CE388 - FUNDAMENTALS OF STEEL DESIGN

2014-2015 Spring Term

Problem Set 2

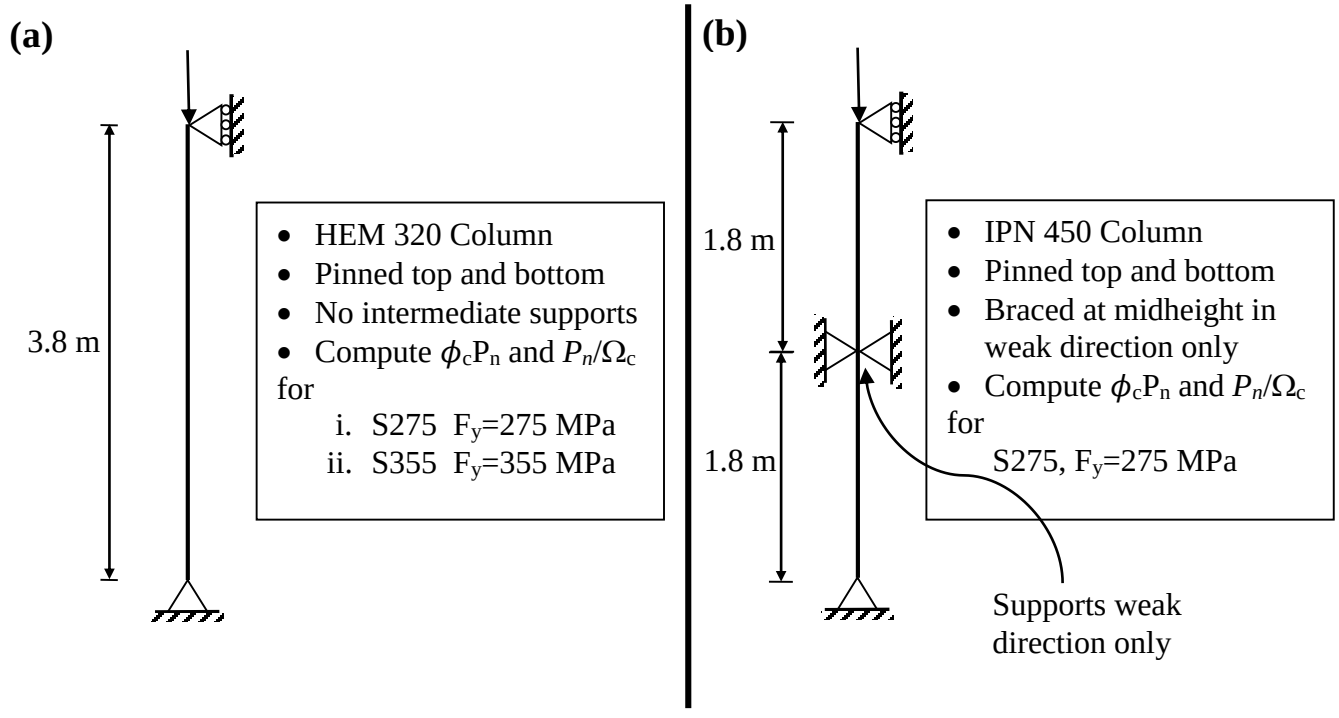
1) An HEM220 column is pinned at the top and bottom and has no intermediate supports. On the same graph neatly plot the following curves for this column :

- ***a)*** P_n vs L for F_y = 235 MPa
- ***b)*** P_n vs L for F_y = 275 MPa
- ***c)*** P_n vs L for F_y = 355 MPa
- ***d)*** P_E vs L

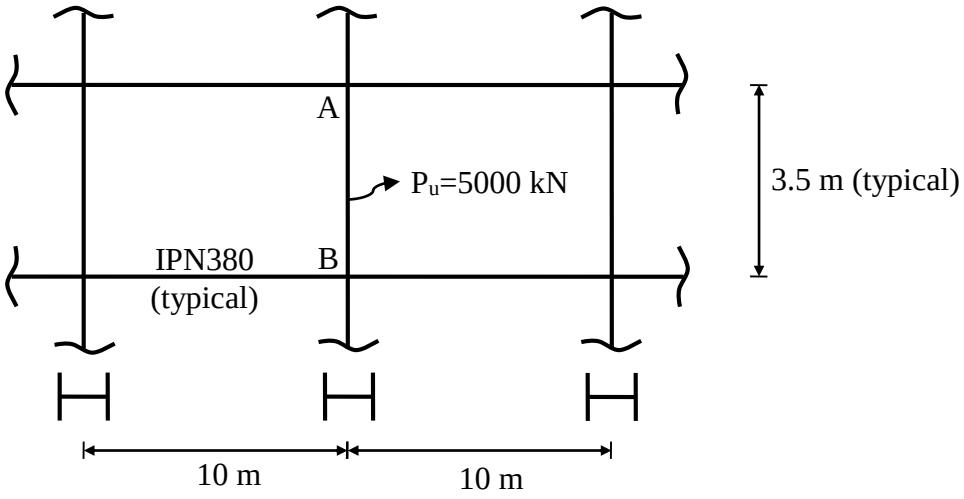
where L is the length of column, P_n is the nominal compressive strength per Chapter E of AISC Specification and P_E is the Euler buckling load $\left(P_E = \pi^2 \frac{EI}{L^2}\right)$.

Plot P on the vertical axis (0 to 550 kN) and L on the horizontal axis (0 to 15 m). For curves (a), (b), and (c), identify the regions of the curve corresponding to elastic and inelastic buckling.

2) Compute the design compressive strength ($\phi_c P_n$) and allowable compressive strength (P_n/Ω_c) for each of the following columns.



3) Shown below is a portion of a multi-story unbraced frame. All stories are 3.5 m high. All beams are IPN380. Out of plane, all columns are braced top and bottom. (K_y=1) Design column "AB". Choose the lightest I-shape of S275 (F_y=275 MPa). Assume the columns above and below are the same as "AB". Given axial load is factored load. (i.e. use LRFD). Try IPN, IPE, HEA, HEB, HEM, and HD sections.



4) Consider a pin ended I-section column constructed with this type of steel. Assuming that the material fully yields at 250 MPa (F_y=250 MPa), calculate the following:

a) Determine the initial elastic modulus (E) for this type of steel.

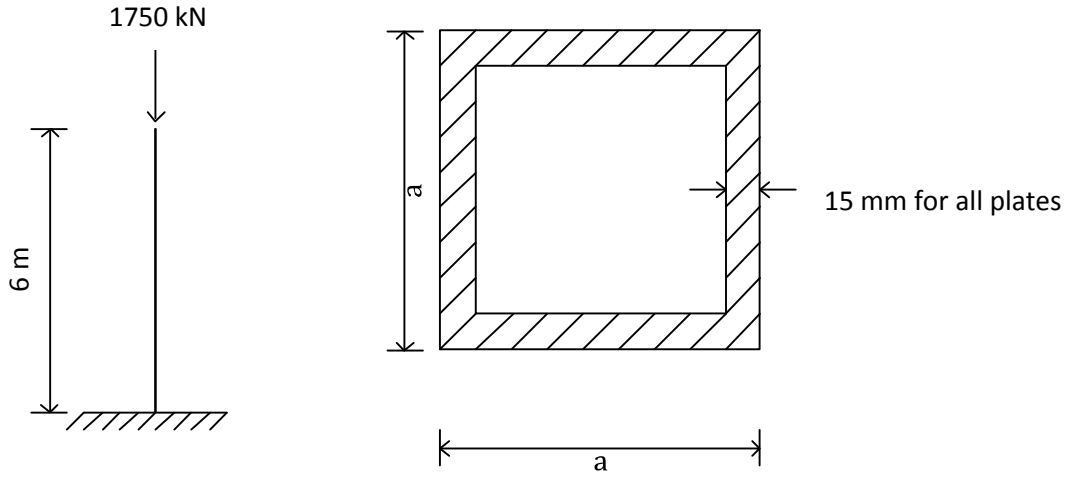
b) On a single graph plot normalized stress (critical stress divided by the yield stress) versus slenderness (L/r) for the following cases:

Case 1: Consider the elastic critical stress
Case 2: Consider the tangent modulus critical stress

Your (L/r) values should change between 80 and 300 for case 1 and between zero and 300 for case 2.

Strain	Stress (MPa)
0	0
0.0001	20
0.0002	40
0.0003	60
0.0004	80
0.0005	100
0.0006	119
0.0007	137
0.0008	154
0.0009	169
0.0010	183
0.0011	196
0.0012	207
0.0013	217
0.0014	226
0.0015	233
0.0016	239
0.0017	244
0.0018	247
0.0019	249
0.0020	250
0.0021	250
0.0022	250
0.0030	250

5) For the box column shown below determine the value of ‘’a’’ such that the column can safely carry an unfactored load of 1750kN according to ASD provisions. Use recommended K values. S275 Steel, F_y = 275MPa.



6) All columns HEB 650 and all beams HEA 500 (strong axis bending). Out of plane all columns are supported at story levels. Use K=1 out of plane. All members are S275 Steel F_y = 275MPa. Calculate design compressive strength ($\phi_c P_n$) and allowable compressive strengths (P_n/Ω_c) for P_1, P_2, P_3 and P_4 according to AISC specification. All beam-to-column connections are rigid except for one. Use recommended G factors for column bases.