Arch324

STRUCTURES II

Winter 2026
Recitation

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Recitation Guidelines

Homework Problem

Lab

- Please complete the lab sheet during recitation and hand it in before leaving.
- Try to attend all sessions. Unexcused absences will **affect your grade** starting from the second missed class.

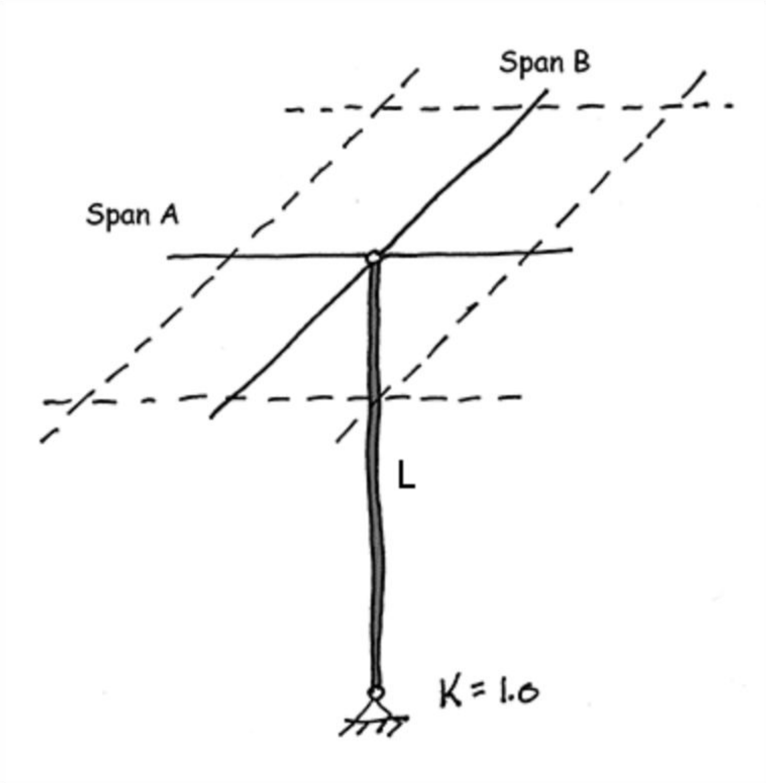
Analysis Example - HW6

6. Steel Column Analysis

For the given axially loaded steel W-section, determine the maximum floor live load capacity, P LL. Assume the column is pinned top and bottom: K = 1.0, and there is no intermediate bracing. Use AISC-LRFD steel equations to determine phi Pn and the load. E = 29000 ksi.

DATASET: 1 -2- -3-

W-section	W8X31
Fy	36 KSI
Span A	32 FT
Span B	30 FT
Height L	17 FT
Floor Dead Load	39 PSF



Analysis Example - HW6

9 Questions

#	Question	Your Response	
1	Total unfactored floor dead load on the column		KIPS
2	Controlling slenderness ratio		
3	Transition slenderness value, 4.71(E/Fy)^.5		
4	Euler stress, Fe		KSI
5	Critical stress, Fcr		KSI
6	Nominal strength, Pn		KIPS
7	Factored nominal strength, phi Pn		KIPS
8	UN-factored live load on column (actual total LL)		KIPS
9	Actual unfactored floor live load		PSF

Answer HW6

9 Questions

#	Question	Your Response	Correct Answer
1	Total unfactored floor dead load on the column	37.44 KIPS	37.44 KIPS
2	Controlling slenderness ratio	100.99	100.990099
3	Transition slenderness value, 4.71(E/Fy)^.5	133.68	133.680683
4	Euler stress, Fe	28.03 KSI	28.06339101 KSI
5	Critical stress, Fcr	21.03 KSI	21.04363936 KSI
6	Nominal strength, Pn	192 KIPS	192.1284274 KIPS
7	Factored nominal strength, phi Pn	172.8 KIPS	172.9155846 KIPS
8	UN-factored live load on column (actual total LL)	79.92 KIPS	79.9922404 KIPS
9	Actual unfactored floor live load	83.25 PSF	83.32525041 PSF

Analysis Example - HW6

Tributary Area: Span A×Span B=32×30=960 FT²

Q1

Floor DL → 39×960=37440   37440/1000=37.44 KIPS   **Q1**

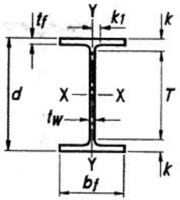


Table 1-1 (continued)
W-Shapes
Dimensions

Shape	Area, A	Depth, d		Web Thickness, t_w		$\frac{t_w}{2}$	Flange Width, b_f		Flange Thickness, t_f		Distance k k_{des}	k k_{det}	k_1	T	Workable Gage
	in.²	in.		in.		in.	in.		in.		in.	in.	in.	in.	in.
W8×67	19.7	9.00	9	0.570	9/16	5/16	8.28	8 1/4	0.935	15/16	1.33	1 5/8	15/16	5 3/4	5 1/2
×58	17.1	8.75	8 3/4	0.510	1/2	1/4	8.22	8 1/4	0.810	13/16	1.20	1 1/2	7/8	↓	↓
×48	14.1	8.50	8 1/2	0.400	3/8	3/16	8.11	8 1/8	0.685	11/16	1.08	1 3/8	13/16		
×40	11.7	8.25	8 1/4	0.360	3/8	3/16	8.07	8 1/8	0.560	9/16	0.954	1 1/4	13/16		
×35	10.3	8.12	8 1/8	0.310	5/16	3/16	8.02	8	0.495	1/2	0.889	1 3/16	13/16		
×31[f]	9.13	8.00	8	0.285	5/16	3/16	8.00	8	0.435	7/16	0.829	1 1/8	3/4		

Table 1-1 (continued)
W-Shapes
Properties

W8-W4

Nominal Wt.	Compact Section Criteria $\frac{b_f}{2t_f}$	$\frac{h}{t_w}$	Axis X-X I	S	r	Z	Axis Y-Y I	S	r	Z	r_{ts}	h_o	Torsional Properties J	C_w
lb/ft			in.⁴	in.³	in.	in.³	in.⁴	in.³	in.	in.³	in.	in.	in.⁴	in.⁶
67	4.43	11.1	272	60.4	3.72	70.1	88.6	21.4	2.12	32.7	2.43	8.07	5.05	1440
58	5.07	12.4	228	52.0	3.65	59.8	75.1	18.3	2.10	27.9	2.39	7.94	3.33	1180
48	5.92	15.9	184	43.2	3.61	49.0	60.9	15.0	2.08	22.9	2.35	7.82	1.96	931
40	7.21	17.6	146	35.5	3.53	39.8	49.1	12.2	2.04	18.5	2.31	7.69	1.12	726
35	8.10	20.5	127	31.2	3.51	34.7	42.6	10.6	2.03	16.1	2.28	7.63	0.769	619
31	9.19	22.3	110	27.5	3.47	30.4	37.1	9.27	2.02	14.1	2.26	7.57	0.536	530

From Table 1-1: W8×31 rx=3.47 in ry=2.02 in A=9.13 in²

Analysis Example - HW6

Q2-Q7

Euler equation:

$$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2}$$

Short & Intermediate Columns:

$$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y$$

$$P_n = F_{cr} A_g$$

$$\phi_c P_n = \phi_c F_{cr} A_g$$

Given: k=1, Height L=17 FT

Transfer to inch

$$\lambda_x = \frac{KL}{r_x} = \frac{1 \times 17 \times 12}{3.47} = 58.79 < 200$$

Maximum

Q2 $$\lambda_y = \frac{KL}{r_y} = \frac{1 \times 17 \times 12}{2.02} = 100.99 < 200 \ \checkmark$$

Q3 $$4.71\sqrt{\frac{E}{F_y}} = 4.71\sqrt{\frac{29000}{36}} = 133.68$$

Q4 $$F_e = \frac{\pi^2 E}{\left(\frac{KL}{r}\right)^2} = \frac{(3.14)^2 \cdot 29000}{(100.99)^2} = 28.03 \text{ KSI}$$

Q5 $$F_{cr} = \left[0.658^{\frac{F_y}{F_e}}\right] F_y = \left[0.658^{\frac{36}{28.03}}\right] \cdot 36 = 21.03 \text{ KSI}$$

A area from Table 1-1

Q6 $$P_n = F_{cr} \cdot A = 21.03 \times 9.13 = 192.0039 \text{ KIPS}$$

Q7 $$\phi P_n = 0.9 \times 192.0039 = 172.80 \text{ KIPS}$$

Analysis Example - HW6

Q8-Q9

Q7

$$P_u = 1.2\,P_D + 1.6\,P_L = 1.2 \times 37.44 + 1.6\,P_L \le \phi P_n = 172.8$$

Q1=PD

Q8 $$\longrightarrow P_L = \frac{\phi P_n - 1.2 P_D}{1.6} = \frac{172.8 - 1.2 \times 37.44}{1.6} = 79.92 \text{ KIPS}$$

Q9 $$\frac{P_L}{\text{Tributary Area}} = \frac{79.92 \times 1000}{960} = 83.25 \text{ PSF}$$

Transfer to LB