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Determination of Cross-Anisotropy Ratios for the Resilient Modulus of Iowa Soils and Geomaterials

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Abstract

Mechanical responses of pavement systems are highly affected by the stress-strain characteristics of pavement foundation layers such as base, subbase, and subgrade. Therefore, accurate determination of stress-strain behavior comes forward as one of the key parameters to achieving designed pavement service life. For simplicity, the mechanical behavior of the base, subbase, and subgrade materials are often evaluated through conventional testing systems where the complicated stress states present in the field cannot be modeled and materials are assumed isotropic. However, the literature reveals that soils and geomaterials exhibit cross-anisotropic mechanical behavior where the stiffness characteristics have a directional dependency and requires advanced testing techniques to determine such characteristics. A custom-designed cyclic true-triaxial apparatus, referred to as Soil Poly-Axial Test System (SPAX-3000), was used in this study to investigate the cross-anisotropic stress-strain behavior of the soils and geomaterials. With the design that enables the prismatic specimen testing, SPAX-3000 is capable of applying independent vertical and horizontal pulsing to determine the resilient modulus of materials for the vertical and horizontal directions. In this study, three base, one subbase, and one subgrade materials were tested through SPAX-3000 to determine resilient moduli in two directions (vertical and horizontal). Cross-anisotropy ratios (the ratio of the horizontal resilient modulus to vertical resilient modulus) were obtained for these materials to understand the directional dependency of the stiffness characteristics. The results revealed that soils and geomaterials are highly cross-anisotropic where the ratios vary between 0.04 and 0.52. It is believed that the results of this study will contribute to the literature by providing cross-anisotropy ratios for various materials to understand the directional dependency of stress-strain behavior.