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Evaluation of Duncan-Chang Deformation Parameters of Granular Fill Materials Using Non-Invasive Seismic Wave Methods

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Abstract : Characterizing the deformation properties of fill materials in a wide stress range always has been an important issue in geotechnical engineering. The hyperbolic Duncan-Chang model is a very popular model of stress-strain relationship that captures the nonlinear deformation of granular geomaterials in a very tractable manner. It consists of a particular set of the model parameters, which are generally measured from an extensive series of laboratory triaxial tests. This practice is both time-consuming and costly, especially in large projects. In addition, undesired effects caused by soil disturbance during the sampling procedure also may yield a large degree of uncertainty in the results. Accordingly, non-invasive geophysical seismic approaches may be utilized as the appropriate alternative surveys for measuring the model parameters based on the seismic wave velocities. To this end, the conventional seismic refraction profiles were carried out in the test sites with the granular fill materials to collect the seismic waves information. The acquired shot gathers are processed, from which the P- and S-wave velocities can be derived. The P-wave velocities are extracted from the Seismic Refraction Tomography (SRT) technique while S-wave velocities are obtained by the Multichannel Analysis of Surface Waves (MASW) method. The velocity values were then utilized with the equations resulting from the rigorous theories of elasticity and soil mechanics to evaluate the Duncan-Chang model parameters. The derived parameters were finally compared with those from laboratory tests to validate the reliability of the results. The findings of this study may confidently serve as the useful references for determination of nonlinear deformation parameters of granular fill geomaterials. Those are environmentally friendly and quite economic, which can yield accurate results under the actual in-situ conditions using the surface seismic methods.

Keywords : Duncan-Chang deformation parameters, granular fill materials, seismic waves velocity, multichannel analysis of surface waves, seismic refraction tomography
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