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Reliability analysis of an RC defense structure loaded by a dense snow avalanche pressure signal

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To protect humans, roads or houses against snow avalanches, civil engineering structures are widely used. Designing these structures is still a challenge especially due to the uncertainties related to the loading developed by a snow avalanche. The case of the avalanche of Taconnaz (France), which occurred in 1999 and where important parts of the RC defense structure were destroyed, underlines the necessary to consider reliability approaches for the design of such structures.

This paper proposes a reliability analysis of an L-shaped reinforced concrete (RC) protective structure subjected to a dense snow avalanche. A deterministic mechanical model, based on the finite element method, has been developed and allows describing the behavior of the structure. Next, a reliable model allows propagating uncertainties through the mechanical model and assessing the failure probability of the structure.

The choices of random variables (the inputs) and their distributions, the failure criteria and the reliability methods are presented and discussed. Two criteria are considered: on the one hand, a local criterion defined in term of stress exceedence within concrete and steel, and on the other hand a global criterion defined in term of maximal displacement of the structure. Moreover, Kernel Smoothing and Monte-Carlo methods are used and compared to assess the failure probability and to derive fragility curves. These latter describe the failure probability of the structure according to the loading magnitude.