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Experimental and numerical investigation of a RC wall loaded by snow-like avalanche pressure signal

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Nowadays, civil engineering structures exposed to snow avalanches are mostly designed considering static loadings involving large safety factors. These latters highlight the lack of knowledge about the effects of the loading generated by a snow flow, and generally lead to oversize the civil structure. Indeed, the transient nature of the loading signal and also the composition of the snow flow can generate dynamic phenomena which cannot be taken into account considering only static loadings. The case of the avalanche of the Taconnaz (France), which occurred in 1999 and where important parts of the defense structure were destroyed, showed that static design approaches can lead to underestimate the potential effect of the snow flow.

Thus, in order to give some new insights about this issue, the effect of the temporal variations of the snow loading on the mechanical behavior of an idealized defense structure is investigated. Therefore, a reinforced concrete (RC) wall with a L-like shape has been considered which is supposed to represent a part of the defense structure situated in Taconnaz. Static pushover tests, carried out in laboratory conditions on 1/6 scale physical model of the RC structure, allowed obtaining the capacity of the tested structure (Berthet-Rambaud et al. (2007)). Finite Element (FE) models have been developed and calibrated from the previous experimental data.

The FE approach allows simulating the dynamic mechanical response of the structure. The effect of the transient nature of the loading of the avalanche has been explored applying out-of-plan dynamic loadings on the RC wall. In order to be as close as possible of a "field" snow avalanche, the imposed time evolution of the loading has been generated from in situ measurements recorded at the French experimental site "le col du Lautaret" (Thibert et al. (2008)).

The RC mechanical behaviour has been described by four nonlinear constitutive laws. The four behaviour laws are compared and analyzed for specific loading situations. Next, the influences of typical parameters characterizing the avalanche loading signal are proposed. In particular, a special focused is presented on the effect of the loading rate.

Finally, the vulnerability of the RC wall is studied in a reliability framework. Damage index are proposed and the probability of failure of the RC wall is derived. These relations might be useful for risk analysis.