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Shear Strength Characteristic of Meta-Sediment Sandstone Rock Joint with Condition of Infilling Material

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In civil engineering, rock mass structures are importantly to be analyze for their stabilization and strengthening. There are many parameters that adopted in determining the strength of rocks such friction angle and cohesion. However, all these parameters significantly controlled by several factors such as joint infilling condition, weathering and joint roughness. The tropical climate in Malaysia which shows the rapid changes of temperature had accelerated the weathering process of the rock mass. This study attempted to determine the physical properties of rock joint infilling material in discontinuities meta-sediment sandstone rock joint and to evaluate the empirical relation between rock joint infilling thickness with rock joint shear strength of the sample. The Direct Shear test is a standard test used to evaluate the shear strength parameters. Meanwhile, the Schmidt Rebound Hammer test is introduced to classify the weathering grade of the host rock sample. The Joint Roughness Coefficient (JRC) assessment graphically classified the surface roughness profile. The tilting test generally was carried out to establish the basic friction angle of the natural jointed rock surface. Other physical properties were obtained such P-wave velocity from Portable Ultrasonic Non-Destructive Test (PUNDIT) and density for the rock sample. the cohesion values inversely proportional to the thickness of infilling material in rock joint. The increasing of the thickness may reduce the shear strength of the joints of rocks. In this condition, the friction resistance from rock joint surface foreseen decrease between each surface of the contacts area of rock and its made shear strength become low. The fine sand particles of infilling between the joint surface seems take the role to influence the shear characteristic by cohesion properties. Hence, this empirical relationship between the shear strength with infilling material in rock joint surface should properly estimate importantly to simulate the shear behavior in numerical analysis.

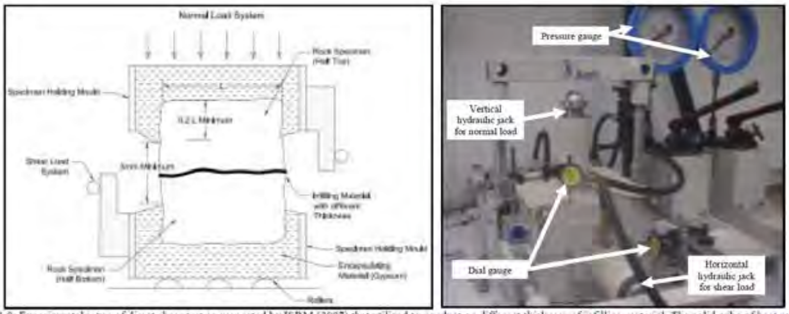

Figure 1.0: Experimental setup of direct shear test as suggested by ISRM (2007) that utilized to conduct on different thickness of infilling material. The solid cube of host rock with dimension of 150mm x 150mm x 30mm was splatted to create a jointed rock specimen with natural surfaces on joint surface and the infilling material was laid onto the joint surface with 3mm, 5mm and 10mm thickness prior with clean surface.

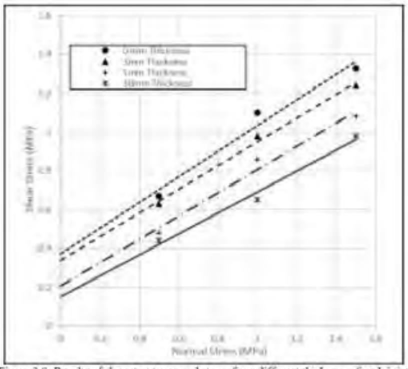

Figure 2.0: Results of shear test to normal stress from different thickness of rock joint infilling material. Consequently, the intersect of linear line with the shear stress axis indicated for the value of cohesion for the joint surfaces (Barton, 2013).

Table 1.0: Summary of basic properties of host rock sample

Properties	Classification / Characterization
Weathering Grade Classification	Grade I/II
Density, ρ (kg/mm^3)	2.829 x 10^{-6}
Average Rebound Hardness Number	46.0
Average P-wave Velocity (m/s)	4030
Basic Friction Angle, ϕ_{basic}	43°
Joint Roughness Coefficient, JRC	10-12 (Rough & Undulating)

$$\tau = C + \sigma_n \tan\phi \qquad \text{(Equation 1.0)}$$

Table 2.0: Summary result of shear strength characteristic obtained from measured friction angle and cohesion values that adapted from linear shear strength parameter constitutive based on Mohr-Columb criterion.

Thickness of Infilling Material (mm)	Peak Friction Angle, ϕ	Cohesion, C (MPa)	Shear Strength, τ (MPa) σ_n = 1.50 MPa
0	34°	0.38	1.39
3	32°	0.34	1.28
5	31°	0.20	1.10
10	28°	0.16	0.96