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CE 1818 PE 31

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Roll No. of candidate ☐☐☐☐☐☐☐☐☐☐

2023

B.Tech. 8th Semester End-Term Examination

ADVANCED STRUCTURAL DESIGN (PROGRAM ELECTIVE-III)

New Regulation (w.e.f. 2017-2018) & New syllabus (w.e.f. 2018-2019)

Full Marks – 70   Time – Three hours

The figures in the margin indicate full marks for the questions.

Answer question No. 1 and any *four* from the rest.

1. Pick up the correct answer   (10 × 1 = 10)

   (i) Which one of the following is the basic assumption involved in designing of prestressed concrete members?   (1)

      (a) A transverse plane section of the member will remain a plane after bending also.

      (b) Within the limits of deformation taking place, Hook's law is applicable to concrete and steel components.

      (c) The stress in the reinforcement does not change along the length of the reinforcement.

      (d) All the above

   (ii) A beam of span 8 meters is carrying a load of 45 kN/m. The prestressing force is 1500 kN. To balance the external loading fully by the upward pressure, the central dip of the parabolic tendon should be   (1)

      (a) 230 mm

      (b) 240 mm

      (c) 250 mm

      (d) 260 mm

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(iii) Factor of safety against overturning and sliding of retaining walls for static loads are (1)

    (a) 2.5 and 2.0 respectively

    (b) 2.25 and 1.75 respectively

    (c) 1.5 and 2.0 respectively

    (d) 2.0 and 1.5 respectively

(iv) A backfill of a retaining wall consists of soil having Y= 18 kN/m³ which is 5 m high. If coefficient of earth pressure at rest is 0.5, then the total earth pressure per meter length is (1)

    (a) 57.5 kN/m

    (b) 76.7 kN/m

    (c) 115 kN/m

    (d) None of the above

(v) Minimum grade of concrete for designing RCC water tank is (1)

    (a) M 25

    (b) M 30

    (c) M 35

    (d) M 40

(vi) A plate girder is composed of flange plates 50 mm × 600 mm and web plate, 16 mm × 2000 mm. Then, the section can be classified as (1)

    (a) Slender

    (b) Compact

    (c) Plastic

    (d) Semi-compact

(vii) The self-weight of the Plate girder section given in Question VI above is (1)

    (a) 722.2 kg/m

    (b) 560 kg/m

    (c) 1024.25 kg/m

    (d) 394.1 kg/m

(viii) In a plate girder designed without any web stiffness, the following criteria is applicable from service ability requirements as per IS 800-2007 (1)

    (a) $\dfrac{d}{t_w} \leq 300 \in$

    (b) $\dfrac{d}{t_w} \leq 345 \in_f^2$

    (c) $\dfrac{d}{t_w} \leq 400 \in_w$

    (d) $\dfrac{d}{t_w} \leq 250 \in_w$

(ix) In a gantry girder, the maximum shear force occurs when one of the wheels loads of the crane girder is positioned at (1)

   (a) Mid-span

   (b) Quarter span

   (c) Support

   (d) Middle third span

(x) The basic wind speed for Guwahati city is (1)

   (a) 55 m/s

   (b) 47 m/s

   (c) 39 m/s

   (d) 50 m/s

2. (a) A beam of symmetrical I section spanning 8 metres is shown in figure 1. All dimensions are in mm. The beam is prestressed by a parabolic cable with an eccentricity of 150 mm at the centre and zero at the supports with an effective force of 100 kN. The live load of the beam is 2 kN/m. Determine the final stress at the mid span section. Consider unit weight of concrete as 25 kN/m³. (8)
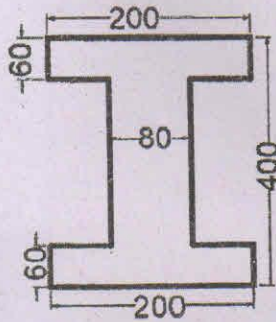
   (b) A Prestressed concrete beam of 250 mm wide and 400 mm deep has a span of 16 m. The beam is prestressed by a steel wire of area 400 mm² provided at a uniform eccentricity of 50 mm with an initial prestress of 1100 N/mm². Determine the percentage loss of stress to the wire, if the beam is a pre-tensioned beam. (7)

   Given data

   (i) Modulus of elasticity of steel, $E_s = 210 \, kN/mm^2$

   (ii) Modulus of elasticity of concrete, $E_c = 36 \, k/mm^2$

   (iii) Ultimate creep strain = 45 x 10⁻⁶ mm/mm per N/mm²

   (iv) Shrinkage of concrete = 300 x 10⁻⁶

   (v) Relaxation of steel stress = 5 % of initial stress

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3. (a) What are the different types of retaining wall?   (5)

    (b) A cantilever type retaining wall is shown in figure 2. The wall retains soil level with its top. The soil weighs 18 kN/m³ and has an angle of repose of 30°. Determine the extreme pressure intensities at the base. Also, check for sliding of the wall by considering the coefficient of friction, $\mu = 0.65$.   (10)
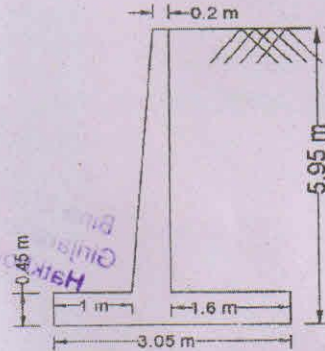

Figure 2.

4. (a) Write a note about the joints of the liquid retaining structures.   (5)

    (b) An open square tank 6 m x 6 m x 3 m deep rests on the firm ground. Design the tank. Use M 30 concrete and Fe 415 steel.   (10)

5. (a) A welded plate girder of 25 m span is subjected to a superimposed load of 100 kN/m on the entire span. Calculate the design forces on the girder.   (5)

    (b) Design the cross section of this plate girder for bending moment only, considering the compression flange to be laterally restrained. Assume that the girder is not provided any web stiffener except at the support.   (10)

6. (a) Write briefly about pressure coefficients used for wind analysis of industrial buildings.   (5)

    (b) A plate girder section is of overall size 550 mm x 2100 mm. The flange plates are 50 mm thick and the web plate is 16 mm thick. The bearing stiffener at the supports consists of 16 mm x 200 mm plates placed on both sides of the web plate. Calculate the bearing capacity of the stiffener.   (10)

7. (a) In a gantry girder of 10 m span, the wheel load transferred from the crane girder is 200 kN each. If wheel base distance is 3.5 m, calculate the design bending moment in the gantry girder due to this wheel load.   (10)

    (b) Calculate the wind pressure on the truss of pitched roof of an industrial building located in Dibrugath (Assam) having a mean probable design life of 50 years. The building has a height of 13 m and width of 25 m. Truss height is 5 m. The building is located in a partially developed industrial area.   (5)

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