Question Paper 2008

Civil Engineering

(Paper II)

SECTION – I

(Civil)

1. (*a*) Discuss the operations involved in the manufacture of bricks. (10)

(*b*) Describe the following tests to be performed in case of burnt clay bricks: (10)

(*i*) Compressive strength test

(*ii*) Water absorption test

(*c*) Write a brief note on the characteristics of good timber. (10)

2. (*a*) A chain line CDE crosses a river, D and E being on the near and distant banks respectively. A perpendicular DF 54.865 m long is set out at D on the left of the chain line. The respective bearings of E and C taken at F are 67° 30′ and 157° 30′. Find the chainage of E, given that CD is 27. 630 m and the chainage of D is 382.52 m. (15)

(*b*) Define and explain contour, contour interval, necessity of contour plotting. Discuss factors affecting the choice of contour interval. (15)

3. (*a*) A sample of dry soil having specific gravity of 2.74 and having a mass of 133.7 gm is uniformly dispersed in water to form 1000 cc of suspension.

(*i*) Determine the density of suspension immediately after it is prepared.

(*ii*) A 10 cc of the suspensions was removed from the depth of 21 cm beneath the top surface after the suspension was allowed to stand for 2 min 30 sec. The dry mass of the soil in the sample drawn was found to be 0.406 gm. Determine one point on the grain-size distribution curve corresponding to this observation.

Temperature of suspension = 20°C

Viscosity of water at 20°C = 0.0102 poise (15)

(*b*) 60 cm diameter well is being pumped at a rate of 1360 litres/ minute. Measurements in a nearby test well were made at the same time as follows. At a distance of 6 m from the well being pumped, the drawdown was 6 m, and at 15 m the drawdown was 1.5 m. The bottom of the well is 90 m below the ground water table.

(*i*) Find out the coefficient of permeability.

(*ii*) If all the observed points were on the Dupuit curve, what was the drawdown in the well during pumping?

(*iii*) What is the specific capacity of the well?

(*iv*) What is the rate at which water can be drawn from this well? (15)

4. (*a*) A direct shear box test performed on a remoulded sand sample yielded the following observation at the time of failure:

Normal load = 0.36 kN

Shear load = 0.18 kN

The sample area was 36 cm^2.

Determine:

(*i*) the angle of internal friction,

(*ii*) the magnitude and direction of the principal stresses in the zone of failure, and

(*iii*) the magnitude of maximum deviator stress if a sample of the same sand with the same void ratio were tested in a triaxial test with an all-round pressure of 60 kN/m^2. Assume c = 0. (18)

(*b*) A 2.2 m square footing is located at a depth of 4.4 m in a stiff clay of saturated unit weight 21 kN/m^3. The undrained strength of clay at a depth of 4.4 M is given by parameter w = 120 kN/m^2. and $\varphi_u = 0$. For a factor of safety 3, with respect to shear failure, compute

(*i*) the net value of bearing capacity, and

(*ii*) the value of maximum load that could be carried by the footing. (12)

5. (*a*) The space between two square flat parallel plates is filled with oil. Each side of the plate is 60 cm. The thickness of the oil film is 12.5 mm. The upper plate, which moves at 2.5 m per sec requires a force of 98.1 N to maintain the speed.

Determine:

(*i*) the dynamic viscosity of the oil, in poise, and

(*ii*) the kinematic viscosity of the oil, in stokes, if the specific gravity of the oil is 0.95. (15)

(*b*) A pelton wheel is to be designed for the following specifications:

Shaft power = 11,772 kW; Head = 330 m;

Speed = 750 r.p.m.; Overall efficiency = 86%;

Diameter is not to exceed one-sixth of the wheel diameter:

Determine:

(*i*) the wheel diameter,

(*ii*) the number of jets required, and

(*iii*) diameter of the jet.

Take coefficient of velocity = 0.985 and speed ratio = 0.45. (15)

6. (*a*) Write short notes on the following: (12)

(*i*) Sewer

(*ii*) Sewage

(*iii*) Sewerage system

(*iv*) Drain and trench drain

(*b*) Design a 15×10^6 *l.p.d* water treatment plant with rapid gravity sand filter. Assume suitable design parameters (18)

SECTION – II

(Structural)

7. (*a*) When a bar of certain material 40 cm square is subjected to an axial pull of 1,60, 000 N the extension on a gauge length of 200 mm is 0.1 mm and the decrease in each side of the square is 0.005 mm. Calculate Young's modulus, Poisson's ratio shear modulus and bulk modulus for this material. (10)

(*b*) Draw S.F. and B. M. diagrams for the beam having overhangs on both sides and loaded as shown in Fig. 1. (20)

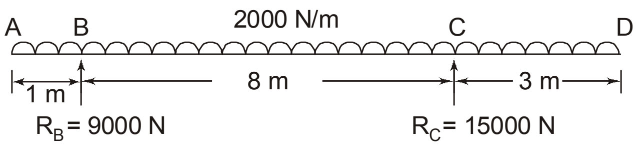

Fig.1

8. (*a*) Find the deflections at points D and C of the beam loaded as shown in Fig. 2. (15)

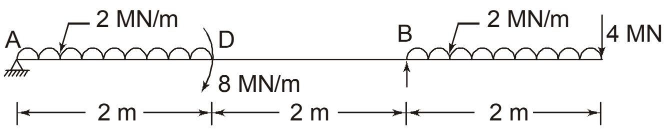

Fig. 2

(*b*) A solid steel column and a hollow steel column, both have the same length and same cross-section area, and are fixed at the ends. If the internal diameter of hollow column is 2/3 of its external diameter, find the ratio of buckling strengths of solid steel column to that of hollow steel column. (15)

9. (*a*) Explain the important properties of cement concreate both in plastic and hardened stage. (15)

(*b*) Describe the sequence of concreting operations. (15)

10. (*a*) A particular sand sample of 250 grams, when sieved successively through the following sieves, left retentions on the sieves as follows:

IS sieve	10 mm	480	240	120	60	30	15
Retention grams	NIL	10	15	50	50	75	50

What is its fineness modulus? What sand is it – fine, medium or coarse? (10)

(*b*) Design a simply supported R.C.C. slab for an office floor having clear dimensions of 4 m by 10 m with 230 mm walls all-around. Adopt M-20 grade concrete and Fe-415 grade HYSD bars. (20)

11. Design a cantilever retaining wall to retain an earth embankment 4 m high above ground level. The density of earth is 18 kN/m^3 and its angle of repose is 30°. The embankment is horizontal at top. The safe bearing capacity of the soil may be taken as 200 kN/m^2 and the coefficient of friction between soil and concrete is 0.5. Adopt M-20 grade concrete and Fe-415 HYSD bars. (30)

12. (*a*) Find the suitable pitch for single riveted lap joint for plates 1 cm thick, if

σ_t = 150 N/mm^2, σ_s = 100 N/mm^2 and σ_b = 300 N/mm^2. (12)

(*b*) Calculate the maximum load that the bracket shown in Fig. 3 can carry if the size of the weld on flange is 8 mm and that on the web is 5 mm. The allowable shear stress is 102.5 N/mm^2. (18)

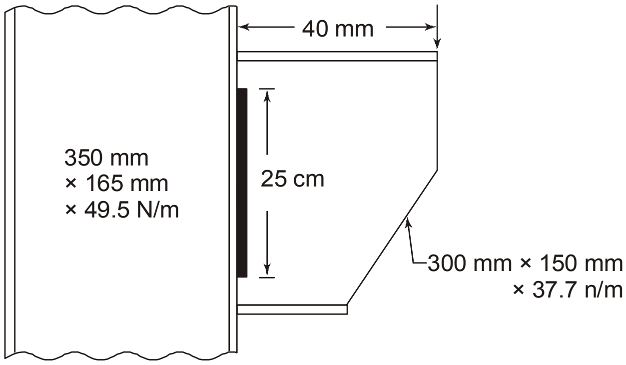

Fig. 3

Essential Tables of IS: 456: 2000 Code of Practice IS 456 : 2000

26.2.1.1 Design bond stress in limit state method for plain bars in tension shall be as below:

Grade of concrete	M 20	M 25	M 30	M 35	M 40 and above
Design bond stress, τ_{bd}, N/mm^2	1.2	1.4	1.5	1.7	1.9

Table 16: Nominal Cover to Meet Durability Requirements (*Clause 26.4.2*)

Exposure	*Nominal Concrete Cover in mm Not Less Than*
Mild	20
Moderate	30
Severe	45
Very severe	50
Extreme	75

Notes:

1. For main reinforcement up to 12 mm diameter bar for mild exposure the nominal cover may be reduced by 5 mm.
2. Unless specified otherwise, actual concrete cover should not deviate from the required nominal cover by + 10_0 mm.
3. For exposure condition 'severe' and 'very severe', reduction of 5 mm may be made, where concrete grade is M 35 and above.

Table 19 : Design Shear Strengh of Concrete, τ_c, N/mm².

(*Clauses 40.2.1, 40. 2, 2, 40.3, 40.4, 40.5.3, 41.3.2, 41.3.3 and 41.4.3*)

$100\frac{A_s}{bd}$	Concrete Grade					
	M 15	M 20	M 25	M 30	M 35	M 40 and above
(1)	(2)	(3)	(4)	(5)	(6)	(7)
≤ 0.15	0.28	0.28	0.29	0.29	0.29	0.30
0.25	0.35	0.36	0.36	0.37	0.37	0.38
0.50	0.46	0.48	0.49	0.50	0.50	0.51
0.75	0.54	0.56	0.57	0.59	0.59	0.60
1.00	0.60	0.62	0.64	0.66	0.67	0.68
1.25	0.64	0.67	0.70	0.71	0.75	0.76
1.50	0.68	0.72	0.74	0.76	0.78	0.79
1.75	0.71	0.75	0.78	0.80	0.82	0.84
2.00	0.71	0.79	0.82	0.84	0.86	0.88
2.25	0.71	0.811	0.85	0.88	0.90	0.92
2.50	0.71	0.82	0.88	0.91	0.93	0.95
2.75	0.71	0.82	0.90	0.94	0.96	0.98
3.00 and above	0.71	0.82	0.92	0.96	0.99	1.01

Note : The term A_s is the area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support where the full area of tension reinforcement may be used provided the detailing conforms to 26.2.2 and 26.2. 3.

Table 20 : Maximum Shear Stress, $\tau_{c\,max}$, N/mm².

(Clauses 40.2.3, 40.2.3.1, 40.5.1, and 41. 3. 1.)

Concrete Grade	M 20	M 25	M 30	M 35	M 40 and above
$\tau_{c\,max}$, N/mm²	2.8	3.1	3.5	3.7	4.0

Table 21: Permissible Stresses in Concrete

(Clauses B-1.3, B-2.1, B-2.1.2, B-2.3 and B-4.2) All values in N/mm²

Grade of Concrete	Permissible Stress in Compression		Permissible Stress in Bond (Average) for plain Bars in Tension
	Bending	Direct	
(1)	(2)	(3)	(4)
	σ_{cbc}	σ_{cc}	τ_{bd}
M 10	3.0	2.5	–
M 15	5.0	4.0	0.6
M 20	7.0	5.0	0.8
M 25	8.5	6.0	0.9
M 30	10.0	8.0	1.0
M 35	11.5	9.0	1.1
M 40	13.0	10.0	1.2
M 45	14.5	11.0	1.3
M 50	16.0	12.0	1.4

Notes:

1. The values of permissible shear stress in concrete are given in Table 23.
2. The bond stress given in col. 4 shall be increased by 25 percent for bars in compression.

Table 23: Permissible Shear Stress in Concrete

(Clauses B-2.1, B-2.3, B-4.2, B-5.2.1, B-5.2.2, B-5.3, B-5.4, B-5.5.1, B-5.5.3, B-6.3.2, B-6.3.3 and B-6.4.3 and Table 21)

$100\frac{A_s}{bd}$	Permissible Shear Stress in Concrete, τ_c, N/mm^2 Grade of concrete					
	M 15	M 20	M 25	M 30	M 35	M 40 and above
(1)	(2)	(3)	(4)	(5)	(6)	(7)
≤ 0.15	0.18	0.18	0.19	0.20	0.20	0.20
0.25	0.22	0.22	0.23	0.23	0.23	0.23
0.50	0.29	0.30	0.31	0.31	0.31	0.32
0.75	0.34	0.35	0.36	0.37	0.37	0.38
1.00	0.37	0.39	0.40	0.41	0.42	0.42
1.25	0.40	0.42	0.44	0.45	0.45	0.46
1.50	0.42	0.45	0.46	0.48	0.49	0.49
1.75	0.44	0.47	0.49	0.50	0.52	0.55
2.00	0.44	0.49	0.51	0.53	0.54	0.55
2.25	0.44	0.51	0.53	0.55	0.56	0.57
2.50	0.44	0.51	0.55	0.57	0.58	0.60
2.75	0.44	0.51	0.56	0.58	0.60	0.62
3.00 and above	0.44	0.51	0.57	0.60	0.62	0.63

Note: A_S is the area of longitudinal tension reinforcement which continues at least one effective depth beyond the section being considered except at support where the full area of tension reinforcement may be used provided the detailing conforms to 26.2.2 and 26.2.3.

Table 24: Maximum Shear Stress, $\tau_{C\,max}$ N/mm^2

(Clauses B.5.2.3, B.5.2.3.1, B.5.5.1 and B.6.3.1.)

Concrete Grade	M 15	M 20	M 25	M 30	M 35	M 40 and above
$\tau_{c\,max}$, N/mm^2	1.6	1.8	1.9	2.2	2.3	2.5