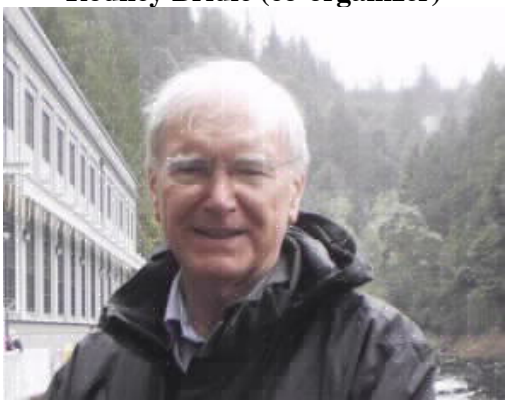
ICOLD Bulletin 164: Internal Erosion Workshop
Friday June 14, 9h00-12h45

Internal erosion is a major cause of embankment dam failures and incidents. ICOLD Bulletin 164 on internal erosion in existing dams, dikes and levees and their foundations provides practical guidance on dealing with the threat of internal erosion in existing water-retaining embankments. Presentations in this workshop will cover the four modes of internal erosion as well as applications of Bulletin 164 to explain incidents and target remediation. Case studies and the latest research will be presented by prominent international practitioners, researchers and academics.

This workshop is aimed at dam engineers and technical specialists, regulators and dam owners involved in the design, construction and operation of dams, levees and tailings dams. Participants will gain improved understanding of internal erosion mechanics and how to make engineering assessments to limit the risks related to this phenomenon.

Presenters and Presentations

Rodney Bridle (co-organizer)



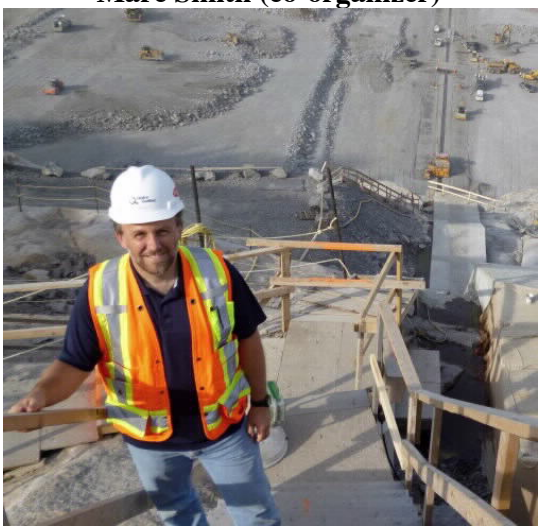
Rodney Bridle, Civil engineer, Dam Safety Ltd, specialist consulting engineer in earth and earth-rock dams, internal erosion and risk. UK Member, ICOLD Technical Committee on Embankment Dams. Editor and part-author of the two volumes of ICOLD Bulletin 164 on Internal Erosion. Regular attendee at ICOLD and ICOLD Internal Erosion Working Group (EWGIE) meetings. Former Chair, British Dam Society. More information at www.damsafety.co.uk.

Overview of internal erosion mechanisms

Internal erosion is a process of erosion in which the hydraulic forces imposed by water flowing through openings or seeping through the pores in soils in water-retaining embankments and their foundations are sufficient to overcome the resistance to erosion of those soils. It has parallels to scour and erosion on river beds. The hydraulic forces are usually greatest when water levels are high as floods pass through reservoirs or along waterways, consequently the probability of the water level causing failure can be estimated from the flood hydrology for use in risk analysis (because risk = probability x consequences). If internal erosion initiates, progress to failure will likely be rapid, unless the erosion is stopped by filters – in designed filter zones or in fill zones of a grading capable of filtering - trapping eroded particles and preventing the continuation of erosion after no-, some- or excessive erosion. Unzoned (often called 'homogeneous') embankment dams and levees are more vulnerable to internal erosion than zoned embankments because there are no more-or-less vertical zones that might arrest erosion.

ICOLD Bulletin 164 provides a comprehensive qualitative understanding of internal erosion and the means to quantify the hydraulic forces that will cause failure through the four internal erosion mechanisms: concentrated leak erosion, suffusion, backward erosion and piping, and contact erosion. It gives methods to assess the filtering capability of filters and fills; guidance on investigations and engineering analyses, and on remediation and surveillance. Recent research has added to the usefulness of the Bulletin, notably in backward erosion and piping, as a case history shows. An important conclusion is that it is not possible to anticipate the onset of internal erosion to failure through surveillance and monitoring; and as failure occurs rapidly, the critical hydraulic load, water level, should be predicted by investigations and engineering analysis, and remediation completed if necessary, before large floods occur.

Marc Smith (co-organizer)



Marc Smith, P.E., Ph.D., is a geotechnical engineer with Hydro Québec. He has more than 34 years of experience in the design and construction of embankment dams as well as in their monitoring during the impoundment and operation phases. He has carried out many specialized dam safety analyses in Québec, Latin America, Africa and Asia. He is also an Associate Professor at Laval University as well as part-author of ICOLD Bulletin 164.

Contact erosion detection and rehabilitation: a case study

An embankment dam with a central impervious core was constructed in 1971 perpendicular to another embankment dam constructed in 1915 to create an intermediate reservoir for environmental purposes. The older dam is comprised of random rockfill with an upstream clay core. After impoundment of the intermediate reservoir, total seepage at the junction of both dams was increasing steadily. Contact erosion in the random rockfill was suspected to be the main cause of these observations. Identification of the variable flow patterns was deemed necessary to design optimal remediation works to reduce seepage quantities.

A global survey of the seepage area was completed using an electromagnetic method to detect and map main flow patterns. Based on these global findings, optical televiewer surveys from boreholes were used to assess the rockfill stratigraphy in more detail. Active temperature monitoring using fibre optics as well as passive temperature monitoring using thermistors helped detect a zone of preferential seepage and estimate flow velocities.

The random rockfill was grouted shortly after these investigations. The contact erosion phenomena was stopped thus reducing significantly the seepage quantities.