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Reinforced concrete structures loaded by snow avalanches : numerical and experimental approaches.

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Today, due to the extension of occupied areas in mountainous regions, new strategies for risk mitigation have to be developed. In the framework of risk analysis, these latter have to take into account not only the natural hazard description but also the physical vulnerability of the exposed structures. From a civil engineering point of view, the dynamic behavior of column or portico was widely investigated especially in the case of reinforced concrete and steel. However, it is not the case of reinforced concrete walls for which only the in-plan dynamic behavior (shear behavior) has been studied in detail in the field of earthquake engineering.
Therefore, the aim of this project is to study the behavior of reinforced concrete civil engineering structures submitted to out-of-plan dynamic loadings coming from snow avalanche interaction. Numerical simulations in 2D or 3D by the finite element method (FEM) are presented. The approach allows solving mechanical problems in dynamic condition involving none linearities (especially none linear materials). Thus, the structure mechanical response can be explored in controlled conditions.
First, a reinforced concrete wall with a L-like shape is considered. The structure is supposed to represent a French defense structure dedicated to protect people against snow avalanches. Experimental pushover tests have been performed on a physical model. The experimental tests consisted to apply a uniform distribution of pressure until the total collapse of the wall. A 2D numerical model has been developed to simulate the mechanical response of the structure under quasi-static loading. Numerical simulations have been compared to experimental datas and results gave a better understanding of the failure mode of the wall. Moreover, the influence of several parameters (geometry and the mechanical properties) is also presented.
Secondly, punching shear experimental tests have also been carried out. Reinforced concrete slabs simply supported have been considered. A concentrated load is monotonously applied on the center of the slab until its perforation. A 3D numerical model has been developed in order to explore the response of the RC slab. The model is based on multi-layered plate theory. Numerical and experimental results are compared.