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# H.P.A.S. (Main)—2011

## CIVIL ENGINEERING—I

*Time :* 3 *Hours* *Maximum Marks :* 150

*Note :*— Question No. 1 is compulsory. Attempt any *four* questions out of the remaining questions. In all *five* questions are to be attempted.

Use of the relevant Indian Standard Codes of Practice and the Steel Sections Handbook is permitted.

1. (*a*) (*i*) Starting from Hooke's law, prove that $\Delta = PL/AE$, where the letters and notation have their usual meaning. 3

(*ii*) Derive a relatioship between the Young's modulus of elasticity, E and Modulus of rigidity, G. 3

P.T.O.

(iii) Stresses of magnitude 120 kN/mm$^2$ (Tensile) and 72 kN/mm$^2$ (Compressive) are acting on two mutually perpendicular planes accompanied by a shear stress of 72 kN/mm$^2$. Calculate the magnitude of principal stresses and the value of shear stress. 4

(b) Show that for a gravity dam to be fully in compression the resultant of all the forces must fall within the middle third of the base of the dam. 10

(c) What do you understand by quicksand ? Why is there more likelyhood of 'quick' condition in sands than clays ? Show that it is impossible to drown in quicksand. 10

2. (a) Using moment distribution method, analyse the continuous beam show in Fig. 1 and draw the bending moment diagram : 15

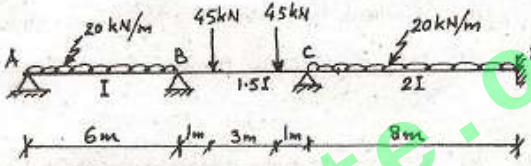


Fig. 1

(b) Determine collapse load W for the portal frame shown in Fig. 2 : 15

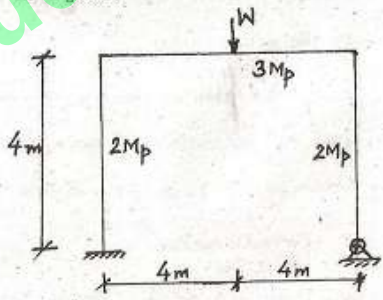


Fig. 2

P.T.O.

3. (a) Design a footing for a circular column 300 mm diameter subjected to an axial load of 1250 kN. Safe bearing capacity of the soil may be taken as 120 kN/m$^2$. 15

(b) A column ISHB 350 @ 674 N/m carries an axial load of 1000 kN. Design a suitable gusset base. 15

4. (a) Calculate the moment of resistance of a balanced section 300 mm × 600 mm taking effective cover as 50 mm if concrete used is M-20. Also calculate the amount of Fe-415 reinforcement in tension required to resist a bending moment of 75 kN.m for the same section. 15

(b) Design the following elements of a 1.4 m Sarda Type Fall for a channel conveying 24 cumecs of discharge at a 1.2 m depth of flow : 15

(i) Crest dimensions

(ii) Depth and length of cistern

(iii) Upstream and downstream cutoffs.

5. (a) The inlet and throat diameters of a horizontal venturimeter are 40 cm and 20 cm respectively. The pressure intensity of water at inlet is 170 kPa and vacuum pressure at throat is 36 cm of mercury. Calculate the discharge, assuming 3% of differential head is lost between inlet and throat. Find also coefficient of discharge. 15

(b) Between two horizontal parallel plates 10 mm apart, one plate in stationary and the other plate moves horizontally at 1 m/sec. If the pressure distribution between two sections 100 m apart is 100 kN/m$^2$, determine the shear stress on the top plate, the velocity distribution and discharge. The relative density of the liquid flowing is 0.9 and the dynamic viscosity is 1 poise. 15

6. (a) A 1 : 50 spillway model has a discharge of 1.25 $m^3/s$. What is the corresponding prototype discharge ? If a flood phenomenon takes 10 h to occur in the prototype, how long should it take in the model ? 10

(b) Calculate the discharge corresponding to a critical depth of 1.20 m in : 10

(i) Rectangular channel of width 3.0 m

(ii) Trapezoidal channel of side slope 1.5 H : IV and bottom width 2.5 m.

(c) A compound piping system consists of 1800 m of 50 cm, 1200 m of 40 cm and 600 m of 30 cm pipes of same material connected in series : 10

(i) What is the equivalent length of a 40 cm pipe of same material ?

(ii) What is the equivalent size of a pipe 3600 m long ?

(iii) If the three pipes are in parallel, what is the equivalent length of a 50 cm pipe ?

7. (*a*) Describe the Standard penetration test for testing of soils. Discuss also the corrections to be applied for cohessionless soils 15

(*b*) Determine gross and net safe bearing capacities of sand having $\varphi = 36°$ and effective unit weight as 1.74 g/cm$^3$ for the following cases : 15

(*i*) 1.0 m wide strip footing

(*ii*) 1.0 m wide square footing

(*iii*) Circular footing of 1.0 m diameter

Consider footings to be placed at 1 m from the ground surface.

Adopt $N_c = 60$, $N_q = 47$, $N_\gamma = 43$.

8. (*a*) Classify the shear tests based on drainage conditions. Explain how the pore water pressure variation and volume change take place during these tests. Also enumerate the field conditions which necessitate each of these tests. 15

(b) A retaining wall 6 m high, with a smooth vertical back is pushed against a soil mass having $c' = 40$ kN/m$^2$ and $\varphi' = 15°$, $\gamma = 19$ kN/m$^2$. What is the total Rankine passive pressure, if the horizontal soil surface carries a uniform load of 50 kN/m$^2$ ? What is the point of application of the resultant thrust ? 15