nhess-2022-93.pdf
Reviewer's Comments to the Authors

The topic of the manuscript is appropriate for the Journal, but due to a number of deficiencies the manuscript cannot be recommended for publication. The reviewer recommends REJECTING based mainly on the following arguments:

A) The analysis is at some steps too simplified and many important aspects are not analysed.
B) In general, the manuscript raises more questions than it provides answers. Based on the arguments below, the conclusions of the study seem to be poorly grounded. The authors fail to adequately support their conclusion "*The collapse of the Irstea Cévennes building can certainly be explained by the intensity of the rain-on-snow event, and by the fact that the water could not flow, as the drainage system was blocked by frozen snow settled at the bottom under cold conditions*." What was wrong then? Structural design? Low design loads in the standard? It is insufficient to claim that a wrong drainage system was the only cause. Can we substantiate that there was free water able to flow on the nearly flat roof at the time of collapse?
C) The manuscript is structured in a way that is difficult to follow – the main text often refers to the annexes where little information is provided then.

Specific comments:

1. "*In our study, it is supposed that the initial state was perfect and corresponded to all the features provided in the previous subsection*." From a perspective of forensic engineering, this assumption is very doubtful. We have evidence that the structure collapsed and a similar neighbouring structure survived, and by experience we know that a vast majority of collapses was caused by gross errors. And yet we still consider the state of the structure before the collapse was perfect? Assuming the perfect initial state, the analysis of the second structure may reveal similar load bearing capacity as for the collapsed one.
2. Did past surveys of the structure report any defects? Corrosion? Deflections and imperfections? How about the second building – is there any evidence of imperfections, deflections? This could be relevant, assuming the structures were built in a similar way.
3. Is there any evidence that the drainage system was blocked and water pooled on the roof? Was the snowpack frozen / icy due to previous freeze-thaw cycles or was it already melting? Analysis of air temperatures a few days before the collapse could help.
4. Many details of the structural analysis are missing; some assumptions need thorough revision:
    a. The authors try to make a retrospective analysis of "what likely happened before the collapse". While correctly considering best estimates of the roof snow load, they fail to consider best estimates for material properties – according to the new Eurocode for design of steel structures, prEN 1993-1-1:2022, S235 has mean of $f_y = 1,25 \times 235 = 294$ MPa, mean of $f_u = 1,2 \times 360 = 432$ MPa, $\varepsilon_u \geq 15\%$. In prEN 1993, 235 MPa is said to correspond to a 1‰ fractile of the distribution of f_y, thus a very low – very conservative – very unlikely value. Consideration of more realistic values for material properties would likely amplify the importance of failure modes related to loss of stability.

Table E.1 — Assumed variability of material properties

Parameter	Steel grade	Mean value X_m	Coefficient of variation	Upper reference value $X_{5\%}$	Lower reference value $X_{0,12\%}$
Yield strength, f_y	S235, S275	1,25 $R_{eH,min}$ [a]	5,5 %	1,14 $R_{eH,min}$ [a]	1,06 $R_{eH,min}$ [a]
	S355, S420	1,20 $R_{eH,min}$ [a]	5,0 %	1,11 $R_{eH,min}$ [a]	1,03 $R_{eH,min}$ [a]
	S460	1,15 $R_{eH,min}$ [a]	4,5 %	1,07 $R_{eH,min}$ [a]	1,00 $R_{eH,min}$ [a]
	Above S460	1,10 $R_{eH,min}$ [a]	3,5 %	1,04 $R_{eH,min}$ [a]	1,00 $R_{eH,min}$ [a]
Ultimate tensile strength, f_u	S235, S275	1,20 $R_{m,min}$ [a]	5,0 %	1,11 $R_{m,min}$ [a]	1,03 $R_{m,min}$ [a]
	S355, S420	1,15 $R_{m,min}$ [a]	4,0 %	1,08 $R_{m,min}$ [a]	1,02 $R_{m,min}$ [a]
	S460 and above	1,10 $R_{m,min}$ [a]	3,5 %	1,04 $R_{m,min}$ [a]	1,00 $R_{m,min}$ [a]
Modulus of elasticity, E	All steel grades	210 000 N/mm^2	3,0 %	200 000 N/mm^2	192 000 N/mm^2

[a] $R_{eH,min}$ and $R_{m,min}$ are the minimum yield strength R_{eH} and the lower bound of the ultimate tensile strength R_m, according to the applicable product standard, e.g. EN 10025 (all parts).

   b. Loss of stability will contribute to collapse mechanisms of common steel structural members. Expected values of eccentricities and imperfections should be considered in the analysis. How was this done?
   c. *ultimate limit criterion (full failure and collapse of the structure)*. When considering εu ≥ 15%, exceeded fu in one cross-section is unlikely to lead to collapse, right?
   d. *We also conclude that the building, at the moment of its collapse in 2018, was respecting the new regulations*. How is this substantiated? Assuming it was in the perfect initial state before the collapse?
   e. *Under current regulations, yield occurs for a load less than the exceptional load recommended by Eurocode but the building fails serviceability (excessive deflection) for snow load largely above the permanent project situation and slightly above the accidental project situation recommended by Eurocode*. Numbers are missing here.
5. Details of the roof snow load modelling are also missing:
   a. *This rain-on-snow event is exceptional* – this should be quantified – what is an occurrence rate of such an event? Snow load maxima (including the effect of rain on snow) should be analysed for the location and the return period for the ground snow load experienced at the event should be estimated. This would help to classify if the ground snow load reached serviceability, design (return period of ~hundred years) or accidental load levels.
   Missing are details for the roof snow load – what is the characteristic roof load? What is the design value? How do they compare to the estimated roof load?
   b. … *we can roughly estimate that the very wet snowpack on the roof easily reached a high density around 600 kg.m−3 at the time of the collapse*. In the scientific paper such estimates should be based on sound arguments.
   c. How was the effect of exposure considered? What was the wind speed during the snowfall? For many flat roofs, it holds roof snow load = 0,8 x ground snow load. Discuss this.
   d. How important are wind effects for the design of structural members? Is wind negligible in comparison to snow?
6. The first paragraph of the introduction is very general – it seems to have no link with the other text. Delete it or make clear how it is related to the following analysis.

Editorial comments:

- Terminology: this type of roof is commonly referred to as “flat roof”, not a plate roof.
- The use of English could be improved. In particular damage should not be (in the context of this study) used in plural.
- The check by a native speaker experienced with technical texts would help to re-phrase some clumsy statements.
- Some typos appear in the text. Lineic is line load?