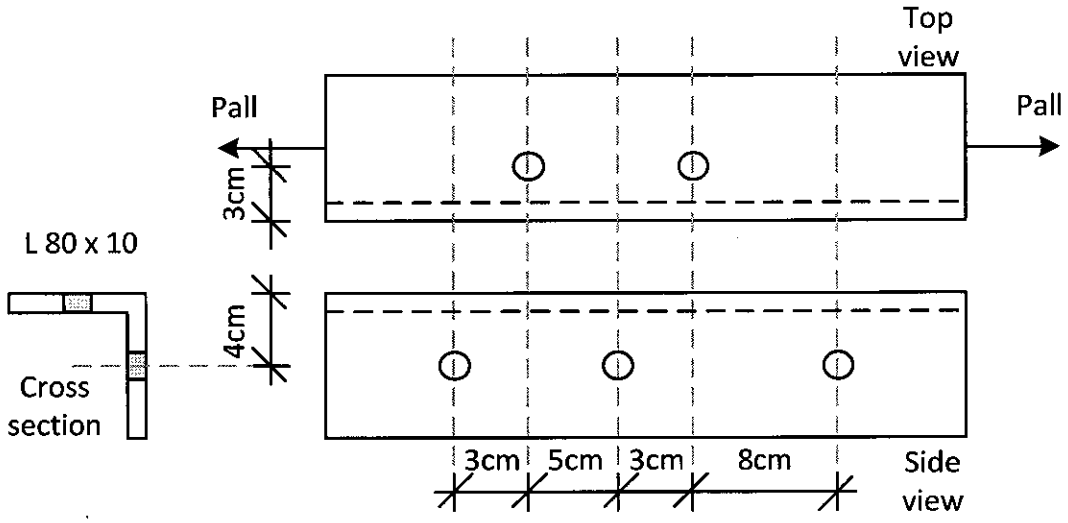
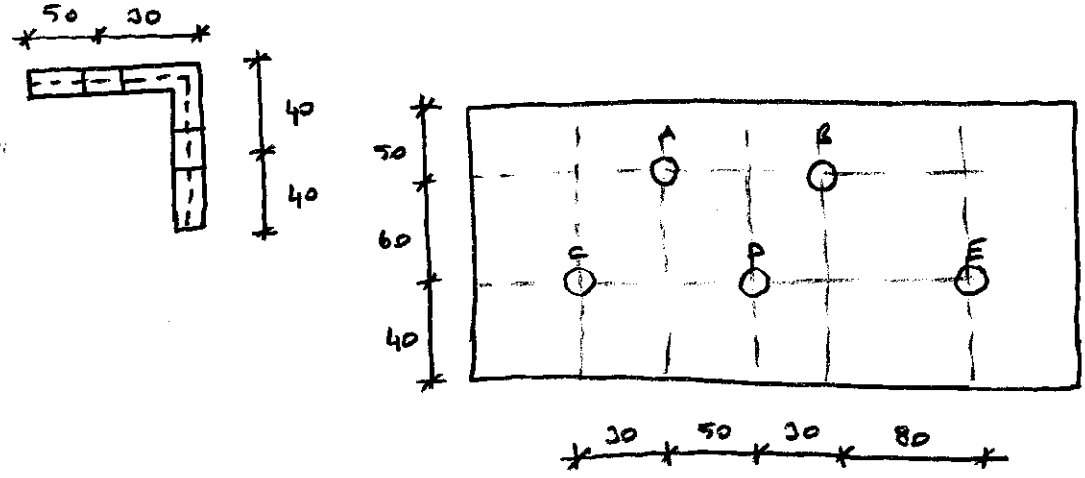
Dr. Oğuzhan Hasançebi Dr. Ahmet Türer	**Middle East Technical University** **Department of Civil Engineering** **CE388 – Fundamentals of Steel Design** TUTORIAL TEST 1 Duration: 50 min. 1 November 2013	Total	
ID No:	**Name:**	**Section:**	

1. Calculate allowable tensile force for the shown tension member according to TS 648 provisions. Use St37 Steel. Hole diameters are 26 mm.





$A_{gross} = 15\ cm^2 \rightarrow 0.85\,A_g = 12.75\ cm^2$

$A_c = 15 - 1 \times 2.6 \times 1 = 12.4\ cm^2$

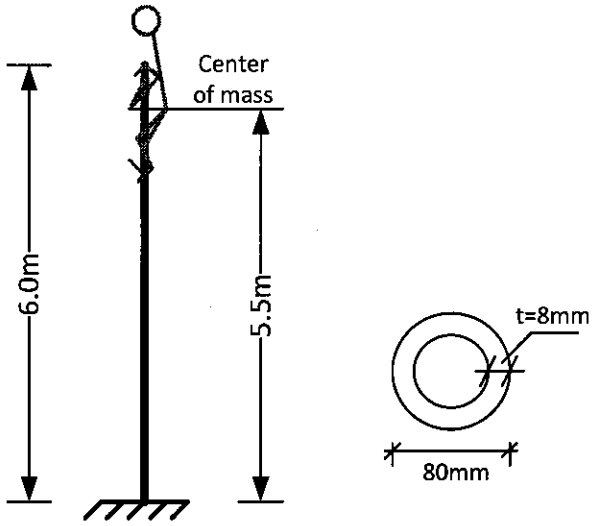
$A_{Ac} = 15 - 2 \times 2.6 \times 1 + \frac{3.0^2}{4 \times 6.0} \times 1 = 10.175\ cm^2$

$A_{net} = 10.175\ cm^2 < 0.85\,A_{gross} = 12.75\ cm^2$ ✓

$P_{all} = 1.44 \times 10.175 = 14.65\ t$

ID No:	Name:	Section:

2. Calculate the allowable weight of a person who will climb a 6m tall flag pole. Assume maximum height of the weight as 5.5m. Consider TS 648 provisions and use St37 Steel. Neglect self-weight of the pole.



$A = \pi(4^2 - 3.2^2) = 18.1\ cm^2$

$I = \frac{\pi}{4}(4^4 - 3.2^4) = 118.71\ cm^2$ } $i = 2.56\ cm$

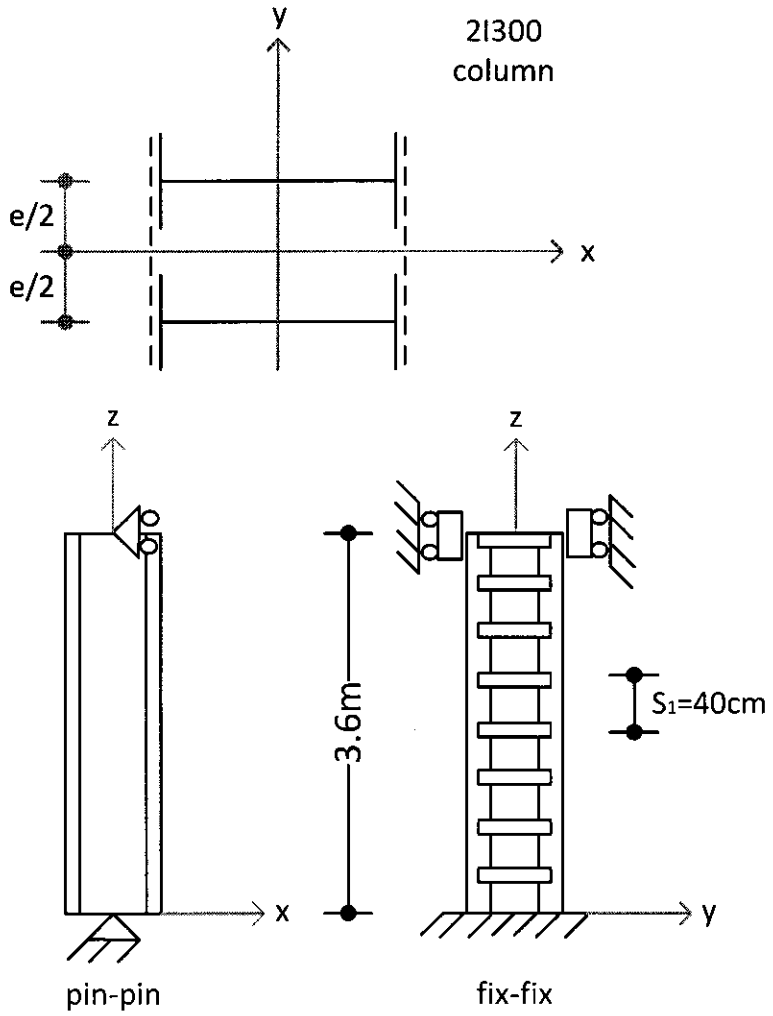
$\lambda = \frac{2.1 \times 550}{2.56} = 451 > \lambda_p = 131$

$\sigma_{cr} = \frac{2\pi^2 E}{5\lambda^2} = \frac{\pi^2 \times 2100}{2.5 \times 451^2} = 0.041\ t/cm^2$

$\rightarrow P = 0.041 \times 18.1 = 0.74^t$

Dr. Oğuzhan Hasançebi Dr. Ahmet Türer	**Middle East Technical University** **Department of Civil Engineering** **CE388 – Fundamentals of Steel Design** TUTORIAL TEST 2 Duration: 50 min. 22 November 2013	Total	
ID No:	**Name:**	**Section:**	

1. a) Calculate P_{all} for the shown column. Consider TS 648 provisions, use St37 Steel and take e=30cm.
b) Design battens.



a) I 300 $\Rightarrow$ $A = 69\ cm^2$ $I_x = 9800\ cm^4$ $i_x = 11.9\ cm$

$I_y = 451\ cm^4$ $i_y = 2.56\ cm$

$i_1 = 2.56\ cm$

$\lambda_x = \frac{1.0 \times 360}{11.9} = 30.25$ $\lambda_{yi} = \sqrt{\lambda_y^2 + \left(\frac{m}{2}\right)\lambda_1^2}$

$\lambda_y = \frac{360 \times 0.65}{\sqrt{2.56^2 + (30/2)^2}} = 15.38$

$\lambda_1 = \frac{40}{2.56} = 15.63 < 50$ ✓

$\lambda_{yi} = \sqrt{15.38^2 + \left(\frac{2}{2}\right) 15.63^2} = 21.93$

λ_x is more critical $\Rightarrow$ $\sigma_{bem} = 1.3195\ t/cm^2$ or $w = 1.09$

$$P_{all} = \frac{\sigma_{bem} \times A}{w} = \frac{1.44 \times 2 \times 69}{1.09} = 182.3\ t$$ ✓

b) $e = 30\ cm < 20 \times i_1 = 20 \times 2.56 = 51.2\ cm$ ✓

$$Q_i = \frac{F \times \sigma_{bem}}{80} = \frac{2 \times 69 \times 1.44}{80} = 2.484\ t$$

$$T_i = \frac{Q_i\ S_1}{e} = \frac{2.484 \times 40}{30} = 3.312\ t \rightarrow V = \frac{3.312}{2} = 1.656\ t/\text{batten}$$

shear stress: $\tau_{max} = \frac{3}{2}\ \frac{T}{bt} \Rightarrow 0.831 = \frac{3}{2} \times \frac{1.656}{bt} \Rightarrow bt = 2.99\ cm^2$

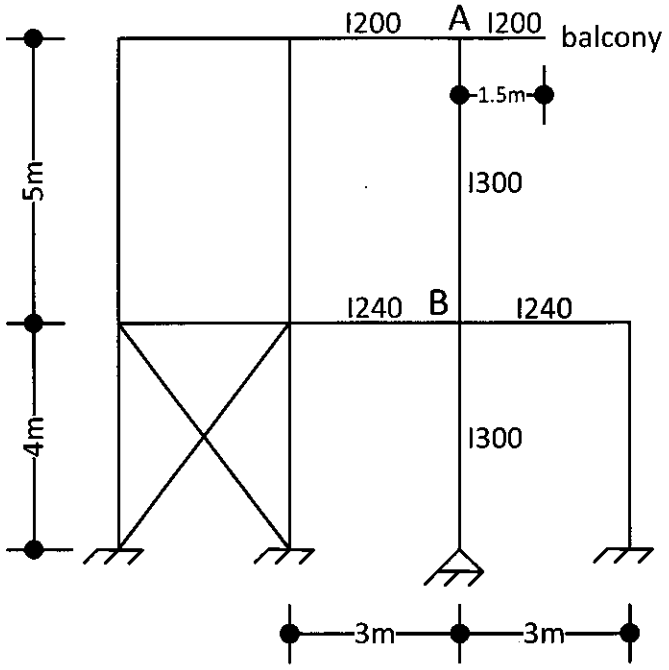
Axial stress: $M = 1.656 \times \frac{30}{2} = 24.84\ t\,cm$

$$\sigma_{bem} = \frac{Mc}{I} \Rightarrow \frac{24.84 \times 6}{tb^2} = 1.44 \Rightarrow tb^2 = 103.5\ cm^2$$

$t = 0.5\ cm$, $b = 15\ cm$ $\rightarrow$ ⌀ 150 × 5 ✓

ID No:	Name:	Section:

2. Calculate effective length of column AB located in 2D frame. All members (beams and columns) play in their strong axes.



	I_x	I_y
I 200	2140	117
I 240	4250	221
I 300	9800	451

$$G_A = \frac{9800/500}{2140/300 + 0} = 2.75$$

$$G_B = \frac{9800/500 + 9800/400}{2 \times 4250/300} = 1.56$$

$$k \cong 1.62$$