

ENDS 231. Assignment #11

Date: 11/15/07, due 11/27/07

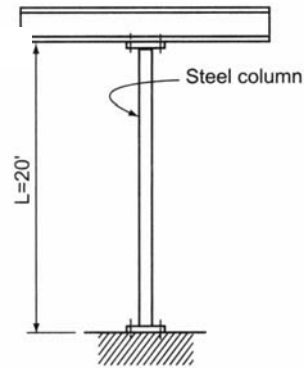
Pass-fail work

Problems: from Onouye, Chapter 10.

Note: Problems marked with a * have been altered with respect to the problem stated in the text.

(5%) *Use A992 steel: $F_y = 50$ ksi, $E = 30,000$ ksi,
 Also select the column using LRFD design method and the column chart. $\gamma_D = 1.2$, $\gamma_L = 1.6$ (LRFD)

(30%)* 10.3.9 What is the most economical W8 (W200) column for Problem 10.3.8 to support a load of 46 k dead and 70 k live and a length of $L = 20$ ft. Assume $F_y = 50$ ksi and $K = 1$.
 (steel column analysis – allowable stress)

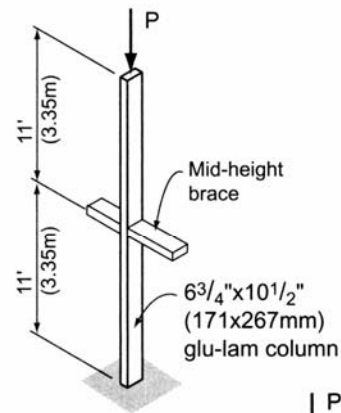


Partial answers to check with:

ASD: $A_{req'd} \geq 10.82 \text{ in}^2$ with $F_a = 10.72$,

LRFD: $P_u = 167 \text{ k}$, $\phi_c P_n = \text{___} \text{ k}$

(30%) 10.4.3 Determine the axial load capacity of a $6\frac{3}{4}'' \times 10\frac{1}{2}''$ glu-lam column with an area $A = 70.88 \text{ in}^2$, assuming lateral bracing about the weak axis at the midheight level. Assume pin connections top and bottom in both directions of buckling. ($F_c = 1650$ psi; $E = 1.8 \times 10^6$ psi)
 (wood column analysis)



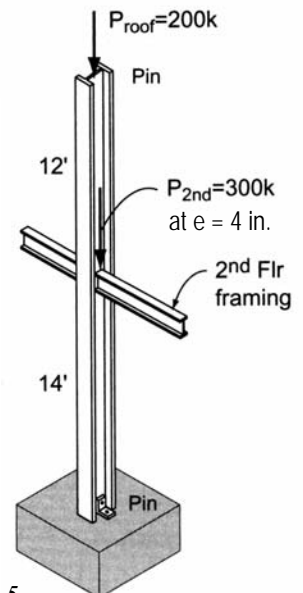
Problem 10.4.3

(35%)*The column has been changed to a W14 x 109. Use A992 steel ($F_y = 50$ ksi, $F_b = 33$ ksi, $E = 30 \times 10^3$ ksi). And assume that the second-floor load is applied at an eccentricity (e) of 4 inches in the direction of the framing.

*10.3.5 A two-story, continuous W14 x 109 column supports a roof load of 200 kips and an intermediate (second floor) load of 300 kips. Assume the top and bottom have pin connections. Is the column section shown adequate? (beam-column analysis)

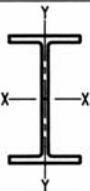
Partial answers to check with:

$kL/r_x = 50.2$, $kL/r_y = 45$, $f_b = 19.6 \text{ ksi}$, interaction value: 1.09



Problem 10.3.5

MORE NEXT PAGE



COLUMNS
W shapes
Design axial strength in kips ($\phi = 0.85$)

$F_y = 36$ ksi
 $F_y = 50$ ksi

Designation	W8												W8					
	Wt./ft		67		58		48		40		35		31		28		24	
	F_y	36	50	36	50	36	50	36	50	36	50	36	50	36	50	36	50	
Effective length KL (ft) with respect to least radius of gyration r_y	0	603	837	523	727	431	599	358	497	315	438	279	388	252	351	217	301	
	6	567	770	492	667	405	549	335	454	295	399	261	354	228	303	195	260	
	7	555	746	481	647	396	532	327	439	288	386	255	342	219	288	188	247	
	8	541	721	469	624	386	513	319	423	280	372	248	329	210	271	180	232	
	9	526	693	455	599	374	492	309	405	272	356	240	315	200	253	171	217	
	10	509	662	441	572	362	470	298	386	262	339	232	300	189	235	162	200	
	11	492	631	425	544	349	446	287	366	252	321	223	284	178	216	152	184	
	12	473	598	409	515	335	422	275	345	242	303	214	268	167	197	142	168	
	13	453	564	391	485	321	397	263	324	231	284	204	251	155	178	132	151	
	14	433	529	374	455	306	372	251	303	220	265	194	234	143	160	122	136	
	15	412	494	355	425	291	347	238	281	208	246	184	217	132	142	112	121	
	16	391	460	337	394	276	321	225	260	197	228	174	200	121	125	102	106	
	17	370	425	318	365	260	297	211	239	185	209	163	184	110	111	93	94	
	18	349	392	300	335	245	272	198	219	174	191	153	168	99	99	84	84	
	19	328	359	281	307	229	249	185	199	162	174	143	153	89	89	75	75	
	20	307	328	263	279	214	226	173	180	151	157	133	138	80	80	68	68	
	22	266	271	228	231	185	187	148	149	129	130	114	114	66	66	56	56	
	24	228	228	194	194	157	157	125	125	109	109	96	96	56	56	47	47	
	26	194	194	165	165	134	134	107	107	93	93	82	82	51	51	44	44	
	28	167	167	143	143	115	115	92	92	80	80	70	70	47	47	40	40	
30	146	146	124	124	100	100	80	80	70	70	61	61	44	44				
32	128	128	109	109	88	88	70	70	61	61	54	54						
33	120	120	103	103	83	83	66	66	58	58	51	51						
34	113	113	97	97	78	78	62	62										
35	107	107	91	91														
Properties													2.17	1.87	2.07	1.71		
u	2.03	1.96	2	1.93	1.97	1.87	1.93	1.8	1.89	1.74	1.85	1.65	48	67	39	54		
P_{wo} (kips)	147	205	120	167	86	119	69	96	56	78	48	67	10	14	9	12		
P_{wi} (kips/in.)	21	28	18	26	14	20	13	18	11	16	10	14	81	95	52	61		
P_{wb} (kips)	648	764	464	547	224	264	163	192	104	123	81	95	44	61	32	45		
P_b (kips)	177	246	133	185	95	132	64	88	50	69	38	53	6.8	5.7	6.7	5.7		
L_p (ft)	8.8	7.5	8.8	7.4	8.7	7.4	8.5	7.2	8.5	7.2	8.4	7.1	27.2	18.8	24.3	17.2		
L_r (ft)	64.0	41.9	55.9	36.8	46.7	31.1	39.1	26.5	35.1	24.1	32.0	22.4						
A (in. ²)	19.7		17.1		14.1		11.7		10.3		9.13		8.25		7.08			
I_x (in. ⁴)	272		228		184		146		127		110		98.0		82.8			
I_y (in. ⁴)	88.6		75.1		60.9		49.1		42.6		37.1		21.7		18.3			
r_y (in.)	2.12		2.10		2.08		2.04		2.03		2.02		1.62		1.61			
Ratio r_x / r_y	1.75		1.74		1.74		1.73		1.73		1.72		2.13		2.12			
$P_{ax} (KL)^2 / 10^4$	7800		6520		5260		4170		3630		3150		2810		2370			
$P_{ay} (KL)^2 / 10^4$	2530		2160		1750		1390		1210		1070		620		525			

Note: Heavy line indicates $K1 / r$ of 200. Compact; see discussion preceding column indicates $K1 / r$ of 200.