**DIRECT HAZARD FROM WAVE OVERTOPPING: A REVIEW AND FORWARD LOOK**

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CONTEXT AND RATIONALE

A primary purpose of many coastal defences is to protect people from direct hazard due to wave overtopping. This is reflected by the use of an *admissible overtopping* as a key parameter in design or assessment of structures. Despite this long-established design driver, it is less than 20 years since guidance on admissible overtopping started to move from being based simply upon mean discharge to consider the volumes associated with individual wave overtopping events. Only in the past five years or so has attention zoomed in further, to associate the influences of direct hazard on the actual flow parameters (typically water depth and speed at the pedestrian). This paper will provide a developed view of the current state of the art and improved guidance, and the research from which it has emerged.

EXISTING GUIDANCE

The principal guidance internationally is EurOtop (2018), which extended guidance in EurOtop (2007) incorporating improved understanding of the relationship between mean discharge (q) and individual volumes (V), and also explicitly identifying the additional hazard posed by violent overtopping. The EurOtop (2007) guidance came from various studies of actual events and model tests, taken together with earlier mean discharge-based guidance and expert judgement (Allsop *et al*., 2005) in the EU “CLASH” project (*e.g.* Geeraerts *et al.*, 2007).

RECENT STUDIES

Basing admissible overtopping upon V instead of q moved closer to directly linking the source of the hazard (the wave’s interaction with the structure) and the receptor (the pedestrian) but this is still not a direct link – it is not the volume V that causes a pedestrian to lose stability, but rather some combination of the speed (u) and depth (d) of the flow of overtopped water at the person. Sandoval & Bruce (2017) used video evidence of actual overtopping accidents, concluding that (i) critical combinations of u and d for hazard onset could be established with some confidence, and (ii) these combinations were typically at smaller depths but higher speeds than those previously researched in the context of fluvial flood hazard. Very recently, Koosheh *et al.* (2021) focus on improving the detailing of the prediction of the individual volumes and the arising layer thicknesses and speeds. Cao *et al.* (2022) combine the improved prediction of hazard with models predicting the exposure to synthesise an “accident likelihood model”.

NEW GUIDANCE

Combining Sandoval & Bruce’s (2017) and new human-subject studies using the overtopping simulator, Van der Meer *et al.* (2022) offer a simple rule for initial assessment of whether hazard is likely to be present (Figure.1).



Figure 1 – Simplified guidance (Van der Meer *et al.*, 2022).

NEW WORK

Despite progress in characterising post-overtopping flows and in understanding what constitutes hazardous combinations of (u, d) in that flow, and some work (Van der Meer *et al.*, 2022) to translate a predicted V into a worst-case simultaneous combination of (u, d) over a dike, there is no comparable work for post-overtopping at vertical walls. A tentative methodology for this step for vertical walls is presented here based upon literature and assumptions.

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