

INPUT PARAMETERS TO RMR₁₉₈₉
(from Bieniawski, 1989)

PARAMETER			Range of values // RATINGS						
1	Strength of intact rock material	Point-load strength index	> 10 MPa	4 - 10 MPa	2 - 4 MPa	1 - 2 MPa	For this low range uniaxial compr. strength is preferred		
		Uniaxial compressive strength	> 250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5 - 25 MPa	1 - 5 MPa	< 1 MPa
		RATING	15	12	7	4	2	1	0
2	Drill core quality RQD		90 - 100%	75 - 90%	50 - 75%	25 - 50%	< 25%		
	RATING		20	17	13	8	5		
3	Spacing of discontinuities		> 2 m	0.6 - 2 m	200 - 600 mm	60 - 200 mm	< 60 mm		
	RATING		20	15	10	8	5		
4	Condition of discontinuities	Length, persistence	< 1 m	1 - 3 m	3 - 10 m	10 - 20 m	> 20 m		
		Rating	6	4	2	1	0		
		Separation	none	< 0.1 mm	0.1 - 1 mm	1 - 5 mm	> 5 mm		
		Rating	6	5	4	1	0		
		Roughness	very rough	rough	slightly rough	smooth	slickensided		
		Rating	6	5	3	1	0		
5	Ground water	Inflow per 10 m tunnel length	none	< 10 litres/min	10 - 25 litres/min	25 - 125 litres/min	> 125 litres /min		
		p_w / σ_1	0	0 - 0.1	0.1 - 0.2	0.2 - 0.5	> 0.5		
		General conditions	completely dry	damp	wet	dripping	flowing		
		RATING	15	10	7	4	0		

p_w = joint water pressure; σ_1 = major principal stress

RATING ADJUSTMENT FOR DISCONTINUITY ORIENTATIONS

		Very favourable	Favourable	Fair	Unfavourable	Very unfavourable
RATINGS	Tunnels	0	-2	-5	-10	-12
	Foundations	0	-2	-7	-15	-25
	Slopes	0	-5	-25	-50	-60

ROCK MASS CLASSES DETERMINED FROM TOTAL RATINGS

Rating	100 - 81	80 - 61	60 - 41	40 - 21	< 20
Class No.	I	II	III	IV	V
Description	VERY GOOD	GOOD	FAIR	POOR	VERY POOR

MEANING OF ROCK MASS CLASSES

Class No.	I	II	III	IV	V
Average stand-up time	10 years for 15 m span	6 months for 8 m span	1 week for 5 m span	10 hours for 2.5 m span	30 minutes for 1 m span
Cohesion of the rock mass	> 400 kPa	300 - 400 kPa	200 - 300 kPa	100 - 200 kPa	< 100 kPa
Friction angle of the rock mass	< 45°	35 - 45°	25 - 35°	15 - 25°	< 15°

RMR classification guide for excavation and support in rock tunnels.

Tunnel shape: horseshoe; width: 10m. Vertical stress: below 25MPa.

(from Bieniawski, 1989)

Rock mass class	Excavation by drill & blast	Rock support (for 10m wide tunnels)		
		Rock bolts (20mm diam., fully bonded)	Shotcrete	Steel sets
1. Very good rock RMR: 81 - 100	Full face: 3m advance	Generally no support required except for occasional spot bolting		
2. Good rock RMR: 61 - 80	Full face: 1.0 - 1.5m advance; Complete support 20m from face	Locally bolts in crown, 3m long, spaced 2.5m with occasional wire mesh	50mm in crown where required	None
3. Fair rock RMR: 41 - 60	Top heading and bench: 1.5 - 3m advance in top heading; Commence support after each blast; Commence support 10m from face	Systematic bolts 4m long, spaced 1.5 - 2m in crown and walls with wire mesh in crown	50 - 100mm in crown, and 30mm in sides	None
4. Poor rock RMR: 21 - 40	Top heading and bench: 1.0 - 1.5m advance in top heading; Install support concurrently with excavation - 10m from face	Systematic bolts 4 - 5m long, spaced 1-1.5m in crown and walls with wire mesh	100-150mm in crown and 100mm in sides	Light ribs spaced 1.5m where required
5. Very poor rock RMR < 21	Multiple drifts: 0.5 - 1.5m advance in top heading; Install support concurrently with excavation; shotcrete as soon as possible after blasting	Systematic bolts 5 - 6m long, spaced 1 - 1.5m in crown and walls with wire mesh. Bolt the invert	150 - 200mm in crown, 150mm in sides, and 50mm on face	Medium to heavy ribs spaced 0.75m with steel lagging and forepoling if required. Close invert