Numerical simulation of Vajont disaster using the Particle Finite Element Method

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ABSTRACT

On the night of October 9th, 1963, a massive rockslide of about 275 million cubic meters detached from the northern flank of Mount Toc (eastern Italian Alps) and slumped on the underlying hydroelectric basin of the Vajont dam producing massive water waves, which caused enormous damages in the neighboring villages and around 2000 casualties [1].

In this work, we reproduce the dynamics of the Vajont disaster with a three-dimensional numerical model based on the Particle Finite Element Method (PFEM) [2]. The computational domain has an area of 12 square kilometers and it is discretized with a tetrahedral finite element mesh with a mean size of 10m. Water is modeled with a standard Newtonian law, while landslide material is described using a frictional viscoplastic model [3].

The PFEM strategy is shown to be capable of reproducing the main phenomena of this multiple natural hazard scenario, from the detachment, propagation and stoppage of the landslide, to the impressive water runup, the propagation of tsunami-type waves along the residual Vajont lake and the overtopping water flow above the dam crest. The results of the numerical simulations are also in good agreement with the post-event observations and reconstructions, proving the suitability of the PFEM model for the simulation of large-scale landslide events [3].

The same method is also used to analyze multi-failure scenarios of the Vajont rockslide, as they were considered in a physical models created before the tragic event, and to help understanding what could have been a safe operational reservoir level for the landslide-generated impulse wave scenario [4].

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