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Using timber to counter natural hazards

Erosion | Landslide | Torrent | Avalanche

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Foreword

Natural hazards pose a threat to people, property and the environment in Switzerland. Particularly significant in the context of this publication are gravitational hazards (e.g. floods, landslides, avalanches) and also, indirectly, meteorological events (e.g. storms and hail). Direct threats from meteorological and gravitational natural hazards will increase as a result of climate change, but also due to the steadily growing area under settlements and increasingly dense development. Heavy rainfall events and more intensive rain periods, which lead to local floods or to landslides and erosion phenomena, but also sliding snow avalanches due to temperature changes are expected to become more frequent.

Switzerland has a long tradition in the construction of hazard mitigation structures. It is therefore not surprising that Swiss avalanche protection, and thus the extensive knowledge of the use of timber for this purpose, was awarded UNESCO intangible cultural heritage status in 2018, emphasising the interplay of traditional knowledge, technology and folk culture.

The construction of hazard mitigation structures made from timber has been perfected over the centuries and utilises locally occurring tree species. In addition to the frequently used species of spruce and fir, Swiss forests also contain species such as larch and sweet chestnut, which are particularly suitable for hazard mitigation structures due to the natural durability of their wood. However, Swiss timber is also a component of innovative products such as wood wool mats, which can be used for erosion control.

In recent decades, building materials such as steel, concrete or plastics have often been used for hazard mitigation structures in addition to timber. Due to their specific properties, there are arguments for using these materials in such structures. Depending on the application, the expected event and the desired service life, it is advisable to choose a building material that optimally meets all technical requirements. However, hazard mitigation structures made of round timber always win out in terms of sustainability, especially when local resources are used, and in combination with bioengineering construction measures.

The present Lignatec publication aims to provide a summary description of the use of timber in hazard mitigation structures against erosion and landslides, and in torrent control and avalanche protection, and to publicise tried and tested constructions and their applications. Therefore, this publication is not only aimed at experts in forestry construction technology, but also at planners in natural hazard prevention and those interested in building with wood.

Lignum would like to thank all authors and partners who contributed to this issue of Lignatec.

Gunther Ratsch, Lignum Technology
Editor-in-chief

4.3 Construction and application of erosion control structures made of wood

4.3.1 Slope erosion control matting made from wood wool

Slope erosion control matting reduces erosion by raindrops, surface erosion and the formation of rill erosion. According to the Swiss wood wool standard, wood wool consists of wood fibres that are 0.1–0.25 mm in thickness and 1.3–8 mm in width. The wood wool threads are up to 500 mm long and are felt-quilted together with a biodegradable polypropylene grid or netting made of natural fibres. The production in Switzerland of nets made of domestically produced natural fibres (cellulose) is at a testing stage. Various types of wood wool erosion control matting are available, with the individual mix of fibres from different tree species playing an important role for the wood wool's durability, strength and stability (e.g. beech is less durable than fir or spruce). Timber species such as robinia, chestnut and larch have also already been tested and used. There are no design criteria for the installation of erosion control fabrics; rather the manufacturer's installation instructions are to be followed. It is important that the fabric is laid overlapping and free of tension. The tension generated by its own weight between the fixing points must not be higher than the fabric's tensile strength. [46] During installation, it is important to ensure that no voids are created between the fabric and the ground (cf. Figure 8). To this end, stakes can be used to affix the fabric to the slope (cuttings of willow species are best suited), 3–5 cm in diameter and 30–50 cm in length. Depending on the situation, appropriate seed is used before or after fabric installation to establish a vegetation cover. The mats must function perfectly until the vegetation can assume their function (approximately 6–24 months, 2–3 vegetation periods depending on the location). Due to the fabric's excellent water retention capacity, good surface drainage and the niches between the fibres, wood wool erosion control mats improve the microclimate (moisture, temperature) for rapid vegetation establishment and reduce the risk of undercutting.

Figure 8
Erosion protection with slope erosion control matting made of wood wool.

The general advantages of slope erosion control matting are the immediately effective protection of the soil surface, easy handling and the fact that the mats are completely biodegradable. Moreover, wood wool erosion control mats are made from local wood – certified with the 'Swiss Wood' label. They are a sustainable alternative to imported natural fibre variants such as coconut and jute and prevent introductions of unwanted exotic organisms. As a result, the product offers strong life cycle benefits.