

## DAFTAR PUSTAKA

1. Bieniawski. "*Rock Mechanics Design in Mining and Tunneling*" A A Baikema. 1984
2. E. Hoek & ET Brown." *Under ground Excavation in Rock* ". The Institution of Mining and Metallurgi. London .1980
3. Evert Hoek Dr,"*Rock Engineering*" Evert Hoek Consulting Engineer Inc. North Vancouver – Canada. 2000
4. Engineering and design. "*Standard Practice for Shotcrete* " US Army Corps Washington USA. 1993
5. Engineer and Design. "*Tunnels and Shaft in rock*". US Army Corps of Engineers. Washington USA 1997
6. Geoguide 4. "*Guide to Cavern Engineering* " Geotechnical Eng. Office Civil Engineering Deft. Hongkong. 1992
7. Irwandi Arif , Dr. Ir. Msc "*Teknik Penyangga dan Perkuatan* " Laboratorium Geoteknik – Pusat antar Universitas Ilmu Rekayasa ITB. Bandung. 1992
8. KSTT PLN ." *Pertemuan Kelompok Study Terowongan*" Perum Listrik Negara – Jakarta. 1986
9. Nippon Koei Co LTD. "*Detailed Design Report . Civil Works*" Perum Listrik Negara. Jakarta.1980
10. PNW. Verhoef ." *Geologi untuk Teknik Sipil* " Erlangga – Jakarta. 1994
11. Richard E. Goodman. "*Engineering Geology* " John Wiley & Sons, Inc. New York / Chichester/ Brisbane/ Toronto / Singapore. 1989

**LANGKAH – LANGKAH DI DALAM PENGKLASIFIKASIAN DENGAN MENGGUNAKAN CARA THE ROCK MASS RATING SYSTEM (RMR).**

**Langkah pertama.**

Langkah pertama adalah menghitung rating total parameter seperti yang terdapat didalam tabel .I. dibawah ini.

A. CLASSIFICATION PARAMETERS AND THEIR RATINGS								
Parameter		Range of values						
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 compressive test is preferred	
		Uniaxial comp. strength	>250 MPa	100 - 250 MPa	50 - 100 MPa	25 - 50 MPa	5 - 25 MPa	1 - 5 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	3		
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 (See E)	Very rough surfaces Not continuous No separation Unweathered wall rock	Slightly rough surfaces Separation < 1 mm Slightly weathered walls	Slightly rough surfaces Separation < 1 mm Highly weathered walls	Slickensided surfaces or Gouge < 5 mm thick or Separation 1-5 mm Continuous	Soft gouge >5 mm thick or Separation > 5 mm Continuous		
		Rating	30	25	20	10	0	
5	Ground water	Inflow per 10 m tunnel length (l/m)	None	< 10	10 - 25	25 - 125	> 125	
		(Joint water press)/ (Major principal $\sigma$ )	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		

Parameter dan Ratingnya.

**Tabel. I.**

**Langkah kedua.**

Menilai kedudukan sumbu terowongan terhadap jurus ( stike ) dan kemiringan (dip) pada bidang diskontinuitas , seperti terlihat pada tabel. II dibawah ini .

F. EFFECT OF DISCONTINUITY STRIKE AND DIP ORIENTATION IN TUNNELLING**			
Strike perpendicular to tunnel axis		Strike parallel to tunnel axis	
Drive with dip - Dip 45 - 90°	Drive with dip - Dip 20 - 45°	Dip 45 - 90°	Dip 20 - 45°
Very favourable	Favourable	Very unfavourable	Fair
Drive against dip - Dip 45-90°	Drive against dip - Dip 20-45°	Dip 0-20 - Irrespective of strike°	
Fair	Unfavourable	Fair	

Efek orientasi jurus dan kemiringan diskontinuitas di dalam terowongan

**Tabel. II.**

**Perhitungan Koefisien variasi dan faktor nilai tambah Allowence (  $\alpha$  )**

DATA HASIL QUALITY CONTROL

No	Tanggal	X ( $\sigma_{28}$ )	X (X - $X_r$ )	(X - $X_r$ ) <sup>2</sup>
1	06-12	255	- 29	841
2	07-12	333	49	2401
3	08-12	273	-11	121
4	11-12	291	7	49
5	12-12	352	68	4624
6	13-12	270	-14	196
7	15-12	252	-32	1024
8	17-12	259	-25	625
9	18-12	311	27	729
10	26-12	275	-9	81
11	27-12	321	37	1364
12	28-12	239	-45	2025
13	29-12	254	-30	100
14	02-01	295	11	121
15	02-01	277	-7	49
16	03-01	274	-10	100
17	04-01	201	-83	6889
18	04-01	206	-78	6084
19	05-01	252	-32	1024
20	07-01	370	86	7396
21	08-01	292	8	64
22	08-01	265	-14	361
23	09-01	259	-25	625
24	10-01	344	60	3600
25	11-01	290	6	36
26	12-01	275	-9	81
27	14-01	306	22	284
28	15-01	254	-30	900
29	21-01	345	61	3721
30	24-01	317	33	1009
Jumlah		8507		47609

- PETA GEOLOGI PENSTOCK TUNNEL
- PROPIL MEMANJANG
- RANGKUMAN HASIL BOR INTI
- DENAH & POTONGAN MEMANJANG
- DETAIL STRUKTUR (1)
- DETAIL STRUKTUR (2)
- DETAIL STRUKTUR (3)
- PEKERJAAN PENSTOCK ADIT
- STRUKTUR PENSTOCK ADIT. P.1
- DENAH & POTONGAN PENSTOCK ADIT P.2
- STRUKTUR DETAIL PENSTOCK ADIT P.2
- GENERAL PLAN / GENERAL PROFILE
- TUNNEL EXCAVATION PROGRESS
- DATA TEKNIS PLTA RENUN