New Approach to Resonant Column Testing

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ABSTRACT: This paper describes a new type of torsional resonant column device that has a quasi-fixed base and free top. In this device, a relatively rigid torque transducer is placed between the bottom platen and the fixed chamber base. A large capacity torque motor excites the top platen. The primary measurements during the test are the rotation of the top platen, the torque at the specimen base and excitation frequency. An equilibrium equation for the bottom platen relates the torque transducer output to the torque applied by the specimen to the bottom platen. Using equivalent linear viscoelastic theory, a stiffness matrix is generated that relates the torque and rotation at each end of the specimen to specimen properties. A hybrid magnification factor is d+efined as the ratio of motion at the top of the specimen to that at the base. These two measurements provide the data needed to determine the shear modulus and damping ratio in the specimen for each frequency. The benefit of this approach is that the modulus and damping ratio of the soil are determined independent of the torque applied by the torque motor to the top platen. This removes the problems of torque motor characteristics, bearing friction, back EMF, and eddy current damping that occur with torque motors, which in turn allow more precise and repeatable determination of shear modulus and damping ratio over a wide range of shear strain and frequency. The paper outlines the theory, describes the apparatus and calibration procedures, and provides sample test data.

KEYWORDS: resonant column, soil testing, shear modulus, damping, shear strain amplitude, boundary conditions, torque motor, torque transducer

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