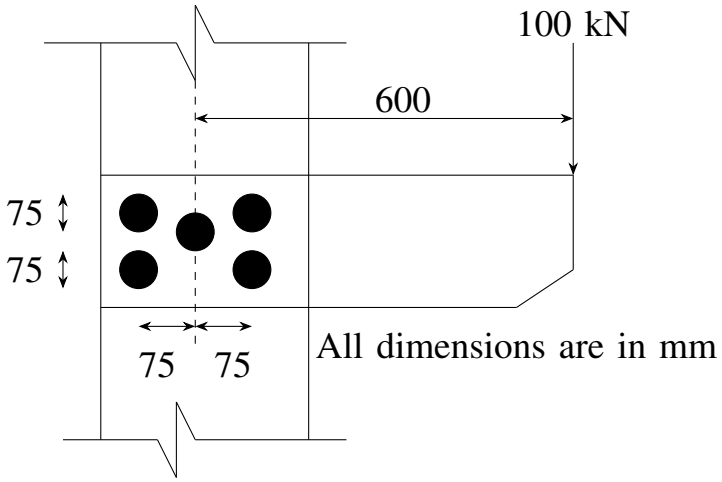
2015-AE-40-52

EE24BTECH11003 - Akshara Sarma Chennubhatla

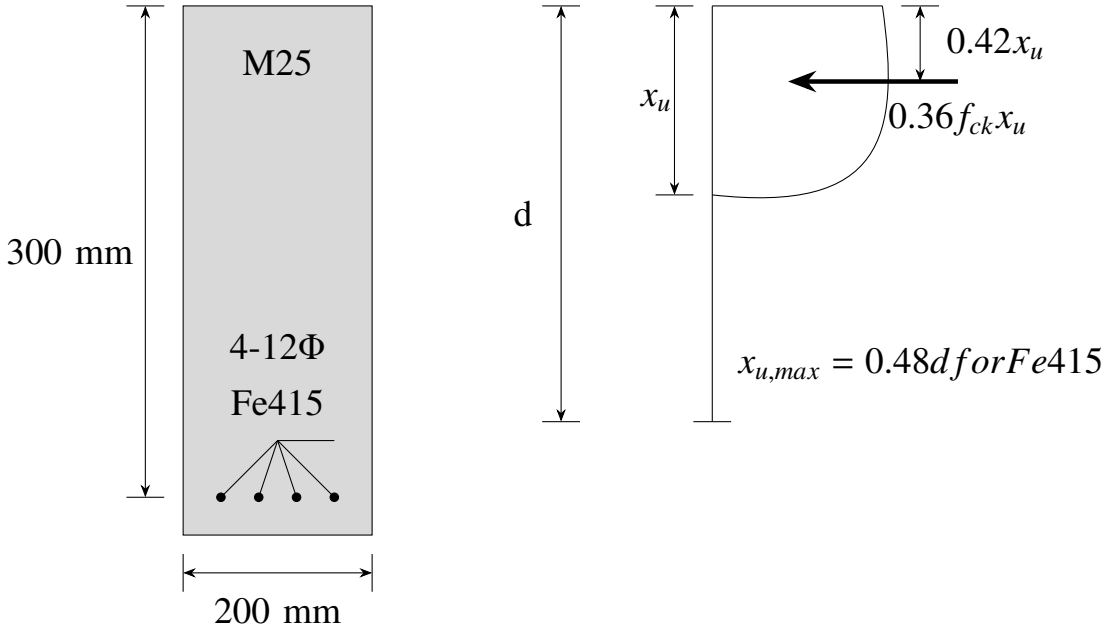
1) The directional derivative of the field $u(x,y,z) = x^2 - 3yz$ in the direction of the vector $(\mathbf{i} + \mathbf{j} - 2\mathbf{k})$ at point $(2,-1,4)$ is _____
2) The composition of an air-entrained concrete is given below:

$$\text{Water} : 184 kg/m^3$$
$$\text{Ordinary Portland Cement (OPC)} : 368 kg/m^3$$
$$\text{Sand} : 606 kg/m^3$$
$$\text{Coarse aggregate} : 1155 kg/m^3$$

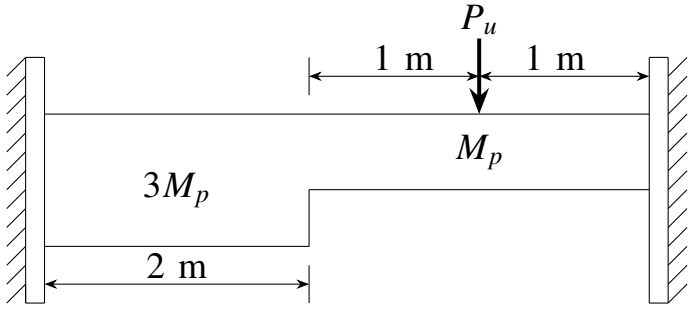
   Assume the specific gravity of OPC, sand and course aggregate to be 3.14, 2.67 and 2.74, respectively. TYhe air content is _____ litres/m^3.
3) A bracket plate connected to a column flange transmits a load of 100 kN as shown in the following figure. The maximum force for which the bolts should be designed is _____ kN.



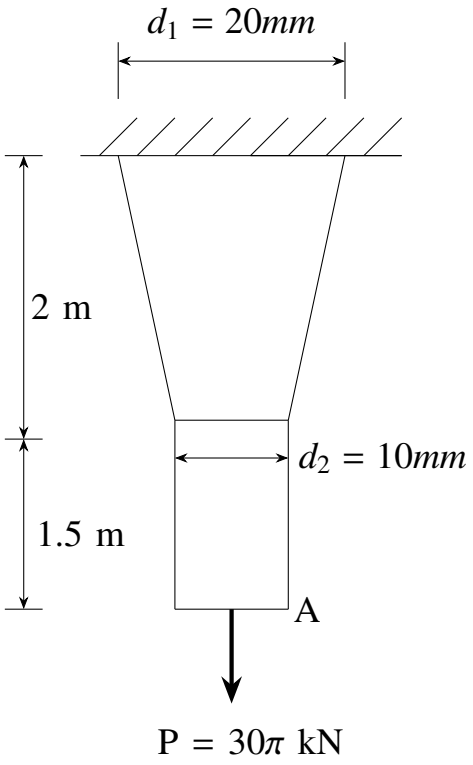
4) Consider the singly reinforced beam section given below (left figure). The stress block parameters for the cross-section from IS:456 – 2000 are also given below (right figure). The moment of resistance for the given section by the limit state method is _____ kN-m.



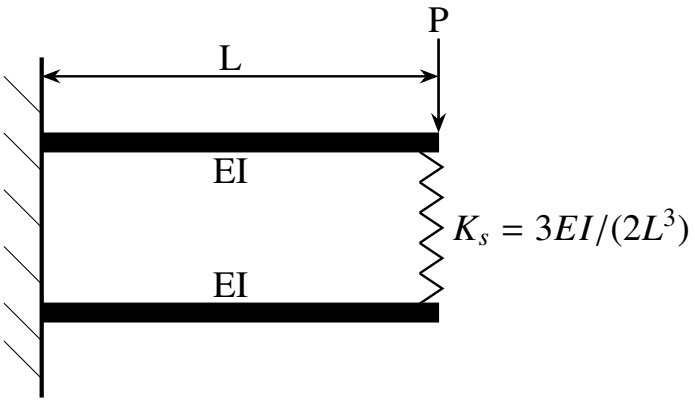
5) For formation of collapse mechanism in the following figure, the minimum value of P_u is xM_p/L. M_p and $3M_p$ denote the plastic moment capacities of beam section as shown in this figure. The value of c is _____.



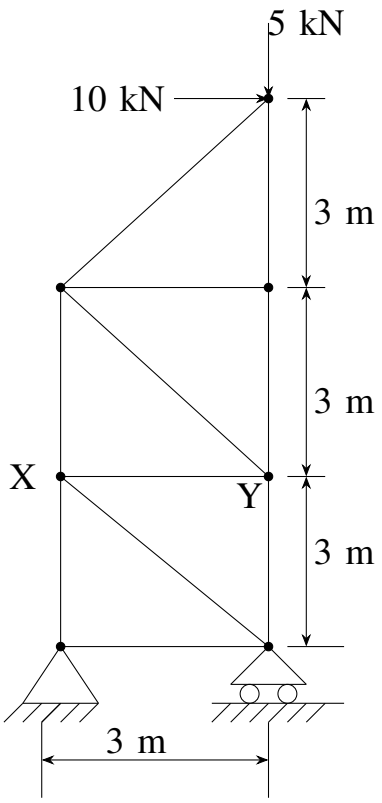
6) A tapered circular rod of diameter varying from 20 mm to 10 mm is connected to another uniform circular rod of diameter 10 mm as shown in the figure. Both bars are made of same material with the modulus of elasticity, E = 2 x 10^5 MPa. When subjected to a load $P = 30\pi$ kN, the deflection at point A is _____ mm.



7) Two beams are connected by a linear spring as shown in the following figure. For a load P as shown in the figure, the percentage of the applied load P carried by the spring is _____.

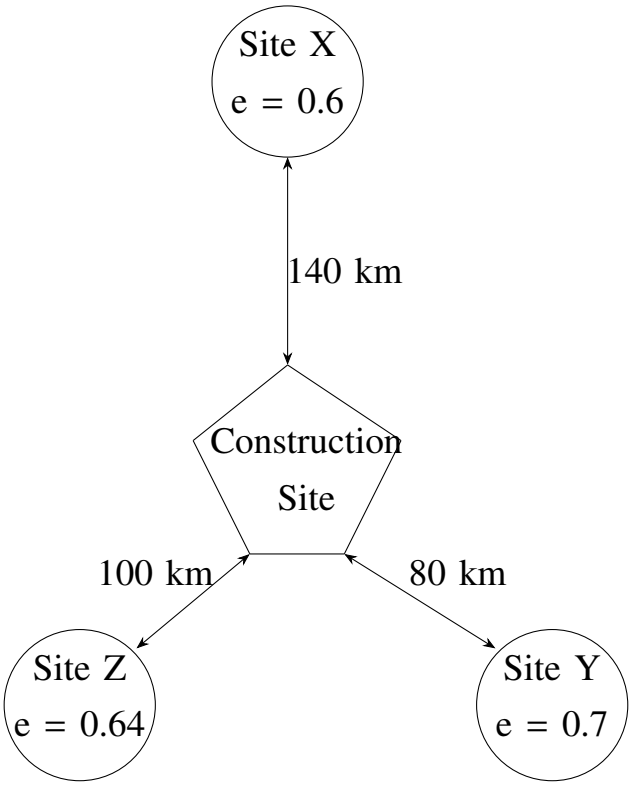


8) For the $2D$ truss with the applied loads shown below, the strain energy in the member XY is _____ kN-m. For the member XY, assume $AE = 30$ kN, where A is cross-section area and E is the modulus of elasticity.

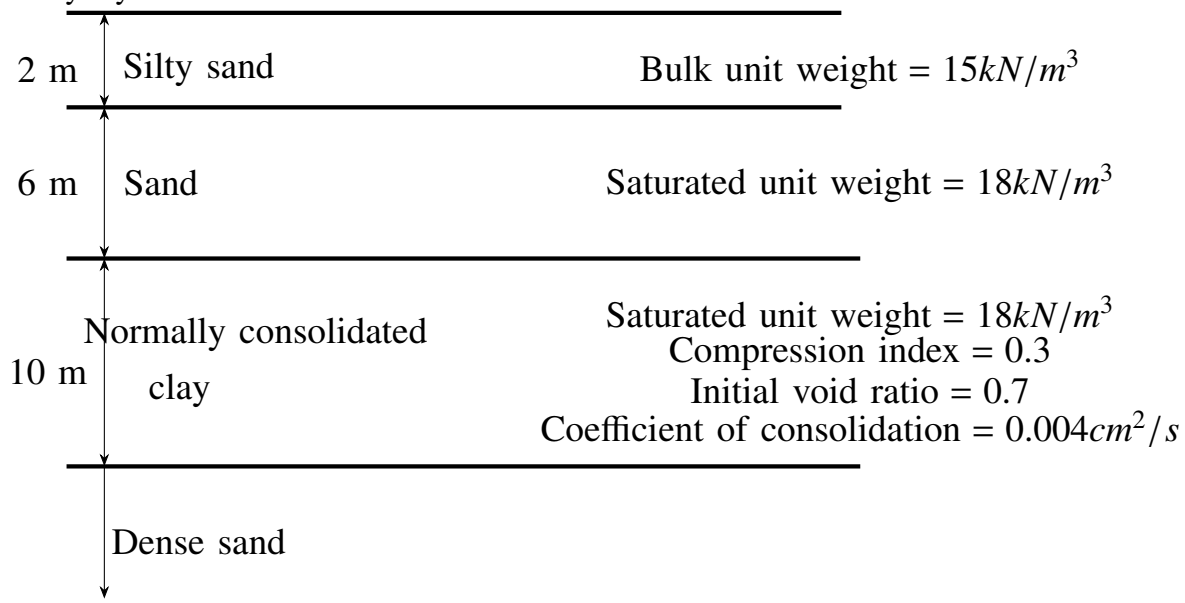


9) An earth embankment is to be constructed with compacted codesionless soil. The volume of the embankment is $5000m^3$ and the target dry unit weight is 16.2 kN/m^3. Three nearby sites, see the figure below, have been identified from where the required soil can be transported to the construction site. The void ratios (e) of different sites are shown in the figure. Assume the specific gravity of soil to be 2.7 for all three sites. If the cost of transportation per km is twice the cost of excavation per m^3 of borrow pits, which site would you choose as the most economic solution?$\left(\text{Use unit weight of water} = 10kN/m^3\right)$

a) Site X
b) Site Y
c) Site Z
d) Any of the sites



10) A water tank is to be constructed on th soil deposit shown in the figure below. A circular footing of diameter 3 m and depth of embedment 1 m has been designed to support the tank. The total vertical load to be taken by the footing is 1500 kN. Assume the unit weight of water as 10 kN/m^3 and the load dispersion pattern as $2V : 1H$. The expected settlement of the tank due to primary consolidation of the clay layer is _____ mm.



11) A 20 m thick clay layer is sandwiched between a silty sand layer and a gravelly sand layer. The layer experiences 30 mm settlement in 2 years.
Given:

$$T_v = \begin{cases} \frac{\pi}{4}\left(\frac{U}{100}\right)^2 & for U \leq 60\% \\ 1.781 - 0.933\log_{10}(100 - U) & U > 60\% \end{cases}$$

where T_v is the time factor and U is the degree of consolidation in %.
If the coefficient of consolidation of the layer is 0.003 cm^2/s, the deposit will experience a total of

50 mm settlement in the next _____ years.

12) A non-homogeneous soil deposit consiste of a silt later sandwiched between a fine-sand layer at top and a clat later below. Permeability of the silt layer is 10 times the permeability of the clay layer and one-tenth of the permeability of the sand layer. Thickness of the silt layer is 2 times the thickness of the sand layer and two-third of the thickness of the clay layer. The ratio of equivalent horizontal and equivalent vertical permeability of the deposit is _____.

13) A square footing, 2 m x 2 m, is subjected to an inclined point load, P as shown in the figure below. The water table is located below the base of the footing. Considering one-way eccentricity, the net safe load carrying capacity of the footing for a factor of safety of 3.0 is _____ kN.
The following factors may be used:
Bearing capacity factors: $N_q = 33.3, N_\gamma = 37.16$; Shape factors: $F_{qs} = F_{\gamma s} = 1.314$; Depth factors: $F_{qd} = F_{\gamma d} = 1.113$; Inclination factors: $F_{qi} = 0.444, F_{\gamma i} = 0.02$