

**DIPLOMA EXAMINATION IN ENGINEERING/TECHNOLOGY/  
MANAGEMENT/COMMERCIAL PRACTICE — APRIL, 2018**

**STRUCTURAL DESIGN - II**

[Time : 3 hours

(Maximum marks : 100)

[Note :— Use of IS-800-2007, IS 1905, IS 875- Part 3 and Steel table are permitted.]

PART — A

(Maximum marks : 10)

Marks

I Answer *all* questions in one or two sentences. Each question carries 2 marks.

1. List any two mechanical properties of steel.
2. Define 'pitch' of the bolt.
3. List any two mode of failure of a tension member.
4. Define the term 'beam'.
5. List the loads acting on a roof truss.

(5×2 = 10)

PART — B

(Maximum marks : 30)

II Answer any *five* of the following questions. Each question carries 6 marks.

1. List out any six advantages of welded connections.
2. Calculate the shear strength of a 16 mm diameter bolt of grade 4.6 used for a lap joint of 10 mm thick plates of Fe 410.
3. Write the expressions for determine 'design strength of a tension member'.
  - (a) Due to yielding of gross section.
  - (b) Due to rupture.
4. Define the following terms of a compression member.
  - (a) Actual length
  - (b) Effective length
  - (c) Slenderness ratio.
5. An ISWB 400 @ 667N/m carries maximum shear force 100 KN, check the safety of the beam in shear, with  $f_y = 250$  MPa.
6. (a) Write the situations under which 'plate girders' are used.  
(b) Write any six component parts of a plate girder.
7. Write short notes on 'Effective height' and 'Effective length' of wall.

(5×6 = 30)

PART — C  
(Maximum marks : 60)

(Answer *one* full question from each unit. Each full question carries 15 marks.)

UNIT — I

- III (a) List out any four advantages and three disadvantages of steel structures. 7  
 (b) Calculate the safe load transmitted by a shop welded joint, if the size of weld is 6 mm and its length is 330mm, the ultimate stress is 410 MPa. 8

OR

- IV (a) Explain the Design Philosophy of steel structures. 7  
 (b) Find the strength of a lap joint of Fe 415 steel plates of width 250 mm, thickness 20 mm connected by means of 3 numbers 20mm dia bolts of 4.6 grade at a spacing of 50 mm. 8

UNIT — II

- V (a) Explain the use of Lug angle and its any four specifications as per IS 800. 7  
 (b) A single angle ISA 9060, 6 mm thick is connected to a gusset plate of 10 mm thick by fillet weld of 4 mm size. Given  $f_y = 250 \text{ N/mm}^2$ ,  $f_u = 410 \text{ N/mm}^2$  and length of weld is 200 mm. Determine tensile strength in yielding and rupture. 8

OR

- VI (a) Design a single angle strut connected to gusset plate carry a factored load of 200 KN. The length of member is 3 m,  $f_y = 250 \text{ MPa}$ . 7  
 (b) Explain the procedure for determination of 'design strength' of a single angle tension member. 8

UNIT — III

- VII (a) Explain plastic moment carrying capacity of a beam section. 7  
 (b) Determine the design bending moment of a laterally supported beam ISMB 350@524N/m,  $f_y = 250 \text{ MPa}$ . 8

OR

- VIII (a) Write short notes on classifications of beam section. 7  
 (b) An ISMB 500@869N/m carries a uniformly distributed load over an effective span of 6.50m. If the beam is restrained laterally, what udl the beam can carry, considering bending condition only, take  $f_y = 250 \text{ N/mm}^2$ . 8

UNIT — IV

- IX (a) List any seven component parts of a roof truss. 7  
 (b) A masonry wall carrying an axial load of 10KN/m is of 3.30 m effective length. It is not braced by cross walls. The effective height of wall is 3.0m. Design the masonry wall. Given  $f_b = 0.50 \text{ N/mm}^2$ ,  $K_a = 1$ ,  $K_s = 0.84$ ,  $K_p = 1.20$ . 8

OR

- X (a) Write the design considerations of a masonry wall. 7  
 (b) A roof truss shed is to be built in Lucknow for an industry. The size of shed is 24 m  $\times$  40 m. The height of building is 12m at the eaves. Determine the basic wind pressure. Given basic wind pressure at Lucknow = 47 m/sec. 8

SCHEME OF VALUATION

(Scoring Indicators)

Revision: 2015

Course code: 6013

Course title: Structural design II

Qn no.	Scoring Indicator	Spilt up score	Sub total	Total
<b>1</b>	<b><u>PART A</u></b> (Max. mark : 10)			
1.	a) Yield stress ( $f_y$ ), b) ultimate stress ( $f_u$ ) c) percentage elongation d) Notch toughness (Any two)	1+1	2	
2.	It is the centre to centre spacing of the bolt in a row, measured along the direction of load.	2	2	
3.	a) Yielding of cross section. b) Rupture c) Block shear (Any two)	1+1	2	
4.	A 'beam' is a structural member in which load acts perpendicular to the axis of member.	2	2	
5.	<del>(i) Principal rafter (ii) bottom chord (iii) ties (iv) strut (v) purlin (vi) rafter (vii) Eaves etc</del> 1) Dead load. 2) Live load 3) Wind load (Any 2)	<del>4 x 1/2</del> 1+1	2	10

Qn. no.	Scoring Indicator	Spilt up	Sub total	Total
Qn. II	<b>PART B</b> (Max. mark : 30, Answer any five question $5 \times 6 = 30$ )	Spilt	SubT.	Total
1.	<p><u>Advantage of welded connection.</u></p> <ol style="list-style-type: none"> <li>1. Joints are more stiff</li> <li>2. Better appearance.</li> <li>3. Less weight</li> <li>4. Less noise pollution.</li> <li>5. <del>High speed of</del> High speed of fabrication</li> <li>6. No maintenance required hence economical</li> <li>7. possible to achieve 100% efficiency.</li> <li>8. Alterations can be easily done <del>for</del> (Any 6)</li> </ol>	1x6	6.	
2.	<p>Given: <math>f_u = 410 \text{ N/mm}^2</math>, <math>f_{ub} = 400 \text{ N/mm}^2</math>, <math>d = 16 \text{ mm}</math>, <math>r_{mb} = 1.25</math></p> <p>Sol: <math>A_{nb} = 0.78 \times \frac{\pi}{4} (16)^2 = 156.82 \text{ mm}^2</math> — 1</p> <p>For lap joint 1 n single shear <math>V_{dsb} = \frac{V_{nsb}}{r_{mb}}</math> — 1 <math>V_{nsb} = \frac{f_u}{\sqrt{3}} (n_n A_{nb} + n_s A_{sb})</math> — 1 For single shear <math>n_s = 0</math>, <math>n_n = 1</math>. — 1 <math>V_{nsb} = \frac{410}{\sqrt{3}} \times (1 \times 156.82) = 44.58 \text{ KN}</math> — 1 <math>\therefore V_{dsb} = \frac{44.58}{1.25} = \underline{\underline{35.66 \text{ KN}}}</math> — 1</p>		6.	
3.	<p>(a) Design strength in yielding of cross section</p> $T_{dg} = \frac{A_g f_y}{\gamma_{mo}}$ <p><math>f_y</math> - yield stress <math>A_g</math> - gross area <math>\gamma_{mo}</math> - partial safety factor</p>		2 (+1)	

Qn no.	Scoring Indicator	Spilt up	Sub total	Total
Ans.	<b>PART B</b>			
	b) Design str: due to rupture $T_{dn} = \frac{0.90 A_n f_u}{\gamma_{ml}}$ $A_n = \left[ b - ndh + \sum \frac{P_{si}^2}{F_{gi}} \right] t$ $A_n = 0.78 \frac{\pi}{4} d^2 \quad (\text{for ISO threads})$	→ 2		
4.	(a) <u>Actual length</u> : It is the centre to centre distance of compression member between the restrained ends. — 2 (b) <u>Effective length</u> : The eff length of a compression member is the length of an equivalent member with hinged ends having the same effect of buckling. — 2 (c) <u>Slenderness ratio</u> : Defined as the ratio of effective length to corresponding radius of gyration of the section $Sl. \text{ ratio} = \frac{l_e}{r} = \frac{KL}{r}$ where $l_e = KL$ - effective length — 2		6.	
5.	<u>Given:</u> $V = 100 \text{ kN}$ $f_y = 250 \text{ MPa}$ <u>Properties of ISWB 400 @ 667 N/m</u> $h = 400 \text{ mm}$ $t_{we} = 8.60 \text{ mm}$ , (steel table) — 1 Factored SF $V_u = 1.50 \times 100 = 150 \text{ kN}$ — 1 <u>Condition</u> : $(0.60 V_d > V_u)$			
Qn no.	Scoring Indicator	Spilt up	Sub total	Total

Qn.	PART B	Spilt	SubT.	Total
	$V_d = \frac{A_r f_y}{\sqrt{3} \gamma_{mo}}$ $A_r = (h \times t_w) = 400 \times 8 = 3200 \text{ mm}^2$ $V_d = \frac{3200 \times 250}{\sqrt{3} \times 1.10} = 381.86 \text{ KN} \quad 2$ $\therefore 0.60 V_d = 0.60 \times 381.86 = 229.1 \text{ KN}$ $\underline{229.10 \text{ KN}} > 150 \text{ KN} \text{ hence safe} \quad 2 \quad 6.$			
6.	<p>① <u>Plate girders</u> (Situations).</p> <ol style="list-style-type: none"> <li>1. Larger column free halls are required in the lower floor of a multistorey building.</li> <li>2. In work shops, where girders are required to carry crane beams.</li> <li>3. In road and railway bridges. — 3.</li> </ol> <p>(b). 1. web plate 2. Flang angle  3. Bearing stiffeners 4. Vertical stiffeners.  5. Horizontal stiffeners 6. web splice  7. Flange splice (Any 6 of 6x1/2) 3. 6.</p>			
7.	<p><u>Effective height:</u></p> <p>The effective height of a wall (h) to be used for calculating the slenderness ratio, is the junction of the actual height (H) of the wall and the condition of lateral support. 'h' varies from 0.75 H to 1.50 H depending on the lateral support condition. (The value adopted as per IS 1905-1987) 3.</p>			
Qn no.	Scoring Indicator	Spilt up	Sub total	Total

Qn. no.	Scoring Indicator	Spilt up	Sub total	Total
Qn. PART B	<p><u>Eff. length:</u> The eff. length of the wall (<math>l</math>) to be used in the calculation of slenderness ratio depends upon the length of wall from or between centres of cross wall, piers or buttresses (<math>L</math>) and the support conditions. The eff. length varies from <math>0.80L</math> to <math>2.0L</math> depending upon support conditions (IS 1905-Part 3)</p> <p>(Any 5x6)</p> <p><u>PART.C</u> (max. mark: 60).</p> <p><u>UNIT-I</u></p> <p>(a). <u>Advantages:</u></p> <ol style="list-style-type: none"> <li>1. speedy construction.</li> <li>2. Dismantling and reuse of steel structures will be possible</li> <li>3. to occupy less space.</li> <li>4. Modification of sectional properties can be easily carry out.</li> <li>5. Less self weight.</li> <li>6. Assured quality and high durability (Any four)</li> </ol> <p>(b) <u>dis advantages:</u></p> <ol style="list-style-type: none"> <li>1. Suspect to corrosion</li> <li>2. Maintenance cost is high.</li> <li>3. costly.</li> </ol> <p>(b) <u>Given:</u></p> <p>Size of weld <math>S = 6\text{mm}</math>.</p> <p>length of weld <math>L_w = 330\text{mm}</math>.</p> <p>ultimate stress <math>f_u = 410\text{N/mm}^2</math></p>	3	6	30
III		4	7	
Qn no.	Scoring Indicator	Spilt up	Sub total	Total

Qn. no.	Scoring Indicator	Spilt up	Sub total	Total
Qm.	<u>PART B</u>	Spilt	Sub T.	Total
	<p><u>Sol:</u></p> <p>throat thickness 't' = <math>0.70 \times 6 = 4.2 \text{ mm}</math></p> <p>Design stress <math>f_{ud} = \frac{f_u}{\sqrt{3} \gamma_{m2}} \quad [\gamma_{m2} = 1.25 \text{ shop weld}]</math> - 1</p> <p><math>f_{ud} = \frac{410}{\sqrt{3} \times 1.25} = 151.85 \text{ N/mm}^2</math> - 2</p> <p>Design strength = <math>(L_v \cdot t) f_{ud}</math> - 1</p> <p>= <math>330 \times 4.2 \times 151.85 = \underline{210.46 \text{ kN}}</math> - 2</p> <p>Safe load = <math>\frac{\text{Ultimate load}}{\text{Factor of Safety}}</math></p> <p><math>\therefore</math> Safe load = <math>\frac{210.46}{1.55} = \underline{140.30 \text{ kN}}</math> - 2</p> <p style="text-align: center;"><u>OR</u></p>			15.
IV	<p>9) The aim of design is to decide shape, size and connection details of the member so that the structure being designed will perform satisfactorily during its intended life. with an appropriate degree of safety, the structure should</p> <ul style="list-style-type: none"> <li>(a) sustain all loads expected on it.</li> <li>(b) sustain all deformations during and after construction.</li> <li>(c) should have adequate durability.</li> <li>(d) should have adequate resistance to corrosion and fire.</li> <li>(e) should have be stable and have alternate load paths to prevent overall collapse under accidental loading.</li> </ul> <p>The design philosophies used are</p> <ul style="list-style-type: none"> <li>(1) working stress method</li> <li>(2) Ultimate load Design</li> <li>(3) Limit State Design</li> </ul>	- 2		7.
Qn. no.	Scoring Indicator	Spilt up	Sub total	Total

Qn.

PART B

Spilt

Sub T.

Total

b) Given:

$$f_u = 410 \text{ N/mm}^2, t = 20 \text{ mm}$$

$$b = 250 \text{ mm}$$

No. of bolt in single shear  $n_s = 3$ .

Grade of bolt - dia = 20 mm

$$\therefore d_o = 22 \text{ mm}$$

$$f_{ub} = 400 \text{ N/mm}^2$$

Solution:

Net area of plate

$$A_n = [b - n d_o] t = [250 - 3 \times 22] 20$$

$$= 3680 \text{ mm}^2$$

(i) Design str. of plate

$$T_{dm} = \frac{0.90 f_u A_n}{\gamma_{ml}} = \frac{0.90 \times 410 \times 3680}{1.25}$$

$$= \underline{1086.33 \text{ kN}}$$

2

(ii) Strength of bolt in shear:

$$V_{dsb} = \frac{f_{ub}}{\sqrt{3}} (n_s A_{nb} + n_s A_{sb})$$

$$= \frac{400}{\sqrt{3}} (3 \times 245) = \underline{169.74 \text{ kN}}$$

$$(A_{nb} = 0.78 \times \pi \times 20^2 / 4)$$

(iii) Design strength of bolt in bearing:

$$V_{dsb} = \frac{V_{nsb}}{\gamma_{mb}} \cdot V_{nsb} =$$

$$\therefore \text{Design strength in shear } V_{dsb} = \frac{V_{nsb}}{\gamma_{mb}}$$

$$= \frac{169.74}{1.25} = \underline{135.79 \text{ kN}}$$

3

Qn  
no.

Scoring Indicator

Spilt  
upSub  
total

Total

Qn.

PART B

Split

Sub T.

Total

iii) Design strength in bearing of bolt

$$V_{npb} = 2.50 k_b \cdot d \cdot t \cdot f_u$$

where  $k_b$  least of the following

$$a) \frac{e}{3d_0} = \frac{50}{3 \times 22} = 0.75 \quad \left[ e = \frac{(250 - 3 \times 50)}{2} \right]$$

$$b) \frac{p}{3d_0} = \frac{50}{3 \times 22} = 0.75$$

$$c) \frac{f_{ub}}{f_u} = \frac{400}{410} = 0.97$$

$$d) 1.0$$

$$\therefore k_b = 0.75$$

$$\therefore V_{npb} = 2.50 \times 0.75 \times 20 \times 20 \times 410$$

$$= 307.50 \text{ kN}$$

$$\therefore \text{Design strength} = \frac{V_{npb}}{\gamma_{mb}} = \frac{307.50}{1.25}$$

$$= \underline{\underline{246 \text{ kN}}}$$

2

Ans: Design strength joint is the least of the above three

$$\text{i.e. } \underline{\underline{135.79 \text{ kN}}} \text{ (Ans).}$$

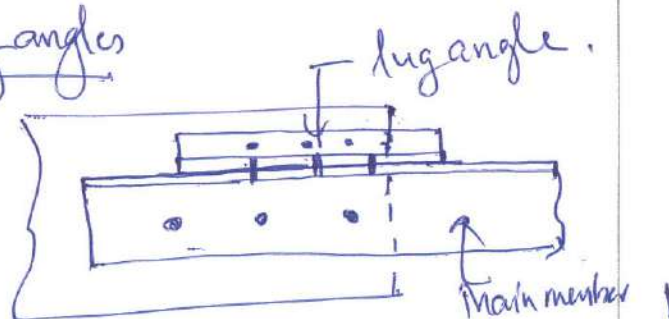
1

8

15

UNIT-II

V

a) use of lug anglesQn  
no.

Scoring Indicator

Spilt  
upSub  
total

Total

Qn.

PART B

Spilt

Sub T.

Total

Length of the end connections of a heavily loaded tension members may be reduced by using lug angles. By using lug angles there will be saving in gusset plate, but it is upset by additional fasteners and angles required.

- 2

IS specifications: (cl: 10.12.1 to 12.6)

1. Leg angle connecting leg of a channel shaped member shall as far as possible, be disposed symmetrically with respect to the section of member.
2. In the case of angle member, the lug angle shall be capable of developing a strength not less than 20% in excess of forces in the outstand leg of the member.
3. In case of a channel member shall be capable of developing a strength not less than 10% in excess of forces in the outstand leg of the member.
4. In no case shall fewer than two bolts, rivets or equivalent welds be used for attaching lug angles to gusset plate or support member.
5. The effective connection to the lug angle shall as far as possible terminate at the end of the member connected.
6. Where lug angles are used to connect an angle member, the whole area of the member shall be taken as effective not withstanding the requirement of section of this standard.  
(Any force) →

~~5~~  
4

7.

Qn  
no.

Scoring Indicator

Spilt  
upSub  
total

Total



Qn.		score split	SubT	Total
	<b>PART C</b>			
<u>(vi)</u>	<p>a) Given: <math>P_u = 200</math> KN.</p> <p><math>l = 3</math> m.</p> <p><math>f_y = 250</math> N/mm<sup>2</sup> <math>\therefore k l = 0.70 l</math>.</p> <p><u>Sol<sup>n</sup></u>: <math>k l = 2.10</math> m.</p> <p><math>f_{cd} = 90</math> N/mm<sup>2</sup> (for angle sections), 2</p> <p><math>P_u = A \cdot f_{cd}</math></p> <p><math>\therefore A = \frac{P_u}{f_{cd}} = \frac{200 \times 10^3}{90} = \underline{\underline{2222.22 \text{ mm}^2}}</math> 3</p> <p>Provide a section ISA 125x95x12 mm which has area more than calculated area</p> <p>ISA 125x95x12 mm <math>A_g = \underline{\underline{2498 \text{ mm}^2}}</math> 2 7.</p>			
	<p>b) Procedure of determination of design strength of single angle tension member.</p> <p>i) Design str: due to yielding of gross section</p> <p><math>\phi_{dy} = \frac{A_g f_y}{\gamma_{m0}}</math></p> <p>where <math>A_g =</math> gross area of given angle section. (from steel table)</p> <p><math>f_y =</math> yield stress</p> <p><math>\gamma_{m0} =</math> partial safety factor = 1.10 2</p> <p>ii) <u>Design strength due to rupture.</u></p> <p><math>\phi_{dn} = \frac{0.90 A_n f_u}{\gamma_{m1}} + \beta \frac{A_g f_y}{\gamma_{m0}}</math></p> <p>where <math>\beta = 1.40 - 0.076 \left(\frac{W}{t}\right) \left(\frac{f_y}{f_u}\right) \left(\frac{h_s}{l_c}\right)</math></p>			

PART C

where  $W$  = length of outstand leg,  
 $b_s = a_s$  = shear leg width.  
 $t$  = thickness of angle  
 $L_c$  = length of weld along load direction.  
 $A_{nc} = [L - t/2] t$ ,  $A_{go} = [b - t/2] t$ .

3

iii) Design strength is due to block shear:

$$\phi_{db} = \left[ \frac{A_{vg} f_y}{\sqrt{3} \gamma_{mo}} + \frac{0.90 A_{tn} f_u}{\gamma_{ml}} \right]$$

or

$$\phi_{db} = \left[ \frac{0.90 A_{vn} f_u}{\sqrt{3} \gamma_{ml}} + \frac{A_{tg} f_y}{\gamma_{mo}} \right]$$

where  $A_{vg}$  = gross area in shear.

$$A_{vg} = L_w (2 \times S)$$

$$A_{vn} = L_w (2S)$$

$A_{tg}$  = gross area in tension.

$$A_{tg} = A_{tn} = L \times 2S$$

$S$  = size of weld.

3

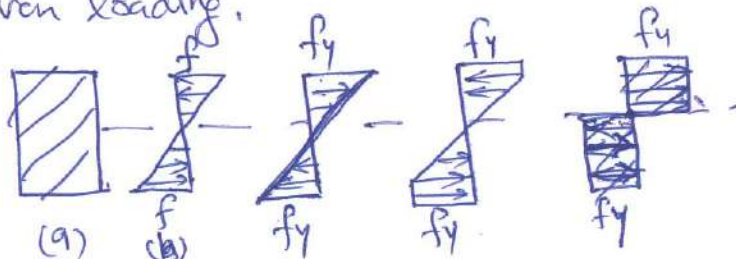
8

15.

UNIT - IIIVII

9) Plastic moment carrying capacity of a beam section;

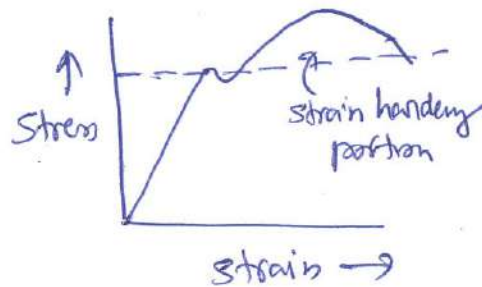
consider a SS beam where BM is max for given loading.



2.

PART C

As per this analysis, it is assumed that after yield point is reached strain goes on yielding without resisting any additional load. Hence according to theory of plastic analysis highly stressed fibre once yield is not capable of resisting any moment. But interior fibres are not yet yielded and hence additional loads are resisted by unyielded portion of these the section. As the load is gradually increased one by one fibre reach yield stress and stop resist additional load. Fig (d) shows partially yielded case. However resistance to load continuously continues till all fibres are yielded as shown fig (e). This condition is formation of plastic hinge. After this stage rotation at section will take place without resisting additional moment. This moment capacity is called plastic moment capacity  $M_p$  of the section.



b) Given: ISMB 350 @ 524 N/m,  
 $f_y = 250 \text{ N/mm}^2$ .

Properties

$$h = 350 \text{ mm.}$$

$$b_f = 140 \text{ mm.}$$

$$t_f = 14.20 \text{ mm.}$$

$$t_w = 8.10 \text{ mm.}$$

Solution:

$$\begin{aligned} \text{depth of web } d &= h - 2t_f \\ &= 350 - 2 \times 14.20 \\ &= 321.60 \text{ mm.} \end{aligned}$$

PART C

$$Z_{xx} = 778.90 \times 10^3 \text{ mm}^3.$$

$$M_d = \frac{\beta_o Z_p f_y}{\gamma_{mo}} = \frac{\beta_b Z_p f_y}{\gamma_{mo}}$$

Assuming plastic section,  $\beta_b = 1$

$$S = \frac{Z_p}{Z_e} = 1.14 \text{ for symmetrical I section.}$$

$$Z_p = 1.14 \times Z_{xx}$$

$$= 1.14 \times 778.90 \times 10^3 =$$

$$= \underline{887.946 \times 10^3 \text{ mm}^3}$$

3

$$\therefore M_d = \frac{\beta_b \cdot Z_p \cdot f_y}{\gamma_{mo}} = \frac{1 \times 887.946 \times 10^3 \times 250}{1.10}$$

3

$$= \underline{\underline{201.80 \text{ kNm}}}$$

8.

15.

OR

VIII

9)

Classification of beam sections:

i) class-1 (Plastic) cross section:

These sections can develop plastic hinges and have rotation capacity required for failure of the structure by formation of plastic mechanism (width to

ii) thickness ratio less than that specified in Table-7.1 of IS 800.

ii) class-2 (compact): Such sections can develop plastic moment of resistance but have inadequate plastic hinge rotation capacity for formation of plastic mechanism, due to local buckling.

iii) class-3 (Semi-compact): In which extreme fibre in compression can reach yield stress, but can't develop plastic

Qn.		score split	SubT	Total
	<p><b>PART C</b></p> <p>moment of resistance, due to local buckling.</p> <p>iv) <u>class-4 (slender)</u>: The cross section of element of which buckle locally even before reaching yield stress belongs to this category.</p> <p>b) <u>Given</u>: ISMB 500 @ 869 N/m,            Span <math>l = 6.50</math> m,  <math>f_y = 250</math> N/mm<sup>2</sup></p> <p><u>Solution</u>:</p> <p>Properties <math>A = 11074</math> mm<sup>2</sup>  <math>h = 500</math> mm,  <math>b_f = 180</math> mm,  <math>t_f = 17.20</math> mm,  <math>t_w = 10.20</math> mm,</p> <p><math>I_{xx} = 45218.3 \times 10^4</math> mm<sup>4</sup>  <math>Z_{xx} = Z_e = 1808.7 \times 10^3</math> mm<sup>3</sup>.</p> <p><math>Z_p = \frac{A}{2} (\bar{y}_1 + \bar{y}_2)</math>            where <math>\bar{y}_1 = \bar{y}_2 = \frac{A_1 y_1 + A_2 y_2}{A_1 + A_2}</math>  <math>\bar{y}_1 = \bar{y}_2 = 187.14</math> mm.</p> <p><math>Z_p = \frac{11074}{2} (2 \times 187.14)</math>  <math>Z_p = 2.072 \times 10^6</math> mm<sup>3</sup>.</p> <p><u>bending consideration</u>:</p> <p><math>Z_p = \frac{M_u \gamma_{mo}}{f_y}</math>  <math>\therefore M_u = \frac{2.072 \times 10^6 \times 250}{1.10} = 470.90 \times 10^6</math> Nmm.</p>	(7).		
	15)	2		

Qn.		score out	SubT	Total
	<p><b>PART C</b></p> $M_u = \frac{W_u l^2}{8} = 470.90 \times 10^6 \text{ Nmm}$ $\therefore W_u = 89.16 \text{ N/mm}$ $\therefore W_b = \frac{W_u}{1.50} = \frac{89.16}{1.50} = \underline{\underline{59.44 \text{ N/mm}}}$ <p style="text-align: center;"><u>UNIT - IV</u></p>		8	15
IX a)	<p>Component parts of a roof truss.</p> <ol style="list-style-type: none"> <li>1. Principal rafter.</li> <li>2. Bottom chord.</li> <li>3. Pies.</li> <li>4. Struts.</li> <li>5. Purlins.</li> <li>6. Rafters.</li> <li>7. Ridge line.</li> <li>8. Eaves.</li> <li>9. Panel points.</li> <li>10. Roof covering</li> </ol> <p style="text-align: right;">(Any 7)</p>		7	15
b)	<p><u>Given:</u> Load = <del>780</del> 10 kN/m.</p> <p>eff. length = 3.30 m.</p> <p>eff. height = 3.0 m.</p> <p><u>Solution:</u></p> <p>Assuming a wall thickness 200 mm</p> <p>eff. height &lt; eff. length</p> $\therefore \text{Slenderness ratio} = \frac{\text{Eff. height}}{\text{Eff. thickness}}$ $= \frac{3000}{200} = 15.$ <p>Assuming cement mortar (1:5) and brick with comp. strength 5.0 N/mm<sup>2</sup> the basic comp. stress from table (8) of IS 1905</p>	2		

Qn.

score  
out

Sub T

Total

PART C

$$f_b = 0.50 \text{ N/mm}^2.$$

$$\begin{aligned} \text{Net area of wall} = A &= \frac{3.3 \times 2}{3300 \times 200} \\ &= \underline{660000 \text{ mm}^2}. \end{aligned}$$

$= 0.66 \text{ m}^2 > 0.20 \text{ m}^2$  hence no reduction factor needed  $\therefore k_a = 1$ .

Permissible comp. stress  $f_c = k_a \cdot k_s \cdot k_p \cdot f_b$

$$\begin{aligned} &= 1 \times 0.84 \times 1.20 \times 0.50 \\ &= 0.504 \text{ N/mm}^2. \end{aligned}$$

$$\begin{aligned} \therefore \text{Actual comp. stress } f &= \frac{P}{A} = \frac{10 \times 10^3}{0.20 \times 10^4} \\ &= \frac{10000}{1000 \times 200} = 0.05 \text{ N/mm}^2 \quad 2 \end{aligned}$$

$$0.05 \text{ N/mm}^2 < 0.50 \text{ N/mm}^2$$

Hence provide 200 mm thick wall with bricks of comp. strength 5.00 N/mm<sup>2</sup> in cm 1:5.

ORX  
a)Design considerations:

Masonry structures gain stability from the support offered by cross walls, floors, roofs and other elements such as piers and buttresses. Eccentric loading is to be avoided by providing adequate bearing of floor slab or roof slab on the wall.

The strength of wall is measured in terms of its resistance to the combination of self wt,

Qn.		score out	SubT	Total
	<p><b>PART C</b></p> <p>super imposed loads and lateral pressure.</p> <p>The stability of wall is indicated by resistance to overturning by lateral force and buckling caused by excessive slenderness ratio.</p> <p>The strength of masonry wall depends on the strength of masonry unit and strength of mortar.</p> <p>The quality of workmanship and method of bonding also have effect on strength.</p> <p>The thickness of load bearing wall should be such that it is sufficient at all points to ensure the resulting stresses due to the loading for which the wall is designed.</p> <p>The design is on basis of permissible comp. stress.</p>			
b)	<p><u>Solution:</u></p> <p>From wind zone Map <math>V_b = 47 \text{ m/sec}</math></p> <p>Risk coefficient <math>k_1 = 1.0</math> (Refer table for Gen. buldy).</p> <p><math>k_2 = 0.88</math> if <math>h = 10 \text{ m}</math>  <math>= 0.94</math> if <math>h = 15 \text{ m}</math>.</p> <p><math>\therefore</math> for <math>h = 12 \text{ m}</math>, (Refer table 875.)  <math>k_2 = 0.904</math></p> <p>Topographic factor <math>k_3 = 1 + C_s</math>.  where <math>C = \frac{Z}{L} = 0</math>.  <math>\therefore k_3 = 1</math>.</p> <p>Design wind speed <math>V_z = k_1 k_2 k_3 V_b</math></p>		2	2

Qn.		score out	Subt	Total
	<p><u>PART C</u></p> <p><math>= 1.0 \times 0.904 \times 10 \times 47.</math></p> <p><math>= 42.488 \text{ m/sec.}</math></p> <p>Hence basic wind pressure</p> <p><math>P_s = 0.60 V^2 = 0.60 \times 42.488^2</math></p> <p><math>= 1083 \text{ N/m}^2 \text{ or } \underline{1.083 \text{ kN/m}^2}</math></p>	2	8	15