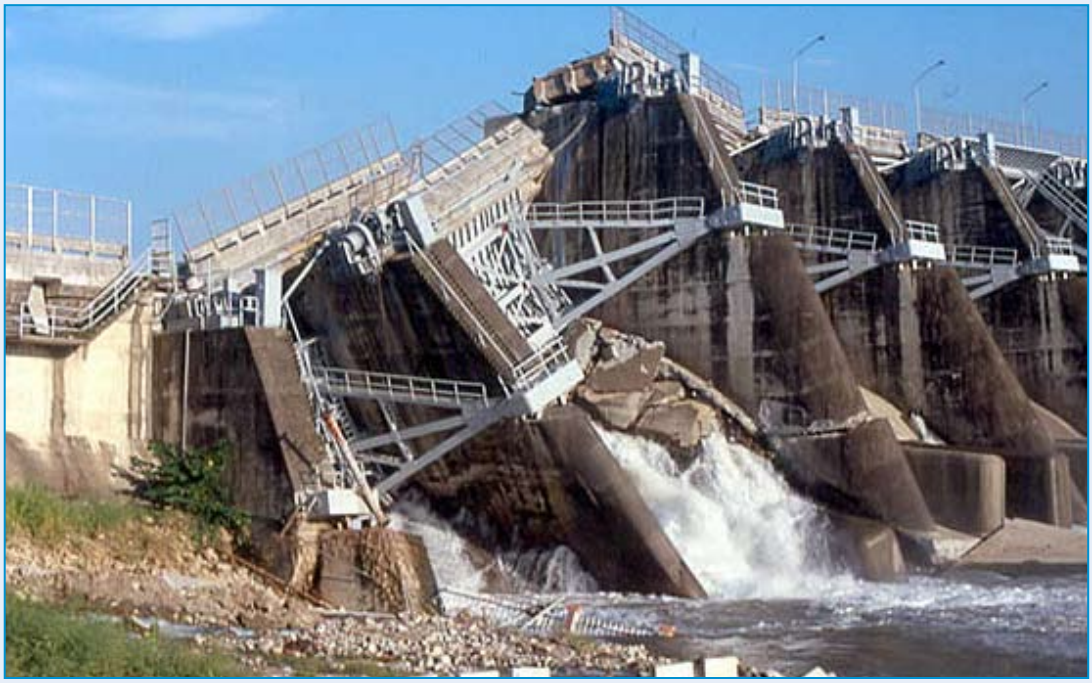
Virtual Training Course on

EARTHQUAKE AND DAM SAFETY

September 2021 to January 2022

(5 Virtual Workshops)

New Delhi



Organised by

Indian Committee on Large Dams

INCOLD Young Engineers Forum

Central Board of Irrigation & Power

under the aegis of

International Commission on Large Dams (ICOLD)

INTRODUCTION AND OVERVIEW

Storage dams are the most challenging projects in the civil engineering profession, requiring knowledge of different technical and non-technical disciplines. The virtual training course offered by INCOLD is concerned with the seismic safety aspects of dams, which is a purely technical discipline. Unlike buildings and other structures, which are mainly designed to resist ground shaking, large dams can be affected in different ways by strong earthquakes, i.e.

1. Ground shaking causing cracks and deformations in concrete and rockfill dams, spillways, bottom outlets and appurtenant structures (powerhouse, switchyard, etc.).
2. Movements of active faults or discontinuities in footprint of dam or spillways.
3. Rockfalls and mass movements at dam site and in reservoir causing (i) impulse waves that may overtop the dam, (ii) blocking intakes of safety-critical spillways and low-level outlets, (iii) damaging the dam body, spillway gates, equipment and appurtenant structures, and (iv) blocking access roads to the dam.
4. Liquefaction in earth dams causing large deformations in dam and/or foundation (liquefaction of loose sediments in reservoirs and turbidity currents blocking intakes), etc.

It is important to note that storage dams with a large damage potential, must be able to withstand the strongest ground motion to be expected at the dam site. This is very different from building structures, which are designed against earthquakes using earthquake ground motion parameters with a return period of typically 475 years, whereas large storage dams must withstand ground motions with a return period of up to 10,000 years as well as the effects of the worst-case earthquake scenario for the dam site.

Dams were the first structures designed against earthquakes, on a worldwide basis, starting in the 1930s. At that time, the ground shaking was the main seismic hazard and was represented by a seismic coefficient of typically 0.1, almost irrespective of the seismic hazard at the dam site, which was often unknown. The seismic analysis was done with the pseudo-static method, ignoring the dynamic characteristics of dams. Because of its simplicity, this method is still in use today, although it has become clear that this method is obsolete following the observations made during the 1971 San Fernando earthquake. The pseudo-static method is also not compatible with current seismic guidelines (ICOLD Bulletin 148) and, therefore, this obsolete method shall no longer be used for the safety checks of large storage dams. Using the pseudo-static concept, the seismic load case was very seldom the governing one. This has changed by using today's rational concepts for seismic hazard analyses and dynamic analyses of dams. The earthquake load case has become the dominant one for most dams.

Since the 1930s considerable developments in the seismic analysis and design of large storage dams have taken place. The main developments, documented in several ICOLD Bulletins, may be described as follows:

1. Change from pseudo-static analysis to dynamic seismic analysis of dams,
2. Change from the representation of the earthquake ground shaking by a seismic coefficient to safety evaluation earthquake ground motion parameters,
3. Change from the single ground shaking hazard to multiple seismic hazards including ground shaking mass movements, faulting, etc. and
4. Change from the stability safety factor and allowable stresses concepts to rational seismic performance criteria, characterized by dam deformations and seismic failure modes of dams.

Today, a modern dam safety concept includes the following elements:

1. Structural safety
2. Dam safety monitoring
3. Operational safety and maintenance, and
4. Emergency planning

Earthquakes play a role in all these safety elements, which will be addressed in the training course.

If we use modern seismic design criteria for large dams (ICOLD Bulletin 148), the following, very general, performance criteria apply for the effects of the strongest ground motion at a dam site:

1. to retain the reservoir and to protect people from the catastrophic release of water from the reservoir,
2. to control the reservoir level after an earthquake as a dam could be overtopped and destroyed if the inflowing water into the reservoir cannot be released through damaged spillways or low-level outlets, and
3. to lower the reservoir level after an earthquake (i) for repair works or (ii) for increasing the safety of a damaged dam or when there are doubts about the safety of a dam.

These new seismic performance criteria are different from those used in the past, when a dam was declared safe, when for different load combinations including static and seismic loads, the stresses were within the allowable stresses, the deformations were within allowable deformations, and the safety factors against sliding, overturning and others were larger than the safety factors specified in design guidelines. This concept has been used in the past and is still being used by some engineers today.

The safety criteria for the dam body and safety-critical components and equipment are as follows:

1. Dam body: Structural damage (cracks, deformations, leakage etc.) is accepted as long as the stability of the dam is ensured when there is no uncontrolled release of large quantities of water from the reservoir causing flooding in the downstream region of the dam.
2. Safety-critical components and equipment: These components and equipment must be fully operable during and after the SEE. Minor distortions are accepted as long as they have no impact on the proper functioning of the components and equipment.
3. Abutment rock (important for arch dams): All abutment wedges must be safe.
4. Reservoir slopes: no mass movements into the reservoir are accepted, which block intakes of the spillway or low-level outlets or which create large impulse waves in the reservoir that could cause overtopping of the dam crest. The last requirement is very important for embankment dams. Furthermore, the possibility of large earthquake-triggered mass movements and the release of stored water, sediments and debris in the catchment area must be considered.

As safety-critical elements must function after strong earthquakes, the hydro-mechanical and electro-mechanical engineers must also be familiar with the seismic safety philosophy used for large dams. It is not only the concern of civil engineers as people may believe wrongly.

FACILITATION FEE

	INCOLD YEF	INCOLD Members	Non Members	Remarks
Option 1	Rs. 2000/-	Rs. 3000/-	Rs. 3500/-	Charges for per Workshop (2 days - 4 Sessions of two hours each)
Option 2	Rs. 8000/-	Rs. 12000/-	Rs. 15000/-	Charges for five Workshops (10 days - 20 Sessions of two hours each)

Sponsorship fee for 5 Virtual Workshops will be Rs. 2.00 lac which will allow 10 officers to join each workshop free of charge.

Bank Details for arranging Payment:

Payments of registration fee should be made by cheque at par/ Demand Draft drawn in favour of "**Central Board of Irrigation and Power**", payable at New Delhi or by transfer the amount to HDFC Bank, Address : 209-214, Kailash Building, 26 Kasturba Gandhi, Marg, New Delhi 110001,

Saving Bank Account No. : 00031110004411;

Swift Code: HDFCINBBDEL; IFSC: HDFC 0000003

MICR Code: 110240001

GST 18% extra

Program for Online Training Course, September 2021 to January 2022

PROGRAMME SCHEDULE

1.	Earthquake and Dam Safety	Sep. 23-24, 2021 (Thu and Fri); 11:00 to 13:00 hours & 15:00 to 17:00 hours
2.	Seismic Aspects of Dam Design	Oct. 21-22, 2021 (Thu and Fri); 11:00 to 13:00 hours & 15:00 to 17:00 hours
3.	Reservoirs triggered Seismicity	Dec. 2-3, 2021 (Thu and Fri); 11:00 to 13:00 hours & 15:00 to 17:00 hours
4.	Seismic Safety of Existing Dams	Dec. 16-17, 2021 (Thu and Fri); 11:00 to 13:00 hours & 15:00 to 17:00 hours
5.	Multiple Hazards Caused by Strong Earthquakes to Dams and Appurtenant Structures	Jan. 20-21, 2022 (Thu and Fri); 11:00 to 13:00 hours & 15:00 to 17:00 hours

Each workshop consists of two 2-hour online presentations delivered on two subsequent days. There will be time for questions and discussions and there will be case studies presented for most subjects.

The subjects discussed in the five workshops are as follows (not in priority order):

1. Seismic design criteria for large storage dams: ICOLD Bulletin 148 on Selecting Seismic Parameters for Large Dams
2. Seismic behaviour of dams during strong earthquakes
3. Seismically active faults and discontinuities in dam foundations and reservoir-triggered seismicity
4. What information the dam engineers need from seismologists
5. Models of earthquake ground shaking used in seismic design and safety checks of large dams
6. Seismic performance criteria for large embankment dams
7. Selection of dam types in areas of high seismicity
8. Pseudo-static seismic analysis of dams
9. Dynamic stability analysis of a gravity dam subject to the safety evaluation earthquake ground motion
10. Seismic aspects of hydro-mechanical and electro-mechanical equipment
11. Seismic safety of the 249 m high Deriner Arch Dam in Turkey
12. Seismic safety of the 156 m high Rudbar Lorestan Earth Core Rockfill Dam in Iran
13. Seismic safety of the 170 m high Ataturk Earth Core Rockfill Dam in Turkey

Who Should Attend?

This online course is strongly recommended for engineers involved in the safety of dams and in particular for young professionals, who want to be up-to-date with the current state-of-the-art and state-of-the-practice in the seismic analysis, design and safety assessment of dams, i.e.

1. Dam professionals (civil, geotechnical, earthquake engineering, and hydro-mechanical and electro-mechanical engineers),
2. Dam consultants,
3. Dam owners. and
4. Dam safety authorities.

COURSE SECRETARIAT

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RESOURCE SPEAKER

DR. MARTIN WIELAND

Martin Wieland has been the Chairman of the Committee on Seismic Aspects of Dam Design of the International Commission on Large Dams (ICOLD) since 1999. Until 2015 he was also the Chairman of the Earthquake Committee of the Swiss Dam Society. He is a senior dam and earthquake expert at AFRY Switzerland Ltd. in Zurich (formerly Poyry Switzerland), Switzerland, where he has been involved in the seismic safety evaluation of some of the world's largest dams and other major infrastructure projects.

He obtained his MSc and PhD in civil engineering from the Swiss Federal Institute of Technology (ETH), Zurich, Switzerland in 1971 and 1978, respectively. He was an associated faculty member of ETH from 1978 to 1980, offering the first course on earthquake-resistant design of structures.

From 1980 to 1990, he was a faculty member in the Division of Structural Engineering and Construction at the Asian Institute of Technology in Bangkok, Thailand where he offered courses on earthquake engineering and structural dynamics and other subjects.

He was a member of the Structural Advisory Board for the Panama Canal Authority (ship locks for the recently completed new Panama Canal). He is also a member of the panel of experts for large storage dams in Colombia, Ethiopia, Iran, Latvia, Pakistan, Papua New Guinea, Sudan and others. He was also the advisor for the newly established Dam Safety Directorate of the Government of Ethiopia, the country with the largest dams and largest dam construction activities in Africa. During the last 40 years, Dr. Wieland has worked on large dam and major infrastructure projects in 35 different countries. He has been involved in over 115 large dam projects and has visited many more.

He has received an Honorary Professorship from Hohai University in Nanjing, China in 2002, he is a Visiting Professor at China Three Gorges University in Yichang, and a Distinguished Adjunct Professor at the Asian Institute of Technology in Thailand. He was a member of the board of directors of the Swiss Society of Earthquake Engineering and Structural Dynamics and the Civil Engineering Division of the Swiss Society of Engineers and Architects. He has authored 300 technical papers in the fields of dam and earthquake engineering.

Dr. Wieland can be contacted under the following address:

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EARTHQUAKE AND DAM SAFETY

New Delhi

REGISTRATION FORM

(To be filled in block letters, preferably typed)

1. Name of Participant _____
   (Surname) (First Name) (Prefix Prof/Dr./Mr./Mrs./Ms.)
2. Designation : _____
3. Name of Organization: _____
4. E-mail : _____ Mobile No. _____
5. Payment details
   Bank Draft/cheque No. _____ dated _____ INR _____ drawn on Bank _____
   is enclosed/is being sent separately.

I intend to participate in the deliberations of the workshop.

Dated _____ Signature_____