INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date_____FN/AN, Time: 2 Hrs., Full Marks 60, Deptt. Mining Engineering

No. of Students: 69 Mid Spring Semester Examination: 2013-14

Sub. No.: MI40021 Sub. Name: APPLIED ROCK ENGINEERING

3RD Yr. B.Tech. (H)

Instruction: Answer all questions. Write all parts of a question in one place.

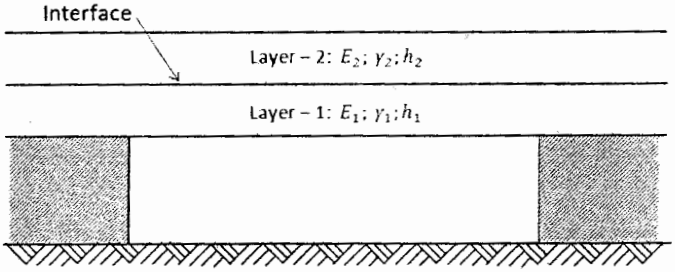
Q1. (a) Classify the artificial support for ground control. Explain the supporting mechanism of roof bolts. **[5]**

(b) Explain the reason behind support classification based on the concept of ground reaction curve (GRC) and support reaction curve (SRC). **[5]**

(c) A tunnel of radius 1.85 m is excavated in rock subjected to an initial hydrostatic stress field of 20 MPa and provided with a concrete lining of stiffness $k = 3.0$ GPa. Assuming elastic behavior of the rock and concrete lining, calculate the radial pressure and the radial displacement at the rock-lining interface if the lining is installed **[10]**

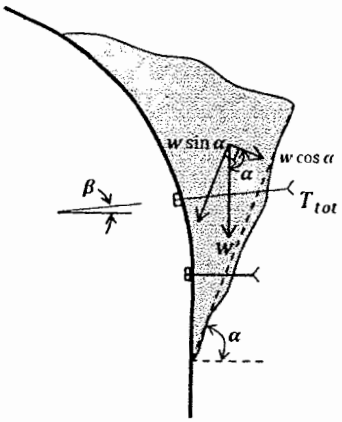
(i) before any displacement of the rock-lining interface; and
(ii) following a tunnel radial deformation of 2 mm.

Q2. (a) Two weak rock layers of thickness ($h_1 = h_2 = h$), modulus of elasticity ($E_1 = kE$; $E_2 = E$), unit weight ($\gamma_1 = \gamma_2 = \gamma$) are simply supported and layer – 2 lying on top of layer -1 as shown in the Figure below. State the behaviour of interface between layer – 1 and layer - 2 when $k = 0$; $k > 1$; $k < 1$. **[5]**



(b) A rock block of weight 40 kN is separated by cracks making and angle $\alpha = 60^0$ with horizontal. The area of the sliding surface is 1 m^2. The cohesion and angle of friction of sliding surface are 6 kPa, and 25^0 respectively. Find the FOS of the sliding block **[6]**

(i) With unbolted block
(ii) With bolted block. The horizontal inclination of the bolt is 30^0 clockwise. Find the applied tightening force if factor of safety of bolt is 2.



(c) A 4 m wide and 20 m long roadway is supported by point anchored bolts in a square bolting pattern with spacing 1m. If the roof is supported by suspension mechanism with thick of suspended rock layers are 1.5m above the exposed roof. If average unit weight of suspended roof layers is 25 kN/m^3. Then find the **[9]**

(i) stress in bolts if 20 mm diameter circular cross-section steel rods are used

(ii) FoS of bolt. If breaking strength of steel is 15 MPa, and

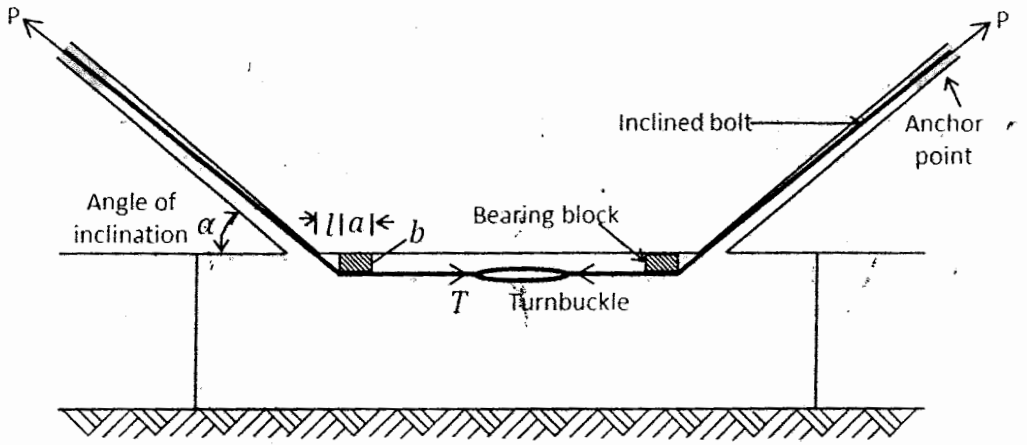
(iii)bolt density

Q3. (a) Discuss with neat sketches the anchor mechanism of a grouted rock bolt. **[4]**

(b) Determine the anchorage force of a mechanically anchored slot-wedge-bolt installed in rock mass having bearing capacity of 20MPa. Assume the borehole diameter is 25 mm, bolt contact length is 150 mm, conical angle is 4^0 and friction angle between bolt and rock mass is 20^0. **[4]**

(c) An expansion-shell bolt, consists of four pieces of expansion shell each having friction surface area 5 cm^2. The bearing capacity of rock mass is 20 MPa and coefficient of friction between expansion shell and bolt is 0.25. Determine the anchorage force of the expansion shell bolt. **[4]**

(d) The fixing force of a rod in the hole of a roof truss tightening force of 10 kN. The holes are driven at an angle of 60^0, the block of thickness ($b = 8$ cm) and length ($a = 10$ cm) is placed at a distance of ($l = 22$ cm) from drillhole edge. The coefficient of friction between block and roof is 0.4. Find the anchorage force (P) if the same block is placed at ($l = 5$ cm) from the drillhole edge. Comment on the effect of block location on anchorage force. **[8]**



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