

ROCKFALL-X™
Damping system



ROCKFALL-X™ Damping system with cellular glass fill material and TECCO® mesh as protection for the rockfall galleries Mattstock and Churfiristen, Weesen / Amden, Switzerland

ROCKFALL-X™ Damping system for the rockfall protection gallery Mattstock and Churfiristen, Weesen / Amden, Switzerland

Location:	Rockfall protection gallery Mattstock and Churfiristen, Weesen / Amden, Switzerland
Client:	Tiefbauamt des Kantons St.Gallen, Abteilung Strassen- und Kunstbauten
Planning:	Engineering office CASUTT WYRSCH ZWICKY, Switzerland
Constructor:	Locher Bauunternehmer AG, Zürich, Switzerland
Installation:	September / October 2011
Rockfall energies:	200 kJ–1'900 kJ
Cellular glass filled damping modules:	1'300 pieces 1,3 m und 575 pieces 2,0 m heigh



Rockfall protection gallery Mattstock and Churfiristen

Initial position and job definition

The state road No. 17 between Weesen and Amden in Switzerland is rockfall hazard exposed. Therefore the rockfall gallery "Mattstock" with a length of 110 m and the rockfall gallery "Churfiristen" with a length of 155 m were constructed during the time period of autumn in 1978 to August 1981.

As a result of several rockfall events the risk situation of the entire road section was reviewed. A static calculation has revealed that only impacts up to 500 kJ can be absorbed with the existing gravel covering of the rockfall galleries "Mattstock" and "Churfiristen". The disruptive strength respectively the shear carrying capacity of the roof is critical. The low load capacity is mainly caused by the poor properties of the gravel roof covering.

Due to the risk assessment it was decided to strenghten the two rockfall galleries up to an energy absorption capacity of 200 – 1900 kJ, thus protecting against rockfall risk with an expected occurrence of between 10 - 30 years.

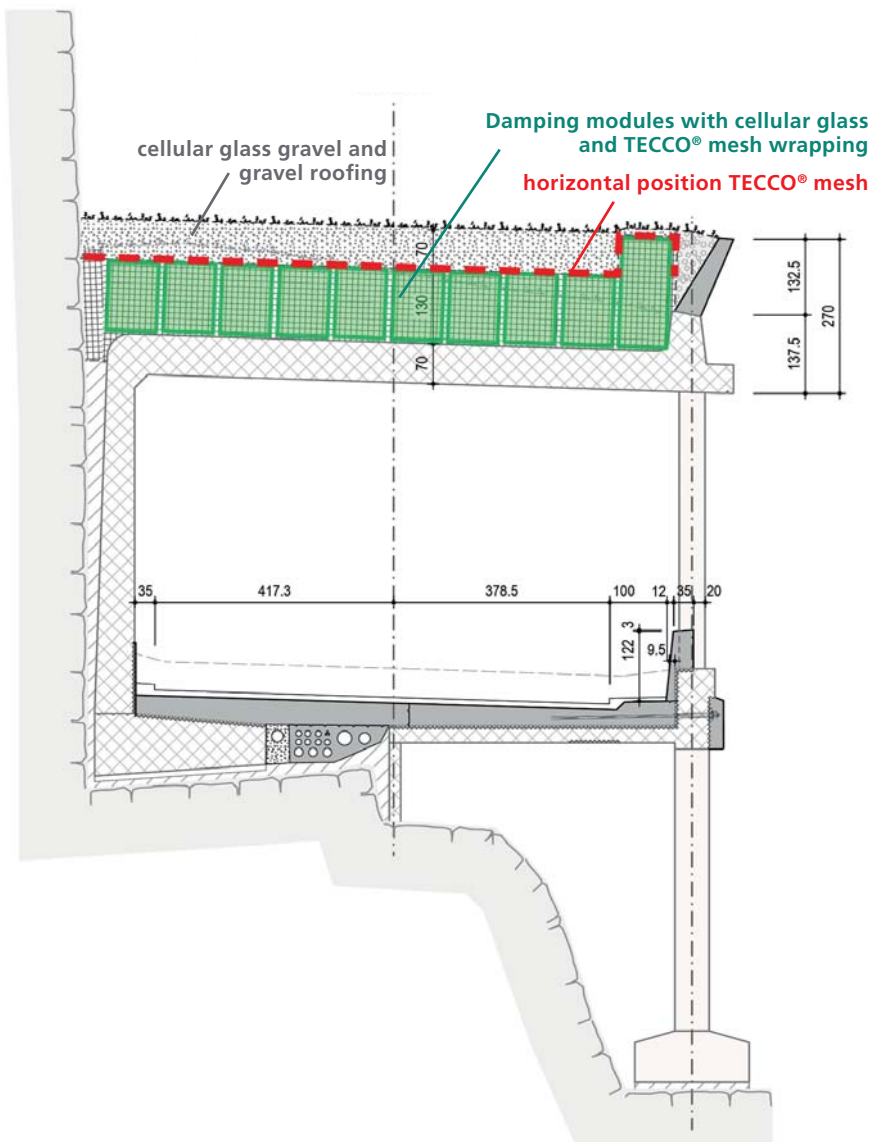


Description of the Geobruigg damping modules

As a replacement for traditional gravel damping material, the ROCKFALL-X™ damping system is installed on the roof of a rockfall protection gallery increasing its protection capacity while dramatically reducing the static load on the overall structure. Their light weight of the damping moduls filled with special cellular glass fill material enable six to eight times the volume of damping material to be applied. The special ROCKFALL-X™ cylinder modular design wrapped with the TECCO® mesh works with the cellular glass to create an elastic-plastic response to rockfall impact. The system dissipates impact energies smoothly throughout more damping material, consequently reducing impact loading on the concrete protection gallery. The light weight modular system aids both installation and system repairs after impact events. Product development and rigorous field testing of Geobruigg damping modules wrapped with the TECCO® mesh have proven the excellent energy absorption capacity of this well thought-out system. Further to delivering a strong product assurance, testing has provided a greater understanding of the impact loading for existing rockfall protection galleries. The research work supported by Geobruigg and field tests of the ROCKFALL-X™ damping system contributed to the development of new guidelines for rockfall galleries as well as for the assessment of existing concrete protective galleries.



The ROCKFALL-X™ cylinder modules are filled up with cellular glass as cushioning material



Cross section of the rockfall protection gallery with ROCKFALL-X™ damping system

Alternative protection measurement

The installation of a flexible rockfall barrier was impossible due to the necessary big cantilever and furthermore the question of maintenance. To keep the cost of maintenance to a minimum, a self-cleaning barrier would be a solution. However since a public road and hiking trail are close by on the downhill side, this solution is not possible.

Advantages

Geobrugg ROCKFALL-X™ damping system offers many advantages over traditional damping materials, particularly when applied to existing protection galleries:

- Where potential rockfall hazards have increased or the structure is underdesigned, Geobrugg's modular damping system with cellular glass fill provides a cost effective remediation solution for existing structures.
- The impact load capacity is greatly enhanced while dramatically reducing the static load to the support structure, potentially eliminating the requirements for costly structural reinforcements.
- The special damping moduls wrapped with TECCO® mesh activate more compression resistant cellular glass.
- The elastic plastic response of the system design preserves a greater thickness of damping material, enhancing the performance of the system in case of multiple impacts.
- Apart from strengthening of existing galleries, the system is well suited to improve the design of future protection galleries, optimizing design and construction.

Installation

The installation of 1'300 pieces of 1.3 m heigh and 575 pieces of 2.0 m heigh damping modules took place between September and October 2011.





Possible breakout zone above the rock-fall gallery protection

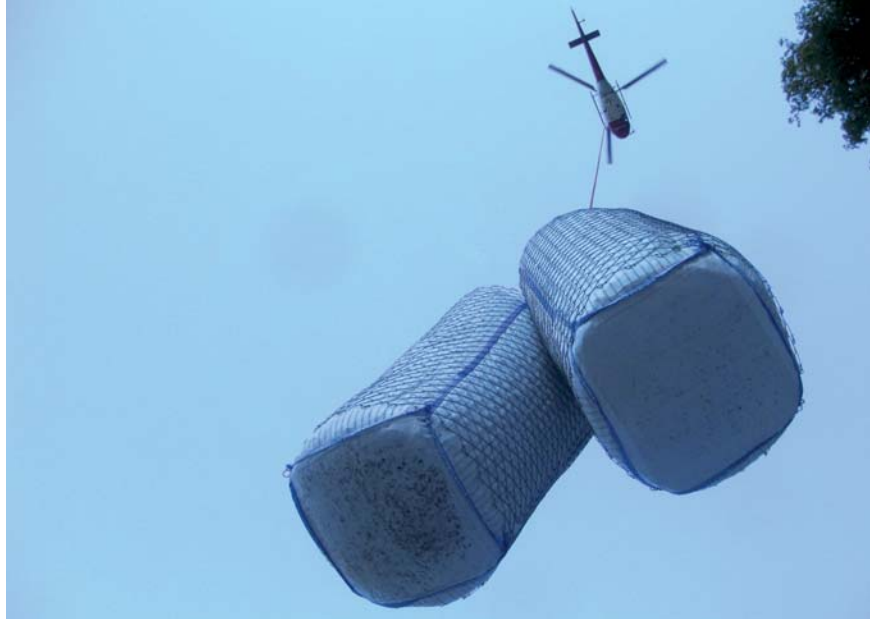


Excavated gallery roof and renewal of the joint sealings



Delivery of the ROCKFALL-X™ damping moduls by truck

The ROCKFALL-X™ moduls were flown by helicopter to the roof of the rockfall protection gallery



Positioning of the individual ROCKFALL-X™ damping moduls



Up to four damping moduls can be transported at the same flight rotation





Filling of the gaps with cellular glass fill material



Installation of the TECCO® G65/3 horizontal mesh covering the damping system



Regular gravel is placed above the installed ROCKFALL-X™ damping systems



Rockfall barriers

Rockfall drapes

Slope stabilization systems

Debris flow barriers

Avalanche prevention structures

Open pit rockfall barriers

Special applications

Geobrugg protects people and infrastructures from the forces of nature

It is the task of our engineers and partners to analyze the problem together with you in detail and then, together with local consultants, to present solutions. Painstaking planning is not the only thing you can expect from us, however; since we have our own production plants on three continents, we can offer not only short delivery paths and times, but also optimal local customer service. With a view towards a trouble-free execution, we deliver preassembled and clearly identified system components right to the construction site. There we provide support, if desired, including technical support – from installation right on up until acceptance of the structure.



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