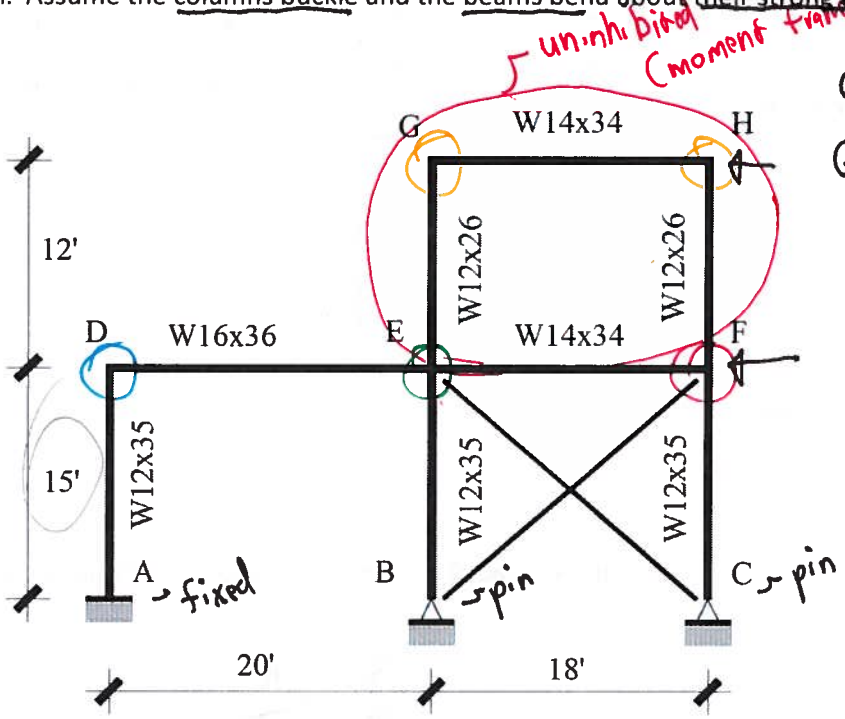
CVEN 446

Relative Stiffness Example

For the building frame shown, determine the effective column length factor, *K*, the slenderness ratio, *KL/r* for each column. Assume the columns buckle and the beams bend about their strong axis.

$$G = \frac{\sum\left(\frac{EI_c}{L_c}\right)}{\sum\left(\frac{EI_G}{L_G}\right)} = \frac{\sum\left(\frac{I_c}{L_c}\right)}{\sum\left(\frac{I_G}{L_G}\right)}$$



$G_{pin} = 10$

$G_{fixed} = 1.0$

W12X35: $I_x = 285\ in^4$, $r_x = 5.25\ in$

W12X26: $I_x = 204\ in^4$; $r_x = 5.17\ in$

W16X36: $I_x = 448\ in^4$

W14X34: $I_x = 340\ in^4$

$$G_B = \frac{285/15'}{448\ in^4/20'} = 0.85$$

$$G_E = \frac{285/15' + 204/12'}{448/20' + 340/18'} = 0.87$$

Column	G_{Top}	G_{Bot}	*K*		*KL/r*
AD	0.85	1.0	0.76	sidesway inhibited	$0.76(15')(12)/5.25\ in = 26.1$
BE	0.87	10	0.85	"	
CF	1.9	10	0.90	"	
EG	0.9	0.87	1.29	uninhibited	$1.29(12')(12)/5.17 = 35.9$
FH	0.9	1.9	1.44	"	

$$G_F = \frac{285/15' + 204/12'}{340/18'} = 1.9$$

$$G_G = G_H = \frac{204/12'}{340/18'} = 0.9$$

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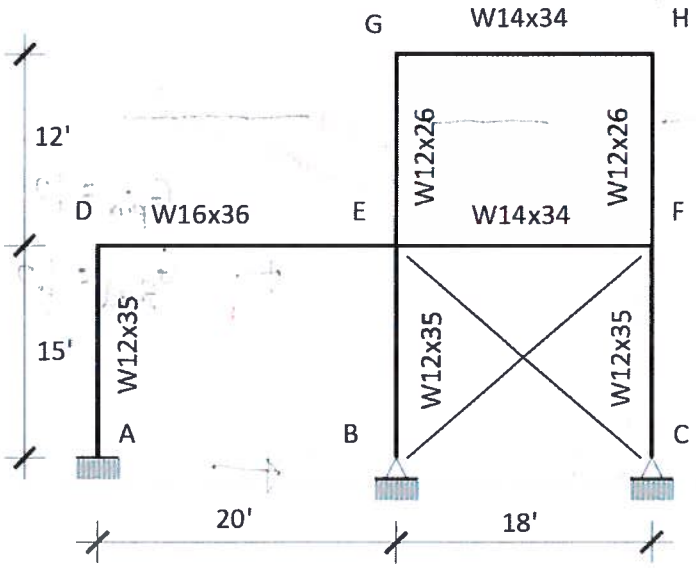
Note that the diagonal bracing inhibits sidesway only in the first story.



W12x26: I_x = 204 in.^{4}, r_x = 5.17 in.^{2}

W12x35: I_x = 285 in.^{4}, r_x = 5.25 in.^{2}

W14x34: I_x = 340 in.^{4}

W16x36: I_x = 448 in.^{4}

G_A = 1.0 (fixed support), G_B = G_C = 10.0 (pinned supports)

$$G_D = \frac{\frac{285}{15}}{\frac{448}{20}} = 0.85$$

$$G_E = \frac{\frac{285}{15}+\frac{204}{12}}{\frac{448}{20}+\frac{340}{18}} = 0.87$$

$$G_F = \frac{\frac{285}{15}+\frac{204}{12}}{\frac{340}{18}} = 1.91$$

$$G_G = G_H = \frac{\frac{204}{12}}{\frac{340}{18}} = 0.90$$

Column	G_{Top}	G_{Bot}	K		KL/r
AD	0.85	1.0	0.76	Braced	0.76(15)(12)/5.25 = 26.1
BE	0.87	10.0	0.85	Braced	0.85(15)(12)/5.25 = 29.1
CF	1.91	10.0	0.90	Braced	0.90(15)(12)/5.25 = 30.9
EG	0.90	0.87	1.29	Unbraced	1.29(12)(12)/5.17 = 35.9
FH	0.90	1.91	1.43	Unbraced	1.43(12)(12)/5.17 = 39.8