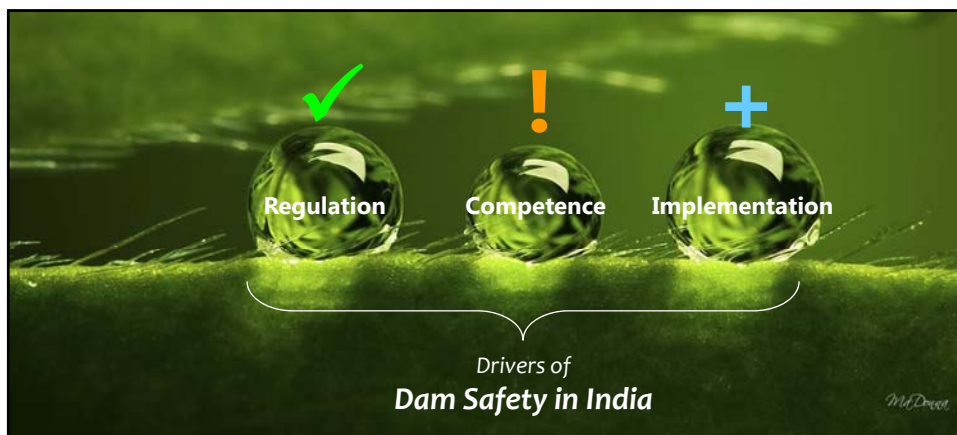


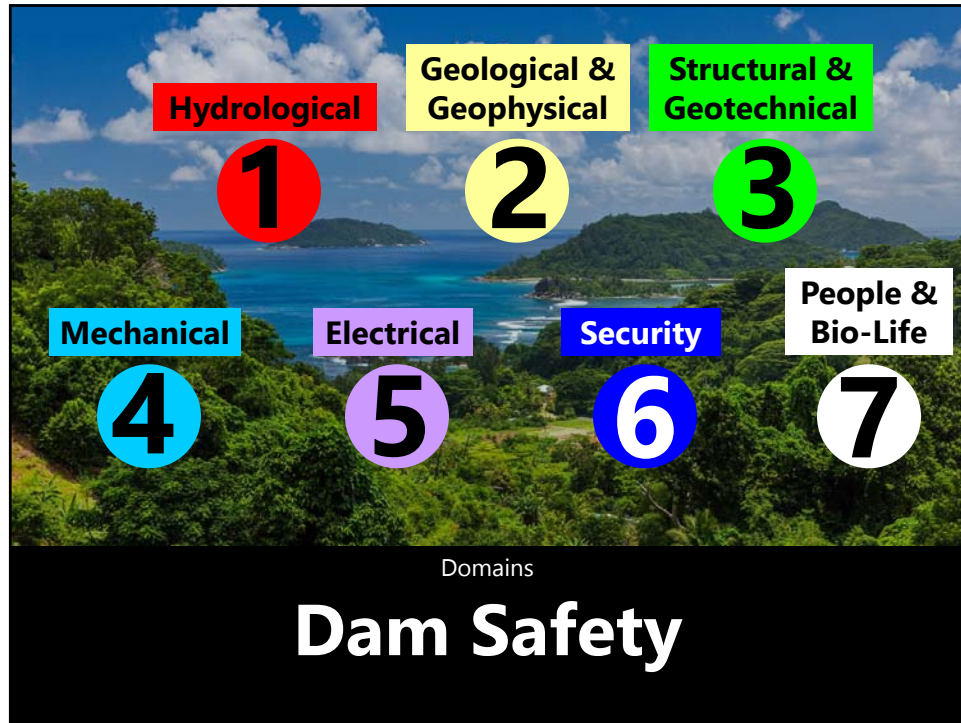
Ensuring Dam Safety in India

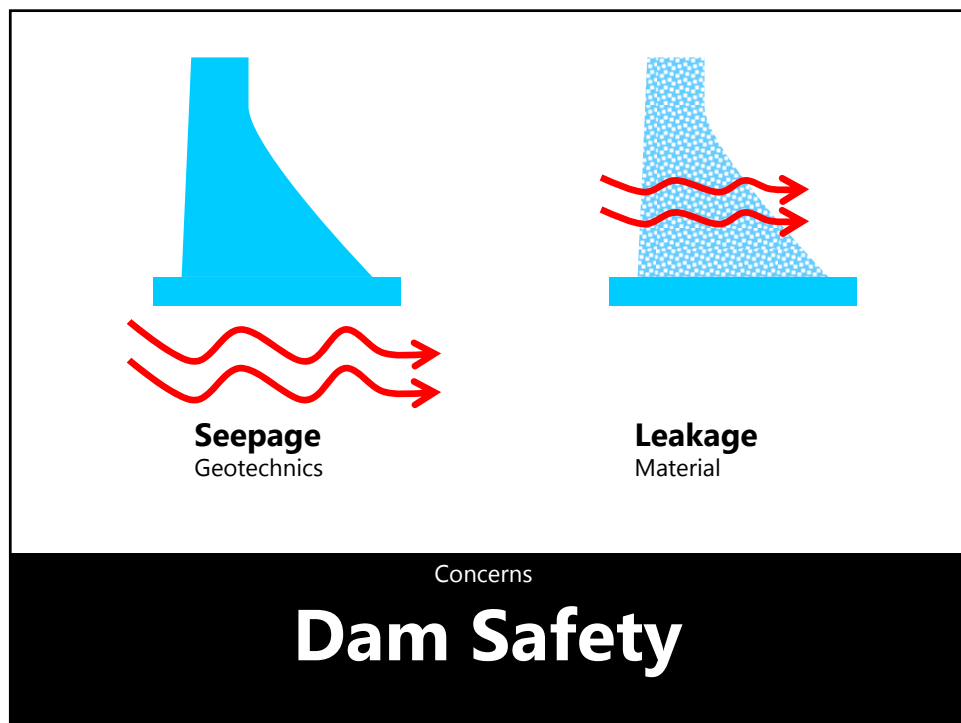
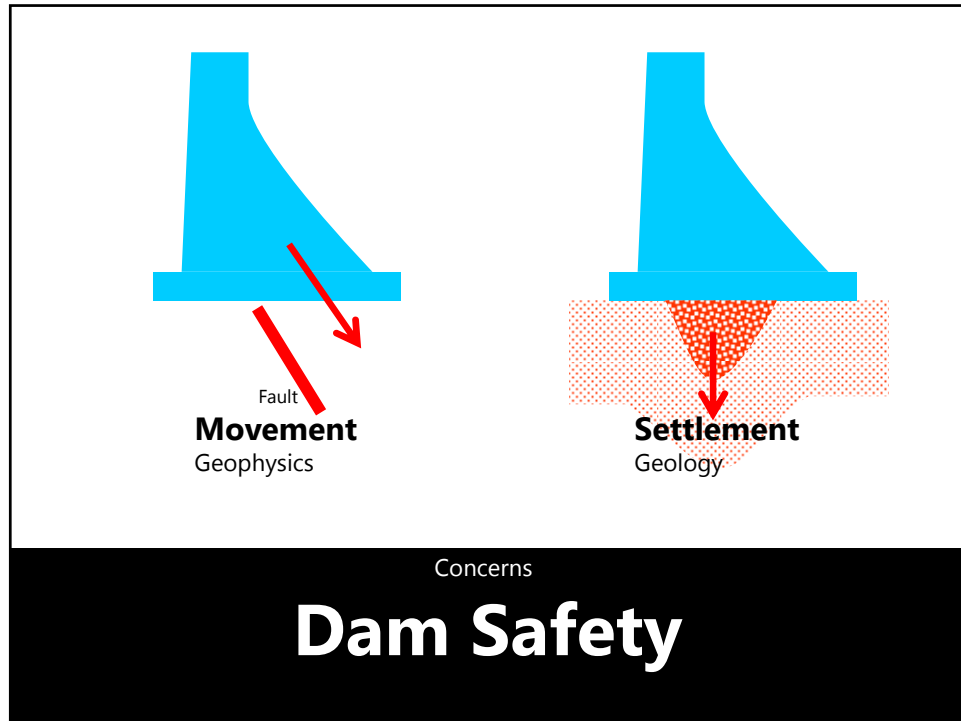
*a Science & Technology
Road Map*

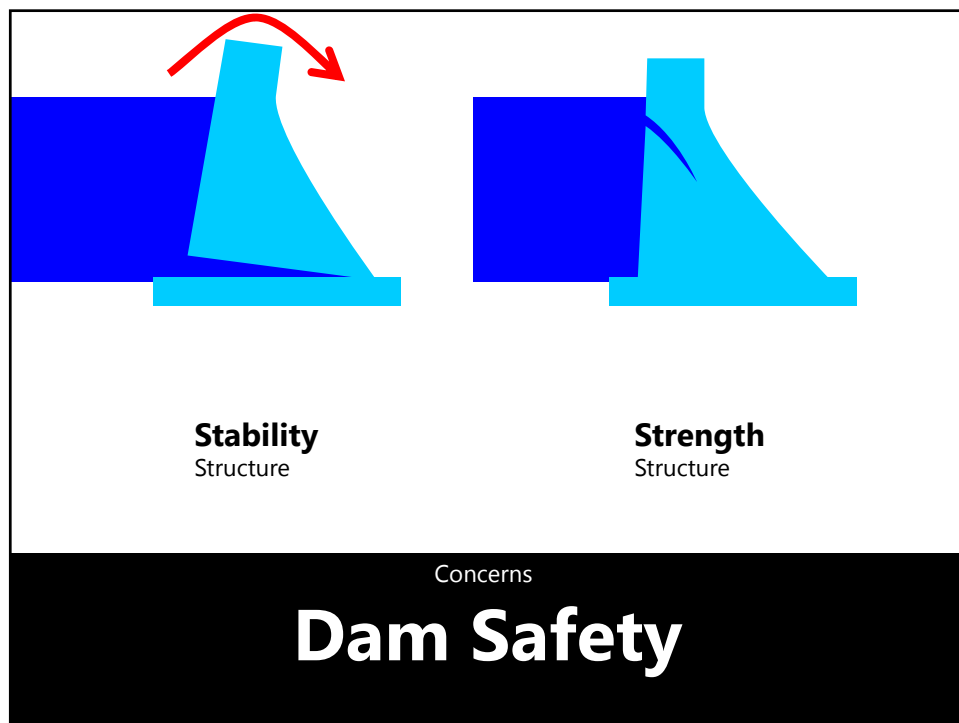
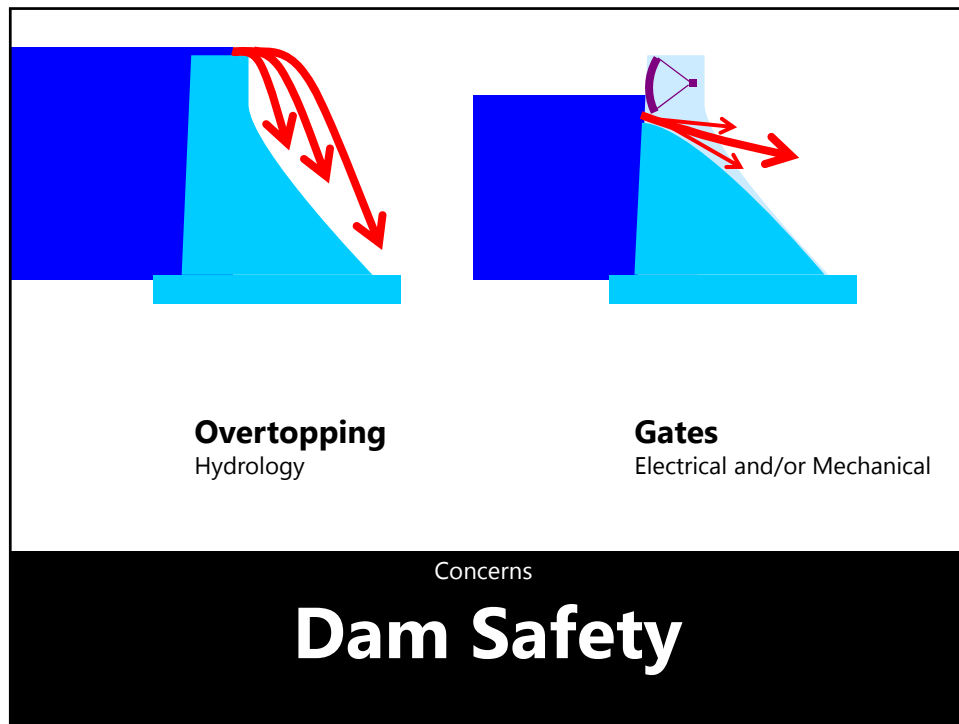


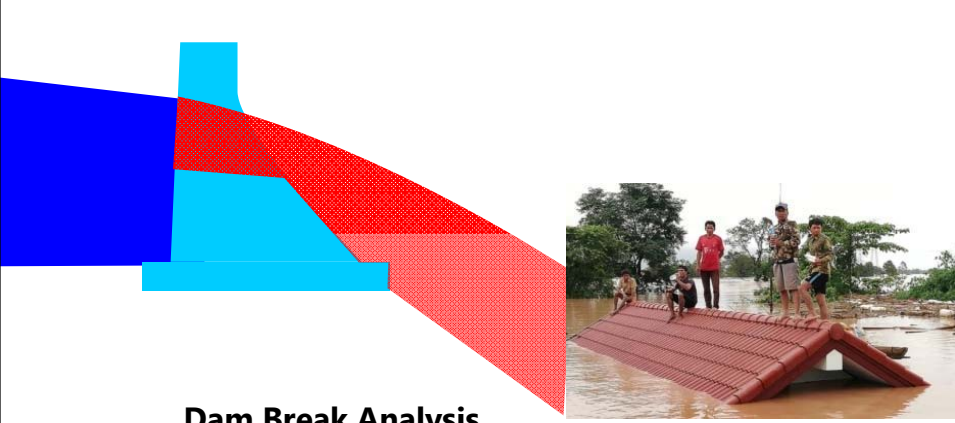
TODAY

- Challenges
- Assessment and Retrofit
- Implementation









Dam Break Analysis
if for ANY Reason

People
Bye-Laws on Land Use

Concerns

Dam Safety



The Challenges in India

1
FACT

Dam Engineering

Planning
Designing
Constructing
Maintaining
Retrofitting
Decommissioning

No single Institute has critical number of subject experts
Continued dependence on foreign experts

**Colleges to teach aspects of Dam Safety
as part of the mandatory curriculum**

Education

2
FACT

Dam Safety

Site-Specific Hazard Assessment
Dynamic Decision Making to Operate Dams at times
Sustained Field Investigations
Dam Instrumentation, Monitoring & Aging Analysis
Dam Break Analysis
Disaster Management
Surveillance and Protection

No system in place for assessing Dam Safety

**Need a system with Dam Owners to build
technical competence of its Engineers**

Continuing Education

3
FACT

Dam Studies

State-of-the-Art Technical Software
Calibration with Field Investigations
Scaled Model Laboratory Investigations
Sedimentation
Structural Distress
Safety Standards

No major and comprehensive studies undertaken yet

**Need a holistic effort
to study key aspects of Dam Engineering**

R&D

4
FACT

Dam Safety Standards and Guidelines

Indian Standards revised long back

CWC guidelines only on limited aspects

**No major dam has undergone the safety evaluation
as per these Guidelines**

**Need dynamic and periodic revision by
the Standards bodies**

Norms

Dam Safety Assessment

5
FACT

Certify safety of ~5,500 Significant Dams every 5 years
(~3 dams per day)

with **limited available**

Technically Competent Hands
Advanced technical tools

Compliance with safety requirements not demonstrated

**Need comprehensive plan to comply with
the Dam Safety Act, 2021**

Compliance

Dam Status

6
FACT

~5,500 Dams in 28 States & Union Territories in India

Documentation of Dam Safety

Current Status Reports

Review of Status Reports

Health Monitoring

Decision Making and Technical Interventions

Master Dashboards at Dam Owners and CWC

No comprehensive repository available on Dams of India

**Need a formal IT plan
to manage the Dams with objectivity**

Coordination

7 FACT

Dam Failures and Accidents

Dam Safety an involved technical and specialized subject

Lessons learnt from losses should be a benchmark for all Dam Owners and Dam Engineers

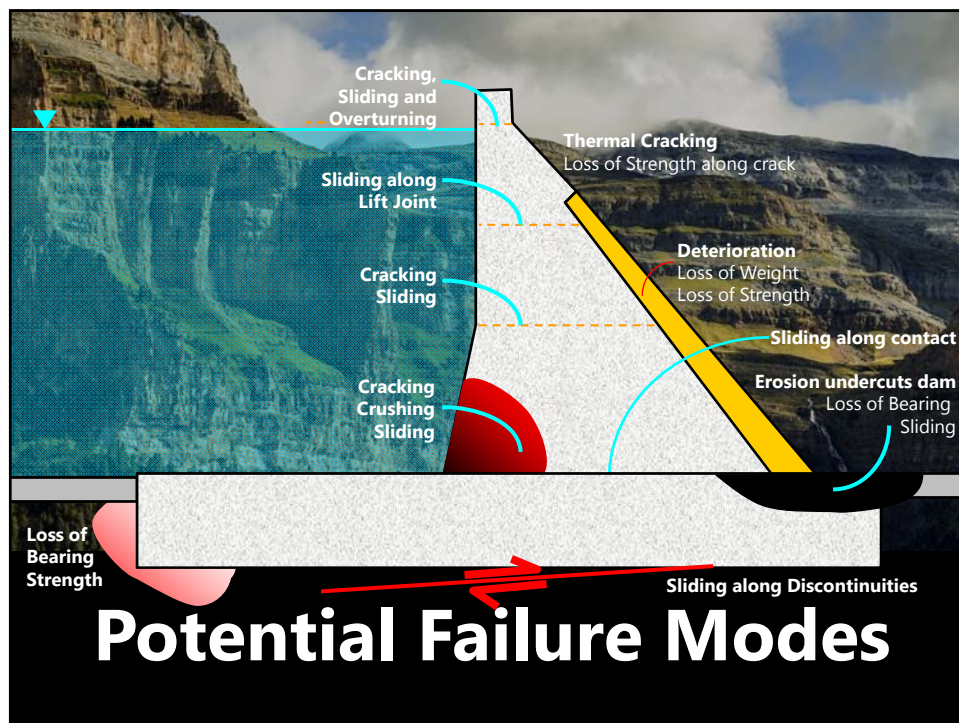
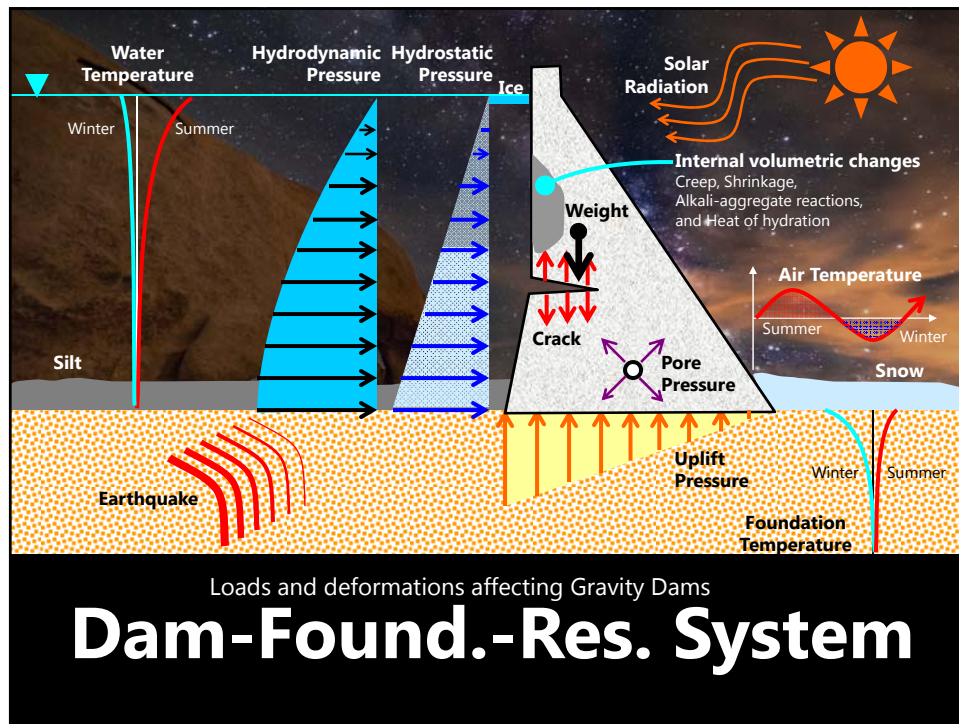
No Dam Failure technical documented & disseminated publicly

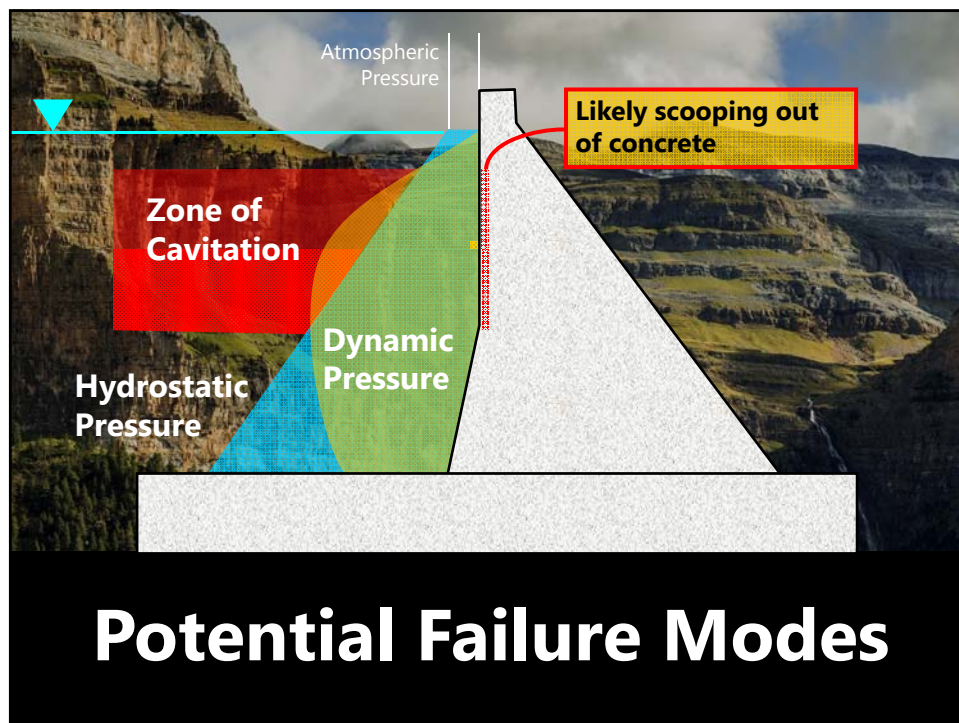
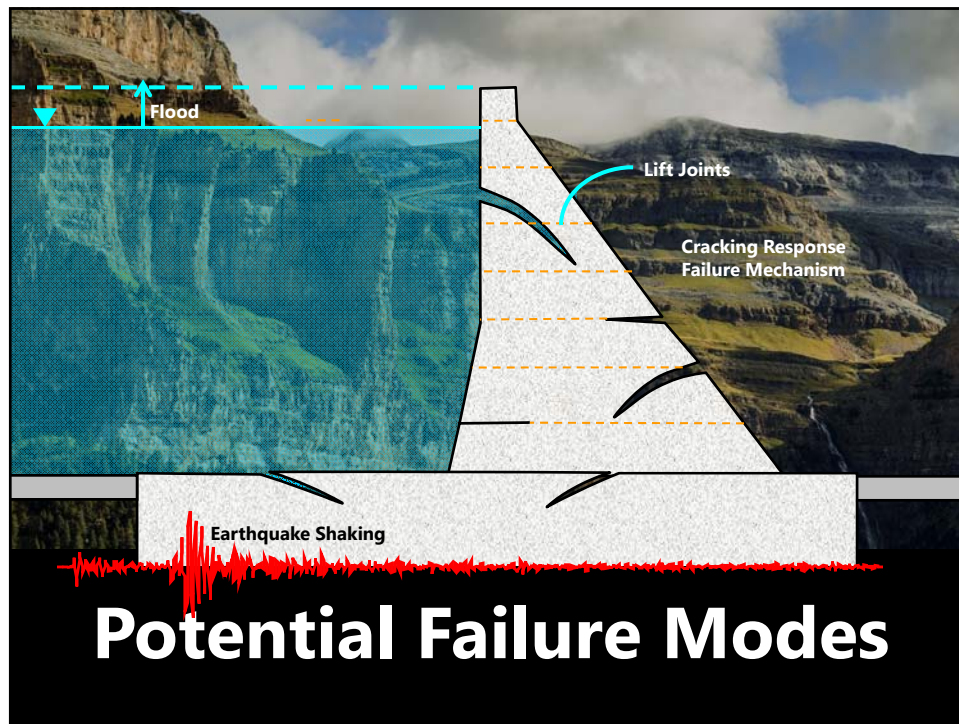
Need a formal documentation and dissemination program on lessons learnt

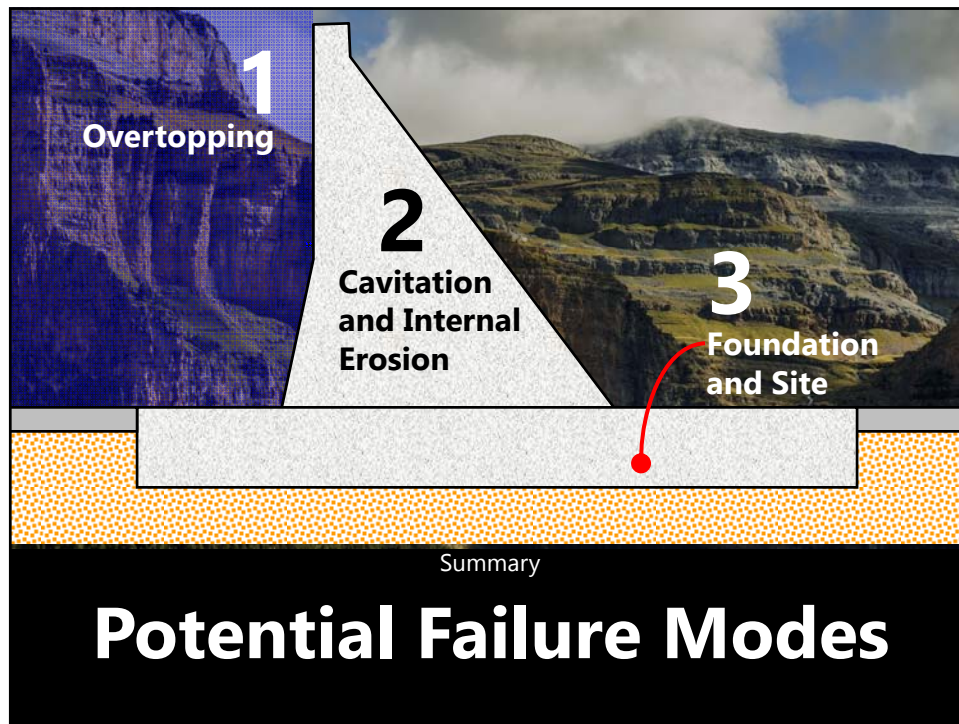
Experience

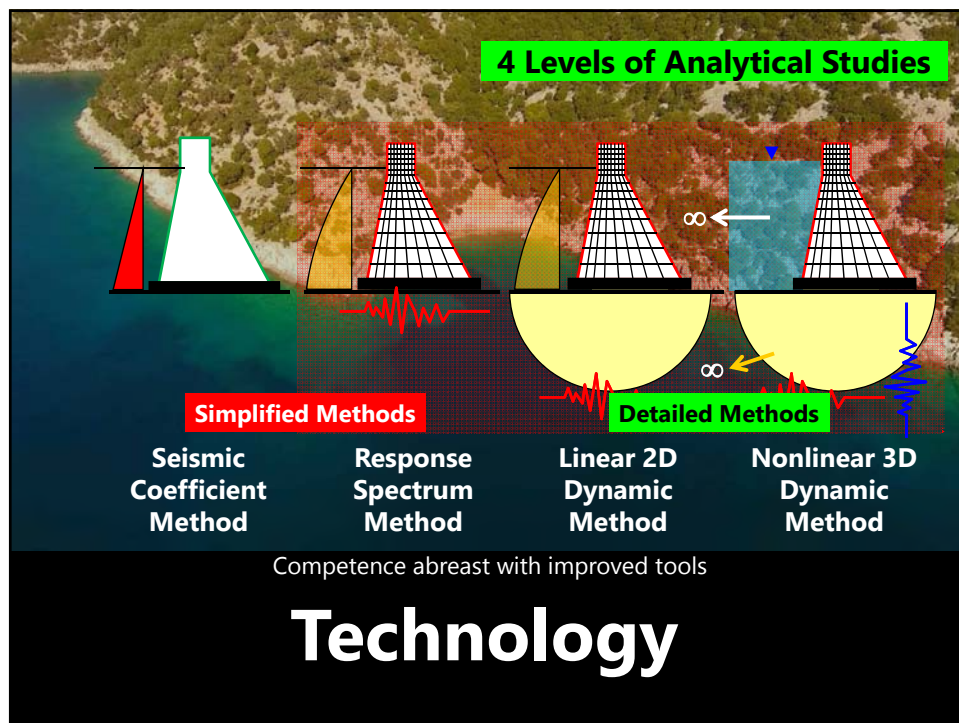
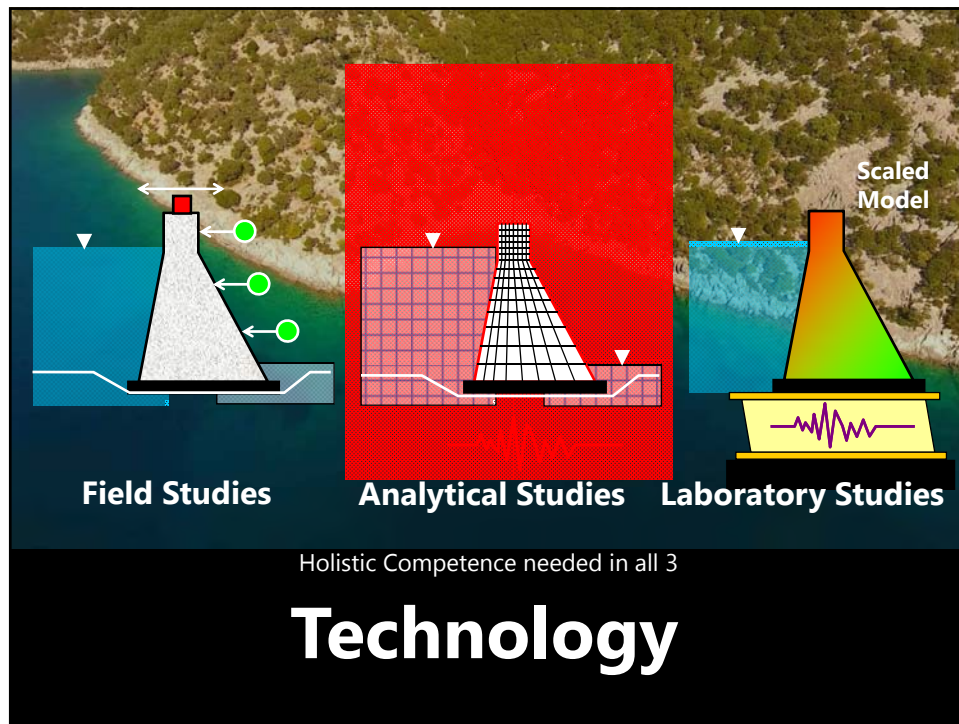


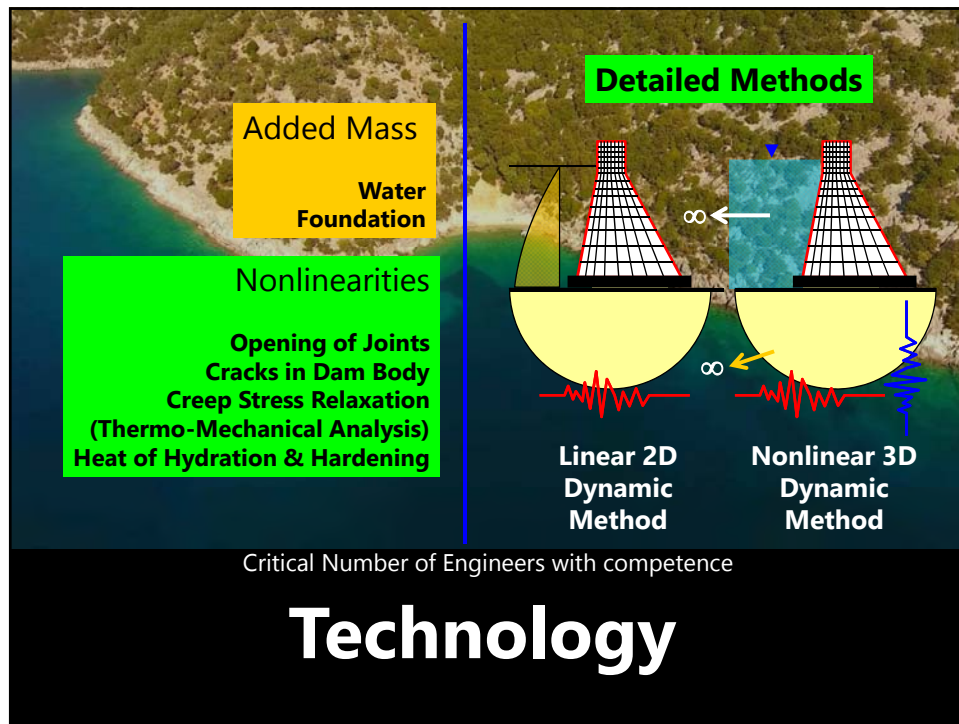
Assessment & Retrofit

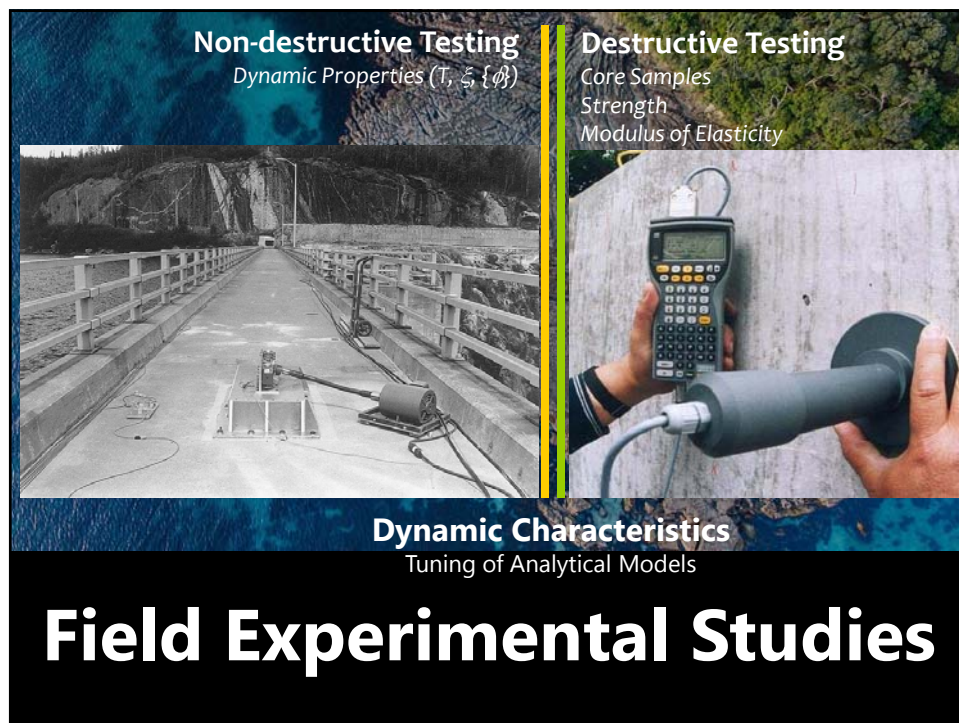
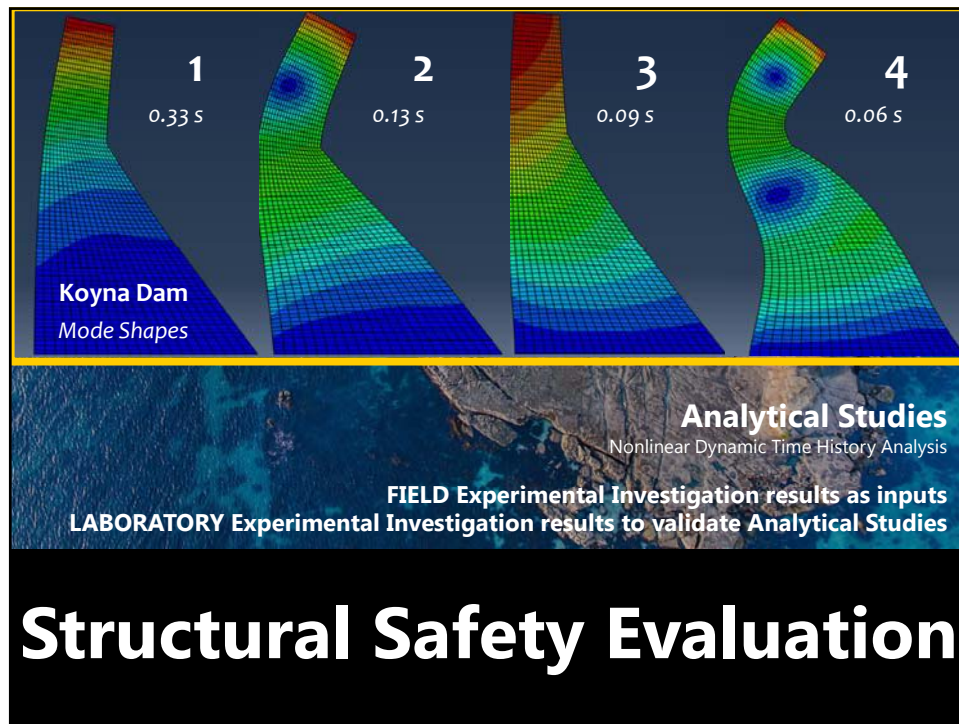










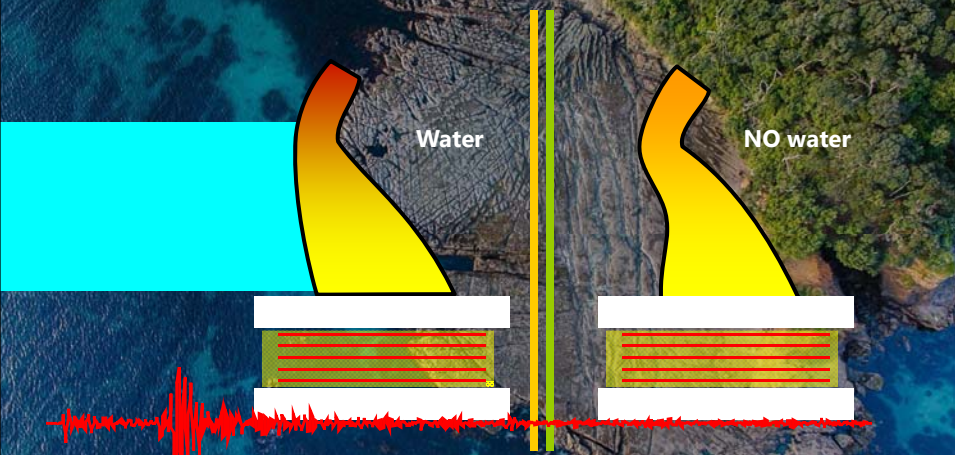


Non-destructive Testing
Dynamic Properties ($T, \zeta, \{\phi\}$)



Dynamic Characteristics
Tuning of Analytical Models

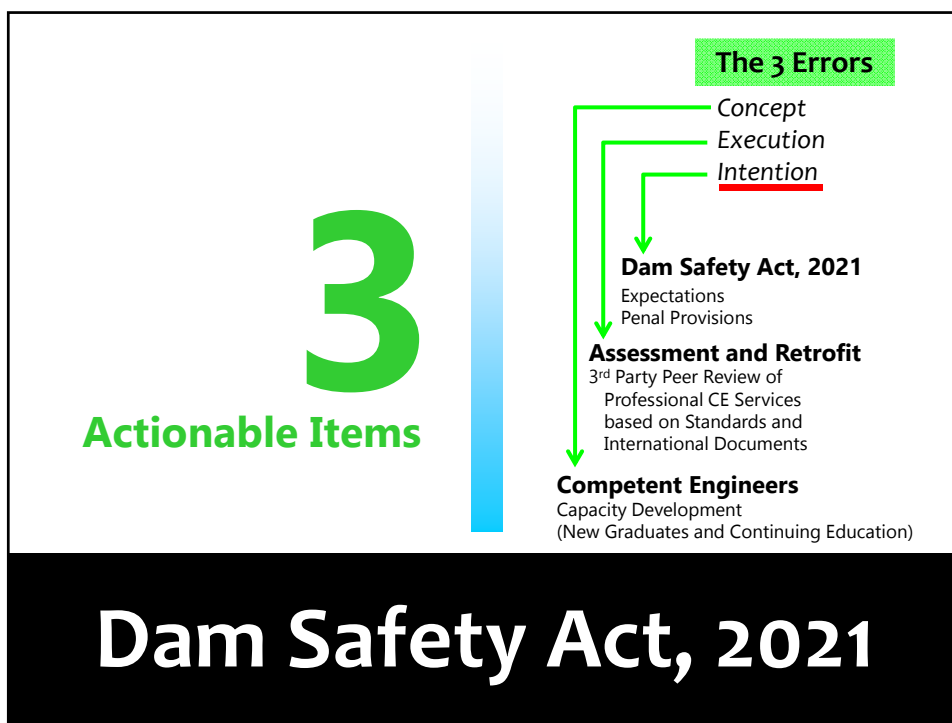
Field Experimental Studies

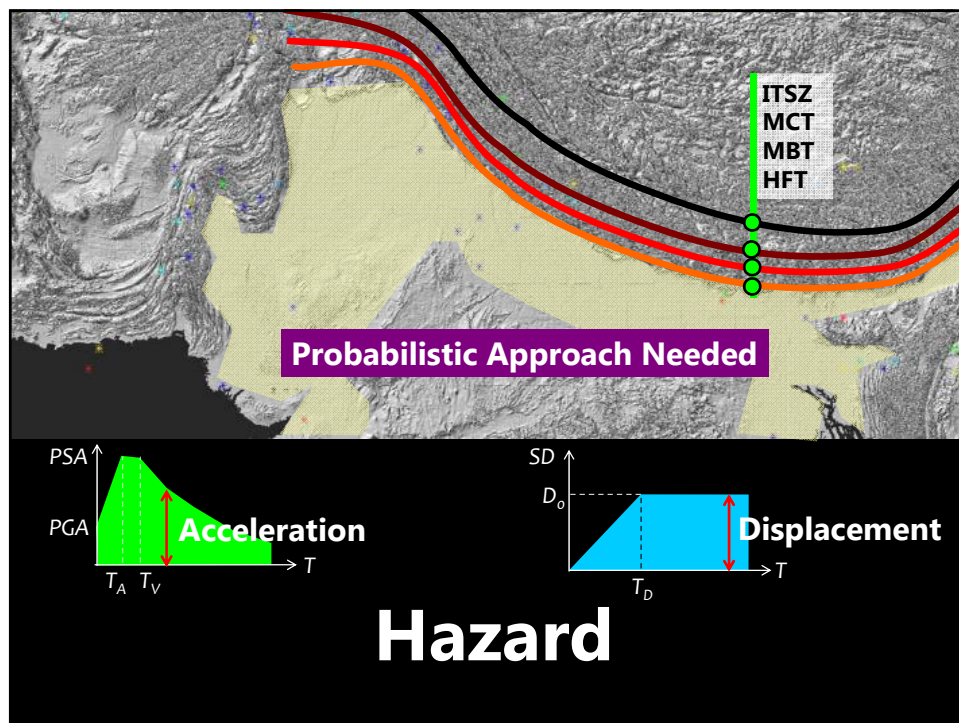
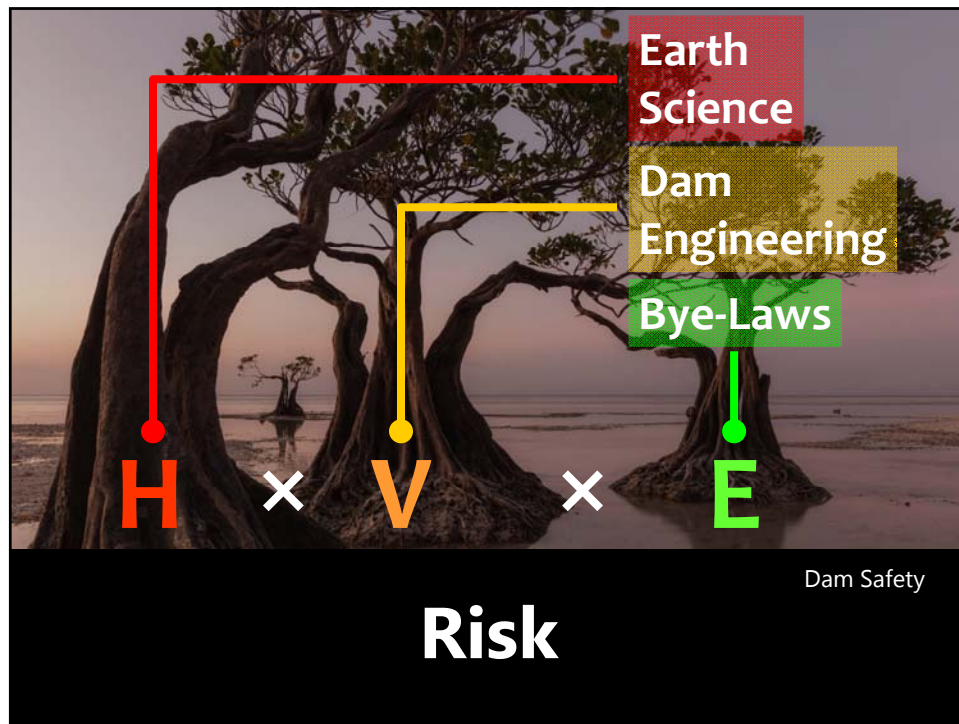


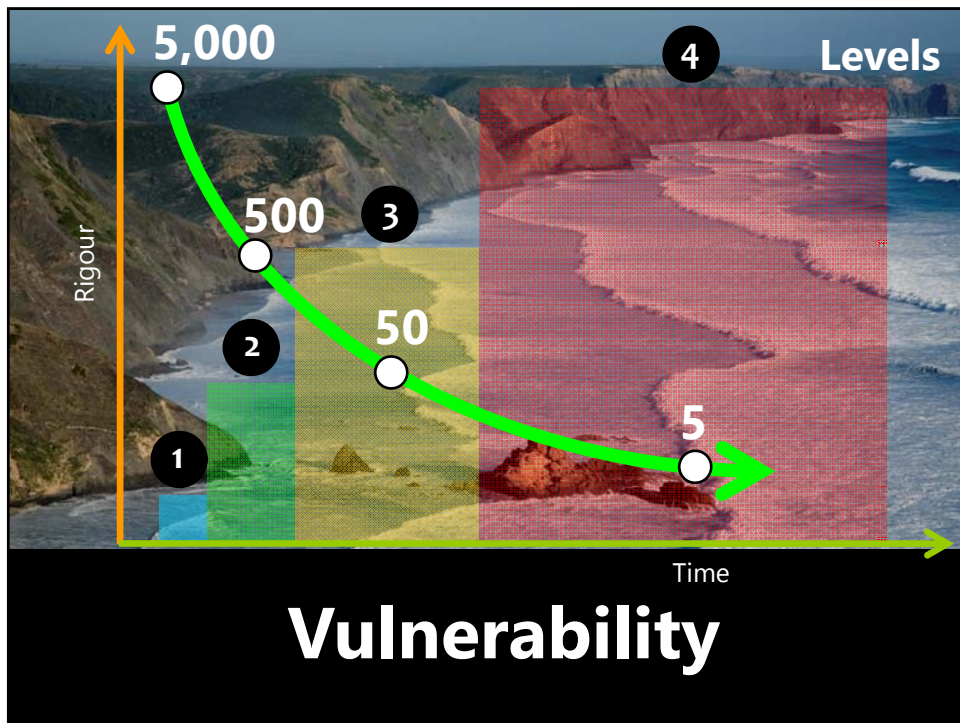
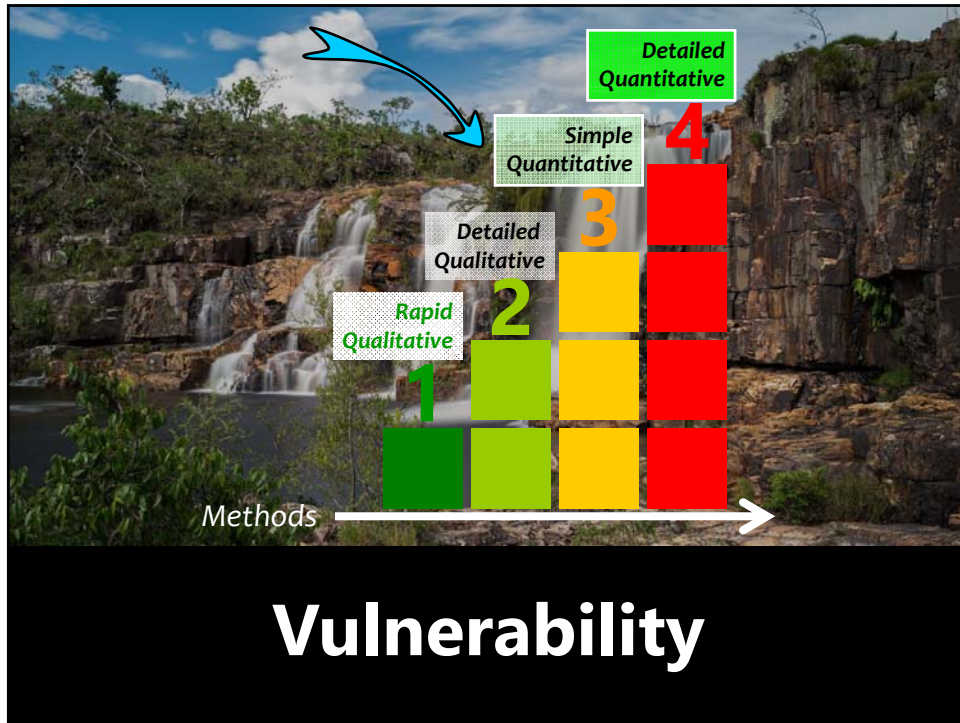
Two-dimensional dam slice models (Scaled down)
Validating results of Analytical Studies

Dynamic Shake Table Testing

Lab. Experimental Studies







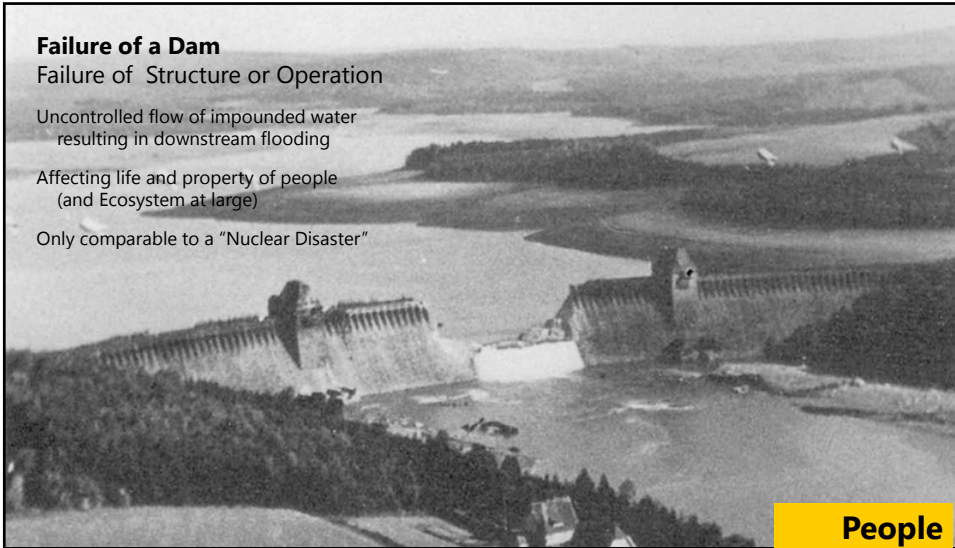
Failure of a Dam

Failure of Structure or Operation

Uncontrolled flow of impounded water
resulting in downstream flooding

Affecting life and property of people
(and Ecosystem at large)

Only comparable to a "Nuclear Disaster"



Breached Mohne Dam

Exposure

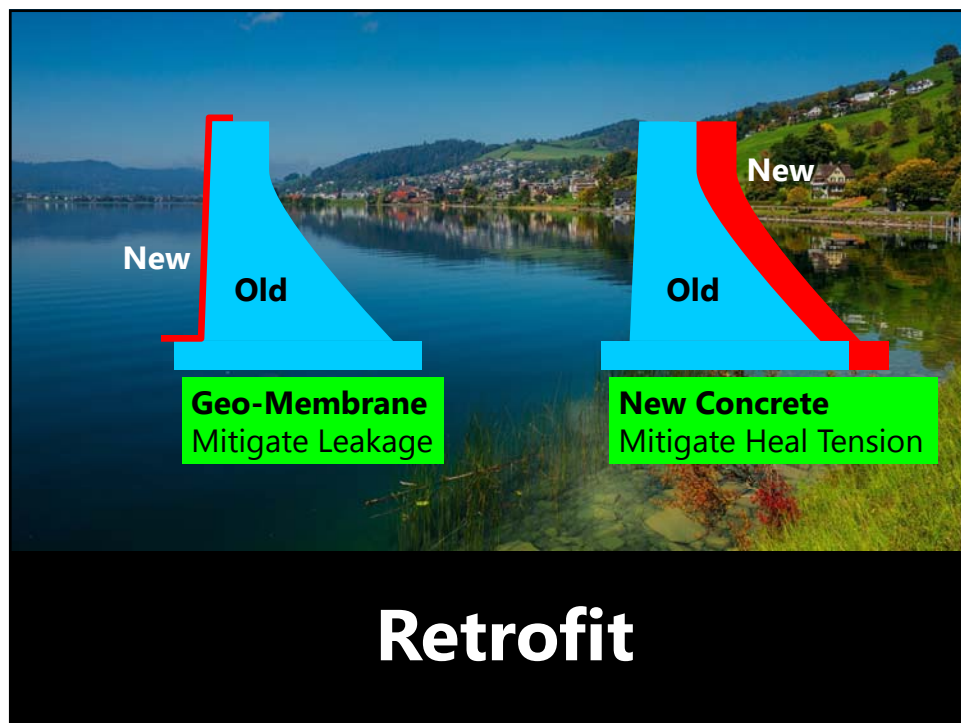
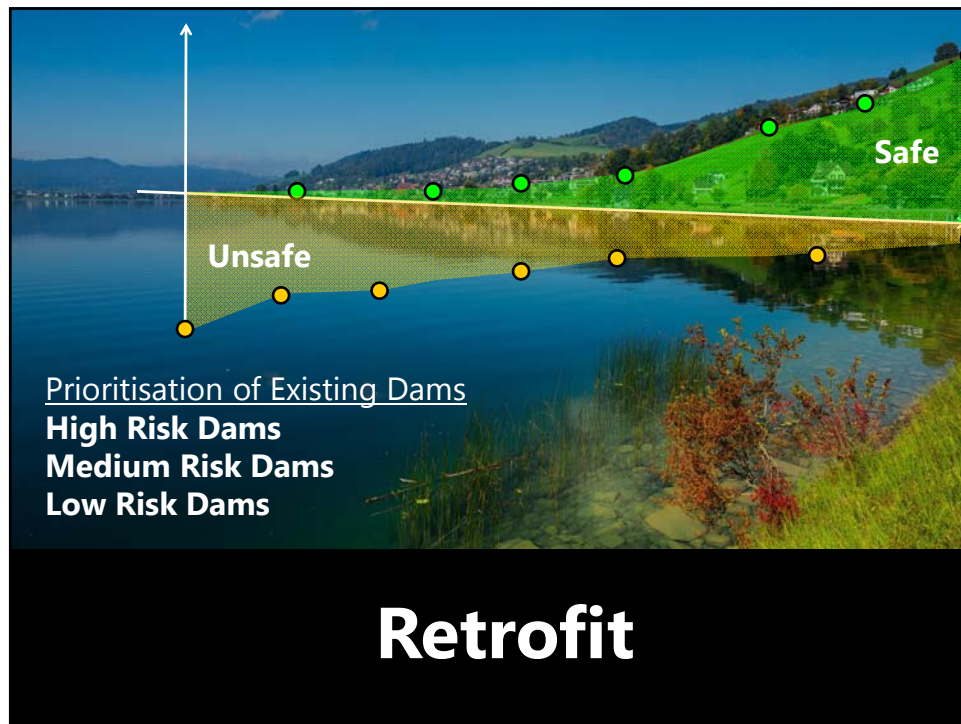
People
Property
Businesses
Finances

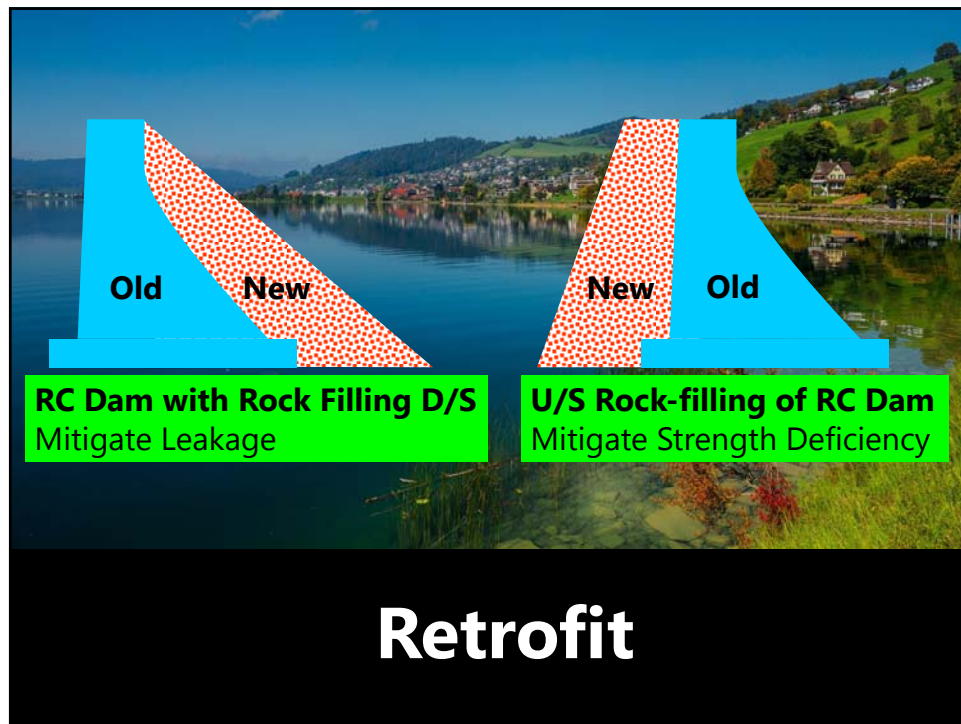


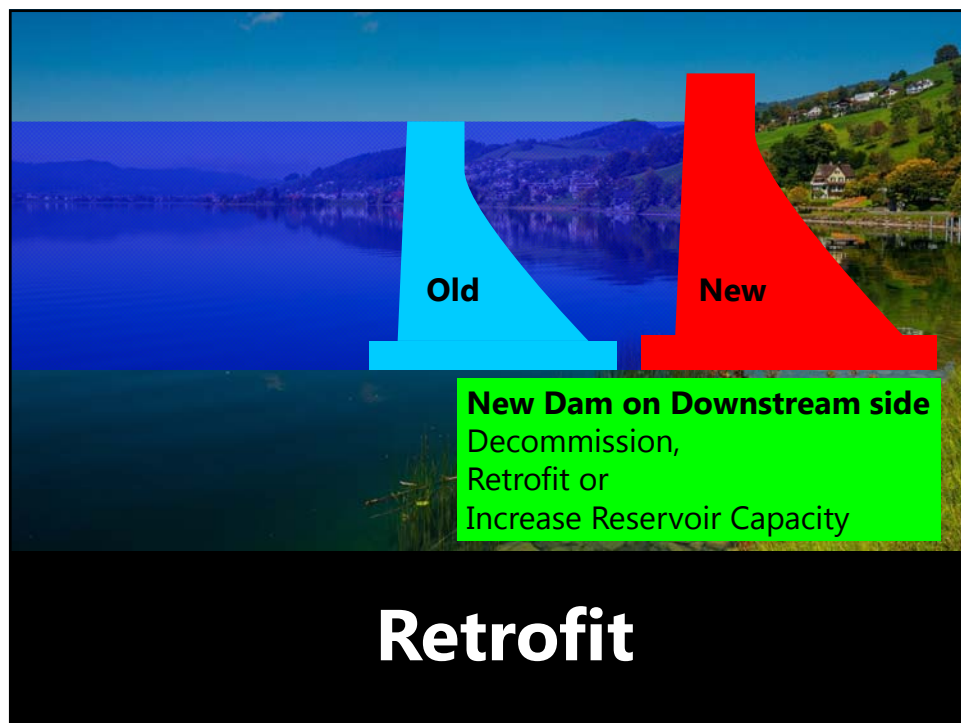
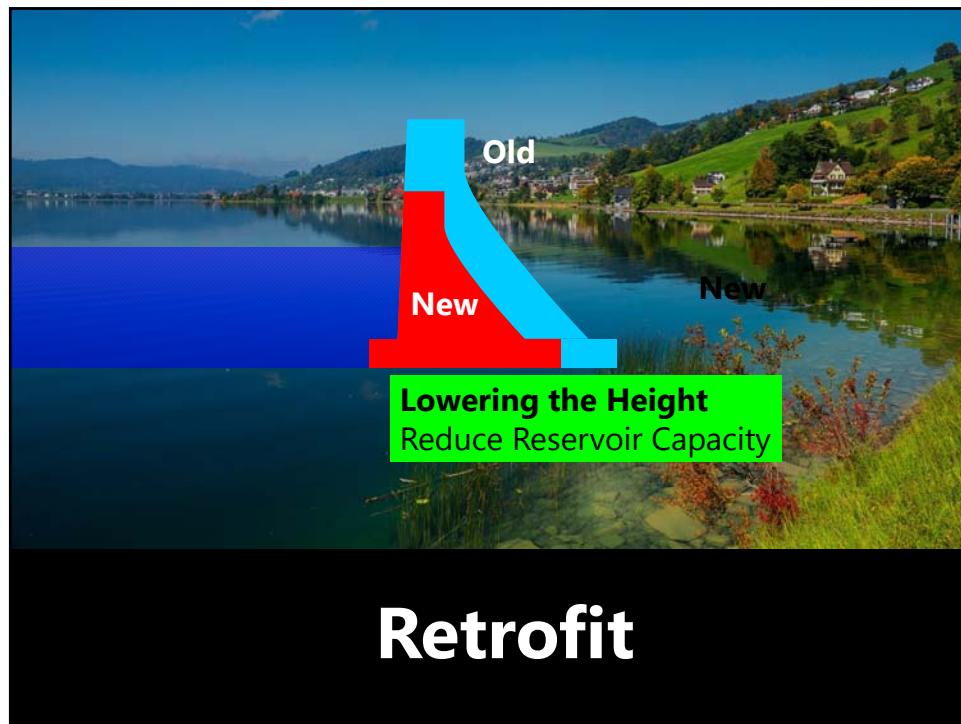
Failed Laos Dam

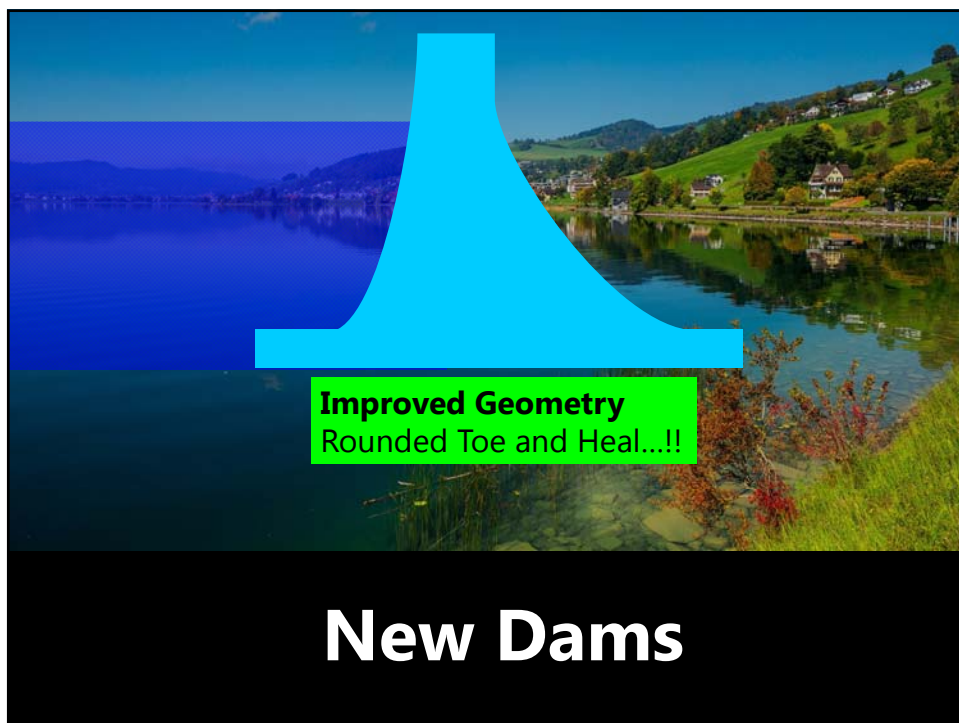
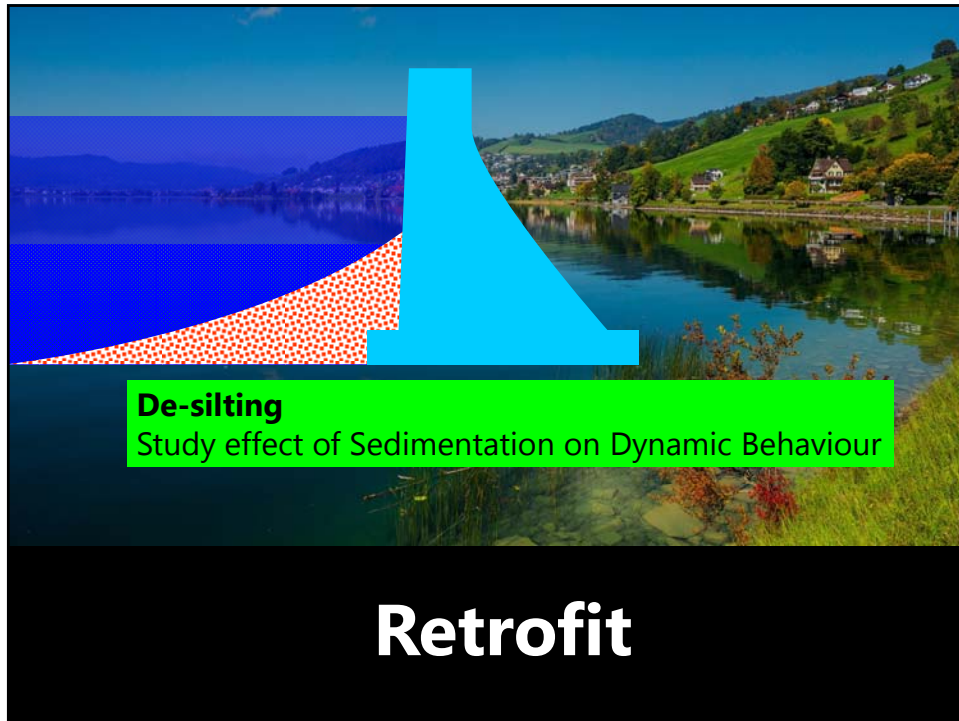
Exposure

People
Property
Businesses
Finances









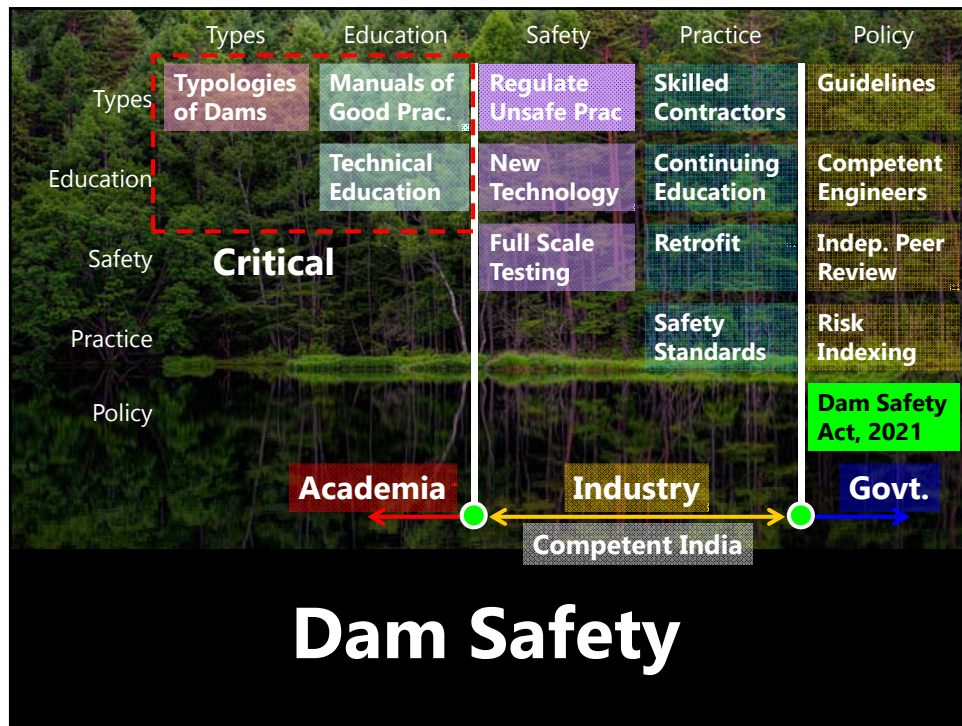


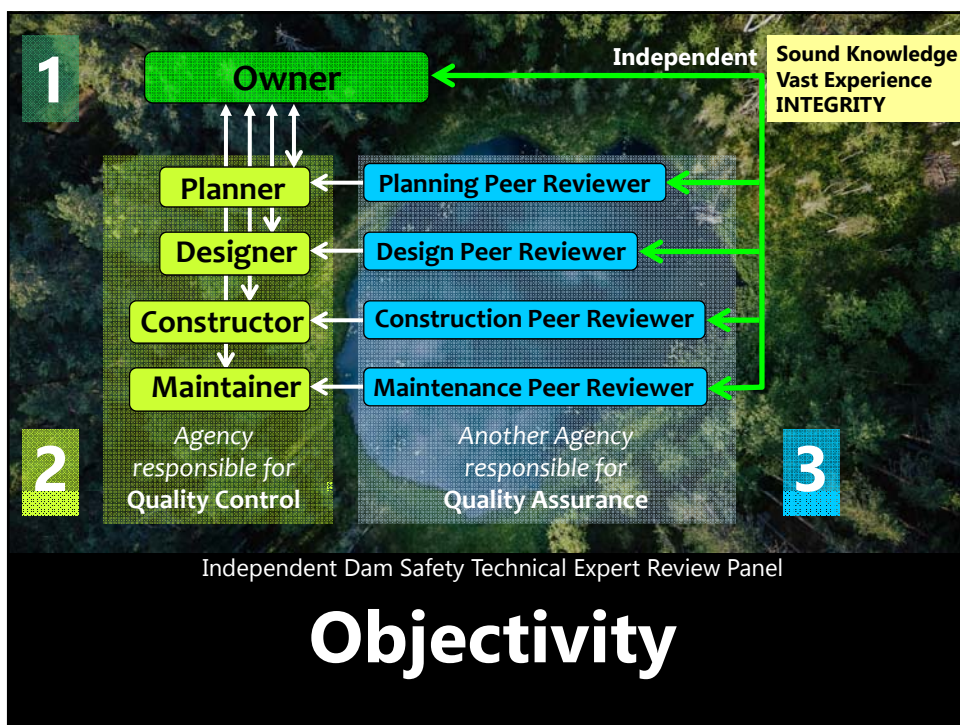
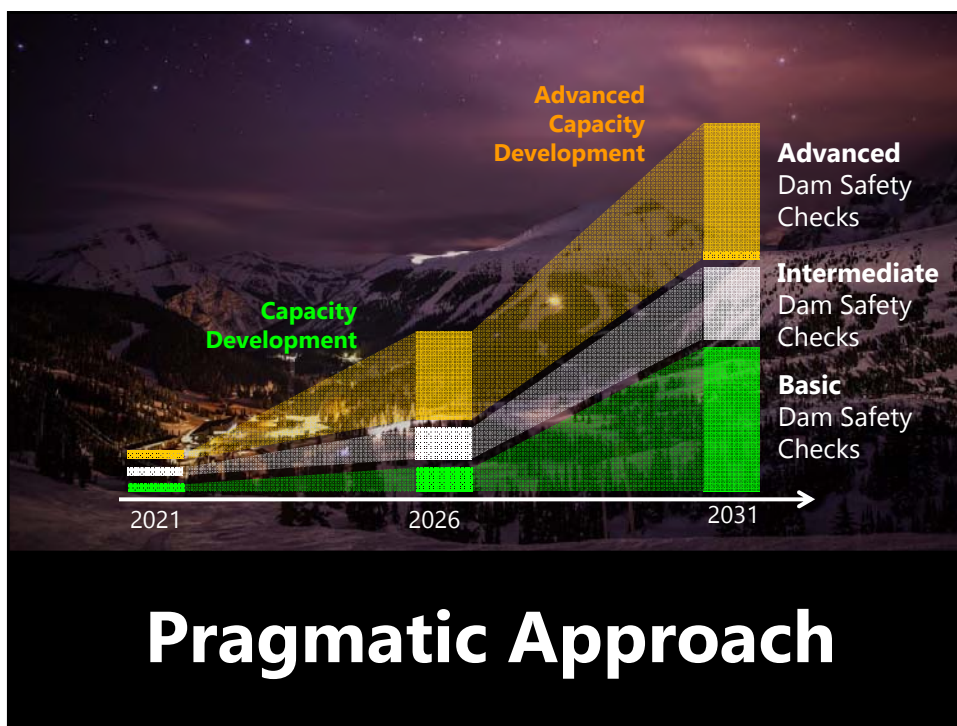
Dam Safety Act, 2021

Far reaching impact and importance
 Save people, property & every life form
 in the riverine ecosystem
 Consequences of dam failure catastrophic

Effective Implementation of the Act
 A gigantic task
 of national importance beyond local boundaries

Historic Legislation





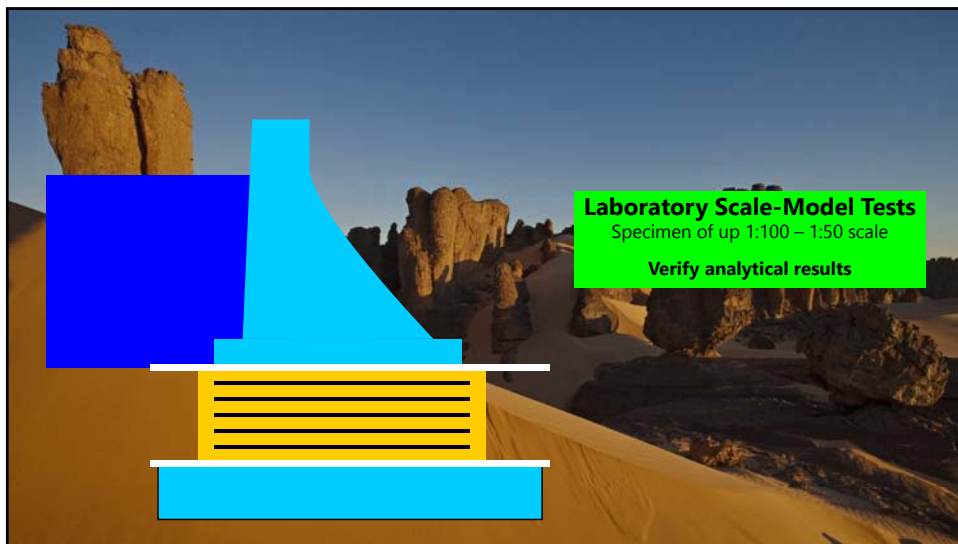


Field Tests on Dams

Dynamic Characteristics

Natural Periods
Natural Mode Shapes
Damping at Natural Periods

Test Existing Dams

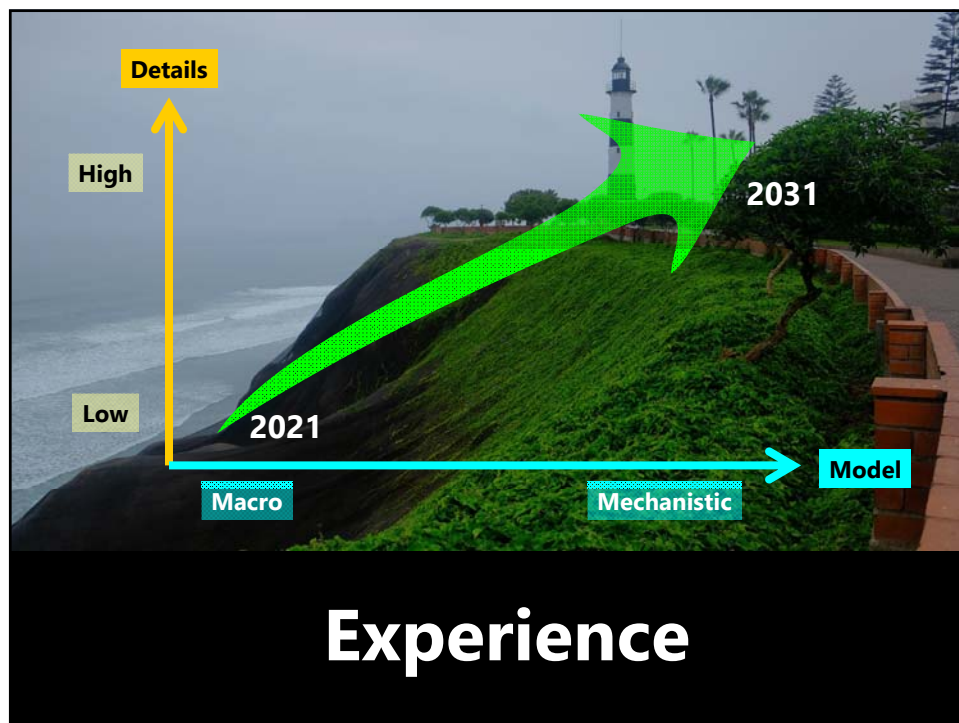
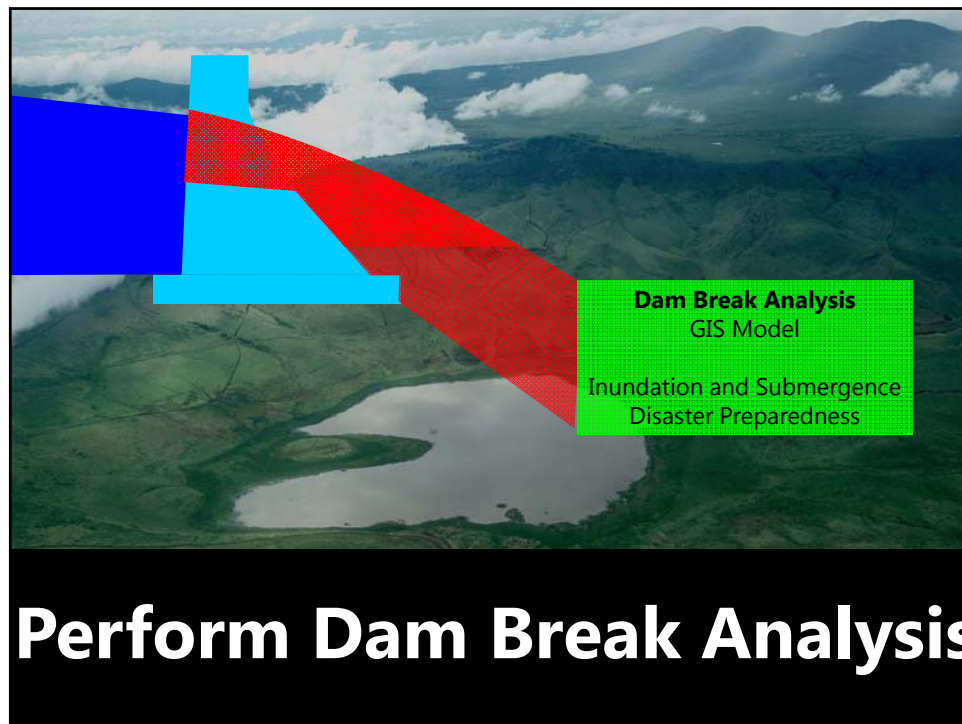


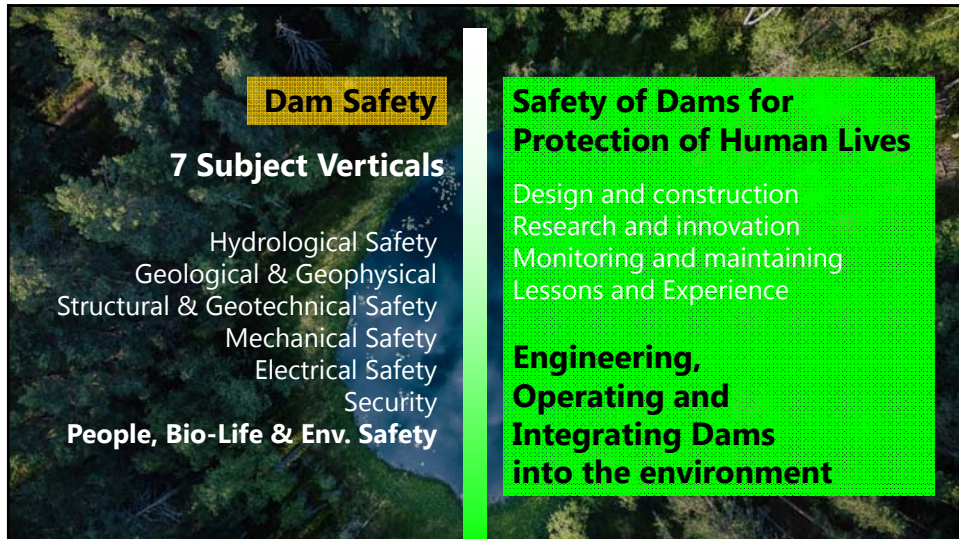
Laboratory Scale-Model Tests

Specimen of up 1:100 – 1:50 scale

Verify analytical results

Build Test Capabilities





Dam Safety

7 Subject Verticals

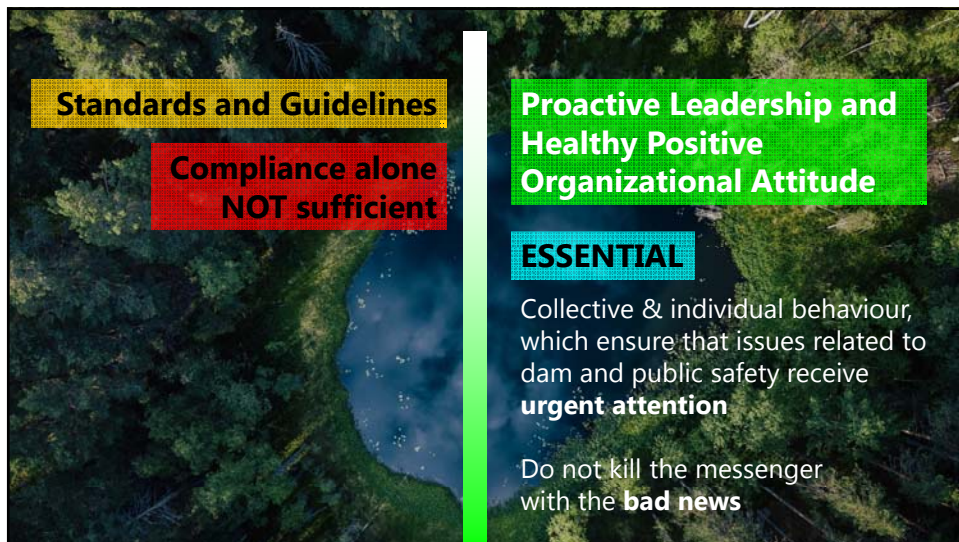
- Hydrological Safety
- Geological & Geophysical
- Structural & Geotechnical Safety
- Mechanical Safety
- Electrical Safety
- Security
- People, Bio-Life & Env. Safety

Safety of Dams for Protection of Human Lives

- Design and construction
- Research and innovation
- Monitoring and maintaining
- Lessons and Experience

Engineering, Operating and Integrating Dams into the environment

Safety Culture



Standards and Guidelines

**Compliance alone
NOT sufficient**

Proactive Leadership and Healthy Positive Organizational Attitude

ESSENTIAL

Collective & individual behaviour, which ensure that issues related to dam and public safety receive **urgent attention**

Do not kill the messenger with the **bad news**

Safety Culture



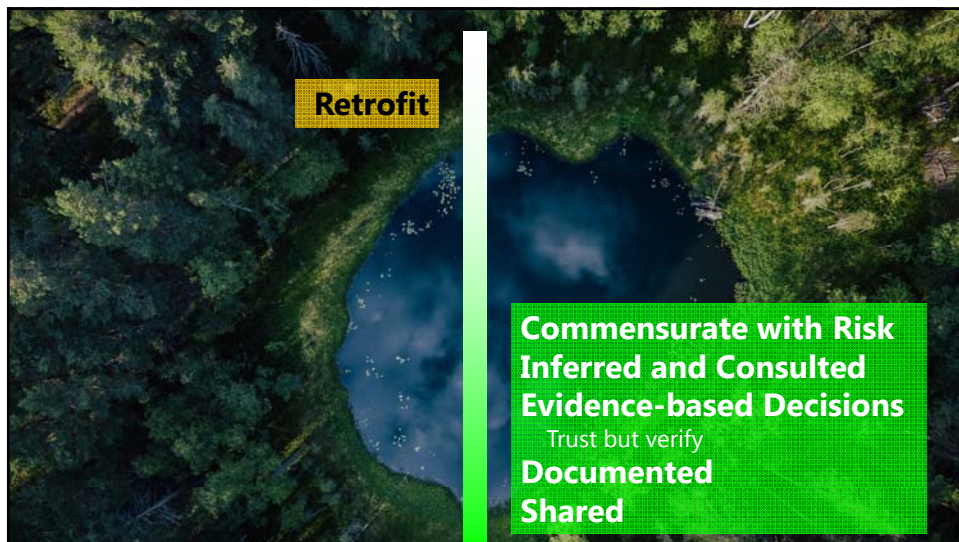
Quality Assurance

- Owner
- Designer
- Contractor
- Supervisor
- Engineer
- Maintainer
- Retrofitter

**Right Person
Right Place
Right Time**

ESSENTIAL

Safety Culture



Retrofit

**Commensurate with Risk
Inferred and Consulted
Evidence-based Decisions**

Trust but verify

**Documented
Shared**

Safety Culture



The URGENT Need

**Technical Human
Resource Development**

- Bachelors Degree
- Masters Degree
- Post-Graduate Diploma
- Doctoral Degree

Safety Culture

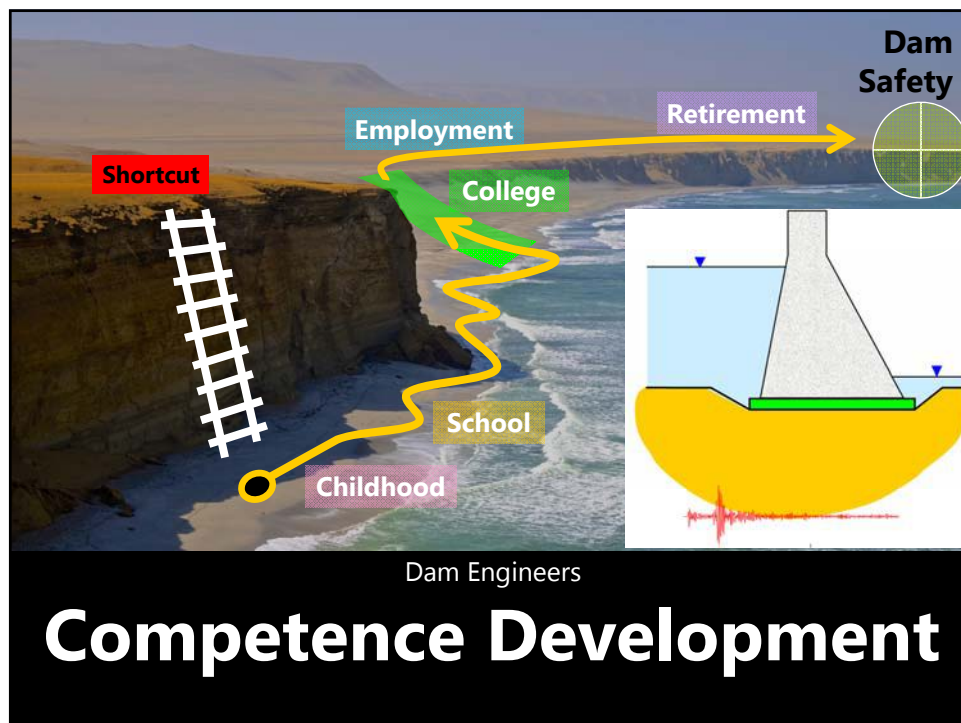
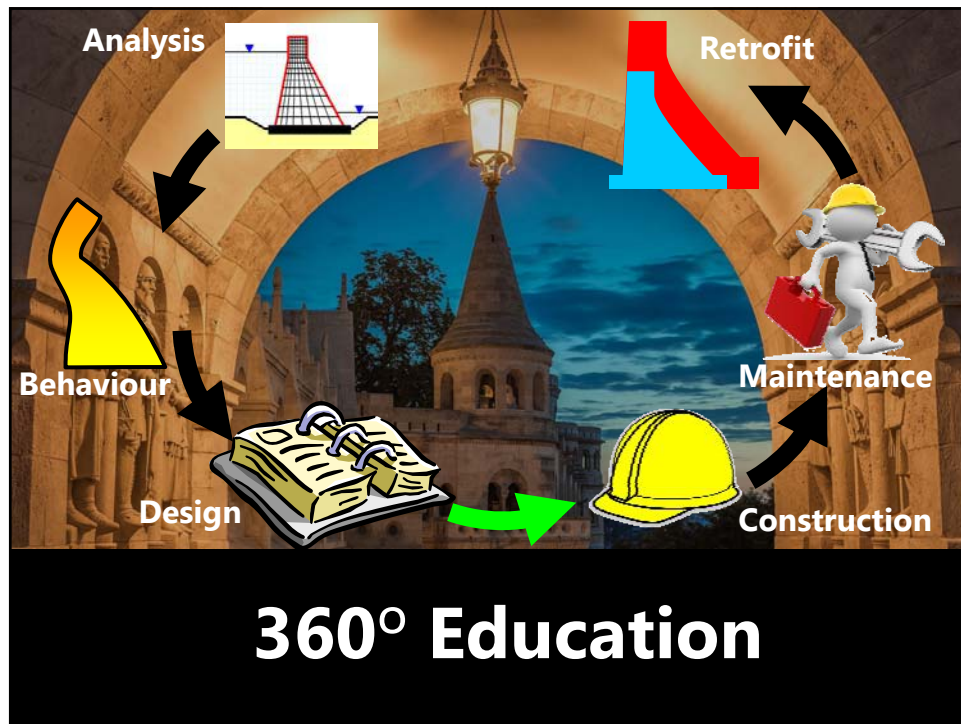


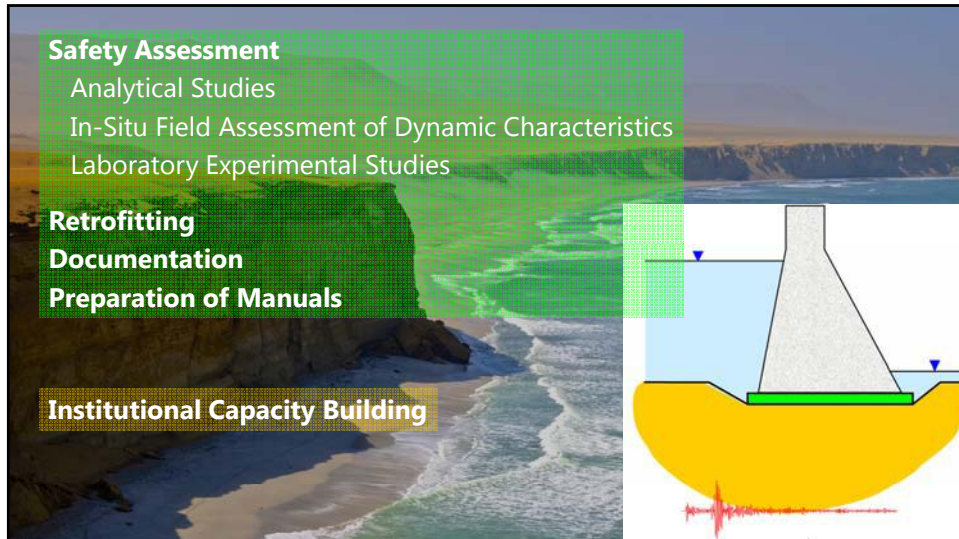
**Central Water Commission
and
State Governments**

**Dedicated Officers & Staff
to Mainstream
Dam Safety Act, 2021**

- Thematic Competence
- Coordination with States
- Administrative Aspects
 - :: NCDS, and NDSA
 - :: SCDS, and SDSO

Safety Culture





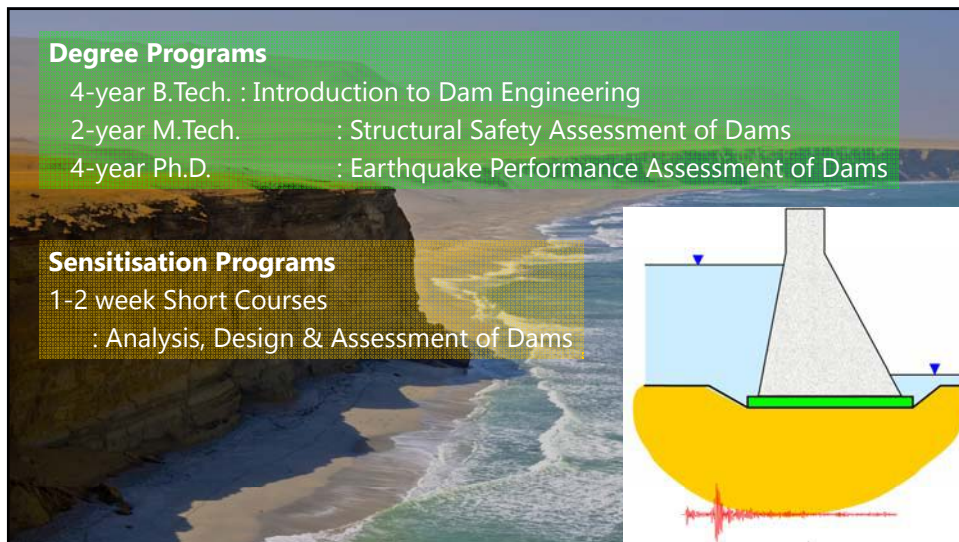
Safety Assessment
 Analytical Studies
 In-Situ Field Assessment of Dynamic Characteristics
 Laboratory Experimental Studies

Retrofitting
Documentation
Preparation of Manuals

Institutional Capacity Building

Dam Engineers

Competence Development

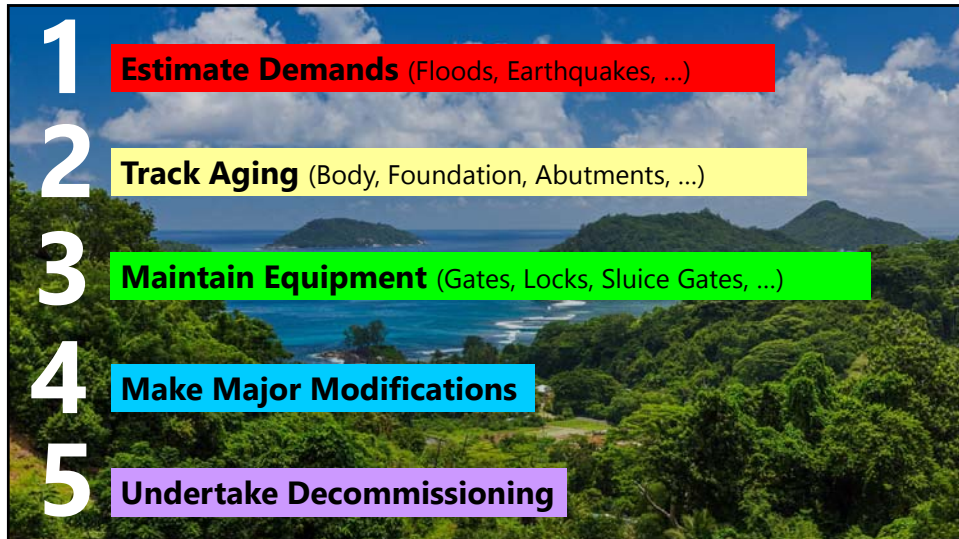


Degree Programs
 4-year B.Tech. : Introduction to Dam Engineering
 2-year M.Tech. : Structural Safety Assessment of Dams
 4-year Ph.D. : Earthquake Performance Assessment of Dams

Sensitisation Programs
 1-2 week Short Courses
 : Analysis, Design & Assessment of Dams

Dam Engineers

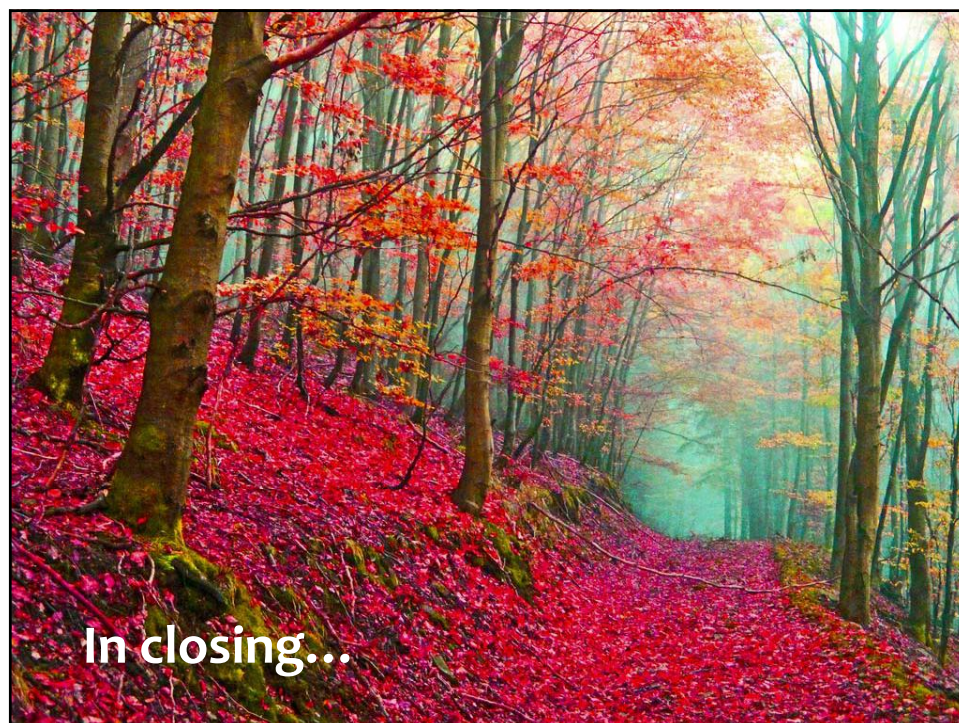
Competence Development



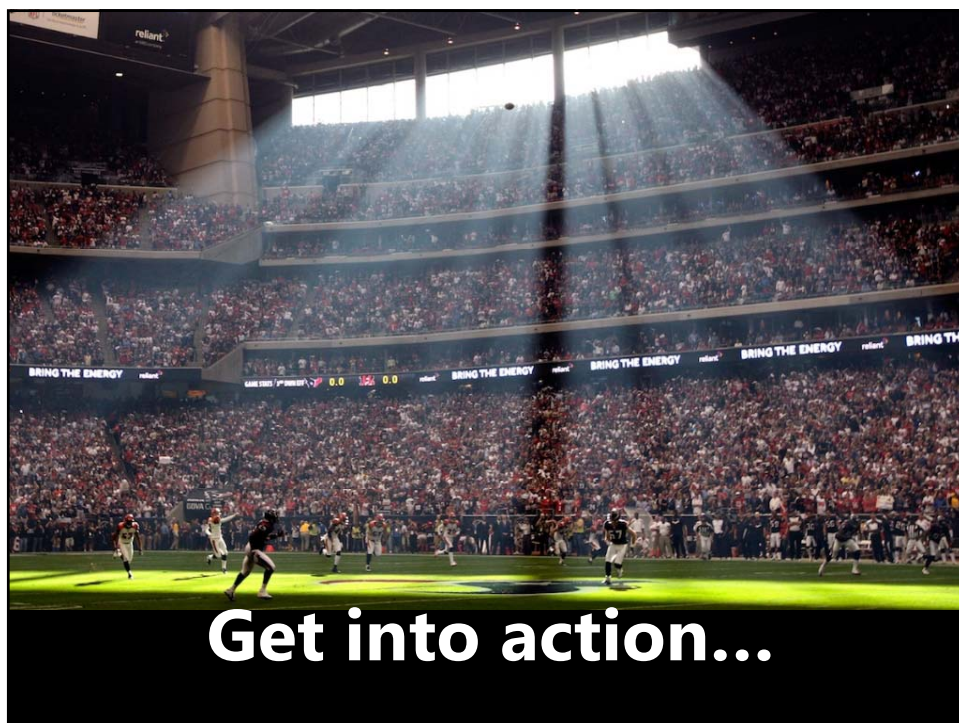
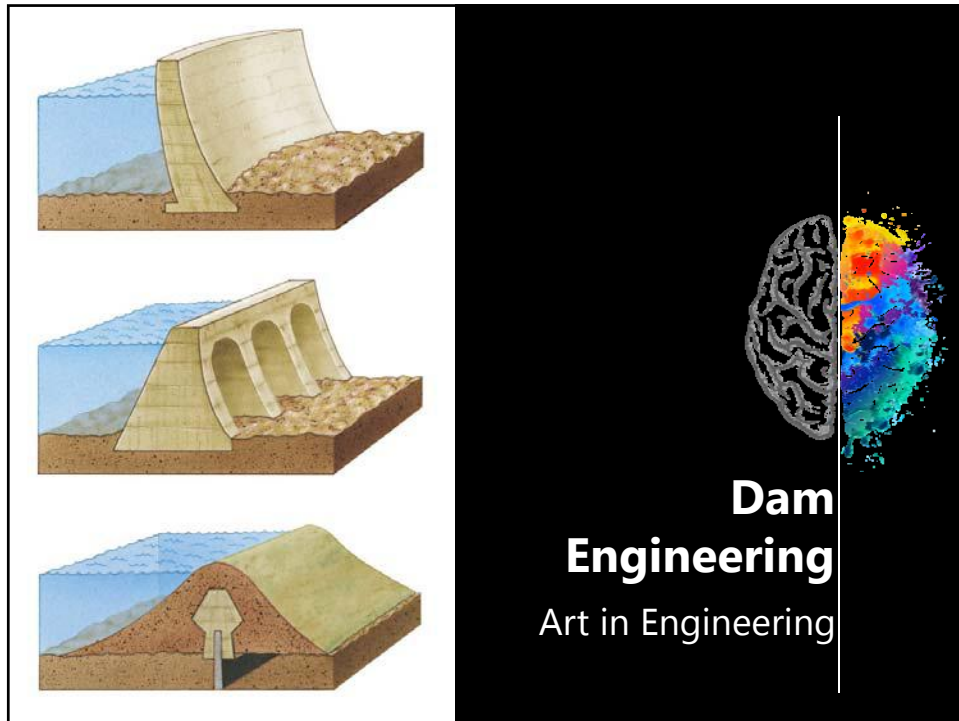
- 1** **Estimate Demands** (Floods, Earthquakes, ...)
- 2** **Track Aging** (Body, Foundation, Abutments, ...)
- 3** **Maintain Equipment** (Gates, Locks, Sluice Gates, ...)
- 4** **Make Major Modifications**
- 5** **Undertake Decommissioning**

Dam Safety timeline for EXISTING Dams...

A Lifelong Crusade...





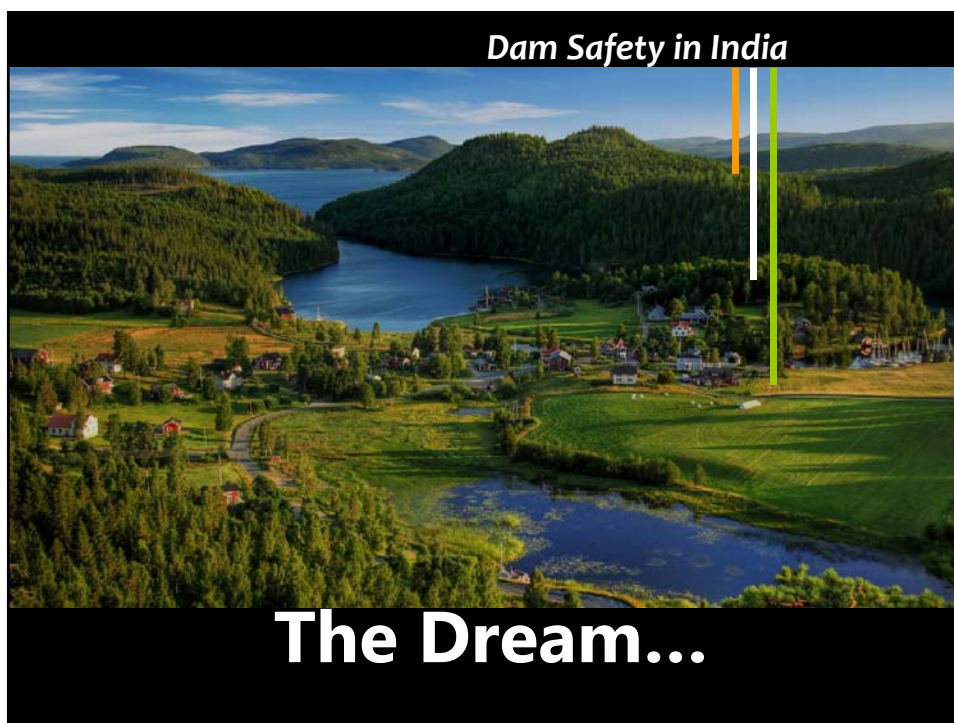




Tough conditions



Hard work...



Grateful

- **Ministry of Jal Shakti, Government of India**

- *Hon'ble Minister of Jal Shakti*

- **Shri Gajendra Singh Shekhawat Sahab**

- *Hon'ble Ministers of State*

- *Officers*

- **Secretary**

Shri Pankaj Kumar

- **Additional Secretary**

Smt. Debashree Mukherjee

- **Joint Secretary**

Shri Sanjay Awasthi

- **Chairman, CWC**

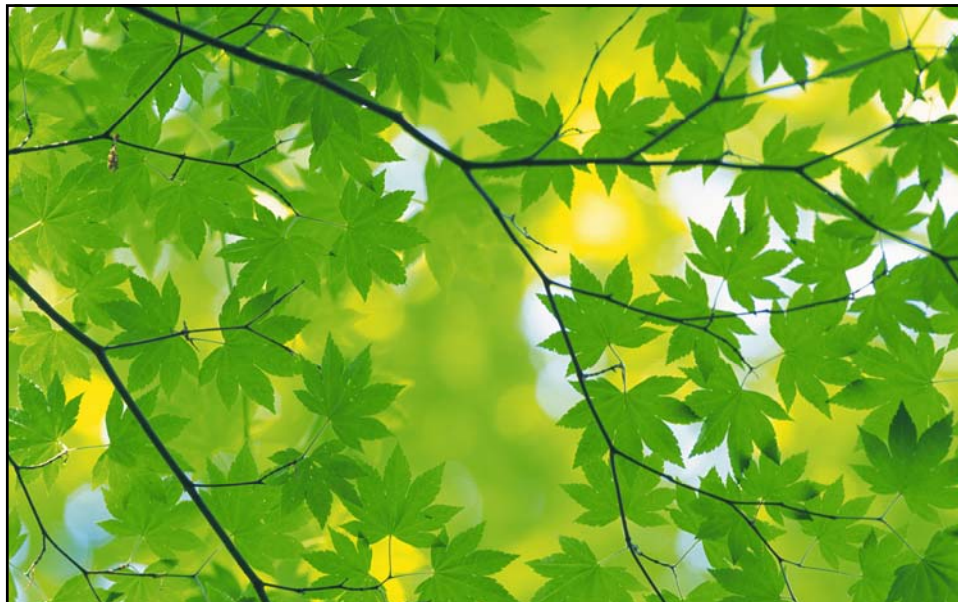
Shri R. K. Gupta

- *Colleagues of CWC*

- **Hon'ble Ministers of State Governments**

Clipart and Photos from Internet





Thank you!!



Jai Hind !!

