CE388 - FUNDAMENTALS OF STEEL DESIGN

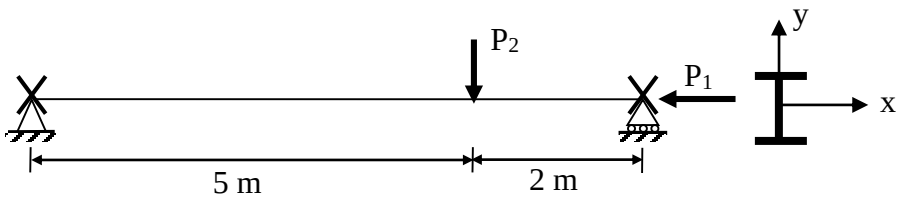
2014-2015 Spring Term

Problem Set 4

1) Determine if the beam is capable of safely carrying the applied loads. Use LRFD. Given loads were determined from LRFD load combinations. Note that there are lateral supports only at the ends.

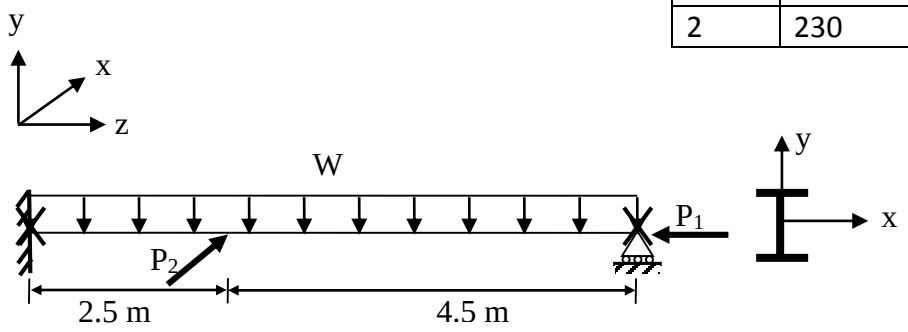
S275 Steel, IPE400

a)



Cases	P1 (kN)	P2 (kN)
1	60	130
2	230	130

b)



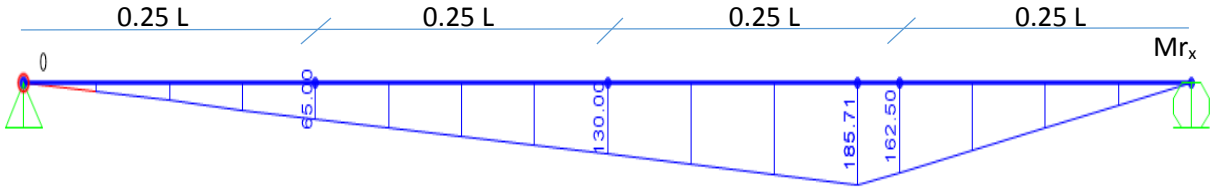
Cases	P1 (kN)	P2 (kN)	W (kN/m)
1	150	20	15
2	180	10	15

Note that W is acting in the negative y direction while P_2 is acting in positive x direction. Use theoretical K factors in calculation of P_c.

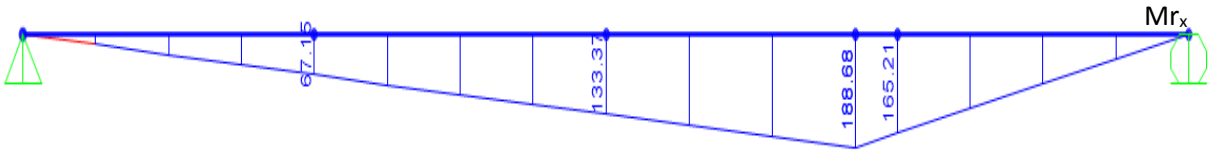
Moment Diagrams **(Units are all kNm)**

a)

Case 1:

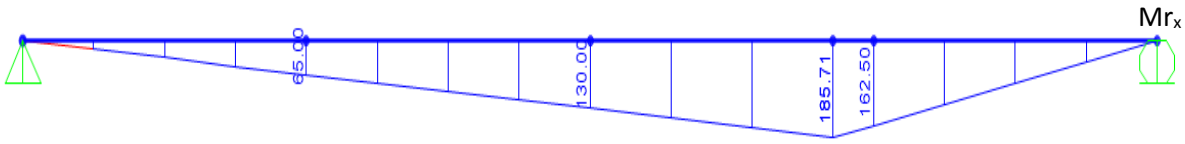


Moment Diagram (First Order Analysis)

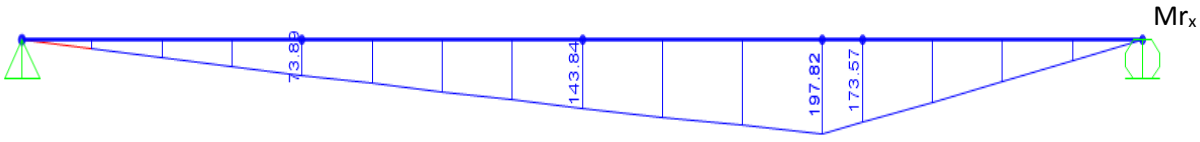


Moment Diagram (Second Order Analysis)

Case 2:



Moment Diagram (First Order Analysis)

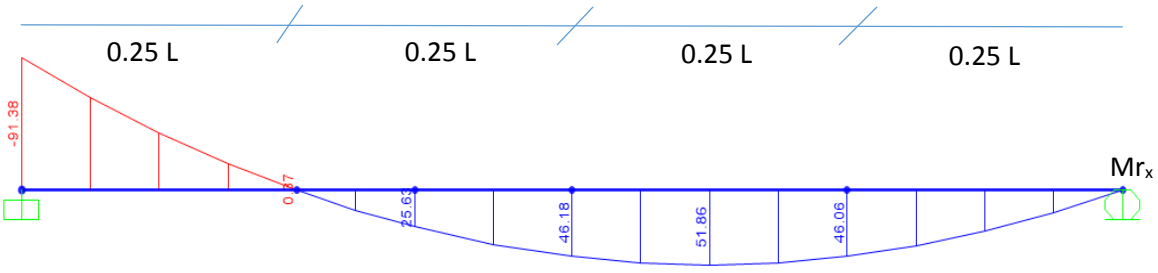


Moment Diagram (Second Order Analysis)

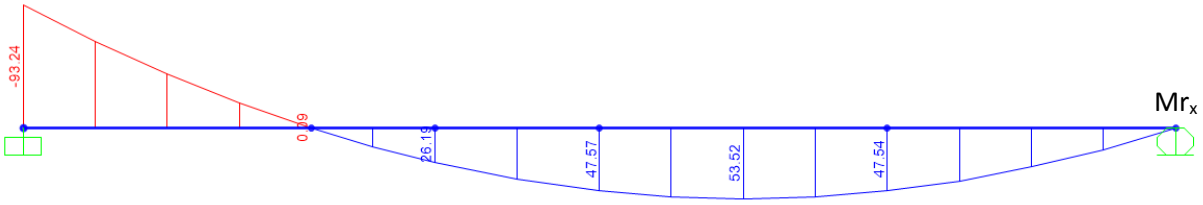
b)

Case 1:

Bending about Strong Axis:

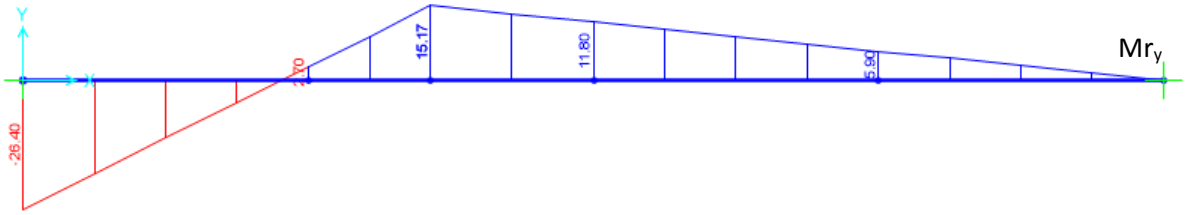


Moment Diagram (First Order Analysis)

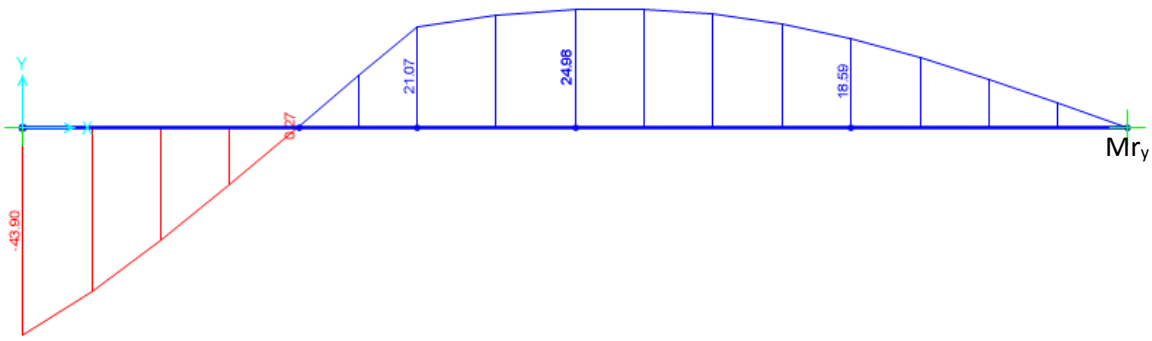


Moment Diagram (Second Order Analysis)

Bending about Weak Axis:



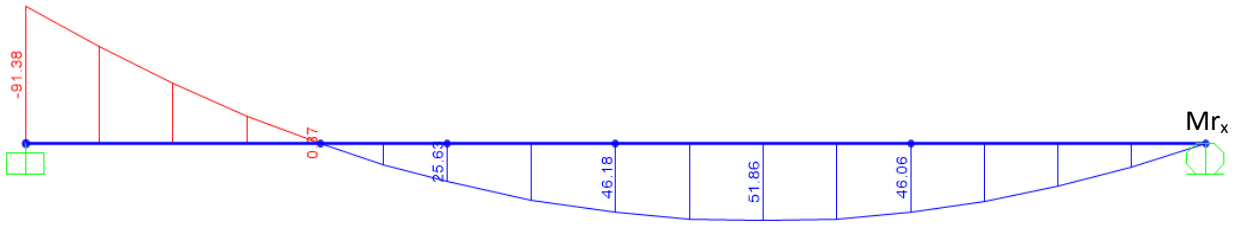
Moment Diagram (First Order Analysis)



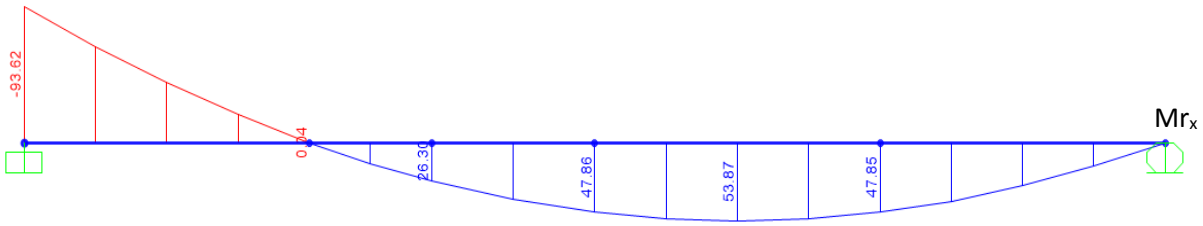
Moment Diagram (Second Order Analysis)

Case 2:

Bending about Strong Axis:

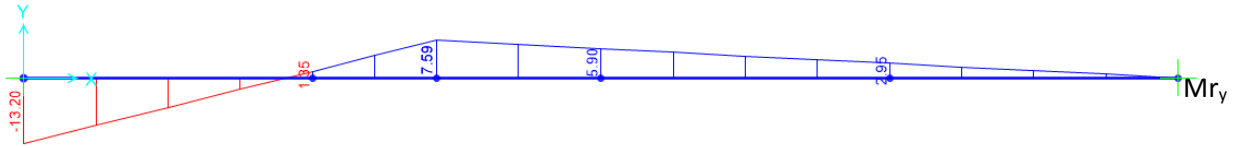


Moment Diagram (First Order Analysis)

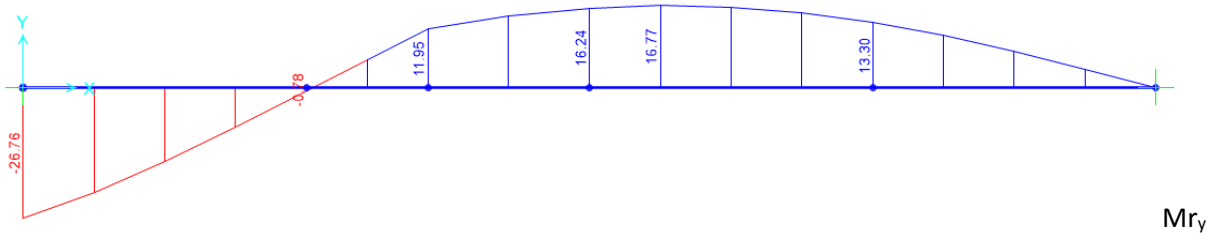


Moment Diagram (Second Order Analysis)

Bending about Weak Axis:



Moment Diagram (First Order Analysis)



Moment Diagram (Second Order Analysis)

2) Plot interaction surface for an HEB300 cross-section bend with respect to its strong axis. On vertical axis, plot P/P_y, on horizontal axis plot M/M_p. Draw P vs M plot also. S275 Steel

Consider the following cases – plot on the same graph.

a) $\frac{M}{M_p} = 1 - \left(\frac{P}{P_y}\right)^2 \frac{A^2}{4t_w z}$ for $\frac{P}{Py} \leq \frac{A_w}{A}$

$\frac{M}{M_p} = A\left(1 - \frac{P}{P_y}\right)\left[d - \frac{A}{2b_f}\left(1 - \frac{P}{P_y}\right)\right]\left(\frac{1}{2z}\right)$ for $\frac{P}{Py} > \frac{A_w}{A}$

Where A_w is area of web.

b) $\frac{M}{M_p} = 1.18\left(1 - \frac{P}{P_y}\right) \leq 1.0$

c) From AISC equations (H1-1a) (H1-1b)

Where $P_c = P_y$

$M_{cx} = M_p$