CGPDTM
Patent
Examiner

Previous Year Paper
(Mains) (Civil Engg)
Oct, 2015

111

Civil Engineering

TIME : **3** HOURS

MAXIMUM MARKS : **300**

INSTRUCTIONS :

1. *All* questions are **compulsory**.

2. *Question Paper may be divided into **4 (four)** Sections from **Section-A** to **Section-D** and carry marks as under :*

  a. ***Section - A** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **12** marks × 3 Questions = Total **36** Marks.*

  b. ***Section - B** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **20** marks × 3 Questions = Total **60** Marks.*

  c. ***Section - C** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **28** marks × 3 Questions = Total **84** Marks.*

  d. ***Section - D** - Total **3** Questions having **two** parts, i.e. **(a) and (b)** each questions carries **40** marks × 3 Questions = Total **120** Marks.*

SECTION - A

(Each question is of **12** marks and each sub part **(a)** and **(b)** are of **6** marks each)

1 (a) Define "Shape factor". Determine shape factor for a T-section with flange dimension of 100 mm × 10 mm and web dimension of 150 mm × 10 mm.

  (b) What do you mean by "Shear center" ? Determine the shear center for a Channel section with the following properties: Flange width = 50 mm, Overall depth = 100 mm, Thickness of flange and web = 10 mm each, Moment of inertia about strong axis = 256 cm^4.

2 (a) A sample of sand above water table was found to have a natural moisture content of 15% and a unit weight of 18.84 kN/m^3. Laboratory tests on a dried sample indicated the value of 0.5 and 0.85 for minimum and maximum void ratios, respectively, for the densest and loosest states. Calculate the degree of saturation and relative density. Assume, G = 2.65.

(b) What special measures and precautions are required in geometric features of a modern railway track?

3 (a) Describe with neat sketch the working of a sludge digestion tank with floating cover.

(b) During a recuperation test, the water in an open well was depressed by pumping by 2.1 m and it recuperated by 1.6 m in 90 minutes. Find the diameter of a well to yield 10 liter/sec under a depression head of 2 m.

SECTION - B

(Each question is of **20** marks and each sub part **(a)** and **(b)** are of **10** marks each)

4 (a) Design an RC column of unsupported length of 3 m to carry factored axial load of 280 kN. Use M20 Grade of concrete and Fe415 steel bars.

(b) A bracket plate is welded to the flange of a column as shown in figure. Calculate the size of the weld required to support a factored load of 200 kN. Assume Fe410 grade steel.
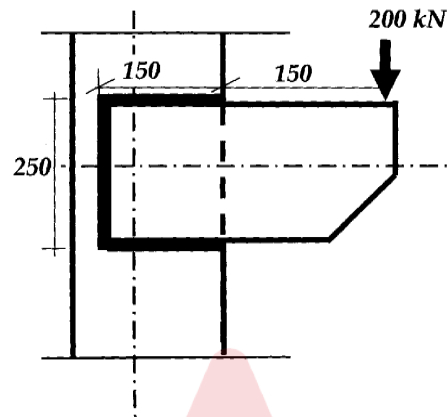
5 (a) A circular sewer of 45 cm diameter was designed for a town of population of 30000. The sewer designed to carry 3.5 times of the dry weather flow. What slope should be provided to the sewer when running full? Value of n = 0.012 in Manning's equation. Assume other data suitably.

   (b) 200 mm diameter and 8m long piles are used as foundation for a column in a uniform deposit of medium clay (unconfined compressive strength =100 kN/m^2 and adhesion factor= 0.9). There are nine piles arranged in a square pattern of 3×3. For a group efficiency =1.0, find the spacing between the piles neglecting bearing.

6 (a) Find the length of transition curve and extra width of pavement required on a horizontal curve of radius 300 m of a two lane highway passing through rolling terrain for a design speed of 80 kmph. Assume all other data as per IRC recommendations.

(b) Prove that the degree of saturation (S) can be expressed

$$S = \frac{w}{\frac{\gamma w}{\gamma}(1+w) - \frac{1}{S_1}}, \text{ where, } w = \text{water content, } \gamma_w = \text{unit weight}$$

of water, γ = Unit weight of soil, S_s = specific gravity of soil grains.

SECTION - C

(Each question is of **28** marks and each sub part **(a)** and **(b)** are of **14** marks each)

7 (a) A bar of square cross-section is used as a beam with one of its diagonals as horizontal. Calculate the value of shear stress at the neutral axis ad the position and magnitude of the maximum shear stress. Sketch the shear distribution curve along the vertical diagonal:

(b) A rectangular RC column of 600 mm × 400 mm carried an axial load of 800 kN. Design a rectangular footing to support the column using M25 concrete and Fe415 steel reinforcement. Safe bearing capacity of soil = 200 kPa.

8 (a) Calculate the friction drag on a plate of 150 mm wide and 450 mm long placed longitudinally in a stream of oil having a free stream velocity of 6 m/s. Also, find the thickness of the boundary layer and shear stress at the trailing edge. Specific gravity of oil is 0.925 and kinematic viscosity is 90 mm^2/s.

(b) Enumerate the various types of track junction in use. Discuss the suitability of each under different conditions.

9 (a) For border strip method of irrigation, determine the time required to irrigate a strip of land of 0.04 hectares in area from a tube well with a discharge of 0.02 cumec. The infiltration capacity of the soil is 5 cm/hr and the average depth of flow on the field as 10 cm. Also, determine the maximum area that can be irrigated from this tube well.

(b) A test on Pelton wheel provided following data: Head at the base of nozzle = 32 m, Discharge of the nozzle = 0.18 cumec, Area of the jet = 7500 sq mm, Power available at the shaft = 44 kW, Mechanical efficiency= 94%. Calculate the power lost in the (i) nozzle, (ii) runner, and mechanical friction.

SECTION - D

(Each question is of **40** marks and each sub part **(a)** and **(b)** are of **20** marks each)

10 (a) Analyze the rigid frame shown in figure using Slope Deflection method. Draw the bending moment and shear force diagrams.

(b) A post-tensioned prestressed concrete beam is tensioned initially by a prestressing force of 1458 kN transferred at 28-days strength of concrete. The cable is of parabolic profile with the maximum eccentricity of 520 mm at the center of span. Determine the losses in prestress due to (i) elastic shortening, (ii) shrinkage in concrete, (iii) creep in concrete and steel, (iv) slip in anchorage, and (v) friction. Use the following data: A = 2420 cm^2; I = 5.3 × 10^6 cm^4; A_t = 13.85 cm^2; f_s = 1059 MPa at transfer; E = 210 GPa; E_c = 38.2 GPa; Frictional coefficient = 0.25; Wobble correction factor, k = 0.0015 per meter; Anchorage slip = 2.5 mm.

11 (a) Show that hydraulically most efficient trapezoidal section is half of a regular hexagon and its hydraulic radius is equal to half the depth of flow.

(b) A non-overflow portion of a gravity dam is built of concrete as shown in figure. Calculate the maximum vertical stresses at the heel and toe of the dam. Assume unit weight of concrete as 23.5 kN/m^3. Neglect the earthquake effect.

12 (a) Determine the dimensions of a high-rate trickling filter for the following data : Sewage flow = 30 mld; Recirculation ratio = 1.5; BOD of raw sewage = 250 mg/l; BOD removed in primary tank = 25%, Final effluent BOD desired = 30 mg/l. By what percentage the diameter of the filter has to be modified if it would be designed as a standard-rate trickling filter for the above requirements.

(b) A 4m high vertical wall supports a saturated cohesive soil with horizontal surface. The top 2.5 m of the backfill has bulk density of 17.6 kN/m³ and apparent cohesion of 15 kN/m². The bulk density and apparent cohesion of the bottom 1.5 m is 19.2 kN/m³ and 20 kN/m², respectively. If the tension cracks develop, what would be the total active pressure on the wall? Also, draw the pressure distribution diagram.