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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "A reliability assessment of physical vulnerability of reinforced concrete walls loaded by snow avalanches" *by* P. Favier et al.

Anonymous Referee #3

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General comments

The authors present an interesting approach for the derivation of fragility curves of RC walls loaded by snow avalanches.

In the reviewer's opinion, however, the paper presents a number of questionable issues.

The use of partial safety factors on material strengths does not appear appropriate in the framework of reliability assessment, where the probability distributions of strength are directly taken into account. The partial safety factors affect both the ULS (ALS), where the partial safety factors are assumed equal to 1.5 (1.15) for concrete and 1.15

(1) for steel. The authors state that the definition of the limit states is inspired by the EC2. However, the framework of the EC2 (semi-probabilistic method) is different from the reliability method adopted in the paper. According to the semi-probabilistic method, the design value of strength is calculated by dividing the characteristic value by the partial safety factor. In contrast, reliability analysis makes direct use of the probability distribution of strength. Therefore, the use of partial safety factors appears to have no motivation.

The consideration of the ULS needs to be clarified. The authors state that the loads taken into account by the ULS shall not be exceptional. Exceptional loads are taken into account in the ALS. If the pressure induced by an avalanche is considered an exceptional loading, it should not be taken into account in the ULS.

The assumed COV = 0.05 of the probability distributions (see, for instance, Tab. 3) is unrealistic. On one hand, it appears too large for geometric characteristics (e.g. it implies standard deviation = 0.40 m for mean = 8.00 m). On the other hand, it is too small for concrete strengths. Assuming, for instance, that the characteristic strength is equal to 0.7 times the mean strength implies COV = 0.18, under the assumption of normal distribution.

Specific comments

In par. 2.3.1, the definition of failure probability is rather unusual. Failure probability accounts for the uncertainties of both capacity and demand, leading to the classical convolution integral. In the paper, the probability of failure is calculated assuming a given value of the demand. Therefore, it is rather a conditional probability of failure, i.e. a fragility.

p. 2, line 9 "failure probability" is rather "fragility curve" (see above).

Par. 2.1.5 is apparently contradictory. On one hand the authors state that: "The ALS differs from the ULS only in the loading description", and on the other: "The two limit states diverge each other because of different multiplicative (?) safety coefficients applied on the strength of the two materials". Explanation is needed.

In Fig. 4, the strain diagrams of ULS and ALS do not correspond, in general, to simple bending. For a ductile failure of the section, the concrete strain is at its maximum value (0.0035) and the steel strain is determined by the condition that the axial force in the cross section is equal to zero. The resulting steel strain shall be greater than the strain corresponding to the onset of yielding.

The definition of hazard in terms of "the consequences of an avalanche in terms of structural damages" (p. 3, lines 32-34) is questionable. Damage results from the combination of hazard and vulnerability.

p. 2, lines 21-22 "the physical vulnerability of civil engineering structures is concerned by snow avalanche risk management". Unclear sentence.

p. 3, lines 26-28 "the mechanical model of the RC wall, the snow avalanche loading description and the damage level definitions are presented following by the statistical distributions of the inputs of the deterministic mechanical model". Unclear sentence.

p. 4, lines 2-3 "The damage of the entire structure can be assessed from the wall's resistance capacity". Damage depends on hazard and vulnerability.

p. 4, line 10 "and how it evolves over time" is unclear.

Technical corrections

p. 2, line 13 "tested" should be rather: "analyzed" or "studied".

p. 3, lines 35-36 "at less than 100 years" should be: "less than 100 years"

p. 4, line 3 "stress applied" should be: "pressure applied".

p. 4, line 15 "The bars are orthogonal to one another and distributed homogeneously" should be: "The bars are distributed homogeneously along the horizontal and vertical

directions".

p. 5, line 5 "loss of stability" should be: "loss of equilibrium".

p. 6, line 28 "structure characteristic times" is unclear. Probably the authors mean: "structural natural periods".

p. 6, lines 35-36 "The uniform pressure distribution are considered as a safety factor" should be: "The assumption of uniform pressure distribution is conservative".

p. 7, line 17 "Strain evolution is linear though the thickness" should be: "The strain is linear along the thickness". It is not an independent assumption but a consequence of the assumption that sections remain plane after deformation.

p. 8, line 29 "isotropic reinforcement" should be: "equal reinforcement along the horizontal and vertical directions".

Captions of Tables 3 – 6. "Table presenting the . . ." is redundant.

Fig. 5b. The values 2 and 3.5 on the horizontal axis are out of scale.

The paper needs a revision by a mother tongue colleague.

Examples of poor English are:

p. 3, line 32 "several" should be: "different".

p. 3, line 33 "damages" should be: "damage".

p. 4, line 27 and elsewhere: "security coefficient" should be: "safety factor".

p. 5, line 3 "describes" should be: "described".

p. 6, line 33 "axis" should be: "axes".

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., 1, 2589, 2013.