

CE388 - FUNDAMENTALS OF STEEL DESIGN

2014-2015 Spring Term

Problem Set 1 - Answers

1)

	Case A	Case B
x_s (mm)	34.42	21.28
y_s (mm)	34.42	71.28
I_x (cm ⁴)	373.26	1449.24
I_y (cm ⁴)	373.26	254.36
r_x (mm)	36.94	64.76
r_y (mm)	36.94	27.13
I_u (cm ⁴)	594.26	1541.53
I_v (cm ⁴)	152.26	162.07
r_u (mm)	46.6	66.79
r_v (mm)	23.59	21.66
α (deg)	45	0.26

2)

	Yielding of Gross Area	Fracture of Net Section
P_n (kN)	825	1032
$\phi_t P_n$ (kN)	742.5	774
$A_n = A_e$ (mm ²)		2400

3)

	Yielding of Gross Area
P_n (kN)	2698
$\phi_t P_n$ (kN)	2428.2

	Fracture of Net Section
U (shear lag factor)	0.74 (case2)
A_n (mm ²)	Assmp1 6200
	Assmp2 6760
P_n (kN)	2339.88
$\phi_t P_n$ (kN)	1754.91

If all critical sections are considered to be subjected to full load.

If critical sections are assessed based on their load share.

According to Assmp1

4)

	a	b
U (shear lag factor)	0.757 (case2) 0.850 (case 7)	0.668 (case2) 0.700 (case7)
U (selected)	0.85	0.70
A_n (mm ²)	5215.2	10808
A_e (mm ²)	4432.92	7565.6

5) HEM300 (No HEA and HEB)

	$\phi_t P_n$ (yield) (kN)	$\phi_t P_n$ (fracture) (kN)	U	A_e (mm ²)
HEM300	6410.57	6379.72	0.74 (case2) 0.90 (case7)	23628.6
Select U as 0.90				
Block Shear	$\phi_t R_n$ (kN)	A_{gv} (mm ²)	A_{nv} (mm ²)	A_{nt} (mm ²)
HEM300	5068.44	31200	21060	6552

For 4 blocks

6)

P_u LRFD	580 kN	Select U as 0.657
P_a ASD	400 kN	
U	0.657 (case2) 0.600 (case8)	
A_e (mm ²)	2097.1	
$\phi_t P_n$ (yield)	861.3 > 580 kN	
$\frac{P_n}{\phi}$ (yield)	573.05 > 400 kN	
$\phi_t P_n$ (fracture)	676.33 > 580 kN	
$\frac{P_n}{\phi}$ (fracture)	450.89 > 400 kN	
ϕR_n (block shear)	453.06 < 580 kN	
$\frac{P_n}{\phi}$ (block shear)	302.04 < 400 kN	