Question Paper 2015

Civil Engineering

(Paper II)

1. (*a*) What are the factors that influence the strength of cement concrete? Briefly discuss the effects of water-cement ratio and workability on the strength of concrete. (15)

(*b*) Explain the purpose of conducting soundness test of cement. Describe the apparatus and method of test with the help of neat sketches. (15)

(*c*) Give a short description of preservation of wood using various wood preservatives. (10)

(*d*) List the four important tests conducted on bricks. Explain the various defects in bricks. (20)

2. (*a*) Write the characteristics of contour lines. (10)

(*b*) The following readings were extracted from a level field book. Some of the entries are missing because of exposure to rain. Insert the missing reading and check your results. (20)

Station	B.S.	I.S.	F.S.	Rise	Fall	RL	Remarks
1.	3.250					?	Bench mark
2.	1.755		?		0.750	?	Change point
3.		1.950			?	?	
4.	?		1.920	?		?	
5.		2.340		1.500		?	
6.				1.000		?	
7.	1.850		2.185		?	250.00	Change point
8.		1.575		?		?	
9.		?		?		?	
10.	?		1.895		1.650	?	Change point
11.			1.350	0.750		?	Last point

(*c*) The soil from a borrow area having an average in-situ unit weight of 15.5 kN/m^3 and water content of 10%, was used for the construction of an embankment (total finished volume 6000 m^3). In half of the embankment due to improper rolling, the dry unit weight achieved was slightly lower. If the dry unit weights in the two parts are 16.5 kN/m^3 and 16.0 kN/m^3, find the volume of borrow area soil used in each part and the amount of soil used. (15)

(*d*) A 6.0 m high retaining wall is to support a soil with unit weight 17.4 kN/m^3, $\phi = 26°$ and $c' = 14.36$ kN/m^2. Determine the Rankine active force per unit length of the wall before the tensile crack occurs. Find the critical depth. (15)

3. (*a*) Two pipes of diameters 'D' and 'd' and equal length 'L' are arranged in parallel. The loss of head for a flow of 'Q' is 'h'. If the same pipes are arranged in series, the loss of head for the same flow is 'H'. If d = 0.5 D, find the percentage of total flow through each pipe when placed in parallel. Also, find the ratio H/h. Neglect minor losses and assume friction factor to be constant. (15)

(*b*) Water flows over the spillway of a dam at a depth of 2.73 m over it. The difference of elevation between spillway crest and downstream bed level is 30 m. If the discharge coefficient of spillway is 0.75, determine the water depth after the jump and head loss in the jump. (15)

(*c*) Calculate the minimum required sight distance to avoid a head-on collision of two cars approaching from the opposite directions at 90 and 60 kmph. Assume reaction time as 2.5 sec and coefficient of friction of 0.7 and brake efficiency 50% in either case. (15)

(*d*) Differentiate canal design methods by Lacey and Kennedy. (15)

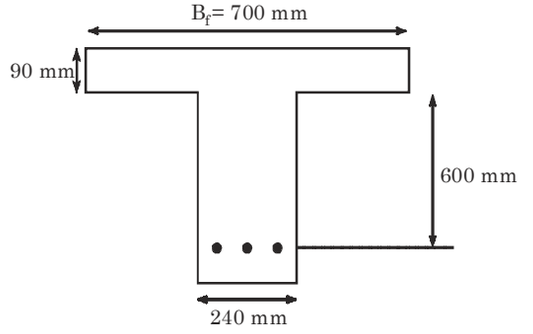
4. (*a*) A cantilever, 3 m long, is loaded with a uniformly distributed load of 15 kN/m over a length of 2 m from the fixed end. Determine the slope and deflection at the free end of the cantilever. Take E = 2.1×10^8 kN/m^2 and I = 0.000095 m^4. (20)

(*b*) Draw the flow sheet showing sequence of a typical water treatment with perennial river as source of water. Explain these treatment units sequentially. (20)

(*c*) What is meant by solid waste management? Describe briefly the principles of design of a sanitary landfill for solid wastes disposal. (20)

5. (*a*) Explain under-reinforced, balanced and over-reinforced section with respect to WSM as well as LSM. (30)

(*b*) Using limit state method (LSM), determine the moment of resistance of the T-Beam as shown in the figure below. Use M 15 concrete and Fe 415 steel. (30)

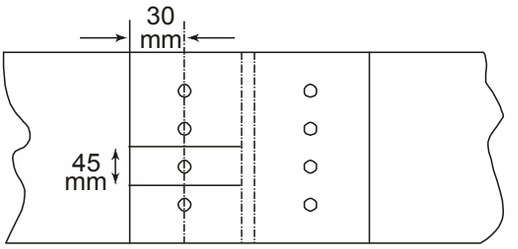


6. (*a*) Explain the following:

(*i*) Elastic curve of mild steel with a suitable diagram showing important points. (10)

(*ii*) Different types of welds with suitable figures and symbols (10)

(*b*) A single-bolted double cover butt joint is used to connect two plates which are 8 mm thick. Assuming 16 mm diameter bolts of grade 4.6 and cover plates to be 6 mm thick, calculate the strength and efficiency of the joint, if 4 bolts are provided in the bolt line at a pitch of 45 mm as shown is the figure below. Take the end distance of the fastener along bearing direction as 30 mm. (40)



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 sever', reduction of 5 mm may be made, where concrete grade is M 35 and above.

Table 19: Design Shear Strength 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	0.73	0.74
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	0.81	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/mm^2	2.8	3.1	3.5	3.7	4.0

Table 21 : Permissible Stresses in Concrete

(Clauses B-1.3, P.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 column 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/mm² 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	0.52
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, $t_c$max, N/mm²

(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/mm²	1.6	1.8	1.9	2.2	2.3	2.5