Welcome Message

TC210 Workshop on Embankment Dams
Reykjavik, 1 September 2019

Limin Zhang
Chair, ISSMGE TC210
Chair Professor, Hong Kong Univ. of Science and Technology
Workshop on Embankment Dams
Harpa Conference and Concert halls
Reykjavik, 1 September 2019

Chair : Daniele Cazzuffi (CESI SpA, Milano)

13.00-13.15: Introduction
Limin Zhang (University of Science & Technology, Hong Kong and Chair of TC 210)

13.15-13.35: 3D Stress State and the slope stability of embankment dams in narrow valleys
Nicolas Moura & Gilson Gitirana (University Goiania, Brazil) and Murray Fredlund (SollVision Systems, Canada)

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14.55-15.25: Discussion

15.25-15.40: Summary and Closure
Daniele Cazzuffi (CESI SpA, Milano)
Limin Zhang (University of Science & Technology, Hong Kong and Chair of TC 210)

15.40-15.55: Break

15.55-16.55: ISSMGE TC210 Committee Meeting
**TC210 on Embankment Dams**

- Restructured in June 2018
- 42 nominated members and 7 corresponding members

<table>
<thead>
<tr>
<th>Name</th>
<th>Country</th>
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<tbody>
<tr>
<td>Limin Zhang (Chair)</td>
<td>Hong Kong SAR</td>
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<tr>
<td>Rui Wang (Secretary)</td>
<td>China</td>
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<td>Zuyu Chen</td>
<td>China</td>
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<td>Jean-Pierre Tournier</td>
<td>Canada</td>
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<td>Kaare Hoeg</td>
<td>Norway</td>
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<td>Malcolm Eddleston</td>
<td>United Kingdom</td>
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<td>Nihal Vitharana</td>
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<td>Paolo Pitasi</td>
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<td>Luca Pagano</td>
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<td>Angelo Amorosi</td>
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<td>EDUARDO OSCAR CAPDEVILA</td>
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<td>S.R. Gandhi</td>
<td>India</td>
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<td>George Dounias</td>
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<td>Nikolaos Klimis</td>
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<td>Hongxin Chen</td>
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<td>Meysam Safavian</td>
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<td>Behrooz Gahremannejad</td>
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<td>Fernando Delgado</td>
<td>Spain</td>
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<td>James Burr</td>
<td>New Zealand</td>
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<td>Suttisak Soralump</td>
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<td>Duruo Huang</td>
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<td>Mahendra Singh</td>
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<td>Daniele Cazzuffi</td>
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<td>Krzysztof Parylak</td>
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<td>Baris Trak</td>
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<td>Deniz Ulgen</td>
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<td>Laura Caldeira</td>
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<td>João Marcelino</td>
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<td>Octávio Pereira</td>
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<td>GILSON GITIRANA Jr.</td>
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<td>Daniel Pradel</td>
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<td>Yoshikazu Yamaguchi</td>
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<td>Jörg Klompmaker</td>
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<td>Bernhard Odenwald</td>
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<td>ALBERTO SAYÃO</td>
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<td>Feyza Cinicioglu</td>
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<td>Didiek Djarwadi</td>
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<td>Shijin Feng</td>
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<td>Koen Haelterman</td>
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<td>Jean-François Vanden Berghe</td>
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<td>Siavash Litkoohi</td>
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<td>Sven Knutsson</td>
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<td>Zdzislaw Skutnik</td>
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<td>José María Villarroel</td>
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<td>Jean-Jacques Fry</td>
<td>France</td>
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TC210 Terms of Reference

- **Dissemination**
  - To promote co-operation and exchange of information concerning research and developments in geotechnical issues of dam construction among TC members and ISSMGE member societies

- **Guidelines and recommendations**
  - To develop guidelines and bulletins for the design, construction and safe operation of embankment dams

- **Conference assistance**
  - To assist with technical programs of international and regional conferences organized by the ISSMGE:

- **Industry links**
  - Interact with industry and overlapping organizations working in areas related to TC210’s specialist areas
Key Targets

- Launch the ISSMGE TC210 conference series: International Conference on Embankment Dams (ICED).
- Launch an ISSMGE lecture in honour of a distinguished researcher in embankment dam engineering.
- Launch a Developing Country Training Program, which supports delegates from developing countries to attend conferences and training programs organised by TC210.
- Develop guidelines and bulletins for the design, construction and safe operation of embankment dams.
Significant Past/ongoing Activities

Workshop on Embankment Dams
Harpa Conference and Concert halls
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<table>
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<th>Conference Proceedings</th>
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<td>The conference proceedings will be published by Taylor &amp; Francis.</td>
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<th>Important Deadlines</th>
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<td>Deadline for submission of abstracts: 31 Aug. 2019</td>
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<td>Notification of acceptance of abstracts: 15 Sept. 2019</td>
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<td>Deadline for submission of full papers: 30 Nov. 2019</td>
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<td>Notification of acceptance/rejection of papers: 31 Dec. 2019</td>
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<td>Notification of final acceptance of papers: 31 Jan. 2020</td>
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FIRST INTERNATIONAL CONFERENCE ON EMBANKMENT DAMS (ICED’2020):
DAM BREACH MODELLING AND RISK DISPOSAL
5-7 June 2020, Beijing International Convention Center Beijing, China
http://iced-2020.host30.yousite.com/

Submit abstracts at iced2020@163.com
All TC210 members as Technical Committee members
Subcommittee on Keynote Lectures
ISSMGE Bright Spark Lectures
Why on Dam Breach Modelling and Risk Disposal?

Gongo Soco tailing dam failure on 25 January 2019 in Brazil that claimed nearly 300 people

Mount Polley open pit mine dam failure in British Columbia, Canada on 4 August 2014

Laos dam collapse on 23 July 2018 that hit both Laos and Cambodia and killed 39 people

Sheyuegou dam failure, Xingjiang, China on 31 July 2018. 20 fatalities.
Landslide dams on Yangtze River and Yalung Tsangpo, Oct-Nov 2018

**Baige, 11 Oct 2018**
金沙江白格堰塞湖(1)

- **Formation:** 7:10 am, 11 Oct
- **Water depth:** 46 m
- **Lake capacity:** 2.7x10^8 m³
- **Breaching:** 18:00, 12 Oct. -14:00, 13 Oct.
- **Q_{max}:** 10000 m³/s
- **Lifespan:** 2.5 days

**Baige, 3 Nov 2018**
金沙江白格堰塞湖 (2)

- **Formation:** 17:15, 3 Nov
- **Water depth:** 86 m
- **Lake capacity:** 8.2x10^8 m³
- **Breaching:** 4:45, 12 Nov -2:00 14 Nov
- **Q_{max}:** 33900 m³/s
- **Lifespan:** 10.5 days

**Yalung Tsangbo, 17 Oct 2018**
雅鲁藏布堰塞

- **Formation:** 5:00 am, 17 Oct
- **Water depth:** 79 m
- **Lake capacity:** 5.9x10^8 m³
- **Breaching:** 13:30, 19 Oct -7:00, 20 Oct
- **Q_{max}:** 32000 m³/s
- **Lifespan:** 3 days
First Landslide Damming

Scar length = 1350 m, average width = 600 m, top elevation = 3680 m, bottom elevation = 2980 m, elevation difference = 700 m (ALOS-1DEM)

Dam length: 1600 m along river, 490 m across river, max height 150 m, average thickness 40 m, volume = 3400 \times 10^4 \text{ m}^3 (质灾害InSAR技术研究中心)

Formation: 7:10 am, 11 Oct 2018
Water depth: 46 m
Lake volume: 2.7 \times 10^8 \text{ m}^3
Breaching: 18:00, 12 Oct. 2018
- 14:00 13 Oct. 2018

Q_{\text{max}}: \sim 10000 \text{ m}^3/\text{s}

Lifespan: 2.5 days
Overtopped at 18:00, 12 Oct 2018; Breached: early morning 13 Oct 2018
Second Landslide Damming

17:15 pm, 3 Nov. 2018
New dam volume:
$3 \times 10^6$ m$^3$

The second lake:
Formation: 17:15, 3 Nov 2018
Water depth: 86 m
Volume: $8.2 \times 10^8$ m$^3$
Breaching: 4:45 12 Nov 2018
- 2:00 14 Nov 2018
$Q_{\text{max}}$: 33900 m$^3$/s
Lifespan: 10.5 days
Diversion channel: $h_{\text{max}} = 15 \text{ m} \ (\text{Elev}\ 2966-2951 \text{ m})$, top width = 42m, bottom width = 3m, $L = 220\text{ m}$, $V = 135,000 \text{ m}^3$.

Overflow: 4:45, 12 Nov; $V_{\text{max}} = 5.78 \times 10^8 \text{ m}^3$

$Q_{\text{max}} = 33,900 \text{ m}^3/\text{s}$ at 6:20 pm on 13 Nov 2018
plagioclase gneiss
Safety of cascading hydropower systems in China under extreme loading conditions

When would the dam break?
What would be the peak flood?
What would be the consequences?
Safety of the cascading reservoirs?
How many people downstream the dam could be flooded?
How many people should be evacuated?
When they should be evacuated?

Xiluodu Concrete Gravity Arch Dam, 13860 MW, H = 285.5 m, V = 128x10^8 m³
Physically based dam breaching model

\[ E = K_d (\tau - \tau_c) \]
\[ K_d = 20075e^{4.77} C_u^{-0.76} \]
\[ \tau = \gamma_w R_h S \]
\[ \tau_c = 6.8 (\text{PI})^{1.68} P^{-1.73} e^{-0.97} \]

(Chang and Zhang, 2010)
Numerical simulation of Jinsha River breaches

**Base flow**

- **13 Oct. 18:00**: 10,000 m$^3$/s
- **13 Oct. 06:00**: 9,683 m$^3$/s
- **13 Oct. 05:02**: 9,683 m$^3$/s

**Breaching flow rate (10$^4$ m$^3$/s)**

- **13 Oct. 12:00**: Simulation: 33,900 m$^3$/s, Observation: 34,597 m$^3$/s
- **13 Nov. 12:00**: Simulation: 33,900 m$^3$/s, Observation: 34,597 m$^3$/s

**Cross section**

- **2870**: 0 m
- **2966**: Time (h)

**Longitudinal section**

- **2870**: 0 m
- **2966**: Time (h)

- **0 h, 10 h, 20 h, 30 h, 40 h, 50 h**

**Graphs**

- Simulation vs. Observation
- 9,683 m$^3$/s (05:02, 13 Oct.)
- 10,000 m$^3$/s (06:00, 13 Oct.)
- 33,900 m$^3$/s (18:20, 13 Nov.)
- 34,597 m$^3$/s (19:00, 13 Nov.)
Cofferdam for the Suwalong asphalt core wall dam. 20-y return period flow rate = 6180 m$^3$/s, actual flow rate = 7800 m$^3$/s on 13 Oct. 2018

Cofferdam partially removed before the arrival of the second flood.

The cofferdam completely breached, Qmax = 19800 m$^3$/s on 14 Nov. 2018
Removal of 2.75 million m$^3$ of barrier, July 2019

Relief of crown of landslide, July 2019
Thank you very much!