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Endurance of rockfall protection fences

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Research on rockfall protection systems usually focuses on the performance of flexible barriers regarding their limit or design energy retention capacity. This research increased the maximum retention by a factor 15 within the last 15-20 years. Today rockfall energies up to 5'000 kJ can be retained. But this is relevant only for actual projects and newly erected barriers. However, the majority of all barriers installed in the alpine area were built many years ago and there is little knowledge on their long-term performance. Among others this includes not only the consideration of maintenance works such as man and machine power as well as yearly costs, but also the endurance of such barriers over the years. Such information normally stays at the authority or institution that initiated the construction of a protection system and/or is responsible for the maintenance of the object. But even if an institution maintains a large number of barriers, there mostly does not exist a general inventory because the barriers were installed over a time period of sometimes more than 30 years enduring many changes in the inventory procedures, drawings and documentations.

Therefore, an actual investigation of all rockfall barriers protecting a sector of the Swiss railways (SBB) was performed in order to obtain an overview of their conditions. This project delivers both a detailed analysis of more than 100 single barriers and a statistically evaluable overview. It also allows a comparison between different generations of barrier types, independently from the different producers of the barriers.

In a first step existing catalogues and data belonging to the relevant barriers were evaluated, summarized and mapped into topographic maps using GIS allowing a proper planning of the field trip, optimised regarding route, time consumption and possibly necessary closures of rail tracks.

During the field investigations each barrier was inspected and all details regarding structural system, geometry, age, retained rockfall volume, probable remaining load capacity, damages, mistakes during erection, sufficient distance to rail tracks for the stopping process of the falling rock etc. were logged and photographically documented.

The posterior analyses then lead to an overall classification of the single barriers into the three groups good/sufficent/insufficent resulting in different priority levels regarding the next suggested maintenance steps. The classification depends on whether a barrier can stop a frequent and a medium-sized rockfall event or not. The analysis gives a general overview of all barriers as well as a separate describtion of all criticised barriers to enable a proper planning of the repair tasks.

The final summary over all barriers within the investigated sector can also be used to predict the expenditure on repairs for other areas assuming that the investigated barriers reflect the average of barriers installed in other areas. It also revealed that the barriers can be divided into two main groups older and younger than 1990. Around this date the rockfall retention techniques changed completely from more or less rigid fences towards full dynamically operating systems with net curtain effects along support ropes and special energy absorbing devices.

For the first time, such an extensive inventory has been compiled and revealed its necessity to now have a unified data basis. The investigation also showed – and this will be shown more closely in the presentation – an in general good status of the protection systems after many years of operation.

Although most of the modern flexible barriers are general in a good status, too, it has to be pointed out, that they are not necessarily appropriate to protect the railway infrastructure if they are erected to close to the tracks. The required stopping distance of the barriers has to be taken into account.