Season's Greetings and Happy New Year 2026 – The Importance of Earthquake Safety of Dams

Dear Colleagues and Friends

I wish you good health and all the best in the New Year.

Here are a few personal comments:

Why are earthquakes the most difficult hazard from the natural environment, which a dam must be able to withstand? The answer is as follows:

1. The earthquake hazard is a multi-hazard for large dam projects, which besides ground shaking may include (i) fault movements in the footprint of a dam or in the area of the reservoir are for concrete dams more dangerous than the effects of ground shaking, (ii) mass movements into the reservoir and mass movements at the dam site, which may plug the intakes of spillways and/or low-level outlets, (iii) mass movements in the catchment area, which may block rivers or cause huge sediment transport into the reservoir, (iv) impulse waves in reservoirs that may overtop the dam crest and are most critical for embankment dams, and (v) other site and project-specific hazards such as liquefaction, etc.
2. Strong earthquakes cannot be predicted so there is no adequate warning time to lower the reservoir.
3. Earthquakes affect all components of a large dam at the same time, therefore redundancy and barrier concepts used to decrease the probability of failure do not provide additional safety.

Therefore, large consequence dams must be able to withstand the effects of the strongest earthquakes that may affect a dam project. This includes water storage and tailings dams.

It is well known that a dam that can withstand strong earthquakes will also be safer under other types of hazards from the natural and man-made environment. For example, static liquefaction should not become a dam failure mode if a proper seismic safety assessment of a dam were carried out.

With respect to dam safety there should not be any difference in the safety of people living below an old or a new dam. This universal safety principle also applies to the earthquake safety. As a consequence, all dams must always meet the same current seismic safety criteria. This would be the ultimate goal of any dam safety authority, but we know that there is still a lot of work needed to achieve this goal. It also means that a dam's safety must be checked periodically. To believe that a dam that was declared safe at the time of its construction remains safe forever would be a very dangerous assumption. Therefore, regular safety checks are prerequisites for a long lifespan of a dam.

Until March 11, 2011 no one has died from failure or damage of a large water storage dam due to earthquakes. However, during the magnitude 9.0 Tohoku earthquake in Japan in 2011 the 18.5 m high Fujinuma embankment dam failed, and the flood wave created by the release of the reservoir water caused the loss of eight lives. Thus some people believe that the seismic safety standards are too conservative and may be relaxed. However, it has to be kept in mind that during the

2008 Wenchuan earthquake in China 1803 dams, reservoirs and powerhouses were damaged. More recently, on February 6, 2023 two strong earthquakes with moment magnitudes Mw 7.8 and 7.7 occurred in the border area of Turkey and Syria and damaged several large dams. Due to the low reservoir levels at the time of the earthquakes there was no threat of a catastrophic release of water from the reservoirs. Also, during the magnitude Mw 7.7 Mandalay earthquake in Myanmar on March 25, 2025, several embankment dams close to the Sagaing fault suffered some damage, i.e. mainly cracks along the crest and settlements. This recent damage and the fact there is still limited data available on the performance of dams during very strong earthquakes, show that it would be premature to lower the seismic safety standards for large dams. However, it is true that well designed, well-constructed and well-maintained dams perform well during strong earthquakes.

Finally, I would like to draw your attention to the ICOLD Congress, held in Chengdu, China from May 16-23, 2025, where one of the four questions discussed was “Earthquake Performance and Safety of Dams”. The reports submitted for this question give an overview on the current state-of-the-art on the seismic safety of dams.

The average age of Swiss dams is about 77 years. In 2025 I visited several of them and all fit well in their natural mountainous environment. One of these dams is the 117 m high Mattmark dam (see photo below), an earth-rockfill dam made of moraine material founded on an up to 70 m thick soil layer. 2025 was also the 60th anniversary of a tragic icefall (see the right side of the photo showing several small streams of the melting Allalin glacier). It destroyed the labourer’s camp and caused the loss of 88 labourer’s lives working at the Mattmark dam site.

I would like to take this opportunity to thank all who contributed to the work of our ICOLD committee in the past year.

With my best wishes for 2026

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