Laboratory Measurements of Shear and Compressional Velocities

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ABSTRACT

Bender elements can be used to send and receive both shear and propagational waves through soft materials, such as clays and sands, with a strain of 0.003%. Distinguishing P and S wave arrivals can be difficult, making it important to isolate the S-wave and reduce any P-wave reflections. Additionally, with varying BE tip geometries, the signals can be drastically different and velocity measurements can vary by as much as a factor of two. Experiments on both Ticino Sand and Boston Blue Clay were conducted to observe the stress and frequency dependence of velocity measurements. Comparisons between various methods of obtaining the moduli have historically shown inconsistencies, so an investigation of different methods is pursued. The goal is to provide a non-ambiguous method of signal interpretation and a modulus database on mudrocks, also showing where bender elements lie in relation to published data. Finally, a brief overview of velocity anisotropy on clay specimens is introduced with experimental results on oven-dried RBBC.

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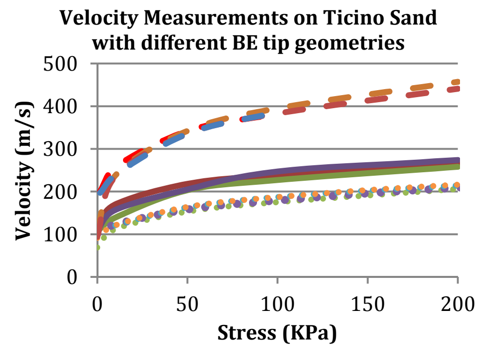


Fig. 1: All experiments conducted using the same setup and with the same porosities, heights, and stress ranges. Additionally, the experiments were done in a random manner, all at a frequency of 8kHz. Bender tip geometry is clearly a factor.

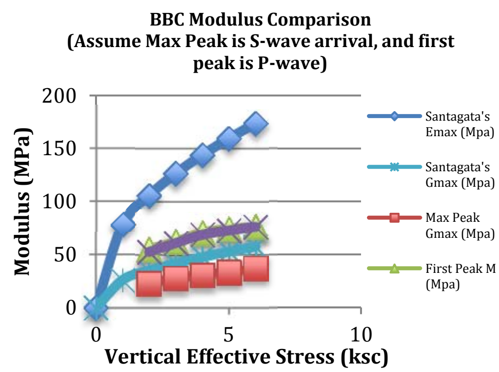
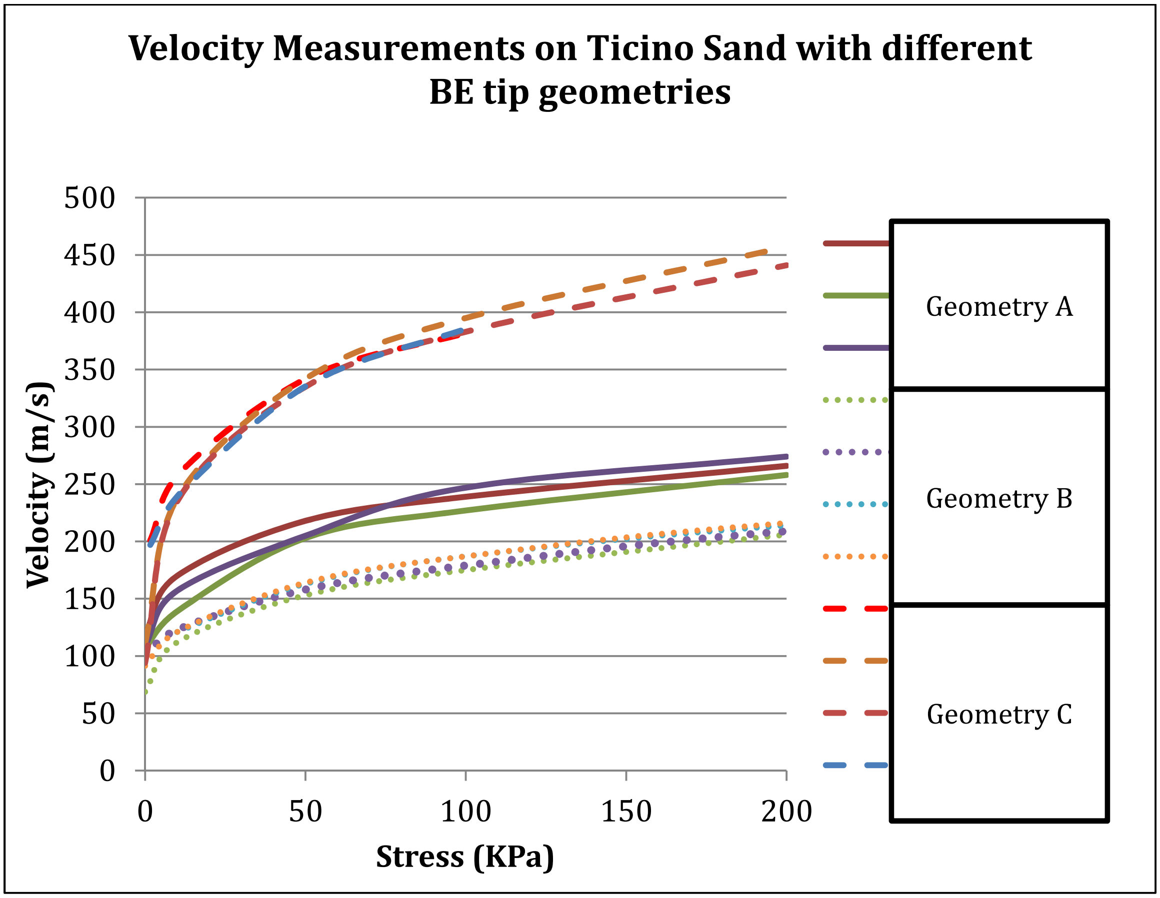


Fig. 2: When comparing bender element results on Boston Blue Clay with results using small strain triaxial setup from Santagata (1999), the BE results are lower than Santagata's. If the first signal is taken to be the shear wave arrival, then the BE shear modulus would be higher than Santagata's. Since Santagata's modulus is based on larger strains, it is expected that it would be an underestimation.



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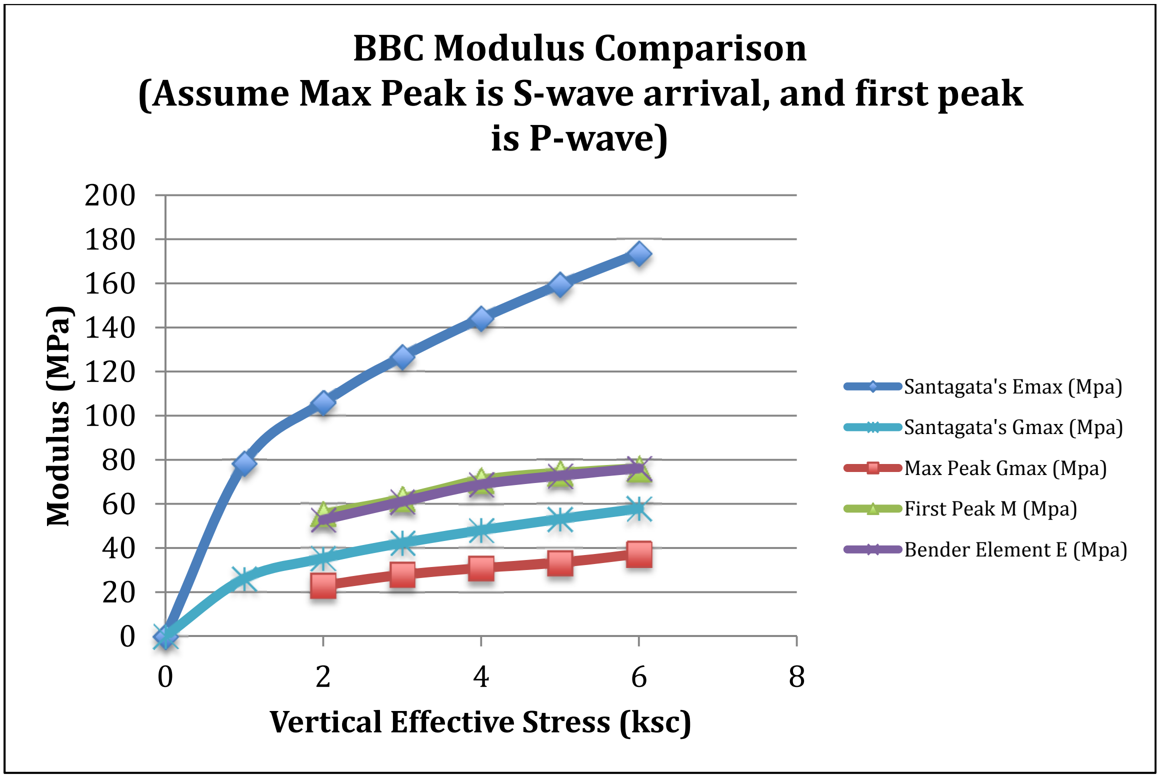

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