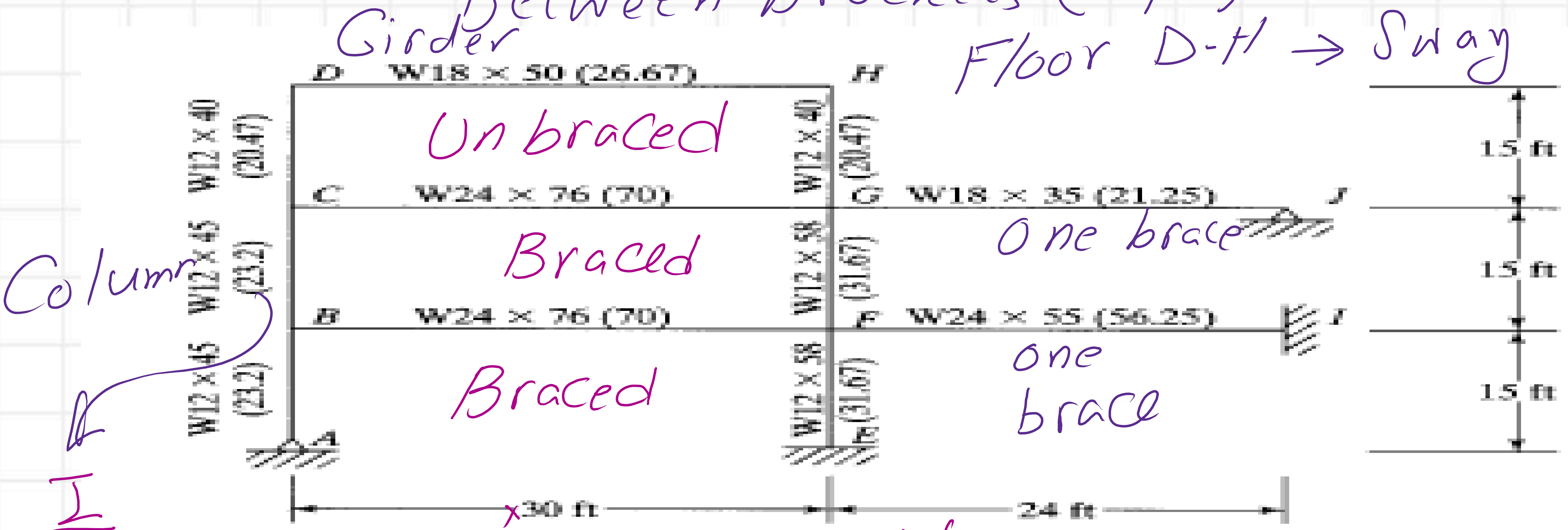
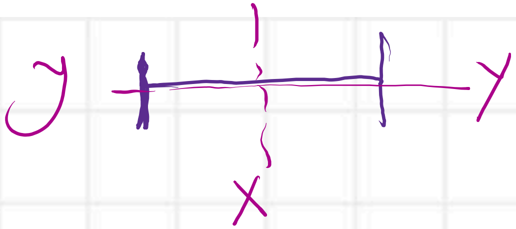
Example 7-2 ↗ K Factors ? Structural steel design

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, 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.

Between brackets (I/L) ratios





W section orientation

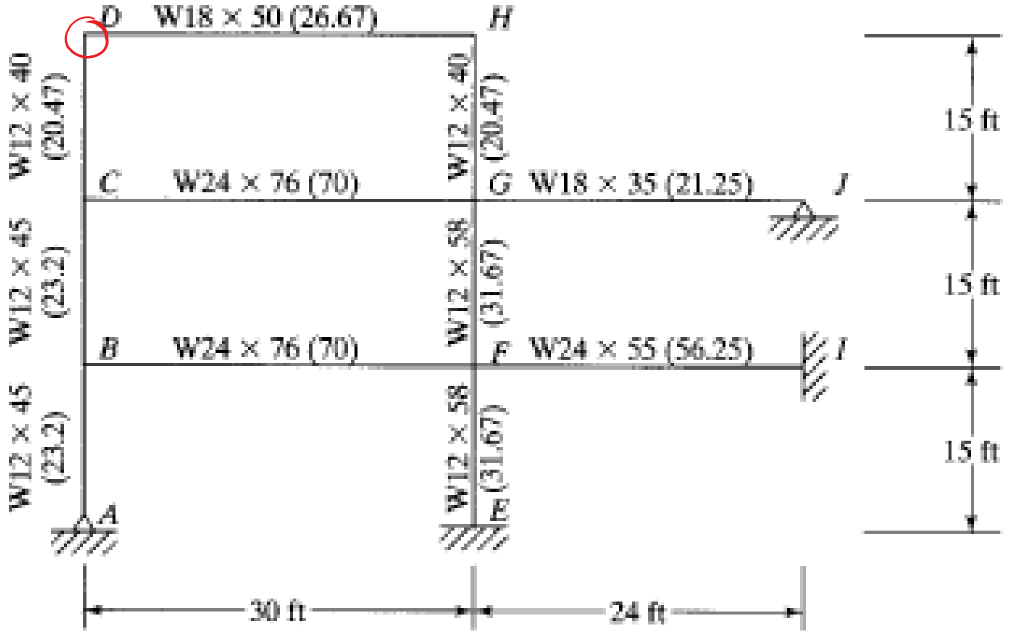
major x – x
Minor y – y

Prepared by Eng.Maged Kamel.

Example 7-2

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, 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.

Solution



Number of Joints = 10

2 movements
1 rotation } 3(10) = 30

Deduct

2 Fixed 2(3)
2 Hinged 2(2) } = 10

6 Columns
5 Girders } ⇒ 11

Final rotations & Translations
= 30 − 21 = 9

We have 8 rotations at (A, B, C, G, D, H, F, J)

One Translation at H

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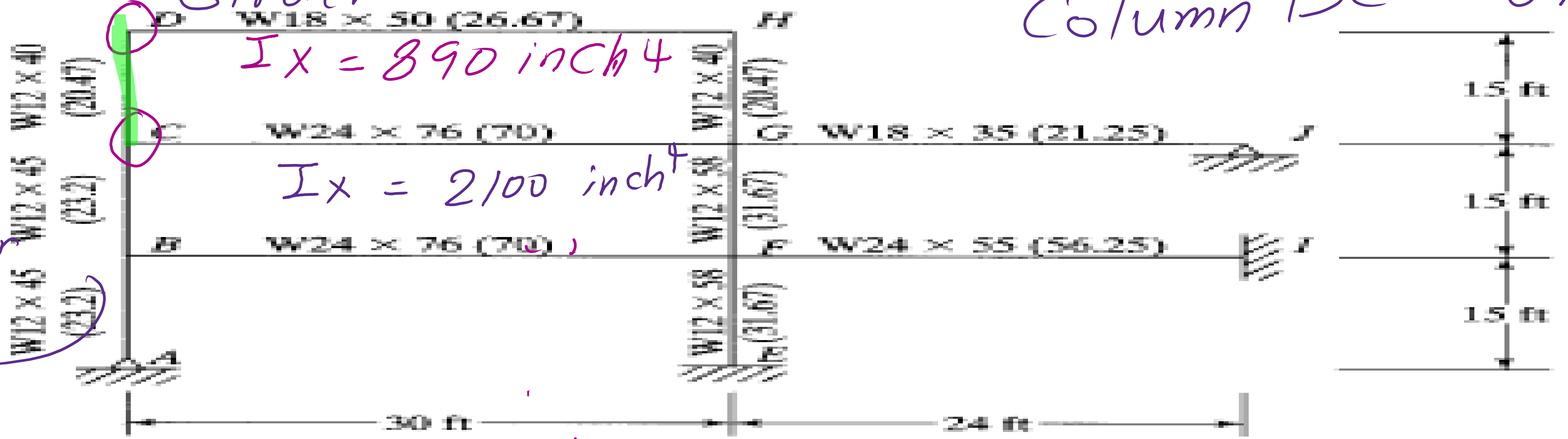
Example 7-2 → K Factors ? Structural steel design

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, 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.

Between brackets (I/L) ratios

Girder

Column DC - Unbraced Frame



Column

$\frac{I}{L}$ Alignment chart

$$G_D = \frac{\Sigma (I/L) \text{ Column DC}}{\Sigma I/L \text{ Girder DH}} = \frac{20.47}{26.67} = 0.7675$$

$$G_C = \frac{(\frac{I}{L}) CD + \frac{I}{L} CB}{\Sigma I/L \text{ Girder CG}} = \frac{23.2 + 20.47}{70} = 0.6238$$

$G=1$
For Fixed support

$G=10$
for hinged Support

$\rightarrow G_D = 0.7675$

$G_c = 0.6238$

Unbraced Frame

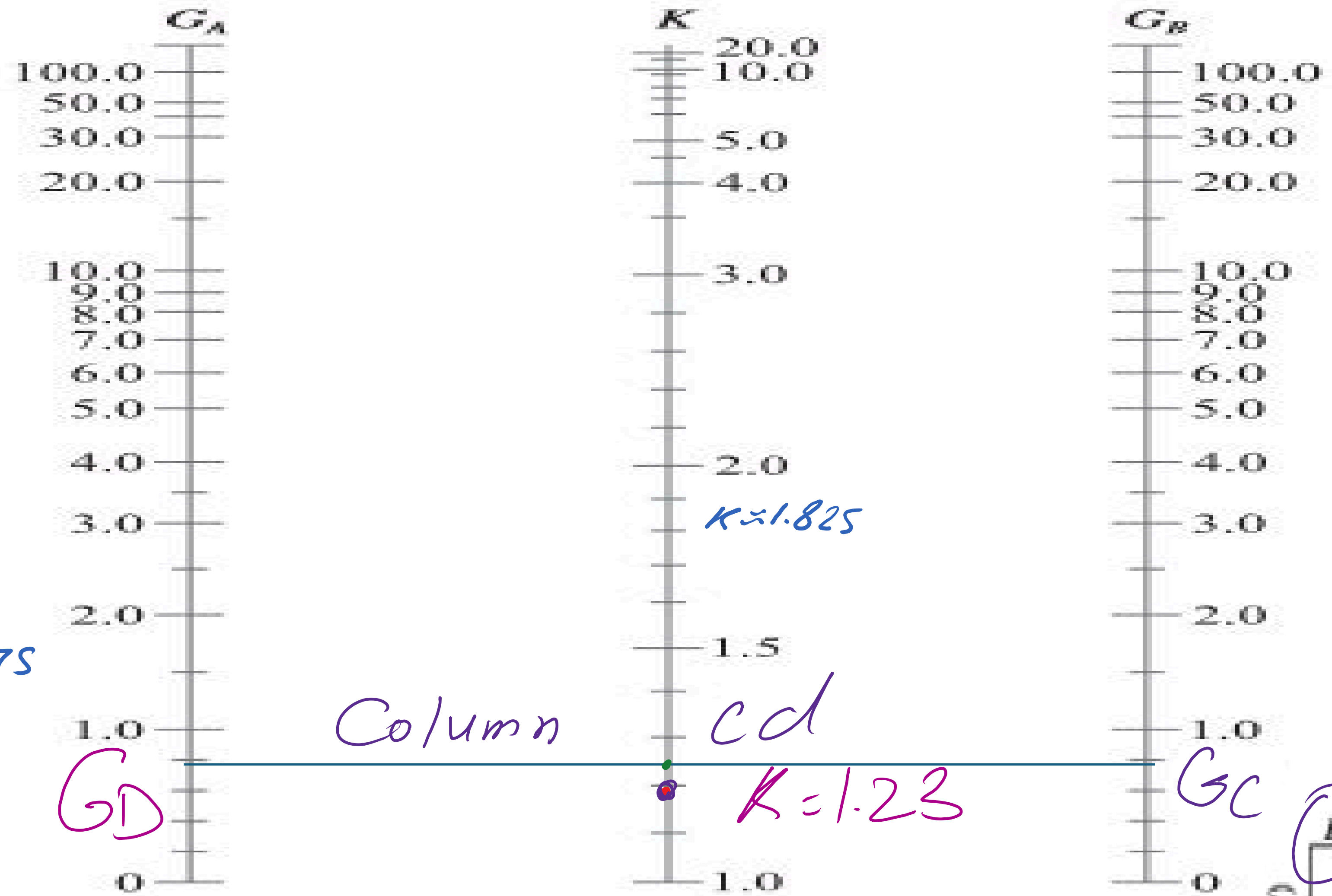
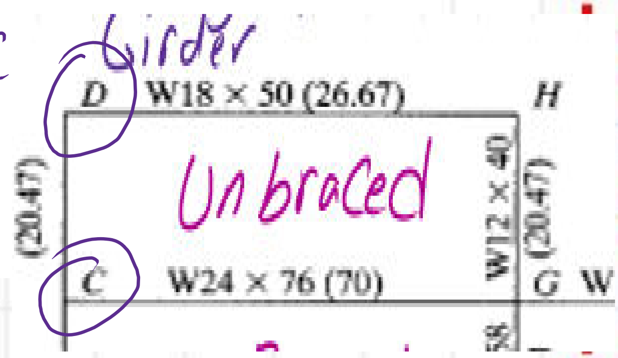


Figure 5-10 Alignment chart: Sidesway uninhibited (i.e., moment frames). [1]



Column-DC Uninhibited

For sidesway uninhibited,

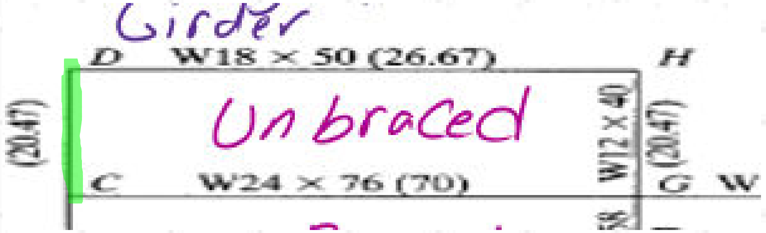
$$K = \sqrt{\frac{1.6G_AG_B + 4(G_A + G_B) + 7.5}{G_A + G_B + 7.5}}$$

$G_C = 0.6238$

$G_D = 0.7675$

$$K = \sqrt{\frac{1.6(0.6238)(0.7625) + 4(0.6238 + 0.7675) + 7.5}{0.6238 + 0.7675 + 7.5}}$$

$K = 1.2473$ ~ Close to $k = 1.23$ from Chart



Example 7-2

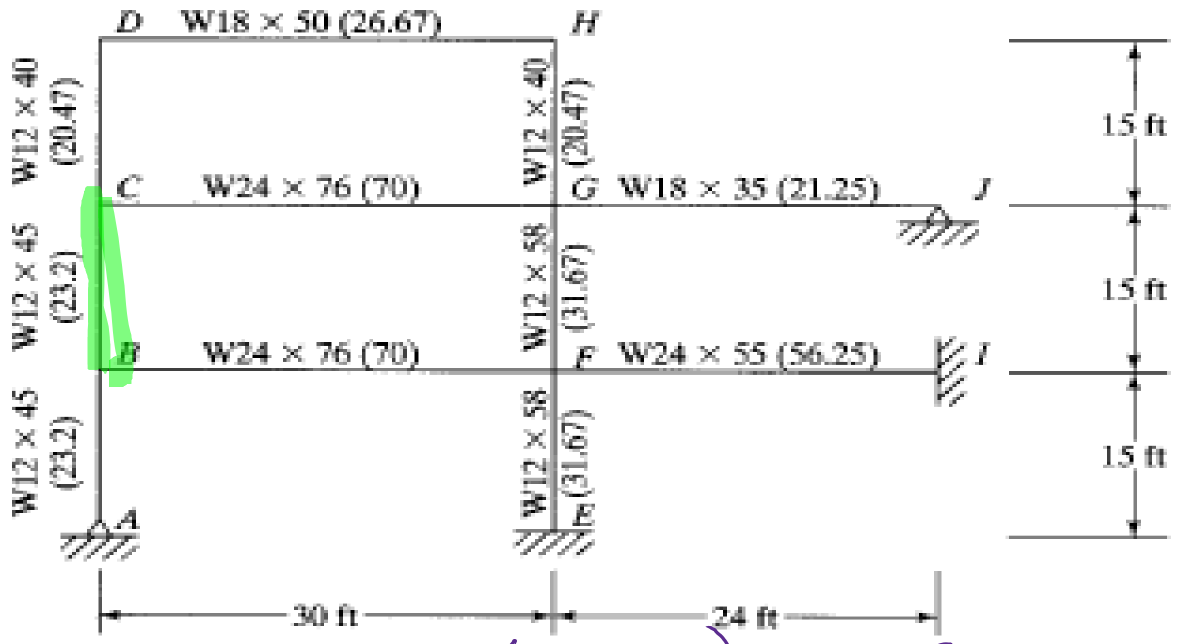
Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, W sections have been tentatively selected for each of the members of the frame and their I/L values determined and shown in the figure.

Column CB _ Braced Frame

Two Column joined at C

DC & CB

CB, BA Joined at B



Sum EI Columns / Sum Girders

$$G_C = \frac{(20.47) + (23.2)}{70} = 0.6239$$

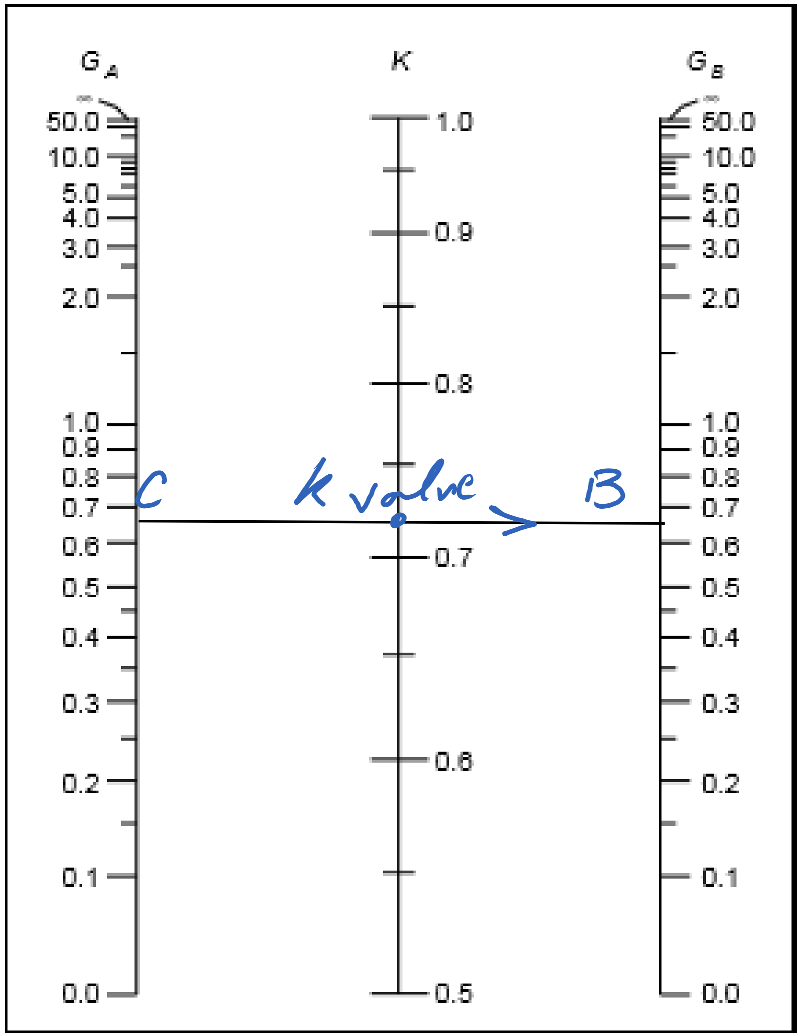
$$G_B = 2(23.2)/70 = 0.6629$$

Prepared by Eng.Maged Kamel.

inhibited

AISC Figure C-A-7.1

Alignment chart, sidesway inhibited (braced frame)



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

since 1966. For sidesway inhibited,

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

For sidesway uninhibited,

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

$G_C = 0.6239$

$G_B = 0.6629$

K value $= 0.72$

From French Equation

$$K = \frac{3(0.6235)(0.6629) + 1.4(0.6235 + 0.6629) + 0.64}{3(0.6235)(0.6629) + 2(0.6235 + 0.6629) + 1.28}$$

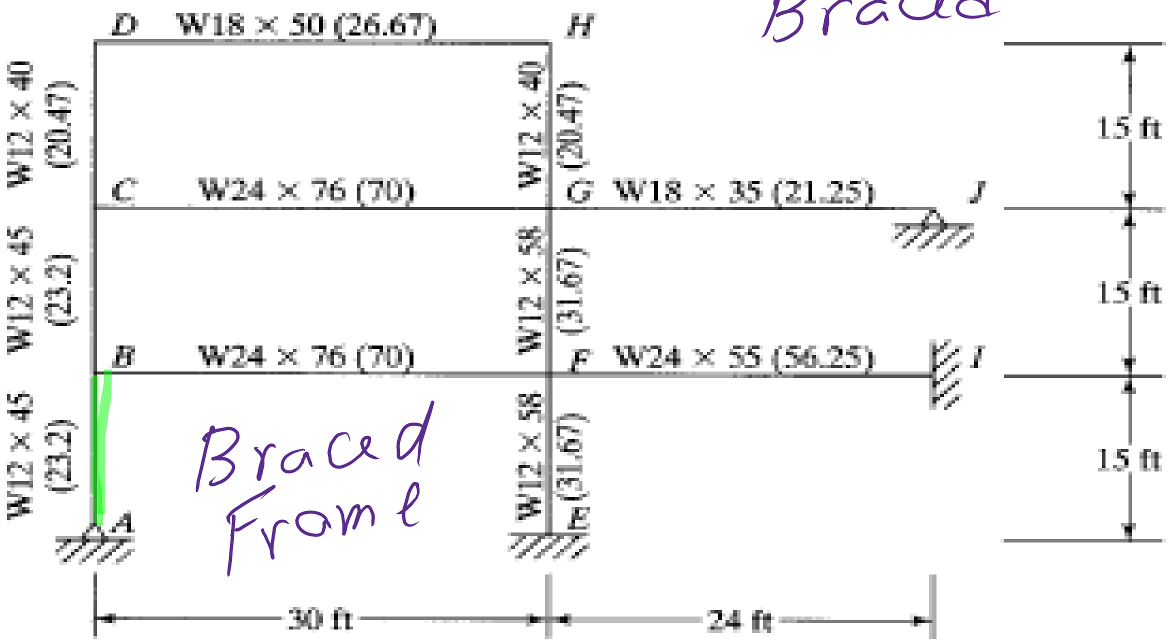
$K = 0.7228 \rightarrow$ Very Close ~ 0.72

Example 7-2

Determine K factors for each of the columns of the frame shown in Fig. 7.6. Here, 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.

Column BA
Braced

Two Column are joined at B
CB & BA



One Column only at A

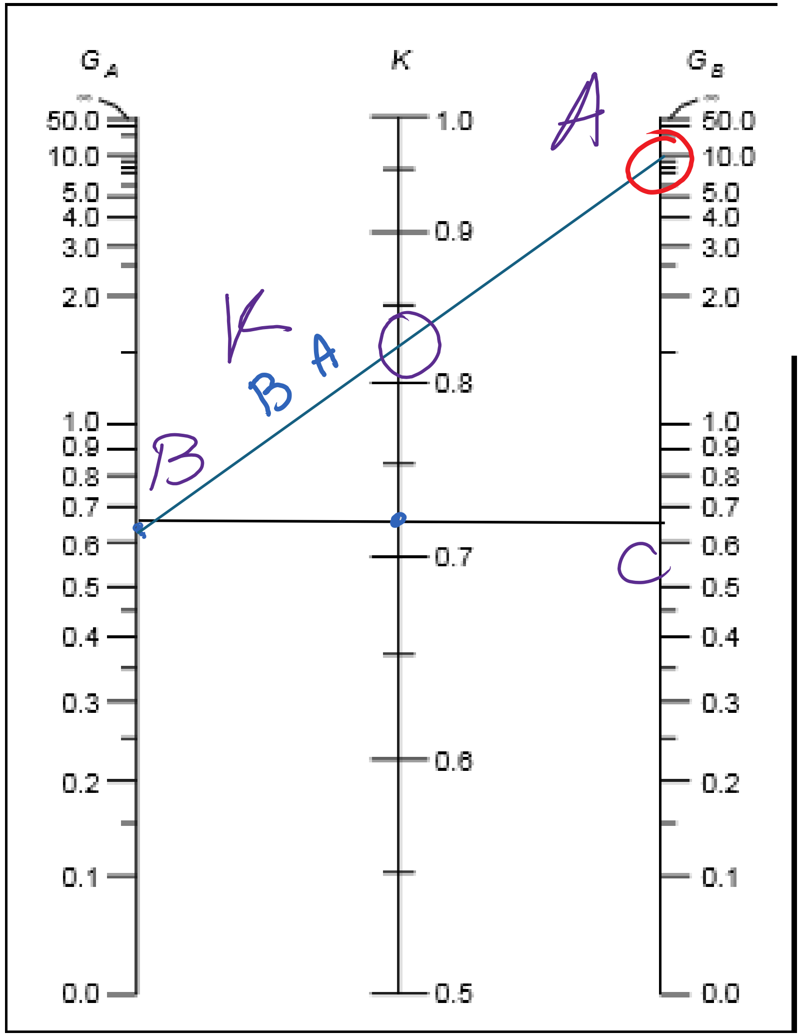
$G_A = 10$

$G_B = \frac{(23.2) + 23.20}{70} = 0.6629$ Sum EI Columns / Sum Girders

Prepared by Eng.Maged Kamel.

AISC Figure C-A-7.1

Alignment chart, sidesway inhibited (braced frame)



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

since 1966. For sidesway inhibited,

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

For sidesway uninhibited,

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

$G_A = 10$

$G_B = 0.6629$

K From Graph = 0.83

$$K_{French\ BA} = \frac{3G_AG_B + 1.4(G_A + G_B) + 0.64}{+2(G_A + G_B) + 1.28}$$

$K_{Fr} = 0.8344 \rightarrow 0.83$ Close to

Prepared by Eng.Maged Kamel.