

Interactive comment on “A physical approach on flood risk vulnerability of buildings” by B. Mazzorana et al.

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Dear Reviewer, many thanks for your insightful review and the constructive comments on our work. We are pleased that you found the presented method innovative, the paper well-structured and -explained. Your comments were very helpful for a further improvement of our manuscript. Please find below our reply to the specific remarks.

Reviewer: Abstract: P. 1412, L. 13: In order to provide a reader of the abstract with more concrete indications on your approach, you may want to include another sentence with some characteristics of your “conceptual assessment scheme” and state explicitly how it responds to the research gap you outlined before.

Reply: The details are provided in the following sentences: Therefore, we propose a
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conceptual assessment scheme to close this gap. This assessment scheme encompasses distinct analytical steps: modelling (a) the process intensity, (b) the impact on the element at risk exposed and (c) the physical response of the building envelope. Furthermore, these results provide the input data for the subsequent damage evaluation and economic damage valuation. This dynamic assessment supports all relevant planning activities with respect to a minimisation of losses, and can be implemented in the operational risk assessment procedure.

Reviewer:

Introduction: P. 1413, L. 1ff: In lines 1&2 you outline that there is a particular gap you see and the following paragraph deals with different types of vulnerability as well as the disconnect between them. While I fully agree that this is a gap, the article at hand is not focusing on solving this issue and in the discussion you state “Taking an engineering perspective, and therefore neglecting any social implications, we presented a method to quantify vulnerability of buildings exposed to torrent processes.” Thus, presenting this issue in such a prominent position in your introduction may mislead the reader and suggest that this problem will actually be addressed in the article. I would propose to clearer focus the introduction on the research gap you approach in this paper while this doesn’t mean that you have to eliminate the challenges related to different types of vulnerability but explain clearer what your work aims at and what it doesn’t.

Reply: We acknowledge the comment; however, we would like to provide this holistic view of vulnerability before we focus on physical vulnerability and the related gaps.

Reviewer:

P1413, L. 29: You mention three vulnerability curves Quan Luna developed – are those separate ones for depth and impact pressure (or a third component) or for different building types while combining depth and impact pressure? Some additional detail would be helpful.

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Reply: Quan Luna et al. (2011) added a further step: Based on intensity information derived by numerical modelling recalculating the Selvetta debris flow event, they presented vulnerability curves for the following independent variables: flow height [m], kinematic viscosity [m^2/s] and impact pressure [kPa].

Reviewer:

P.1414, L. 9: The term “hazard-proof” suggests the complete elimination of vulnerability while I imagine that this is not the idea you want to give.

Reply: We modified the expression towards hazard adapted

Reviewer:

P. 1416, L. 23: The figure is presented without any further explanation. I would suggest you mention the figure much earlier and explain the components you already outline in the introduction in relation to the figure. I would also propose that you state much clearer where your innovation lies – currently I find it a bit challenging to read this out of the introduction.

Reply: We tried to modify the manuscript in order to clarify these issues.

Reviewer:

2.1 Overview P. 1417 L. 22: I would suggest to briefly define/explain the terms control volume and control sections

Reply: We modified section 2.1 accordingly by adding the requested explanation.

Reviewer:

P. 1419, L. 26: “TRENT 2D [: : :] proved to be suitable” – why, how? Since it covers all your requirements for the hazard assessment? An additional half sentence could clarify

Reply: The text now reads: Regarding the debris flow simulation process in the en-

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dangered area, the two-dimensional simulation model over mobile bed – TRENT 2D – developed by Armanini et al. (2009) and substantially enhanced by Rosatti et al. (2013) has been applied. In this model the system of partial differential equations derived from the mass and momentum conservation principles is hyperbolic and characterized by a non-conservative nature. The details about the mathematical model and the associated finite-volume, explicit Godunov-type numerical approach are documented in Rosatti et al. (2013).

Reviewer:

P. 1420, L. 5: Please explain the variable “W”

Reply: is described in the text as transposed vector of primitive physical variables ()

Reviewer:

P. 1433: You mention in the introduction the use of such analysis approaches for planning and risk reduction measures. I think it would be very useful if you could make reference to the application of your methodology for such purposes.

Reply: We modified the text: In addition to the existing empirical vulnerability functions, which were deduced using an ex-post approach, our conceptual and methodological setup allows to identify triggers for damage amplification (e.g. potential material intrusion through openings of the building envelope, or structural weaknesses) and may be useful in the ex-ante definition of risk mitigation strategies.

Reviewer:

The following comment may be beyond your scope but I would like to raise it for a potential expansion of your methodology: I understand that you currently only determine “potential material intrusion”. However, in the context of practical applications I am also wondering how the vulnerability of the openings could be considered in more detail since they are the weakest spot of the buildings – e.g. window shutters could make a considerable difference, could this be included?

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Reply: So far the effects of local structural protection are not explicitly considered for this paper.

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