THE WORKING GROUP ON LEVEES AND FLOOD DEFENCES UNDER THE EUROPEAN CLUB OF ICOLD

ISSUE 03 – April 2019

lfd-eurcold.irstea.fr

LEVEES Working Group Newsletter

External erosion damage due to overtopping on a small dam (L'Horte dam) caused by flash floods in the south of France. See page 7. (Photo Credit: Irstea)

Note from the Chairman

Rémy Tourment

This first issue of our Working Group Newsletter after the Vienna ICOLD congress has been a long time coming. Nonetheless, here it is, and the editorial team hopes that you will find it an interesting read and worth the wait.

As we announced in the last issue of the newsletter, following developments in Vienna, the European Working Group on Levees and Flood Defences continues, even after the creation of the ICOLD Technical Committee on Levees. It took us some time to adapt to the new format and terms of references and this explains (partly) the delay for this issue of the newsletter.

To clarify to our members and the wider levee community, we have included in this newsletter the differences and similarities between our EUCOLD Working Group and the ICOLD Technical Committee.

This issue will further present the various meetings and workshops that are organised for our working group to attend this year, during both the ICOLD Ottawa meeting and the EUCOLD Crete Symposium. A lot of information on levees will be shared in these events, as we succeeded in having the organisational committees of both events accept levees in the papers topics.

We also have many levee related articles from different countries and from international groups within this issue. We hope to share even more in the future as we count on every one of you to contribute and communicate information with the community, either through this newsletter or through the website.

Finally, we look forward to seeing you in both Ottawa and in Crete.

Transitions in Levees

By Dr Marta Roca (HR Wallingford)

Workshop "Assessing and managing the risks of transitions in flood defence infrastructure"

The Environment Agency has teamed up with international experts to help risk management authorities to consider the risks associated with transitions in flood defence structures. The international consortium, made up of HR Wallingford, Royal Haskoning DHV, Deltares, IRSTEA and USACE, integrates current international knowledge and practice on transitions combined with working UK knowledge and practice on risk based tools for asset inspection and management.

The project aims to:

- *Consider the presence of transitions during flood defence condition assessment*
- *Quantify the effects of transitions on flood defence performance and flood risk*
- *Manage the risk of transitions with improved design and retrofit solutions.*

IN THIS ISSUE

On 9th of October 2018 a stakeholder meeting was held in London to provide the opportunity to influence the direction of the project and to benefit from stakeholder's experience managing flood defences. The animated discussion focused on specific reliability methods for transitions and the approaches for inspecting them. The workshop also provided the opportunity to hear about the management strategies being employed in the US, France and the Netherland to mitigate the risks associated with transitions.

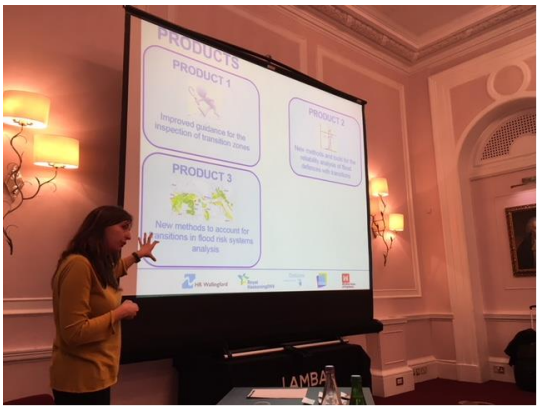

Figure 1- Dr Marta Roca talking at stake holder meeting in London (Photo Credit: Owen Tarrant)

Integration of non-flood-defence-specific structures into the flood defence line

Call for 3rd party funding

CIRIA in association with the Environment Agency have proposed a project (P3172) to investigate how best to integrate non flood defence structures into the line of defence. To ensure the infrastructure is able to withstand the loads associated with a flood event, it is often necessary to water proof, reinforce and retrofit components.

There are challenges of ownership, access, maintenance and inspection, insurance, changes of use and/or ownership as well as potential future adaption in the face of climate change. This project would synthesise the latest research and practice and would draw on-going work on property resilience, to develop case study-based guidance on the design, retrofitting and management of embedded infrastructure in the defence line.

This project will cover river, estuary and coastal flood defences, drawing together experiences with such situations across the UK and internationally to identify lessons learned in terms of successful approaches to incorporating non-flood-defence structures into the flood defence line. The project will engage with the wide range of partners, and produce guidance / decision tools for use when approaching such situations in the future.

CIRIA are seeking funding contributions. If you are interested in supporting the project, please contact Owen Jenkins, Director

owen.jenkins@ciria.org

Figure 2 - Hotel Dieu acting as a flood defence between two stretches of flood wall. Toulouse, France. (Photo Credit: Remy Tourment)

UPCOMING EVENTS

https://lfd-eurcold.irstea.fr/

2019

- 9-14 June 2019, **ICOLD Annual Meeting 2019 Ottawa**, Conference Theme is “Safety and Environment for Global Benefit”. Website under construction http://icold-cigb2019.ca/
- 4.-5 September 2019. **DWA-Levee-day** in Koblenz (Germany) on Rhine
  NB: the language of the event is German
- 1-6 Sept 2019, The XVII **European Conference on Soil Mechanics and Geotechnical Engineering** in Reykjavik (Iceland). Includes a session on dikes and levees. Also includes a workshop of ISSMGE TC201 on September 1st.
  http://www.ecsmge-2019.com
- 2-4 Oct 2019, **European Club Symposium Crete, abstract deadline is 18/02/2019**, See the announcement on http://cnpgb.apambiente.pt/IcoldClub/index.htm
- 9-12 Oct 2019, **Combined NZSOLD / ANCOLD technical workshop and conference** in October in Auckland (New Zealand). See: https://nzsoldancold2019.co.nz/speaker/
- Workshop of ISSMGE TC 201 on November 20th 2019 in Cancun Mexico, part of the **PanAmerican conference on soil mechanics and geotechnical engineering**
  http://panamerican2019mexico.com/panamerican/

2020

- April 2020 **Annual Meeting of ICOLD in New Delhi** (India)
- Workshop of ISSMGE TC 201 on November 20th 2019 in Cancun Mexico, part of the **PanAmerican conference on soil mechanics and geotechnical engineering**
  http://panamerican2019mexico.com/panamerican/

2021

- ICOLD Congress in Marseille (France) 27th Congress – 89th Annual Meeting http://cigb-icold2021.fr/en/

Figure 3 – Adama Nombre speaking at the Vienna conference. (Photo credit: Elena Sossenkina)

ICOLD Congress, Vienna

By Adrian Rushworth (Environment Agency) and Jonathan Simm (HR Wallingford)

The ICOLD LE TC was agreed and inaugurated at the annual meeting in Prague in 2017. The Vienna Congress in July 2018 was not only the first formal meeting of the LE TC but was also important because Q103 for the Congress was on the subject of small dams and levees. Rémy Tourment from France was the general reporter for this question. Remy is also the chairman of the ICOLD LE TC.

The meeting of the TC was preceded on the first day by a meeting of EUCOLD Working Group on Levees and Flood Defences. The Working Group was the predecessor to the TC. One outcome was a decision to continue this group, in part to be a backing group for the TC. Therefore the website and the newsletter will continue.

The ICOLD TC started by members introducing themselves and giving an update on the levees in their countries. The TC had members from 22 countries. Following discussion and some minor changes the Committee agreed the draft Terms of Reference. Other than providing an opportunity for presentations from new member countries, a significant amount of time was spent in gathering ideas for the dams and levees intercomparison report as well as the levee situation report/overview, using a facilitated brainstorming process. The meeting also identified other ICOLD TCs to work with. By the end a wall of Post It notes had been produced by attendees with very useful material. This material is being used by a small team from the Committee to further develop the reports.

The TC also agreed to expand the EUCOLD working group levee inventory report with reports from other member countries.

Regarding Question 103, in addition to the presentation of the General Report in a plenary session, 47 reports were sent from 26 different countries in response to this question. The main contributing countries are France, the USA and the Netherlands, with 4 reports or more each. Note that the all the continents are represented by the 25 contributing countries (14 European countries, 6 from Pacific Asia, 3 from America and 3 from Africa). 20 reports concerned small dams, 20 reports concerned levees, 3 reports focussed on canal or basin embankments and 4 reports focussed on techniques that apply to small dams and levees. It is interesting to note that the reports that concern levees mainly come from European countries and the USA, which corresponds to the core of the new "Levees" Technical Committee.

A recent issue of "Hydropower and Dams" (Vol. 26, Issue 1, 2019) presented an overview of the Questions 101 (Safety and Risk Analysis) and 103 (Small Dams and Levees). It is interesting to read although stress was made on the dams related Reports and not on the Levee related ones, which is not completely surprising given the general topic of this Journal.

Link to buy the proceedings of the Vienna congress : https://www.crcpress.com/Twenty-Sixth-International-Congress-on-Large-Dams--Vingt-Sixieme-Congres/ICOLD/p/book/9781138612280

USE OF ENGINEERED SEDIMENTS FOR LEVEE CONSTRUCTION

Report by Patrik Peters (Flanders Hydraulic Research)

After the 1976 North Sea storm surge, a flood safety plan, called the Sigmaplan, was conceived to protect the Flemish part of the River Schelde* against uncontrolled flooding. More recently, in 2005, an updated Sigmaplan was developed aiming for a sustainable Schelde estuary. It consisted of levee heightening, (additional) flood control areas, and managed re-alignments.

In addition, maintaining and improving the navigability of the River Schelde is a key aim of the Flemish Waterways, because the river yields a huge amount of sediments. As in the case in many rivers, the material to be dredged lacks the necessary geotechnical characteristics for direct construction purposes due to its fine granular nature.

The Flemish waterways together with Envisan (member of Jan De Nul Group) a pilot was setup involving the construction of a compartment dike and part of the ring dike using dredged material from the River Schelde without intermediate storage. An extensive testing campaign to develop engineered sediments for use in the construction phase was set out. This involved the geotechnical characterization of the sediment and testing of multiple additive combinations to enhance these poor characteristics. Based on the test results, with respect to the dike design requirements and an economical appraisal, the best performing additive combination was selected.

Pumping often involves fluidizing the sediment with water; in this case the dredged material was delivered to a barge fitted out with filters and a set of piston pumps that were able to push the sediment approximately 600m to the solidification plant without adding extra water. This custom built unit constantly monitored the incoming sediment flow and automatically dosed the additives to obtain a material with appropriate geotechnical characteristics for dike construction.

The most relevant aspect to be monitored and tested for the Vlassenbroek pilot project is the stability of the dike material. Therefore, during construction multiple field tests were conducted to determine strength (by means of the hand vane tester) and permeability (by means of a double ring infiltrometer) of the engineered Sediments in the dike body. Post-construction testing involved cone penetration testing, in situ hydraulic conductivity testing in boreholes and additional laboratory testing on undisturbed samples taken at multiple locations and depths at the completed dike. In addition, a long term survey of the permeability of the top layer as well as vegetation growth (coverage, rooting, and species) will take place.

If you would like to learn more about and/or are interested in sharing your own experiences regarding use of dredged sediment as well as soil improvement techniques at levee construction please let us know via by emailing lfd-eurcold@irstea.fr

Note *The previous newsletter mentioned Living Lab Hedwige-Prosperpolder, also situated along the river Schelde, where in situ destructive experiments on levees will take place for learning, testing and training purposes.

Figure 4 - Projects of the Sigmaplan in Belgium

COMPARING LEVEES WITH DAMS

Summary of lecture by Sam Leonard (Environment Agency)

I attended the online ICE lecture presented by Johnathan Simm from HR Wallingford, titled Comparing Levees with Dams, held in London.

The lecture focussed on:

1) Progress with the Dams vs Levees Inter-comparison Report which was commenced by the EUCOLD WG and is being taken up by the new Levees TC.

The report will cover: functions, components and failure modes; dams and levees in flood risk management; governance; design, construction, operation and maintenance; emergency management. The aim will be to highlight or discuss the areas of levee knowledge that might have added value for the dam community, areas where dam knowledge may or may not be directly applicable to levees. Understanding differences in terminology will be crucial for common understanding. The report is also expected to help to identify key areas where the Levee Committee should aim to co-operate with other ICOLD Committees.

2) Discussion on research being carried out for the Environment Agency on interfaces between levees and flood walls or other hard structures (Transitions project as mentioned in the above article by Marta Rocca). It is understood from historical floods (both in the UK and internationally) that a huge proportion of levee failures occur around transitions. The research is delivering improved assessment/inspection guidance, quantifying the effects of transitions for use in flood risk analysis via fragility curves and is hoped to provide guidance on retrofitting, which will supplement that available in the International Levee Handbook

Figure 5 – Kielder earth embankment reservoir. Largest reservoir in the United Kingdom (Photo credit: Stephen Richards)

Differences and similarities between EUCOLD LFD WG and ICOLD LE TC

By Patrik Peters (Flander Hydrulic Research), Adrian Rushworth (Environment Agency) and Remy Tourment (IRSTEA)

During the 2018 ICOLD Congress, the first meeting of the ICOLD Levee Committee took place, and the European Working Group on Levees and Flood Defences finished its first term. It was decided to continue the Working Group in a more informal way, but also to make sure it would be able to support the Levee Committee where needed.

EUCOLD LFD WG and ICOLD LE TC have important and distinct roles. To show how the two groups will work together we have made up the table below with some of the differences and similarities between both groups.

EUCOLD LFD WG	ICOLD LE TC
The Working Group on Levees and Flood Defenses of the European Club of ICOLD (EUCOLD LFD WG) has been officially created in 2015	The creation of the ICOLD Technical Committee on Levees (ICOLD LE TC) was approved by the General Assembly of ICOLD in 2017. The Terms of reference were finalized in 2018.
The working group is set up without a fixed lifetime, but with a three year renewal cycle (next update 2021).	A 6 year time frame is aimed for (2018-2024) with an interim deadline in 2021.
Membership is open to all individuals linking with National Committees from countries members of the European Club. 46 members from 17 member countries.	Membership of a country is formally organized from the National Committees through 1 representative. 25 members from 22 member countries.
LFD WG will act as the European level backing group to ICOLD LE TC.	• LE TC will collect information on levees in countries all over the world. • LE TC will collaborate with other ICOLD Technical Committees on levee-related topics. • LE TC will explore similarities and differences between dams and levees.
LFD WG will provide a European community of practice on levees, acting as a counterpart to the US Levee Safety Coalition.	
LFD WG will create a network for supporting national and EU funded research on levees.	
LFD WG will enhance the dissemination of experiences via workshops, info sessions, a newsletter and a web site.	LE TC will produce a position paper as well as a bulletin.
LFD WG will organize meetings and workshops at EUCOLD symposiums and site visits on other occasions. LE TC members are welcome. Workshops can support LE TC activities by working on TC topics.	LE TC will organize a meeting and workshop at each ICOLD annual meeting or congress. LFD WG members are welcome to attend.

The two groups will work closely together building on each other's work. In this way we will maximize everyone's input, increase our impact and use our time most efficiently.

LOOKING FORWARD TO OTTOWA AND CRETE

by Adrian Rushworth (Environment Agency)

The 87th Annual Meeting of ICOLD will be held June 9 to 14, 2019 in Ottawa, the Capital of Canada. The Levee TC will have a full day meeting which will include considering the dam/Levee comparison report. The article by Sam Leonard on "comparing Levees with Dams" has more information about the report. There will also be two half day workshops of the TC and a half day "partners" workshop also involving the Embankment dams TC and the Internal erosion EUCOLD WG.

From 30th September to the 4th October the 11th ICOLD European Club Symposium will be held at Chania in western Crete, Greece. Our LFD European Working Group will meet on Monday 30 September followed by an interesting consideration of the use of fibre optics for monitoring. On Tuesday the dam/levee comparison report will be the topic for the day. Other Levee topics are being considered for inclusion in the programme.

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Other Levee topics are being considered for inclusion in the programme.

Hopefully many representatives of the Levee community will be able to attend one or both these meetings

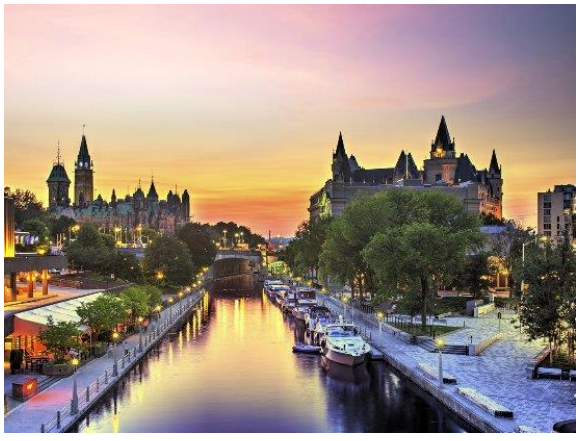

Figure 6 – Rideau Canal – Ottawa (Photo Credit: Ottawa Tourism)

PROLONGED DRY WEATHER AND THE EFFECT ON EMBANKMENTS

by Phil Welton (Environment Agency)

During June and July 2018 England saw two of the driest months on record, along with higher than average temperatures.

The prolonged dry weather and high temperatures has the potential to impact Environment Agency fixed assets in a number of ways, through drying out of assets and through the impact on vegetation growth.

Embankments suffered shrinkage cracks and loss of grass cover, with some deeper cracks forming up to 600mm in depth. Autumn 2018 saw an increase in rainfall and as a result cracks in embankments self-healed due to absorption of water and swelling of embankment material.

If the cracks had remained through the winter period then erosion due to rainfall, and freeze-thaw weathering may have propagated the cracks worsening condition. Current guidance to asset maintainers is to fill in cracks with topsoil and seed and monitor condition.

Figure 7 - Measurement of depth of shrinkage crack in embankment. (Photo Credit: Phil Welton)

In Holland, the Dutch are managing impacts to their embankments with the main concern being the shrinkage and 'floatation' of peat embankments. Previously, in Wilnis in 2003, an embankment formed from peat failed when it was forced sideways through hydrostatic pressure from the adjacent canal, and pore-water pressures beneath the dried and extremely light embankment enabling it to 'float'.

This resulted in extensive flooding to property. The Dutch now actively manage drought conditions of peat embankments.

The main focus of response in the Netherlands is on embankments formed from peat as these present the greatest risk. In response to the 2003 failure, the Dutch have implemented a protocol which recommends that from a certain drought level asset owners start spraying or irrigating their peat embankments, together with intensified inspections. Peat embankments are categorised based on their vulnerability to drought. The response protocol was first implemented on the highest category peat embankments but it is now in place across all peat embankments.

Figure 8 - Sprinkler Irrigation (Photo Credit: Colette Fatou, Irstea)

Civil Engineers from the Environment Agency are travelling to the Netherlands this spring in order to understand more about how the Dutch manage their assets in dry weather periods.

A report from this visit will be included in the next newsletter!

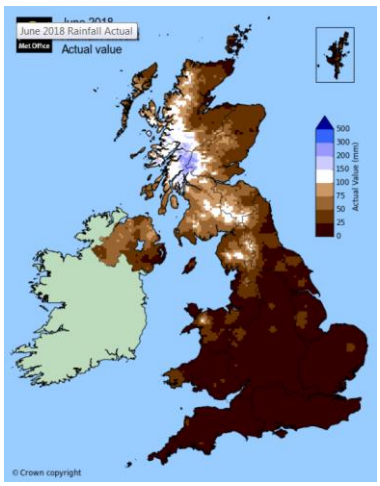

Figure 9 – Map of rainfall across the United Kingdom in June 2018. (Photo Credit: Met Office)

WHAT IS TC201??

by Cor Zwanenburg (Deltares)

TC201 is the technical committee on Geotechnical Aspects of Dykes, Levees and Shore Protection from the International Society Soil Mechanics and Geotechnical Engineering (ISSMGE).

The work by TC201 focusses on sharing information about the science and engineering involves in Levees, contributing to technical guidance documents, talks at conferences and creating links with relevant industries.

Upcoming Events for TC201

https://www.issmge.org/committees/technical-committees/applications/dykes-and-levees-

In 2019 TC201 have the following events planned:

-**Workshop** on September 1st in Reykjavik, Iceland, As part of the pre-programme for the 17th **European Conference Soil Mechanics and Geotechnical Engineering**, ECSMGE, 1 – 6 September 2019 Reykjavik

-**Session on dikes and levees** during the 17th ECSMGE in Reykjavik (https://www.ecsmge-2019.com/)

-**Workshop November** 20th 2019 in Cancun Mexico, part of the PanAmerican conference on **soil mechanics and geotechnical engineering** http://panamerican2019mexico.com/panamerican/

FLASH FLOODS IN THE SOUTH OF FRANCE

By Anthony MOUYEAUX (Irstea) and Mathieu SUTTER (Irstea)

The South West of the Mediterranean coast, and especially the Carcassonne area, experienced an intense hydrological event in the night between the 14th and the 15th of October 2018.

This short concentrated episode was caused by the combination of several meteorological factors: the passage of the ex-hurricane Leslie over the Iberian Peninsula, the presence of a resisting anticyclone on the East from Tunisia to Scandinavia, the unnatural warmth of the Mediterranean Sea at the end of 2018 and a cold flow descending on the Bay of Biscay. Due to all these factors, a stormy and rainy formation was blocked at the bottom of the “Montagne Noire” massif. The radar data gives an estimation of the rainfall intensity in the order of 150 to 200 mm in 2h (Fig. 10).

This event had catastrophic consequences, with fifteen human lives lost, one hundred people injured and, in first assessment, about 220 million euros of damage to infrastructure.

Regarding the hydraulic forces, many dams and levee systems suffered from the flash floods. Generally, the levee systems did their job and prevented the spreading of the floods. However, some incidents and damages were observed in the most intense rainfall areas, for the localized dams and subsequent levees downstream. These incidents needed an expert assessment and in some cases, emergency repair works were necessary.

In the area where the rain was intense (> 300 mm during the night), initial feedback on the dams has shown that the small dams were far more sensitive than the larger dams to this kind of flash flooding. Six dams were overtopped, with a water level higher than one metre above the crest in some cases. Luckily, no complete failures occurred, but severe damage was observed on these six dams (See cover photo), which required emergency repair works. A complete feedback involving laboratory tests on in-situ samples and hydrological and numerical analyses is in progress.

For levees located downstream of the event area, along the Fresquel River and the Aude River, two failures were noticed due to overtopping and internal erosion respectively, fortunately without impact on the population. Furthermore, incidents like external erosion, local instabilities and leaks were observed at some spots on the levee systems. These problems have led to emergency repair works and to specific surveillance.

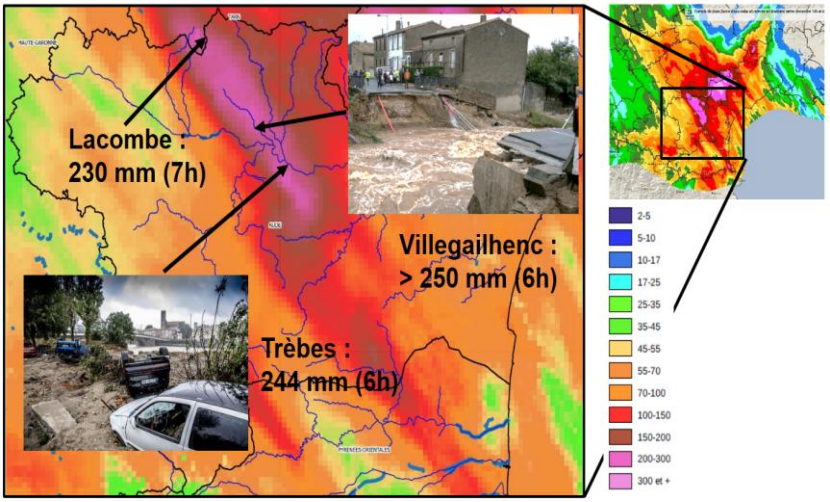

Figure 10 - Cumulative rainfall (mm) over the entire episode (Photo Credit: DREAL Occitanie)

INTERNATIONAL WORKING GROUP ON OVERTOPPING EROSION

by Jean-Robert Courivaud (EDF)

Following the International Workshop on overflowing erosion of dams and dykes held in Aussois, France, in December 2017, the International Working Group on Overflowing and Overtopping Erosion will be launched during the ICOLD annual meeting in Ottawa, in June 2019. This Working Group will be focused on overflowing erosion of embankment dams and fluvial levees, overflowing erosion downstream of concrete dams, overflowing erosion of spillways, overtopping erosion of marine levees and protections technologies against overflowing erosion.

Like the International Working Group on Internal Erosion, this Working Group will be hosted by the European Club of ICOLD.

Its objectives will be to share issues, current practices and progresses of ongoing researches between dam and levee owners, consulting engineers and academic researchers, in order to improve the state-of-the-art and facilitate international research collaboration.

This Working Group is open to the entire world and it is hoped that dam and levee owners, consulting engineers and academic researchers from all continents will contribute to this group.

It will be structured into four sub-groups:

- A sub-group devoted to overflowing erosion of embankment dams and fluvial levees;
- A sub-group devoted to overflowing erosion downstream of concrete dams and erosion of spillways;
- A sub-group devoted to overtopping erosion of marine levees;
- A sub-group devoted to protection technologies against overflowing erosion.

Each sub-group will be co-chaired by two persons.

It is hoped that this Working Group develops strong links with the EUCOLD WG LFD, overflowing erosion being one of the main failure modes of levees.

Contact: jean-robert.courivaud@edf.fr

RISK INFORMED DESIGN OF LEVEE'S FORUM

By Dr Michael Sharp (US Army Corps of Engineers)

In November 2018, representatives from Canada (British Columbia), France, Netherlands, United Kingdom, and United States met to discuss risk-informed decision making and design of levees. The Risk-Informed Decision Making and Design Forum was held in Wallingford, United Kingdom on November 29th and 30th. During the forum, each country representative shared his or her agency/countries levee decision making and design processes and how risk assessment information is applied to levee design and other management decisions.

In efforts to determine the extent that each agency/country uses risk information, each of the five countries answered the following questions during the forum:

1. Is your agency/country using risk to inform decisions?
2. If so, which components (hazard, performance, consequence) of risk are being used?
3. In what stages of the levee life cycle is risk being used?
4. Does it specifically inform the design of a levee?
5. What is your agency/county levee design process?

During the forum, all five countries participated in a SWOT analysis. A SWOT Analysis guides organizations to develop a stronger awareness of their strengths and weaknesses as well as outline opportunities and threats that they might face in the future. For this exercise, each agency/country performed a SWOT on their own organization examining both their risk-informed decision making process and then more specifically, their risk-informed design methodology. The SWOT Analysis cast light on many of the challenges and opportunities associated with risk-informed levee decision making and levee design. Among the five countries, the internal strengths and weaknesses varied, but many of the same external opportunities and threats were shared. At the conclusion of the forum, all five countries agreed that sharing knowledge and participating in international discussions is helpful to challenge and improve existing processes.

Findings from the forum will be presented at the ICOLD 87th Annual Meeting/Symposium through the Levee Committee Technical Workshop and detailed in a paper to be submitted for acceptance at a future international conference. Any questions regarding this workshop can be directed to Dr. Michael Sharp at Michael.K.Sharp@usace.army.mil

Figure 11 - Design Forum, Wallingford. (Photo Credit: Dr Michael Sharp)

INTERNATIONAL LEVEE PERFORMANCE DATABASE

A Brief Overview by Myron Van Damme (Tu Delft)

An international levee performance database is under development as part of the Dutch Research Project SAFElevee. The database aims to facilitate data sharing, model development and validation, and statistical analyses. The database is freely accessible via the website leveefailures.tudelft.nl. and currently contains over 800 entries. The failures are linked to specific events when known. The database contains a map view and several filters to facilitate in searching for specific information. The database currently contains:

1. Generic information on historical levee failures
2. Experimental data of large and small scale physical experiments to the breaching of earthen dams or levees

In the database, failure is assumed to occur when the levee no longer fulfils its water retaining function. A levee failure mechanism can occur with or without breaching. For example, water might overtop the levee, or a geotechnical failure mechanism could initiate without a full breach. The database therefore distinguishes between failures with and without a breach.

For those cases where more than one failure mechanism has been observed the database notes both the primary initiating failure mechanism and the secondary failure mechanism. All identified failure mechanisms are entered in chronological order. The database will be extended with data on near failures, and experimental data on processes related to breaching. Near failure thereby refers to those situations in which levees were subjected to loads beyond the theoretical design load, but failure did not initiate.

It is still possible to contribute your data to the database. Please send your documents or information on levee failures that you would like to share to leveefailures@tudelft.nl, along with the (approximate) location of the failure and the name and permission to share it. Credits will be provided to the original data source whenever this is known.

A CALL FOR CONTRIBUTIONS

- *News, media or press releases on current storm events involving levees and flood defences.*
- *Current, ongoing or recently complete research projects with web links.*
- *Documents related to levees or flood defences: handbooks, guidance, reports and regulations.*
- *Information on events relating to levees or flood defences*
- *Links to informative/educational web sites and related organisations.*
- *Contact the WG –* lfd-eurcold@irstea.fr