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Comment on nhess-2022-93

Anonymous Referee #3

Referee comment on "Back analysis of a building collapse under snow and rain loads in Mediterranean area" by Isabelle Ousset et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-93-RC3>, 2022

The paper investigates the collapse of a steel building, built in 1982 in Montpellier in the south of France, under snow and rain loads occurred in 2018, providing detailed information of the meteorological event, its features, influence on snow accumulation on the building as well as on the subsequent rain event, heavily affecting the snow density and the resulting load acting on the roof.

The paper continues with the FE modelling of the structure, to simulate the collapse condition trying to estimate, by means of back analysis, the actual load intensity which led to the collapse.

On the following parts clarifications are needed.

- In Annex C it is stated that the structure is not known in detail and some simplifications and assumptions on the real geometry are introduced in the FE model, the influence of which in the results is also checked by means of a "virtual" This kind of assumptions may significantly affect the validity of the FE results and more explanations are needed. In particular, a detailed list of missing information should be added, commenting on the potential impact of the induced uncertainty in the FE model. Some drawings showing the structure and its elements (cross sections, dimensions, etc.), possibly from the time of the construction, could help in better understanding the structural behaviour.
- Steel properties are reported in Table 1, clearly referring to nominal values for S235 steel. In a static non-linear analysis, the actual mechanical properties of steel play a fundamental role in the determination of ultimate loads leading to the structural collapse. A clarification on this aspect should be introduced, possibly referring to test results on specimens extracted from the steel members after the collapse or, at least, by making reference to mean values of resistances instead of characteristic values, as it is the case in Table 1.
- The mesh sensitivity study, mentioned in line 170-175 and illustrated in Annex A, does

not seem appropriate for a truss system, with hinged beams

- Collapse criteria illustrated in 3.3 (lines 195-203) are not clear, as it could be interpreted that the collapse is reached as soon as one steel beam yields or reaches the ultimate strength (which is then not expected to occur as this happens only after yielding). In pushover analyses the final collapse mechanism is identified under non-linear static analysis under increasing loads, which is not evident in methodology illustrated in the paper. A clarification is needed.
- Among the collapse criteria no mention is made on buckling of compressed members, which as expected and as confirmed by the photos of the collapsed structure, has occurred. Buckling anticipates the failure of members with respect to the uniform compression till yielding and this aspect could lead to a significant reduction of the ultimate load in the FE analysis. A clarification is needed.
- Considering the flexibility of the structural system of the roof, the assumption of the uniform distribution of the snow load, and moreover of the rain load, all over the roof surface is a strong assumption, which could lead to wrong unconservative results. This aspect is only mentioned as a limitation of the analysis, but should be better illustrated as ponding effects could have caused a significant redistribution of the load, with concentration in the centre of the roof area, i.e. where its effects are more onerous for the system.
- Based on the above comments the discussion of the FE results in 4.4 may need to be reconsidered.
- Paragraph 4.2. It is claimed that the structure respected the structural design codes at the time of the construction as well as at the time of the collapse (2018). Later on in the Appendix it is stated that the SLS limit states were not verified. The particular structural scheme, a steel 3D truss plate with no intermediate supports, is particularly prone to deformation effects, which generally end up in governing the design. Some more details on these aspects are needed, to better understand the validity of the drawn conclusions about the compliance with the design standards.
- Line 315: recent climate models provide also snow variables, such as snow depth or SWE.
- In the conclusions it should be better highlighted which are the main outcomes of the study, i.e. which sort of recommendations are proposed by the Authors also in view of the revision of structural design standard or for the analysis of existing buildings.