ARTICLE: Georgiannou VN, Konstadinou M, Triantafyllos PK (2018) Sand behavior under stress states involving principal stress rotation. Journal of Geotechnical and Geoenvironmental Engineering, 2018, 144(6): 04018028

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ABSTRACT: The behavior of sands exhibiting both unstable and stable response, in their loose deposited state, under axial - torsional shearing involving continuous principal stress rotation is investigated using the hollow cylinder apparatus. This paper examines the parameters affecting the major principal stress direction attained at instability and / or phase transformation during torsional shearing following anisotropic consolidation. It is shown that constant stress ratio (t / p') lines, including the instability and phase transformation lines, are associated with the same major principal stress rotation with respect to the vertical within a wide range of initial mean effective stresses along the same consolidation stress ratio, K_c. In sands exhibiting instability, smaller principal stress rotations are required for the mobilization of the effective stress ratio at the onset of instability as the initial shear stress level increases (K_c decreases). In sands exhibiting stable response, principal stress rotation at phase transformation increases with increasing dilatancy tendencies. The dependence of the angle of shearing resistance, φ', mobilized at instability (IL), phase transformation (PTL), and failure (FL) lines on principal stress rotation and the intermediate stress parameter, b, is examined to verify whether the mobilized angle of shearing resistance can be considered as a material property. In continuous rotation tests, contrary to fixed principal stress direction and b tests, the angle of shearing resistance at IL can be considered as material property. However, the angle of shearing resistance at PTL depends on b and the direction of the principal stress. Moreover, phase transformation takes place at lower stress ratios as density increases.

ARTICLE: Triantafyllos PK, Georgiannou VN, Dafalias YF, Georgopoulos I-O (2020) New findings on the evolution of the instability surface of loose sand. Acta Geotechnica, 2020, 15(1): 197-221

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ABSTRACT: The conditions that trigger the unrestrained flow deformation of loose anisotropic sand are investigated. An Instability Surface (IS) is defined in the deviatoric plane. It comprises the transient-peak states at which flow instability is triggered when isotropically consolidated sand is subjected to monotonic undrained loading at various fixed directions of principal stress, α, under constant mean total stress, p, and fixed stress parameter, $b = (\sigma'_2 - \sigma'_3) / (\sigma'_1 - \sigma'_3) = 0.5$. Generalised undrained loading including rotation of the σ'_1-axis is also imposed on anisotropically consolidated sand. The mobilisation of the instability stress ratio, $\sin \varphi_{ip} = (\sigma'_1 - \sigma'_3) / (\sigma'_1 + \sigma'_3)$, that corresponds to stress direction α via the IS-locus, generally, triggers flow under loading with both fixed and rotating σ'_1-axis. Novel results are also presented: loose sand is subjected to undrained principal stress rotation at constant deviatoric stress, yet, the previously established IS

is crossed stably and flow is triggered after stress rotation is imposed on the failure surface, while a non-flow diffuse instability is triggered on the failure surface under increasing stresses and decreasing stress ratio. The experimental results indicate that the triggering of flow instability depends on the stress - strain history as well as on the incremental stress direction. It is also shown that both diffuse and localised instabilities occur preferably at stress states corresponding to unfavourable deformation kinematics.