

*Short Course on*  
**EARTHQUAKE AND DAM SAFETY**  
(Seismic Aspects of Dam Design and Dam Safety)

**12-13 November 2018**  
**Conference Hall of CBIP, New Delhi**



*Organised by*



Indian Committee  
on Large Dams



Dam Rehabilitation and  
Improvement Project, CWC



The World Bank



Central Board of  
Irrigation & Power

*under the aegis of*



International Commission on Large Dams (ICOLD)

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## INTRODUCTION

The Committee on Seismic Aspects of Dam Design is one of ICOLD's oldest technical committees, which at present comprises dam and earthquake experts from 34 countries from all continents. The Committee was created in 1968 and celebrates its 50<sup>th</sup> anniversary in 2018. Guidelines on the following seismic aspects of dams have been published:

- (i) different seismic hazards affecting storage dams, such as fault movements in the footprint of dams, and reservoir-triggered seismicity,
- (ii) seismic design criteria,
- (iii) dynamic analysis of dams,
- (iv) conceptual guidelines for earthquake-resistant design of dams and design of appurtenant structures, and
- (v) seismic monitoring and inspection of dams after earthquakes,

Following guidelines, represent the international state-of-the-art in the seismic design, construction and safety assessment of large storage dams, i.e.

- Bulletin 52 (1986): Earthquake analysis procedures for dams,
- Bulletin 112 (1998): Neotectonics and dams,
- Bulletin 113 (1999): Seismic observation of dams,
- Bulletin 120 (2001): Design features of dams to resist seismic ground motion,
- Bulletin 123 (2002): Earthquake design and evaluation of structures appurtenant to dams,
- Bulletin 137 (2011): Reservoirs and seismicity,
- Bulletin 148 (2016): Selecting seismic parameters for large dams, and
- Bulletin 166 (2016) : Inspection of dams following earthquakes

Among these guidelines, Bulletin 137 provides information on reservoir-triggered seismicity (RTS), a hazard unique to large storage dams, which is often a key dam safety argument brought forward by opponents against new dams. For properly designed and constructed dams, RTS is not a new safety concern. However, the publication with the greatest long-term impact on the seismic design and safety assessment of existing dams is Bulletin 148, which includes the concept of two earthquake levels for dams and safety-critical elements, i.e. the Operating Basis Earthquake (OBE) and the Safety Evaluation Earthquake (SEE). The safety-critical elements are the spillway and low level outlets, which are needed to control the reservoir level after the SEE or for lowering the reservoir for repair works or for increasing the safety of a dam. Bulletin 120 complements Bulletin 148 as it includes conceptual features for the seismic design of dams, which are extremely important, as it is well known that it will be difficult to have a structure to perform well during an earthquake, when the basic seismic design concepts are not observed.

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 pseudostatic 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 pseudostatic method is also not compatible with current seismic guidelines (Bulletin 148) and, therefore, this obsolete method should no longer be used for the safety checks of large storage dams. Using the pseudostatic 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 formation of the seismic committee, the magnitude 8 Wenchuan earthquake of May 12, 2008 that occurred in Sichuan province, China, was the most damacity earthquake for dam engineers as it damaged some 1580 dams. Most of them were small earth dams, but also some large dams were damaged. The main lesson from this earthquake was that the seismic hazard is a multi-hazard. Thousands of mass movements occurred in the mountainous epicentral region. Mass movements that can be triggered by strong earthquakes are often ignored or the hazard is assessed using criteria, which are different from those used for the dam body. Based on the past experience, it is obvious that dams are not inherently safe and can be damaged by strong earthquakes. The most vulnerable dams are those, which are poorly constructed and/or designed. Still a lot of work is required in order to ensure that all dams comply with modern seismic safety criteria, which is the main concern of the Committee. One of the main tasks of the Committee is to promote good practice in dam engineering, which includes the dissemination of the international state-of-the-art. This is also the objective of this short course.

The main developments in the seismic design of dams, which have taken place during the last 50 years and which will be addressed in this short course, can be described as follows:

From pseudostatic to dynamic seismic analysis of dams.

From seismic coefficient to Safety Evaluation Earthquake ground motion.

From single ground shaking hazard to multiple seismic hazards.

From safety factors to rational seismic performance criteria.

Keeping in view the importance of the subject, the Indian Committee on Large Dams (INCOLD), Central Board of Irrigation & Power and Dam Rehabilitation and Improvement Project (DRIP) under the aegis of ICOLD propose to organize two days short course on "Earthquake and Dam Safety" on 12-13 November 2018 in the Conference Hall of Central Board of Irrigation and Power, Malcha Marg, Chanakyapuri, New Delhi - 110021. The short course will offer a good scope for interchange of experiences to facilitate exposure of state of art technology in all aspects of earthquake and dam safety management, especially considering participation of eminent dam expert from Switzerland.

## PROGRAMME SCHEDULE

MONDAY, 12 NOVEMBER 2018		
09:00 – 09:30 hrs.	Registration	
09:30 – 10:00 hrs.	Inaugural Session Welcome and Opening	
10:00 – 11:00 hrs.	Technical Session 1	50 <sup>th</sup> anniversary of ICOLD Committee on Seismic Aspects of Dam Design and overview on main developments in seismic analysis, design and safety assessment of dams
11:30 – 12:30 hrs.	Technical Session 2	Seismic design criteria for large storage dams: New ICOLD guidelines on selecting seismic parameters for large dams
12:30 – 13:30 hrs.	Technical Session 3	Hazards affecting large dam projects with emphasis on seismic hazards
14:00 – 15:30 hrs.	Technical Session 4	Seismically active faults and discontinuities in dam foundations and reservoir-triggered seismicity
	Technical Session 5	What information the dam engineers need from seismologists
16:00 – 17:30 hrs.	Technical Session 6	Models of earthquake ground shaking used in seismic design and safety checks of large dams
TUESDAY, 13 NOVEMBER 2018		
09:30 – 10:30 hrs.	Technical Session 7	Seismic performance criteria for large embankment dams
10:30 – 11:30 hrs.	Technical Session 8	Selection of dam types in areas of high seismicity
12:00 – 13:00 hrs.	Technical Session 9	Pseudostatic seismic analysis of dams
14:00 – 14:45 hrs.	Technical Session 10	Dynamic stability analysis of a gravity dam subject to the safety evaluation earthquake ground motion
14:45 – 15:30 hrs.	Technical Session 11	Design, Construction and Seismic Safety Evaluation of the 249 m High Deriner Arch Dam in Turkey
16:00 – 17:00 hrs.	Technical Session 12	Long-term dam safety monitoring of concrete arch dam in Switzerland
17:00 – 17:30 hrs.		Question and Answers
<b>Morning Tea : 11:00 – 11:30 hrs.</b> <b>Lunch : 13:00 – 14:00 hrs.</b> <b>Evening Tea : 15:30 – 16:00 hrs.</b>		

### COURSE NOTES

Course participants will receive a hard copy of the PowerPoint slides (paper).

### WHO SHOULD ATTEND?

The Course is of interest to Planners, Designers, Scientists, Researchers, Engineers, Geologists, Regulatory Bodies, Government Department, Developers, Contractors, Consultants and Students working in hydropower Engineering, Dam Design, Hydropower Development, Environmental Engineering, and Structural Hydraulics.

### VENUE

The course will be held in the Conference Hall of Central Board of Irrigation and Power, Malcha Marg, Chanakyapuri, New Delhi - 110021

### OFFICIAL LANGUAGE

The official language of the course will be English only.

### REGISTRATION FEE

The registration fee for participation in the Course is Rs.15,000/- plus GST @ 18% per participant payable by cash/cheque at par/demand draft drawn in favour of “**Central Board of Irrigation and Power**”, payable at New Delhi. 10% discount in the registration fee will be extended to the members of INCOLD and CBIP.

The registration fee includes working lunch, tea during the Course. Registration fee does not include payment for hotel accommodation or meals except those specifically indicated in the Course Programme. Registration fee once paid will not be refunded.

GST No. : 07AAAJC0237F1ZU

### SPONSORSHIP

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### COURSE SECRETARIAT

#### Indian Committee on Large Dams

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Tel: 91-11-26115984/26116567/26111294 Extn: 113;  
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Web <http://www.cbip.org>

### CONTACT PERSON

**Mr. Sunil Sharma**, Chief Manager – Tech., M : 9811299136

### NOTES

1. Participants will have to make their own arrangement for travel, boarding and lodging, etc.
2. Last date for receipt of Registration Form is 10<sup>th</sup> November 2018. Spot registration facility will also be available, provided prior information is received.

## 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. He was also the Chairman of the Earthquake Committee of the Swiss Dam Society. He is a senior dam and earthquake expert at Poyry Switzerland Ltd. in Zurich, Switzerland, where he has been involved in the seismic safety evaluation of some of the world's largest dams and other major infrastructure projects.

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 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 a faculty member of ETH from 1978 to 1980 and was the first earthquake engineer in Switzerland.

He was a member of the Structural Advisory Board for the Panama Canal Authority (ship locks for the new Panama Canal recently completed). He was also a member of the panel of experts for the 230 m high Karun 4 and the 203 m high Dez arch dams in Iran, the 195 m high Sogamoso concrete faced rockfill dam in Colombia, 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.

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 from 1993 to 2005. He has authored 300 technical papers in the fields of dam and earthquake engineering and has worked on dam and other infrastructure projects in 34 countries.

### DR. MARTIN WIELAND

Chairman, ICOLD Committee on Seismic Aspects of Dam Design

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## Short Course on EARTHQUAKE AND DAM SAFETY

12-13 November 2018, CBIP Conference Hall at 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. Mailing Address : \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_  
Country \_\_\_\_\_ PIN \_\_\_\_\_  
Phone : \_\_\_\_\_ Fax \_\_\_\_\_  
E-mail : \_\_\_\_\_
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.

Place \_\_\_\_\_

Signature \_\_\_\_\_

Dated \_\_\_\_\_

### COURSE SECRETARIAT

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