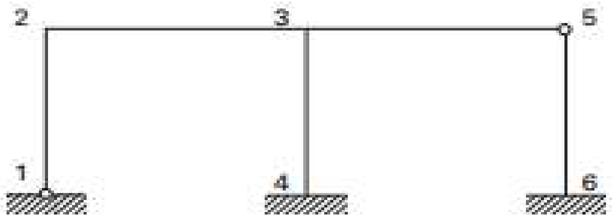
Reminder of the data of Example 4-16

Example 4.16

The sway frame shown consists of members with identical I/L values. Determine the effective length factors of columns 12 and 34.



hinged

hinged

Fixed

Solution

For the pinned connection at joint 1, AISC 360 Comm. App. 7.2 specifies a stiffness ratio of $G_1 = 10$.

At joint 2,

$$G_2 = \frac{\sum\left(\frac{I_c}{L_c}\right)}{\sum\left(\frac{I_g}{L_g}\right)} = \frac{1.0 \text{ in}^3}{1.0 \text{ in}^3} = 1$$

From the alignment chart for sway frames, the effective length factor is

$$K_{12} = 1.9$$

Allowing for the pinned end at joint 5, the sum of the adjusted relative stiffness values for the two girders connected to joint 3 is

$$\sum\left(\frac{I_g}{L_g}\right) = 1.0 \text{ in}^3 + 0.5 \text{ in}^3$$
$$= 1.5 \text{ in}^3$$

The stiffness ratio at joint 3 is given by

$$G_3 = \frac{\sum\left(\frac{I_c}{L_c}\right)}{\sum\left(\frac{I_g}{L_g}\right)} = \frac{1.0 \text{ in}^3}{1.5 \text{ in}^3}$$
$$= 0.67$$

For the fixed connection at joint 4, AISC 360 Comm. App. 7.2 specifies a stiffness ratio of $G_4 = 1.0$. From the alignment chart for a sway frame, the effective length factor for column 34 is

$$K_{34} = 1.27$$

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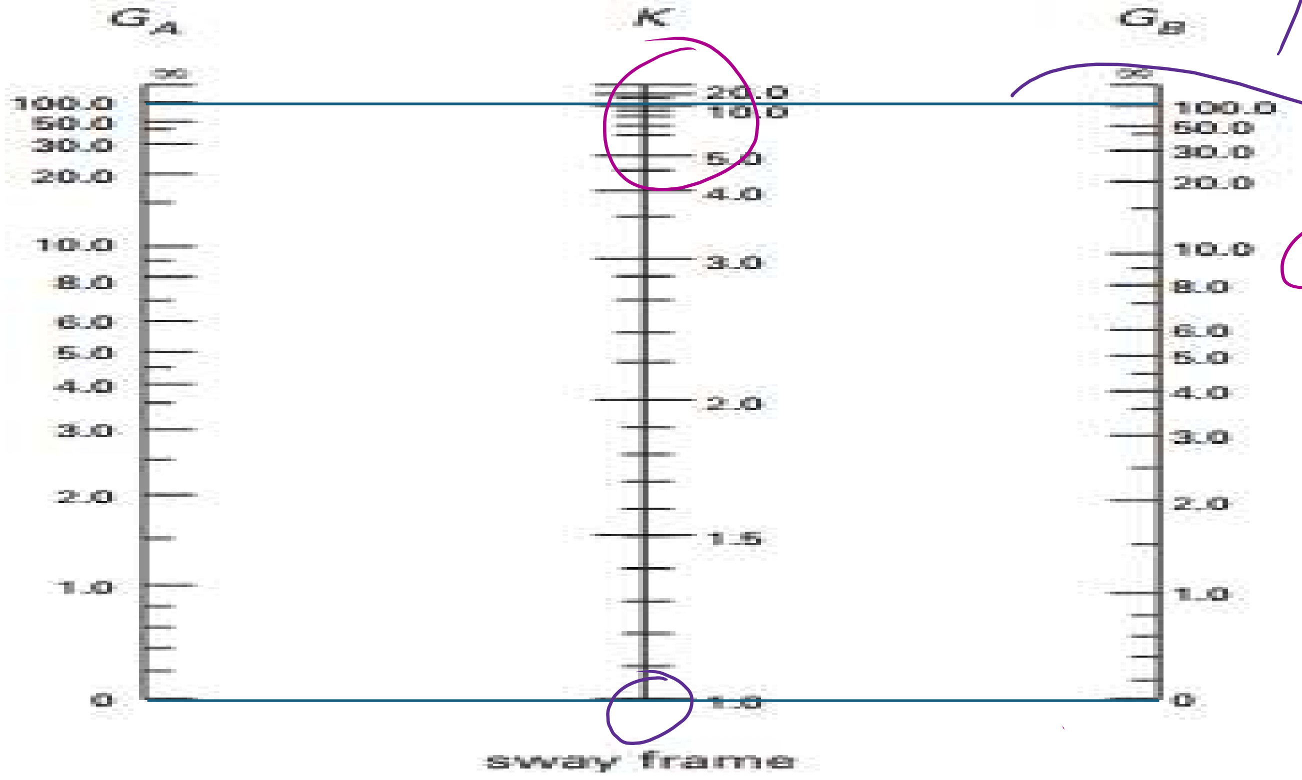
French Equation for effective length Factor

For sidesway uninhibited,

$$K = \sqrt{\frac{1.6G_AG_B + 4(G_A + G_B) + 7.5}{G_A + G_B + 7.5}} \Rightarrow K = \sqrt{\frac{7.5}{7.5}} = 1$$



For $G_A = G_B = 0$

$G_A = G_B = 100$

$$K = \sqrt{\frac{1.6(100)(100) + 4(100+100) + 7.5}{100(2)(7.5)}}$$

$K = 9$

K Equation matches with Graph

Refer to Example 4-16

$G_1 = 10$ } Case of hinged support

$G_2 = 1$

$K = 1.90$

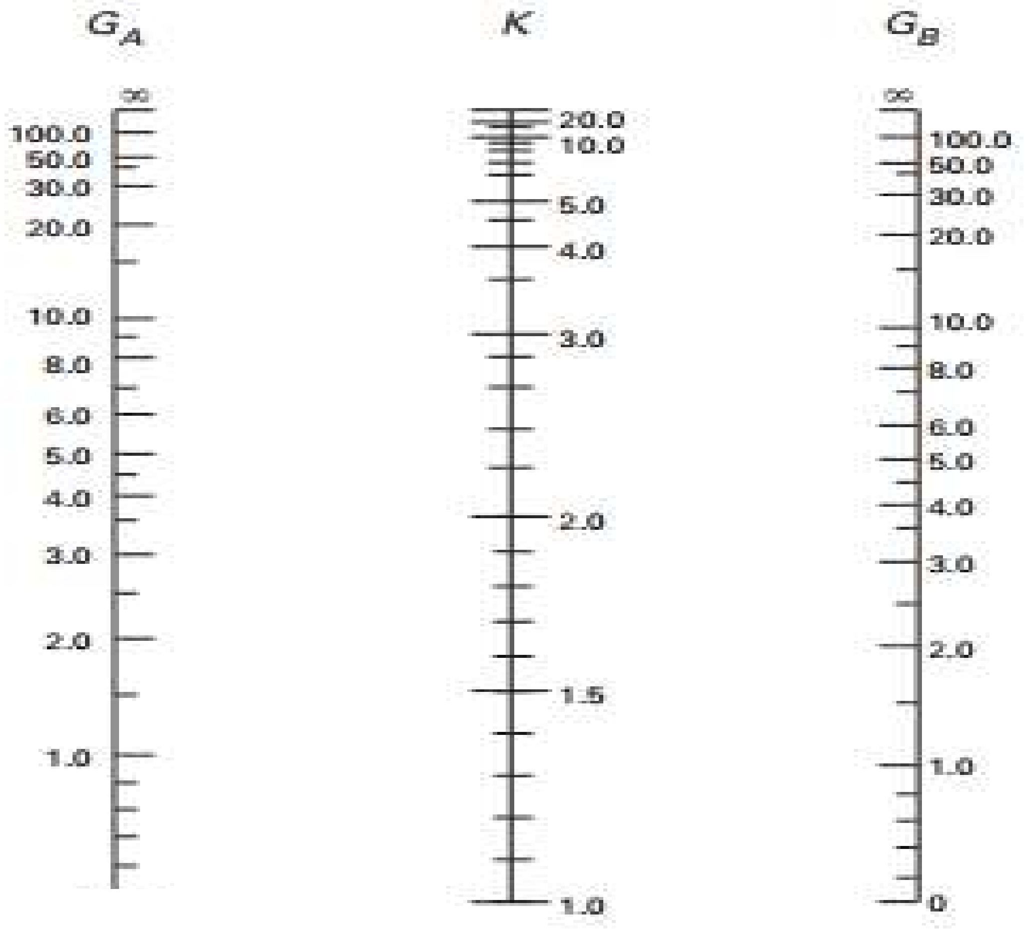
Using French Equation

$$K = \sqrt{\frac{1.6(10)(1) + 4(10+1) + 7.50}{10 + 1 + 7.50}}$$

$K = 1.90144$

For sidesway uninhibited,

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



sway frame

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For Example 4-16

$G_3 = 0.67$

$G_4 = 1$ → Fixed support

$K = 1.27$

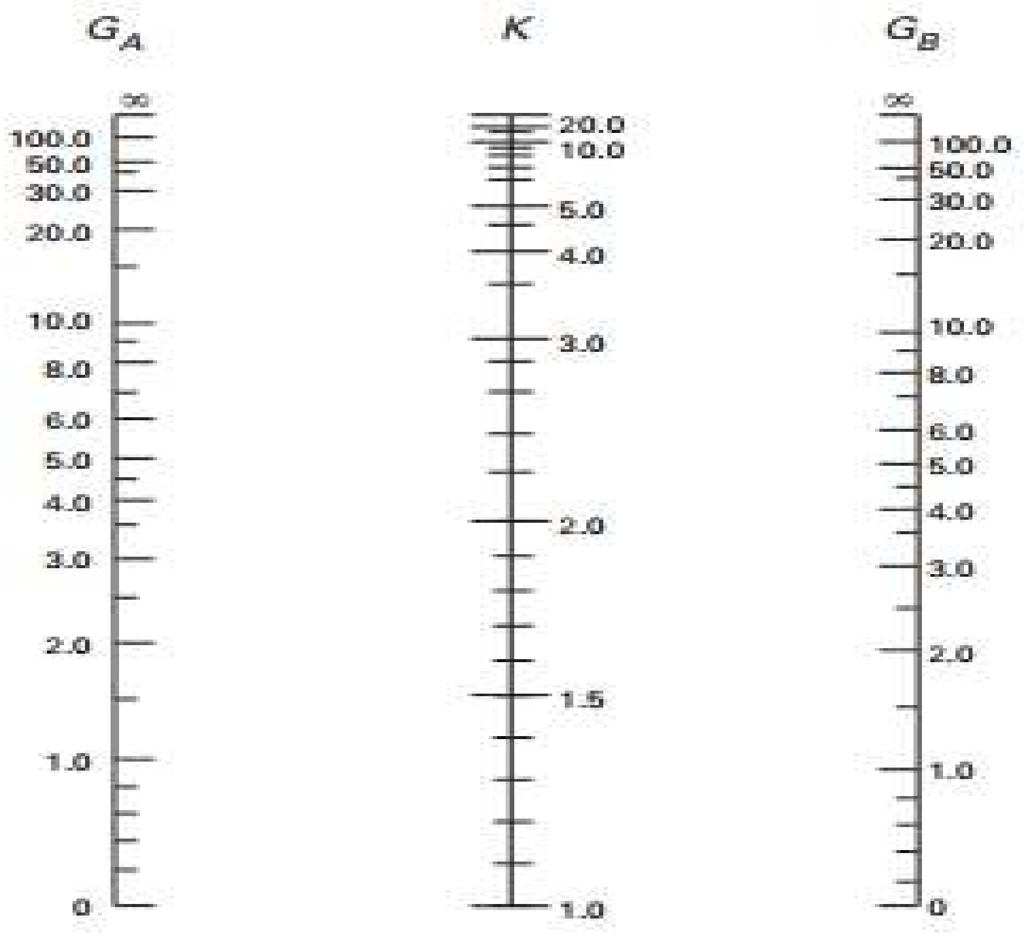
Use French Equation

$$K = \sqrt{\frac{1.6(0.67)(1) + 4(1.67) + 7.50}{0.67 + 1 + 7.50}}$$

$K = 1.289$

For sidesway uninhibited,

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



sway frame

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