



Presentation

on

Geophysical Investigation of Talakalale Dam
(A case study)

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Geophysical Investigation of Talakalale Dam (A case study)

- The Talakalale dam is a balancing reservoir situated in Shimoga District, Karnataka.
- The dam was completed during the year 1964.
- It is a composite gravity dam of height 62.48m and total length of the dam is 515.00m.
- It is the main source of water for power generation in Sharavathy Generating Station having installed capacity of 1035 MW.

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- Since from inception seepage of water was observed in the masonry portion of the dam.
- Treatment like grouting, deep pointing on the upstream face of the dam, under water plugging of suction points on the upstream side etc. were carried out.
- In spite of these treatments seepage problem is still persisting.
- To analyse the root cause of seepage, seepage path, zone of water accumulation and marking weak portions of the dam body Geophysical investigation survey has been carried out.

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The following geophysical investigation tests were conducted

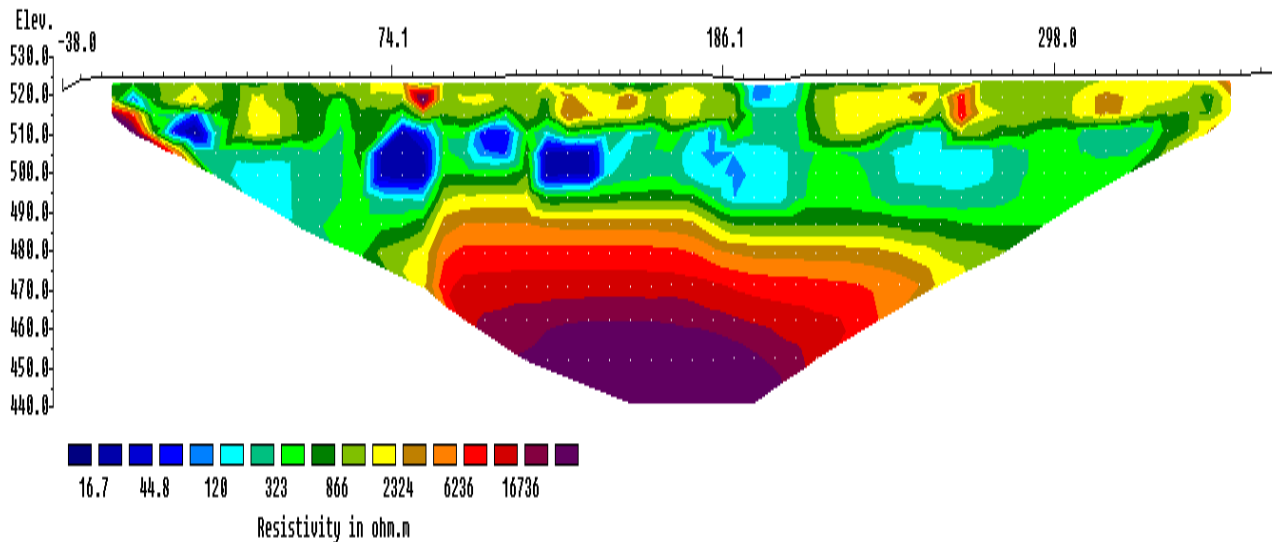
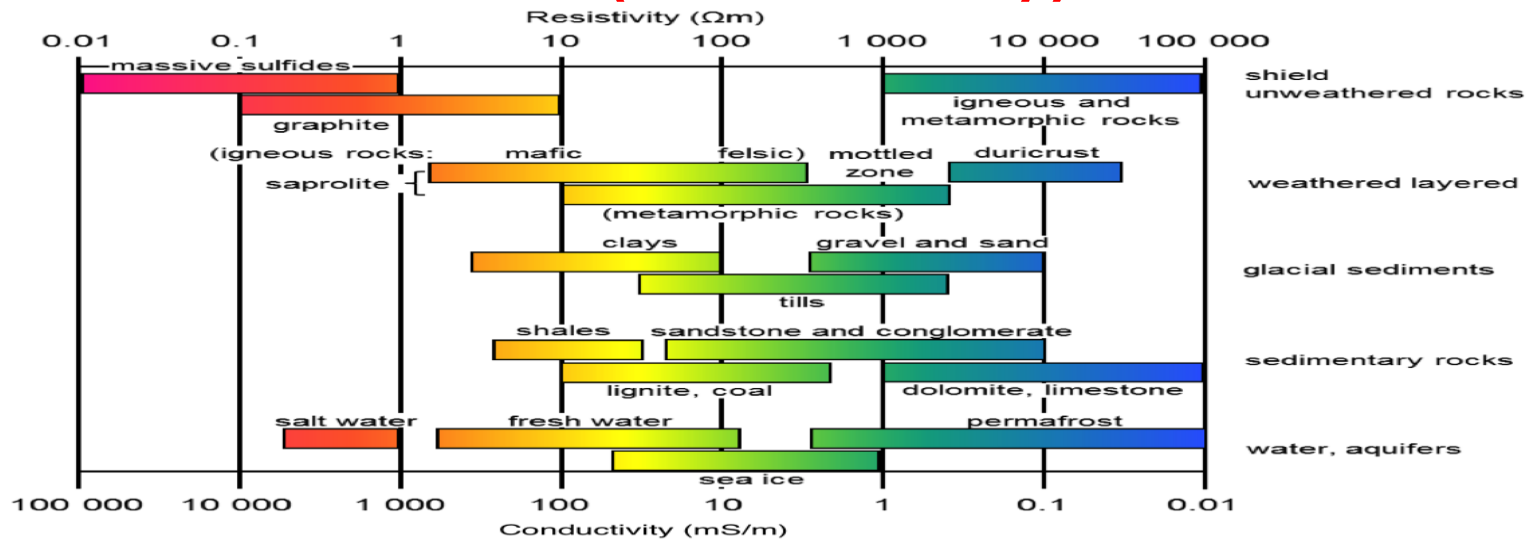
- Electrical resistivity imaging
- Streaming potential survey
- Sonic/Seismic refraction tomography
- Multi channel analysis of surface waves

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Electrical Resistivity Imaging (ERI)

- It is based on the principle that the distribution of electrical potential in the ground around a current-carrying electrode.
- Electrical direct current (DC) is applied between two electrodes implanted in the ground.
- By measuring the difference of potential between two additional electrodes that do not carry current gives the internal resistivity distribution of the dam .
- This survey helps in identifying areas of water saturation in the dam body, zones of water accumulation and wetting.
- The low resistivity zones represent the zones having a higher degree of moisture/ water content/ conductive material. The high resistivity zones are relatively dry/ compact/ rock strata.

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Higher saturation low resistivity zones are observed in ERI profile (dark blue).

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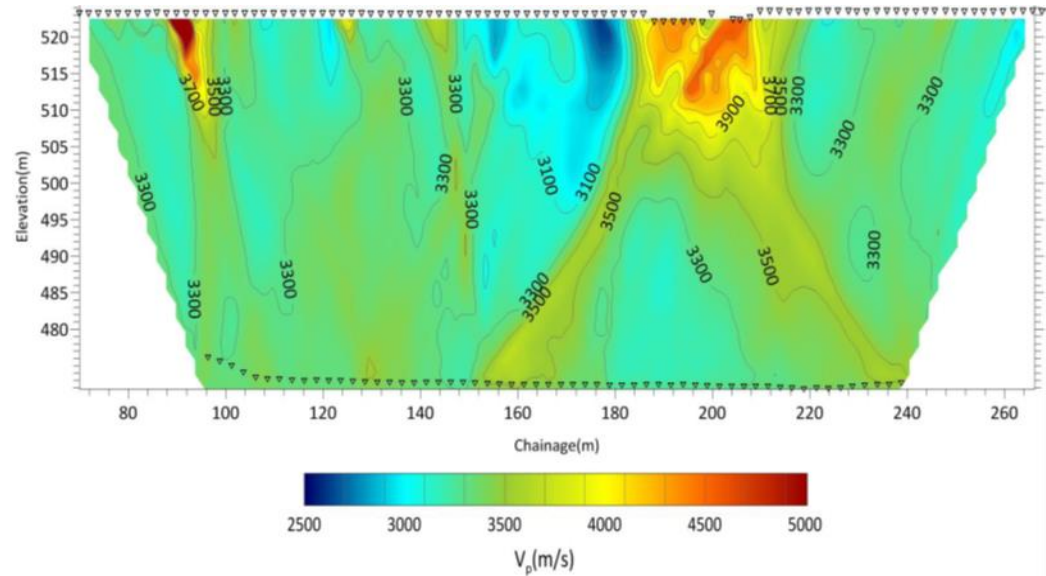
Streaming Potential Survey (SP)

- It consists of measuring the electrical potential by flowing water within the structure.
- Water flowing through the porous space generates electrical current flow. This electro-kinetic phenomenon is called streaming potential and gives rise to SP signals.
- SP is measured by determining the voltage across a pair of electrodes using a voltmeter.
- This study is to identify the zones in the dam body through which seepage is taking place. The results are correlated with resistivity sections.

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Sonic/ Seismic Tomography

- It is based on generation of elastic energy.
- The elastic waves which is propagated through the investigated structure is depending on elastic property of particular mass of material crossed. The elastic waves are recorded by receiver sensors in the form of electric signals.
- Sonic tomography L-sections were recorded with geophones installed in dam gallery roof and source hammer on dam top.
- Sonic tomograms will identify the variation in the density, porosity and saturation sections in the body of the dam.



Seismic tomography testing

- The P wave velocity in the dam body is observed in the range of 3500m/s. The high velocity zone are observed from 186-210m which corresponds to old spillway plugged.
- There is a zone from 155m to 180m showing much lower P wave velocities (less than 3100m/s corresponding to 2.31 gm/cc) and within this there is an even slower velocity zones showing velocity of 2500m/s (corresponding to density of 2.19 gm/cc) should be considered as anomalous zone.

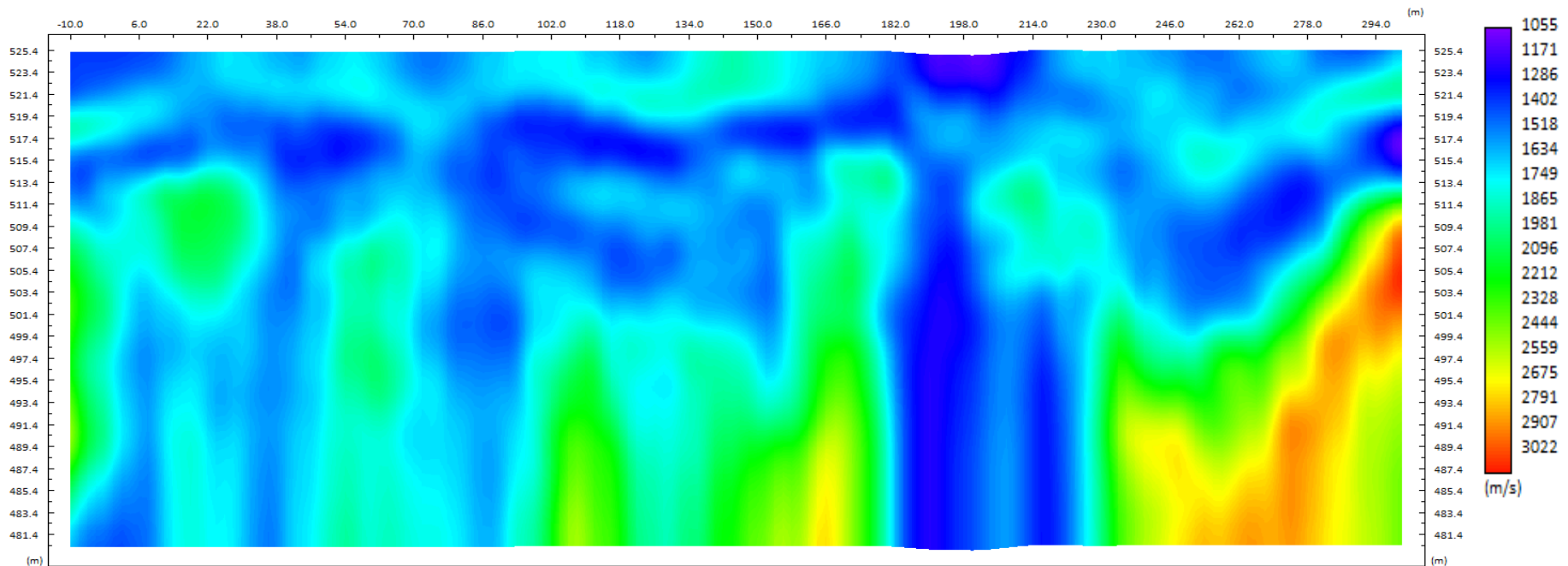
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Multi-Channel Analysis of Surface Waves (MASW)

- MASW measures seismic surface waves generated from sledge hammer and analyses the propagation velocities of those surface waves, and then finally deduces shear-wave velocity (V_s).
- MASW provides shear wave velocities of the subsurface, indicating of stiffness of the strata.

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MASW Dam Top



•The shear wave velocities observed in the dam body are between 1000m/s (corresponding to firm and hard strata) and 3000m/s (very hard strata/ hard rock).

NEHRP Category	Description	Mean Shear-Wave to 30 m
A	Hard rock	> 1500 m/sec
B	Firm to hard rock	760–1500 m/sec
C	Dense soil, soft rock	360–760 m/sec
D	Stiff soil	180–360 m/sec
E	Soft clays	< 180 m/sec
F	Special study soils (e.g., liquefiable soils, sensitive clays, organic soils, soft clays > 36 m thick)	

The conditions are measured as a function of the weighted average shear-wave velocity in the upper 30-m of the profile. Information in this table is taken from Dobry *et al.*, 2000.

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CONCLUSIONS

- The integrated geophysical investigations were carried out at Talakalale dam using Electrical Resistivity Imaging, Streaming Potential, Multi-Channel Analysis of Surface Waves (MASW) and Seismic Tomography reveals various anomalous zones.
- Very few saturated zones are associated with development of SP. Zones with low resistivity and profound SP are termed as possible seepage paths and moisture content.
- The shear wave velocities observed in the dam body are between 1000m/s (corresponding to firm and hard strata) and 3000m/s (very hard strata/ hard rock).
- The P wave velocity in the dam body is observed in the range of 3500m/s which correspond to density of 2.38 gm/cc. Lower P wave velocity of 2500m/s (corresponding to density of 2.19 gm/cc) and considered as anomalous zone.



Thank you ...