A novel method for determining the small-strain shear modulus of soil using the bender elements technique

Bender elements technique has become a popular tool for determining shear wave velocity, Vs, hence the small-strain shear modulus of soils, Gmax, thanks to its simplicity and nondestructive character among other advantages. Several methods were proposed to determine the first arrival of Vs. However, none of them can be widely adopted as a standard and there is still an uncertainty on the detection of the first arrival. In this study, bender elements tests were performed on lime-treated soil and both shear wave and compression wave velocities at various frequencies were measured. In-depth analysis showed that the S-wave received signal presents an identical travel time and opposite polarity compared with that of the S-wave components in P-wave received signal, especially at high frequency. From this observation, a novel interpretation method based on the comparison between the S-wave and P-wave received signals at high frequency is proposed. This method enables the determination of the arrival time of S-wave objectively, avoiding a less reliable arrival pick-up point. Furthermore, the 'p-point' method and cross-correlation method were also employed and the obtained results agree well with those from the proposed method, indicating the accuracy and reliability of the latter. The effects of frequency on the shear wave velocity are also discussed.

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