

Q&A: Advances in dam breach assessment

Question #	Question	Answer
1	Can Dam breach for a well-defined dam be prevented by adhering to best practices in project operation and maintenance?	That's why guidelines ask for credible failure mode assessment first
2	Can Dam breach for a well-defined dam be prevented by adhering to best practices in project operation and maintenance?	What happens if the dam designer is unable to correctly assess the reservoir sedimentation during the planning and design stage of the project?
3	How do we determine the best dam breach equations to use? There's 'Froelich 1995a', 'Forelich 2008', Von Thun and Gilette, Xu and Zhang, 'MacDonald and Langridge – Monopolis (1984)' We used Froelich equations for our studies as it was easier to understand for our project	live answered
4	How do we determine the best dam breach equations to use? There's 'Froelich 1995a', 'Forelich 2008', Von Thun and Gilette, Xu and Zhang, 'MacDonald and Langridge – Monopolis (1984)' We used Froelich equations for our studies as it was easier to understand for our project	Monte Azmi i believe weights the equations to get a 'best estimate' - but with the inherent uncertainty I'm not sure there is a 'best' option per se. Often in Australia multiple options are run and weighted - or worst case adopted subject to the application :)
5	How do we determine the best dam breach equations to use? There's 'Froelich 1995a', 'Forelich 2008', Von Thun and Gilette, Xu and Zhang, 'MacDonald and Langridge – Monopolis (1984)' We used Froelich equations for our studies as it was easier to understand for our project	Hi Ask, hope my response was a good answer to your question too
6	Hi Dr Mayari, thanks for that. How much more 'accurate' is the probabilistic model compared to empirical methods (ie is the larger effort and Monte Carlo runs worth it in practice?)	I think it's being answered by Monte Azmi :)
7	I would wish to get some clarification on how I can classify the probability failure modes while conducting Dam safety studies??	Hydrology studies may be used to provide probabilities for overtopping failures. Earthquake and piping failure modes probabilities are assessed as part of separate analyses that require specialist input from seismologists and geotech dams engineers respectively.
8	How does changes to land-use plans in the catchment areas impact the safety of the dams and appurtenant structures that needs to be protected ?	In the downstream floodplain, the risk profile can change with increased development. When undertaking an assessment, the projected development over the future planning horizon should be included. In such a case, the risk posed by the dam to the downstream community man vary over time.
9	There is a belief by quite a few engineers that hydrological parameters such as inflow hydrographs storm durations are not as important as hydraulic parameters when it comes to ultimate breach phenomena. Do the data and the modelling runs approve this mentality?	Sensitivity testing hydrological parameters becomes important for dams with low storage relative to catchment area. We very briefly investigated this with Breach Hydro for two dams and updated the software to streamline this process a little better. https://www.linkedin.com/feed/update/urn:li:activity:7175242002949705728 My view is this should be tested more for regulated or high risk dams
10	Is there research on the coincident probability on the timing of breach hydrograph peak and the the timing of the storm/hydrological hydrograph peak arriving at the embankment? Is there any historic data collected on this information? This is often critical to the severity of the impacts.	It may be a conservative assumption, but it's best practice here in Aus to assume the breach peak occurs at the hydrograph peak. This may be reasonable depending on the failure mode (ie undercutting of embankment toe due to flooding causing the failure completion.
11	Is there research on the coincident probability on the timing of breach hydrograph peak and the the timing of the storm/hydrological hydrograph peak arriving at the embankment? Is there any historic data collected on this information? This is often critical to the severity of the impacts.	For piping or even overtopping this might be a reasonable assumption too as it may also be reasonable to assume the maximum hydrostatic pressure would also occur during the hydrograph peak, depending on the dam and catchment contributing to the dam relative to the overall catchment

12	the Xu and Zhang formation time equations are based on times that include the initiation time in many cases, therefore they overestimate the formation time (or at the very least, not comparable to estimates from Froehlich's equations or others). What is the impact and potential error of including the Xu and Zhang equations in the data fusion approach?	yes, there are a level of uncertainties in Xu Zhang however it is still one of the most used/applied/cited equation even used in HEC-RAS. In Data-Fusion equation, while the equation has been selected the derived regressions calibration/validation has ensured that the embedded uncertainties are applied in form of applied weights. It is very important to have at least one empirical equation which considered geotechnical component which can help on cases like additional safety or well compacted dams etc
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14	Is there any relationship between peak flows estimated for various levels of risk and inundation areas that needs to be mapped due to overtopping floods or piping failures?	There is no set area or downstream extent that should be modelled. It is a function of the breach hydrograph volume and the storage volume in the downstream floodplain. Some guideline documents suggest indicative downstream modelled extents, but it generally should be reviewed case by case.
15	Hi, If we have a cascade dam system, how are the parameters of the downstream dams estimated? What are the factors considered?	The failure hydrograph from the upstream dam is used as an additional inflow hydrograph to the downstream dam, from there, the same process is applicable
16	How could we modify the results of the existing Dam Breach Framework by applying Sensitivity analysis to breach parameters ?	I answer but I'm not sure if you can see my answer.
17	I note there has been no mention of physically based models where hydraulic and erosive processes are explicitly modelled (EMBREA, AREBA). How do the empirical / probability models discussed here compare to physically based models?	I briefly did but didn't compare models results. However, the purpose of each modelling is different.
18	If we are using probabilistic models for historic failures and our breach parameters, and if we don't always have enough data - which probabilistic model is used and how do we know that it's applicable?	live answered
19	If we are using probabilistic models for historic failures and our breach parameters, and if we don't always have enough data - which probabilistic model is used and how do we know that it's applicable?	My preference is uniform random sampling, where parameter ranges are dictated by empirical equations and the ultimate breach parameters are validated against historical dam failure datasets
20	Hi Tim, thanks - this is a great preso. Can you give examples of other parameters that may influence outcomes by 'orders of magnitude' if the dam breach parameters are not?	Simply, fatality rates. They are most strongly influenced by the degree of evacuation which occurs prior to the arrival.
21	Tim, How are you defining breach outcomes (Community risk/Loss of Life) in a consistent manner across Australia? For the work I did in the UK under the national reservoir flood mapping project we use our national property dataset but this level of information is not available consistently across Australia.	Estimating breach outcomes is, in effect, an independent analysis. Guidance on estimating consequences is documented in an ANCOLD guideline document on consequence assessment. The guideline still provides scope for individual assessments. There is no single correct method. The detail to be applied in any assessment can be adjusted as appropriate to achieve the desired level of accuracy. Broadly, life loss is related to the number of individuals residing in the floodplain, but it is not precise. Human behaviour plays a role. In natural floods and some dam break events, the majority of life loss occurs when individuals voluntarily enter the waterway. In a more direct answer to your query, in cases where there is no database, we identify houses individually using aerial imagery. If the region is densely residential, then we estimate at a coarser scale using a combination of census data and block size.
22	What is recommended approach to adjust estimated breach parameters if site constraints limit breach progression?	In most cases, breach sizes will be constrained by the waterway within which they are constructed. This will be accounted for in most models either by limiting the size or by the control which will be effected by the waterway section immediately downstream of the dam.
23	Do you suggest some document or manual for tailing dams break? where we have non newtonian liquids!	NM Rana et al

24	Tim, You commented on small dams 0.5m. What would be recommended base scenarios to assess sensitivity of outcome where resource for advanced study is not typically available?	<p>This can be a challenging area to assess accurately. Breach times are likely to be much longer than for larger dams as the stored water energy in a basin is low relative to the embodied energy in the dam embankment. In the case of a detention basin, the water storage is a transient feature that limits the available time for breach formation also. Modelling assumptions which ignore the time for the toe to erode are probably unduly conservative for very low height dams.</p> <p>Available regression equations from a dam failure database may not extrapolate well to the lower end of the range. It seems likely that longer breach times and narrow breach widths would occur for smaller dam heights. Fortunately, In the case of very low height dams, the asset tends to sit in the very low consequence category range regardless of the adopted parameters, so it is not generally necessary to undertake sensitivity analysis. Note that by convention, when incremental depths are less than 300 mm, risk to life is typically assessed as negligible.</p>
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