	19
Spodi-Dystric Cambisol on silicate material	4	*Soils under ground water influence*	
Climate-induced Podzols derived from dystric silicate material	5	Gleysols	20
Substrate-induced Podzols (derived form Quartzite, Quartz-Phyllite, Quartz-Sand, Quartz sandstone, Arkose)	6	Fluvisols along small rivers	21
Substrate-induced Gleyic Podzol	7	Fluvisols	22
Loose sediments and clayey shale		*Organogenous soils*	
Light-textured Cambisols and Spodic Cambisols derived from unconsolidated sediments	8	Mollic and Umbric Gleysols	23
Heavy-textured Cambisols and Luvisols derived from moraine material, non-calcareous loess, or mudstone	9	Histic Gleysols and Terric Histosols	24
Cambisols and Luvisols derived from calcareous loess	10	Fibric Histosols	25
Group of Similigleys		Anthrosols	26
(Eutric) Planosols and Stagnic Gleysols derived from flysch or mudstone	11		
(Eutric) Planosols and Stagnic Gleysols derived from loess	12		
Temporarily waterlogged (Stagno-gleyic) soils on unconsolidated sediments	13		
Stagnic Cambisols or Gleysols with marked interflow	14		
Relic soil material showing ferralic properties (Ferralic Cambisols)	15		
Chernozsem	16		

Info sheet C

Ad C1)

The device list serves for the documentation of the measured unities.

Ad C2)

Rock strength

Table 3: Rock strength

Description (SELBY, 1993)	UCS [Mpa]	Class
Extremely weak rock – crumbles under sharp blows with geological pick point, can be cut with pocket knife	1–25	(1)
Weak rock – shallow buts or scraping with pocket knife with difficulty, pick point indents deeply with firm blow	25–50	(2)
Moderately strong rock – knife cannot be used to scrape or peel surface, shallow indentations under firm blow from pick point	50–100	(3)
Strong rock – hand-held sample breaks with one firm blow from hammer end of geological pick	100–200	(4)
Very strong rock – requires many blows from geological pick to break intact sample	>200	(5)

Example:

Figure 1: Example of joints description

Slope exposition: 280 gon

	a	b		c		d	e	f	g
Parting	Type	Strike		Dip		Widths of joints	Spacing of joints	Continuity of joints	Critical layer
		[gon]	Class	[°]	Class	[cm]		Class	Class
1	S	315/313/321	1	45/45/40	5	3	X	2	4

$Strike_{rel}$ = | 280 - (315+313+321)/3 | = 36 ➔ Class 1

Dip_{rel} = (45+45+40)/3 = 43 ➔ Class 1

a.) Type:

Bedding (B), planes of schistosity (S), joint (J)

b.) Strike orientation relative to slope

$$Strike_{rel} = \left| Exposition - Strike_{abs} \right|$$

Table 4: Strike orientation

Class	(1)	(2)	(3)
Name	Horizontal	Moderate	Steep
Range	<10°	10 to 30°	>30°

c.) Dip direction

Table 5: Dip direction

Class	(1)	(2)	(3)	(4)	(5)
Name	Steep dips into slope	Moderate dips into slope	Horizontal dips	Moderate dips out from slope	Steep dips out from slope
Range	>30°	10° to 30°	<10°	10° to 30°	>30°

d.) Width of joints

Open (1), closed (2), filled - clay (3), filled – loose material (4)

e.) Spacing of joints

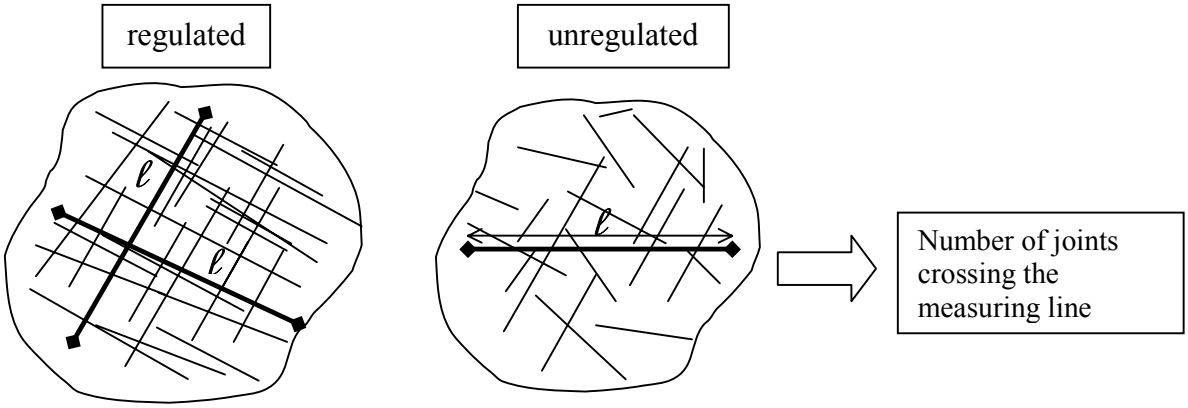
$$K = \frac{n}{\ell} \; [\mathrm{m}^{-1}]$$

Table 6: Spacing of joints

Rock class	**K**	**Width [cm]**	**Class**
Very favorable	<1	>100	(1)
Favorable	1-5	20-100	(2)
Fair	5-8	12,5-20	(3)
Unfavorable	8-15	7-12,5	(4)
Very unfavorable	>15	<7	(5)

Manual to the measuring method: Dependent on recognizable regulation degree of the cliff surface, regulated or unregulated (Figure 2), the number of crossings of the joints with a thought line is counted. In case of oriented joints the measuring lines are defined perpendicular to every general joint direction. The Klüftigkeitsziffer is the mean value for all joint orientations. If the joint directions are irregular the measuring line has to be defined by chance. In this case crossings just for one measuring line have to be counted.

Figure 2: Measuring directions to determine the spacing of the joints



f.) Continuity of joints

The RQD index is defined as the proportional rate of the distances between the dividing gaps > 10cm (l) and the length of the measuring distance in cm (L).

$$RQD = \frac{\sum l}{L} \cdot 100\%$$

Table 7: Continuity of joints

Rock class	RQD-Index [%]	Class
Very favorable	90-100	(1)
Favorable	75-90	(2)
Fair	50-75	(3)
Unfavorable	25-50	(4)
Very unfavorable	0-25	(5)

g.) Critical layer

The critical layer is the joint, that will most probably initiate rock fall.
Criteria to be kept in mind during the definition of the critical layer:

- Existing spacing of joints, even more critical if without infill
- Joint dipping steep out from slope (> 30°)
- RQD < 40% (ORR, 1974, from SELBY, 1993)
- Existing/visible seepage(s)

Ad C2

Rock classification

After SELBY (1993)

The qualities of the whole cliff formation of the demolition zone and the qualities of the critical dividing surface are valued with a point-key. Then the reached score proves the cliff quality.

Table 8: Parameter rating for rock classification after SELBY (1993)

Parameter	**Rating of the cliff formation**				
Rock strength Class (Page 6, Table 3)	(1)	(2)	(3)	(4)	(5)
Rating	**5**	**10**	**14**	**18**	**20**
Weathering (Page 10, Table 10)	(1)	(2)	(3)	(4)	(5)
Rating	**10**	**9**	**7**	**5**	**3**
Seepage	Not visible	Damp places visibly, trace	Slight, <25l/min/10m²	Moderate, 25-125l/min/m²	Great, >125l/min/m²
Rating	**6**	**5**	**4**	**3**	**1**

Parameter	**Rating of the critical layer**				
Spacing of joint (Page 7, Table 6)	(1)	(2)	(3)	(4)	(5)
Rating	**30**	**28**	**21**	**15**	**8**
Dip direction and orientation of joint Class (Page 7, Table 5)	(1) cross joints interlocked	(2)	(3)	(4)	(5)
Rating	**20**	**18**	**14**	**9**	**5**
Width of joint	<0,1mm	0,1-1mm	1-5mm	5-20mm	>20mm
Rating	**7**	**6**	**5**	**4**	**2**
Continuity of joint	None continuous	Few continuous	Continuous, no infill	Continuous, thin infill	Continuous, thick infill
Rating	**7**	**6**	**5**	**4**	**1**

↓ ↓ ↓

Table 9: Rating of the rock mass strength after SELBY (1993)

Total rating	1-26	50-26	70-51	90-71	100-91
Rock mass quality	Very weak rock	Weak rock	Moderate rock	Strong rock	Very strong rock

Table 10: Types of weathering following DEARMAN (1974 and 1976, from SELBY, 1993)

Class	Description
(1)	**unweathered**: mainly fresh failure scars, no weathering on fracture surfaces visible, no moos on fracture surfaces
(2)	**Slightly weathered**: starting discoloration on fracture surfaces
(3)	**Moderately weathered**: < 50 % of fracture surfaces are discolored, moss fouling starting at edges of surfaces
(4)	**Weathered**: > 50 % of fracture surfaces are discolored, extension of moos layer throughout most of the surface
(5)	**Highly weathered**: 100 % of fracture surfaces are discolored, edges are rounded, moos layer on fracture surfaces

After BEHR (1968, from RICHTER 1992):

Table 11: Rock classification after BEHR (1968, from RICHTER, 1992)

Rock class	RQD-Index	Klüftigkeitsziffer K
Very favorable	(1)	(1)
Favorable	(2)	(2)
Fair	(3)	(3)
Unfavorable	(4)	(4)
Very unfavorable	(5)	(5)

Ad C4)

General

For a detailed assessment of a slope the trajectory and several properties are mapped.
The slope profile is divided into homogeny sections. For a proper description the single sections may not exceed 30m.

Section borders:

Variations of the inclination, of the exposition, of the direction of rock fall, deposited rocks, obstacles,...
Forest stand borders are obligatory section borders!

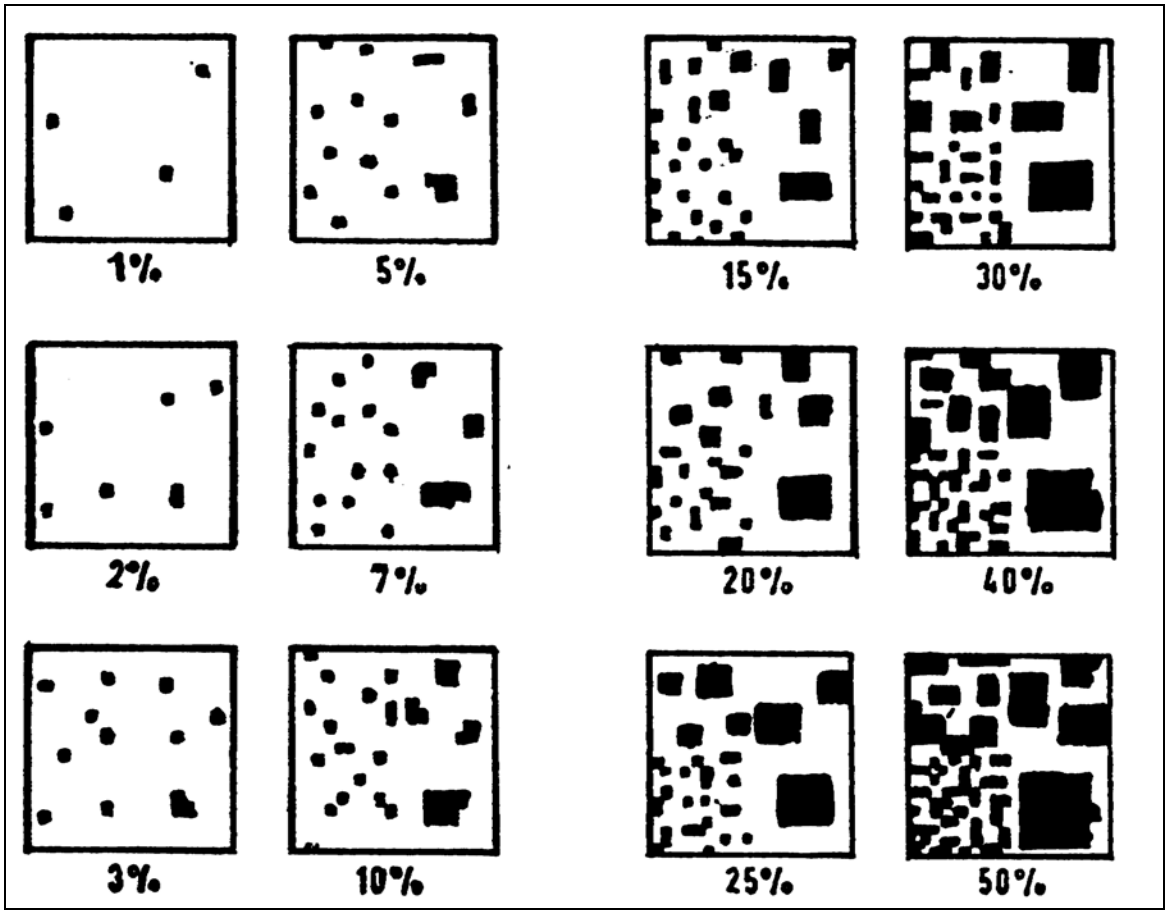
Soil depth

See page 4, Table 1

Skeleton

The spatial proportion of stones, rocks, and bed rock in an outcrope is estimated in percent.

Figure 3: Examples for spatial proportion



Soilt type

See page 5, Table 2

Surface roughness factors O_a & O_f

The surface roughness can be defined by surface amplitude (O_a) and the surface frequency (O_f).

- **O_a**: Maximum deflection of the surface perpendicular to the slope inclination within a given distance (usually equal to the length of the appropriate section), measured in meter [m]. I t represents the maximum deviation from the inclination of the section.
- **O_f** : Length between the peaks, measured in meter [m].

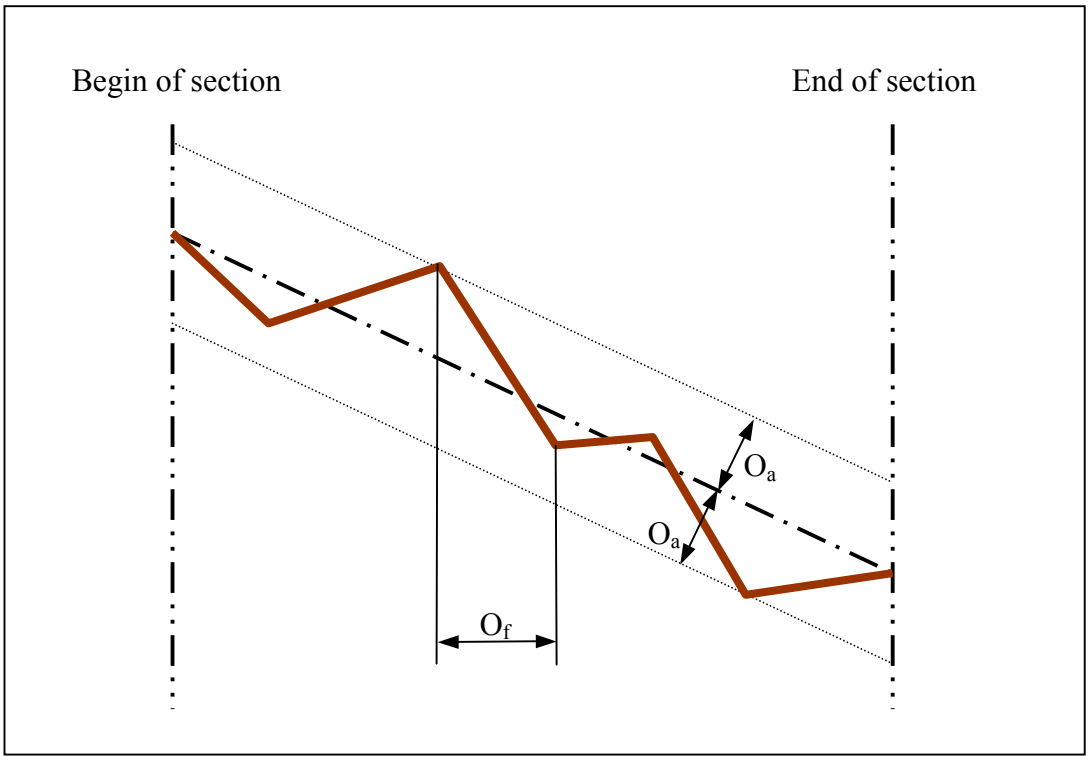
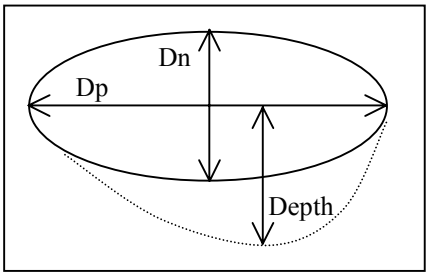


Figure 4: Surface roughness

Rock fall crater

Figure 5: Rock fall crater



Dp ..... Diameter in slope direction
Dn ..... Diameter perpendicular to slope direction
Tiefe ..... maximum depth

Rock properties

Position

The length from the section start point to the center of a stopped rock is measured [m].

Shape

Table 12: Rock shape

Class	Shape
CB	Cubic
S	Sphere
CL	Cylinder
D	Discoidal

Technical mitigation measures

Position

The length from the section start point to the technical mitigation measure is measured [m].

Figures and tables

Rock Fall Event Assessment

A1) General

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Date of assessment:	**Person:**

District:	**ZIP-code, municipality:**
Exact term and description of the site:	
Date of event: **Time of event:**	**Picture No.:**
Eyewitness: O Yes O No Name: Address: Phone-number.:	
Topographic map:	**Personal damage or damage to property:** o No o Yes (additionally fill in Module B) O Personal damage .....…….....(number) O Damage to property .....……....(number) type ..... O Damage to infrastructure (streets, railway,...) .....lm type ..... O damage to forest, area .....ha Description of damage:

A2) Weather Situation

Remark: multiple selection possible,
Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Day of event:	**1. Day before event:**	**2. Day before event:**
O Dry	O Dry	O Dry
O Rain - precipitation (..... mm)	O Rain – precipitation (..... mm)	O Rain – precipitation (..... mm)
O Thunderstorm	O Thunderstorm	O Thunderstorm
O Snow - precipitation (..... mm)	O Snow - precipitation (..... mm)	O Snow - precipitation (..... mm)
O Snow cover ..... cm	O snow cover ..... cm	O snow cover ..... cm
O Thaw	O Thaw	O Thaw
O Frost	O Frost	O Frost
O Frost – dew transition	O Frost – dew transition	O Frost – dew transition
O Wind	O Wind	O Wind
O Storm	O Storm	O Storm
Additional remarks about the weather situation:		

A3) Geology

Geological unit: **Type of rock:**	**Picture number:**
Geological map: O Not available O Yes, full description of the map:	**Detailed assessment by geologist** O No O Yes, name/office: ....

A4) Geomorphology

Source zone:	**Transfer zone:**	**Deposition zone:**
O Upper slope O Middle slope O Lower slope	O Upper slope O Middle slope O Lower slope	O Upper slope O Middle slope O Lower slope
O Bed rock O Mixed rock 50/50 O Loose rock	O Bed rock O Mixed rock 50/50 O Loose rock	O Bed rock O Mixed rock 50/50 O Loose rock
O Rock face (>80°) O Steep slope (50-80°) O Moderate slope (30-50°) O Low slope (10-30°) O Plain (0-10°)	O Rock face (>80°) O Steep slope (50-80°) O Moderate slope (30-50°) O Low slope (10-30°) O Plain (0-10°)	O Rock face (>80°) O Steep slope (50-80°) O Moderate slope (30-50°) O Low slope (10-30°) O Plain (0-10°) O Opposite slope

A5) Technical Mitigation Measures

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

O **Operate available**
Implementing Department .....

Source zone:
- O Non
- O Rock fall net
- O Steel barrier
- O Wooden barrier
- O Slope stabilization
  - O Wire mesh
  - O Berms
  - O Reverse bracing of single blocks
- O Others

Transfer zone:
- O Non
- O Rock fall net
- O Steel barrier
- O Wooden barrier
- O Slope stabilization
  - O Wire mesh
  - O Berms
  - O Reverse bracing of single blocks
- O Deflection dam
- O Retention dam
- O Others

Deposition zone:
- O Non
- O Rock fall net
- O Steel barrier
- O Wooden barrier
- O Deflection dam
- O Retention dam
- O Others (forest roads,...)

Source zone – detailed description

	Length [m]	Ave. width [m]	Height [m]	continuous	discontinuous	Number of rows
Rock fall net						
Steel barrier						
Wooden barrier						
Slope stabilization						
Others						

Transfer zone – detailed description

	Length [m]	Ave. width [m]	Height [m]	continuous	discontinuous	Number of rows
Rock fall net						
Steel barrier						
Wooden barrier						
Slope stabilization						
Deflection dam						
Retention dam						
Others						

Deposition zone – detailed description

	Length [m]	Ave. width [m]	Height [m]	continuous	discontinuous	Number of rows
Rock fall net						
Steel barrier						
Wooden barrier						
Slope stabilization						
Deflection dam						
Retention dam						
Others						

Semi-Detailed Rock Fall Event Assessment

B1) Record of Equipment

Measured parameter	Measuring device	
Length (few meter)	○ Tape measure	○ 30 m
	○	○ .....
Length (up to 2 m)	○ Tape measure	○ 5 m
	○ Folding rule	○ 2 m
	○	○ .....
Soil parameter	○ Spade	
	○	
Slope	○	○ %
		○ grad
		○ gon
Height above sea level	○ GPS	
	○	
Exposition	○ GPS	
	○	
Forest stand parameter	○ Relascope	
	○	

B2) Trajectory

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Start [m a.s.l.]	End [m a.s.l.]	Slope [°]	Oblique distance [m]	Exposition [°]	Soil type [class]	Soil depth [m]	Roughness [class]

Soil type

See annex B

Soil depth

Class 1: 0 - 30cm, shallow soil

Class 2: > 30cm, middle- and deep soil

Class 3: Other
The effective through-root able soil depth is larger than ascertainable by ditch with the spade, because of block corridors, strongly stony, weathered background or very high skeleton proportion.

Roughness

Class 0: coarse steps (> 1 m); bed rock or > 50% mixed rock

Class 1: coarse block debris (d > 30 cm-100 cm); up to 50 % mixed rock

Class 2: bumps overgrown by turf or small shrubs (height of bumps more than 50 cm), deep stamped cow steps, coarse debris (d* ca. 10-30 cm), soil highly structured by roots

Class 3: alternately fine debris (d < 10 cm) and turf or small shrubs, small bumps (height up to 50 cm) overgrown by turf or small shrubs, shallow stamped cow steps; structured forest soil.

Class 4: smooth ground surface, talus slope mixed with soil, A-horizon spatially distributed, primary energy dissipation by absorption in A-horizon, sparse structured forest soil, meadows, grassland.

Class 5: swampy hollows, swampy area

B3) Source Zone (see also annex B)

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Topography:

Sea level: from..... m a.s.l. - to .....m a.s.l.

Slope: maximum:.....° [Grad]

minimum:.....° [Grad]

O	N	O	S
O	NO	O	SW
O	O	O	W
O	SO	O	NW

Geological composition:

Type of rock in the source area:

O Bed rock	Height:	m
O Mixed rock	Height:	m
O Loose rock	Height:	m

Actual deployment zone:

O Visible O Invisible

Number of deployments .....
Average area [m²] .....
Average height [m] .....
Average width [m] .....

Rock shape:

O Shape of detached rocks:

O Sphere O Cylinder
O Cube O Discoidal

Rock size:

Diameter of rocks deposited beneath the rock face:

Average	Maximum
O > 0,01 m	O > 0,01 m
O 0,1-0,25 m	O 0,1-0,25 m
O 0,25-0,5 m	O 0,25-0,5 m
O 0,5-1 m	O 0,5-1 m
O 1 – 1,5 m	O 1 – 1,5 m
O 1,5 – 2 m	O 1,5 – 2 m
O > 2 m	O > 2 m

Probable detachment mechanism:

O Pore pressure (ice/water)
O Toppling
O Root pressure
O Wedge failure
O (Block-)Slide
O Activation by animals
O Residual block
O Activation by human activity
O Ground failure
O Others: .....

Weathering

O Not weathered
O Weathered
O Mossy …….% of area

Seepages:

O No
O Yes,

Forestation

Vegetation type:

O	Not wooded
O	Larix-P. cembra type
O	Subalp. Picea type
O	Picea-Abies-Fagus type
O	Fagus type
O	Tree species typical of avalanche influenced slopes (i.e. Betulus, Alnus, Larix, ...)
O	Others: .....

Structure of forest:

O	Rout structure
O	Mixed ages
O	Mature stand
O	Timber wood
O	Pool stand
O	Thicket
O	Regeneration

Timber or mature wood parameters:

Trees/ha (estimation):	
Stocking (%):	

Angle-count sample:	/ (k-factor/count)

B4) Transfer Zone

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Topography:

Sea level: from ..... m a.s.l. - to..... m a.s.l.

Slope: maximum: ..... ° [Grad]

minimum:..... ° [Grad]

O	N	O	S
O	NO	O	SW
O	O	O	W
O	SO	O	NW

Morphology:

O Narrow gully type

O Gully type with local width variation

O Even

O Homogenous slope

O Slope with multiple steps and flattenings

O Other features: .....

.....

Deposited rocks:

Max. diameter: .....

Ave. diameter:.....

Structures in slope direction:

O Hollow: ..... m a.s.l.

O Gully/ravine: ..... m a.s.l.

O Step: ..... m a.s.l.

O Others: ..... m a.s.l.

Structures perpendicular to the slope:

O Roads: .....m a.s.l.

O Slope terrace: .....m a.s.l.

O Forest ways: .....m a.s.l.

O Travelling path: .....m a.s.l.

O Others: .....m a.s.l.

Forestation

Vegetation type:

O	Not wooded
O	Larix-P. cembra type
O	Subalp. Picea type
O	Picea-Abies-Fagus type
O	Fagus type
O	Tree species typical of avalanche influenced slopes (i.e. Betulus, Alnus, Larix, ...)
O	Others: .....

Structure of forest:

O	Rout structure
O	Mixed ages
O	Mature stand
O	Timber wood
O	Pool stand
O	Thicket
O	Regeneration

Timber or mature wood parameters:

Trees/ha (estimation):	
Stocking (%):	

Angle-count sample:	/ (k-factor/count)

B5) Deposition Zone

Entries according to MAXO-code: (M - measuring, A - assumption, X - missing, O - not available)

Topography:

Sea level: from ..... m a.s.l. - to ..... m a.s.l.

Slope: maximum: ..... ° [Grad]
minimum: ..... ° [Grad]

O	N	O	S
O	NO	O	SW
O	O	O	W
O	SO	O	NW

Spatial description of the deposition zone:

O Narrow gully type
O Gully type with local width variation
O Even
O Gentle cone (B ≥ 200 m)
O Distinctive cone (B ≤ 200 m)
O Hard change of inclination
O Alternating inclination
O Change of slope direction
O Opposite slope
O Obstacles
O Others .....

Infrastructure

O Traffic route: length ..... m
O Residential building: number. .....
O Industrial building: number.....
O Agricultural building: number .....
O Unspoilt
O Others.....

Probable cause of deposition:

O Lowering of slope
O Surface roughness
O Opposite slope
O Stream channel
O Others .....
O Natural obstacles (z.B. dead wood, tree hit)
O Buildings
O Streets
O Technical mitigation measures

Energy slope: ..... [%]

(upper edge of source zone to furthest reach of deposition)

Shadow angle: ..... [%]

(lower edge of source zone to furthest reach of deposition)

Deposited rocks:

Max. diameter: ..... m

Ave. diameter: ..... m

Forestation

Vegetation type:

O	Not wooded
O	Larix-P. cembra type
O	Subalp. Picea type
O	Picea-Abies-Fagus type
O	Fagus type
O	Tree species typical of avalanche influenced slopes (i.e. Betulus, Alnus, Larix, ...)
O	Others: .....

Structure of forest:

O	Rout structure
O	Mixed ages
O	Mature stand
O	Timber wood
O	Pool stand
O	Thicket
O	Regeneration

Timber or mature wood parameters:

Trees/ha (estimation):	
Stocking (%):	

Angle-count sample:	/ (k-factor/count)

General description of deposition zone:

(Morphology, endangered objects, furthest reach of deposition,...)

Detailed Rock Fall Event Assessment

C1) Record of Equipment

Measured parameter	Measuring device	
Strike & dip orientation	○ Geologic compass ○	○ gon ○ grad ○ .....
Rock strength	○ Geologic hammer ○	
Length (few meter)	○ Tape measure ○	○ 30 m ○ .....
Length (up to 2 m)	○ Tape measure ○ Folding rule ○	○ 5 m ○ 2 m ○ .....
Soil parameter	○ Spade ○	
Slope	○	○ % ○ grad ○ gon
Height above sea level	○ GPS ○	
Exposition	○ GPS ○	
Tree diameter	○ Caliper ○ Pi-tape measure ○	
Tree height	○ Relascope ○ Suunto ..... ○	
Forest stand assessment	○ Relascope ○	

C2) Transfer zone

Characteristic values of the rock fall path (see also Annex C)

Starting point: X:____m Y:____m Z:____m a.s.l.

	Slope description																Rock properties						Starting parameter			Tech. mit. meas.		
	slope properties			Soil properties					Jump height		Rock fall crater																	
Segment No.	Oblique distance [m]	Inclination [°]	Exposition [gon]	Soil depth [m]	Skeleton [%]	Soil type [class]	Oa [m]	Of [m]	Maximum [m]	Average [m]	Shape of crater [class]	Dp [m]	Dn [m]	Depth [m]	incoming angle [°]	outgoing angle [°]	Position [X]	Form [CB/S/CL/D]	D max [m]	D min [m]	L max [m]	L min [m]	Free fall (FF) Gliding (G) Rolling (R) [class]	Min. falling height [m]	Max. falling height [m]	Position [X]	Height [m]	Inclination [°]
Starting point																												
1																												
2																												
3																												
4																												
5																												
6																												
7																												
8																												
9																												
10																												
11																												
12																												
13																												
14																												
15																												
16																												
17																												
18																												
19																												
20																												

	Slope description																Rock properties						Starting parameter			Tech. mit. meas.		
	slope properties			Soil properties					Jump height		Rock fall crater																	
Segment No.	Oblique distance [m]	Inclination [°]	Exposition [gon]	Soil depth [m]	Skeleton [%]	Soil type [class]	Oa [m]	Of [m]	Maximum [m]	Average [m]	Shape of crate [class]	Dp [m]	Dn [m]	Depth [m]	incoming angle [°]	outgoing angle [°]	Position [X]	Form [CB/S/CL/D] [class]	D max [m]	D min [m]	L max [m]	L min [m]	Free fall (FF) Gliding (G) Rolling (R) [class]	Min. falling height [m]	Max. falling height [m]	Position [X]	Height [m]	Inclination [°]
21																												
22																												
23																												
24																												
25																												
26																												
27																												
28																												
29																												
30																												
31																												
32																												
33																												
34																												
35																												
36																												
37																												
38																												
39																												
40																												
41																												
42																												
43																												
44																												
45																												

	Slope description																Rock properties						Starting parameter			Tech. mit. meas.		
	slope properties			Soil properties					Jump height		Rock fall crater																	
Segment No.	Oblique distance [m]	Inclination [°]	Exposition [gon]	Soil depth [m]	Skeleton [%]	Soil type [class]	Oa [m]	Of [m]	Maximum [m]	Average [m]	Shape of crate [class]	Dp [m]	Dn [m]	Depth [m]	incoming angle [°]	outgoing angle [°]	Position [X]	Form [CB/S/CL/D] [class]	D max [m]	D min [m]	L max [m]	L min [m]	Free fall (FF) Gliding (G) Rolling (R) [class]	Min. falling height [m]	Max. falling height [m]	Position [X]	Height [m]	Inclination [°]
46																												
47																												
48																												
49																												
50																												
51																												
52																												
53																												
54																												
55																												
56																												
57																												
58																												
59																												
60																												
61																												
62																												
63																												
64																												
65																												
66																												
67																												
68																												
69																												
70																												

	Slope description																Rock properties						Starting parameter			Tech. mit. meas.		
	slope properties			Soil properties					Jump height		Rock fall crater																	
Segment No.	Oblique distance [m]	Inclination [°]	Exposition [gon]	Soil depth [m]	Skeleton [%]	Soil type [class]	Oa [m]	Of [m]	Maximum [m]	Average [m]	Shape of crate [class]	Dp [m]	Dn [m]	Depth [m]	incoming angle [°]	outgoing angle [°]	Position [X]	Form [CB/S/CL/D] [class]	D max [m]	D min [m]	L max [m]	L min [m]	Free fall (FF) Gliding (G) Rolling (R) [class]	Min. falling height [m]	Max. falling height [m]	Position [X]	Height [m]	Inclination [°]
71																												
72																												
73																												
74																												
75																												
76																												
77																												
78																												
79																												
80																												
81																												
82																												
83																												
84																												
85																												
86																												
87																												
88																												
89																												
90																												
91																												
92																												
93																												
94																												
95																												

	Slope description																Rock properties						Starting parameter			Tech. mit. meas.		
	slope properties			Soil properties					Jump height		Rock fall crater																	
Segment No.	Oblique distance [m]	Inclination [°]	Exposition [gon]	Soil depth [m]	Skeleton [%]	Soil type [class]	Oa [m]	Of [m]	Maximum [m]	Average [m]	Shape of crate [class]	Dp [m]	Dn [m]	Depth [m]	incoming angle [°]	outgoing angle [°]	Position [X]	Form [CB/S/CL/D]	D max [m]	D min [m]	L max [m]	L min [m]	Free fall (FF) Gliding (G) Rolling (R) [class]	Min. falling height [m]	Max. falling height [m]	Position [X]	Height [m]	Inclination [°]
96																												
97																												
98																												
99																												
100																												
101																												
102																												
103																												
104																												
105																												
106																												
107																												
108																												
109																												
110																												
111																												
112																												
113																												
114																												
115																												
116																												
117																												
118																												
119																												
120																												

C3) Geology

Rock strength

Uni-axial compressive strength UCS: ..... [Class]

Degree of weathering at the source zone (rates in per cent):

Area of detachment	Other bed rock surface	Feature
.....%	.....%	**unweathered**: mainly fresh failure scars, no weathering on fracture surfaces visible, no moos on fracture surfaces
.....%	.....%	**Slightly weathered**: starting discoloration on fracture surfaces
.....%	.....%	**Moderately weathered**: < 50 % of fracture surfaces are discolored, moss fouling starting at edges of surfaces
.....%	.....%	**Weathered**: > 50 % of fracture surfaces are discolored, extension of moos layer throughout most of the surface
.....%	.....%	**Highly weathered**: 100 % of fracture surfaces are discolored, edges are rounded, moos layer on fracture surfaces

Joint description (spatial)

Parting	**a** Type	**b** Strike [gon]	**b** Class	**c** Dip [°]	**c** Class	**d** Width of joints [cm]	**e** Spacing of joints	**f** Continuity of joints Class	**g** Critical layer
1									
2									
3									
4									
5									
6									

Assessment of the critical layer

Classification following SELBY(1993)		
Parameter	**Class**	**Rating**
Rock strength		
Weathering		
Seepage		
Spacing of joint		
Strike and dip orientation of joint		
Width of joint		
Continuity of joint		
Sum		

Classification following BEHR (1968)			
K-Class	**RQD-Class**	➔	**Rating**
		➔	

C4) Rock Features

Line-count-analysis

Diameter/Length [cm]	Source zone	Deposition zone
0.000 - 6,3		
6,3 – 12,5		
12,5 – 25,0		
25 - 50		
50 - 100		
100 - 200		
200 - 400		
> 400		

ABC-analysis

Assess at least 50 rocks

Source zone			Deposition zone		
A (d_{max})	B (d_{ave})	C (d_{min})	A (d_{max})	B (d_{ave})	C (d_{min})

Line-count-analysis

Diameter/Length [cm]	Source zone	Deposition zone
0.000 - 6,3		
6,3 – 12,5		
12,5 – 25,0		
25 - 50		
50 - 100		
100 - 200		
200 - 400		
> 400		

ABC-analysis

Assess at least 50 rocks

Source zone			Deposition zone		
A (d_{max})	B (d_{ave})	C (d_{min})	A (d_{max})	B (d_{ave})	C (d_{min})

Line-count-analysis

Diameter/Length [cm]	Source zone	Deposition zone
0.000 - 6,3		
6,3 – 12,5		
12,5 – 25,0		
25 - 50		
50 - 100		
100 - 200		
200 - 400		
> 400		

ABC-analysis

Assess at least 50 rocks

Source zone			Deposition zone		
A (d_{max})	B (d_{ave})	C (d_{min})	A (d_{max})	B (d_{ave})	C (d_{min})

C5) Forest Assessment

Method:

O Angle-Count-Sample: k-factor:……. O Circular-Sample: radius:............ m

Tree list

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Tree list

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand		
No.	Species	BHD
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		
36		
37		
38		
39		
40		

Forest stand assessment

	Segment		Tree population		75%-Tree			Regeneration					
No.	Start	End	Species	Count / k-Factor	BHD	Height	Crown height	Species	Number < 25 cm	Number 25 – 130 cm	Shrub layer [%]	Soil vegetation [%]	Mossiness [%]
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									
				/									

Tree hits

Tree		Direct hit		Grazing shot	Picture
Stand no.	Tree no.	Height	Diameter	Number	No.