VIII Semester Examination 2013

Mining Engineering

MN 804/1 Tunnel Engineering

Full marks 70   Time 3 hours

First Half

Answer any three questions.

You can make use of the charts and formula given in the attached sheets.

1. a) Explain the conditions under which Hoek-Brown or Mohr-Coulomb formula to be used for evaluating rock mass strength.

   b) A rock mass is to be evaluated by Hoek-Brown strength criterion. The rock mass is regarded as very blocky/very good. A number of triaxial tests are conducted on rock samples and the values of Hoek and Brown constants are obtained as 15 and 1. Evaluate the rock mass strength and comment on results.

                                                                                                        (3+8)

2. a) Calculate the shear strength of a field discontinuity using Barton's estimate. The following data are given.

Maximum amplitude of asperites- 70 mm for a profile length of 2 m

Unit weight of rock 23 MN/m^3

Schimdt Rebound number 50 with vertical downward orientation.

   b) What do you mean by instantaneous cohesion and friction?

                                                                                                        (8+3)

3. Explain logically how you would proceed to design of supports for a shallow tunnel driven in jointed rock.   (11)

4. Explain with a hypothetical example how you would draw the characteristic curve defining the plastic and elastic deformation surrounding a circular tunnel. Also indicate how a support reaction curve helps in designing an appropriate support system for the tunnel.   (11)

$$\sigma_1' = \sigma_3' + \sigma_{ci}\left(m_b\frac{\sigma_3'}{\sigma_{ci}} + s\right)^a$$

GEOLOGICAL STRENGTH INDEX	SURFACE CONDITIONS	VERY GOOD — Very rough, fresh unweathered surfaces	GOOD — Rough, slightly weathered, iron stained surfaces	FAIR — Smooth, moderately weathered or altered surfaces	POOR — Slickensided, highly weathered surfaces with compact coatings or fillings of angular fragments	VERY POOR — Slickensided, highly weathered surfaces with soft clay coatings or fillings

From the letter codes describing the structure and surface conditions of the rock mass (from Table 4), pick the appropriate box in this chart. Estimate the average value of the Geological Strength Index (GSI) from the contours.
Do not attempt to be too precise. Quoting a range of GSI from 36 to 42 is more realistic than stating that GSI = 38

STRUCTURE — DECREASING SURFACE QUALITY ▷

DECREASING INTERLOCKING OF ROCK PIECES ▽

BLOCKY - very well interlocked undisturbed rock mass consisting of cubical blocks formed by three orthogonal discontinuity sets

80
70

VERY BLOCKY - interlocked, partially disturbed rock mass with multifaceted angular blocks formed by four or more discontinuity sets

60
50

BLOCKY/DISTURBED- folded and/or faulted with angular blocks formed by many intersecting discontinuity sets

40
30

DISINTEGRATED - poorly inter-locked, heavily broken rock mass with a mixture or angular and rounded rock pieces

20
10

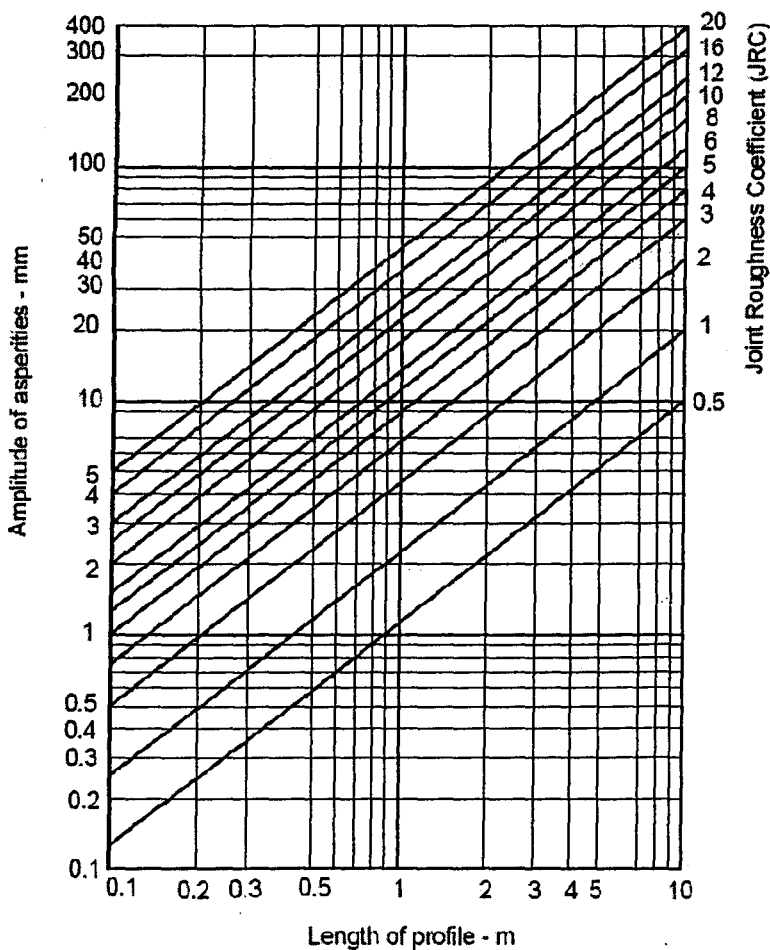$$m_b = m_i \exp\left(\frac{GSI - 100}{28} \right)$$

$$s = \exp\left(\frac{GSI - 100}{9} \right)$$
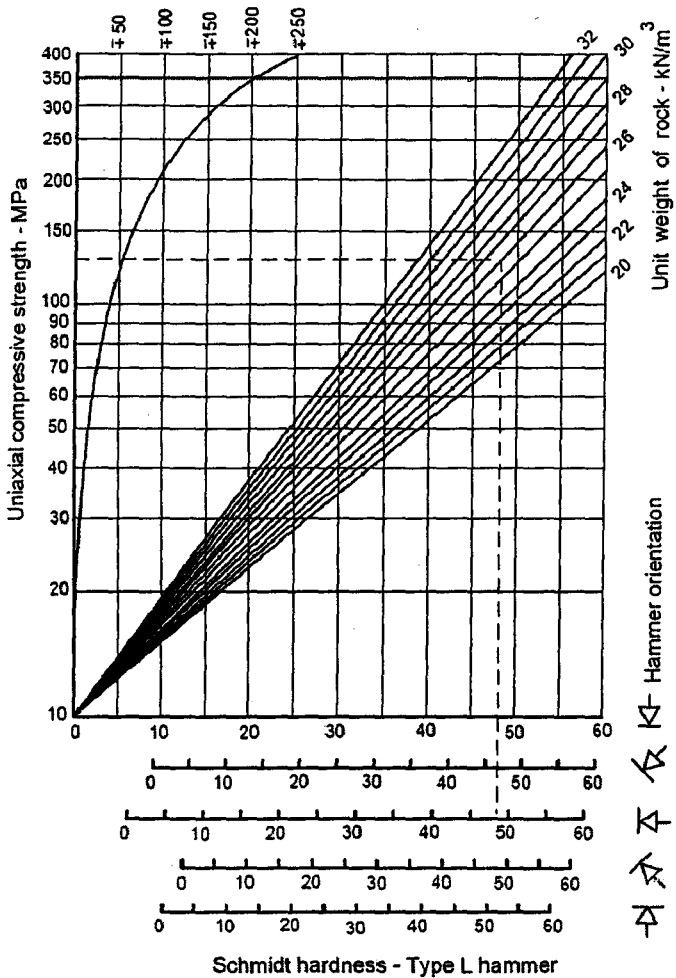
$$a = 0.5$$

$$s = 0$$

$$a = 0.65 - \frac{GSI}{200}$$

$$\tau = \sigma_n \tan\left(\phi_b + JRC \log_{10}\left(\frac{JCS}{\sigma_n} \right) \right)$$

Average dispersion of strength
for most rocks - MPa

Answer question No 6 and 2 from the rest

6. Write short notes on the followings

    a) Spiral burn-cut

    b) Coromant cut

    c) Main-beam TBM

    d) Lifters

(3+3+4+3)

7. a) Explain New Austrian Tunneling Method?

b) Calculate the depth of blastholes, average advances and number of blastholes to carryout blasting in a tunnel with the following geometric dimensions and drill data:

- Tunnel width: 4.8m,
- Tunnel height: 4.0m,
- Height of arch: 0.5m,
- Diameter of the blastholes: 0.044m,
- Diameter of the relief hole: 0.105m,

Lookout angle of the contour blastholes: 3°.

(5+6)

8. a) Comment on use of road headers for tunnel drivages? How the performance of same can be improved?

b) What is tunnel boring machine (TBM)?

(8+3)

9. a) Tabulate the general application ranges for various TBM types on the basis of rock mass rating (RMR) of the rock.

b) Describe the advantages of TBM over drill blast excavation methods?

(5+6)

10. a) Describe the operational and management problems in TBM face?

b) Explain a case study on application of TBM in mining operations.

(4+7)