Modelling the effects of volcanic ash on the strength and likely collapse of concrete roofs: implications for EU Building Code EN1991.

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Explosive volcanic eruptions are risk to human population, buildings, and infrastructure. One consequence of volcanic ash in the built environment, as seen graphically during the recent (2021) St. Vincent and La Palma eruptions, is that it collects on roofs, sometimes overtopping the host building completely. If enough ash collects then the weight on the roof can cause collapse, damaging the structure and endanger people. While it is known that snow loading of roofs is a hazard and is regulated for in EN 1991 Eurocode 1, no guidance currently exists in the Eurocodes for volcanic ash deposition, although during prolonged eruptions loading impact from ash can exceed structural guidelines and recommended safety criteria for exceptional snow loads. One of the main reasons for lack of including is data availability. For snow load calculations the Eurocodes can draw on approximately 2600 weather station that are constantly monitored. Volcanic eruptions are significantly less frequent. To remedy this, we present a computer-based mathematical model for testing stress and deformation levels due to volcanic ash deposition on flat concrete roofs. The mathematical model can take account of variable factors. Using computer models, we can assess the interactions of many variables simultaneously, without the need to perform complex physical experiments. Results show that the stress on concrete roofs due to the weight of accumulating ash can exceed the safety requirements set out in EN1991 Eurocode 1. While more research is needed, our results shows the need to revise the current codes for the built environment in volcanic prone areas of Europe.