

# I TECHNICAL COMMITTEES di ICOLD

## Il contributo italiano



*«HYDRAULICS FOR DAMS*

Technical Committee  
" *HYDRAULICS FOR DAMS* "

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Alessandro Cagiano de Azevedo



# Hydraulics for Dams



ICOLD *technical committees*, il contributo italiano.  
Webinar 12 Maggio 2021

Commissione Tecnica “*Hydraulics for Dams*”  
Ing. Alessandro Cagiano de Azevedo



# Hydraulics for Dams



La commissione “*Hydraulics for Dams*” di ICOLD ha al momento questi tre filoni di lavoro in corso:

- a) La pubblicazione del bollettino 172 dal titolo « *Technical Advancements in Spillway Design - Progress and Innovations from 1985 to 2015* ».



# Hydraulics for Dams



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- b) La pubblicazione del bollettino 176 dal titolo « *Blockage of reservoir outlet structures by floating debris* ».



# Hydraulics for Dams



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- c) La preparazione di un nuovo bollettino (il titolo è ancora in fase di definizione) dedicato specificamente ai grandi sfioratori ad alta velocità e alle relative opere di dissipazione di energia.



# Hydraulics for Dams



Per questo terzo lavoro l'attività si articola su questi aspetti:

## ***Hydraulic and Structural Design of Chute Spillways and Upgrading of Spillways – Recent Developments***

- a) Air entrainment.*
- b) Air aerator design, modeling (physical and numerical modeling).*
- c) Waves, flow bulking and splashing.*
- d) Smooth – Stepped chutes, ongoing research, criteria, how it effects the stilling basin, examples etc.*
- e) Structural design including joints, sealing, drainage system of chute linings interacting with fluid considering dynamic loading and vibrations: Presentation of recent examples.*



## Hydraulics for Dams



**La commissione è composta da 33 membri più tre osservatori,  
provenienti da paesi di tutto il mondo,  
sotto la guida del dott. Schleiss.**





# Hydraulics for Dams



Publications

## Bulletins

Display per page: 8 ?

This is the heart of ICOLD activity. On a single precise subject, our experts have met during 3 to 5 years and produced a « state of the art » with recommendations for engineers from all over the world.



**Bulletin Preprint - 172**  
Technical Advancements in Spillway Design  
- Progress and Innovations from 1985 to 2015

@


Public	90 € 
Member	FREE 

Publications



## Bulletins

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**Bulletin Preprint - 176**  
Blockage of Spillways and Outlet Works

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Public	70 € 
Member	FREE 

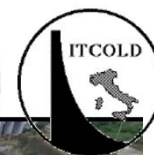


# Hydraulics for Dams

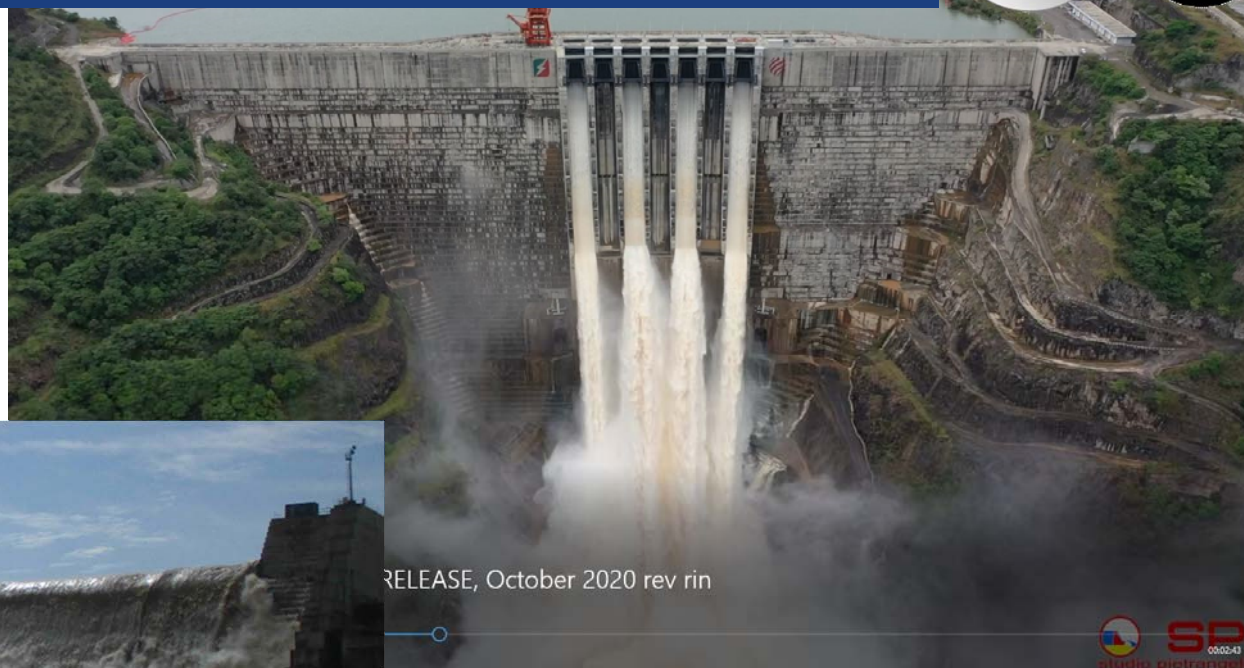




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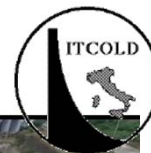
**GIBE III**



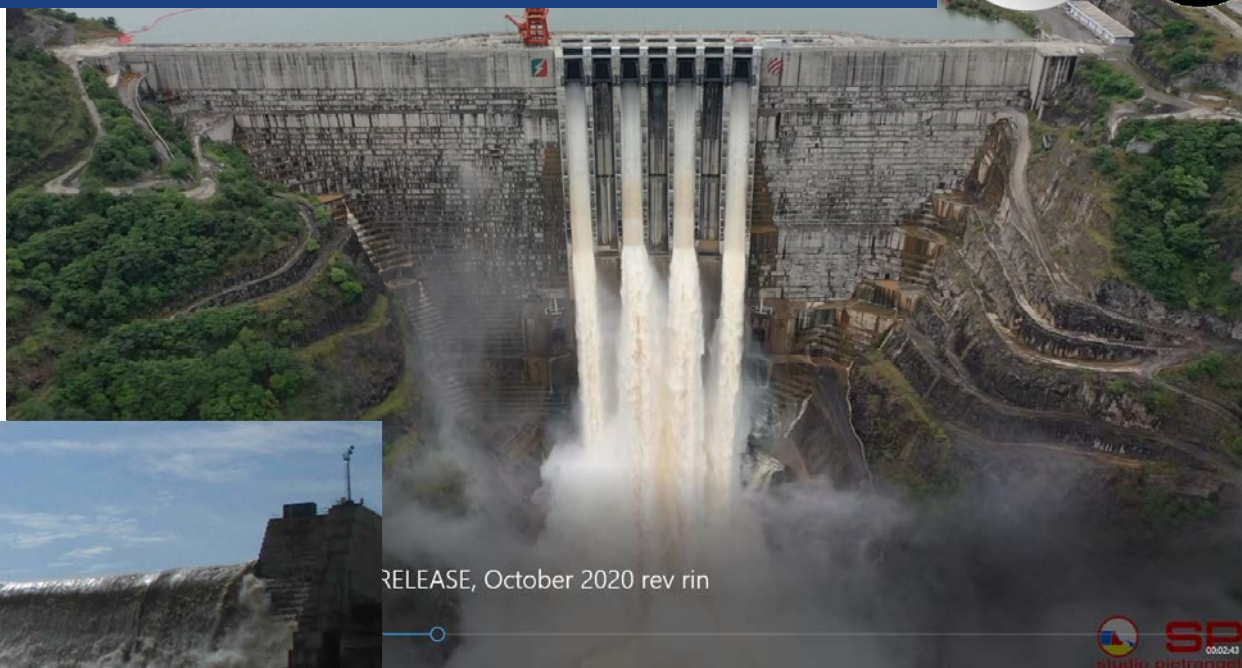
**GERD**



# Hydraulics for Dams



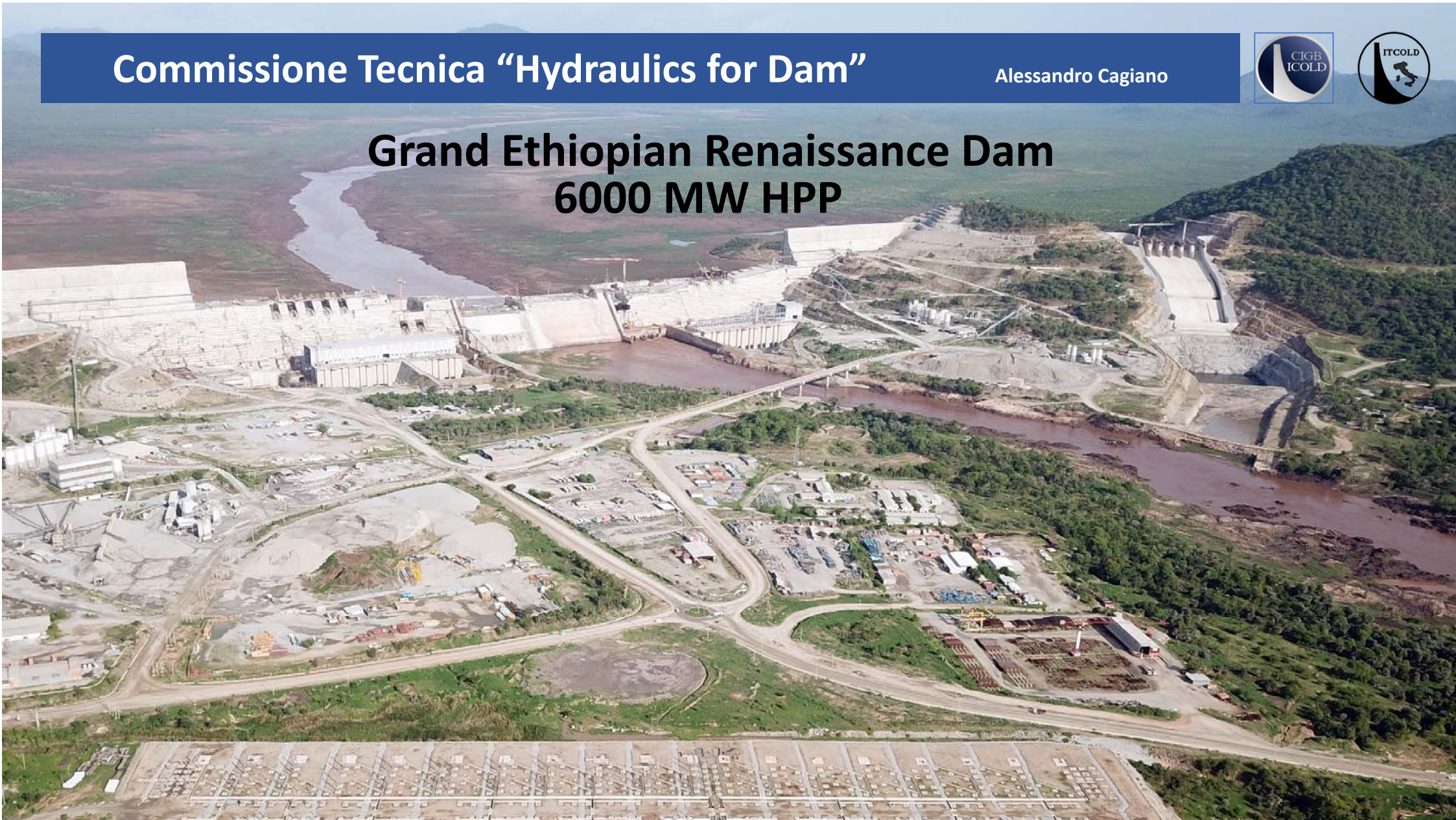
**GIBE III**



- presentazione
- filmato
- osservazioni  
preliminari

**GERD**

## Grand Ethiopian Renaissance Dam 6000 MW HPP



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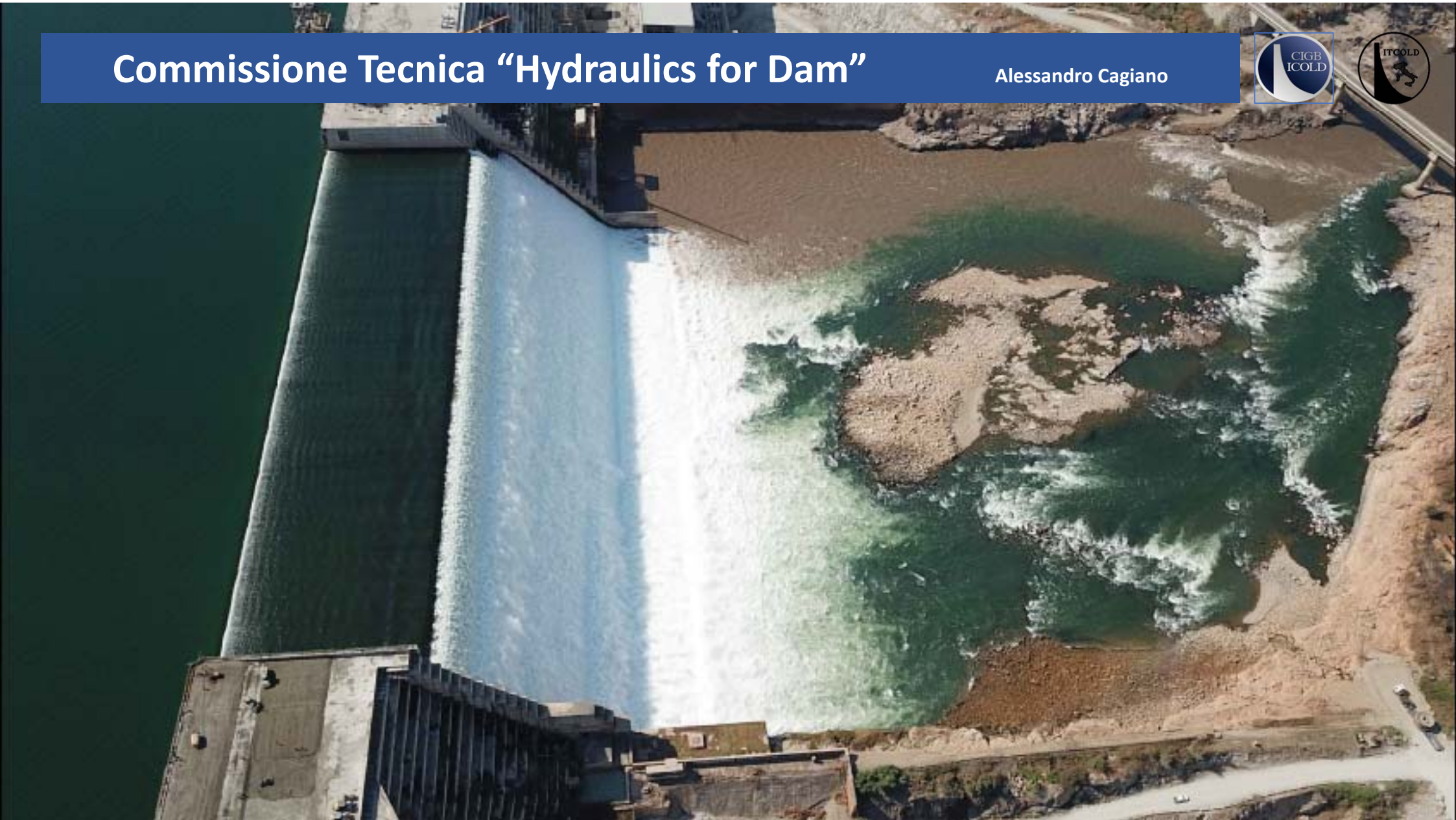
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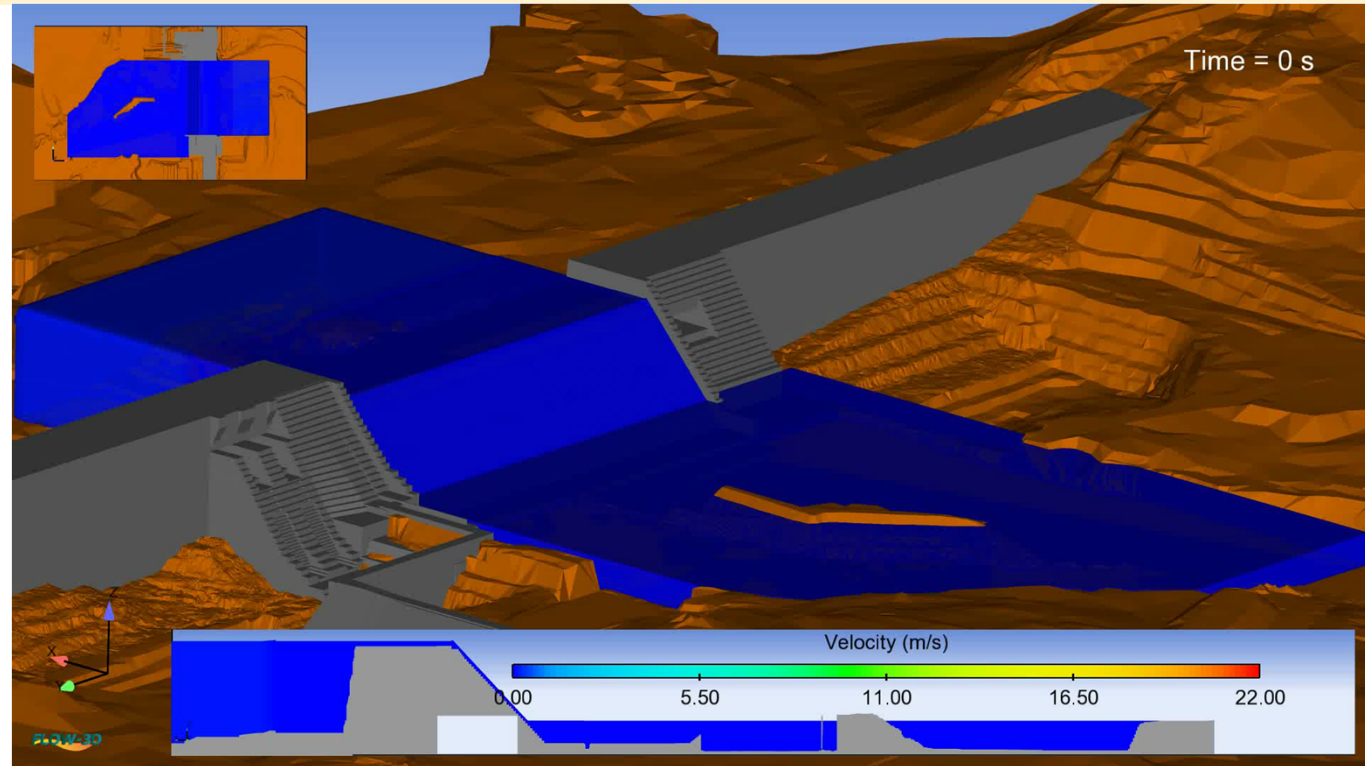
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# Stepped Spillway

- Numerical model – Software: Flow Science, FLOW 3D



- Numerical analysis results
  - Aeration devices neither necessary nor effective
  - Energy dissipation range:  $60 \div 75\%$
  - Cavitation indexes values =  $0.65 \div 1.1 > 0.6$  (critical value)
  - the hydraulic jump at the bottom of the spillway is invariably submerged. The majority of residual stream power entering in the jump, is dissipated in the first 30 m of the stilling basin
  - due to aeration effect and water surface oscillation the maximum tailwater level results to be 3 m higher than black water profile resulting from theoretical calculations (516 against 513 m a.s.l.)



# Hydraulics for Dams

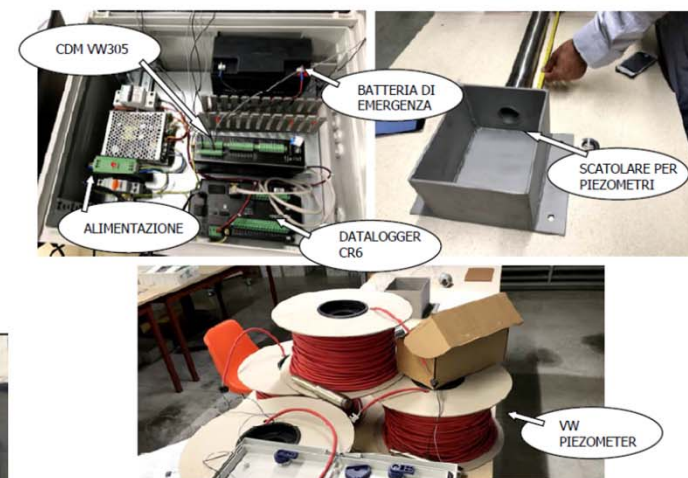
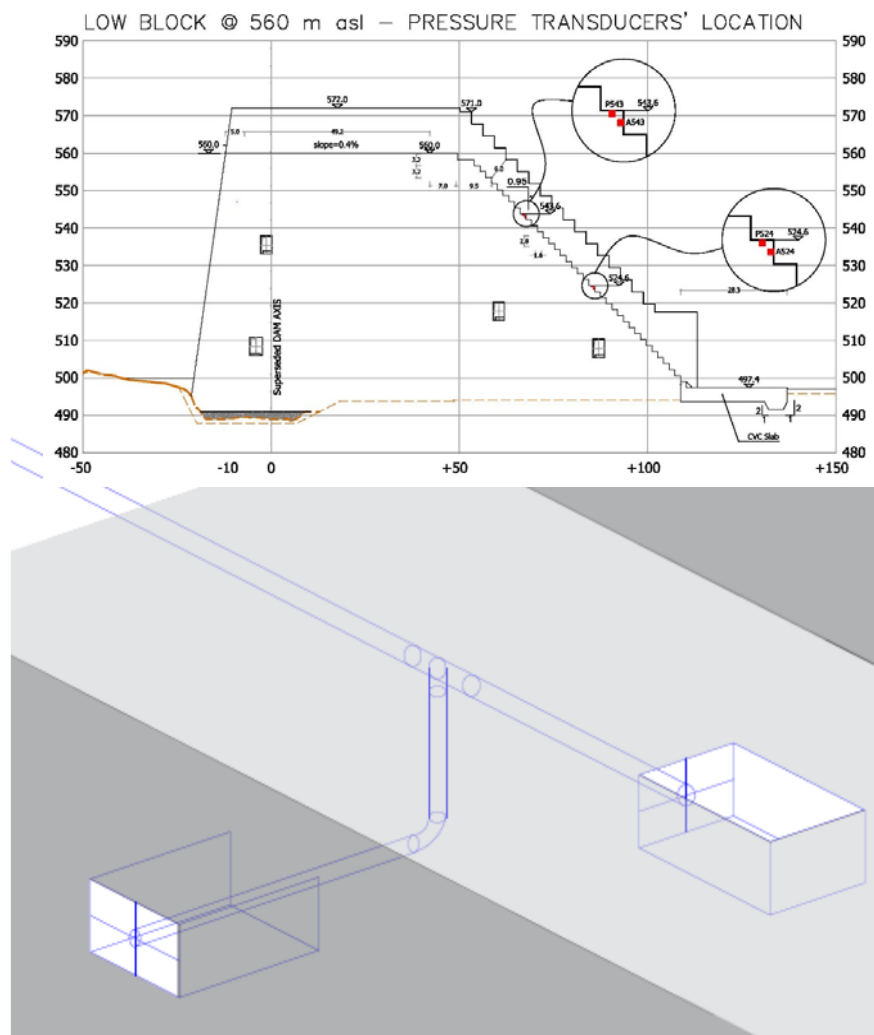


Acquisizione di osservazioni e misure in scala prototipo per validare teorie e formulazioni progettuali basate su modelli matematici o fisici in scala ridotta.





# Hydraulics for Dams

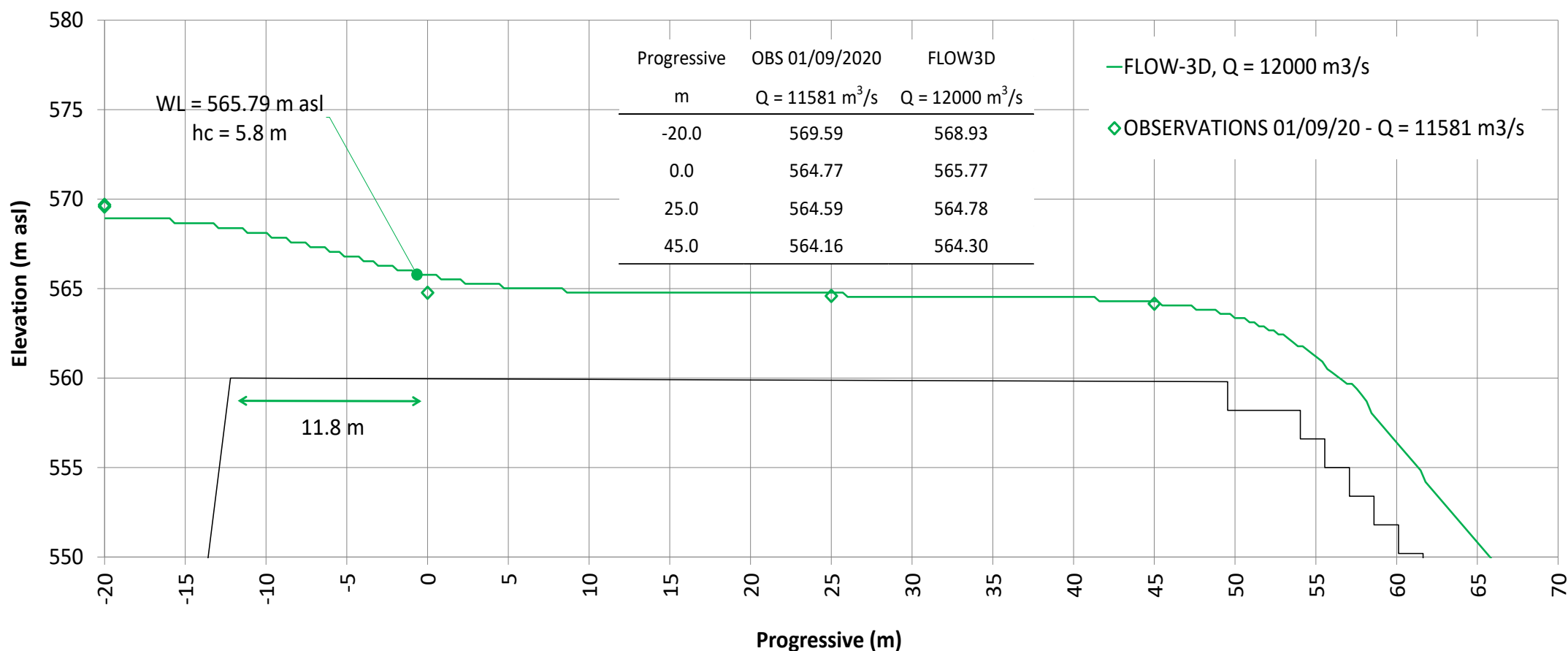




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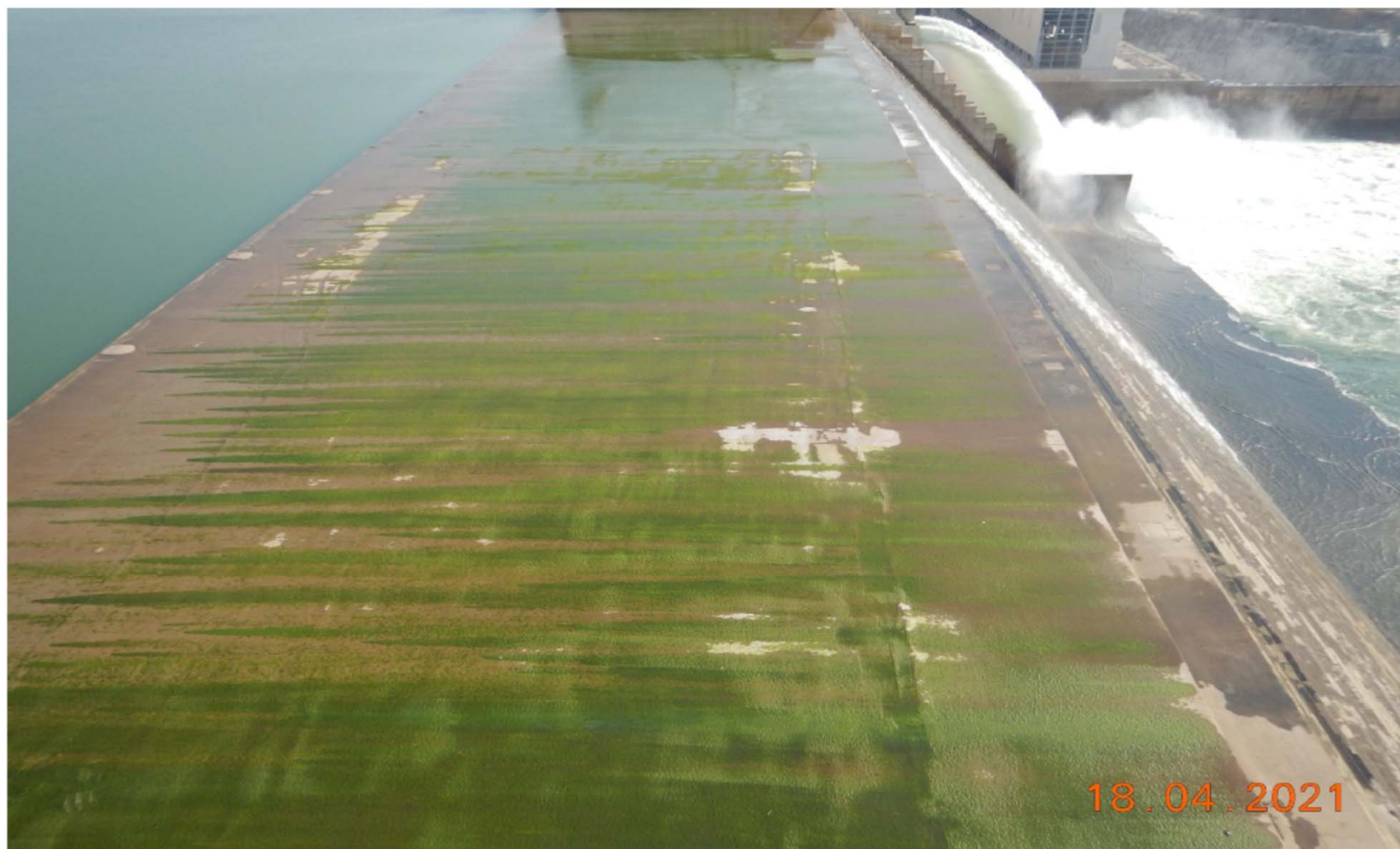
Low-Block 560 m asl. Confronto tra il profilo numerico (FLOW3D) per portata 12000 m<sup>3</sup>/s e i livelli osservati nella giornata del 01.09.2020 al passaggio di una portata di 11581 m<sup>3</sup>/s.



Il confronto pone in risalto l'ottima corrispondenza del risultato numerico con l'osservazione prototipale



# Hydraulics for Dams



18.04.2021



# Hydraulics for Dams



Paramento esposto a fine aprile 2021, dopo il passaggio di acqua per tutta la stagione delle piogge (ottobre-marzo).



# Hydraulics for Dams





# Hydraulics for Dams





# Hydraulics for Dams



## Gibe III

H=250m P=1870MW



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$Q_{\max}=18.000\text{m}^3/\text{s}$   
n.7 gates 12x18m



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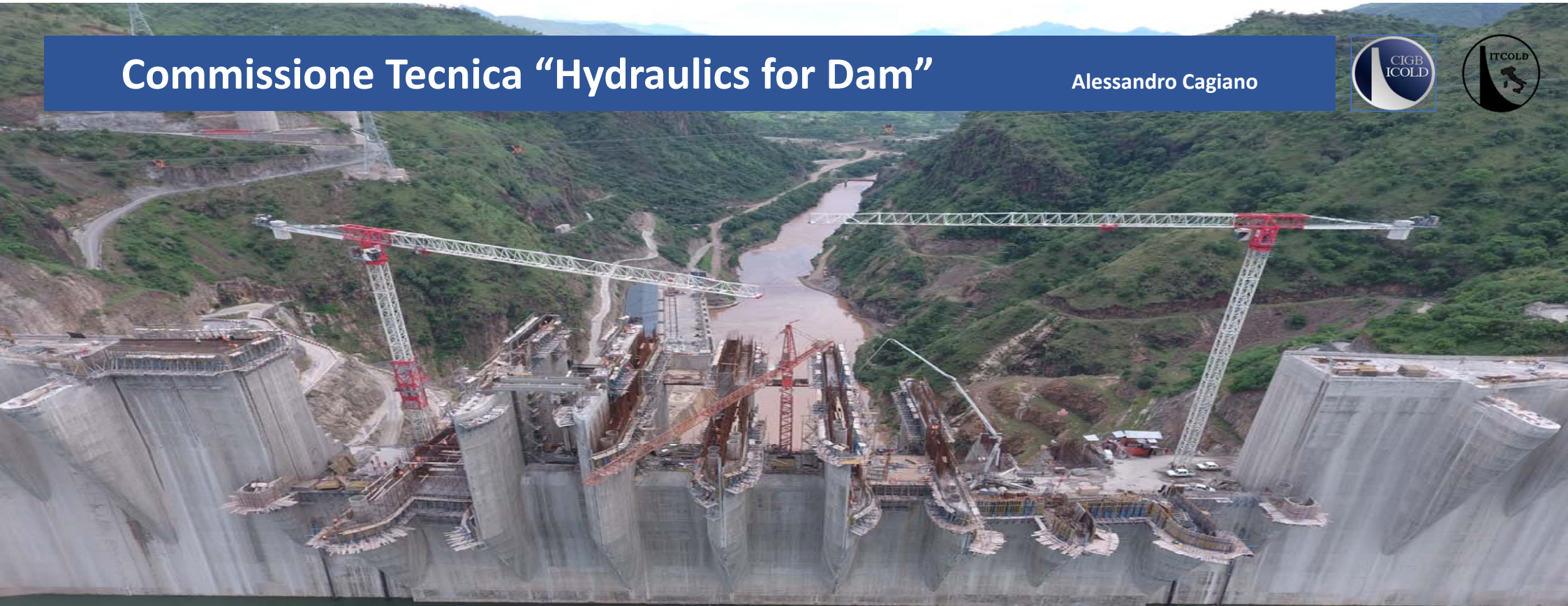
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2016

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L'uso dello sfioratore è previsto solo in caso di necessità per il rilascio di piene, normalmente il rilascio a valle avviene finché possibile tramite le turbine o episodicamente dagli scarichi di mezzo fondo.

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# Hydraulics for Dams

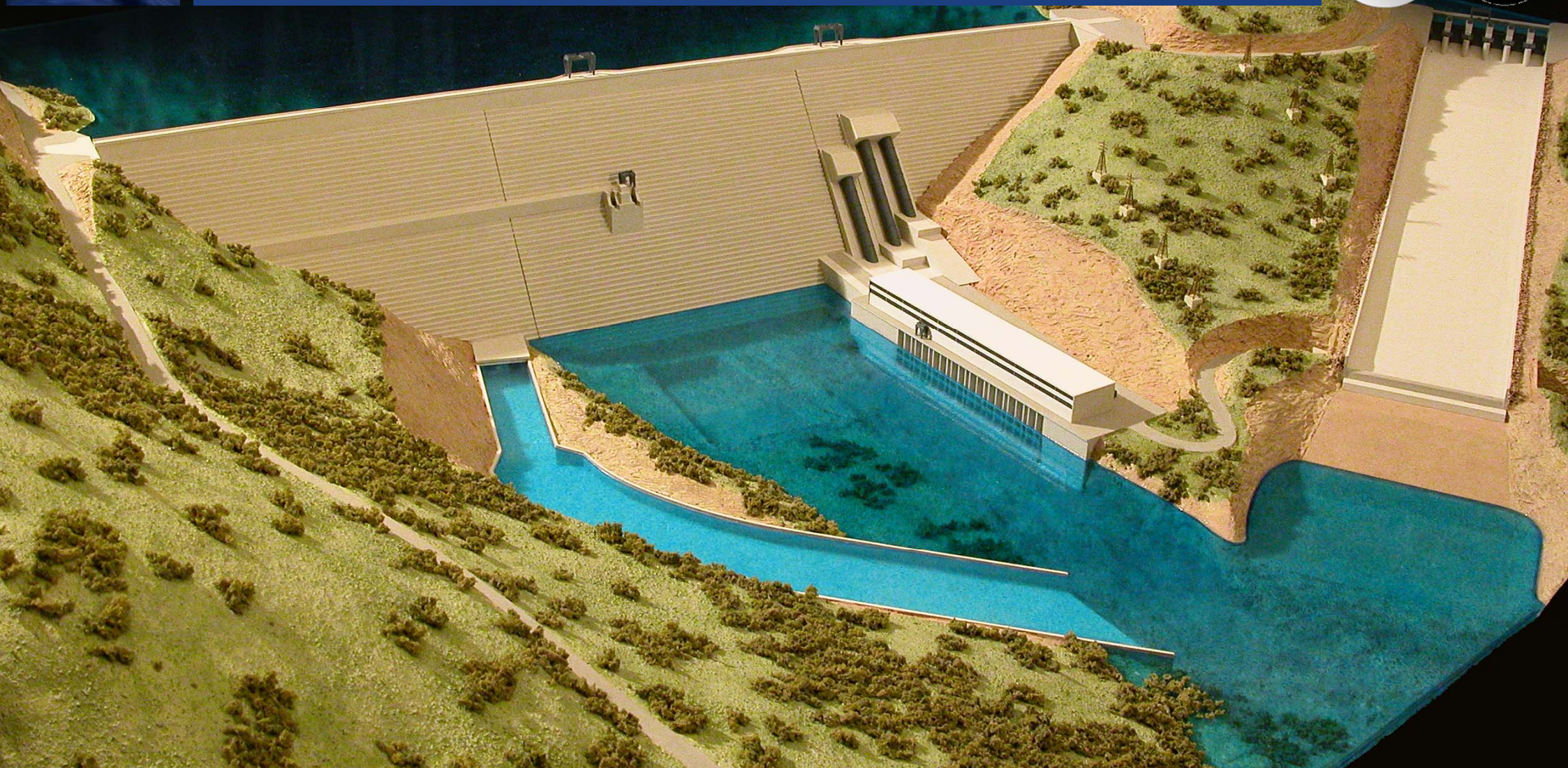


SCATTERED JET TRAJECTORIES, VARYING THE LIP ANGLE OF THE BUCKETS (FROM  $-5^{\circ}$  TO  $30^{\circ}$ )

The scattered trajectories of the jets favor energy dissipation and also regulate better the backward currents, reducing the maximum scour and avoiding potential local erosion concentration.



# Hydraulics for Dams





## Hydraulics for Dams



GRAZIE PER L'ATTENZIONE

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