Constitutive elastic models to predict shallow (<30m) seismic velocities: Natural soils beneath an earthen levee: Marrero, Louisiana, U.S.A.

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Summary

Current constitutive elastic models of granular materials are able to predict shallow (< 30 m) seismic velocities in sands, but can be improved to predict seismic velocities in clay-rich soils where additional interparticle stresses exist, caused by capillarity and cohesion. We calculate the elastic moduli of granular matrices in near-surface environments with an updated definition of total effective stress which also incorporates granular cohesion and capillary pressures. Commonly, Hertz-Mindlin (HM) theory is used to calculate the elastic moduli of granular materials by extending Biot-Gassmann theory to include pressure effects induced by water saturation changes. Hertz-Mindlin theory predicts that seismic velocity (V) will increase as a power function of stress (σ) ($V \propto \sqrt[6]{\sigma}$). HM theory can readily adapt to include the additional effects of interparticle stresses.

Currently the proposed extended model calculates seismic velocities that compare well with sand-tank lab experiments (depths < 1m). However, in mixed organic-rich lower-delta sediments, measured velocities require additional consideration of clay interparticle stresses. We use field velocity measurements from a case study in soils beneath coastal flood-protection levees, south of New Orleans, U.S.A For shallow depths (<100 m), interparticle stresses can be larger than net overburden stress in clay-rich soils.

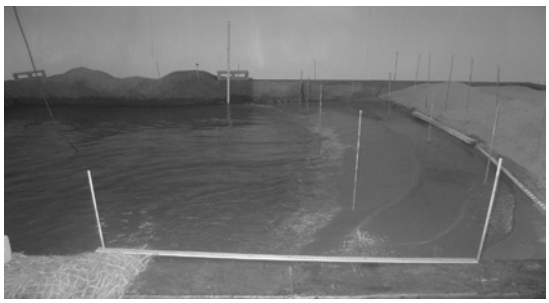

Figure 1. Louisiana State University seismic physical modeling sand tank (Figure 1)

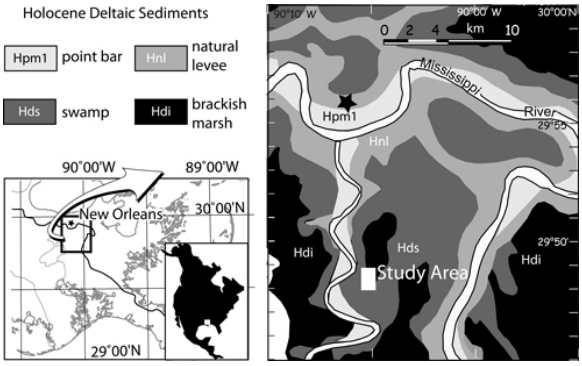

Figure 2. Study area location along northern Gulf of Mexico Coast, USA, lies south of the city of New Orleans, located within facies of a lower delta complex (Saucier, 1994). Location of seismic test locations (white box) lies ~ 15 km south of New Orleans.

Acknowledgments

We thank the following for their support with scholarships and research assistantships to the first[1] and second authors: AAPG Grants-In-Aid [1], Geometrics-SAGEEP Travel Award[1] , SLFPAE, API-Delta Chapter- New Orleans, NOGS, SGS, AFMS, SEG, Red River Desk and Derrick Club, Marathon Oil, Chevron Corporation, and especially to the LSU Department of Geology & Geophysics for its active support of graduate student research. We would also like to thank DOE- LEQSF (2004-7)-L and a Shell E&P Technology Grant for the Sand Tank (2011-2014) that supports Lorenzo, White and Shen.

DOI http://dx.doi.org/10.1190/segam2013-1489.1

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REFERENCES

None