Development Of Simulation Model For Pyroclastic Flows Using COMSOL Multiphysics®

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Abstract

The experience of the eruption in Montserrat in 1997 has shown that the resistance of openings of buildings represents a crucial factor in the evaluation of vulnerability to the stresses caused by pyroclastic flows, although the static nature of the building itself is not compromised. The pyroclastic flows are gas-solid mixture which can flow slope down up to reach considerable distances from the point of emission, with a speed that can easily exceed 100km/h (~ 30m/s). The damage caused by the impact on buildings depends on the combination of several factors: the duration of the phenomenon, the temperature of the flow and the pressure produced by the impact. It clearly has emerged the importance of defining a proper numerical model, which fits best the dynamic pressures and temperature ranges associated with a specific scenario at Vesuvius and the Campi Flegrei, defined in the Emergency Plans. This aim is achieved using the multi-physics based finite element method software COMSOL Multiphysics®. In the analysis carried out, variation in various parameters like geometrical characteristics, different materials, input function temperature were studied and are presented in this paper. In addition, fluid-structure analyses were also carried out, considering the flow as incompressible single-phase fluid and applying the Reynolds Averaged Navier-Stokes (RANS) turbulent model. Another main objective, once the vulnerability has been defined, is identifying some ordinary mitigation strategies which also represent a solution of energy saving.

Figures used in the abstract

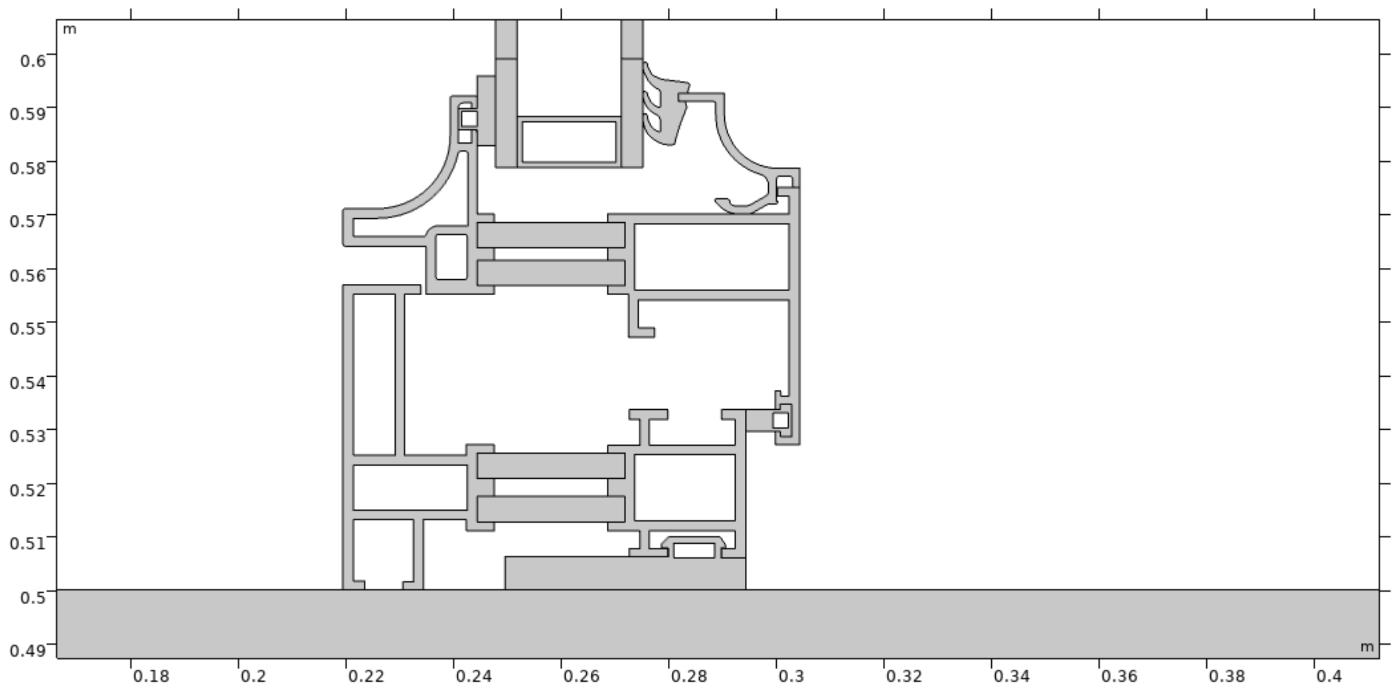

Figure 1 : Thermal break window

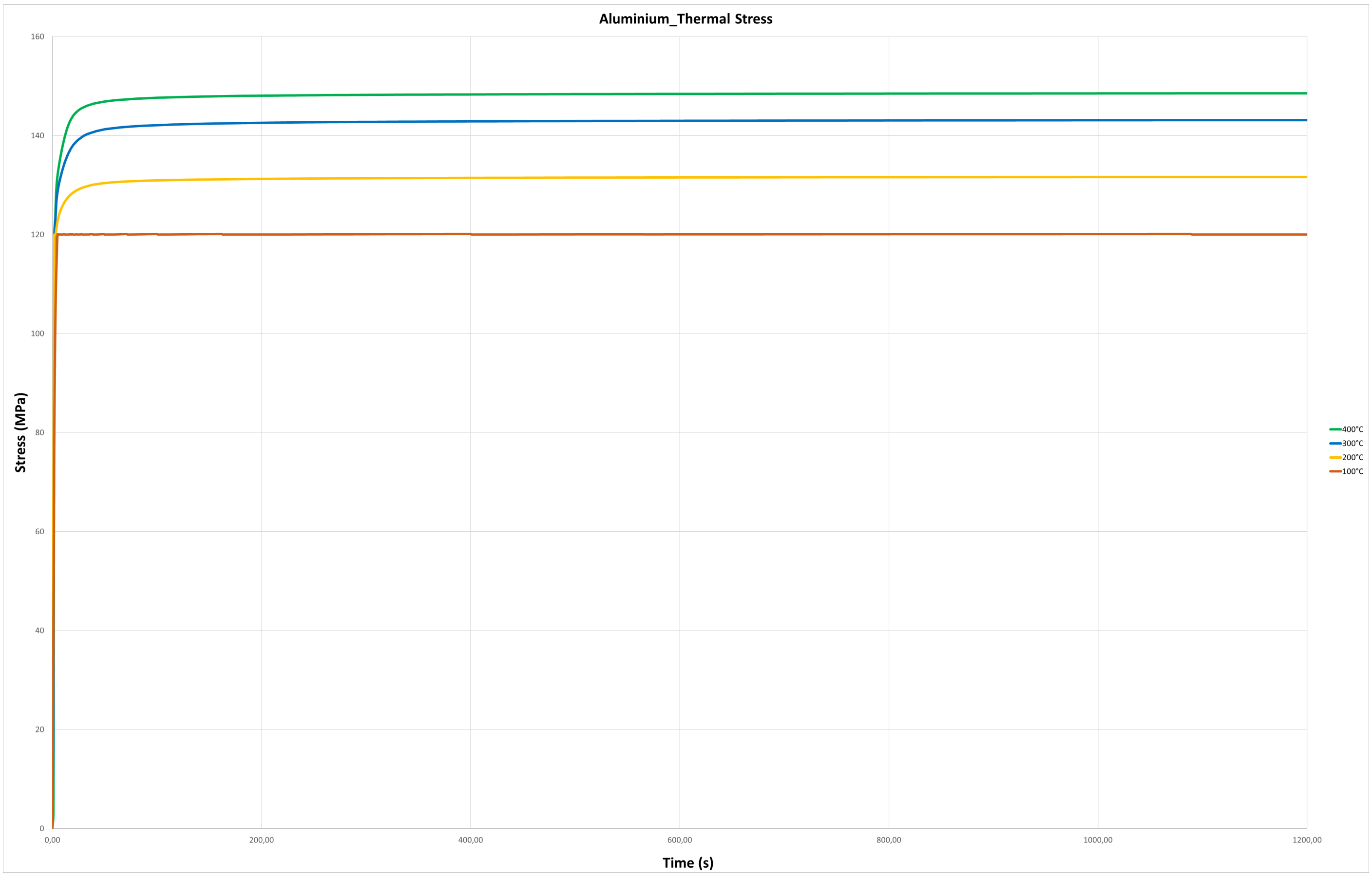

Figure 2 : von Mises stress of the aluminium window due to the Temperature

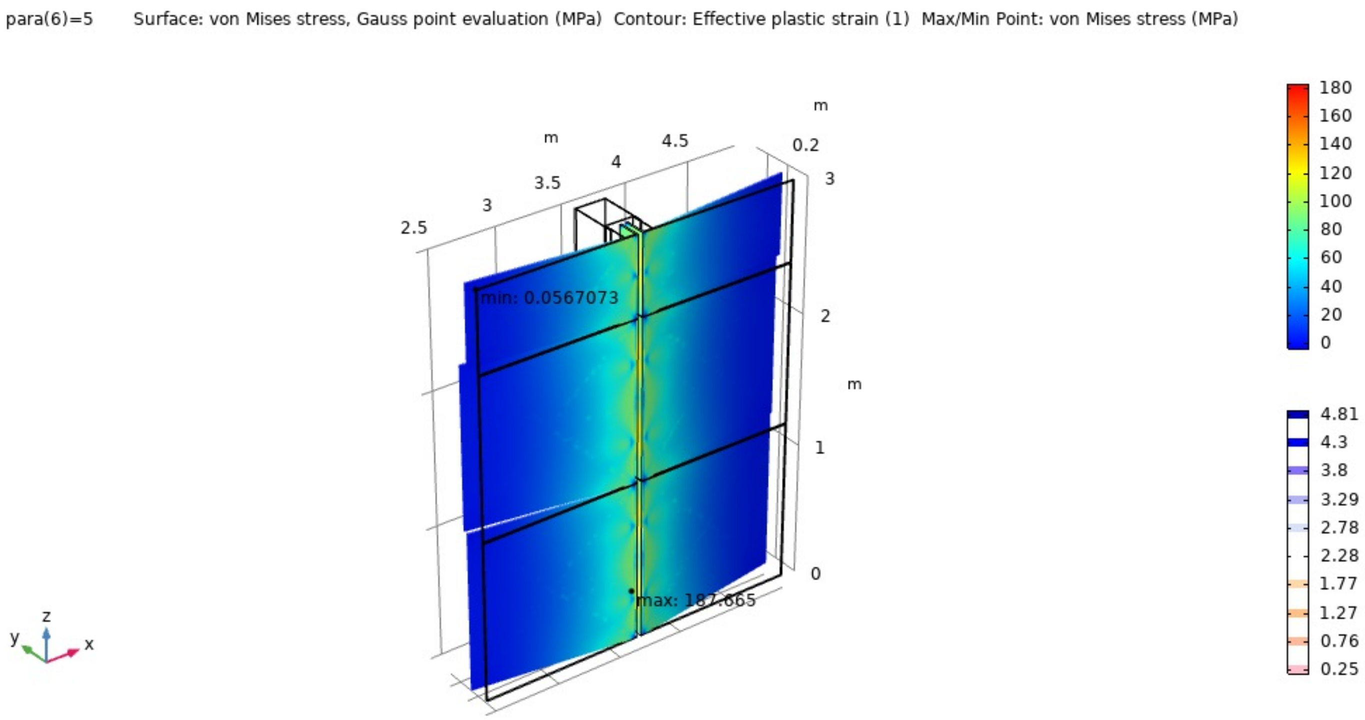

Figure 3 : von Mises stress of the curtain wall due to the pressure

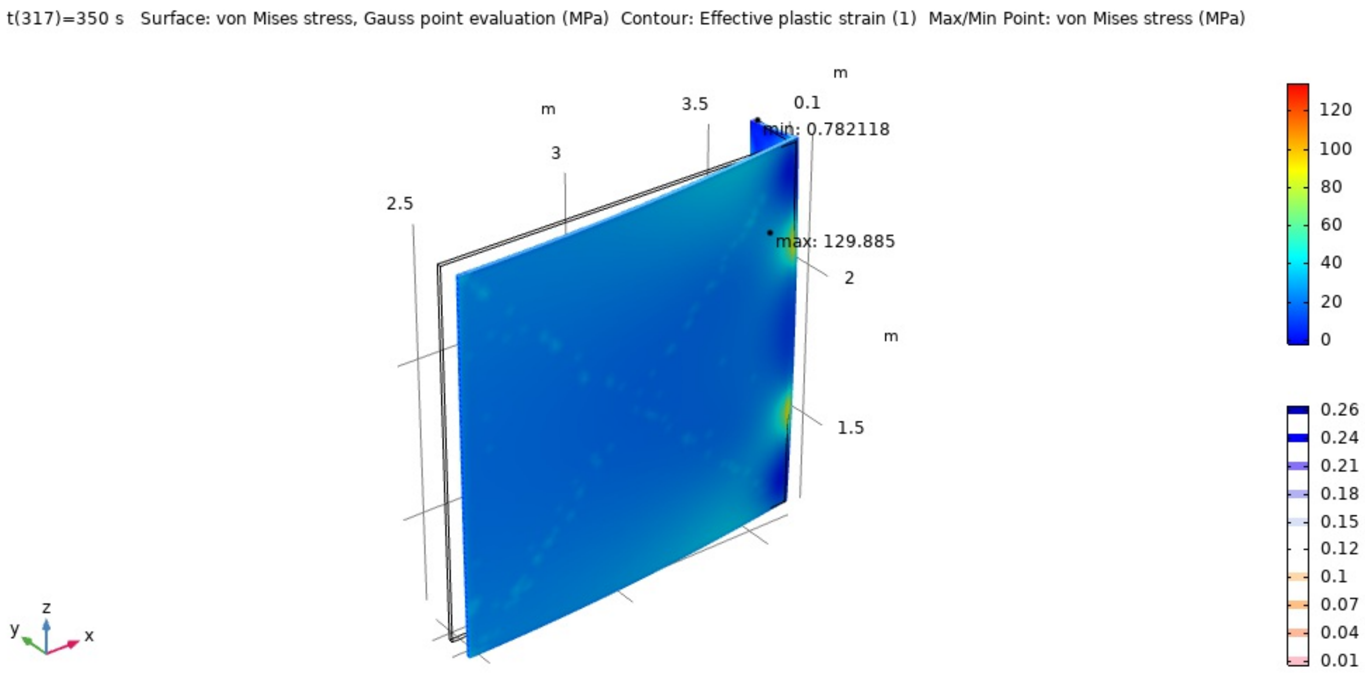

Figure 4 : von Mises stress of the curtain wall due to the temperature