

Determination of Foundation Rock Properties Beneath Folsom Dam



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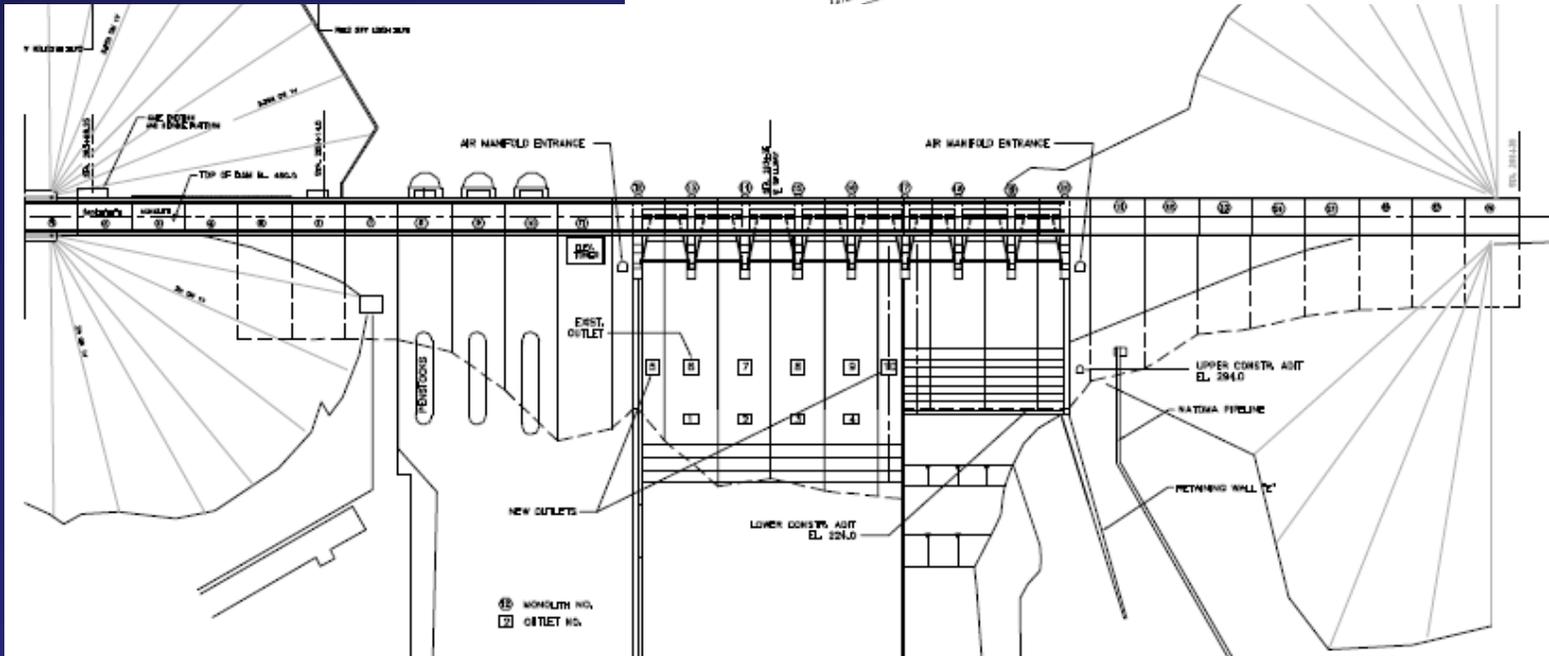
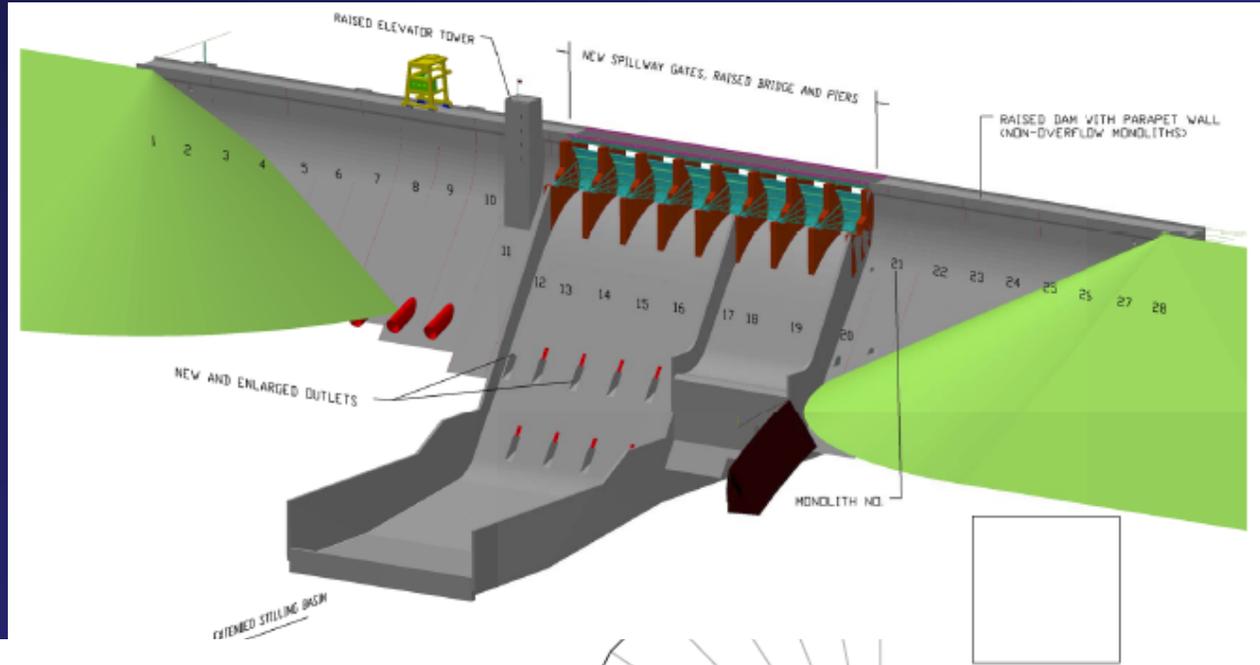
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Background and Purpose

- **USACE proposes a flood damage reduction plan for the Lower American River**
- **A major component of that plan is raising Folsom Dam by seven feet**
- **As part of this plan a dynamic analysis of the dam-foundation system will be conducted**
- **The purpose of this study was to determine foundation properties for input into the dynamic analyses program**



28 Concrete Monoliths 50 ft wide



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Previous Studies

1983 Woodward Clyde

- 6 NX cores and Borehole jacking tests
- Static Young's modulus – 1.6 to 2.1×10^6 psi

1983 ERDC

- Surface seismic refraction, surface vibratory, crosshole and downhole. Estimated density
- Dynamic Young's modulus – 5.8 to 11×10^6 psi

2001 URS

- Re-evaluation of existing data
- Static Young's modulus – 1.2 to 2.5×10^6 psi

District settled on 7.9×10^6 psi

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Measured Insitu Parameters

Compression and Shear wave velocities

Densities



Computed Elastic Parameters

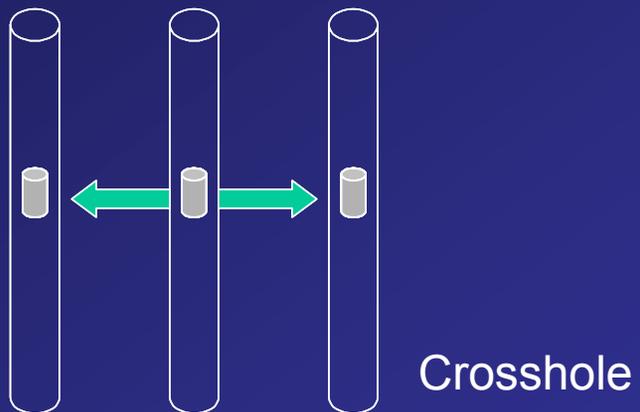
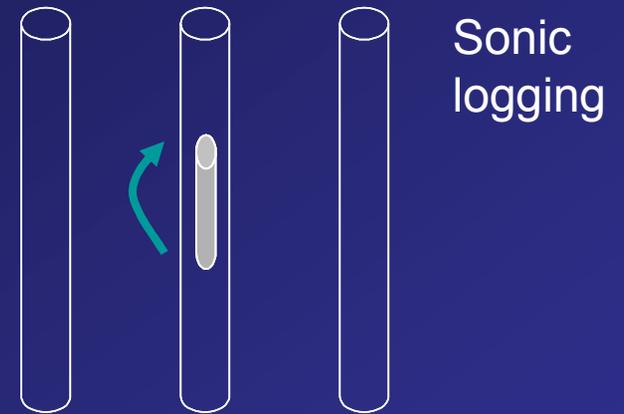
Young's Modulus

Shear Modulus

Bulk Modulus

Constrained Modulus

Poisson's Ratio





Sonic logging, P and S waves
Density logging

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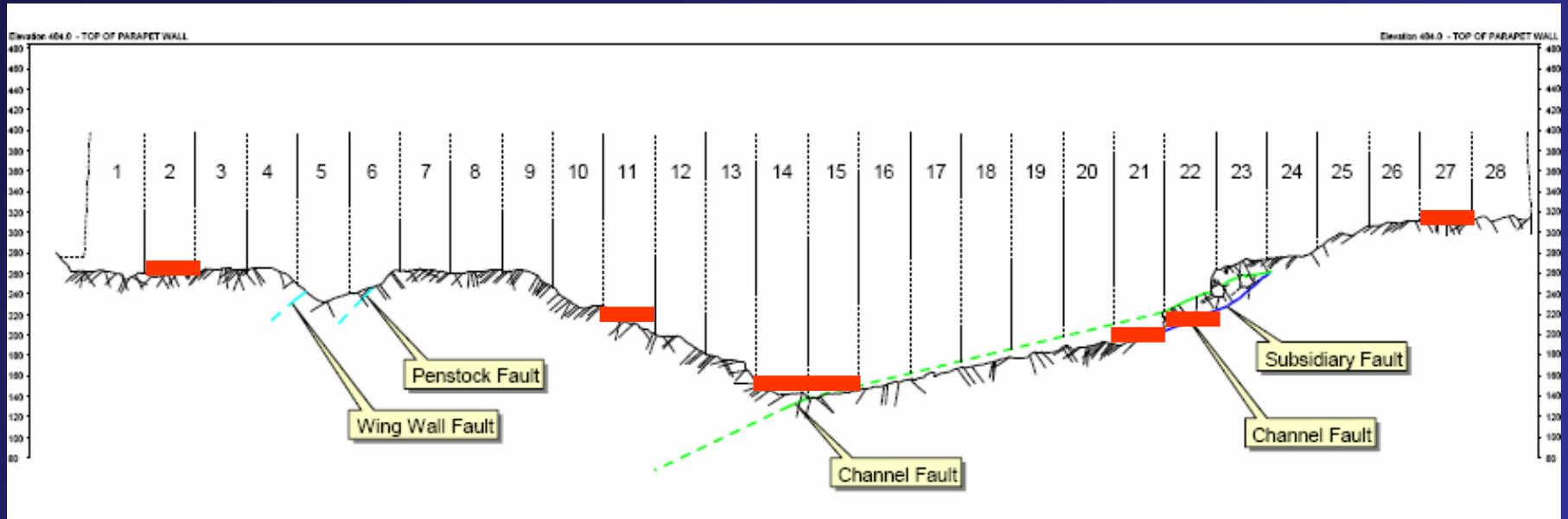
Crosshole, P and S waves

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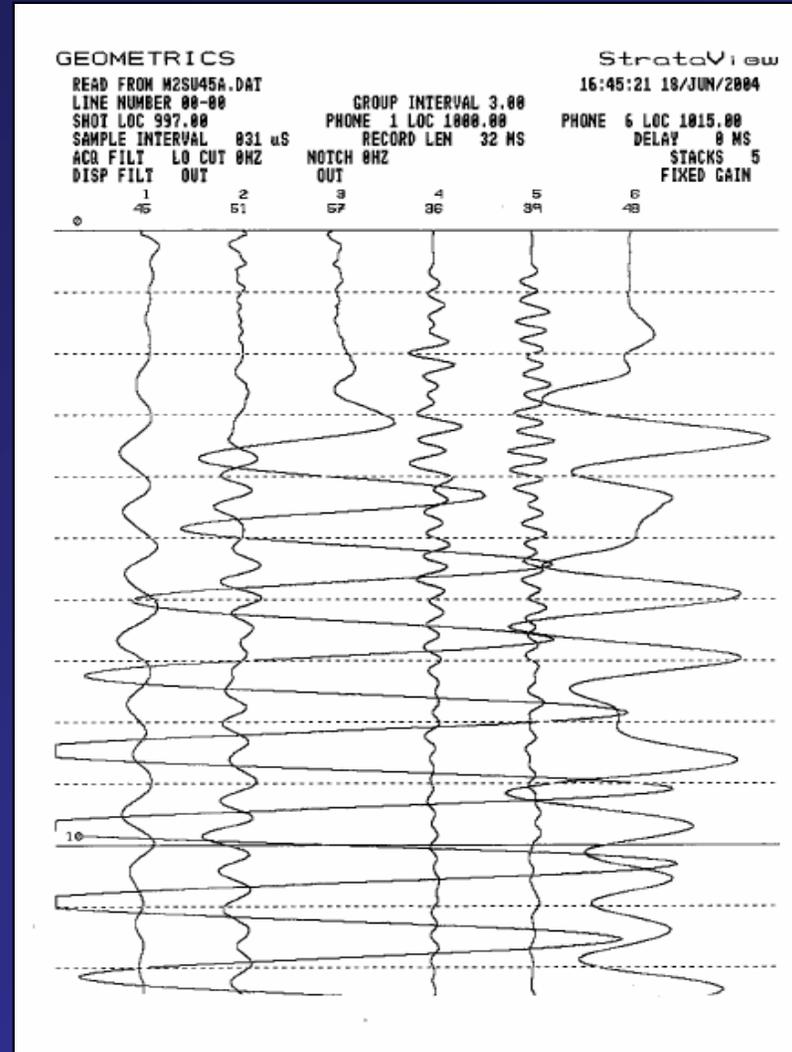
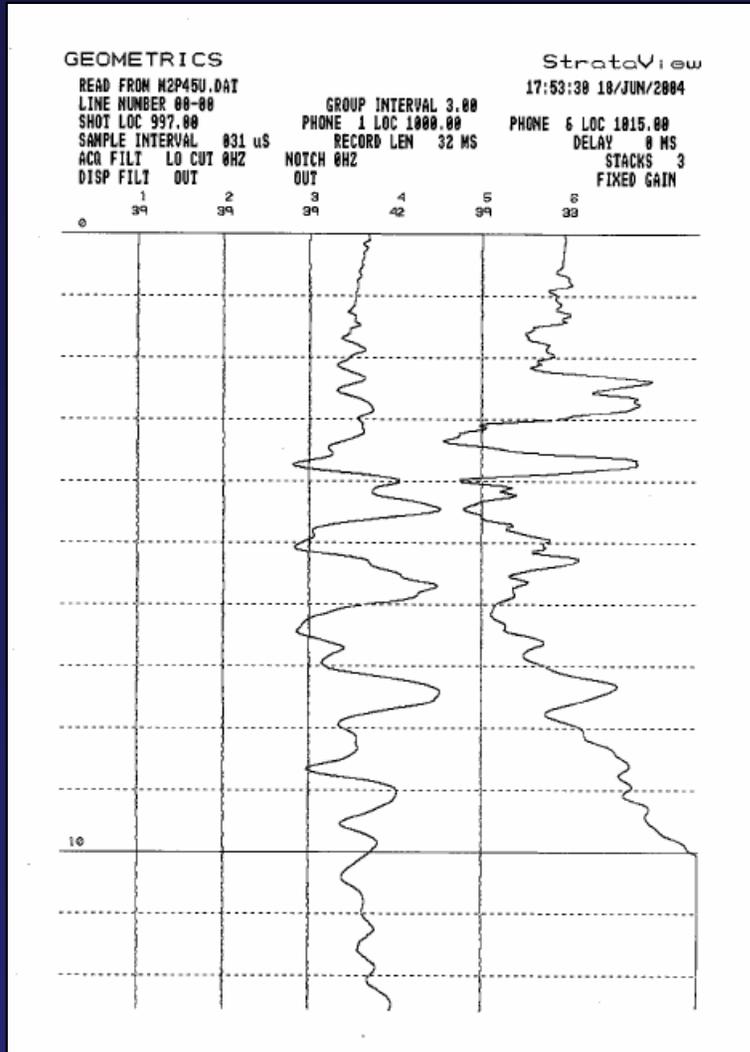
Monoliths tested



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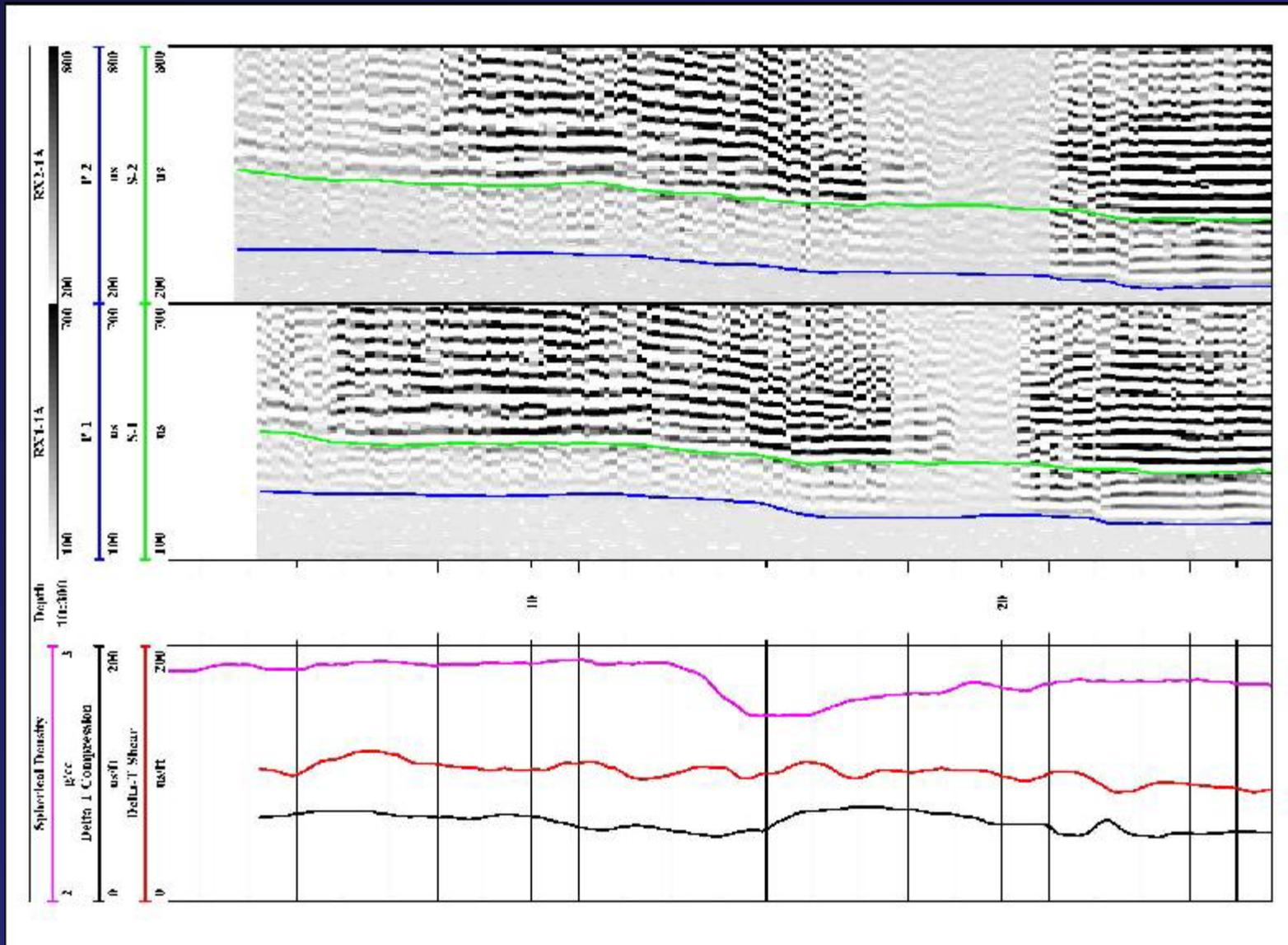




Typical crosshole data

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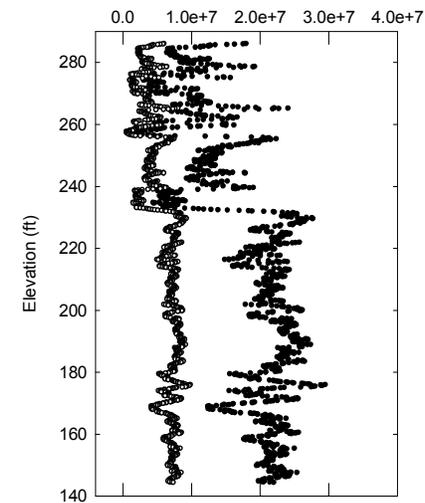
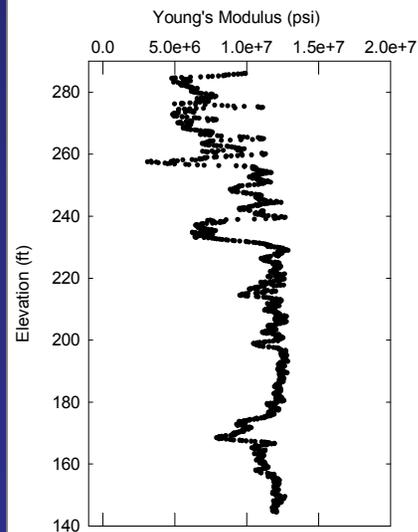
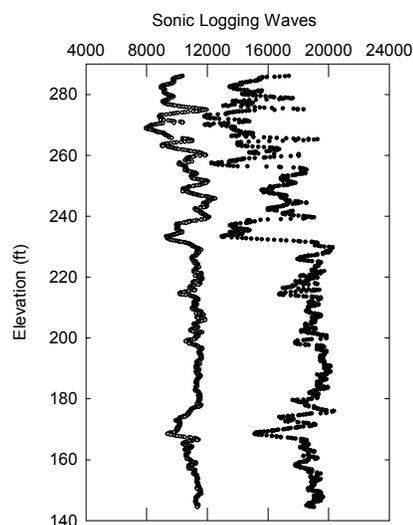
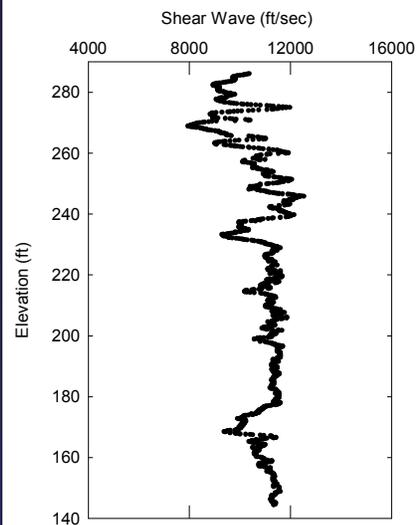
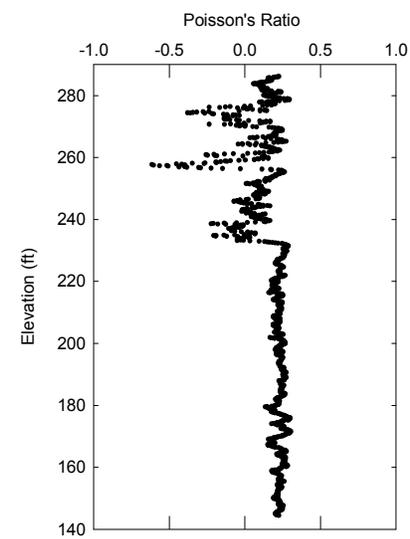
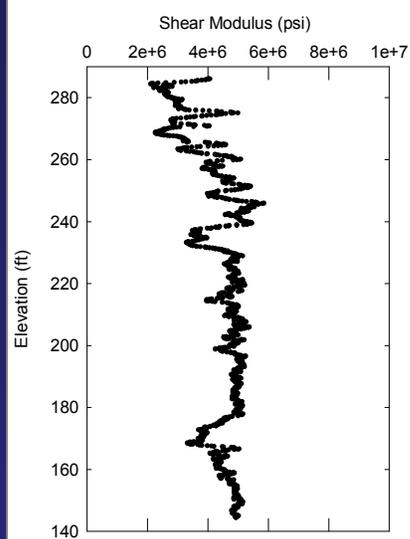
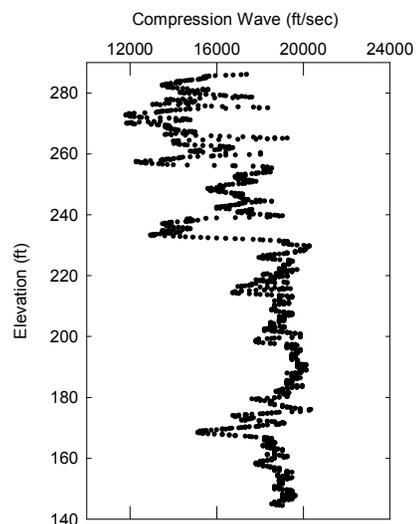
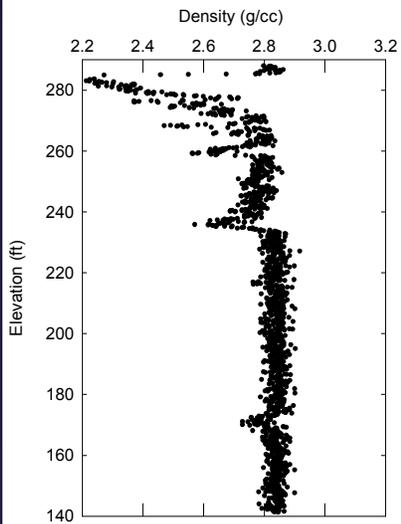




Typical sonic and density logging data

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● Compression Wave (ft/sec)
○ Shear Wave (ft/sec)

● Constrained Modulus (psi)
○ Bulk Modulus (psi)

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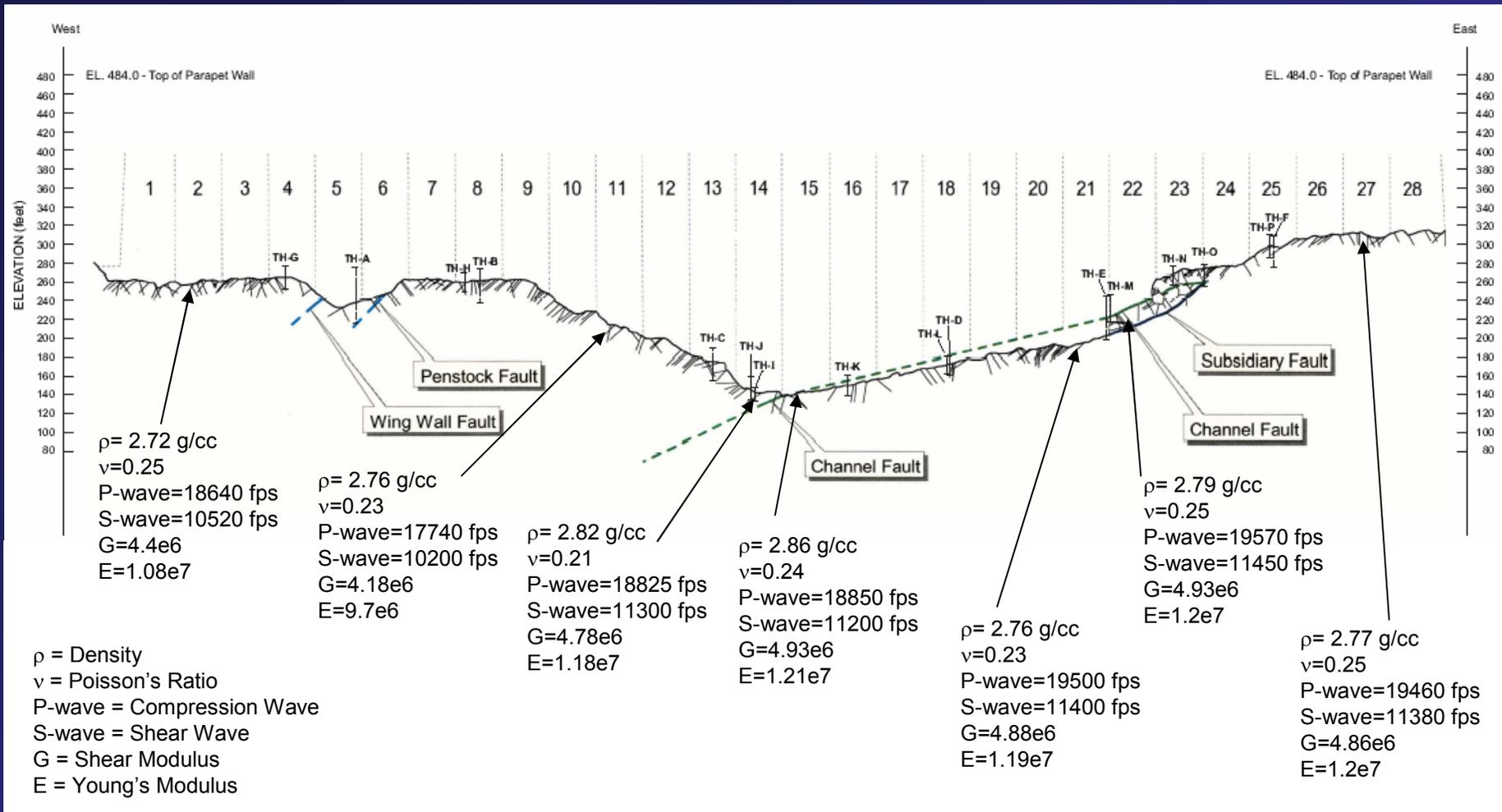


Average Sonic Logging Data and Computed Elastic Parameters

Mono No.	Density g/cc	P-wave velocity fps	S-wave velocity fps	Poisson's ratio	Shear modulus psi	Young's modulus psi	Constrained modulus psi	Bulk modulus psi
2	2.72	18,650	10,500	0.27	4.037E+06	1.024E+07	2.206E+07	7.354E+06
11	2.76	17,550	10,200	0.24	3.866E+06	9.626E+06	1.887E+07	6.290E+06
14	2.82	18,800	11,300	0.22	4.848E+06	1.180E+07	2.086E+07	6.955E+06
15	2.86	18,850	11,200	0.23	4.830E+06	1.185E+07	2.172E+07	7.242E+06
21	2.76	19,500	11,400	0.24	4.829E+06	1.198E+07	2.307E+07	7.691E+06
22	2.79	19,500	11,450	0.24	4.925E+06	1.218E+07	2.315E+07	7.717E+06
27	2.77	19,450	11,400	0.24	4.847E+06	1.200E+07	2.294E+07	7.646E+06
Average	2.78	18,900	11,064	0.24	4.597E+06	1.138E+07	2.181E+07	7.271E+06

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Average Velocity and Elastic Parameter Values for the Foundation Materials Beneath the Concrete Section of Folsom Dam, CA

Density g/cc	P-wave velocity fps	S-wave velocity fps	Poisson ratio	Shear modulus psi	Young's modulus psi	Constrained modulus psi	Bulk modulus psi
2.78	19,300	9,200	0.32	3.3E+06	8.5E+06	2.9E+07	9.9E+06

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Summary

- **The purpose of this study was to determine foundation properties for input into the dynamic analyses program**
- **Evaluate potential for use of sonic logging in drain holes**
- **Comparison of sonic logging and traditional crosshole results was excellent**
- **Foundation properties consistent with those previously reported**

