DAM DISTRESS & DAM FAILURES

EXAMPLES & CASE-STUDIES

IIT-Roorkee

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- Dams: Complex Structures.
- No ‘Unsafe dams’.
- Dams can pose risks – due to:
  - dam failures,
  - miss-operation of dams.

✓ Two important factors:
(i) likelihood of a dam failure,
(ii) extent of damage & deaths it would cause.

- The society in general is risk-averse:

“If consequences of an adverse event were to increase, society will desire a decrease in the likelihood of such event.”

•**Dam safety mgmt**: an integration of '*safety evaluation*', '*risk assessment*' and '*risk management*'.

• **Risk**: product of '*probability of failure*' and '*measure of consequence*'.

•Risks based dam safety mgmt. helps in tradeoff between risk and cost of mitigation.

- **Dam safety mgmt. enables:**

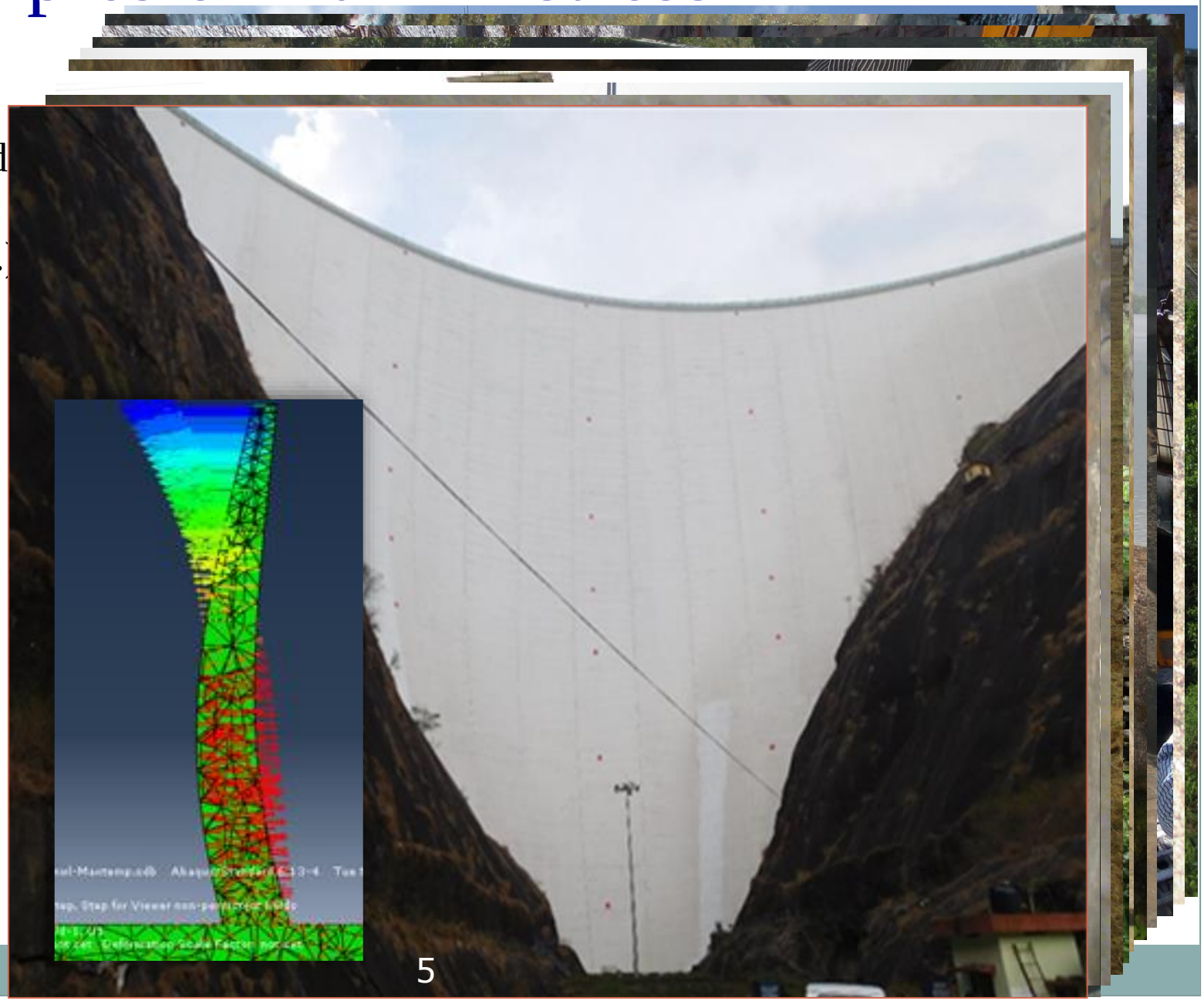
✓ focus on vulnerable elements.
✓ clear understanding of 'chances' and 'consequences' of failure.
✓ shifting of focus from structural to non-structural measures.
✓ prioritization of rehabilitation.
✓ judicious decisions on decommissioning.

- **Distress**: Occurrence or potential development of such conditions in the dam, which if left unattended may impede the safe operation of dam for intended benefit, or may pose unacceptable risks to life and property of people downstream.
- **Threat**: An event or condition that may result in a hazard occurring.
- **Failure Mode**: The mechanism by which a distress, initiated by threat, leads to failure of a dam.

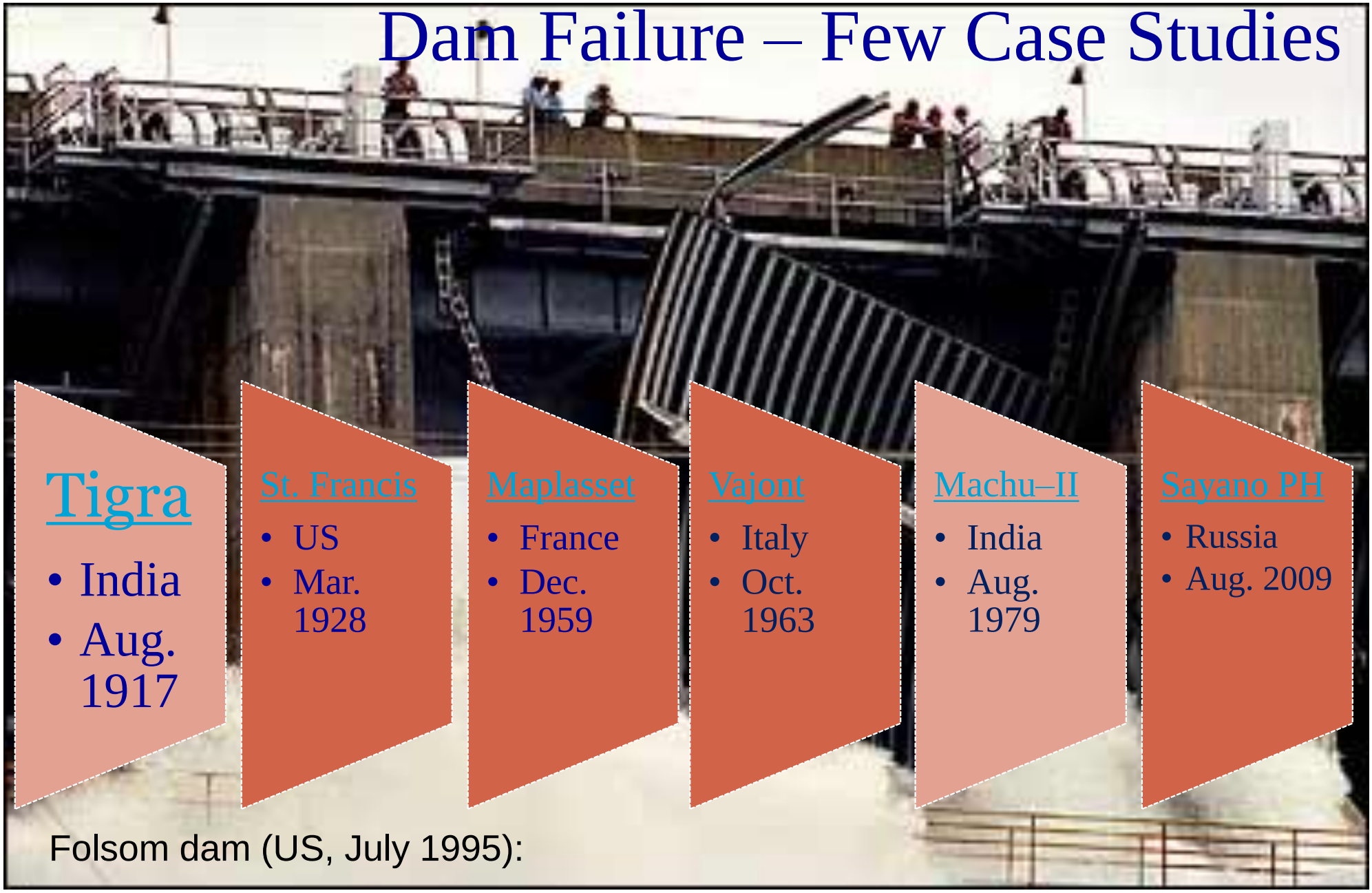
Few Examples of Dam Distress

- Temgardh (Mah)
- Kuttiyadi (Kerala)
- Maneri (Uttrakhand
- Ari (MP)
- Kanhirapuzha (Ker.)
- Chimony (Ker.)
- Chandpatha (MP)
- Durgavati (Bihar)
- Konar (Jharkhand)
- Baghliar (J&K)
- Koteshwar (Uttra.)

- Idukky (Kerala)



Dam Failure – Few Case Studies



Tigra
- India
- Aug. 1917

St. Francis
- US
- Mar. 1928

Maplasset
- France
- Dec. 1959

Vajont
- Italy
- Oct. 1963

Machu–II
- India
- Aug. 1979

Sayano PH
- Russia
- Aug. 2009

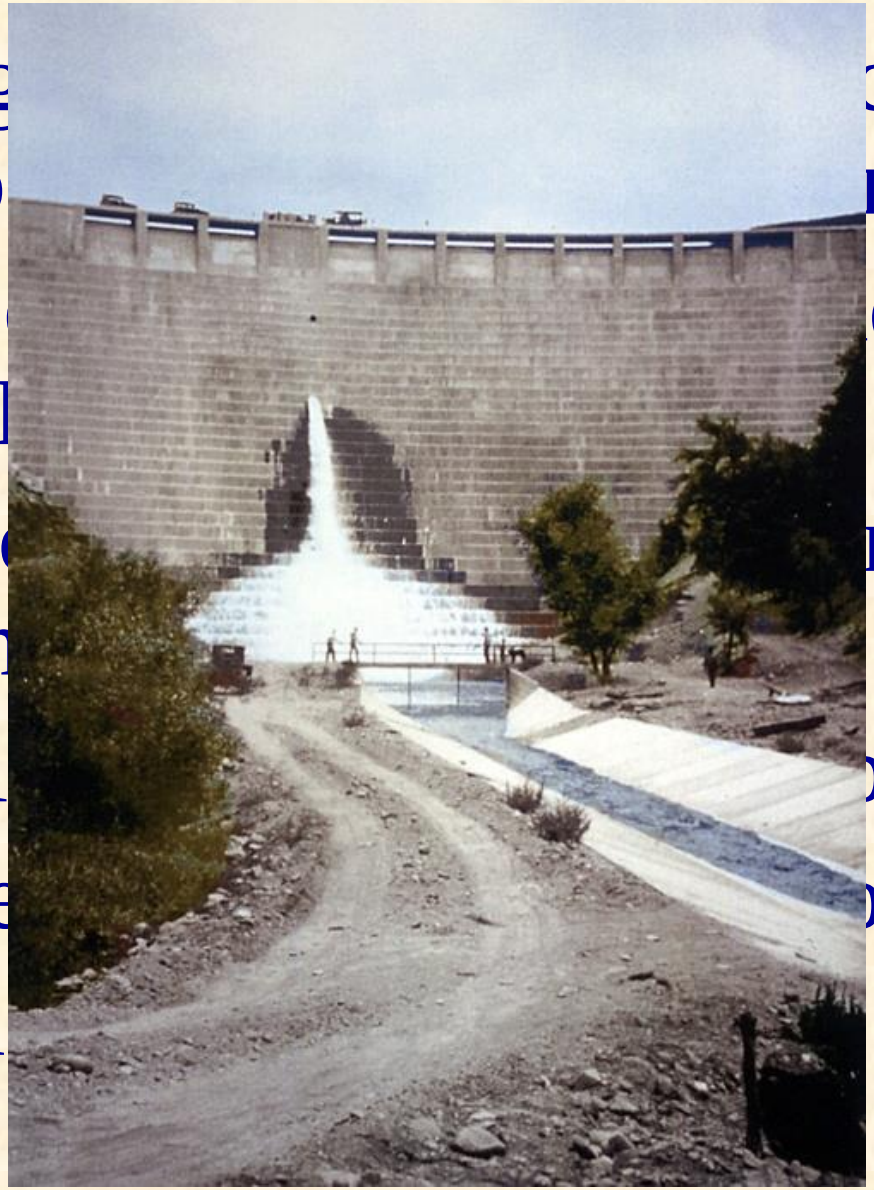
Folsom dam (US, July 1995):


Gararda Dam (Rajasthan, August 2010):
Thanks

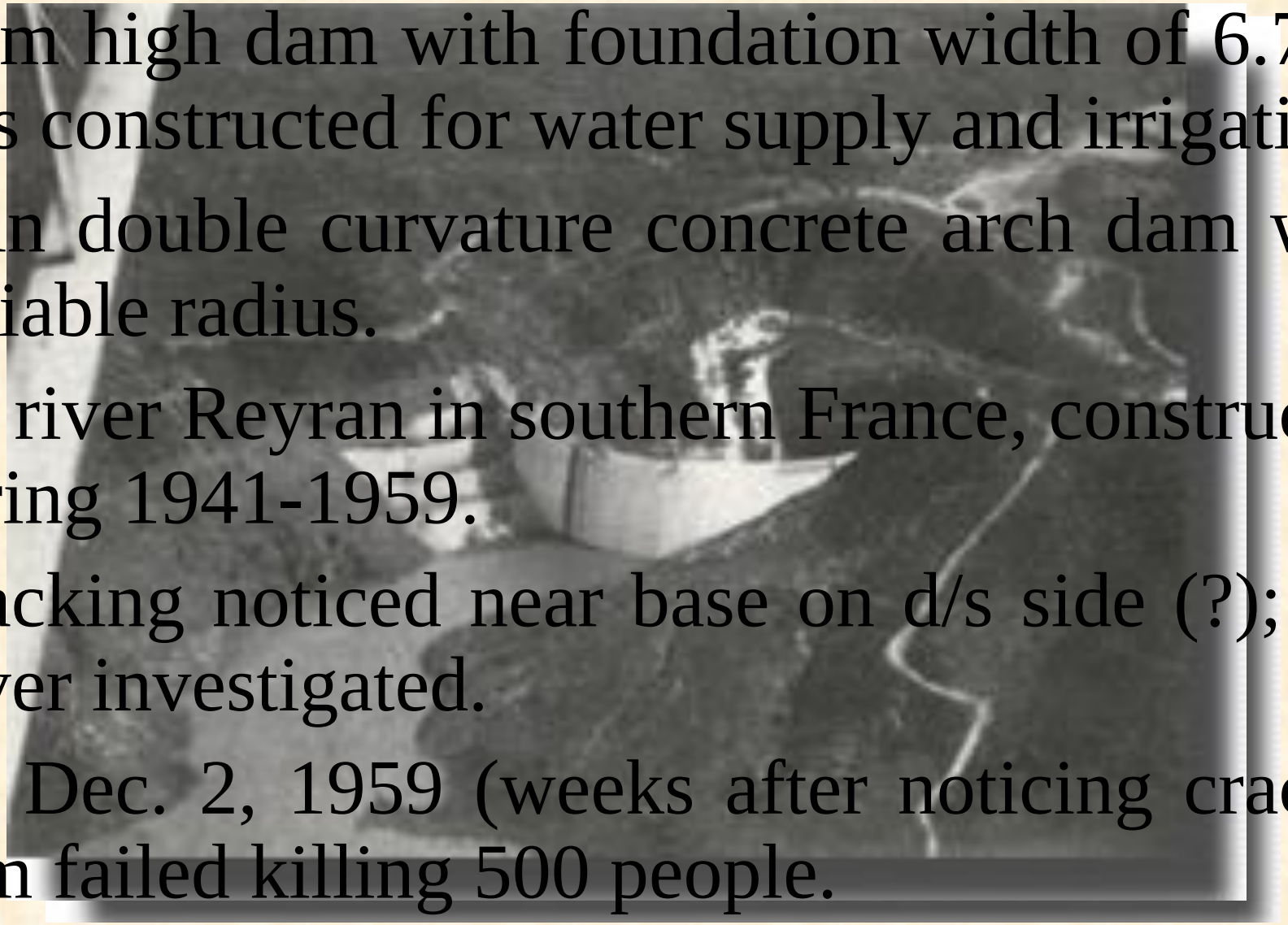
Extra Slides

St. Francis Dam Failure

- **C**oncrete g cated 64 km northwest o nia.
- Built betwe er supervision of William
- Catastrophi nutes before midnight on
- Filled to ful efore failure.
- 36,180 Acre ver 55 miles.
- Resulting fl



Maplasset Dam Failure



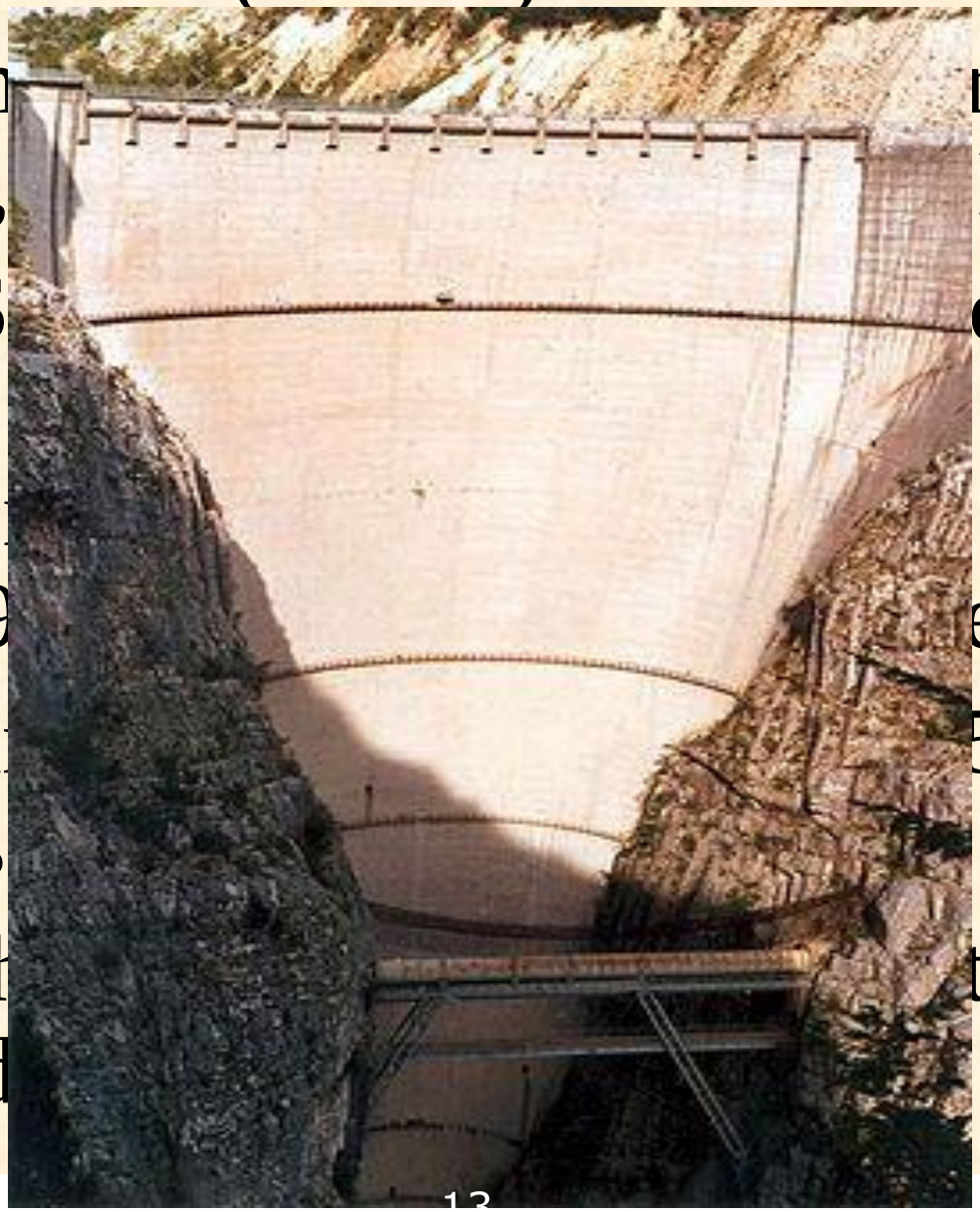
- 60 m high dam with foundation width of 6.78m was constructed for water supply and irrigation.
- Thin double curvature concrete arch dam with variable radius.
- On river Reyran in southern France, constructed during 1941-1959.
- Cracking noticed near base on d/s side (?); but never investigated.
- On Dec. 2, 1959 (weeks after noticing cracks) dam failed killing 500 people.

Maplasset Dam Failure – Contd.

- No
  - l-up
  - left
  - ased
- If day,
- Co king

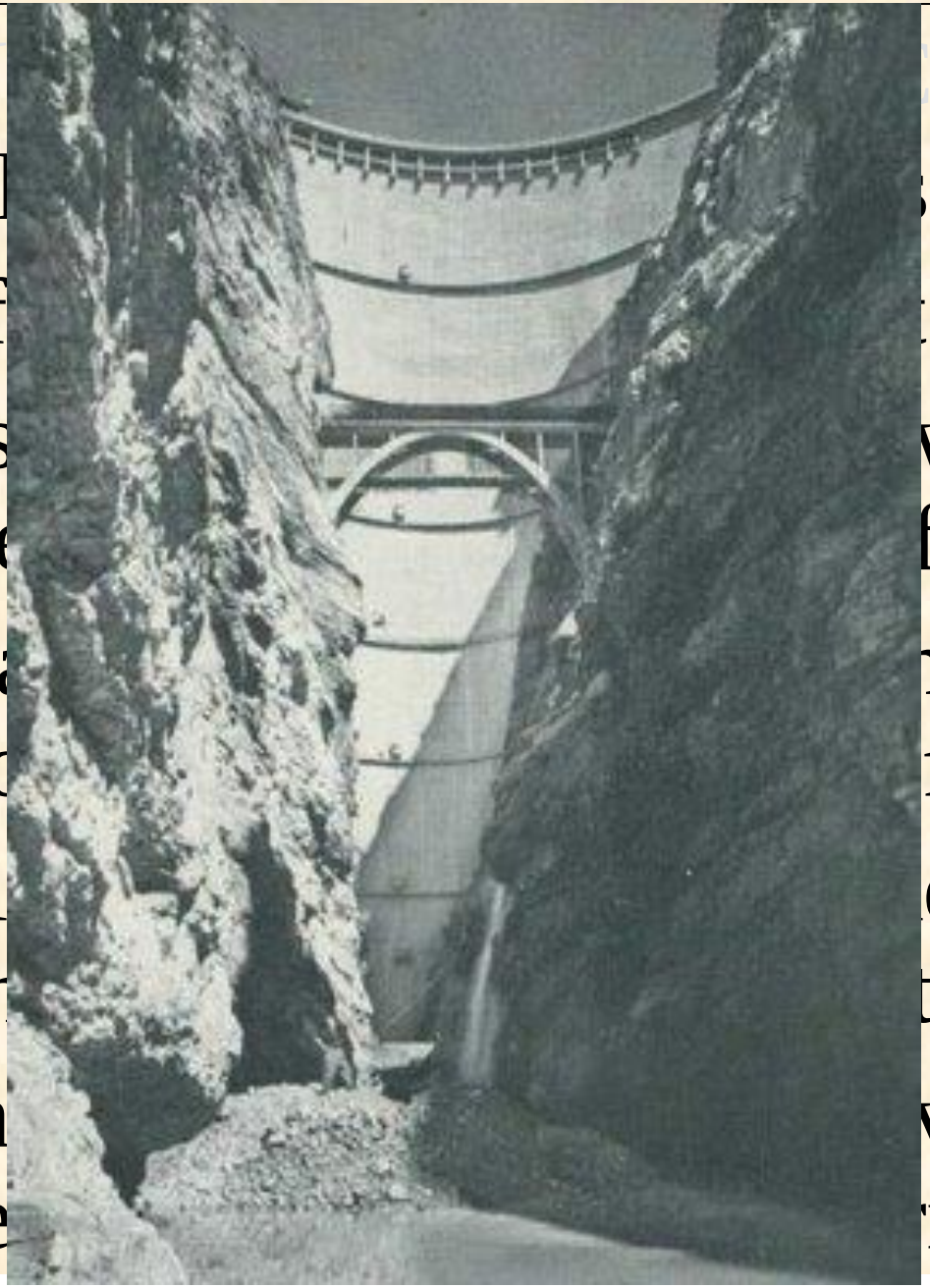
VAJONT (Vaiont) LANDSLIDE

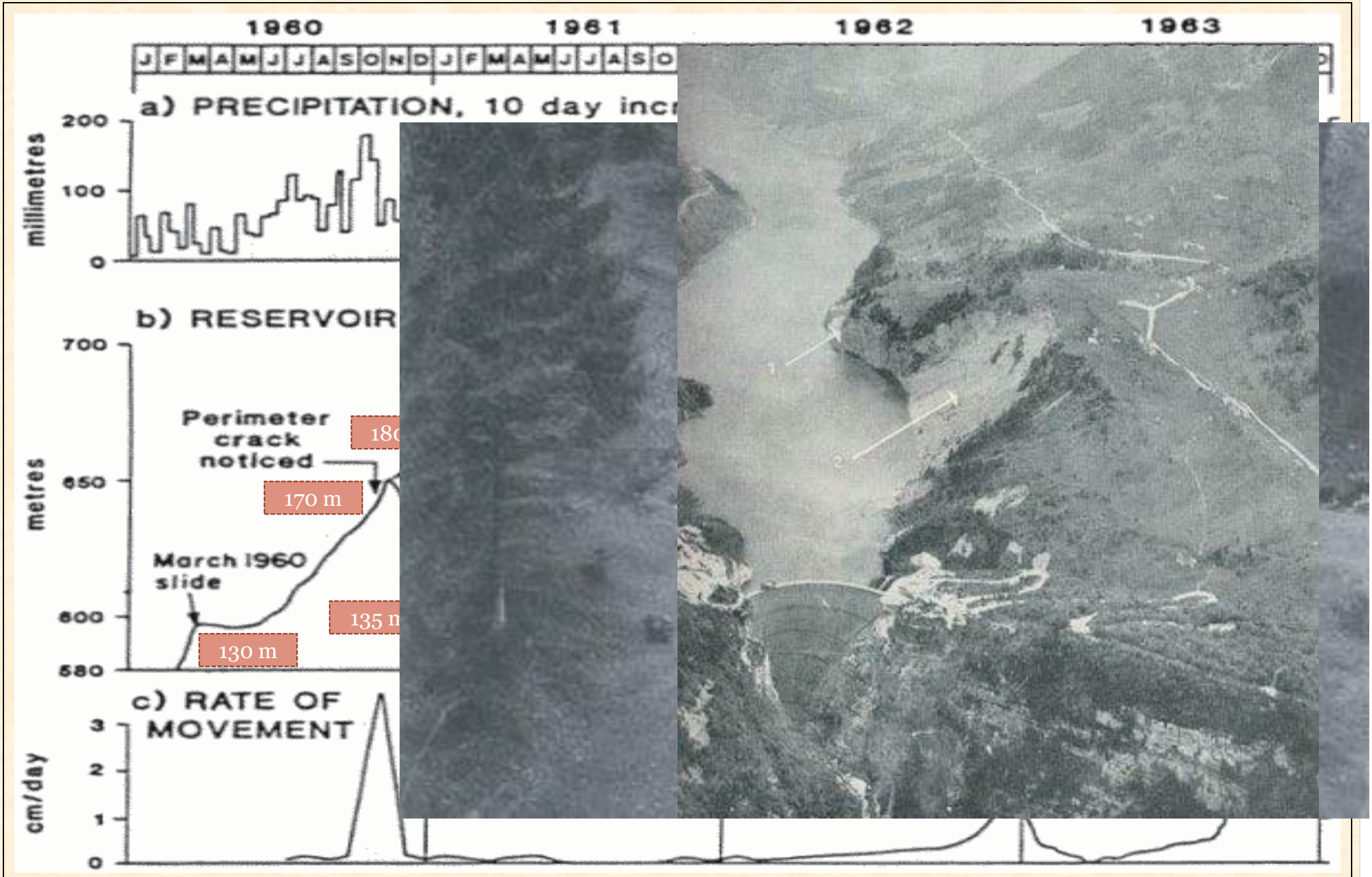
- Vajont Dam river under Monte Toc, Italy.
- Built by S or rapidly-expanding Turin and Modena. P excavation began in 19 ed in 1960.
- Doubly cu 5m height, was worlds
- Chord of th the volume of impound m3.



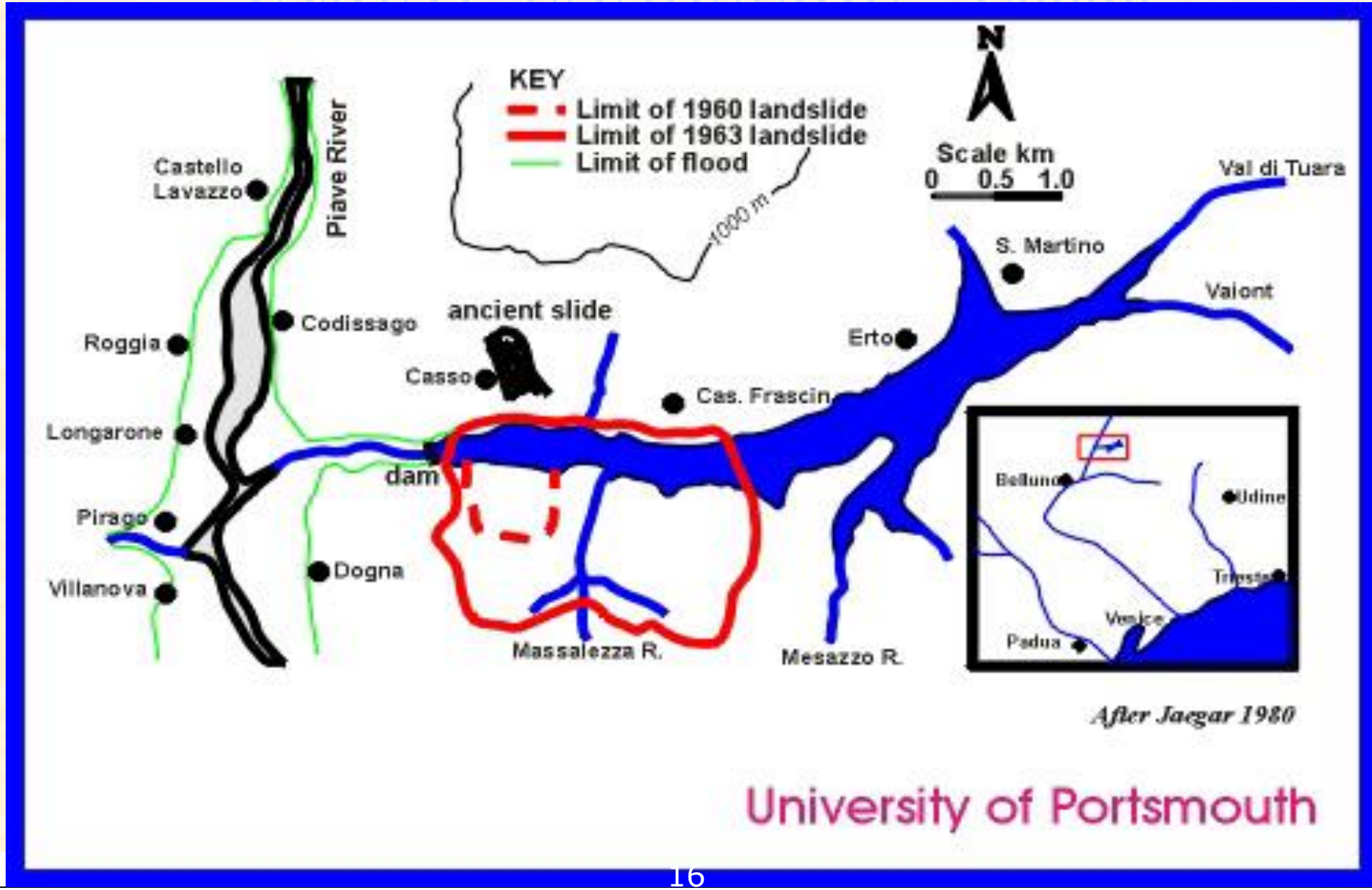
VAJ ontd.

- Bank stabil truction, but:
  - areas of test borings;
  - it was as would have a 'chairlike ffect';
  - seismic a nks have firm in-situ ro f elasticity.
- Smaller sli ely, although volumes ar ted to be low.
- By March voir reached 130m, whe rred.




1960
1961
1962
1963
J F M A M J J A S O N D J F M A M J J A S O
a) PRECIPITATION, 10 day incr
millimetres
200
100
0
b) RESERVOIR
700
650
600
580
metres
Perimeter crack noticed
180
170 m
March 1960 slide
135 m
130 m
c) RATE OF MOVEMENT
cm/day
3
2
1
0

VAJONT LANDSLIDE – Contd



VAJONT LANDSLIDE – Contd.

Sayano-Shushenskaya PH Failure

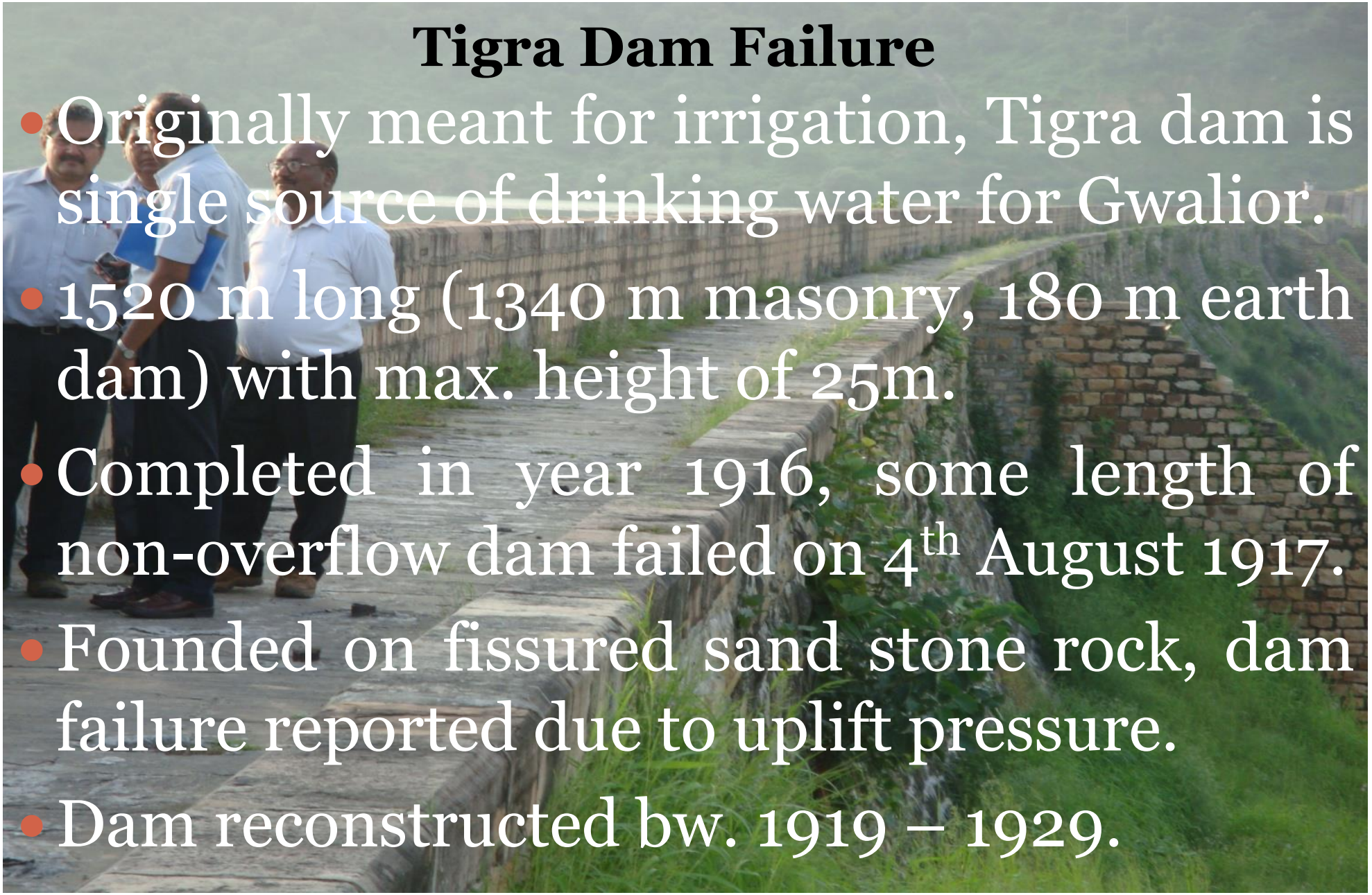
- On August 17th, 2009, near Sayanogorsk in south central Russia, a catastrophic accident took place in the turbine and transformer rooms of the hydroelectric plant of the Sayano-Shushenskaya dam.
- Water from Yenisei River flooded turbine room, causing at least one transformer explosion and extensive damage to all ten turbines, destroying at least three of them.
- 74 workers lost their lives in the accident.
- 40 tons of transformer oil spilled into the river, killing about 400 tons of trout.

Sayano-PH Failure – Contd.

Sayano- PH Failure - Contd.

- The 6th largest HEP of the world, it had 10 units of 650 MW each.
- Rated discharge:358.5 cu.m/sec; Nominal speed: 142.86 rpm; Net head: 194m, Runner wt: 156 ton; Runner dia: 6.77m; Dam height:245m; length: 1 km.
- Cause: Water hammer resulted in ejection of turbine-2 with all equipment(900 tons).
- Trigger: Sudden closure of wicket gates. A large piece probably entered into turbine and turned with runner. It hit wicket gates triggering closure in fraction of a second.

Tigra Dam Failure



- Originally meant for irrigation, Tigra dam is single source of drinking water for Gwalior.
- 1520 m long (1340 m masonry, 180 m earth dam) with max. height of 25m.
- Completed in year 1916, some length of non-overflow dam failed on 4th August 1917.
- Founded on fissured sand stone rock, dam failure reported due to uplift pressure.
- Dam reconstructed bw. 1919 – 1929.

Tigra Dam Failure

Tigra Dam Gates