DURABILITY OF TIMBER STRUCTURES IN TORRENT CONTROL

Christian Rickli[1] and Frank Graf[2]

INTRODUCTION

Timber is widely used for protection measures in torrent control. However, the life span of woody constructions such as check dams is limited. Particularly fungal decay successively reduces the strength of the material and finally endangers the stability and functionality of the entire structure. Indications that fungal colonisation and durability of timber structures in torrent control depends both on environmental conditions and construction characteristics are mainly from field experience but rarely found in scientific literature. In this context we monitored and examined a series of timber check dams specially built for analysing and quantifying different aspects, including colonisation with decay fungi, progress of deterioration as well as the relevance of site characteristics and construction issues with concern to timber structures in torrent control.

METHODS

A series of 15 timber check dams with fall heights from 1.0 to 3.5 m and span widths from 6.0 to 8.5 m was constructed in 1996 near Hergiswil, Switzerland at an elevation of 880 m amsl (Fig. 1). The discharge of the torrent (drainage area: 0.2 km^2) changes depending on precipitation and season but never completely runs dry. The research set up consists of 15 check dams. Eight are entirely built with Norway Spruce (*Picea abies*) and 7 with Silver Fir (*Abies alba*). In addition, for half of the check dams of each wood type the bark of the timber logs was removed prior to construction. The research activities included: (1) assessment of fungal colonisation and decay by visual inspection and simple strength tests every other year, and (2) identification of decayed zones within the timber logs in 2010 (14 years after construction) with a drilling resistance measuring device (IML-Resi400B, Instrumenta Mechanik Labor GmbH). Subsequently, results are presented related to the quality of the topmost longitudinal log of the 15 check dams which we assessed and measured in four sections (Fig. 2).

Fig. 1 Series of investigated timber check dams near Hergiswil, Switzerland. Situation in 2001 (left) and in November 2010 (right).

[1] Federal Research Institute WSL, Zürcherstrasse 111, 8903 Birmensdorf / Switzerland (email: christian.rickli@wsl.ch)
[2] WSL Institute for Snow and Avalanche Research SLF, Switzerland

RESULTS

Qualitative inspection: Colonisation of the timber structure by fungi started three years after the construction. Already then (i.e. in 1999) the brown rot fungi *Gloeophyllum sepiarium* was found on the topmost longitudinal log in sections 1 and 4 of two check dams both made of Norway Spruce without bark. On Silver Fir check dams hyphal strands (2007) and fruit-bodies (2009) of *Armillaria sp*. were recorded from sections 1 and 4 of logs with and without bark. Further rot fungi found on Norway Spruce check dams are *Gloeophyllum trabaeum* and *Postia coerulea*, exclusively found on transverse bars.

Simple strength tests showed first patches with evidence of timber decay in 2001 (Fig. 2). Thereafter decomposition increased with time. In 2009 decay was detected on 11 of the 15 check dams, representing totally 21 sections with beginning or advanced decay. The sections 2 and 3 with permanently high water saturation were less affected than the occasionally dry sections 1 and 4 (Fig. 2). So far, an obvious difference in decay progress dependent on tree species (Norway Spruce, resp. Silver Fir) and bark removal is lacking.

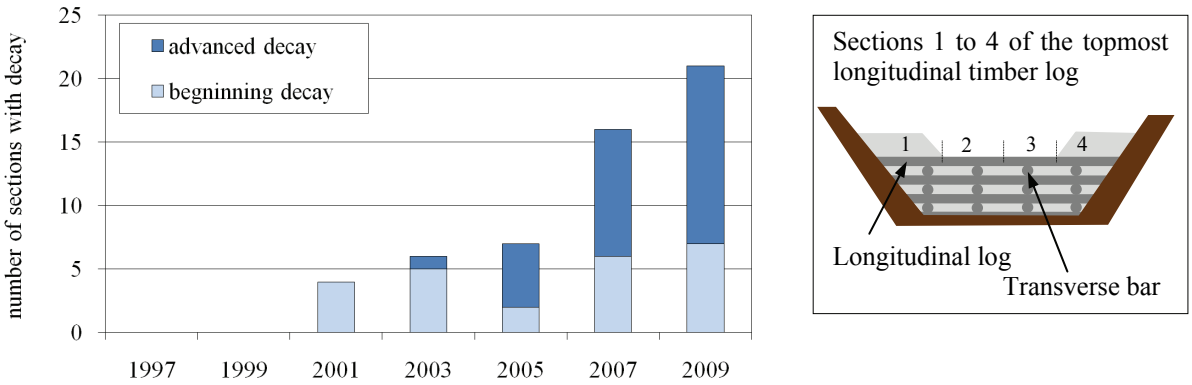

Fig 2. Sections with either beginning or advanced timber decay (assessment by qualitative inspection) in the topmost longitudinal log of the 15 timber check dams. Each log was divided into four sections: mostly dry left and right side (No. 1 and 4), mostly wet central parts of the check dam (No. 2 and 3).

Drilling resistance measurement: In 2010, wood decay was detected by resistography in 11 of the 15 timber check dams confirming the above described results of the qualitative assessment in 2009. Again, wood quality was markedly worse in the occasionally dry sections 1 and 4 (Fig. 3, left). The drilling resistance measurements showed more decay in Norway Spruce compared to Silver Fir (Fig. 3 right) but no consistent results concerning the influence of bark removal. Future investigations and statistical analyses are needed to confirm the observed trends.

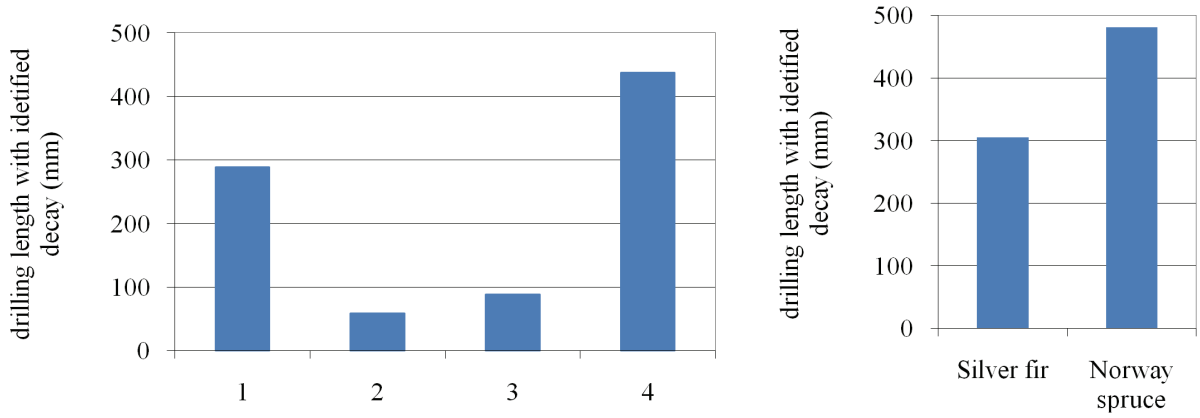

Fig 3. Drilling length (sum of all 15 timber check dams) with identified wood decay in sections 1 to 4 of the topmost longitudinal log measured 14 years after construction (left) and corresponding difference between Silver Fir and Norway spruce (right).

Keywords: timber constructions, check dam, log crib dams, decay, fungi