2016

CIVIL ENGINEERING PAPER - I

Time Allowed : 3 Hours Full Marks : 200

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in English or in Bengali but all answers must be in one and the same language.

All notations/symbols have their usual meanings, unless otherwise specified.

GROUP - A

Answer any four questions

1. (a) A 5.0 m high retaining wall has to retain a stratified backfill as described below. Find out the magnitude of total active thrust on the wall and locate its point of application.

Stratum	Properties	Depth
1.	Sandy silt $\gamma = 1.80\ t/m^3$, $C = 0.9\ t/m^2$, $\phi = 25^\circ$	2.0 m
2.	Loose sand $\gamma = 1.70\ t/m^3$, $C = 0$, $\phi = 30^\circ$	1.5 m
3.	Dense sand $\gamma = 1.90\ t/m^3$, $C = 0$, $\phi = 35^\circ$	1.5 m

25

(b) Prove that the 'Co-efficient of Lateral earth pressure at rest', K_o is given by

$$K_o = \frac{\mu}{1-\mu}$$, where μ = Poisson's ratio of the soil. 10

2. (a) A group of precast concrete piles of 300 mm diameter having length of 10 m is required to safely carry a load of 5000 KN for a given factor of safety of 2.5. Find the number of piles in the group assuming 100% efficiency for the pile group. Given that the soil through the length of the piles is medium stiff clay having C_u = 100 KPa, α = 0.57 and the soil at the bottom of the piles is stiff clay with C_u = 150 KPa. 15

(b) A circular ring type foundation with inner diameter 7 m and outer diameter 8 m exerts a loading intensity of 30 KPa. Find the Vertical stress at a depth of 4 m below the base of the footing, along the line passing through the centre of the circular area. 10

(c) What is negative skin friction in piles ? State the situation, where negative skin friction occurs. How is negative skin friction computed ? 10

3. A simply supported beam ABC of length L hinged at end A has a roller support at end C. A concentrated clockwise moment of magnitude Mo is acting at B which is at midway between A and C. Find out the equation of the deflected shape of the whole beam. 35

4. ABCD is a simply supported prismatic beam of length 7.5 m with a hinge support at A and a roller support at D. Between B and C there is a uniformly distributed load of magnitude 24 kN/m acting downwards. The point B is at a distance of 3.0 m from end A and point C is at a distance of 1.5 m from end D. Determine the value of the vertical deflection at B, given that

$$EI = 50 \times 10^3 \text{ kN.m}^2$$

35

5. (a) For constructing an embankment, the soil is transported from a borrow pit using a truck having carrying capacity of 6 m^3 of soil at a time. With the following details, determine the number of truck loads of soil required to obtain 100 m^3 of compacted earthfill and the volume of soil at the borrowpit.

Properties	Borrow pit	Truck (loose)	Field compacted
Bulk density	16.6 KN/m^3	11.5 KN/m^3	18.2 KN/m^3
Water content	8%	6%	14%

15

(b) A cohesive soil yields a maximum dry density of 18 kN/m^3 at an OMC % 16% during a standard Proctor test. If the value of G is 2.65, what is the degree of saturation ? What is the maximum dry density it can be further compacted to ? 12

(c) How much more compactive energy is transmitted in the Heavy Compaction Test as compared to the Light Compaction Test as per Indian Standards ? Show the calculation. 8

GROUP - B

Answer any four questions

6. A 15 m long beam of uniform section carries a uniformly distributed load of 20 kN/m over the whole length. If the beam has a hinge support at the left end, find the position of the roller support so that maximum bending moment of the beam shall be as small as possible. Also find the magnitude of the maximum bending moment for this case. 15

7. An under-reinforced beam section is designed according to limit State Method of design of IS 456 : 2000 having the following specifications :-

Effective depth	=	500 mm
Width	=	300 mm
Grade of Concrete	=	M 25
Grade of steel	=	Fe 415
Tensile reinforcement	=	4 Nos. 20 mm ϕ

Draw the stress diagram of the concrete in the compression zone indicating its maximum value, when the beam is subjected to its moment of resistance. 15

8. Given that the saturation moisture content of a soil sample is 20% and the specific gravity of solid grains is 2.65. Find the values of void ratio, porosity and saturated unit weight. Take the density of water as 9.81 kN/m^3. 3 x 5

9. A 2 cm thick laboratory soil sample reaches 60% consolidation in 30 seconds under double drainage condition. Find how much time, in days, will be required for a 10 m thick clayey layer in the field to reach the same degree of consolidation if it is sandwiched between two sandy layers. 15

10. A deposit of sand has a void ratio of 0.60 and specific gravity of solid grains of 2.70. The ground water table is 2 m below the ground surface. The capillary rise above water table is 1 m. The soil above capillary rise may be taken to be dry. Compute the total stress, neutral stress and effective stress at depths of 2 m and 6 m below the ground surface. The unit weight of water may be taken to be 9.81 kN/m^3. 15