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Discussions

Interactive comment on "Assessing flooding impact to riverine bridges: an integrated analysis" *by* Maria Pregnolato et al.

Anonymous Referee #2

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The study combines a fluid dynamics model with a structural analysis model to assess the performance of an inundate bridge and then assess the impact on the functionality of the surrounding transport network. The paper lacks of basic bridge engineering understanding and bridge modelling and therefore has inaccuracies and provides limited insights for bridges exposed to flood hazard. The novelty is not clear, although hydrodynamic modelling is included to study the bridge response under flood effects, several simplifications are made, while the description of the models is not adequate. For example:

- The authors do not explain the loads used on the bridge. Are these code-based loads, which design situation/combination has been considered and for which elements?

- The loads shown in Fig. 2 have no relevance to bridge engineering, while there are

errors in bridge engineering terminology.

- The deformations shown in Fig. 2 for bearings are basic, described with wrong terminology and not relevant to the paper. Not correct bearing modelling/bearing failures are shown. Elastomeric bearings are usually deteriorated on isolated bridges, while their connections to the super/substructure are very critical and not discussed in the paper at all (a contact-like connection is insinuated through friction). Instead based on line 280 of the manuscript "These bearing elements were connected to rigid links, which simulated cap beams. . ." i.e. a fully rigid connection. Furthermore, it is not clear if uplift of the deck from the isolators is modelled in Opensees, and if this was done it should be further explained.

- Figure 4 indicates 'abutment', but no abutment is shown here.

- Foundation is shown fully fixed. This is not an acceptable assumption especially for a river crossing bridge. Foundation and SSI effects are activated under dynamic loads, like flooding.

- Yielding of the girders or piers is considered (line 125), however, it is not clear if nonlinearities of the bridge elements were considered in the model, and if this is the case then it is not sufficiently explained; for example, how the nonlinearity of the deck or reinforcement has been included in the model.

- Opensees is an advanced software to simulate the performance of structural systems subjected to earthquakes. It is not clear, why this software was selected for an oversimplified bridge model, and in particular, if a linear elastic simulation has been adopted. Also, validation of the models is not provided.

- The bridge deck and girders are modelled as rigid bodies, however, this is an oversimplified approach. Also, shear, flexural, and axial stiffness properties of the deck are not provided. In line 195, it is mentioned that "The bridge deck and girders are modelled as a rigid cross section (i.e. in 2D)"; this is confusing as a 3D model is shown in Figure

4.

- It is not clear if the CFD model accounts for the river-bed and river channel characteristics, the model input is not explained sufficiently, and no information of the model are given. It is not clear what is the ouput of the hydrodynamic model (e.g. time-histories of the hydrodynamic force?) and how then this output is imposed in the Opensees model.

- In section 2.3, the authors provide relevant literature for the definition of slight, moderate, extensive, and complete damage states, however, it is not clear which thresholds values have been used for the damage assessment of each bridge component, e.g. piers, bearings, deck in section 3.1.

- The framework includes a reliability analysis; however, no such analysis is conducted, which by definition is based on failure probabilities of the structure under study.

- The horizontal lines in Fig. 5 are not defined in the legend or figure caption.

- Recent papers that study the vulnerability of bridges to flood effects are not included in the literature review, e.g.:

Kim, H., Sim, S. H., Lee, J., Lee, Y. J., & Kim, J. M. (2017). Flood fragility analysis for bridges with multiple failure modes. Advances in Mechanical Engineering, 9(3), 1687814017696415.

Ahamed, T., Duan, J. G., & Jo, H. (2020). Flood-fragility analysis of instream bridges–consideration of flow hydraulics, geotechnical uncertainties, and variable scour depth. Structure and Infrastructure Engineering, 1-14.

Hung, C. C., & Yau, W. G. (2017). Vulnerability evaluation of scoured bridges under floods. Engineering Structures, 132, 288-299.

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