Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2018-154-RC1, 2018

Natural Hazards and Earth System Sciences
Open Access
Discussions

Interactive comment on "Avalanche Impact Pressures on Structures with Upstream Pile-Up/Accumulation Zones of Compacted Snow" *by* Perry Bartelt et al.

Anonymous Referee #1

Received and published: 9 October 2018

The discussion paper titled "Avalanche Impact Pressures on Structures with Upstream Pile-Up/Accumulation Zones of Compacted Snow" by Bartelt *et al.* proposes a very interesting approach for dealing with the interaction between snow avalanche flow and isolated obstacles. The model considers that the deceleration of the snow mass turns into impact pressure against the obstacle. The paper clearly states its limitations: in particular, the considered geometry is simple, and an ideal rectangular dead zone is assumed (which is not real for narrow obstacles). In addition, the obstacle is supposed rigid, thus the dynamic effects are not considered. Nevertheless, the proposed mechanical model is worthy of attention, with particular reference to the engineering problems in mountain areas.

Printer-friendly version

Discussion paper

Specific comments

1. The authors state that cohesive flows with strong bonding between the snow clumps have the property $h_\Phi \approx h_\Omega$. In this case, a compaction of the impacting mass occurs, rather than a pile-up. A short comment is probably expected.

2. Referring to the analytical model, as well detailed in the discussion paper, the region Ξ has length $V_\Phi(t)\Delta t$, while the resulting pile-up zone has length $\dot{S}_\Omega(t)\Delta t$. The authors indicate the braking distance as $d_{\Xi\to\Omega}$ (p.4 line 11). From the sketch in Figure 1, it results that the mean braking distance is the distance between the centers of mass of the compacting and the pile-up zones, i.e.

$$d_{\Xi\to\Omega}(t) = \frac{1}{2}\left[V_\Phi(t)\Delta t - \dot{S}_\Omega(t)\Delta t\right].$$

   Why do the authors adopt a different symbol for the braking distance in Eqn. (5), i.e. $\Delta d_{\Xi\to\Omega}$? It is expected that $\Delta d_{\Xi\to\Omega}$ is the variation of the braking distance at different times, say t and $t+\Delta t$. In addition, the authors should also clarify what do they intend with $\dot{d}_{\Xi\to\Omega}(t)$. It is expected that this term is the time derivative of the braking distance, i.e.,

$$\dot{d}_{\Xi\to\Omega}(t) = \lim_{\Delta t\to 0}\frac{\Delta d_{\Xi\to\Omega}}{\Delta t} = \lim_{\Delta t\to 0}\frac{d_{\Xi\to\Omega}(t+\Delta t) - d_{\Xi\to\Omega}(t)}{\Delta t}.$$

   Can the author better explain what do they intend with braking speed? Is it the ratio between the braking distance and Δt? Probably, it would be better to indicate the braking speed with a symbol without the dot.

3. Observing Figure 3, it seems that the shear traction force is directed against the snow avalanche flow, i.e., a negative pressure is acting on the obstacle. Have I well understood?

4. Can the author include some references about the lateral requirements resistance of bridge guardrails? European norms (say EN 1317) relate to performance classes based on impact speed, angle and vehicle mass, rather than impact loadings.

5. Limiting the attention to the failure of the guardrail, any impact pressure larger than the one that caused the observed damage would cause the same damage. However, the presence of further elements that were not destroyed by the avalanche can help in estimating an upper limit of the impact pressure. Have the authors found other elements that can help in estimating an upper limit of the impact pressure?

Minor observations

- $\dot{S}_\Omega$ in Eqn. (5)
- The paper "Formation of levees and en-echelon shear planes during snow avalanche run-out" by Bartelt *et al.* dates back to 2012, rather than 2017.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2018-154, 2018.