# CSM – 18/18

# Civil Engineering

## Paper – I

*Time : 3 hours*

*Full Marks : 300*

*The figures in the right-hand margin indicate marks.*

*Candidates should attempt Q. No. 1 from Section – A and Q. No. 5 from Section – B which are compulsory and* ***three*** *of the remaining questions, selecting at least* ***one*** *from each Section.*

### SECTION – A

1. Answer any **three** of the following :

   (a) (i) State and explain the basic concepts of prestressing and the methods of pre-stressing. 4+4 = 8

   (ii) A simply supported post-tensioned pre-stressed concrete beam of c/s 40cm × 60cm of 15m span is tensioned by a pre-

stressing force of 1500kN through a parabolic cable profile with maximum eccentricity of 10cm below the neutral axis at the centre of the span. Calculate the losses in pre-stress due to elastic shortening and slip in achorage. Area of steel tendon = 1250 $mm^2$, Es = 2.1 $\times 10^5$N/sqmm, Ec = 0.38$\times 10^5$N/sqmm, anchorage slip = 2.5mm. 12

(b) A 5 m high masonry retaining wall of top width, 1m and bottom width of 3m retains earth level with the top on its vertical back. The safe bearing capacity of soil = 18T/sqm, the coefficient of friction between wall and earth = 0.6, density of soil = 1800kg/$m^3$, density of masonry = 2500kg/$m^3$, the back filled soil has an angle of internal friction of $30^o$. Check the stability of the wall wrt the safe bearing capacity and sliding. 20

(c) Design a RCC column of unsupported length of 3m carrying an axial factored load of 500kN. Use M20 concrete and Fe415 steel. Assume any other data, if required. 20

(d) What do you understand by **shape factor** of a section? Find the shape factor of a symmetrical T section with a flange of 100×10mm and a web of 150×10mm. 5+15 = 20

2. (a) (i) The Poisson's ratio value of any material can not be more than 0.5. Is the statement correct? Explain, in support of your answer. 10

(ii) Explain the concept of pure bending. 10

(b) A steel beam of 3m span carries a uniformly distributed load of 40kN/m over the whole span in addition to a concentrated load of 80kN at 1m from the left end. The beam is

simply supported and permissible bending and shear stresses are 150 MPa and 100 MPa respectively. Examine, if a beam of size ISLB 350@r95 N/m will be able to resist the loading system. 20

(c) A simply supported beam of span, 6m carries loads of 60kN and 60kN at 2m and 4m respectively from left end. Find the values of slopes at the ends and the deflections under each load. E = 200GN/sqmm, Moment of Inertia, I = 30000 $cm^4$. 20

3. (a) Find the reinforcement for a RCC beam of 250 mm width and 500 mm effective depth with effective cover to centre of compression reinforcement as 50mm. The maximum bending moment carried by the beam under working conditions is 125kNm. Use M20 concrete and Fe 415 steel. 20

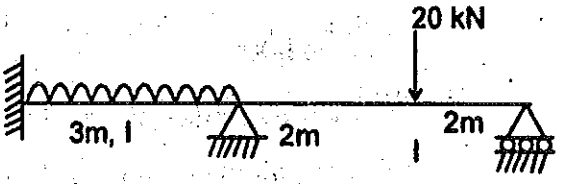
(b) A solid circular shaft of 200mm diameter has the same cross, sectional area as that of a hollow circular shaft of the same material with inside diameter of 150mm. For the same maximum shear stress, calculate the ratio of torque transmitted by the hollow shaft to that of the solid shaft. 20

(c) A symmetrical 3 hinged parabolic arch of span, 20m and central rise of 5m carries a single point load of 15T. Locate the position of the load on arch in order that, the bending moment in the arch is zero at a section, 8m from the left hinge. For this position of the load, find the bending moment under the load. 20

4. (a) Calculate the tensile strength of a truss member, 2ISA, 90×60×6 mm connected to

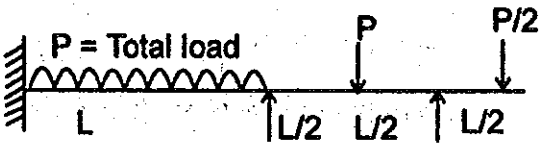
both sides of gusset plate of 8mm thickness by 4mm weld size over an effective length of weld of 200mm. 20

(b)




Analyse the two span continuous beam subjected to the given loading system using moment distribution method. 20

(c)




For the continuous beam having uniform section throughout and subjected to the loading system as shown in the figure, compute the ultimate load, P as function of Mp applying plastic analysis method. 20

## SECTION – B

5. (a) (i) Explain the stability of floating bodies and the conditions of stability for a floating body. 10

(ii) A solid cyclinder of 2m diameter and 2.5m height is floating in water with its axis vertical. The specific gravity of cyclinder is 0.65. Find whether the equilibrium is stable or unstable. 10

(b) An oil of specific gravity 0.8 and kinematic viscocity, 0.3 stokes is floating at the rate of $0.6m^3/sec$ in a circular pipe of diameter, 300mm and length of 1m. Find the head loss due to friction. 20

(c) Distinguish among poorly graded soil, well graded soil and gap graded soil. How can you find uniformity coefficient and coefficient of gradation from the particle size distribution curve ? 10+10 = 20

(d) A cyclinder of soil fails under an axial vertical stress of 15T/sqm, when it is laterally confined. The failure plane makes an angle of 50 degree with the horizontal. Calculate the values of cohesion and the angle of internal frcition of soil. 20

6. (a) Explain, whether the steam function is constant or variable in a stream line. State the properties of a stream function. 10+10 = 20

(b) Water flows at the rate of $0.15m^3$/sec through a 100mm diameter orifice used in a 200mm pipe. Find the difference of pressure head between the upstream section and the vena contracta section. The coefficient of contraction: Cc = 0.55 and coefficient of velocity, Cv = 1.0. 20

(c) For a two dimensional flow, the velocity potential is $\phi = x^2 - y^2$. Find the stream function and the discharge between the stream lines (2, 0) and (2, 3). 20

7. (a) Explain the power law for velocity distribution in pipes for turbulent flows. Explain the various parameters on which the coefficients of friction depend on flow in smooth and rough pipes. 10+10 = 20

(b) For turbulent flow in a pipe of 300mm diameter, find the discharge when the centre line velocity is 3m/sec and the velocity at a point 100mm from the centre is 1.5m/sec. 20

(c) For a sandy soil maximum void ratio is 0.75 and the minimum void ratio is 0.53. The specific gravity of soil is 2.7. Calculate the void ration and the dry unit weight at relative density of 75%. 20

8. (a) Distinguish between effective stress and net stress in a soil mass. Differentiate between the stress in saturated soil without seepage and with seepage. 5+15 = 20

(b) The laboratory consolidation data for an undisturbed clay sample are as follows :

$e_1 = 1.2, \sigma'_1 = 90 kN/m^2$

$e_2 = 0.8, \sigma'_2 = 450 kN/m^2$

Calculate the void ratio for a pressure of $600 kN/m^2$. 20

(c) A pipe network consists of three pipes arranged in series. The length of the pipes are 800m, 600m and 500 m and the respective diameters are 750mm, 500mm and 400mm. Transform the pipe system to an equivalent 350mm diameter pipe. 20