BIRLA INSTITUTE OF TECHNOLOGY AND SCIENCE PILANI
I SEMESTER 2022-23
MID SEMESTER EXAMINATION
CE F325 FUNDAMENTALS OF ROCK MECHANICS (CLOSE BOOK)

Duration: 90 Mins **Max Marks: 35**

1. Explain the importance of angle of installation of rock bolts in enhancing/reducing the stability of rock slopes. **[2 Marks]**

2. Justify the statement: Face bolting is crucial in ensuring the stability of tunnel excavations in challenging environment. Support your answer in the context of pre-convergence **[2 Marks]**

3. Highlight the importance of stemming of blast holes for effective production blasting. **[2 Marks]**

4. Rock coring of 100 cm at a site was conducted to assess the RQD. The individual pieces were found to have lengths of 6, 12, 11, 13, 23, 7, 7, 15 and 6 cm. Find the rock quality designation. Comment on the disadvantages of RQD classification with a suitable example. How does rock mass classification systems overcome the disadvantages stated for RQD? **[3 Marks]**

5. A tunnel is proposed to be driven in a rock formation against the main joint dipping direction at 40^0. Uniaxial compressive strength of rock cores tested ranges between 185 to 250 MPa. RQD determined is 70%. The joint spacing is found to be 700 mm with less than 1 mm separation, surfaces being rough and slightly weathered. If the tunneling condition is expected to be dry, determine the RMR value of the rock mass considering the adjustment required. Assume the depth of the tunnel within practical range. **[4 Marks]**

6. A schematic representation of a slope in jointed rock mass that is threatened by a planar failure is shown in Fig. 1. Determine
a. FOS when there is no water present in the slope and without the consideration of seismic action
b. FOS when the depth of the water table below the crest of the slope is 5 m without the consideration of seismic action
c. FOS when there is no water present in the slope with the consideration of horizontal seismic coefficient of 0.15.
d. FOS when the depth of the water table below the crest of the slope is 5 m and with the consideration of horizontal seismic coefficient of 0.15. **[8 Marks]**

The following information is available.
1. Slope height = 165 m
2. Failure surface angle = 25^0
3. Slope angle = 45^0
4. Friction angle (intact rock) = 35^0
5. Cohesion (intact rock) = 15.8 MPa
6. Friction angle (joint) = 28^0
7. Cohesion (joint) = 0.06 MPa
8. Unit weight = 25 kN/m^3
9. Tension crack depth = 15 m
10. Surcharge = 0 kPa

7. A tunnel is being planned to be constructed in a mountainous region as shown in Fig. 2. A preliminary site investigation led to the characterization of the rock mass along the stretch as documented in Table below. Given the data, a preliminary analysis needs to be taken up to determine the following for a tunnel excavation with a diameter of 10 m.

a. Minimum support pressure required at Sections 1-1, 2-2 and 3-3 to maintain the excavation in the elastic region.

b. Suppose the internal support pressure provided for the three sections are 0.89 MPa, 2.23 MPa and 2.64 MPa for Sections 1-1, 2-2 and 3-3 respectively, evaluate the radius of the plastic zone.

c. Probable displacement for Section 3-3 considering the internal support pressure to be 0. **[11 Marks]**

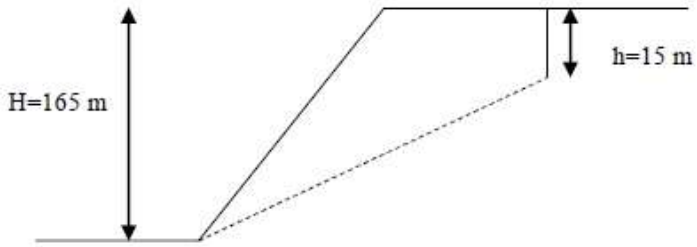

Fig. 1. Slope configuration

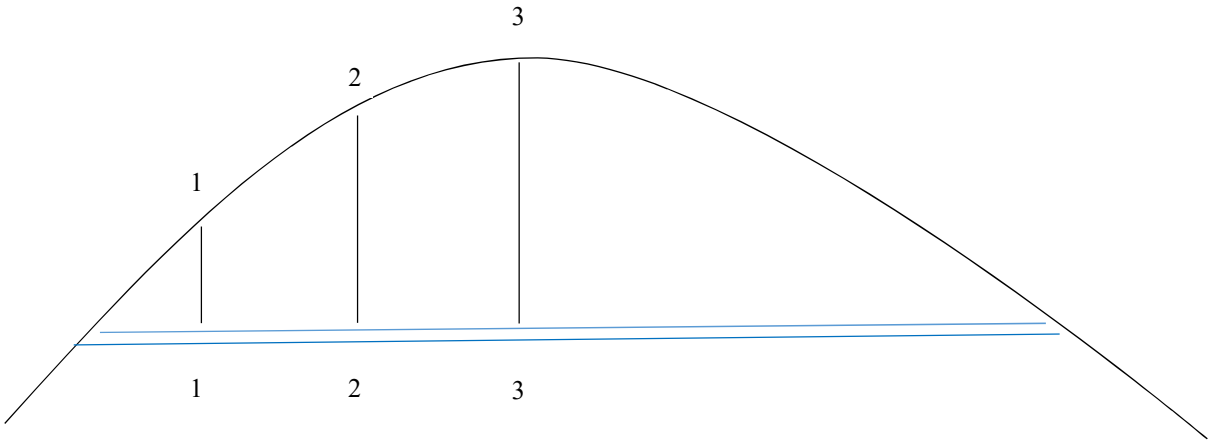

Fig. 2. Tunnel Route

Data Available	Section 1-1	Section 2-2	Section 3-3
Depth (m)	250	550	750
Density (kN/m^3)	23	23	23
Cohesion (MPa)	0.25	0.15	0.25
Friction Angle (^{0})	30	20	30
Young's Modulus, E (GPa)	11.8	3.5	11.8
Poisson's ratio	0.2	0.2	0.2
Internal Support Pressure (MPa)	0.89	2.23	2.64

8. A loose deposit of soil is underlain by rock. A seismic reflection survey was conducted which showed the arrival of distinct p-waves at a geophone at 28 msec and 200 msec after an impulse was applied at a distance of 20 m from the geophone. Determine the thickness of the soil layer over the rock layer. **[3 Marks]**