



Welcome




COST EFFECTIVE LOW ENERGY ROCKFALL SOLUTIONS

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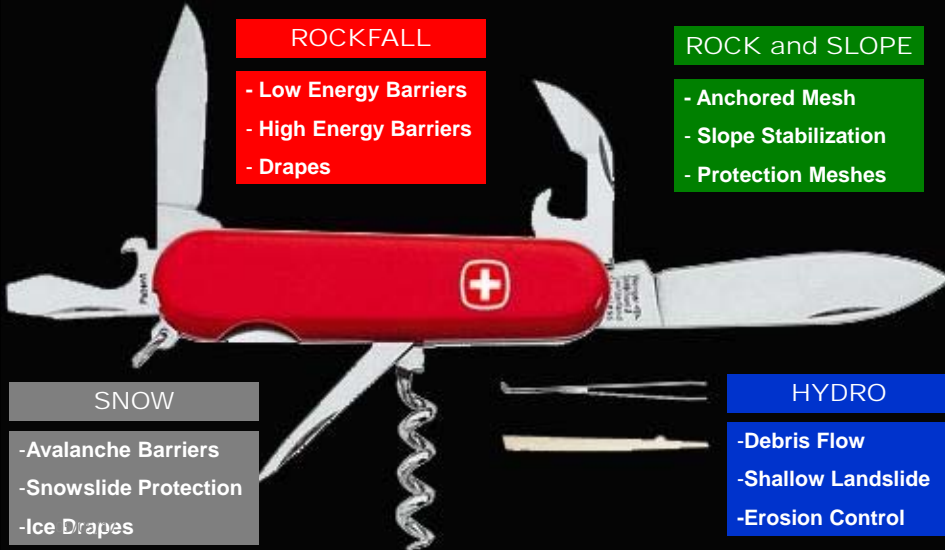
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GEOHAZARD SOLUTIONS

Geohazard Solutions 

The Use of Flexible Systems for Natural Hazard Mitigation



ROCKFALL

- Low Energy Barriers
- High Energy Barriers
- Drapes

ROCK and SLOPE

- Anchored Mesh
- Slope Stabilization
- Protection Meshes

SNOW

- Avalanche Barriers
- Snowslide Protection
- Ice Drapes


HYDRO

- Debris Flow
- Shallow Landslide
- Erosion Control



Geobrugg Protection Systems

SNOW – Avalanche Prevention Structures



Historic installation from the 1950's

Natural Hazard Protection Systems

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Geobrugg Protection Systems

SNOW Avalanche Protection Structures



Natural Hazard Protection Systems

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Geobrugg Protection Systems

SNOW Avalanche Prevention



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Geobrug Protection Systems

SNOW



Natural Hazard Protection Systems

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Geobrug Protection Systems

ROCKFALL - Barriers and Catchfences



Natural Hazard Protection Systems

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GeobruGG Protection Systems

ROCKFALL - Barriers and Catchfences



Natural Hazard Protection Systems

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ROCK & SLOPE - Drapes and Attenuators



Slope Stabilization

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ROCK and SLOPE – Anchored Mesh Solutions for Unstable Slopes




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Slope Stabilization

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ROCK and SLOPE – Anchored Mesh Solutions for Unstable Slopes



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Natural Hazard Protection Systems 

Geobruigg Protection Systems

HYDRO - Debris Flow Barriers



Natural Hazard Protection Systems 

Geobruigg Protection Systems

HYDRO - Shallow Landslide Barriers



Geobrugg's Greatest Hits 



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Geobrugg's Greatest Hits 



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Rockfall Mitigation Solutions

GEOBRUGG®


- **Passive Systems**
 - Mesh Draperies
 - Ditches & Swales
- **Tensioned Systems**
 - TECCO Slope Stabilization System
 - SPIDER Slope Stabilization System
- **Basic Chain Link Fence**
 - Up to 13.5 kJ (5 ft-tons)
- **Rigid Barriers**
 - K-Rail, Gabions, Various Structures
 - Low Energies
 - < 30 ft-tons
- **Flexible Rockfall Barriers– Dynamic Systems**
 - Certified and Tested according to Guidelines
 - EOTA
 - Swiss Guidelines
 - Structural Netting – Rings Nets, TECCO, and/or SPIDER
 - 100 kJ to 8,000 kJ
- **Attenuator or Hybrid Rockfall Systems**
 - Rockfall Barrier and draped mesh combination
- **Berms and MSE Embankments**
 - Very High Energy

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ROCKFALL PROTECTION BARRIERS

GEOBRUGG®
Safety is our nature

- ▶ Full range of applications
- ▶ From 35 kJ – 8000 kJ (164kg – 20,000kg @ 25m/s)
- ▶ Tested and approved to relevant guidelines (BAFU & EOTA)



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Available Low Cost Low Energy Options

- Jersey Barriers (K-rail)
- Lock Blocks
- Guard Rail
- Chain Link Fencing
- T35 Barrier

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JERSEY BARRIERS (K-RAIL)



- ▶ 10-35 kj (not reinforced)
- ▶ Up to 50 kj (reinforced)
- ▶ Heavy (difficult to move)
- ▶ Height Limitations

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LOCK BLOCKS



- ▶ Heavy (difficult to move)
- ▶ Costly

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GUARD RAIL



- ▶ Good for angular impact (Cars)
- ▶ Not designed for perpendicular impact (Rocks)
- ▶ Impact from upslope rockfall tears metal from posts
- ▶ Height limitations

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CHAIN LINK



- ▶ Not designed for rockfall impacts
- ▶ Impacts +/-10 kj
- ▶ Limited post options
- ▶ No force transmission between panels

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T-35 RADSIDE BARRIER



- ▶ Tested to 50 kj (rated 35 kj)
- ▶ Simple design
- ▶ Range of heights
- ▶ Multiple anchoring options
- ▶ Light weight
- ▶ Easy Installation
- ▶ Cost effective

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T35 BARRIER



- ▶ Originated in Australia
- ▶ Low energy protection
- ▶ Protection from rockfall upslope.
- ▶ Tested for perpendicular impacts (1:1 and projectile tests)
- ▶ Cost effective

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T35 BARRIER LOCAL EXAMPLES

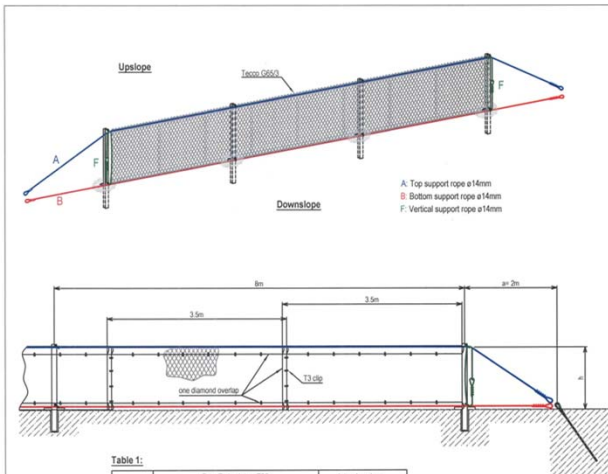


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T35 - TESTING



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- Installation:**
- 1.) Mark out post locations and lateral anchors. The distance between the lateral anchors and the end post vary depending on the barrier height (see table 1). Make sure that the lateral anchors are in line or slightly in front (downslope) of the barrier.
 - 2.) Drill a 200mm hole (as a minimum) for the posts. The hole diameter may increase if more concrete coverage is required. The depth will depend on the ground conditions (see table 1).
 - 3.) Drill the holes for the lateral anchors. The drill depth and diameter will also depend on the ground conditions (see table 1).
 - 4.) Install posts and lateral anchors into holes. Make sure the posts are installed with the holes for the shackles facing downslope. Concrete and grout (minimum 32 MPa) in place, making sure the posts are 'plumb' and the concrete has been compacted.
 - 5.) Install the 5/8 inch shackles on the top and bottom of each post.
 - 6.) Once the concrete and grout has cured, install the 14mm top and bottom rope. This is done by threading the rope through the 5/8 inch shackles on the top and bottom of each post.
 - 7.) Attach the top and bottom rope to the lateral (wire rope anchors). One end is attached using 7/8 inch shackles, the other is attached using wire rope grips. Make sure you pay attention to the orientation of the wire rope grips and their spacing (see figure 3). Tension both ropes to approximately 10kN.
 - 8.) Starting at one end, hang a panel of the TECCO mesh over the top support rope. Fold it back on itself, making sure it hangs down below the top rope by one diamond. Fix it back onto itself using one T3 clip per diamond (see figure 4).
 - 9.) Repeat the process above, however this time for the bottom support rope. Fix the mesh back onto itself using one T3 clip per diamond, making sure the mesh is tight.
 - 10.) Move along to the next section of the barrier, and repeat the process above. Overlap the adjacent TECCO mesh panel by a minimum of one diamond, and connect the two panels together using one T3 clip per diamond (see figure 5).
 - 11.) Repeat the process above until all the TECCO mesh has been hung. Depending on the overall length of the barrier, you may end up with more overlap on the last two mesh panels.
 - 12.) Install the vertical ropes at the end posts of the barrier. Thread the rope through the top shackle, then thread it through the mesh (every diamond), and finally through the bottom shackle. Thread the rope through the thimble, and connect using wire rope grips. Make sure you pay attention to the orientation of the wire rope grips and their spacing (see figure 7).

Table 1:

height	Post Embedment T35			ROCK		lateral anchor		
	SOL	mid	strong	distance	anchor Force	distance	anchor Force	
h	weak	mid	strong	0.38-0.80	MPa	m	kN	
m	MPa	MPa	MPa	m	MPa	m	kN	
1.20	0.17-0.28	0.17-0.28	0.28-0.40	0.8	0.8	0.8	2	200
1.35	1	0.8	0.8	0.8	0.8	2	200	
1.50	1.2	1	1	1	1	2	200	
1.80	1.2	1	1	1	1	2	200	

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modification	DATE	initiated by	GS-10869 ed. 04.02.14
checked	25.08.15	by	GS-10869.1e
approved	25.08.15	by	GS-10869.1e

Standard drawing
T35 Roadside Rockfall Barrier

GEOBRUGG AG
20-850-00000000

GS-10869.1e

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Installation:

- 1) Mark out post locations and lateral anchors. The distance between the lateral anchors and the end is 2.00m (see table 1). Make sure that the lateral anchors are in line or slightly in front (downslope) of the barrier.
- 2) Drill 2 or 3 holes for the post anchors, depending on the ground conditions. The required depth will vary from site to site, depending on the ground conditions it has been calculated prior to the work commencing. The depth will depend on the ground conditions, (see table 1)
- 3) Drill the holes for the lateral anchors. The drill depth and diameter will also depend on the ground conditions, (see table 1)
- 4) Install posts and lateral anchors into holes
- 5) Grout (minimum 32 MPa) the anchor holes
- 6) Form a flat surface for the post base using excess grout or concrete (~50-100mm thickness)
- 7) Install the post, once the grout or concrete has set. Fix the post to the bars using nuts
- 8) Attach the top and bottom rope to the lateral (wire rope anchors). One end is attached using 7/8 inch shackles, the other is attached using wire rope grips. Make sure you pay attention to the orientation of the wire rope grips and their spacing (see figure 3). Tension both ropes to approximately 10kN.
- 9) Starting at one end, hang a panel of the TECCO mesh over the top support rope. Fold it back on itself, making sure it hangs down below the top rope by one diamond. Fix it back onto itself using one T3 clip per diamond (see figure 4)
- 10) Repeat the process above, however this time for the bottom support rope. Fix the mesh back onto itself using one T3 clip per diamond, making sure the mesh is tight.
- 11) Move along to the next section of the barrier, and repeat the process above. Overlap the adjacent TECCO mesh panel by a minimum of one diamond, and connect the two panels together using one T3 clip per diamond (see figure 4)
- 12) Repeat the process above until all the TECCO mesh has been hung. Depending on the overall length of the barrier, you may end up with more overlap on the last two mesh panels.
- 13) Install the vertical ropes at the end posts of the barrier. Thread the rope through the top shackle, then thread it through the mesh (every diamond), and finally through the bottom shackle. Thread the rope through the thimble, and connect using wire rope grips. Make sure you pay attention to the orientation of the wire rope grips and their spacing (see figure 1)

Table 1:

height h	lateral anchor distance a	anchor Force kN	post anchor depth			
			SOIL weak 0.15-0.18 MPa	SOIL med 0.17-0.20 MPa	SOIL strong 0.28-0.40 MPa	ROCK 0.38-0.60 MPa
m	m					
1.20	2	200	2 x GEWI 20, L=2.0m	2 x GEWI 20, L=2.0m	3 x GEWI 20, L=1.5m	3 x GEWI 20, L=1.0m
1.35	2	200	2 x GEWI 20, L=2.5m	2 x GEWI 20, L=2.0m	3 x GEWI 20, L=1.5m	3 x GEWI 20, L=1.0m
1.50	2	200	2 x GEWI 25, L=2.5m	2 x GEWI 25, L=2.0m	3 x GEWI 20, L=1.5m	3 x GEWI 20, L=1.0m
1.80	2	200	2 x GEWI 25, L=3.0m	2 x GEWI 25, L=2.5m	3 x GEWI 20, L=2.0m	3 x GEWI 20, L=1.5m

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 checked: 25.08.15 [signature]
 approved: 25.08.15 [signature]
Standard drawing
T35 Roadside Rockfall Barrier
 for Concrete/Rock/Soil
 GEORUGG AG
 CH-8500 Hohenstein
 GS-11393.1e

VARIETY OF POST OPTIONS

Adaptable to site conditions

Fixed

Hinged

Embedded

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DIRECT BURIED POST

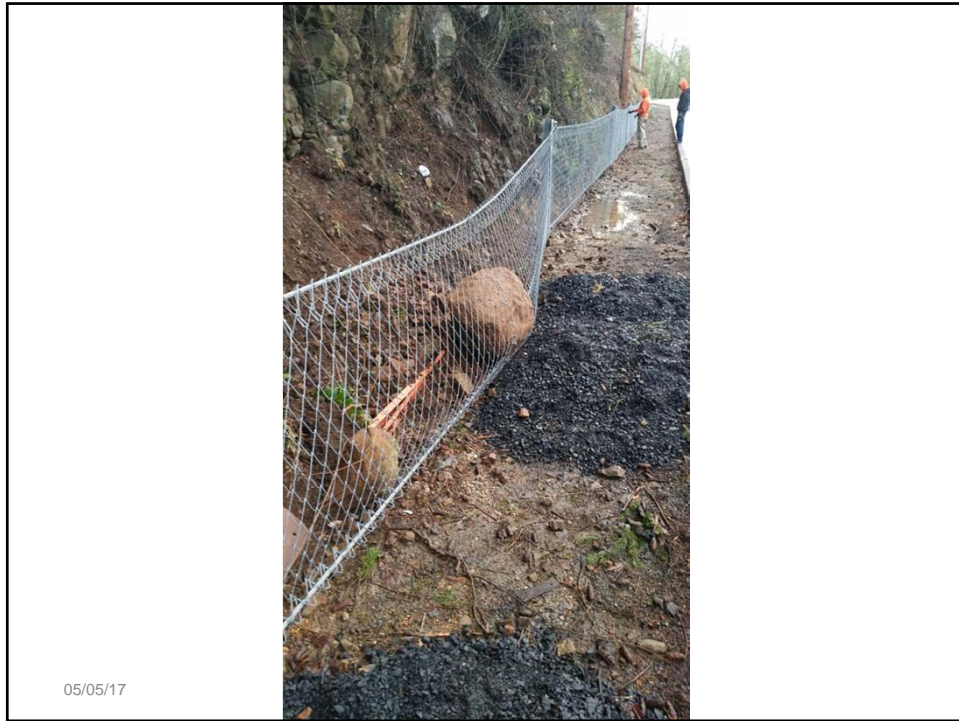


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DIRECT BURIED POST



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CONCRETE MOUNTED POST

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ADDITIONAL POST OPTIONS

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ADDITIONAL POST OPTIONS



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WITHOUT LATERAL ANCHORS



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EASY INSTALLATION



- ▶ Lightweight
- ▶ Simple design
- ▶ No braking elements
- ▶ Adaptable to site conditions
- ▶ Installed by local maintenance division

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DESIGN AND SUPPORT



- ▶ Site support, evaluation
- ▶ Technical support, information, consultation, drawings
- ▶ Pricing, options
- ▶ Support district maintenance with materials, product/installation manuals

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QUESTIONS?

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