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SPH model for the simulation of lava-buildings interactions

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Numerical simulation is a fundamental aspect of modern volcanology, providing tools for the forecasting of lava flows behavior, so as to assist in the design of mitigation actions for volcanic risk. In addition to the prediction of the emplacement topology, numerical simulation can be useful to study the possible outcomes of the interaction between a lava flow and a building. This kind of information can help to estimate the vulnerability of buildings so as to produce more accurate risk evaluations. Smoothed Particle Hydrodynamics (SPH) is a particle-based numerical method, particularly suited for the simulation of fluids with a high level of complexity, that can intrinsically deal with all of the physical properties of lava. GPUSPH is a simulation engine based on the SPH method that has been developed in order to take into account the challenging aspects of lava simulations and has been successfully applied to the simulation of lava-related benchmark tests. Here we use the SPH method, coupled within the framework of GPUSPH with a rigid body mechanics solver provided by the Project Chrono engine, for the realistic study of lava-buildings interaction. The resulting coupled model is able to simulate masonry with a brick-level accurate description, providing insights on any damages happening to the structure. We will show the simulation of a lava flow interacting with an elementary masonry piece, where a total collapse of the structure is induced by the action of the lava.