SwedCOLD

NEWSLETTER # 2 / 2025

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SwedCOLD's newsletter

Editorial committee's note

With SwedCOLD's newsletter, we aim to provide a consolidated source of information on developments in the dam safety sector – from the perspectives of owners, authorities, consultants, and contractors in Sweden – and this time we extend a little further to the Nordics. The newsletter is published twice a year, both in print and as a digital version available for download from our website.

We hope the newsletter will contribute to increased awareness and activity in the field, and that everyone helps by contributing articles on ongoing projects and events. **The SwedCOLD newsletter becomes what we all make of it together. Contributions from all types of dams are welcome – so if you have something to share from a smaller dam, don't hesitate to send us your story as well.**

Each author is responsible for their material, which is also reviewed by the editorial committee.

Editorial committee

Per Elvnejd, Statkraft
Sara Töyrä, LKAB
Maria Bartsch, Svenska kraftnät
Finn Midböe, Fortum
Cecilia Woolford, Vattenregleringsföretagen

Next Issue – back to normal

Next spring we expect to be back on the familiar path again, the newsletter will be in Swedish and distributed in print at our gathering in Stockholm on April 14th. Contributions should include a headline, a short text (maximum two pages including figures/images in the final newsletter format), and a reference to the author/contact person. All articles should include pictures or illustrations. Please submit your contribution using the template and instructions available on our website http://www.swedcold.org, the template available is the same old Swedish one again. Submissions must reach the editorial committee no later than **March 6th 2026**.

Please email your contribution to swedcold@vattenreglering.se.

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Editorial committee

COVER: Mjövattsforsen hydropower facility in river Bureälven, Skellefteå.
PHOTO: Lisa Carlsson, Sweco.

Apply for funding of masters thesis projects in hydropower!

Energiforsk programme "Vattenkraftens framtidsprogram" are now looking for masters thesis projects to fund!

If you are a supervisor for master's students and have a thesis project that applies to the hydropower industry, then you can now apply for funding of the master's thesis project. Energiforsk programme "Vattenkraftens framtidsprogram", funded by the hydropower industry and Svenska kraftnät, will review applications for master's thesis projects in all areas of hydropower: dams, environment, technology etc. By funding more master's thesis projects within hydropower and raising the interest of hydropower to students at the technical universites all over Sweden, we can assure that new abilities will enter the industry to carry the torch. So if you or anyone that you know are looking for funding for a project, then you are welcome to submit your application to Vattenkraftens framtidsprogram. You will find an application form at the Energiforsk website. Last day to submit is January 31, 2026.

/Erik Isberg, Energiforsk.
You can find more information at the Energiforsk website, or by contacting Erik at erik.isberg@energiforsk.se.

Motala power station. Photo: Erik Isberg.

Rebuilding of the Hästberga hydropower plant

Following the failure of the Hästberga hydropower dam on the Helge River, a legal process is currently underway, and a reconstruction project has been initiated to restore the facility with both technical upgrades and improved dam safety measures

Following the dam failure in 2010, a legal process was initiated to determine whether the Hästberga hydropower plant in the Helge River had the legal standing to be rebuilt. After several years, the court has confirmed that the plant has legal force. As a result, a new project is now underway to reconstruct the facility, incorporating both technical improvements and enhanced dam safety measures.

The previous facility, which had been in operation since 1953, was severely damaged during the dam breach. Since then, water has been diverted around the old power station via the original river path. The new facility is proposed to be built at the same location and featuring an improved design in accordance with RIDAS guidelines, with increased capacity to accommodate future climate change.

Following the failure, a reassessment of the dam classification was conducted to verify whether the previous designation of Consequence Class 2 was still appropriate. The study confirmed this classification, and the new facility is therefore being designed according to Dam Safety Class C and corresponding flood capacity design.

In addition, the dam breach created ecological connectivity in the Helge River, which is now being preserved—and for some species, enhanced—through modern fish migration adaptations. These include a fish bypass channel enabling both upstream and downstream migration, and fish screens at the intakes to guide fish toward the bypass.

The project has undergone consultation with Länsstyrelsen Skåne, and supplementary documentation has been prepared. All documents have now been submitted, and a final court decision regarding the reconstruction is expected in early 2026.

/Tomas Ekström AFRY, Erik Winqvist AFRY and Frank Gunnarsson Hästberga kraft AB.

Visualization of the Hästberga hydropower plant. Model by Erik Winqvist, AFRY.

Report from the general assembly in Chengdu

In connection with ICOLD's annual meetings, a General Assembly is held – the highest decision-making body of ICOLD. This year's edition included the election of a new president, as well as the discussion of a motion submitted by the Nordic countries.

Participants from SwedCOLD gathering during a short break at the General Assembly in Chengdu 2025. Photo: SwedCOLD

Ahead of this year's General Assembly — ICOLD's highest decision-making body — a few interesting points were on the agenda. A new ICOLD President as well as Vice Presidents from Africa and the Americas were to be elected, unusually with at least two candidates for each position. The voting turned out to be quite exciting, but in the end, Devendra Kumar Sharma from India was elected as the new President (by a narrow margin), Harrisson Mutikanga from Uganda was elected Vice President for Africa, and Luis Guillermo Vellacich Mas was elected Vice President for the Americas. Furthermore, Jordania was accepted as a new member country and for the first time in ICOLD history some countries were excluded; Bosnia-Herzegovina, Algeria, Denmark, Guinea-Bissau, Lesotho and Libya – all due to inactiveness and unpaid fees, except Denmark that applied for exclusion some years ago.

In addition, the Nordic countries' ICOLD committees had jointly submitted a motion proposing changes and modernization of ICOLD. More background on this can be found in Per's report on how things typically unfold at the ICOLD General Assembly, published in last year's autumn issue of the newsletter. The proposals in the motion included the following (short version):

1. English should be the only allowed language at the General Assembly.
2. All suggestions that are subject for voting should be circulated to the National Committees four weeks in advance of the General Assembly, to make sure that there is sufficient time for national discussions of the proposal.
3. Every item/motion that is subject for voting at the General Assembly should be presented in writing on screens for clarity.
4. It should be possible for all member countries to participate and vote in the General Assembly online.
5. ICOLD bulletins should be published in two separate versions, one in English and one in French. The two separate versions should be able to be published at different times, which means if one of the versions is ready for publishing, it should be published even if the translation to the other language is not completed.

The Nordic countries' representatives had, in connection with the motion, been invited to a meeting with the Secretary General and another member of the board to discuss the proposals in advance. The board's position was that proposals 2, 3, and 5 of the motion were within the board's mandate to decide on without requiring a vote in the General Assembly — and that the board was supportive of all three proposals. This includes proposal no. 5 regarding the publication of technical bulletins, which has previously been a major issue. There are examples of bulletins that were fully completed in English but were delayed for several years because the French translation had not been finalized and the former policy required it. A very significant step forward!

Concerning suggestion number 1, to skip French as an official language during the general assembly, adjustments to the ICOLD Constitution and by-laws are necessary. ICOLD secretary general and board therefore suggested that an ad-hoc committee would be formed to work out if and how such changes could be made. During the General Assembly, the French committee spoke out, expressing the result of a discussion amongst a few French speaking National Committees. They had concluded that they were open to use English exclusively as the spoken language during the General Assembly, while also pointing out that it might be important to keep the agenda and minutes bi-lingual to fulfill legal requirements since ICOLD is formally registered as an organization in France.

With support from the French-speaking national committees, hopefully there is little standing in the way for the necessary changes that should be made to the constitution and by-laws. The president was commissioned to appoint members for an ad-hoc committee to develop the changes, including also to look into point number 4 in the motion. Apart from this, the committee will also look into what changes are needed to include the suggestions from the current committee on gender diversity and inclusion – making this a permanent forum rather than an ad-hoc committee.

/ Finn Midböe, secretary of SwedCOLD

Berm construction in clarification pond

Berm construction purpose, process and lessons learned.

Background

During winter and autumn this year construction of a 300 m long and approx. 20 m wide berm for extension of support fill buttress of Dam I at Boliden's tailings dam facility Ryllshyttemagasinet has been completed. The purpose of the newly built berm is to increase stability and to collect the seepage water from Dam I. The collected seepage water will be pumped back to the tailings dam and then flow through the treatment facility (which reduces the oxygen consuming substances and metals from the water, which forms a sludge). Water then flows to our outlet from the clarification where our control point for the environmental permit is located.

Construction and design

Work with the berm has included dredging to reach a stable foundation and then filling of support rockfill, moraine, filters and erosion protection. All work has been done with an excavator with extra-long reach and trucks with high emphasis on safe work environment. Sweco, our design team, have supervised the construction and followed up the different steps and ensured that the design intent is fulfilled.

Before work started with detail design, geotechnical drilling was conducted to understand the foundation conditions. From the investigation and evaluation by geotechnical expertise and the designers, a section from the detailed design was produced. However, several changes were made due to optimization of the construction on site and stability of the berm. Designers and contractors helped to create the final design of the berm.

Concerns and challenges

Our concerns during construction were that the ongoing work could create a flow of particles that could affect our recycling of water to the mill and leakage of nitrogen from blasting that could affect our permitted nitrogen values.

Before work was started silt curtains were installed in the clarification pond to minimize suspension of solid particles. During the construction water quality was measured in several points and the project and our environmental department had continuous meetings if any parameter deviated. There were higher uranium values than expected which could have been a combination of natural uranium level in the rock that was put in the water and from the dredging. This challenge was handled by pumping water back to the water treatment facility and other pumping solutions during the construction.

Lessons learned

Priority should have been given to complete the "impermeable" part of the berm and have a pumping plan in place if there would be a release of substances that could affect the water quality. A more thorough investigation should also have been performed of the potential leakage of substances from the material that was to be placed in the water and a mitigation plan for each of those substances.

/ Erik Månsson, Carin Alderman
Boliden Garpenberg

Drone photo processed in skymap.

New reports from Energiforsk focusing on dam safety

During spring and summer 2025, five new reports were published within Energiforsk's Dam Safety Programme. The programme provides new knowledge to strengthen dam safety work and supports the long-term development of Swedish hydropower.

"Five exciting new reports have recently been published, supporting dam safety in many ways! They cover everything from the reuse of bottom outlets to the history of hydropower in southern Sweden and the challenges of coexisting with the public," says Andreas Larsson, Programme Manager. The reports are written in Swedish with English summaries.

Design flood calculations – follow-up (Uppföljning av dimensioneringsberäkningar)

Since the 2014 follow-up of guidelines, many new design-flood calculations and analyses have been carried out in Sweden while the guidelines themselves have evolved. This study updates the database with new calculations, complements earlier follow-ups, adds information about peak observed flows, and reviews how the 2015 and 2022 guidelines are applied. The guidelines describe two methods:

Example of barriers with safety booms upstream of the Mjövattsforsen hydropower facility in river Bureälven, Skellefteå, from the report "Allmänhetens säkerhet vid vattenkraftanläggningar – val och utformning av åtgärder" Photo: Lisa Carlsson, Sweco.

Method I combines extreme hydrological events in a model, while Method II uses statistical analysis of annual peak flows, based on observed or modelled data.

Authors: Anna Ebbersten, Jonas German

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/uppfoljning-av-dimensioneringsberakningar/

(Re)Commissioning of decommissioned bottom outlets (Idrifttagning av avställda djup- och bottenutskov)

Recommissioning a bottom outlet after years of inactivity is technically demanding and costly. This study collects experiences from completed projects, focusing on needs analysis, reconstruction planning, commissioning, and necessary preparations. Insights were gathered through interviews with commissioning leaders, project managers, and hydraulic engineers.

Authors: Elin Johansson Torén, Karin Appelquist, Pierre-Louis Ligier, Björn Eriksson

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/idrifttagning-av-avstallda-djup-och-bottenutskov/

Public safety at hydropower plants (Allmänhetens säkerhet vid vattenkraftanläggningar)

This project maps suitable safety measures under different conditions and risks and describes how they should be designed. The goal was to develop a framework to help the hydropower industry choose and design effective safety measures. The work included a literature review, international comparisons, interviews, and site visits to four hydropower plants. One key finding is that raising awareness and providing clear local information is among the most effective safety measures.

Authors: Lisa Carlsson, Anna Risberg, Ingvill Storøy

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/allmanhetens-sakerhet-vid-vattenkraftanlaggningar/

The history of drainage systems in southern and central Sweden (1870s–1950s) (Avbördningsanordningars historia i södra och mellersta Sverige)

Swedish hydropower has developed under changing technical, economic, legal, and environmental conditions. This report combines archive material and interviews to describe the historical development of flow-control structures in dams in southern and central Sweden. The study begins in the late 19th century, when hydropower expanded rapidly alongside industrialization and power transmission technology enabled energy use far from production sites. As we now know, hydropower soon became competitive with fossil fuels, supported by Sweden's abundant watercourses.

Authors: Jacob Friman, Johnny Rönngren, Mats Stenmarck, Magnus Jewert, Peter Bergkvist

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/avbordningsanordningars-historia-i-sodra-och-mellersta-sverige-en-studie-mellan-1870-talet-till-1950-talet/

Accessible and user-friendly documentation for dam failure contingency planning (Tillgängliga och användarvänliga underlag för beredskapsplanering för dammhaveri)

Since 2005, emergency preparedness documents (EPD) have been developed for about 20 Swedish rivers. These documents are often difficult to use, partly due to their volume and confidentiality restrictions. This project explores how to make EPDs more accessible and user-friendly for stakeholders, while also providing guidance on security classification and alternative uses.

Authors: Lisa Carlsson, Anna Risberg

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/tillgangliga-och-anvandarvanliga-underlag-for-beredskapsplanering-for-dammhaveri/

Guidance for measuring and evaluating the function of dams (Vägledning för mätning och utvärdering av dammars funktion)

Long-term monitoring is crucial for dam safety. Instruments are used to track dam status, detect performance changes early, and assess safety margins. This report compiles international and Swedish knowledge on dam measurement and monitoring, with a focus on embankment and concrete dams. It highlights what should be measured and how results should be analyzed to support safety evaluations.

Authors: Sam Johansson, Magnus Lindgren, Peter Viklander

Read the report here:

https://energiforsk.se/program/dammsakerhet/rapporter/vagledning-for-matning-och-utvardering-av-dammars-funktion/

/Andreas Larsson, Programme manager at Energiforsk. All information on webinars, seminars, conferences and new reports can be found on www.energiforsk.se

Committee Z rebooted: A fresh strategy for capacity building in ICOLD

ICOLD's Capacity Building Committee (TC-Z) is entering a new chapter with renewed leadership and a bold strategy for the future. With Marc Smith as the new Chair, and Brandon Pearce and Emma Hagner stepping in as Vice Chairs, the committee is poised to play a unique and vital role within ICOLD – focusing on people, skills, and collaboration.

Unlike ICOLD's technical committees, TC-Z is envisioned as a supportive branch—connecting professionals, sharing knowledge, and building capacity across ICOLD's 100+ member countries. Its work will center on facilitating training, communicating and disseminating knowledge from other technical committees, and acting as a knowledge hub for capacity-building initiatives.

A new awakening

When Committee Z was first established, its primary focus was on training and capacity building in developing countries. However, as capacity-building challenges are now shared across all ICOLD member countries, albeit in different forms and with varying needs, our mission has evolved. We aim to remain relevant to all members by broadening our scope.

The new strategic plan outlines a clear and ambitious path forward. Our key objectives are:

Enhance Technical Expertise

Leverage the knowledge of ICOLD's technical committees (TCs) and National Committees (NCs) to upskill professionals in dam safety, design, and sustainable practices.

Promote Knowledge Sharing

Facilitate the exchange of best practices among ICOLD's member countries through coordinated platforms and events.

Support Young Professionals

Engage young engineers in the committee's work to help build a skilled and innovative future workforce.

Address Emerging Challenges

Equip members to respond to climate change, technological advancements, and socio-environmental issues through targeted workshops and resources.

Strengthen Global Collaboration

Foster partnerships with national committees, academic institutions, and industry stakeholders to amplify capacity-building efforts.

Sharing Experiences from Capacity-Building Initiatives

TC-Z will produce and share an annual report deck showcasing capacity-building initiatives from across ICOLD. These reports are intended to inspire professionals working in the field and will form the foundation of a centralized knowledge hub—designed to promote learning, share insights, and help us build on each other's successes rather than starting from scratch.

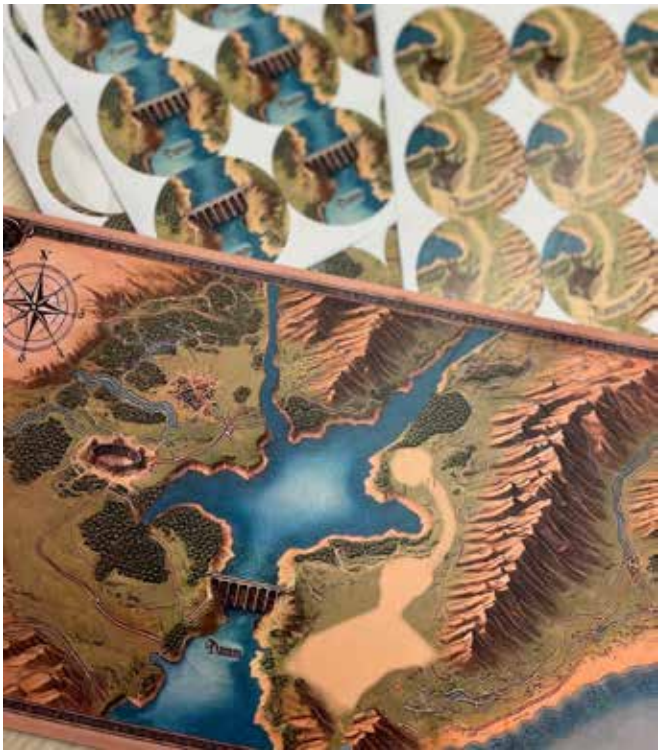
Wondering what a capacity-building initiative might look like? It can be something as simple and effective as a student competition at a career fair—where participants are guided past all the hydropower companies, giving them a natural icebreaker to start conversations with industry representatives. Or it could be a more structured effort, like the creation of the Swedish Centre for Sustainable Hydropower, which was established two decades ago as a platform for capacity building in the hydropower sector. Sharing the key learnings from such projects is exactly the kind of insight we aim to highlight.

What's next?

We are currently finalizing the new strategy, launching work groups in each target area, and building a sustainable structure for how the committee will operate moving forward. One of our first tasks is to establish communication protocols with other technical committees and the Central Office. We are also reviewing our committee membership and warmly welcome anyone interested in contributing to this important work in the coming years.

/Emma Hagner, Energiforsk, emma.hagner@energiforsk.se
Feel free to contact me if you'd like to learn more about the reboot of Committee Z – or even better – if you're interested in joining us!

Capacity building is defined as the process of developing and strengthening the skills, instincts, abilities, processes, and resources that organizations and communities need to survive, adapt, and thrive in a fast-changing world.



The dam keeper's quest. A competition for students where the goal is to seek stickers to build your very own hydropower plant. Photo: Emma Hagner.

Engineering insights and cultural encounters: A young professional's journey to the ICOLD annual meeting in Chengdu

As a SwedCOLD scholarship recipient, I had the great opportunity to attend the 2025 ICOLD Annual Meeting and Congress in Chengdu, China – a global gathering of experts and young professionals in the dam engineering industry. The week-long event combines technical workshops, cultural experiences and insightful networking with other attendees from all around the world. This report offers a glimpse into the highlights, insights and lasting impression from a young professional's point of view.

Arrival in Chengdu: First impressions and missed pandas

I arrived in Chengdu on Thursday afternoon after a long journey from Copenhagen via Frankfurt and Beijing. A thorough security check and a missed transfer made me a bit late, which meant I missed the planned visit to the panda park – one of the city's main attractions. In the Sichuan province, where Chengdu is located, together with two other provinces, the world's entire population of pandas can be found. This was evident everywhere – from souvenirs at the conference, decorations on buildings, to stuffed toys in the hotel lobby.


A panda climbing the building.

The first thing that struck me in Chengdu, besides the heat, was the silence in the city thanks to the number of electric vehicles. The presence of surveillance cameras was also noticeable, with cameras mounted on nearly every lamppost.

On my first evening, I took a walk in the city and followed the locals to a small "hole-in-the-wall" eatery. In the second evening, I had dinner with other Swedes at a restaurant next to the conference venue. It was good, but strong! In total, we were around 21 Swedes attending the annual meeting.


Dinner with the Swedes.

Workshops and Young Professional Voices

On Saturday, the conference began with registration and continued with workshops. I participated in one focused on dams and water resource management in relation to the ongoing energy transition, where young engineers presented ideas, technologies, and practical experiences on the topic. One presentation discussed integrated sediment management in reservoirs, while another presented a study on Zambia's energy sources under the constraints of climate change. Interesting lectures in grand halls!

Concrete Dams and Sustainability

Sunday was focused on the technical committees, and I spent most of the day listening to the technical committee on concrete dams. I learned more about alkali-silica reactions in concrete dams and how drying can extend a dam's lifespan. Another interesting presentation addressed carbon emissions from a life cycle perspective for different types of concrete dams.

During lunch, I attended a mentoring session where I, together with four other young professionals in the industry, sat down with a mentor. We discussed sustainability, with much of the conversation revolving around the importance of attracting and retaining young talent in the industry, as well

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The Grand Halls.

as the significance of knowledge transfer from seniors to juniors. The day ended with a YPF event complete with food, drinks, mingling, and – not least – karaoke.

Opening ceremony and exhibition

Monday began with an opening ceremony for the symposium, followed by the opening of the conference's exhibition area. New and exciting technologies were highlighted here. Among other things, a digital twin of a river was presented, focusing on flood control and regulation, as well as the management and distribution of water resources within the river basin. The digital twin has many functions, such as hydrological forecasting for the area, flood assessments, and recommendations for flood control strategies. Very impressive!

A cultural highlight

On Tuesday evening, the conference's cultural event took place. We visited the "Jinsha Site Museum." This location was a part of the Shu Kingdom about 2600–3200 years ago. The museum contains collections of ivory and gold artifacts from that time – a fascinating visit.

The following days were filled with interesting lectures and panel discussions before it was time for me to fly back to Sweden.

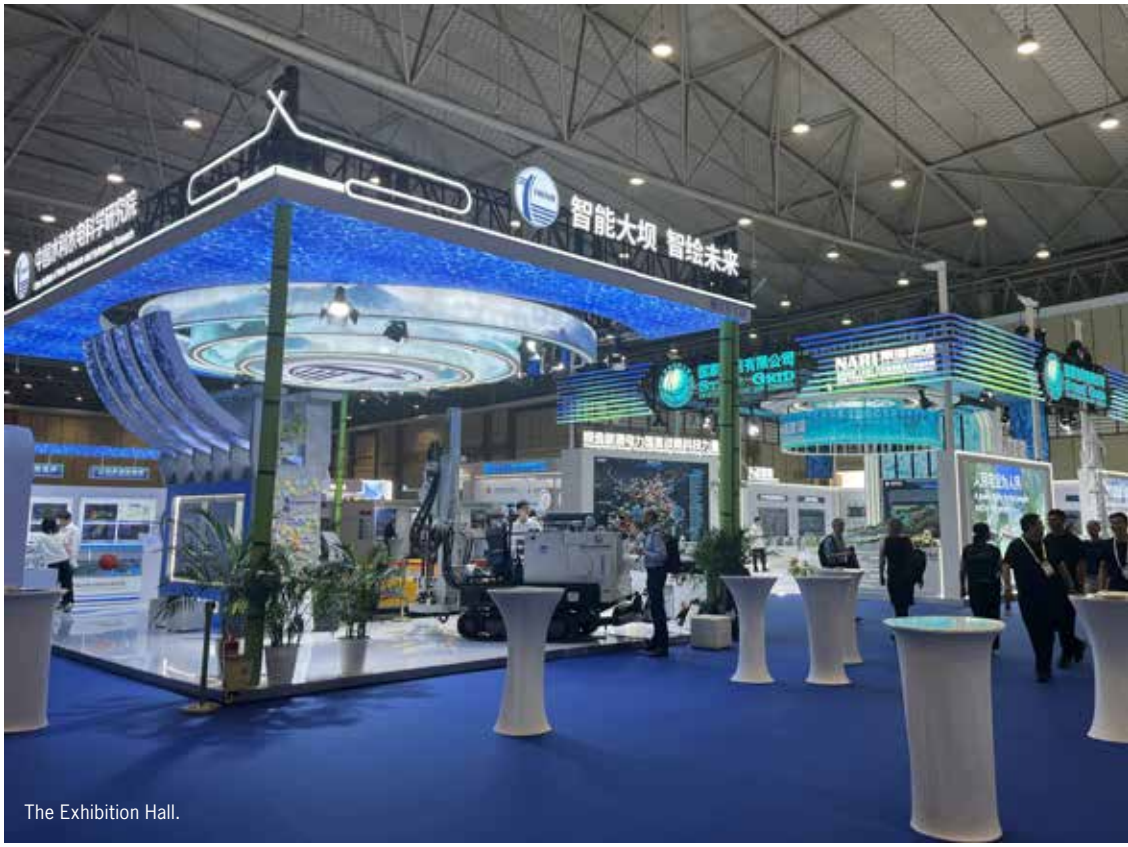
Conclusion

The 2025 ICOLD Annual Meeting in Chengdu brought together dam professionals from all over the world to share knowledge and innovations. A key theme throughout the week was adapting dam designs and water resource management to the challenges associated with climate change and it was often the centre of the discussions.

The week in Chengdu was fantastic, full of impressions, new contacts and experiences. Thank you to SwedCOLD for this opportunity and to everyone involved, both organizers and participants, who made this trip a memory for life.

/Alice Stilgård, AFRY

For more information, do not hesitate to contact me at: alice.stilgard@afry.com



The Exhibition Hall.

ICOLD technical committee Q on dam surveillance – Current work and key insights

ICOLD Committee Q on Dam Surveillance is working to improve methods for monitoring, data handling, and interpretation to strengthen dam safety and optimize maintenance. Recent publications and upcoming bulletins focus on data quality, diagnostic analyses, and the surveillance of embankment and tailings dams. The Committee also shares practical lessons learned from case studies.

The ICOLD Technical Committee Q on Dam Surveillance works to provide guidance on how to best use monitoring components for dams. This covers measurements, systems, instrumentation, and aspects of operation and maintenance. A main focus is on how to handle, present, and interpret monitoring data in an efficient way.

Recent publications include Dam surveillance - Lessons learnt from case histories (Bulletin 180) and Surveillance, instrumentation, monitoring and data acquisition and processing (ICOLD Question 106 General Report). For the 2022–2025 period, the Committee's work is centered on:

- Improving the quality and reliability of monitoring data,
- Developing better methods for data processing and presentation,
- Carrying out diagnostic analyses to identify behavior patterns,
- Using surveillance to optimize maintenance and life-cycle costs, and
- Showing the role of surveillance in preventing incidents and failures.

Three new bulletins are in preparation:

1. Diagnostic analyses to determine behavior patterns (final draft),
2. Methods to improve data quality and management of monitoring data (final draft), and
3. Tailings facility and embankment dams surveillance (in progress, in cooperation with Committee L).

For the next terms of reference, two main themes has been highlighted: the Life cycle of monitoring programs and the Installation, rehabilitation, re-instrumentation, and dismissal of Instrumentation.

An important part of the work activities is the annual Lessons learned session, which by sharing experiences aims to make dam monitoring reliable and useful and to support safe and cost-effective dam management. At the 2025 meeting in Chengdu, the presentations covered the following topics:

- The impact of a 6.8 magnitude earthquake on the Dagangshan Arch Dam (China),
- Experience with fully grouted piezometers,
- Use of machine learning to interpret the dynamic behavior of a large concrete dam,
- Ongoing results from the Älvkarleby experimental dam (Figure 1), and
- Approaches to post-evaluation of monitoring schemes in hydropower projects.

Finally, Committee Q has received access to a Surveillance Manual developed by Severn Trent Water in the UK. The document can be distributed within Swedcold. Please contact me if you are interested.

/Christian Bernstone, Vattenfall AB

Figure 1. Construction of the experimental dam in 2019 with placement of the moraine core. Excavated in 2025 to map built-in and unintended damages. Results will be shared by Vattenfall and research groups (photo by Vattenfall).

Findings from the dam owners annual reporting on dam safety in Sweden

Svenska kraftnät has analyzed the dam owners' annual reports on dam safety to the county administrative boards for 2024/2025. While the overall compliance with the dam safety regulation is good – 96 % of the classified dams are reported to have satisfactory safety – about a third of them require remedial measures. Since the classification started in 2015, overall dam safety assessments have still only been conducted for a limited share of the dams.

Annual reporting on dam safety

All owners of dams in a dam safety class, i.e. where a dam failure could lead to loss of life or significant societal consequences, shall annually submit a dam safety report to the county administrative board – the supervisory authority for dam safety. The purpose is to give a good insight into the dam owners' self-regulatory work and the overall dam safety conditions. To enable a national follow-up, the county administrative boards on request share the owner's reports with Svenska kraftnät. Svenska kraftnät annually compiles the data, evaluates progress over time and remaining development needs. Below, results from the 2025 follow-up are summarized.

Classified dams and their owners

The compilation encompasses 456 facilities with dams in dam safety class A, B and/or C owned by 120 different owners. Five companies within the hydropower industry owns more than half of the dams while close to 100 small owners have one or two dams. The majority of the dams were classified in 2015-2019 as illustrated in Figure 1, since then the number of classified dams has remained relatively stable.

Technical documentation and routines for dam safety management

The owners shall report on whether they have up-to-date identification and assessments of potential hazards, routines for operation, program for maintenance and controls as well as emergency preparedness plans. The owners report having up-to-date:

- Identification and assessments of serious hazards for 90 % of the facilities, and partly for 6 %.
- Routines for operation for 93 % of the facilities, and partly for 5 %.
- Programs for maintenance and control for 88 %, and partly for 9 %.
- Plans for managing emergencies for 90 % of the facilities, and partly for 6 %.

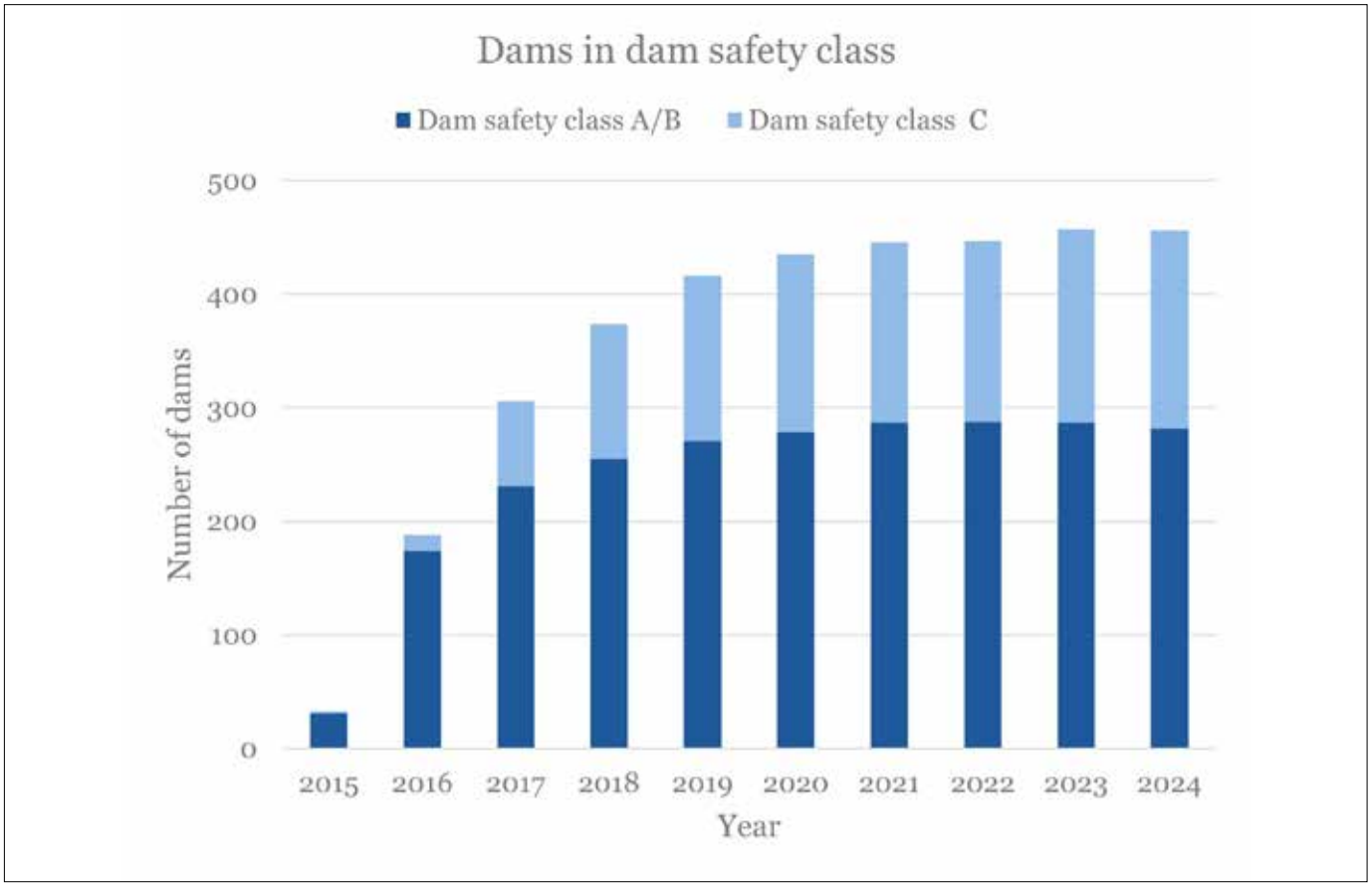


Figure 1. Number of dams in dam safety class for 2015-2024.

There has been a slight improvement in the technical documentation and routines for dam safety management. However, there are differences among the owners, the larger owners generally have this in place while the smaller owners lack this to a greater extent.

Deficiencies, remedial measures and incidents

The owners shall report on whether serious deficiencies have been observed and/or remediated, as well as whether operational malfunctions have occurred or if community emergency management has been activated, during the last year. The owners report that:

- Serious deficiencies have been identified at 17 % of the facilities and partly at an additional 1 %.
- Remedial measures are needed at 36 % of the facilities and partly needed at an additional 2 %.
- Incidents, including operational malfunctions and activation of community emergency management, have occurred at 3 % of the facilities, and partly at less than 1 %.

The reporting on serious deficiencies and incidents has been quite consistent over the years and no general trend can be observed, neither over time nor between different groups of owners. The share of facilities needing remedial measures has increased slightly in comparison to earlier follow-ups. Remedial measures are generally reported to a greater extent by the larger owners, in comparison to smaller owners.

Overall dam safety assessment

The owners shall conduct an overall assessment of the dam safety within 10 years from classification and thereafter at least every 10 years. The owners report that:

- Overall assessments – given that the reported plans are followed - will be conducted within the stipulated time period for 87 %. For 7 % of the dams, overall assessments are planned to be conducted more than 10 years from classification, and for the remaining 6 % no year for assessment has been reported.
- They assess that 61 % of the dams have satisfactory safety. An additional 35 % are assessed to have satisfactory safety however with an acknowledged need for remedial measures. The safety is assessed to be unsatisfactory for 1 % of the dams, and has not been assessed or reported for the remaining 3 %.

In comparison to earlier follow-ups, an improvement in the completion and planning of overall assessments of dam safety is observed, with a larger share being planned to be completed on time. So far, only a small share (12 %) of the overall assessments have been conducted, with the majority of these reported by the larger owners. Since around 300 dams were classified in dam safety class in 2015-2017, many overall dam safety assessments are planned to be conducted in a near future, as shown in Figure 2.

/ Linnea Taxén (M.Sc. student KTH, summer internship), Maria Bartsch and Karen Kemling, Dam Safety Specialists, Svenska kraftnät, dammsakerhet@svk.se

For more information on the dam owners annual report: Ägares dammsäkerhetsrapportering till länsstyrelsen avseende 2024 (svk.se)

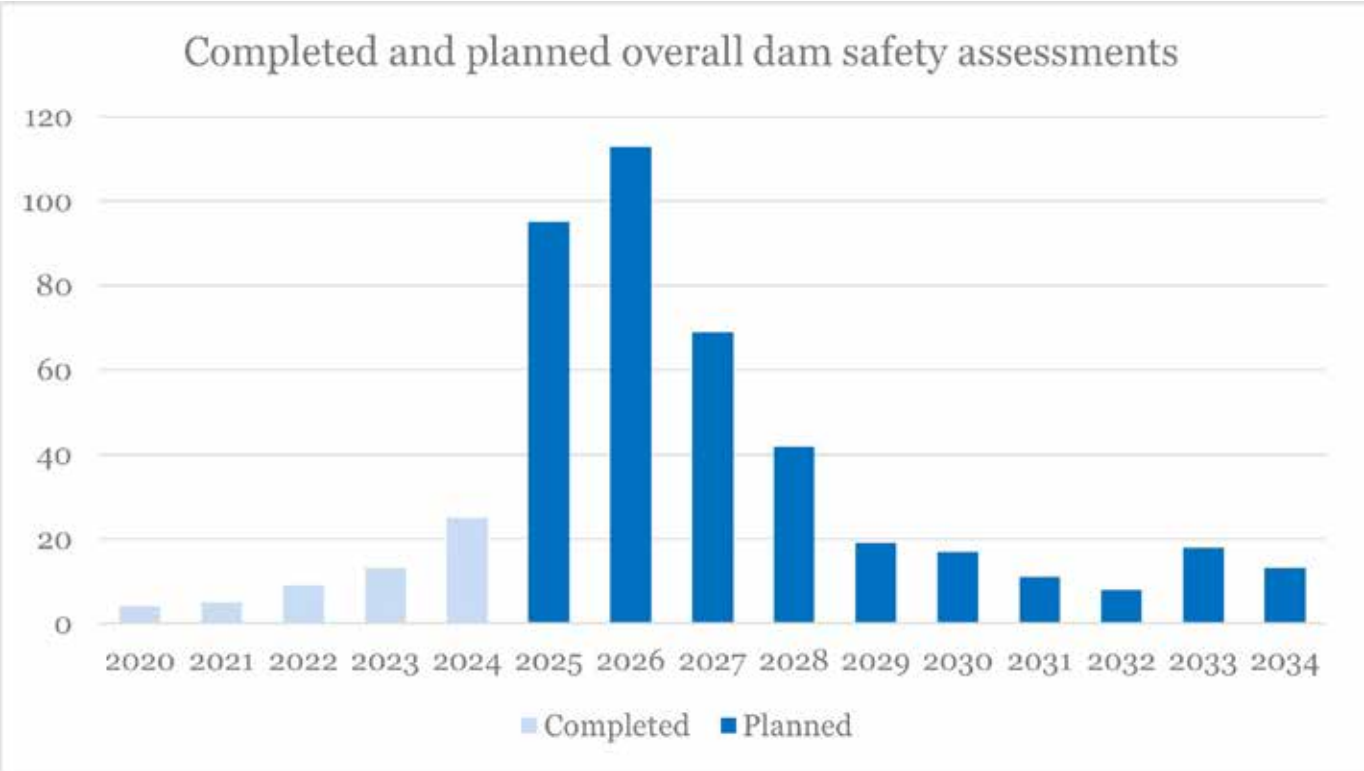


Figure 2. Completed and planned overall dam safety assessments for 2020-2032

Probabilistic methods for dam breach analysis (master's thesis)

Dam breach modeling is usually associated with large uncertainties due to the complex and often unpredictable nature of breach development. To analyze these uncertainties and identify key sensitivities, probabilistic methods can be applied in dam breach calculations. This approach explores their potential to strengthen dam safety evaluations by capturing an extended spectrum of potential dam breach outcomes.

From deterministic assumptions to probabilistic approaches

Traditionally, dam breach calculations have relied on conservative assumptions regarding breach parameters, such as breach width and breach formation time, to estimate the dam breach peak discharge. The drawback of this deterministic approach is that it obscures the inherent uncertainty of breach development. In contrast, probabilistic methods address this limitation by treating key parameters as stochastic variables within defined probability intervals and distributions. Using Monte Carlo simulations in the software *Breacher* and *Embrea*, these methods were applied to demonstrate how traditional dam breach assessments can be improved).

Monte Carlo Simulation Random sampling and statistical modeling to forecast a range of possible outcomes for unpredictable events, repeatedly performing calculations based on a model of potential results.

Case studies and method overview

Two case studies were used in the two software applications:

1. A real dam failure of the Tous Dam in Spain 1982.
2. A field test dam break in Norway 2002.

In the parametric model *Breacher*, stochastic variation of parameters such as final breach width, final breach depth and breach formation time were conducted using uniform distributions, resulting in distribution plots of discharge hydrographs. An example of this is presented in figure 1 for the Tous dam. Each grey hydrograph represents one of the 1,000 performed dam breach calculations. All hydrographs with a peak discharge within a ±1 % range from the mean peak discharge are marked in red; in the same way the median, the 25th and 75th percentile hydrographs are illustrated, all in relation to the observed outflow hydrograph with a peak discharge of 15,000 m^3/s marked in black. Performing a large number of dam breach calculations and estimating the expected hydrograph as the mean one appears to be a viable alternative.

Probability-based result analysis

The probabilistic approach enables both sensitivity evaluation of parameters and quantification of uncertainties. Figure 2 shows a scatter plot of final breach width and breach formation time from the Tous dam case study, color-coded by each calculation's resulting peak discharge, while figure 3 shows a percentile curve of peak discharges color-coded by erosion rate (final breach width/breach formation time), illustrating the result distributions from the dam breach calculations. Figure 2 makes it clear that for this specific case study, the resulting peak discharge of the dam break is more sensitive to the final breach bottom width than to breach formation time. The percentile curve in figure 3 illustrates the probability of a specific peak discharge, highlighting which results are most likely, and which are the more unlikely extremes.

The main findings from the thesis work, based on the two case studies analyzed, include:

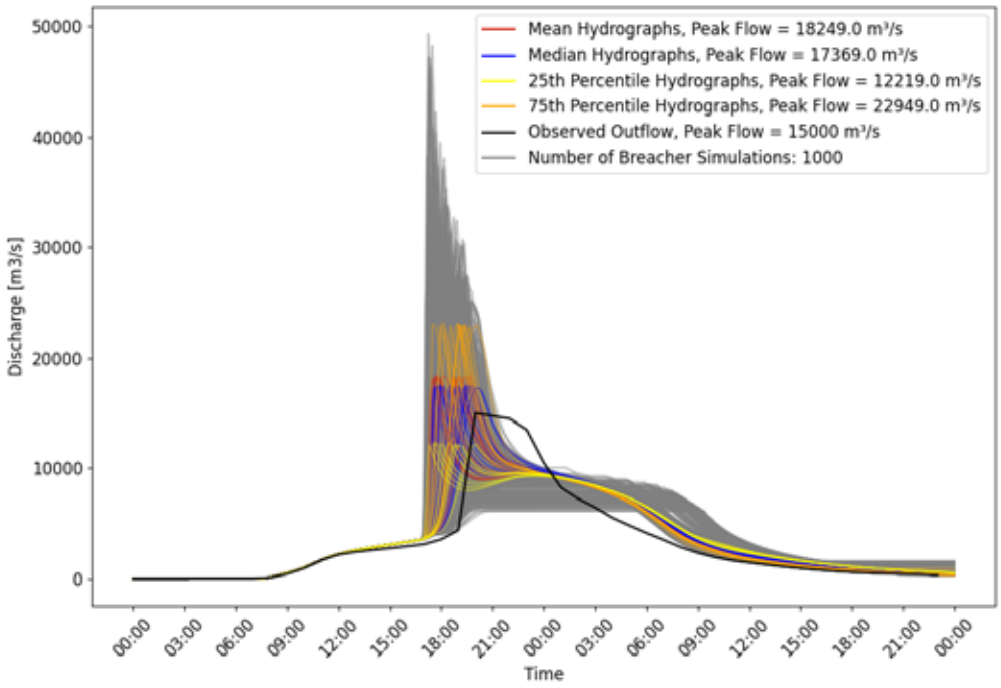
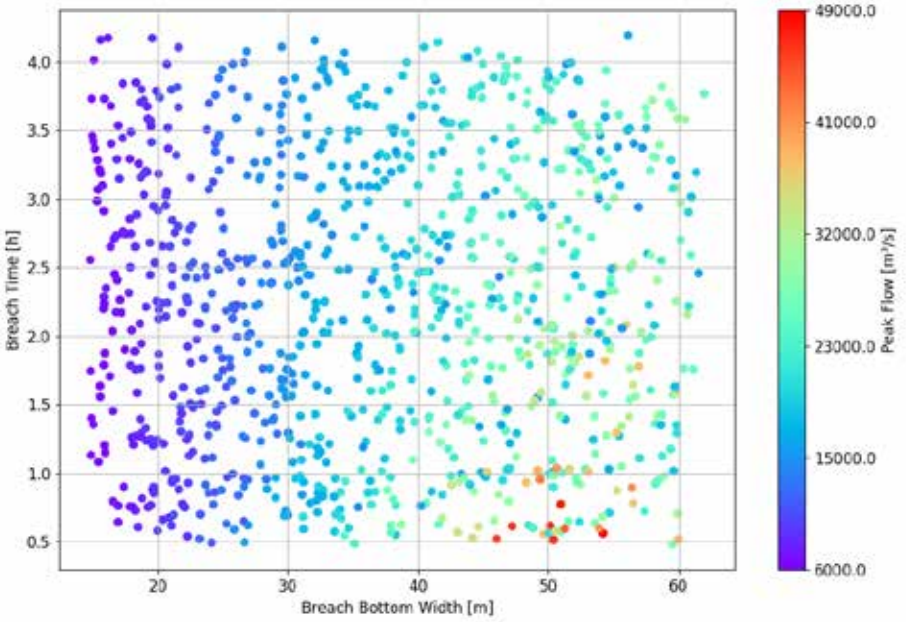


Figure 1. Discharge hydrographs of 1000 stochastic dam breach calculations of Tous dam in Breacher.

Figure 2. Scatter plot of final breach bottom width and breach formation time, color coded by peak discharge, from 1000 stochastic dam breach calculations of Tous dam in Breacher.



- Both parametric models (e.g. Breacher) and physically based models (e.g. Embrea) are suitable tools for stochastic dam breach modelling, but each model type has its limitations. For parametric models, the main source of uncertainty lies in the choice of parameter intervals. For physically based models, results show that the breaching process can vary significantly depending on the erosion model used.
- The choice of parameter interval is crucial, whereas the choice of probability distribution is not.
- Percentile analyses and distribution plots provide valuable tools for visualizing uncertainties and improving transparency compared to deterministic single-value results.

Towards Improved Risk-Informed Dam Safety

Probabilistic methods have strong potential to complement traditional dam breach analyses by making uncertainties explicit and identifying the most critical parameters. This supports improved risk communication and provides a broader decision basis for dam safety classification, risk-informed design and emergency planning. With further development and integration with flood models, these methods could become an important part of future dam safety practice.

Acknowledgements

This master's thesis work has been performed under the supervision of the Hydropower & Dams Department at Sweco (Sweden). We would like to thank Energiforsk for the financial support provided for the supervision work. We would also like to thank James Yang (Vattenfall R&D Älvkarleby and KTH, Stockholm) for providing literature and the background material used in the two case studies.

The thesis report (in Swedish) is available on the DiVA portal through the following link: urn:nbn:se:uu:diva-561283

/ Lina Gudmundsson, Pierre-Louis Ligier, Sweco (Sweden).
For more information: lina.gudmundsson@sweco.se

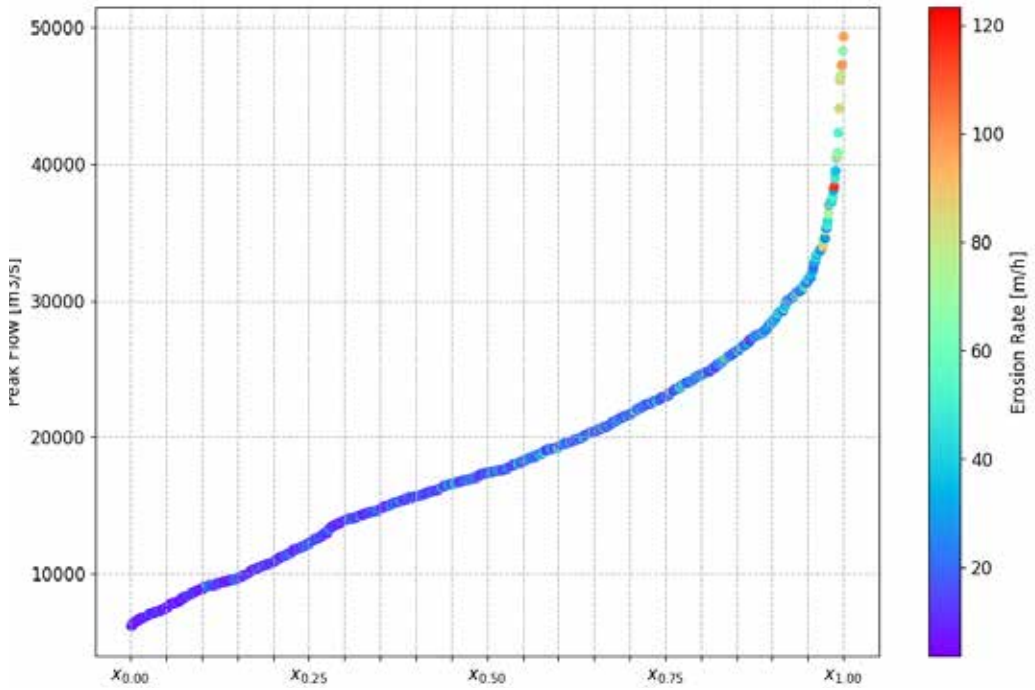


Figure 3. Percentile curve of peak discharge, color coded by the breach erosion rate, from 1000 stochastic dam breach calculations of Tous dam in Breacher.

Join the hydropower concrete and geotechnical programmes for improved dam safety

There is a lot interesting research being conducted outside of the dam safety programme. We want you to be part of it!

Energiforsks programmes for concrete and geotechnical aspects

Both concrete and rock are two of the most important materials used in dams and hydropower plants. However, exposure to the elements typically causes these materials to age, shortening their lives. Through collaborative investments in research and development, knowledge of the properties and durability of concrete and rock can be enhanced for all of the Swedish hydropower sector. Additionally, new strategies and methods for repair and maintenance can be developed more effectively. Improved understanding strengthens the ability to achieve and extend the service life of hydraulic concrete structures and rock tunnels, while also maintaining high standards of dam safety. Energiforsks Hydropower Concrete Programme and Hydropower Geotechnical aspects Programme initiate and lead important projects in close collaboration with the Swedish hydropower industry. Both programmes date back to the end of the 20th century, and their focus areas have continually been adapted to address the challenges and meet the needs of the hydropower infrastructure owners.

Hydropower Concrete programme

The current phase of projects is organized into three main focus areas: condition-based asset management, structural design, and development and digitalization. Projects related to condition-based asset management aim to improve understanding of concrete durability in hydropower environments. The long-term objective is to develop guidelines for identifying and prioritizing structures that require remedial actions.

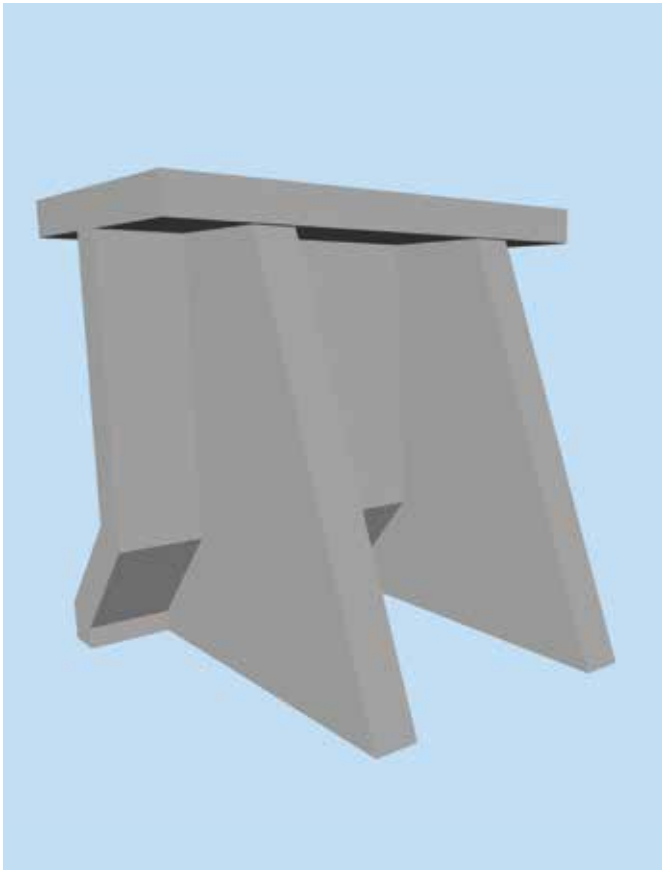
Structural design work ensures that requirements for load-bearing capacity and durability are met. Ongoing projects address current challenges, such as the implications of implementing the second generation of Eurocodes on dams and hydropower plants. Another area of focus is how the hydropower industry can reduce its carbon footprint by using concrete with binders that include supplementary cementitious materials, while still maintaining the expected service life of the structures. In addition, technology monitoring is being conducted to track developments in digitalization, including the rapid advancement of digital inspection methods.

Hydropower Geotechnical aspects Programme

The Hydropower Geotechnical aspects Program was launched to strengthen knowledge and practices related to Sweden's underground hydropower facilities. As many tunnels and underground waterways approach critical stages of their service life, the program emphasizes developing tools, guidelines, and technologies to ensure safe and cost-effective operation. From 2023 to 2025, the program will focus on several priority areas. These include advancing inspection methods for water-filled tunnels, such as condition-based testing and the use of remotely operated vehicles (ROVs) and 3D scanning for long-term monitoring. Another area is the evaluation of rock bolts and reinforcements, where non-destructive testing methods, acceptance criteria, and safety aspects are being further developed. The program also addresses terminology for rock spaces, safety and production challenges linked to foundations and rock stability, monitoring of unstable slopes, and improved grouting techniques for water-bearing fractures.

2nd generation Eurocode

In 2024, both programmes began the work of addressing the coming 2nd generation of Eurocodes and its effects on concrete-related challenges, as well as geotechnical-related challenges for hydropower infrastructure. Both are crucial for a sustainable dam safety.



One example coming from the Hydropower concrete programme, where Mikael Hallgren and Fredrik Stenesand at Tyrens performed a GAP-analysis on the impact of 2nd generation Eurocodes for hydropower dams.

The new Eurocodes introduce a higher consequence class (CC4) specifically mentioning dams, but do not provide clear guidance on how to apply this class in practice. The report includes case studies comparing calculations for typical dam elements using both the old and new standards. The findings show that most new rules result in similar or somewhat more efficient designs, potentially reducing material use without compromising safety.

Some challenges were however identified. Certain requirements—such as minimum reinforcement in thick sections and anchorage lengths for reinforcement—can lead to unnecessarily high values or uncertainty when applied to dams. The new codes also offer improved methods for assessing crack widths and reinforcement for restraint-induced cracking, but these require more detailed knowledge of temperature development in concrete structures.

The authors recommend further studies to clarify the application of the new consequence class, evaluate the impact of new load factors, and adapt rules for reinforcement and anchorage to better suit Swedish dam safety standards.

Calls and tenders

Both the Hydropower Concrete programme and the Hydropower Geotechnical Aspects Programme are continuously opening calls for project proposals, as well as inquires tenders for specific projects. Going forward, both programmes will, in addition to its focus areas, assess the new generation of Eurocodes with high interest. So be on the lookout for coming calls, and if you would like to considered for inquiries about tenders, don´t hesitate to contact the authors down below!

/ Erik Isberg (Energiforsk), programme coordinator and Martin Rosenqvist (AFRY), technical expert, both Hydropower Concrete programme, as well as Andreas Larsson (Energiforsk), programme coordinator Hydropower Geotechnical aspects Programme.

Balancing cost and sustainability in spillway gate design

Sweden's hydropower dams face both aging infrastructure and new sustainability demands. Modernizing spillway gates can be an essential tool to ensure dam safety. A master's thesis in collaboration with WSP, Statkraft and Outokumpu was conducted to explore how digital optimization tools can guide smarter material choices for future hydropower projects.

A digital tool for smarter decisions

To support design choices, a Python-based parametric tool that integrates Eurocode-based calculations with an optimization algorithm was developed. The tool allows to automatically test different gate dimensions and material options against two key objectives: investment cost and environmental impact (measured as CO_2 emissions from steel production).

Steel vs. stainless steel – a trade-off

The study compared different kinds of structural steels and stainless steels in simplified gate models and showed results with a clear trade-off:

- Structural steel minimized costs, making it the most economical option.
- Stainless steel reduced environmental impact, thanks to lower CO_2 emissions and reduced maintenance needs.

However, the analysis also revealed that the choice of material is highly sensitive to assumptions about stiffness and strength, especially in critical components like the skinplate.

Scope and limitations

The study focused only on simplified vertical lift gate models and included the main structural elements: beams, skinplate, and stiffeners. The cost analysis was limited to material purchase prices, and the environmental assessment covered only the production phase of steel. Factors such as manufacturing, maintenance, transport, or end-of-life recycling were excluded.

These delimitations mean the results provide valuable early design insights, but they do not capture the full life-cycle performance of the gates. In practice, including maintenance savings and recycling benefits could yield different conclusions.

Looking ahead

The parametric tool provides a robust framework for early-stage evaluations, helping stakeholders balance economic and environmental goals in hydropower projects. Further development such as including full life-cycle costs, detailed modeling, and finite element validation would strengthen its value for real-world applications.

By combining engineering rigor with sustainability goals, this study highlights the importance of informed material choices in designing the hydropower dam infrastructure of the future.

/Kristy San, Master's Programme in Engineering Mechanics, KTH / WSP

Find the full study at:
https://urn.kb.se/resolve?urn=urn:nbn:se:kth:diva-368490

Guide for dam monitoring and evaluation

Dam safety is constantly in focus for owners and society. An important aspect of maintaining and enhancing dam safety involves measurements and long-term monitoring using different instruments as well as evaluation and understanding of the dam behavior. Instrumentation is installed at various stages and for different purposes to monitor the status and behavior of dams, i.e. failure modes, to assess safety margins. Monitoring selected failure modes over time and detecting changes in dam performance at an early stage are essential to maintain a high level of dam safety.

These relevant and important aspects are addressed in a report recently published by Energiforsk entitled "Guidance for Monitoring and Evaluation of the Function of Dams" (written in Swedish, see link "Vägledning för mätning och utvärdering av dammars funktion"). The report summarizes international best practice and works by CEATI through the Dam Safety Interest Group (DSIG), ICOLD bulletins, and Swedish publications from Energiforsk. The ambition of the report is to increase the knowledge about what needs to be measured and analyzed to monitor dams, and perform dam monitoring data analysis. A Performance Monitoring Program, including all relevant information needed for an in-depth interpretation of dam behavior, is recommended. Some additional key points are summarized in the following.

Improved understanding of what a single measured value represents

Understanding and analyzing monitoring results from dams requires relevant knowledge of various types of measurements. Measurements are performed in separated single points, such as classic geodetic measurements of movement, along a line using e.g. optical cables to measure temperature or strain, or by point-based lines like water pressure with several nearby standpipes in a cross section. In addition, measurements can also be performed on a surface using laser or satellite scanning, or by detecting changes in a volume using geophysical methods e.g. resistivity, ground penetrating radar or seismic refraction. Engineering understanding of what is being measured, where it is measured, and how it is measured is crucial for interpreting results. This is not always apparent in classic monitoring data analysis where isolated values and trends in diagrams sometimes are interpreted in too short time increment and without necessary understanding of dam behavior.

Improved understanding of what data indicate about a specific dam

Advanced analysis of data is a comprehensive knowledge-based assessment according to a monitoring program (Performance Monitoring Program). This approach gathers available information about the dam's design, construction, operation, and rehabilitation measures, along with results from measurements and monitoring of relevant failure modes, loads, known site-specific weaknesses, and local conditions etc.

This more extensive interpretation, not only uses results from traditional monitoring points, but also results and information gathered from sources such as reservoir level, echo sounding, surface scanning, geotechnical and geophysical investigations, material testing, and other assessments including visual inspections. The results are based on an integrated analysis that provides a comprehensive picture of the status of the dam.

Numerical modelling – Support for improved interpretation

Numerical modelling/advanced calculations of crucial physical parameters can be used to better understand the dam, such as water pressure, movements, water flow, and leakage. This helps for a deeper interpretation and understanding of dam behavior and can also be used as a complement in the evaluation and analysis of monitoring data to decide proper alarm limits and to simulate different damages. Normally in dam engineering modelling to simulate hydraulics (flow and pressure) is common, but also more advanced simulations can be performed, such as temperature and stability. Numerical modelling can be used to understand hydraulic gradient and flow velocity to evaluate internal erosion.

Potential defects in dams can effectively be simulated to guide when designing a monitoring system e.g. to calibrate what can be measured, detection limit, and best sensor location.

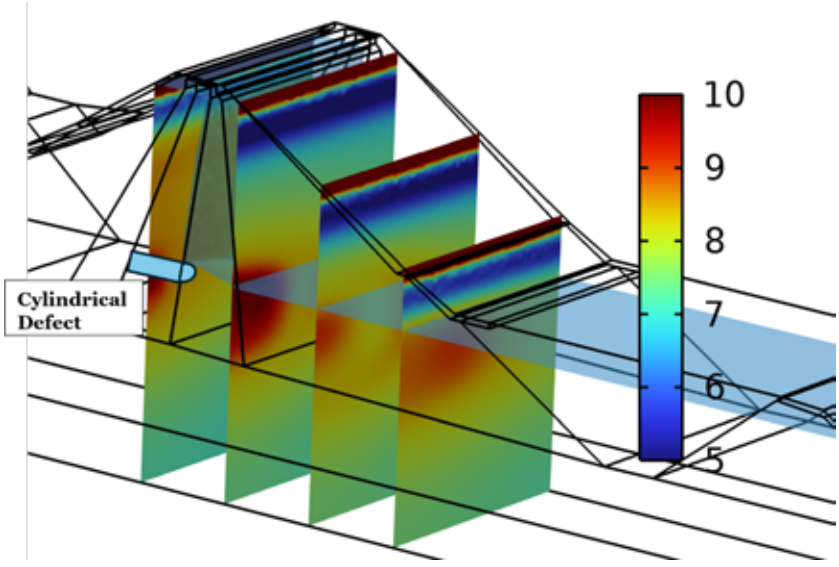


Figure 1. Calculated groundwater level and temperature field (see scale 5-10°C) at a cylindrical defect through the core. (The model is using symmetry, i.e. the damage is described as a half cylinder).

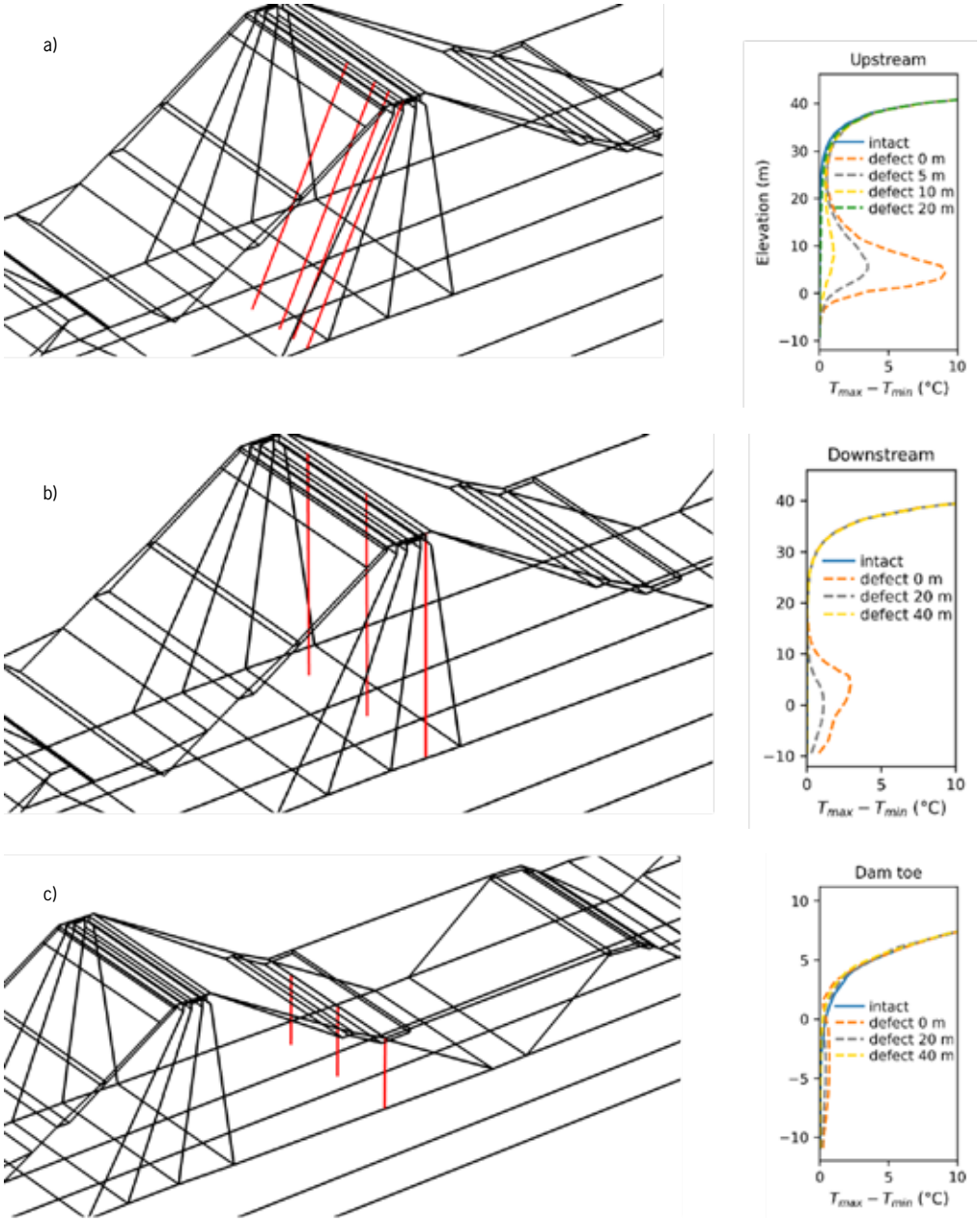


Figure 2. Results of temperature simulation caused by the defect shown in Figure 1. Temperature profiles to the right are shown for the three studied locations of standpipes (a) upstream filter, (b) downstream filter and (c) the dam toe.

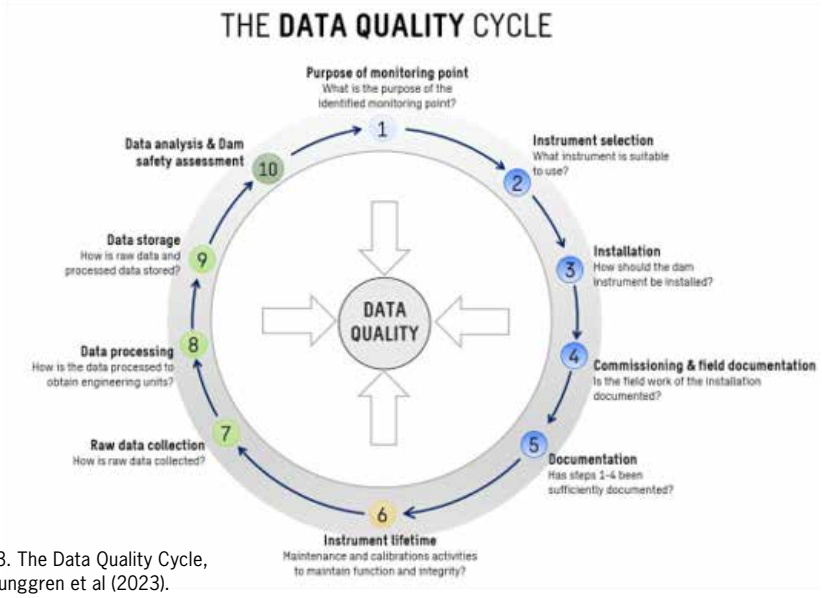


Figure 3. The Data Quality Cycle, after Ljunggren et al (2023).

Some examples from numerical modelling are presented in the report of which one is summarized below, illustrated by a cylindrical defect in the core at elevation 3 m (Figure 1). Possible measurement options to detect the defect in this case are water pressure or temperature in vertical standpipes in the upstream filter, downstream filter or at the toe. The seepage flow cannot be collected in a drainage system due to influence of a downstream water level. As a result, from the simulations, standpipes in the downstream filter were found as the best solution, based on detection ability and coverage (Figure 2).

Data quality assurance

A concept with the introduction of the Data Quality Cycle is described in a ten-step process to ensure high-quality monitoring data from dam instrumentation (Figure 3). It demonstrates that good quality data is important and the result of correctly executed and documented instrument design, and that each step in the process can affect data quality. Influencing factors are discussed, from the identified need and purpose for monitoring in Step 1 to data analysis and assessment of dam safety in Step 10.

The monitoring system performance at the dam site is of great importance, from selection of measuring devices, installation, data quality assurance, data visualization, etc. Verifications must be performed regularly of the individual monitoring devices as well as the whole system. Examples of this are e.g. verification and calibration of sensors, rehabilitation of standpipes, and infiltration test of water in dams to mimic a long term leakage to study behavior of instrumentation, effectiveness of drainage system and seepage monitoring, and increase the knowledge of water flow paths within and from the dam (Figure 4). For details about infiltration test, see Viklander et al (2025).

CONTINUED ON NEXT PAGE >

Figure 4. Infiltration of water from a mobile weir in dam toe to study function of drainage system and seepage flow in a weir. (Photo by Peter Viklander)

Conclusions

The importance of taking a holistic approach to dam monitoring is evident. Fundamental to this is a proper understanding of the monitoring need of the dam, as well as the knowledge to select the best available methodology to detect and monitor changes in a specific case. Measurements must be of high quality so that data can be trusted for interpretation and analysis. Monitoring is a sustained effort that requires prioritization and adequate resources. It is also important that expertise and skills in the field of evaluation and analysis are maintained, or rather increased/improved, with the rapid development of instruments, automated measurement and data collection systems and data-driven monitoring environments.

The results highlight the importance of high-quality measurements to obtain reliable data for interpretation and analysis, and that understanding and right competence as well as understanding of dam behavior must be present throughout the long-term monitoring.

/ Peter Viklander and Sam Johansson, HydroResearch Sam J AB. For further comments/questions, please contact us at: peter.viklander@hydroresearch.se and sam.johansson@hydroresearch.se

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The critical influence of rock joint characteristics on sliding of concrete dams

When we think of dams – those massive structures holding back enormous amounts of water – it's easy to imagine that their stability depends on the strength of the concrete or the shape of the construction. But beneath the surface, quite literally, lies another crucial factor: the rock on which the dam rests. And even more specifically – the joints in that rock. This article is based on a master's thesis [1].

Why rock joints matter more than you think

Sliding stability refers to a dam's ability to resist movement along its foundation. Traditionally, engineers rely on the dead load (the dam's own weight) and the geometry of the structure to ensure stability. These factors are carefully optimized during design to prevent sliding. However, this approach becomes more complex when the dam is built on jointed rock, especially in the case of buttress dams, which have relatively low dead load compared to gravity dams.

If the rock beneath the dam contains unfavourably oriented joints, the risk of sliding increases significantly. In such scenarios, even though the dead load may be slightly increased due to the presence of rock above the joints, the uplift pressure – the water pressure acting upwards beneath the dam – can become critically high. This uplift reduces the effective weight pressing down on the joints, making it easier for the dam to slide along them.

Therefore, the interaction between joint geometry and hydraulic conditions becomes a key factor in dam safety. Sliding along joints can be addressed through both analytical calculations and numerical simulations. These methods help engineers understand how joint inclination, length, friction angle, aperture size, and hydraulic conductivity affect the dam's ability to remain stable.

A recently completed master's thesis has investigated how variations in joint inclination, length, friction angle, aperture size, and hydraulic conductivity influence the sliding stability of dams. The study focused on concrete dams founded on jointed rock.

Models for analysis of parameters

The study analyzed two different joint patterns, representing conditions common in hard crystalline rock such as that found in Sweden:

1. A vertical joint intersecting an inclined joint according to figure 1.

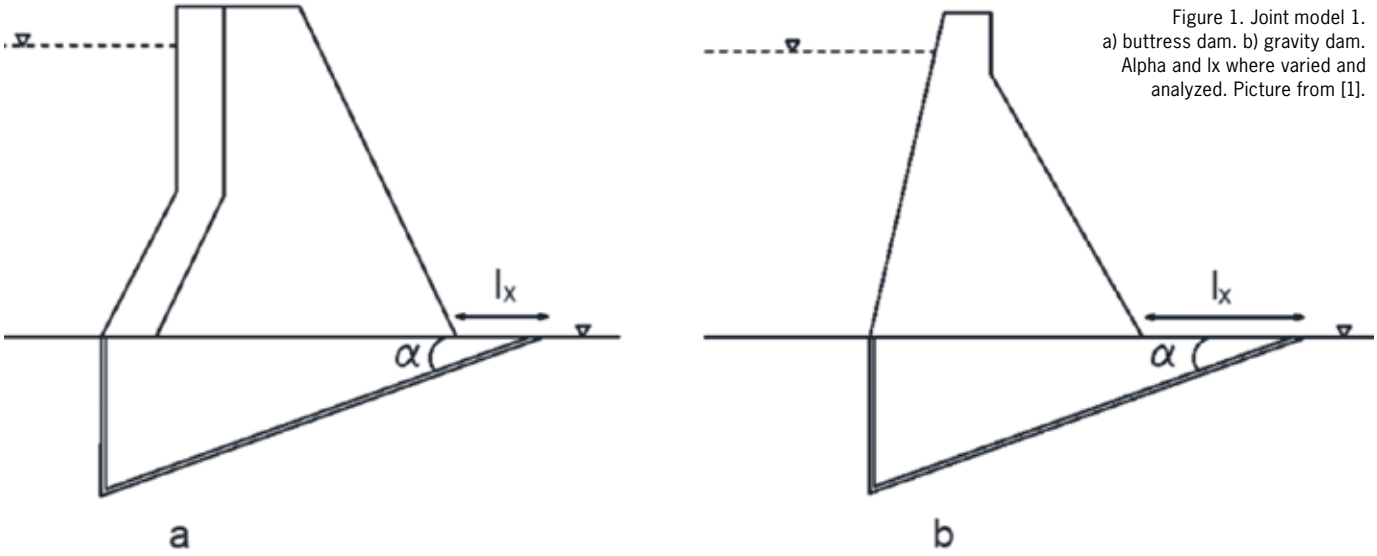

Figure 1. Joint model 1. a) buttress dam. b) gravity dam. Alpha and lx where varied and analyzed. Picture from [1].

2. Two inclined joints forming a downstream wedge according to figure 2.

All parameters shown in the figures were varied, and their impact was evaluated.

Both buttress dams and gravity dams were tested using analytical calculations and advanced simulations in COMSOL Multiphysics.

Results

Numerical models provide a more detailed assessment of stability by accounting for uplift reduction and joint interaction, showing higher levels of safety than analytical models. In numerical models the ratio between the hydraulic conductivity of the joint and the rock mass proved to be crucial for the impact of uplift and may require verification through site investigations.

Results showed that the influence zone for Model 1 was larger for buttress dams than for gravity dams. For all tested joint extension lengths (lx), buttress dams exhibited critical inclination angles (α) of approximately 20°–25° in analytical analysis and 15°–20° in numerical analysis. Gravity dams showed a narrower range with critical angles around 10°–13° analytically and 7°–10° numerically.

Model 2, however, achieved stability only when the joint extension was $lx1$ = 10 m. In this configuration, a higher critical angle of approximately 26° was reached for both dam types when combined with a second joint inclination angle $\alpha 2$ = 15°. For buttress dams, longer and steeper joints contributed to a significant increase in safety factors, while gravity dams, due to their own weight, showed less sensitivity to joint behavior.

Conclusions

The study recommends a combined approach to assess dam safety: use analytical models for initial screening, and then proceed with numerical simulations for more detailed analysis. This way, engineers can gain a more reliable picture of how the dam will behave.

/This article is a summary from a master's thesis by Abdulhak Kanatri and Serah Abdul. The supervisors of the thesis were Martin Gard and Marie Westberg Wilde, AFRY.

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The authors of the master's thesis have given permission to publish this article.

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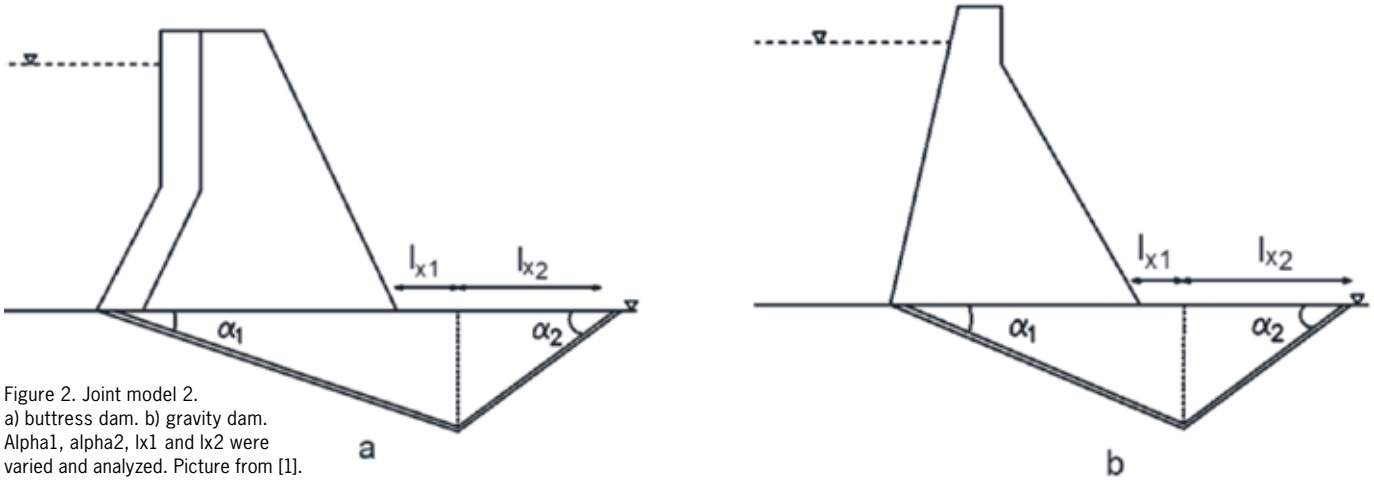

Figure 2. Joint model 2. a) buttress dam. b) gravity dam. Alpha1, alpha2, lx1 and lx2 were varied and analyzed. Picture from [1].

From medieval times to modern day: A global database of dam failures

Data on hundreds of dam failures collected by ICOLD have now been made available on-line in a structured, searchable database. For each failure, or accident, contextual information is provided and, where available, references for further reading.

Database on dam failures – work in progress

In 2025 the ICOLD Failure Database 1900-2024 has been made available on the ICOLD website, even if there is still some development going on. Until now the database includes 436 failures, of which seven concern dams in the Nordic countries. A great majority of them concern large dams. Despite the name, the database covers failures dating back to the year 1305, although most of them have occurred in the later centuries. The database also covers 33 accidents, where a failure was imminent but mitigated, or when appurtenant works have failed without resulting in dam failure. The database aims to provide the dam community with a searchable tool for exploring past failures and accidents, and refer users to further reading for more detailed studies of individual events. Furthermore, the database allows for periodical statistical analysis of dam failures.

The data on failures on large dams was originally collected through ICOLD's Technical Committee on Dam Safety and their work with e.g. Bulletin 99 and Bulletin 188 Statistical analysis of dam failures – ICOLD Incident database Bulletin 99 update. The database is accessible free of charge to all ICOLD members and can be found at the members section on the website.

The database allows for searches by name and filtration on categories such as country, type and height of dam, type of event (categorized as either accident or failure and subcategorized depending on severity) and time of event. General information is shown in the search results, with the option to explore individual incidents in more depth. The details provided for the incidents vary, but for many of them comprehensive information is given, including organizational and technical causes, failure mode and pictures.

Example of findings from the database

An initial search has been carried out, and data from the database has been exported for further analysis. The number of failures with sufficient data for analysis varies depending on the aspect considered. Below some findings on past failures are summarized.

Age at failure

Approximately half of the failures of dams built between 1900 and 2000 have occurred in the first five years, either during construction, the first filling or the first years in operation. The equivalent percentage for dams built after 2000 is higher; 75%. Figure 1 illustrates the age of failed dams by period of 10 years versus their year of construction. Figure 2 illustrates

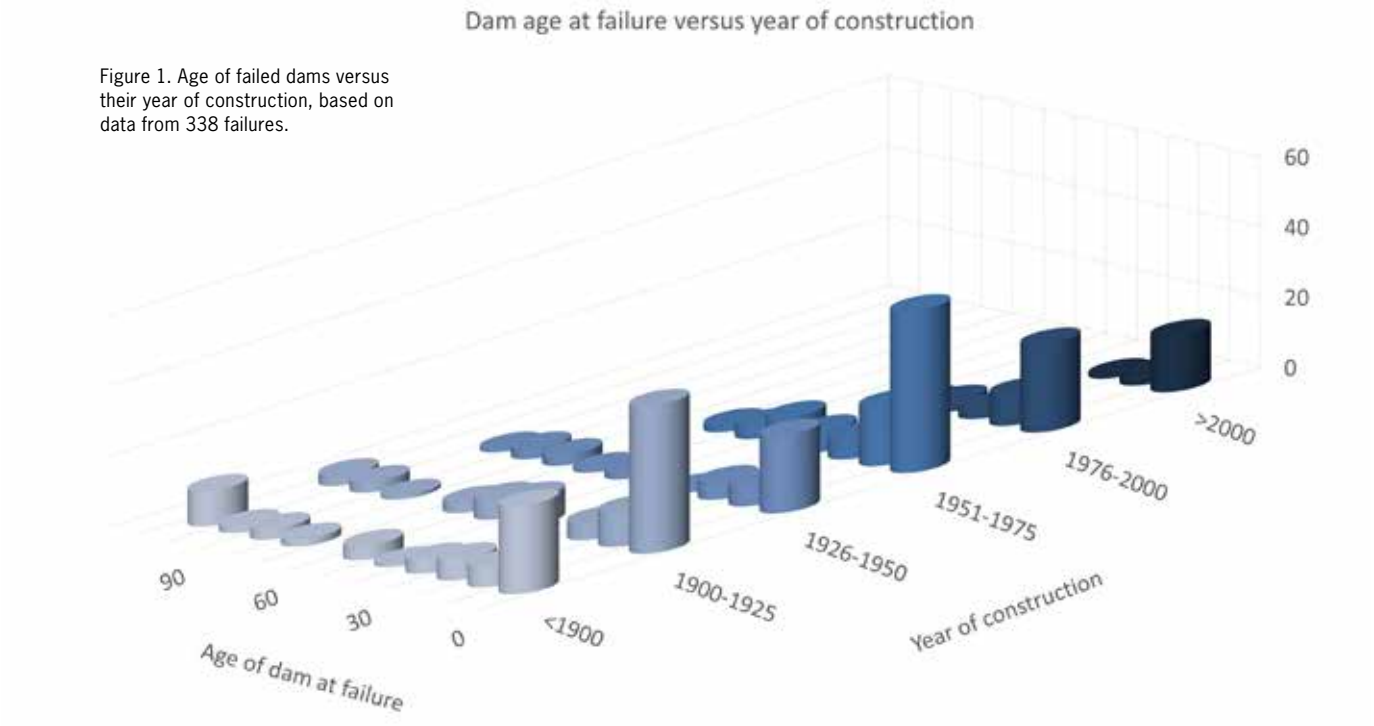

Figure 1. Age of failed dams versus their year of construction, based on data from 338 failures.

Table 1. Dam failures from the Nordics that has been included in the database

Name	Country	Type	Completion	Height range	Incident Type	Incident Year	Context	Incident Time	Last Modified update
Braskereidfoss	Norway	Earth	1978	15 to 30	F1	2023	Unusual Flood	After 5 Years	2025
Hästberga	Sweden	Earth	1953	5 to 15	F1	2010	Unusual Flood	After 5 Years	2018
Munkebotsvannet Lake Dam	Norway	–	0	5 to 15	F	2018	–	–	2025
Noppikoski	Sweden	Earth	1967	15 to 30	F2	1985	Unusual Flood	After 5 Years	2018
Roppa	Norway	Earth	1975	5 to 15	F2	1976	Normal conditions	During 1st filling	2018
Selsfors	Sweden	Buttress	1944	15 to 30	F2	1943	Normal conditions	During 1st filling	2018
Storvatn Dam	Norway	Gravity	1920	5 to 15	F1	1979	Unusual Flood	After 5 Years	2018

at what phase of the dam's lifecycle the failure occurred, per dam type.

Context of failure

The database provides information on the context of the failure, in categories as shown in Figure 3. For failures where information on the context is provided, flood is the most commonly prevailing, reported for a total of 164 failures. In Figure 3 the number of failures that occurred in each context is presented, for contexts reported for at least three failures.

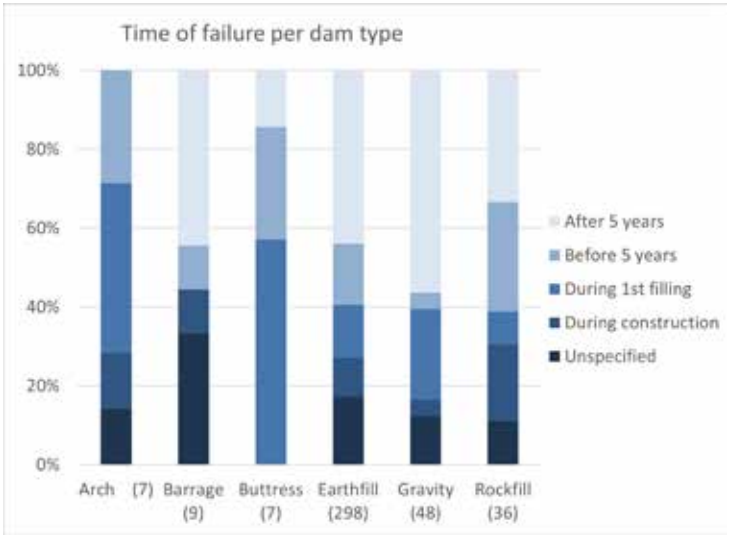

Figure 2. Time of failure per dam type, based on data from 405 failures with the number of failures presented for each dam type.

How to access the database?

To access the members section at ICOLDs website you need a personal login. The registration requires a national committee code, which you as an employee of a SwedCOLD member company can obtain from the national committee secretary or company representative in the SwedCOLD executive committee. When registered, you can access the ICOLD member section where a login to the database is provided. For readers from other countries, contact your national committee for more information.

/ Linnea Taxén (M.Sc. student KTH, summer internship), Maria Bartsch and Karen Kemling, Dam Safety Specialists, Svenska kraftnät, dammsakerhet@svk.se

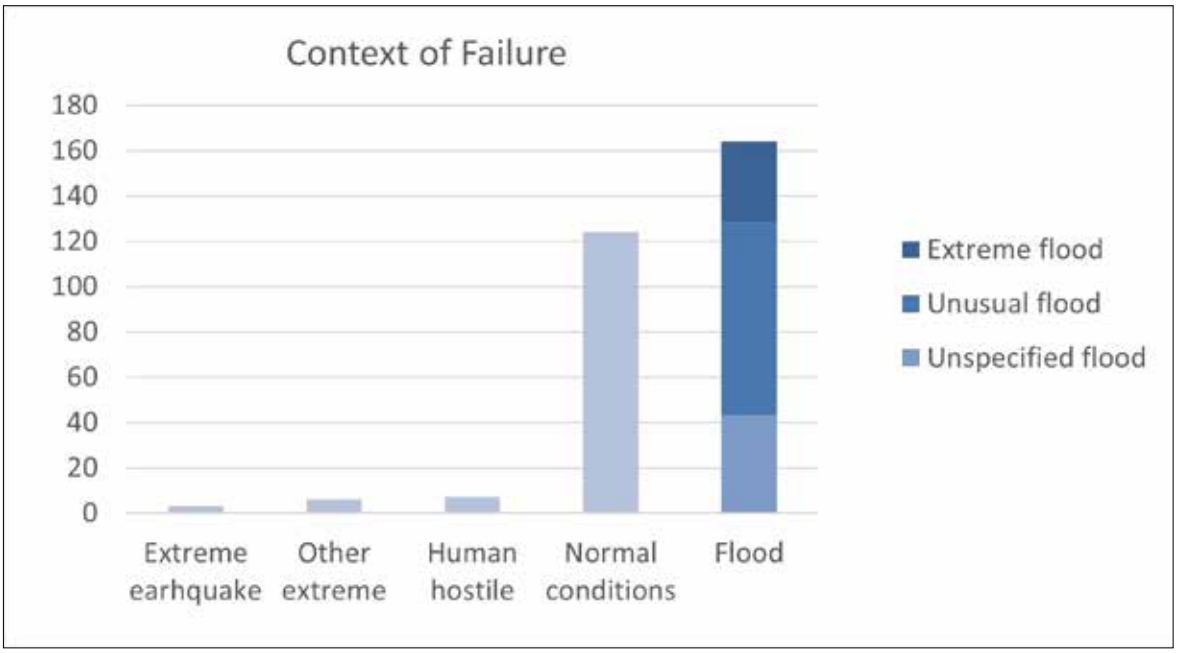

Figure 3. Context of failure, based on data from 304 failures.







ICOLD Committees		SwedCOLD rep.	Co-opted rep.
A	Computational Aspects of Analysis and Design of Dams	D. Rydle	J. Sundin
B	Seismic Aspects of Dam Design		
C	Hydraulics for Dams	P-L Ligier	
D	Concrete Dams	E. Nordström	O. Lindkvist
E	Embankment Dams	M. Ljunggren	
F	Engineering Activities with the Planning Process for Water Resources Projects		
G	Environment	M. Löfqvist	
H	Dam Safety	A. Isander	
HWS	Historical Water Structure (Water Heritage)		
I	Public Safety Around Dams	A. Engström Meyer	N. Okumura
J	Sedimentation of Reservoirs		
K	Integrated Operation of Hydropower Stations and Reservoirs		
L	Tailings Dams & Waste Lagoons	A. Westerfur	E. Månsson
LE	Levees		
M	Operation, Maintenance and Rehabilitation of Dams	M. Svensson	
N	Public Awareness and Education		
O	World Register of Dams and Documentation		
P	Cemented Material Dams		
Q	Dam Surveillance	C. Bernstone	
RE	Resettlement due to Reservoirs		
S	Flood Evaluation and Dam Safety	R. Wolfsborg	
T	Prospective & New Challenges for Dams & Reservoirs in the 21st Century		
TRS	Tropical Residual Soils		
U	Dams and River Basin Management		
V	Hydromechanical Equipment	P. Bennerstedt	
Y	Climate change	M. Sundby	
Z	Capacity Building and Dams	E. Hagner	
ZA1	World Declaration on the role of dam in the energy transition and Climate Change		
ZA2	Gender Diversity and Inclusion	M. Bartsch	
ZX2	Young Engineers Forum (YEF)	D. Carlson Bjernald	

SOME UPCOMING EVENTS

HydroPower R&D Days 2026 March 11th & 12th – Karlstad, Sweden

SwedCOLD spring symposium 2026 April 14th – Stockholm, Sweden

ICOLD annual meeting 2026 May 23th – 29th – Guadalajara, Mexico

9th European Congress - International Association for Hydro-Environment Engineering and Research
June 9th – 12th – Luleå, Sweden

32nd EWG-IE & OOE European Working group on internal erosion and overflowing and overtopping
June 22nd – 26th – Delft, the Netherlands

ICOLD European Club Symposium September 21th –25th – Bydgoszcz, Poland

Keep an eye out for webinars on current topics from Energiforsk, as well as upcoming YPF events!