Design of Concrete Structures-I

Time: 2 hours   Marks 20

General instructions:
All questions are compulsory; options have been provided in some questions.
All questions carry equal marks.
Use of IS 456 (2000) is allowed.

1.   Choose the correct option from the following:

(i)   The limiting compressive strain in concrete in bending is
  (a) 0.002   (b) 0.0015
 (c) 0.0035   (d) 0.0045

(ii) In limit state method of concrete design, the recommended partial material safety factor
  for steel according to IS 456:2000 is
  (a) 1.5   (b) 2.0
  (c) 2.0   (d) 1.15

(iii) Which of the following sections performs better on the ductility criterion
  (a) Balanced section   (b) Over-reinforced section
  (c) Under-reinforced section   (d) Non-prismatic section

(iv) Why is the design of a RC section as over reinforced undesirable
  (a) Consumes more concrete   (b) It undergoes high strains
  (c) It fails suddenly   (d) Its appearance is not good

(v)   The maximum amount of reinforcement permitted in beams, slab as per IS 456
  (a) 3 %   (b) 4.5%
 (c) 5%   (d) 4%

2   Find the moment of resistance of the given rectangular section using Working Stress Method. Assume effective cover to both compression and tension reinforcement to be *30mm*, take $\sigma_{cbc} = 6MPa, \sigma_{st} = 200MPa$. All other data is given in the figure.
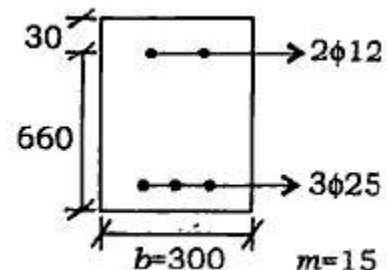
OR

Design a rectangular beam for an effective span of 6m. The superimposed load is 80kN/m and the size of the beam is 300 mm X 700mm overall. Assume effective cover to be 70mm. use M20 concrete and Fe415 grade steel. Use WSM.

3 (a) With the help of suitable figures explain under reinforced, balanced, and over reinforced sections. Also explain the behavior of each section at ultimate (collapse) stage and briefly explain the practical significance of each.

(b) Draw the stress and strain diagram of reinforced concrete section (cracked) for both working stress and limit state method.

4 Calculate limiting moment of resistance ($M_{u\,\text{lim}}$) and $A_{st\,\text{lim}}$ of the given rectangular beam section using limit state method. Hence determine the ultimate load that the beam section can carry. The beam is simply supported on brick walls of $300mm$ thickness and has a clear span of $8m$. Use M20 grade concrete and Fe500 grade steel, unit weight of reinforced concrete $25kN/m^3$.
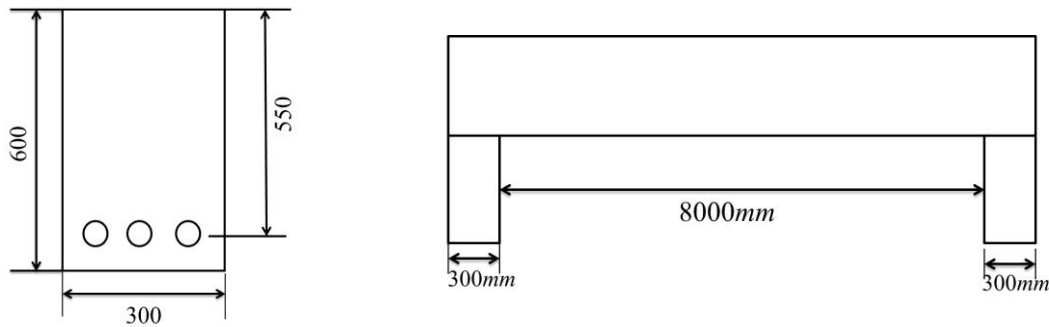
OR

If the stress-strain curve of concrete is as shown in the figure find the stress block parameters (lever arm, net compressive force). Assume linear strain distribution across the cross-section.