

Input parameters to Q system

Rock quality designation (RQD)

Very poor	RQD = 0 - 25%
Poor	25 - 50
Fair	50 - 75
Good	75 - 90
Excellent	90 - 100
Notes:	
(i) Where RQD is reported or measured as < 10 (including 0), a nominal value of 10 is used to evaluate Q	
(ii) RQD intervals of 5, i.e. 100, 95, 90, etc. are sufficiently accurate	

Joint set number (Jn)

Massive, no or few joints	Jn = 0.5 - 1
One joint set	2
One joint set plus random	3
Two joint sets	4
Two joint sets plus random	6
Three joint sets	9
Three joint sets plus random	12
Four or more joint sets, heavily jointed, "sugar-cube", etc.	15
Crushed rock, earthlike	20
Notes: (i) For tunnel intersections, use (3.0 x Jn); (ii) For portals, use (2.0 x Jn)	

Description and ratings for the parameter Jr (joint roughness number)

a) Rock-wall contact,		c) No rock-wall contact when sheared	
b) rock-wall contact before 10 cm shear			
Discontinuous joints	Jr = 4	Zone containing clay minerals thick enough to prevent rock-wall contact	Jr = 1.0
Rough or irregular, undulating	3		
Smooth, undulating	2	Sandy, gravelly or crushed zone thick enough to prevent rock-wall contact	1.0
Slickensided, undulating	1.5		
Rough or irregular, planar	1.5	Notes:	
Smooth, planar	1.0	i) Add 1.0 if the mean spacing of the relevant joint set is greater than 3 m	
Slickensided, planar	0.5	ii) Jr = 0.5 can be used for planar, slickensided joints having lineations, provided the lineations are orientated for minimum strength	
Note: i) Descriptions refer to small scale features, and intermediate scale features, in that order			

Descriptions and ratings for the parameter Ja (joint alteration number)

Contact between joint walls	JOINT WALL CHARACTER		Condition		Wall contact
	CLEAN JOINTS	Healed or welded joints:	filling of quartz, epidote, etc.		Ja = 0,75
		Fresh joint walls:	no coating or filling, except from staining (rust)		1
		Slightly altered joint walls:	non-softening mineral coatings, clay-free particles, etc.		2
COATING OR THIN FILLING	Friction materials:	sand, silt calcite, etc. (non-softening)		3	
	Cohesive materials:	clay, chlorite, talc, etc. (softening)		4	
Partly or no wall contact	FILLING OF:	Type	Partly wall contact	No wall contact	
			<i>Thin filling (< 5 mm)</i>	<i>Thick filling</i>	
	Friction materials	sand, silt calcite, etc. (non-softening)	Ja = 4	Ja = 8	
	Hard cohesive materials	compacted filling of clay, chlorite, talc, etc.	6	5 - 10	
	Soft cohesive materials	medium to low overconsolidated clay, chlorite, talc, etc.	8	12	
Swelling clay materials	filling material exhibits swelling properties	8 - 12	13 - 20		

Description and ratings for the parameter Jw (joint water reduction factor)

Dry excavations or minor inflow, i.e. < 5 l/min locally	$p_w < 1 \text{ kg/cm}^2$	Jw = 1
Medium inflow or pressure, occasional outwash of joint fillings	1 - 2.5	0.66
Large inflow or high pressure in competent rock with unfilled joints	2.5 - 10	0.5
Large inflow or high pressure, considerable outwash of joint fillings	2.5 - 10	0.3
Exceptionally high inflow or water pressure at blasting, decaying with time	> 10	0.2 - 0.1
Exceptionally high inflow or water pressure continuing without noticeable decay	> 10	0.1 - 0.05
Note: (i) The last four factors are crude estimates. Increase Jw if drainage measures are installed		
(ii) Special problems caused by ice formation are not considered		

Description and ratings for parameter SRF (stress reduction factor)

A. Weakness zones intersecting excavation	Multiple weakness zones with clay or chemically disintegrated rock, very loose surrounding rock (any depth)		SRF = 10		
	Single weakness zones containing clay or chemically disintegrated rock (depth of excavation < 50 m)		5		
	Single weakness zones containing clay or chemically disintegrated rock (depth of excavation > 50 m)		2.5		
	Multiple shear zones in competent rock (clay-free), loose surrounding rock (any depth)		7.5		
	Single shear zones in competent rock (clay-free), loose surrounding rock (depth of excavation < 50 m)		5		
	Single shear zones in competent rock (clay-free), loose surrounding rock (depth of excavation > 50 m)		2.5		
	Loose, open joints, heavily jointed or "sugar-cube", etc. (any depth)		5		
B. Competent rock, rock stress problems	Note: (i) Reduce these values of SRF by 25 - 50% if the relevant shear zones only influence, but do not intersect the excavation		σ_c / σ_1	σ_θ / σ_c	
	Low stress, near surface, open joints		> 200	< 0.01	2.5
	Medium stress, favourable stress condition		200 - 10	0.01 - 0.3	1
	High stress, very tight structure. Usually favourable to stability, may be except for walls		10 - 5	0.3 - 0.4	0.5 - 2
	Moderate slabbing after > 1 hour in massive rock		5 - 3	0.5 - 0.65	5 - 50
	Slabbing and rock burst after a few minutes in massive rock		3 - 2	0.65 - 1	50 - 200
Heavy rock burst (strain burst) and immediate dynamic deformation in massive rock		< 2	> 1	200 - 400	
Notes: (ii) For strongly anisotropic stress field (if measured): when $5 < \sigma_1 / \sigma_3 < 10$, reduce σ_c to $0.75 \sigma_c$.					
(iii) When $\sigma_1 / \sigma_3 > 10$, reduce σ_c to $0.5 \sigma_c$					
(iii) Few case records available where depth of crown below surface is less than span width. Suggest SRF increase from 2.5 to 5 for low stress cases					
C. Squeezing rock	Plastic flow of incompetent rock under the influence of high pressure		Mild squeezing rock pressure	1 - 5	5 - 10
			Heavy squeezing rock pressure	> 5	10 - 20
D. Swelling rock	Chemical swelling activity depending on presence of water		Mild swelling rock pressure	5 - 10	
			Heavy swelling rock pressure	10 - 15	