EMPIRICAL STRENGTH ENVELOPE FOR SHALE

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Specially dedicated to my beloved mother, my late father, my siblings and friends.

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ABSTRACT

Effectively, strength envelope describes behavior of a rock body when subjected to common stresses in construction, namely compressive, tri-axial and tensile. This study is aimed at investigating the strength envelope for shale, a sedimentary rock obtained from dam project site in Baram, Sarawak. Series of triaxial compression tests were carried out to obtain the strength envelope for the rock samples. For verification of failure criterion, uniaxial compression and Brazilain tests were also conducted on the rock samples. Results from the related tests were analysed using RocData software to obtain the strength envelope. Subsequently, Mohr-Coulomb and Hoek-Brown failure criterion are used to determine failure envelop for the rock samples. Based on the failure envelopes and the related strengths (i.e. compressive and tensile strength), suitability of both approach, in defining strength envelope for shale, is verified. The study shows that for highly laminated sedimentary rock like shale, Hoek-Brown criterion gave a more representative failure behaviour. The failure envelope clearly shown all the strength limits when the rock subjected to triaxial, uniaxial and tensile stress, which is not observed in Mohr-Coulomb. Hoek-Brown criterion is more superior for describing rock body as mass strength rather than material strength.

ABSTRAK

Had kekuatan batuan adalah julat tingkahlaku sesuatu jasad batuan apabila dikenakan jenis-jenis tegasan yang biasa ditemui di dalam kerja pembinaan seperti tegasan mampatan, tiga paksi, satu paksi dan tegangan. Kajian ini bertujuan untuk mengkaji had kekuatan batu syal, iaitu sejenis batuan enapan yang diperolehi daripada tapak projek empangan di Baram, Sarawak. Beberapa ujian mampatan tiga paksi telah dijalankan untuk mendapatkan had kekuatan bagi sampel batuan. Bagi tujuan pengesahan kriteria kegagalan, ujian mampatan satu paksi dan ujian Brazillian juga dilaksanakan ke atas sampel batuan tersebut. Keputusan daripada ujian-ujian tersebut dianalisis dengan menggunakan perisian RocData bagi tujuan mendapatkan had kekuatan batuan. Setelah itu, had kegagalan batuan dianalisis menggunakan kriteria Mohr-Coulomb and Hoek-Brown. Berdasarkan had kegagalan dan kekuatan yang berkaitan (mampatan dan tegangan), kesesuaian pendekatan analisis bagi kedua-dua kaedah penentuan had kekuatan dibandingkan. Kajian ini mendapati bagi batuan enapan yang berlaminasi seperti syal, ianya lebih sesuai dianalisa menggunakan kriteria kegagalan Hoek-Brown. Kriteria ini dapat memberikan had kegagalan batuan yang lebih jelas apabila dikenakan tegasan-tegasan tiga paksi, satu paksi dan tegangan. Kriteria Hoek Brown bukan sahaja mampu memperjelaskan julat kekuatan batuan pada skala bahan, malahan mampu digunakan dalam skala massa batuan.