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Experimental Study of Sand-Silt Mixtures with Torsional and Flexural Resonant Column Tests

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Abstract : Dynamic properties of soils, especially at the range of very small strains, are of particular interest in geotechnical engineering practice for characterization of the behavior of geo-structures subjected to a variety of stress states. This study reports on the small-strain dynamic properties of sand-silt mixtures with particular emphasis on the effect of non-plastic fines content on the small strain shear modulus (Gmax), Young's Modulus (Emax), material damping (Ds,min) and Poisson's Ratio (v). Several clean sands with a wide range of grain size characteristics and particle shape are mixed with variable percentages of a silica non-plastic silt as fines content. Prepared specimens of sand-silt mixtures at different initial void ratios are subjected to sequential torsional and flexural resonant column tests with elastic dynamic properties measured along an isotropic stress path up to 800 kPa. It is shown that while at low percentages of fines content, there is a significant difference between the dynamic properties of the various samples due to the different characteristics of the sand portion of the mixtures, this variance diminishes as the fines content increases and the soil behavior becomes mainly silt-dominant, rendering no significant influence of sand properties on the elastic dynamic parameters. Indeed, beyond a specific portion of fines content, around 20% to 30% typically denoted as threshold fines content, silt is controlling the behavior of the mixture. Using the experimental results, new expressions for the prediction of small-strain dynamic properties of sand-silt mixtures are developed accounting for the percentage of silt and the characteristics of the sand portion. These expressions are general in nature and are capable of evaluating the elastic dynamic properties of sand-silt mixtures with any types of parent sand in the whole range of silt percentage. The inefficiency of skeleton void ratio concept in the estimation of small-strain stiffness of sand-silt mixtures is also illustrated.

Keywords : damping ratio, Poisson's ratio, resonant column, sand-silt mixture, shear modulus, Young's modulus
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