updated October 2013

Various classifications

	PARAMETER	SYMBOL	UNIT	CLASSIFICATION					REFERENCE
				very low or very small	low or small	medium // moderate	high or large	very high or very large	
ROCKS	Density Unit weight	ρ γ	t/m³ kN/m³ x 10	< 2.4	2.4 – 2.6	2.6 – 2.8	2.8 – 3.0	> 3.0	NBG 1985
	Uniaxial compressive strength	σ_c	MPa	1 – 5	5 – 15	15 – 50	50 – 120	> 120	ISRM
	Point load strength	Is	MPa	< 0.1	0.1 – 0.3	0.3 – 1	1 – 3	> 3	ISRM
	E-modulus (E_{stat})	E	GPa	< 10	10 – 30	30 – 70	70 –100	> 100	ISRM
	Modulus ratio (E_{stat}/σ_c)	-	-		< 200	200 – 500	> 500		NBG, 1985
	Flakiness value	f	-		< 1.3	1.3 – 1.45	> 1.45		NBG, 1985
	Brittleness value	S_{20}	-		< 45	45 – 65	> 65		NBG, 1985
	Drilling rate index	DRI	-	26 – 32	33 – 42	43 – 57	58 – 69	70 – 82	SINTEF, 1998
	Bit wear index	BWI	-	11 – 20	21 – 30	31 – 44	45 – 55	56 – 69	SINTEF, 1998
	Porosity	n	%	< 0.5	0.5 – 2	2 – 5	5 – 20	> 20	NBG, 1985
	Foliation anisotropy	fA	-	1 – 1.2	1.2 – 1.5	1.5 – 2	2 – 2.5	> 2.5	Palmström, 1995
	Permeability coefficient	k	m/s x 10^{-7}	< 0.001	0.001 – 0.1	0.1 - 10	10 – 100	> 100	NBG, 1985
	Weathering of rock	-	%		< 10	10 – 35	35 – 75	> 75	ISRM
	Slaking (two cycles)	I_{d2}	%	< 30	30 – 60	60 – 90	90 – 98	98 – 100	ISRM
	Mineral size	-	mm	< 0.02	0.02 – 0.6	0.6 – 6	6 – 20	> 20	NBG, 1985
CLAY GOUGE	Free swelling (of swelling clay)	Ss	% *)		< 100	100 – 140	140 – 200	> 200	NBG, 1985
	Hygroscopic moisture	-	% *)		< 8	8 – 15	15 – 25	> 25	NBG, 1985
	Swelling pressure	σ_s	MPa		< 0.1	0.1 – 0.3	0.3 – 0.75	> 0.75	NBG, 1985
GROUND WATER	Capacity of drilled well	q_w	l/h	< 3.6	3.6 – 36	36 – 360	360 – 3600	> 3600	NBG, 1985
	Leakage into tunnels // caverns	q_t	l/min/m	< 0.05	0.05 – 0.3	0.3 – 2	2 – 10	> 10	NBG, 1985
	Water leakage test in bore hole	L	Lugeon	< 0.1	0.1 – 1	1 – 10	10 – 100	> 100	NBG, 1985
JOINTING	Joint spacing	S	m	< 0.06	0.06 – 0.2	0.2 – 0.6	0.6 – 2	> 2	ISRM
	Joint persistence (length)	l	m	< 1	1 – 3	3 – 10	10 – 20	> 20	Bieniawski, 1984
	Joint separation	d	mm	< 0.1	0.1 – 0.5	0.5 – 2.5	2.5 – 10	> 10	Bieniawski, 1984
	Angle of friction in joint surfaces	ϕ	degree	< 15°	15 – 25°	25 – 35°	35 – 45°	> 45°	ISRM
	Volumetric joint count	Jv	joints/m³	< 1	1 – 3	3 – 10	10 – 30	> 30	Palmström, 1982
	Block volume	Vb	m³	< 0.001	0.001-0.03	0.03 – 1	1 – 30	> 30	Palmström, 1996
	RQD-value	RQD	%	< 25	25 – 50	50 – 75	75 – 90	90 – 100	ISRM
	Block shape factor	β	-	27 – 32	32 – 50	50 – 100	100 – 500	> 500	Palmström, 1995
ROCK MASSES	Weakness zone thickness	Tz	m	< 1	1 – 3	3 – 10	10 – 30	> 30	NBG, 1985
	Rock mass (strength) index	RMi	MPa	0.1 – 0.4	0.4 – 1	1 – 10	10 – 40	40 – 100	Palmström, 1995
	Geological strength index	GSI	-	< 20	21 – 35	36 – 55	56 – 75	76 – 95	Hoek, 1994
	Rock mass quality	Q	-	0.1 – 1	1 – 4	4 – 10	10 – 40	40 – 100	Barton et al, 1974
		RMR	-	0 – 20	20 – 40	40 – 60	60 – 80	80 – 100	Bieniawski, 1974
		Gc	-	0.1 – 0.4	0.4 – 1	1 – 10	10 – 40	40 – 100	Palmström, 1995
	Stand-up time in tunnels	-	day year	1/24 – 1	1 – 30	30 – 360 1/12 – 1	1 – 10	> 10	NBG, 1985
	Cost for rock support in tunnels	-	% **)	< 5	5 – 15	15 – 50	50 – 200	> 200	NBG, 1985
	Blastability index	RBFI	-		< 1	1 – 2.5	2.5 – 4	> 4	Selmer-Olsen, 1980
	Rock stress ratio	σ_c/σ_1	-	< 5	5 – 10	10 – 20	20 – 200	> 200	NBG, 1985
	Seismic velocity in rock masses	v	km/s	< 2.5	2.5 – 3.5	3.5 – 5	5 – 7	> 7	NBG, 1985

*) % of dry material; **) % of excavation (drill, blast, mucking) cost

ISRM = International Society for Rock Mechanics
NBG = Norwegian Rock Mechanics Group (affiliated ISRM)