

TABLE 1 - APPROXIMATE RELATIONSHIP BETWEEN ROCK MASS QUALITY AND MATERIAL CONSTANTS

<p>m & s Values for disturbed rock masses</p>	<p>m & s Values for undisturbed rock masses</p>				
<p><i>Empirical failure criterion</i></p> $\sigma_1 = \sigma_3 + \sqrt{m\sigma_c\sigma_3 + s\sigma_c^2}$ <p>σ_1 = major principal stress σ_3 = minor principal stress σ_c = uniaxial compressive strength of intact rock, and m, s = empirical constants.</p>	<p>CARBONATE ROCKS WITH WELL DEVELOPED CRYSTAL CLEAVAGE <i>dolomite, limestone and marble</i></p>	<p>LITHIFIED ARGILLACEOUS ROCKS <i>slatstone, siltstone, shale and slate (normal to cleavage)</i></p>	<p>ARENACEOUS ROCKS WITH STRONG CRYSTALS AND POORLY DEVELOPED CRYSTAL CLEAVAGE <i>sandstone and quartzite</i></p>	<p>FINE GRAINED POLYMINERALIC IGNEOUS CRYSTALLINE ROCKS <i>andesite, dolerite, diabase and rhyolite</i></p>	<p>COARSE GRAINED POLYMINERALIC IGNEOUS AND METAMORPHIC CRYSTALLINE ROCKS <i>amphibolite, gabbro, gneiss, granite, norite and quartz-diorite</i></p>
<p>INTACT ROCK SAMPLES <i>Laboratory size specimens free from joints</i> RMR rating 100 Q rating 500</p>	<p>$m = 7.0$ $s = 1.0$ $m = 7.0$ $s = 1.0$</p>	<p>$m = 10.0$ $s = 1.0$ $m = 10.0$ $s = 1.0$</p>	<p>$m = 15.0$ $s = 1.0$ $m = 15.0$ $s = 1.0$</p>	<p>$m = 17.0$ $s = 1.0$ $m = 17.0$ $s = 1.0$</p>	<p>$m = 25.0$ $s = 1.0$ $m = 25.0$ $s = 1.0$</p>
<p>VERY GOOD QUALITY ROCK MASS <i>Tightly interlocking undisturbed rock with unweathered joints at 1 to 3m.</i> RMR rating 85 Q rating 100</p>	<p>$m = 2.38$ $s = 0.008$ $m = 4.10$ $s = 0.189$</p>	<p>$m = 3.40$ $s = 0.008$ $m = 5.85$ $s = 0.189$</p>	<p>$m = 5.10$ $s = 0.008$ $m = 8.78$ $s = 0.189$</p>	<p>$m = 5.78$ $s = 0.008$ $m = 9.95$ $s = 0.189$</p>	<p>$m = 8.50$ $s = 0.008$ $m = 14.63$ $s = 0.189$</p>
<p>GOOD QUALITY ROCK MASS <i>Fresh to slightly weathered rock, slightly disturbed with joints at 1 to 3m.</i> RMR rating 65 Q rating 10</p>	<p>$m = 0.574$ $s = 0.0003$ $m = 2.010$ $s = 0.020$</p>	<p>$m = 0.820$ $s = 0.0003$ $m = 2.870$ $s = 0.020$</p>	<p>$m = 1.230$ $s = 0.0003$ $m = 4.310$ $s = 0.020$</p>	<p>$m = 1.390$ $s = 0.0003$ $m = 4.880$ $s = 0.020$</p>	<p>$m = 2.050$ $s = 0.0003$ $m = 7.180$ $s = 0.020$</p>
<p>FAIR QUALITY ROCK MASS <i>Several sets of moderately weathered joints spaced at 0.3 to 1m.</i> RMR rating 44 Q rating 1</p>	<p>$m = 0.126$ $s = 0.0001$ $m = 0.945$ $s = 0.002$</p>	<p>$m = 0.180$ $s = 0.0001$ $m = 1.380$ $s = 0.002$</p>	<p>$m = 0.270$ $s = 0.0001$ $m = 2.030$ $s = 0.002$</p>	<p>$m = 0.310$ $s = 0.0001$ $m = 2.300$ $s = 0.002$</p>	<p>$m = 0.450$ $s = 0.0001$ $m = 3.380$ $s = 0.002$</p>
<p>POOR QUALITY ROCK MASS <i>Numerous weathered joints at 30 to 500mm with some gouge. Clean compacted waste rock.</i> RMR rating 23 Q rating 0.1</p>	<p>$m = 0.028$ $s = 0.000003$ $m = 0.448$ $s = 0.0002$</p>	<p>$m = 0.040$ $s = 0.000003$ $m = 0.640$ $s = 0.0002$</p>	<p>$m = 0.060$ $s = 0.000003$ $m = 0.960$ $s = 0.0002$</p>	<p>$m = 0.068$ $s = 0.000003$ $m = 1.088$ $s = 0.0002$</p>	<p>$m = 0.100$ $s = 0.000003$ $m = 1.600$ $s = 0.0002$</p>
<p>VERY POOR QUALITY ROCK MASS <i>Numerous heavily weathered joints spaced < 50mm with gouge. Waste rock with fines.</i> RMR rating 3 Q rating 0.01</p>	<p>$m = 0.007$ $s = 0.000001$ $m = 0.217$ $s = 0.00002$</p>	<p>$m = 0.010$ $s = 0.000001$ $m = 0.310$ $s = 0.00002$</p>	<p>$m = 0.015$ $s = 0.000001$ $m = 0.465$ $s = 0.00002$</p>	<p>$m = 0.017$ $s = 0.000001$ $m = 0.527$ $s = 0.00002$</p>	<p>$m = 0.025$ $s = 0.000001$ $m = 0.775$ $s = 0.00002$</p>