# Undrained Shear Response of Gold Tailings under Varied Confining Pressures

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## Abstract

Gold tailings are the fine-grained waste slurry from gold extraction, typically deposited in engineered tailings dams, where the material may remain loose and saturated, influencing its stability. The undrained shear response is important because it controls whether tailings will lose strength rapidly during certain events, which can lead to catastrophic dam failures. This study systematically investigates the undrained shear response of gold tailings under varied effective confining pressures. A key focus of the study is the role of void ratio in controlling undrained behaviour. The research employs a series of isotropically consolidated undrained (CIU) triaxial compression tests on reconstituted gold tailings samples. Key data were collected throughout both consolidation and undrained shearing phases. Initial sample preparation targeted a reproducible loose state to mirror in-situ conditions and enable systematic examination of fabric effects. During testing, the evolution of void ratio and its direct influence on stress path behaviour and shear response were closely monitored, with final void ratios precisely measured post-shearing.

It was found that undrained shear strength increases with increasing confining pressure, and that stress-strain behaviour and excess pore pressure generation are strongly influenced by initial and evolving void ratios. At lower confining pressures, samples exhibited contractive behaviour and rapid pore pressure buildup, while at higher pressures, the material transitioned towards a dilative response, accompanied by delayed pore pressure development and strain-hardening. Critical state analysis revealed a unique critical state line in the e-log(P') space, supporting the existence of a distinct void ratio-dependent failure envelope for the remoulded tailings. The results underscore the necessity of explicit void ratio measurement in interpreting undrained behaviour, informing the development of robust constitutive models and advancing safe geotechnical design for tailings storage facilities.

## Keywords

Gold tailings, undrained shear strength, triaxial testing.