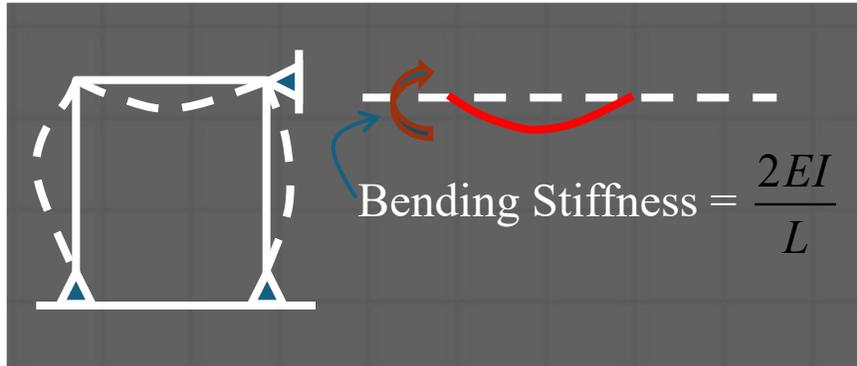


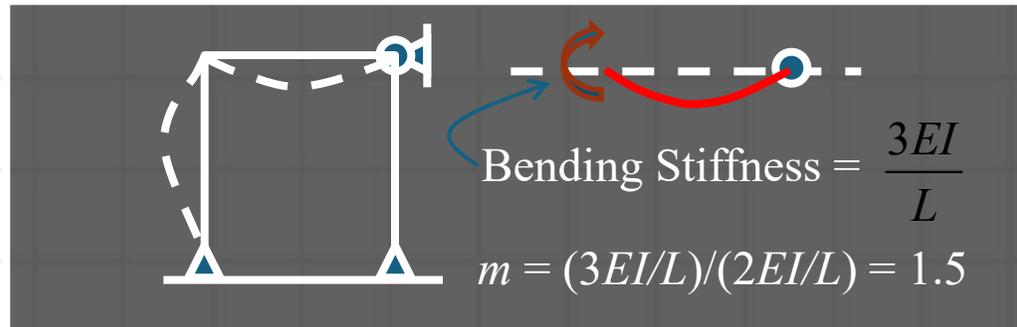
# Alignment Charts

<http://www.ecs.umass.edu/cee542/>

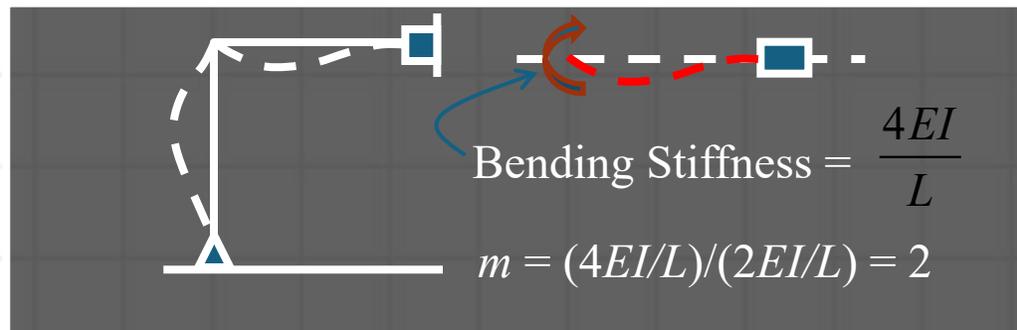


Side-sway Inhibited (Braced)  
Assumption: single curvature  
bending of girder.

$$G = \frac{\sum \left( \frac{EI}{L} \right)_{\text{columns}}}{\sum \left( m \frac{EI}{L} \right)_{\text{girders}}}$$



Far end pinned



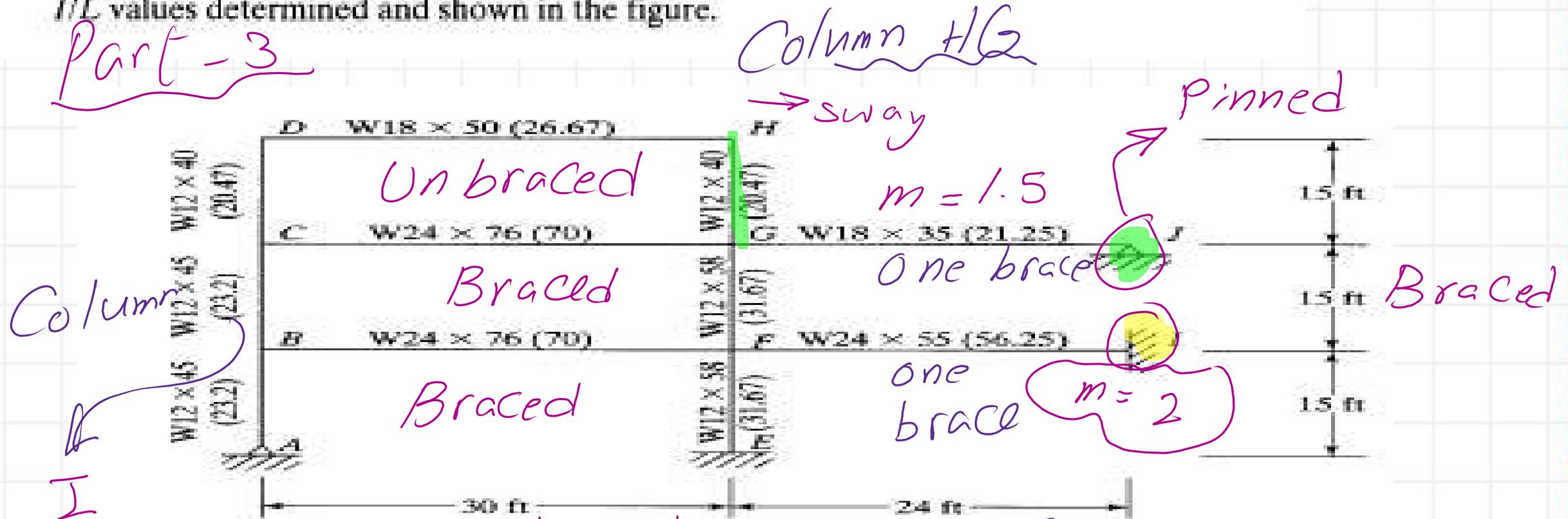
Far end  
fixed

Example 7-2

→ *K* Factors? Structural steel

Determine *K* factors for each of the columns of the frame shown in Fig. 7.6. Here, design *W* sections have been tentatively selected for each of the members of the frame and their *I/L* values determined and shown in the figure.

Part - 3



$\frac{I}{L}$

$$G_H = \frac{\sum EI/L \text{ Columns}}{\sum EI/L \text{ Girders}} = \frac{20.47}{26.67} = 0.7675$$

$$G_G = \frac{(20.47 + 31.67)}{(70 + 1.5(21.25))} = 0.5118$$

$G=1$   
For Fixed  
support

$G=10$   
For hinged  
support

$G_H = 0.7675$   
 $G_G = 0.5118$

$K = 1.2$

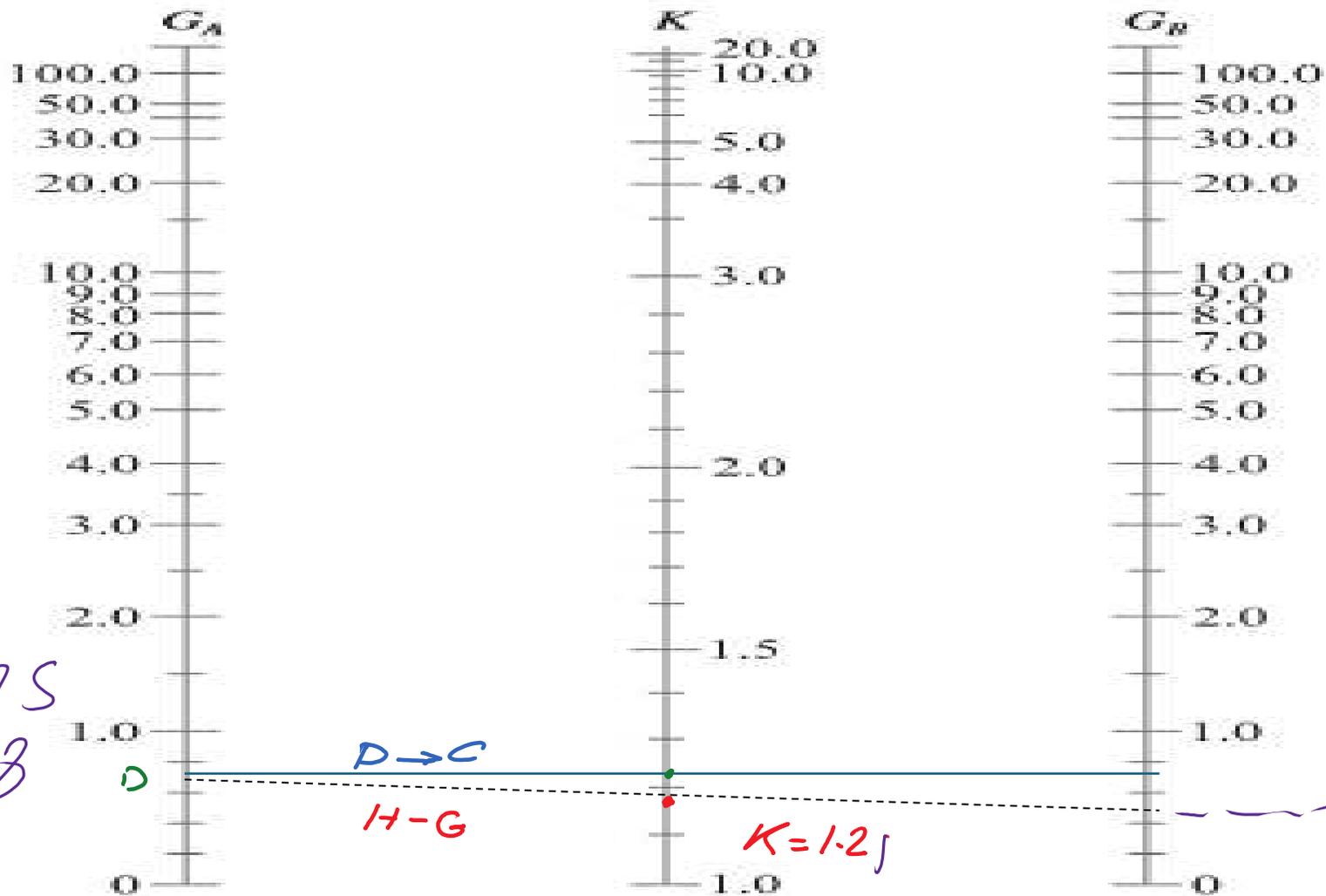


Figure 5-10 Alignment chart: Sidesway uninhibited (i.e., moment frames). [1]

Prepared by Eng. Maged Kamel.

Column HG

— Uninhibited

For sidesway uninhibited,

$$K = \sqrt{\frac{1.6G_A G_B + 4(G_A + G_B) + 7.5}{G_A + G_B + 7.5}}$$

$$G_H = 0.7675$$

$$G_G = 0.5118$$

$$K = \sqrt{\frac{1.6(G_H)(G_G) + 4(G_H + G_G) + 7.5}{G_H + G_G + 7.5}}$$

$$K_{HG} = 1.2283 \sim \text{close to } k = 1.2 \text{ from Chart}$$

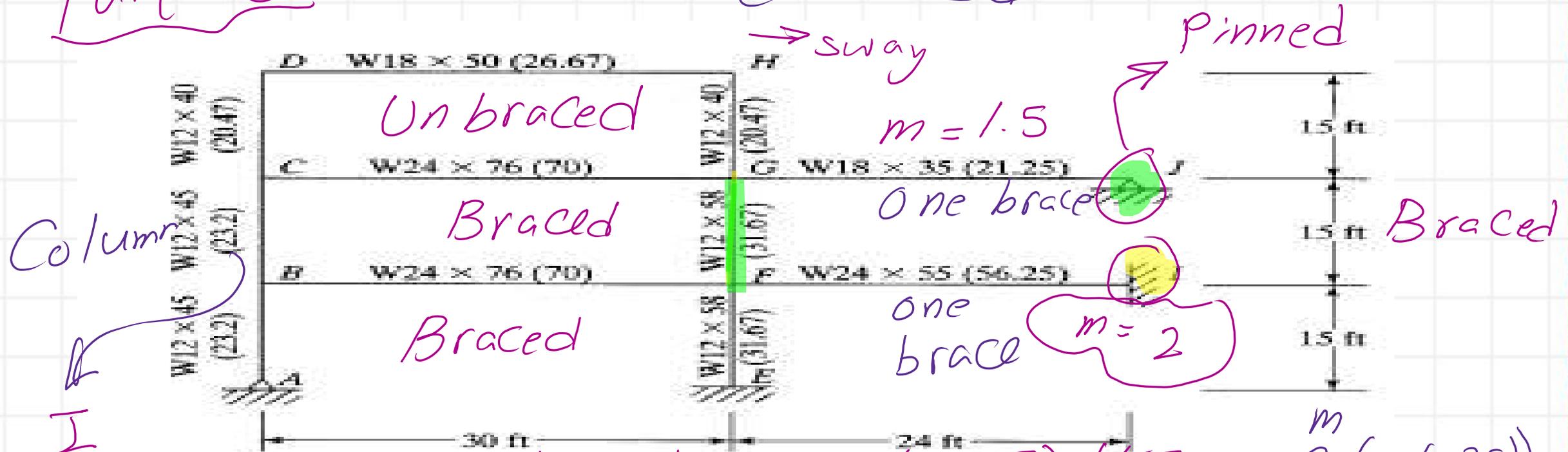
Example 7-2

→ K Factors ?

Structural steel

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, design W sections have been tentatively selected for each of the members of the frame and their I/L values determined and shown in the figure.

Part-3



I/L

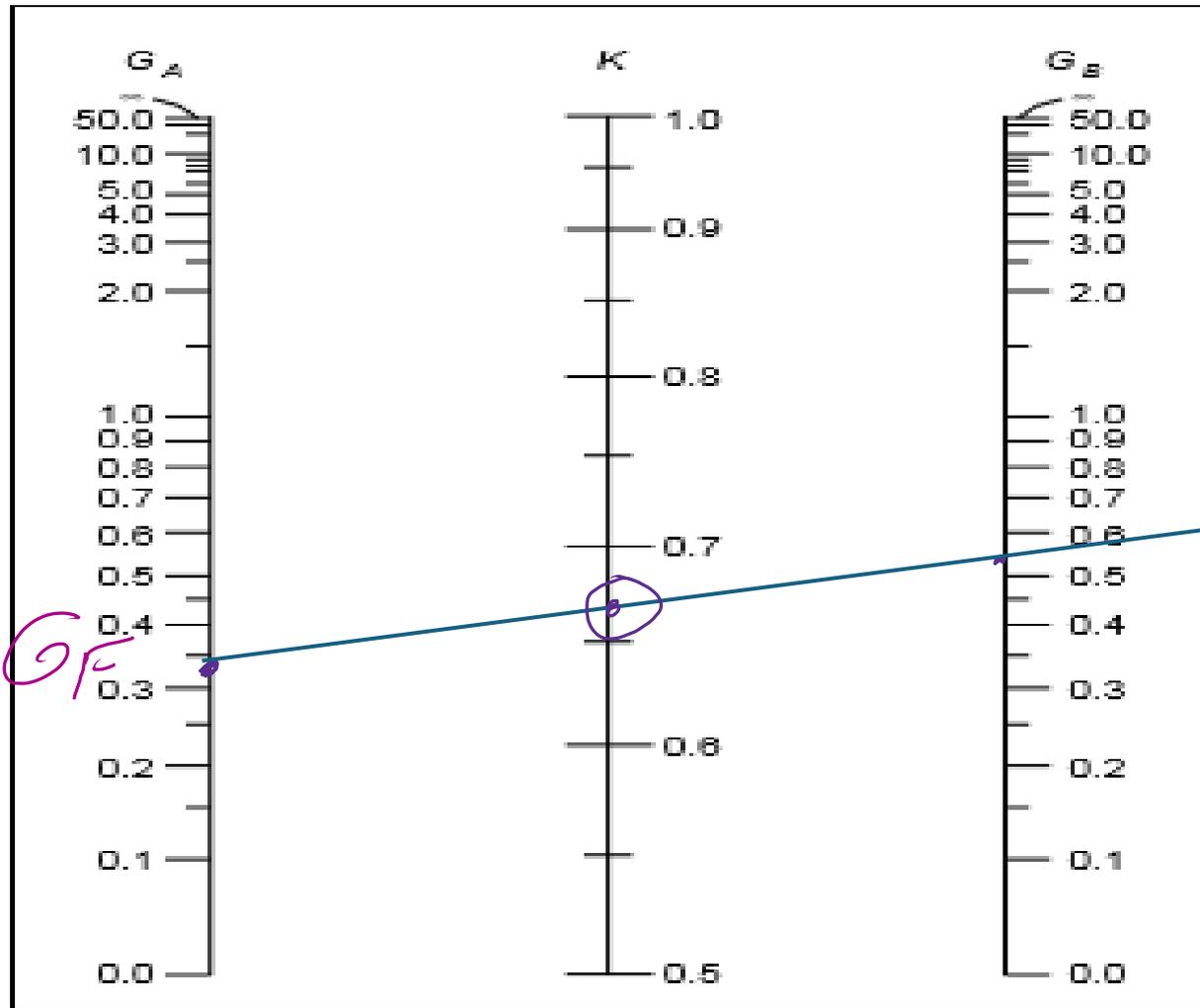
$$G_F = \frac{\sum EI/L \text{ Columns}}{\sum EI/L \text{ Girders}} = \frac{2(31.67)}{(70 + 2(56.25))} = 0.3470$$

$$G_G = \frac{(20.47 + 31.67)}{(70 + 1.5(21.25))} = 0.5118$$

Braced

AISC Figure C-A-7.1

Alignment chart, sidesway inhibited (braced frame)



Column GF

$$G_F = 0.370$$

$$G_G = 0.5118$$

$$K = 0.67$$

GG → Braced

since 1966. For sidesway inhibited,

$$K = \frac{3G_A G_B + 1.4(G_A + G_B) + 0.64}{3G_A G_B + 2(G_A + G_B) + 1.28} \quad (5.13)$$

For sidesway uninhibited,

$$K = \sqrt{\frac{1.6G_A G_B + 4(G_A + G_B) + 7.5}{G_A + G_B + 7.5}} \quad (5.14)$$

$$K = 0.6728 \approx 0.67$$

Example 7-2

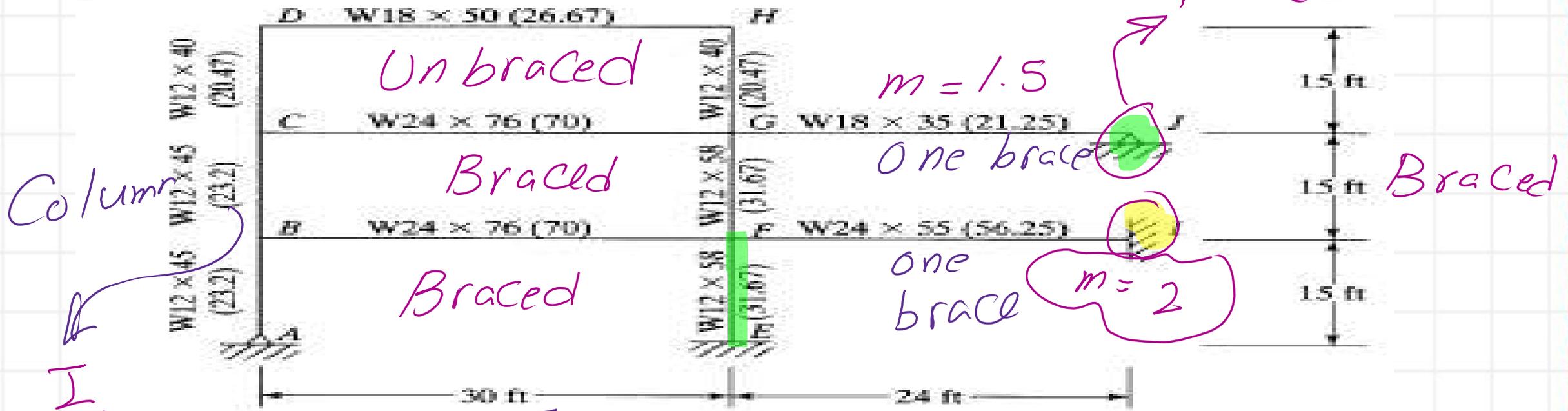
→ K Factors ?

Structural steel

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, design W sections have been tentatively selected for each of the members of the frame and their I/L values determined and shown in the figure.

Part - 3

Column-FE



$\frac{I}{L}$

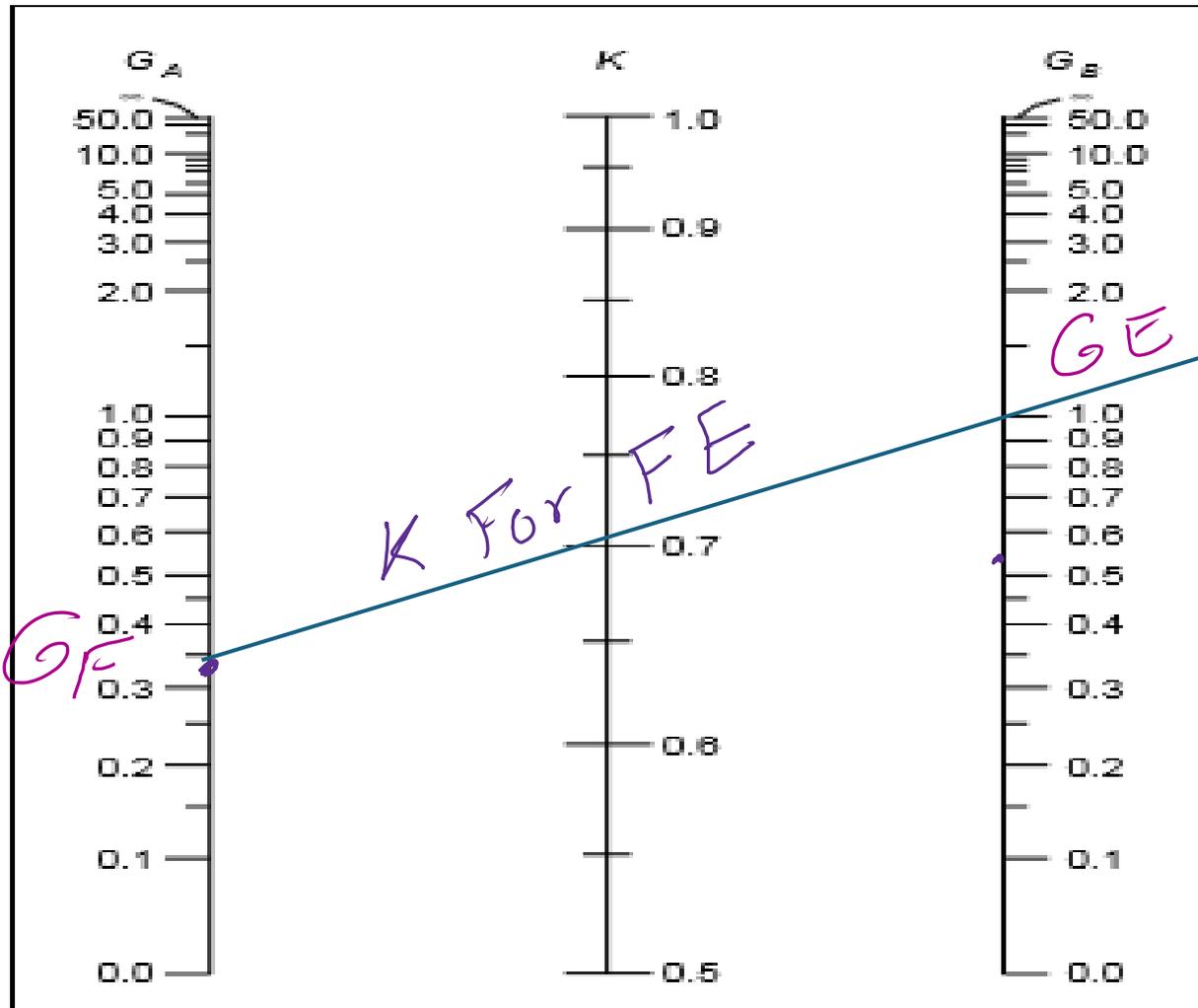
$G_E = 1.0$  Fixed base

$G_F = 0.370$  Estimated earlier

Braced

AISC Figure C-A-7.1

Alignment chart, sidesway inhibited (braced frame)



Steel Construction Manual, 14th ed., AISC, 2011.

Column FE

$$G_F = 0.370$$

$$G_E = 1.00$$

$$K = 0.71$$

since 1966. For sidesway inhibited,

$$K = \frac{3G_A G_B + 1.4(G_A + G_B) + 0.64}{3G_A G_B + 2(G_A + G_B) + 1.28} \quad (5.13)$$

For sidesway uninhibited,

$$K = \sqrt{\frac{1.6G_A G_B + 4(G_A + G_B) + 7.5}{G_A + G_B + 7.5}} \quad (5.14)$$

↙

$$K = 0.7112$$

→  
0.71

↗ Braced

# Author's Solution Part-1

**Solution.** First, the  $G$  factors are computed for each joint in the frame. In this calculation, the  $I/L$  values for members  $FI$  and  $GJ$  are multiplied by the appropriate factors from Table 7.1.

1. For member  $FI$ , the  $I/L$  value is multiplied by 2.0, because its far end is fixed and there is no sidesway on that level.
2. For member,  $GJ$ ,  $I/L$  is multiplied by 1.5, because its far end is pinned and there is no sidesway on that level.

$$G_A = 10 \text{ as described in Section 7.2, Pinned Column}$$

$$G_B = \frac{23.2 + 23.2}{70} = 0.663$$

$$G_C = \frac{23.2 + 20.47}{70} = 0.624$$

## Part - 2

$$G_D = \frac{20.47}{26.67} = 0.768$$

$G_E = 1.0$  as described in Section 7.2, Fixed Column

$$G_F = \frac{31.67 + 31.67}{70 + (2.0)(56.25)} = 0.347$$

$$G_G = \frac{31.67 + 20.47}{70 + (1.5)(21.25)} = 0.512$$

$$G_H = \frac{20.47}{26.67} = 0.768$$

Finally, the  $K$  factors are selected from the appropriate alignment chart of Fig. 7.2.

Column	$G$ Factors	Chart used	$K$ Factors
$AB$	10 and 0.663	7.2 (a) no sidesway	0.83
$BC$	0.663 and 0.624	7.2 (a) no sidesway	0.72
$CD$	0.624 and 0.768	7.2 (b) has sidesway	1.23
$EF$	1.0 and 0.347	7.2 (a) no sidesway	0.71
$FG$	0.347 and 0.512	7.2 (a) no sidesway	0.67
$GH$	0.512 and 0.768	7.2 (b) has sidesway	1.21

Prepared by Eng. Maged Kamel.

**Prepared by Eng.Maged Kamel.**