Himachal Pradesh Administrative Service Combined Competitive (Main / Written) Examination, 2020

CIVIL ENGINEERING (PAPER-I)

Time allowed: Three Hours   Maximum Marks: 100

QUESTION PAPER SPECIFIC INSTRUCTIONS

Please read each of the following instructions carefully before attempting questions.

1. There are EIGHT questions printed in English.
2. Candidate has to attempt FIVE questions in all.
3. Question No.1 is compulsory. Out of the remaining SEVEN questions, FOUR are to be attempted.
4. All questions carry equal marks. The number of marks carried by a question / part is indicated against it.
5. Write answers in legible handwriting. Each part of the question must be answered in sequence and in the same continuation.
6. Wherever any assumptions are made for answering a question, they must be clearly indicated.
7. Diagrams / Figures, wherever required, shall be drawn neatly. Unless otherwise mentioned, symbols and notations carry their usual standard meanings.
8. Use of I.S. Codes of Practice and Steel Section Handbook is permitted.
9. Attempts of questions shall be counted in sequential order. Unless struck off, attempt of a question shall be counted even if attempted partly. Any page or portion of the page left blank in answer book must be clearly struck off.
10. Re-evaluation / Re-checking of answer book of the candidate is not allowed.

1. Explain in details essentials of air conditioning system? (20)

2. (a) The stress state at a point in a body is plane with $\sigma_1 = 60$ N/mm^2 and $\sigma_2 = -36$ N/mm^2. If the allowable stress for the material in simple tension or compression is 100 N/mm^2, calculate the value of factor of safety with each of the following theory of failure. Assume ($\mu = 0.3$)

   (i) Rankine's Theory

   (ii) Guest's Theory

   (iii) St. Venant's Theory

   (iv) Von mises yield Theory

   (10)

(b) If two pieces of materials A and B have the same bulk modulus but the value of E (Young Modulus) for B is 15 greater that for A, find the value of N (Modulus of Rigidity) for the material B in terms of E and N, for material A?   (10)

3. Analyze the beam loaded as shown in Fig.1 below using flexible coefficient method of analysis for the following condition: (20)

(i) Release the fixed end moment at A and bending moment at B.

(ii) If downward settlement of B and C is 2000/EI and 1000/EI in kN-m units respectively.
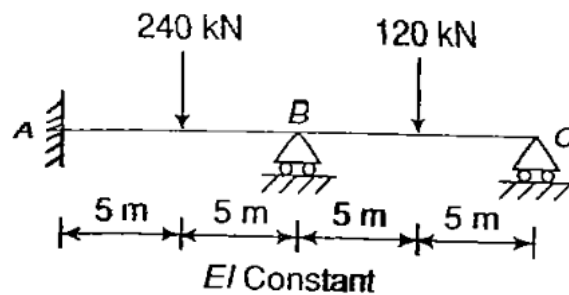

Fig. 1

4. Calculate the collapse load for the portal frame as shown in Fig. 2 below and design the members if factored load is 72 kN and f_y of steel is 250 MPa.   (20)
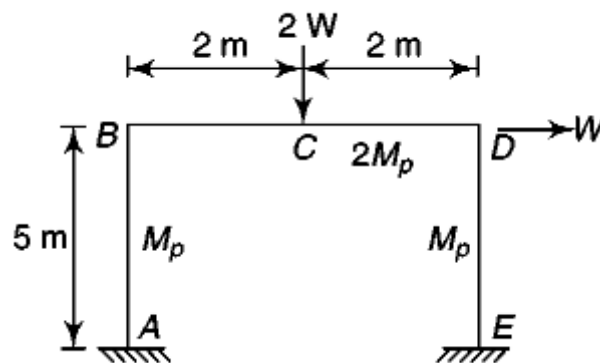

Fig. 2

5. (a) A pretensioned beam, 200 mm wide and 300 mm deep, is prestressed by 10 wires of 7 mm diameter initially stressed to 1200 N/mm^2, with their centroids located 100 mm from the soffit. Find the maximum stress in concrete immediately after transfer, allowing only for elastic shortening of concrete.

If the concrete undergoes a further shortening due to creep and shrinkage while there is a relaxation of five per cent of steel stress, estimate the final percentage loss of stress in the wires using the Indian Standard Code IS: 1343 regulations, and the following data: (10)

$E_s = 210 \text{ kN/mm}^2$

$E_c = 5700 \text{ (fcu)}^{1/2}$

$f_{cu} = 42 \text{ N/mm}^2$

Creep coefficient $(\varphi) = 1.6$

Total residual shrinkage strain $= 3 \times 10^4$

(b) Design the reinforcement in a column of size 400 mm by 600 mm subjected to an axial working load of 2000kN. The column has an unsupported length of 3m and is braced against side sway in both directions. Adopt M-20 grade concrete and Fe-415 HYSD bars. Draw a neat sketch of cross section of column showing the reinforced detail? (10)

6. (a) Differentiate clearly between PERT and CPM network methods. (10)

(b) Explain about continuous stairs with neat diagrams? (10)

7. The subsoil at the typical pier location of a major bridge consists of medium to coarse sand (corrected SPT value = 11) up to a depth of 6m from bed level (RL + 9.20m). This is underlain by 9m thick layer of very stiff to hard sandy silty clay (corrected SPT value is greater than 30) , overlying highly weathered rock (RQD = 0).

Using Lacey's formula, calculate the maximum scour depth and determine the founding level of the well. Also, estimate the allowable net bearing pressure if the diameter of the well is 6m. Use following data:

Maximum flood discharge = 10465 m^3/s, Length of bridge = 382.5 m, HFL = 13.00m, Silt factor = 1.053, submerged unit weight of soil and rock = 10 kN/m^3, C (drained) = 0 and ϕ (drained) = 35^0 for weathered rock. (20)

8. (a) A load 1000 kN acts as a point load at the surface of soil mass. Estimate the stress at a point 3m below and 4m away from the point of action of the load by Boussinesq's formula. Compare the value with the result from Westergaard's theory. (10)

(b) Explain characteristics of good mortar? (10)

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