

HISTORICAL AVALANCHE PROTECTION BARRIERS AS TECHNICAL AND CULTURAL HERITAGE

Anita Drexel^{1*} and Marlies Macher²

¹ Institute of Soil Bioengineering and Landscape Construction (IBLB), BOKU Vienna, Austria

² Institute of Soil Bioengineering and Landscape Construction (IBLB), BOKU Vienna, Austria

ABSTRACT: The project investigated more than 100 years old protection barriers in the Kleinwalsertal, Austria and results in a “Wall Inventory” but also an instrument for the responsible authority (WLVV) to decide and plan the rehabilitation and development of their historical stock. Beside their protective effects, the buildings show multifaceted significance. They are witnesses to the pioneering work in avalanche protection, they are formative landscape elements and keep the volatile avalanche history in people’s mind.

KEYWORDS: Historical avalanche protection barriers, technical heritage, cultural heritage, dry stone wall, preservation, valuation method

1. INTRODUCTION

More than 110 years old and several hundred in number - the avalanche protection barriers on the Walmendinger Horn in the Kleinwalsertal/Mittelberg, made of dry stone walls, gabions and earthworks, rank among the oldest and most impressive avalanche protection structures in Vorarlberg. The project to investigate and record these objects was commissioned by the State Government of Vorarlberg and the Services for Torrent and Avalanche Control in Vorarlberg (WLVV). It was conducted by the Institute of Soil Bioengineering and Landscape Construction at the BOKU (University of Natural Resources and Life Sciences), Vienna in 2017. The Institute and the State Government commit their long-time efforts to preserve the cultural heritage of natural stone walls and craftsmanship using the “Wall Inventory”.



Figure 1: Slope with historical avalanche protection barriers, Kleinwalsertal (WLVV, 1956).

2. AIM AND METHODS

The aim of the project was to define the different building types, their condition and interplay with the environment and to analyse their constructional and sociocultural significance.

* Corresponding author address:

Anita Drexel, Institute of Soil Bioengineering and Landscape Construction, BOKU Vienna, Peter-Jordan-Straße 82/III, 1190 Vienna
tel: +43 1 47654-87407; fax: +43 1 47654-87409
email: am.drexel@boku.ac.at

The development of a new valuation method should provide a basis for reasonable and efficient rehabilitation measures in the future. Furthermore, the project strives for a clear, comprehensive dissemination of the results.

In the research project, different methods of historical building research were used. The basis was a stocktaking exercise of all buildings. Supplementary analyses of historical maps, images and text documents, as well as discussions with experts, allowed assessments of age and significance of the buildings. Of interest were their regional context and the position of the structures within the development of avalanche protection systems.

3. BUILDING TYPES

Three main building types and nine subtypes can be distinguished according to their function, shape and construction:

Building Type	Number
Dry stone wall	95
• Dry stone wall	81
• Dry stone wall in combination with gabion	13
• Retaining wall (without retention space)	1
Gabion	25
• Gabion	14
• Gabion with stone layers	11
Earthwork	170
• Earthwork	80
• Earthwork with scattered stones	66
• Earthwork with stone layers	22
• Earthwork with stone layers constructed as dry stone wall	2

Table 1: Building Types and number of historical avalanche protection barriers (IBLB BOKU Vienna, 2018).

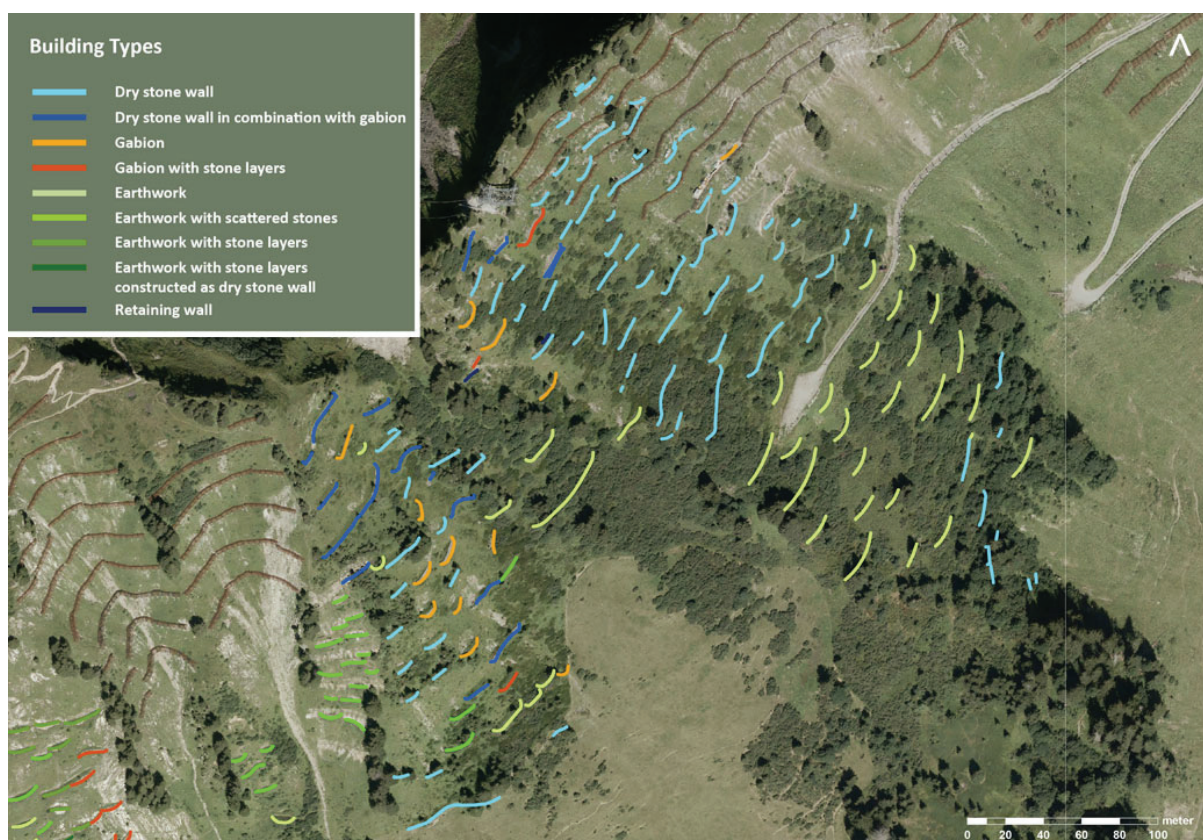


Figure 2: Location of the building types in the area Schreckenmähder and Sigunt on the Wal-mendinger Horn (IBLB BOKU Vienna, 2018; Geodatabase Vorarlberg, 2015).

The types "dry stone wall" and "earthwork" are the oldest forms (1907 to 1920) and despite their age and the challenging terrain, they are in better condition compared to the younger structures, such as "dry stone wall in combination with gabion" and "gabion" (1954 to 1973). This indicates a long durability of professionally constructed dry stone walls.

4. VALUATION

The valuation of the buildings was carried out in terms of their value as cultural heritage but also their current condition and effectiveness.

4.1 *Valuation criteria*

The following nine criteria were generated:

Age and rarity significance: The building is significant from a historic building point of view, because it is a witness of a special technical performance in the time of origin or it is extraordinary due to height, length or special construction details.

Sociocultural significance: The object is linked to important social, cultural and historical devel-

opments in the region. The community members have a close connection to the building.

Formative for the cultural landscape: The building or the building ensemble is a formative element of the landscape or landscape areas.

Construction Technique: The object is built professionally or rather faulty.

Condition: Depending on the extent of damage, the structure is without any damage up to completely destroyed.

Effectiveness of the structure: With regard to forest development, the building is effective up to not effective due to its function for slope support, break effect and the retention space of the terraces for rocks and snow.

Hazards caused by the object: The object may provoke hazards to humans, animals, trails, cultivated areas and other avalanche protection barriers in the transit and exit areas because of collapsing rocks.

Accessibility: The accessibility of a building depends on its proximity to a driveway and a climb, the quality of the path (scree, rocks in-situ), the encroachment caused by scrub and the gradient of the slope.

Ecology: The object is ecologically important, it provides valuable habitats for flora and fauna or offers habitats for rare species in its surroundings.

4.2 Valuation process

The valuation process allows decision-making despite the wide range of parameters and the spectrum of buildings. To identify the sample of more than one hundred objects preferred to be preserved, six main criteria were defined. Figure 3 shows the main- and sub-criteria and the principles of the valuation process.

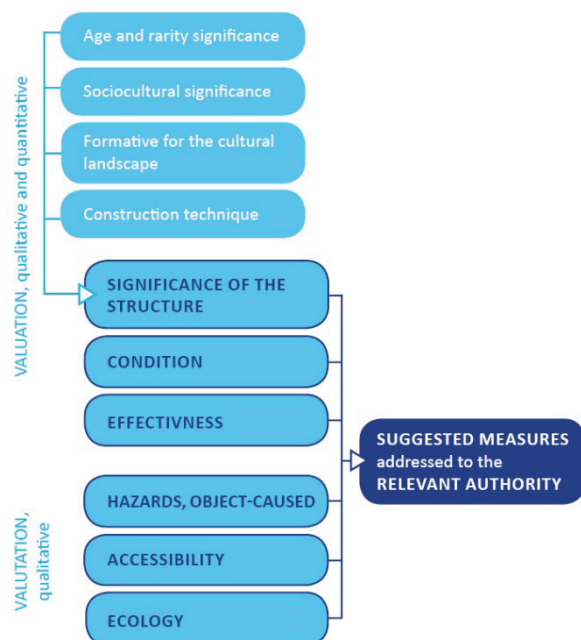


Figure 3: Valuation process and criteria (IBLB BOKU Vienna, 2018).

The main-categories selected are “significance” of an object, its “condition” and “effectiveness” today, followed by “hazards” which may be caused by the construction due to its damages, “accessibility” and “ecology-impact”.

The assessment of the important criteria “significance” is based on four relevant sub-criteria. “Age and rarity significance” is the most important and weighted with 28 percent, the other three sub-parameter – sociocultural significance, shaping effect on the landscape, professionally done – are weighted with 24 percent (see Tab. 2). All four sub-categories together define the rate for authenticity and significance as a historical avalanche protection barrier, due to its history, its impact on the cultural landscape and its special construction technique.

The valuation of the first seven parameters was quantitative and worked out in a second sequence after the qualitative description. For the quantitative valuation the parameters “age and rarity significance”, “sociocultural significance”, “formative for the landscape”, “construction technique” and “effectiveness” were rated by a 3-stage-rating (1-3), in which rate 1 represents the highest value. The assessment of the pa-

rameter “condition” was fairly worked out in 5 steps.

This led to the evaluation and priority of the buildings and illustrated the most significant avalanche protection barriers. Coordinated and tuned with the qualitative information about “hazard caused by the object”, “accessibility” and “ecology” they are the basis for suggested measures. Finally also urgency of the measures and their amount are taken into account.

This holistic approach enables the WLKV as responsible authority to decide which of the buildings and when they should be rehabilitated. The outcome serves as an instrument for a sustainable and locally adapted further development of the historical stock.

4.3 Results

The analyses results in a group of 14 highly ranged buildings on the Walmendinger Horn (see Fig. 4). All of them are “dry stone walls” or “dry stone walls in combination with gabions” and located in the area of Schreckenmähder, Sigunt and Zaferna. They were constructed as dry stone walls between 1907 and 1920.



Figure 4: Location of the 14 most important buildings in the area of Schreckenmähder, Sigunt and Zaferna (IBLB BOKU Vienna, 2018).

Some of them were renovated in the 1950's as dry stone walls or gabions were added. These results emphasizes the long durability of professionally constructed dry stone walls.

5. SUGGESTED MEASURES

To get an overview of suggested measures for the rehabilitation of historical dry stone walls the six usual ones are outlined below:

W - Reconstruction: Reconstruction of missing wall parts, professional and with orientation on the stock. (If necessary removing of existing damaged gabions and replacing them with dry stone walls.)

S – Restoration: Remove defective parts such as bulges, outbreaks, wall coping outbreaks or faulty renovated wall parts et al.; determine causes of damage and fix it; reconstruct professionally and with orientation on the stock.

S (G) – Restoration and removal of trees: Remove wall parts for damage-free removal of trees and roots; reconstruct professional and with orientation on the stock.

V – Secure the bond: Rebuild and secure the bond effect by looking up and wedging loose stones and replacing missing ones in the surface, the base and the coping.

G – Removal of trees: Remove existing and arising trees and their roots; mowing the edge.

P – Maintenance: Preserve the wall condition; care and maintenance of other elements of the ensemble (historical paths, fruit trees, low-nutrient meadows, belts of woodland, stone bars, picked piles of stone, fences, historical buildings like hay cottages et al.).

All objects of the stock got this structural recommendations. Together with the added dimension and time (urgency) of the job, this outcome can lead for future activity planning of the authority WLTV.

6. EXAMPLE: PROTECTION WALL WITH GABION (59M027)

The whole valuation process and the suggested measures are illustrated with the description of a protection wall with gabion (59M027), which emerged from the valuation process as the most important building in the investigation area (see Tab. 2).

The building is located at the highest point of the slope Schreckenmähder and Sigunt (see Fig. 4), directly beneath the ridge. The cable car is running straight above the wall and the object is not easy to reach.

Weightage [%]	Criterion	59M027
28	Age and rarity significance	1
24	Sociocultural significance	1
24	Formative for the cultural landscape	1
24	Construction technique	2
100	Significance of the structure	1.24
	Condition	3
	Effectiveness of the structure	2
	Hazards caused by the object	Hazard for forest development and avalanche protection barriers in the transit areas.
	Accessibility	Located in the area of Schreckenmähder and Sigunt; directly beneath the ridge, one of the steepest parts of the slope (45 - 55°); close to the lift pillar; accessible through a trail and climb from the mountain station Walmendinger Horn; due to the slope difficult to reach; descent 605 m on a path and 55 m in terrain.
	Measures	W + addition / S (G) / V
	Urgency short-term: sofort 1 year medium-term: 2 - 5 years long-term: > 5 years	short-term
	Dimension	large
	Dimension in m ²	at least 26 m ² + punctual

Table 2: Valuation and suggested measures for the object 59M027 (IBLB BOKU Vienna, 2018).

The object was constructed between 1907 and 1920 as a dry stone wall. In 1955 some parts of the wall were removed and replaced with gabions, which is still apparent today (see Fig. 5).

The parameter “age and rarity significance” is rated with 1, because of the extraordinary height of 3.5 meters and the length of 23.7 meters.

The object reflects the avalanche history of the valley. As it is well seen from the valley plain and from the touristy cable car to the Walmendinger Horn it stays in people’s mind. So the “sociocultural significance” is also valued at 1.



Figure 5: Protection wall with gabion – most important building in the area (IBLB BOKU Vienna, 2018).

Because of its highly visible position, the wall and the whole ensemble (see Fig. 6) are very formative for the landscape (rating 1).

Due to some lacks in the construction, such as butt joints and missing interlock between the dry stone wall and the gabion parts, the “construction technique” has rating 2.

This results in the weighted final value of 1.24 for “significance of the structure”, which is the best result of all objects.

Today’s condition of the object is 3. This means that damages do not risk the building. Although, some parts are already lost and the dimension of damaged parts is at least 26 m², which is large.

The wall still stabilizes the slope, whereas its effectiveness for avalanche protection is less. This results in a rating of 2.

Without restoration, the construction is a risk for forest development and other avalanche protection barriers in the transit and exit area, but it will not endanger highly frequented areas.

Therefore, the suggested measures are: It is recommended that the wall will be renovated within one year. The lost parts should be reconstructed and the gabions should be replaced with dry stone walls (W + addition). It is necessary to remove wall parts for a damage-free removal of trees and roots. The professional reconstruction should be realized with orientation on the stock (S(G)). At least the bond effect of well-preserved parts must be secured (V).

For those and all other prospective actions, the coordination of the requirement of avalanche protection and the preservation of regional heritage is essential. This is guaranteed by the co-operation of the municipality of Mittelberg, the State Government of Vorarlberg and the Service for Torrent and Avalanche Control and can thus lead to a sustainable and expedient, good decision to preserve selected buildings.

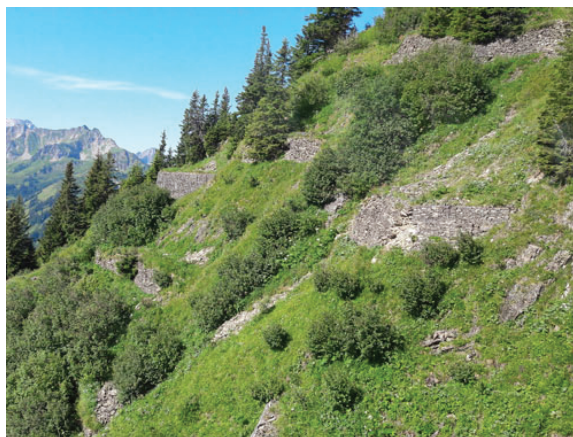


Figure 6: Ensemble of dry stone walls shapes the cultural landscape of the Walmendinger Horn (IBLB BOKU Vienna, 2018).

7. CONCLUSION AND PROSPECTIVE STEPS

In summary, the multifaceted significance of the buildings is still apparent today. They are witnesses to the pioneering work in avalanche protection and reflect their development. Despite their age, they still fulfil important functions, such as sliding snow protection, retention area for rocks, slope stabilization and support of forest rising. Currently, they are formative landscape elements, which keep the volatile avalanche history and the heavy losses of the valley in people’s mind.

The results of the “Wall Inventory” thus form the basis for a sustainable, respectful, professional and proactive handling of the technical and cultural heritage of exceptional avalanche protection barriers.

To preserve the valuable stock of the historical avalanche protection barriers on the Walmendinger Horn first rehabilitation projects of the Service for Torrent and Avalanche Control in Vorarlberg (WLVV) are planned for the next years.

REFERENCES

- Drexel, A., 2017: Kulturlandschaft als Archiv der Nutzungsgeschichte und Idee. In: Rollinger, K., R. Korenjak, (Hg.), *Die Entdeckung der Landschaft*; Böhlau, Wien, Köln, Weimar, 341-359.
- Drexel, A., Macher, M., 2018: *Inventar historischer Mauern. Lawinenschutzbauten Walmendinger Horn, Heuberg Kleinwalsertal*; (Report and Inventory); Institut für Ingenieurbiologie und Landschaftsbau, Universität für Bodenkultur; Wien.
- Margreth, S., M. Blum, 2011: *Umgang mit Lawinenverbauung aus Steinmauern und Mauerterrassen. Anleitung für die Praxis*; Bundesamt für Umwelt (BAFU) (Hg.); Bern.