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

Duration: 180 Mins   **Max Marks: 35**

1. A 7 km long tunnel is proposed in the Himalayas with large overburden. Two critical sections have been identified for the project where the rock mass and in-situ conditions are characterized as shown in Table 1. Considering that full face excavation of a circular tunnel with a radius of 5 m is planned, evaluate the following

a. Face position for the condition corresponding to critical pressure

b. Total deformation corresponding to the face position at 2 m ahead of the face

c. Maximum radius of plastic zone

d. Radius of plastic zone corresponding to 85% deconfinement   **[10 Marks]**

Table 1. Rock mass and in-situ stress characterization

Data Available	Section A	Section B
In-situ stress (MPa)	14	30
Cohesion (MPa)	2	1.16
Friction Angle (^{0})	15	26
Young's Modulus, E (MPa)	4305	7500
Poisson's ratio	0.25	0.25

2. Evaluate the factor of safety for the slope shown in Fig. 1. Consider the horizontal seismic coefficient as 0.12. What should be the bolt force to increase the FOS by 25% considering the bolt inclination with horizontal as 25^0.   **[10 Marks]**

1. Friction angle (intact rock) = 32^0
2. Cohesion (intact rock) = 10.8 MPa
3. Friction angle (joint) = 28^0
4. Cohesion (joint) = 0.05 MPa
5. Unit weight = 25 kN/m^3

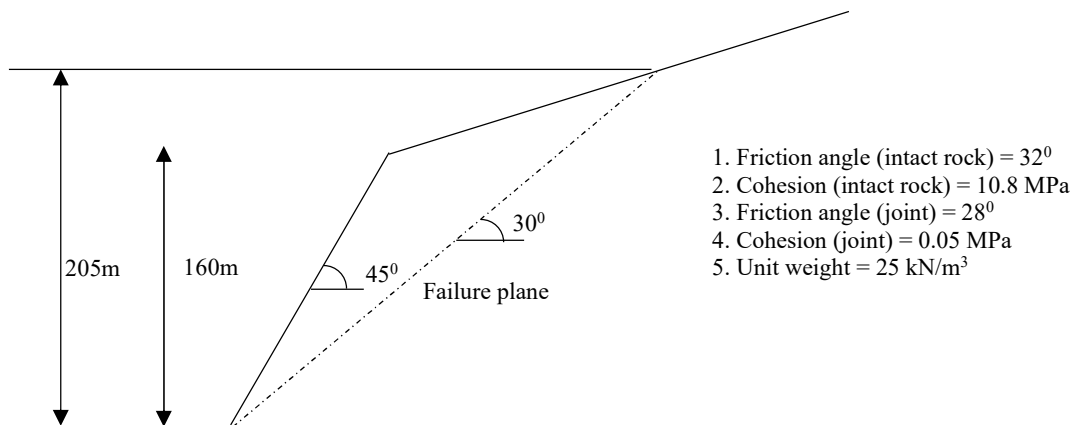205m   160m 45^0 30^0 Failure plane

Fig. 1. Slope

3. 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 18 msec and 400 msec after an impulse was applied at a distance of 30 m from the geophone. Determine the thickness of the soil layer over the rock layer. **[3 Marks]**

4. Justify the following

   a. Bottom-Up Approach provides greater flexibility in construction of the tunnel structures in urban areas in comparison to the top-down approach.
   b. Top-down approach is preferred in urban areas where the traffic disruption may have a serious long term implication.
   c. Tunnel Boring Machines are not preferred in mixed geological conditions and squeezing grounds.
   d. Convergence Confinement Method has limited applicability in practicality and should be used only as a preliminary tool.
   e. Economy of tunnel construction depends on the interaction between GRC and SRC. Explain with the help of a neat diagram. **[5 Marks]**

5. Draw the topographical and cross section along AB for the map provided. **[5 Marks]**

6. Explain the basic mechanism of production blasting. **[2 Marks]**