

HPAS (M)—2015

CIVIL ENGINEERING

Paper I

Time : 3 Hours

Maximum Marks : 150

Note :— (i) Question No. 1 is compulsory. Attempt any *four* questions out of the remaining questions. In all, *five* questions are to be attempted.

(ii) Use relevant I.S. code of practice and the steel section Handbook is permitted.

(iii) Assume any data suitably, if required.

1. (a) A horizontal beam is simply supported at the ends and carries a uniformly distributed load 10 kN/m between the supports 10 m apart.

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Counterclockwise moments of 60 kNm and 40 kNm respectively are applied to the two ends of the beam at the supports. Draw shear force and bending moments diagrams for the beam. 10

(b) A 20 mm diameter brass rod was subjected to a tensile load of 40 kN. The extension of rod was found to be 254 divisions in the 200 mm extensionmeter. If each division is equal to 0.001 mm, find the elastic modulus of brass. 10

(c) A fixed beam of span 5 m carries a uniformly distributed load of 20 kN/m. If the right support sinks by 7.5 mm, find the fixing moments at the supports. Draw BM diagram. Take $E = 200 \text{ kN/mm}^2$ and $I = 5 \times 10^7 \text{ mm}^4$. 10

2. (a) Analyse the frame below. Draw BM diagram. Sketch the deflected shape of the frame. Use strain energy method for analysis. 10

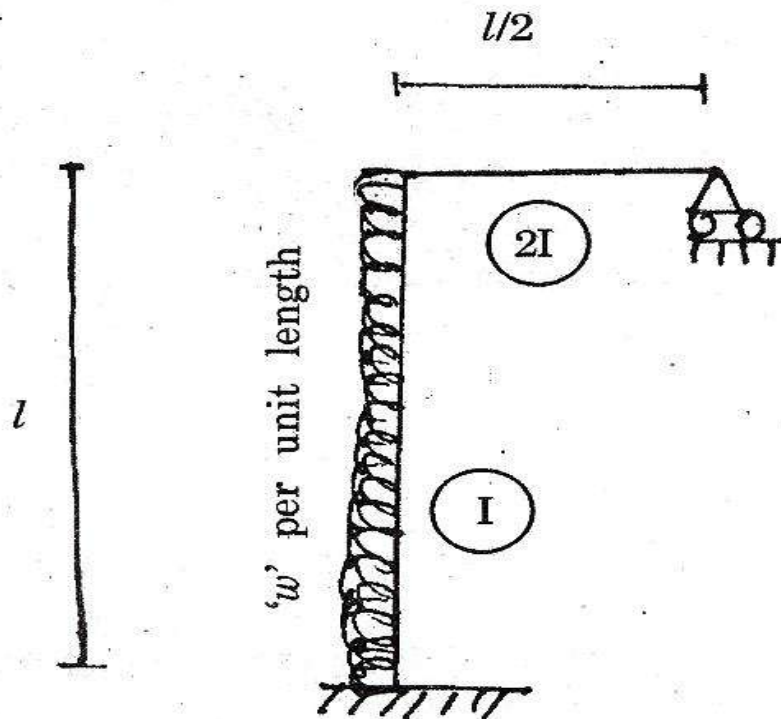


Fig. 1

- (b) The beam shown in Fig. 2 is subjected to the two couple moments. If the centre support settles 1.5 mm, determine the reaction at the supports. Take

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$E = 200 \text{ GPa}$, $I = 22 \times 10^{-6} \text{ m}^4$. Use stiffness method for analysis.

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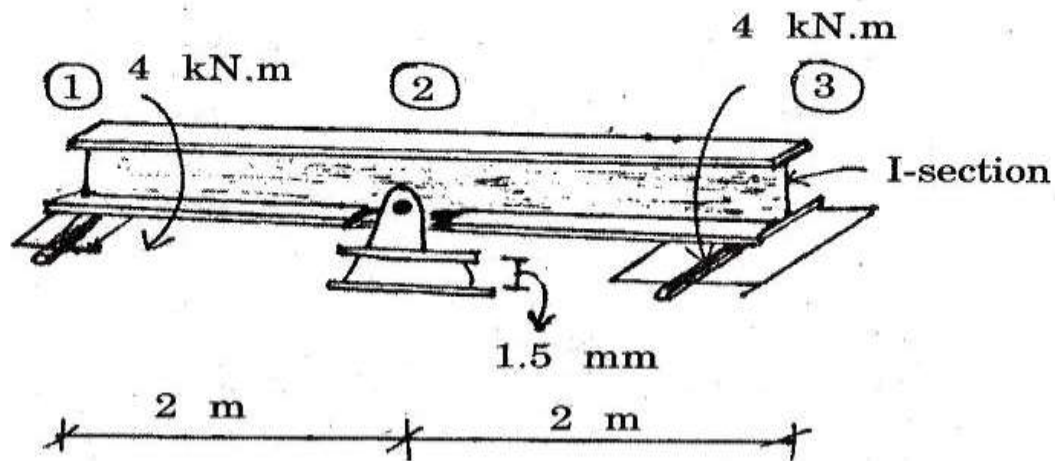


Fig. 2

3. (a) Design a butt joint to connect two plates $240 \times 12 \text{ mm}$ ($f_y = 250 \text{ N/mm}^2$) using ordinary M20 bolts. Arrange the bolts to give maximum efficiency.
- (b) A tie member consisting of angle section I.S.A. $80 \text{ mm} \times 50 \text{ mm} \times 8 \text{ mm}$ ($f_y = 250 \text{ MPa}$) is welded to a 12 mm gusset plate. Design welds

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to transmit a load equal to the full strength of member. Refer the figure 3 given below. 10

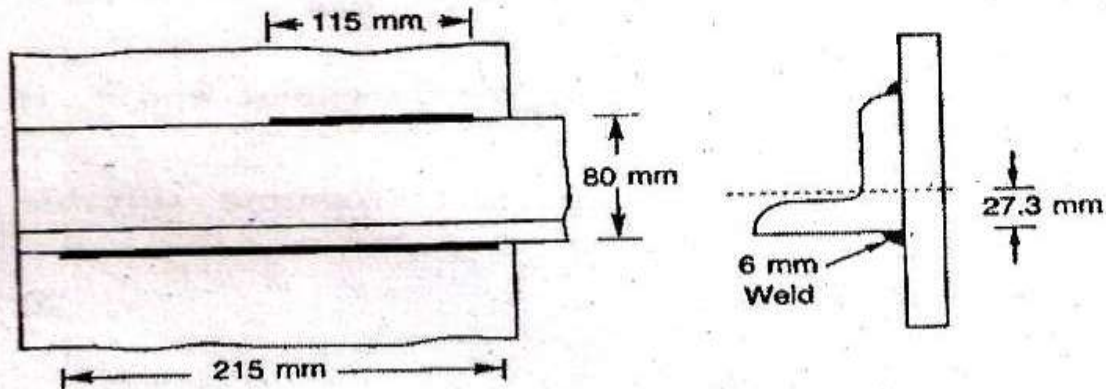


Fig. 3

(c) What is a Plate Girder ? How is it designed ?

Write the design steps.

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4. (a) Design a rectangular concrete beam section to carry a factored bending moment of 200 kNm, factored shear force of 120 kN and factored torsional moment of 75 kNm. Concrete mix of

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grade M20 and HYSD steel of grade Fe415

are to be used in construction. Data given :

$$P_t = 0.835\%, \tau_c = 0.583 \text{ MPa}, \tau_{c(\max)} = 2.8 \text{ MPa},$$

where P_t is transverse reinforcement and τ_c is

shear strength of concrete. Assume suitable

data if required.

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(b) What are the different types of RCC slabs ?

Write the design procedures/steps for designing

one-way slab.

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5. (a) A concrete beam of symmetrical I-section shown below is prestressed by a cable carrying a force of 120 kN at an eccentricity of 150 mm at centre of span section. The beam supports a live load of 2.5 kN/m over the entire span of 8.0 m. Determine the resultant stresses at

mid-span section for the following cases of loading.

Case :

(i) Prestress + self weight

(ii) Prestress + self weight + live load. 15

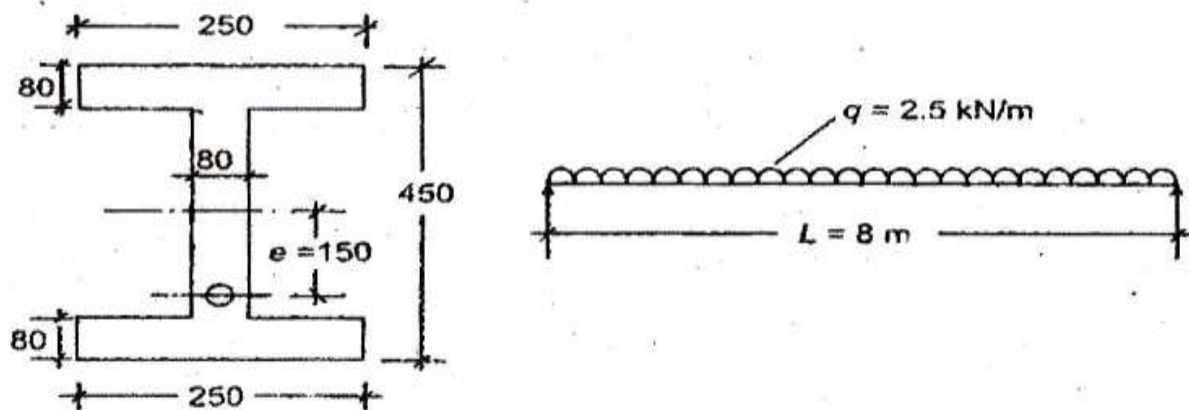


Fig. 4

(b) What do you understand by prestress concrete?

Write a note on methods and system of prestressing.

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6. (a) Classify various types of bricks, enumerating the characteristics of each type. 15
- (b) A dog-legged concrete staircase is to be provided for a two-storey residence. The floor to ceiling height of the ground floor is 3.0 m. The top floor structural slab is 125 mm thick and finishing of flooring on the top floor is 40 mm thick. Design a dog-legged staircase and determine the staircase room needed. Sketch the layout of the staircase. 15
7. (a) What are the different methods of determining the permeability of a soil ? How the constant head permeability test is carried out ? Write the procedure. 10

(b) In a consolidation test done in laboratory, a 20 mm thick sample is consolidated 50% in 15 min with double drainage. In how much time a 5.0 m thick layer of the same soil will consolidate 50% and 30% ? If the soil layer has rock below, how much time it will take to consolidate 50% and 30% ? 20

8. (a) What will be the gross and net safe bearing capacity of sand having $\phi = 30^\circ$, and density of 2.1 t/m^3 below 1 m wide strip footing placed at a depth of 1.2 m below the ground. Take the factor of safety as 2.5 and $N_c = 30.14$, $N_q = 18.4$ and $N_r = 22.4$. 10

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(b) What are the different types of foundations ?

With the help of neat sketches explain different types of shallow foundations required for different conditions.

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