



## The effect of felled tree stems as bio-engineering type rockfall protection

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In mountainous regions forested slopes play an important protective role against rockfall. Up to now, most of the researches on rockfall protection forest have been and are focused on the dissipative effect of standing and living trees. There are hardly any studies on the protective capacity of tree stumps and lying stems against snow avalanches and rockfalls. Although, these techniques are more and more used throughout the Alps. In Austria, the felling technique Alpi has been developed, which allows a specialised lumberjack to create small rockfall barriers using one or two tree stems anchored on high tree stumps. Lying tree stems can be then used to increase efficiently the roughness of the soil and so to limit or avoid triggering and propagation falling rocks. But, due to the wood decay, the efficiency of such bio-engineering type protective works is decreasing with time. One of the questions that the forest and natural hazard managers have to answer is: what is the lifetime of such protective structures? In order to answer to this question we have developed a specific research on this thematic. The main objectives of this research program are to quantify the efficacy of these bio-engineering type rockfall fences depending on their characteristics (stump and stems density, position on the slope, tree species, etc.), and to evaluate their resistance over time. To achieve these objectives we have developed two types of experiments. The first one, performed during the summer 2009 on our experimental site test of Vaujany (France), are full scale rockfall experiments on four felled trees, which have been anchored on their stumps and are lying in an oblique direction to the slope. In total, fifty rocks (from 522 at 2242 kg) have been released one by one. For each rock, the trajectory has been filmed with high speed digital cameras. The second type of experiment is the uprooting of tree stumps (spruce, fir and beech) of different ages and diameter. To uproot the stumps we are using the same technique as for winching tests. For each experiment, stumps samples are taken in order to determine the wood decay ratio. Finally, a statistical analysis will be made in order to study the correlation between the force required to uproot a stump and its wood decay ratio. The first uprooting test campaign has been held during the summer 2009. First results of both experiment types will be presented. This study is part of the European Interreg IV Alpine Space project "MANFRED".