APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Scheme for Valuation/Answer Key

Scheme of evaluation (marks in brackets) and answers of problems/key

SEVENTH SEMESTER B.TECH DEGREE EXAMINATION (S), MAY 2019

Course Code: CE401

Course Name: DESIGN OF STEEL STRUCTURES

Max. Marks: 100 Duration: 3 Hours

PART A

Answer any two full questions, each carries 15 marks. Marks

1 a) Any three types- 3 marks (3)

b) Strength of plate at the joint- 2 marks (12)

Strength of bolt: Shear strength-2 marks, Bearing strength-3 marks

Design strength of joint- 1 mark

Strength of solid plate-2 marks

Efficiency-2 marks

2 a) Any three (3)

b) Properties of Angle ISA 125 x 95 x 8 mm, A= 1014 mm^2. (12)

γ_{m0} = 1.1 , f_y = 250 , γ_{m1} = 1.25

Design strength due to yielding of cross section by using the formula

$$T_{dg} = A_g f_y / \gamma_{m0} = 385.9\text{kN}$$ **2marks**

Design strength due to rupture of critical section by using the formula :

$$T_{dn} = 0.9 A_{nc} f_u / \gamma_{m1} + \beta A_{go} f_y / \gamma_{m0} = 330 \text{ kN.}$$

$$\beta = 1.4 - 0.076(w/t)(f_y/f_u)(b_s/L_c) \le (f_u \gamma_{m0})/(f_y \gamma_{m1})$$

b_s = 172 mm , L_c = 195mm ,β = 0.76 > 0.7

A_{g0} =968 mm^2 , A_{nc} = 552 mm^2 **4marks**

Design strength due to block shear (minimum of below) by using the two formulaes :

$$A_{vg} f_y / \sqrt{3}\gamma_{m0} + 0.9 A_{tn} f_u / \gamma_{m1} = 315 \text{ kN}$$

$$0.9 A_{vn} f_u / \sqrt{3}\gamma_{m1} + A_{tg} f_y / \gamma_{m1} = 288 \text{ kN}$$

A_{vg} = 1880mm^2 ,A_{vn} = 1264mm^2

A_{tg} = 320mm^2 , A_{tn} = 232 mm^2 **4marks**

Design Tensile strength of the angle = 288 kN **2marks**

3 a) Purpose of lug angles 3marks (3)

b) (12)

1) <u>Calculation of net area</u>

An (path 11) = (200-3x22)10 =1340mm^2

Path (1221) = (200-4x22)10+ (2x50^{2}x10)/ (4x30)=1536.67mm^2

Path 12321 = (200-5x22)10+ [4x50^2/ (4x30)]x 10 = 1733.33mm^2

-6 marks

Mini. net area = 1340mm^2

-1 marks

Design Strength governed by yielding Tdg = fy Ag/ ϒm0 = (250x200x10)/1.1 = 454.55kN -2 marks

Tdn = 0.9 fu An/ϒm1 = 0.9 x 410 x 1340/1.25=395.57kN

-2 marks

So Design tensile strength = minimum of Tdg and Tdn= 395.57kN

-1 marks

PART B

Answer any two full questions, each carries 15 marks.

4 a) Calculation of area of cross section required - 2 marks (15)

Calculation of design strength of section chose and showing that it is greater than 1100kN-2 marks

Two numbers of channel sections of appropriate dimensions should be chosen

Calculation of spacing of channels using the equation $2I_z = 2\{I_y + A(S/2+C_{yy})^2\}$ – 3 marks

Fixing up of dimensions of batten (including end batten and intermediate batten)– 3marks

Calculation of compressive force coming and showing that the provided section is safe to take up the load -3marks

Provision bolted connection – 2mark

5 a) Explaining any three failure modes – 5marks (5)

b) h/b_f = 1.2 and t_f < 40mm, since r_{min} is r_{yy}=54.1mm, buckling class C (2) (10)

effective slenderness ratio, λ = 0.624 (1)

for buckling class C, α = 0.49, φ = 0.798 (2)

f_{cd} = 175.44N/mm^2 (3)

design strength of column P_d = 1313.01kN (2)

[Full credit can be given if any student find fcd using table 9(c) of IS 800]

6 a) 4 types- 3marks (3)

b) Calculation of design bending moment and shear force- 2 marks , selection of beam section- 2 marks ,size of cover plates- 4 marks, check for shear- 2 marks. Check for bearing and deflection – 2marks (12)

PART C

Answer any two full questions, each carries 20 marks.

7 a) Truss configuration (2), Loads on panel points - DL on intermediate panel points =7.4 kN and on each end panel =3.7 kN LL on intermediate panel points = 6.7 kN and on each end panel 3.35kN (3) Wind Load: Windward side : -18.8 kN and -9.4 kN and Leeward side : -17.5 kN and -8.75kN (5) . Member forces: graphically or by method of joints due to DL,LL& WL (8) , Member forces due to load combinations (2) (20)

8 a) Force in any bolt due to direct load $F_1 = \frac{P}{n}$ (1) (4)

Force in any bolt due to torque $F_2 = \frac{Per}{\Sigma r^2}$ (1)

Resultant force acting on the critical bolt = F = $\sqrt{(F_1^2 + F_2^2 + 2F_1F_2\cos\theta)}$ (2)

b) Forces acting on the purlins. DL and LL calculation(2), wind load (2) (16)

Factored bending moment and shear force (2 marks each)

Design of section (3)

Check for BM and SF(3)

Check for Deflection. (2)

9 a) Effective span (1) (15)

BM &SF (3)

Design of section (2)

Check for moment (3)

Check for shear (2)

Check for deflection (2)

Check for bearing stress (2)

b) Classification (5)

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