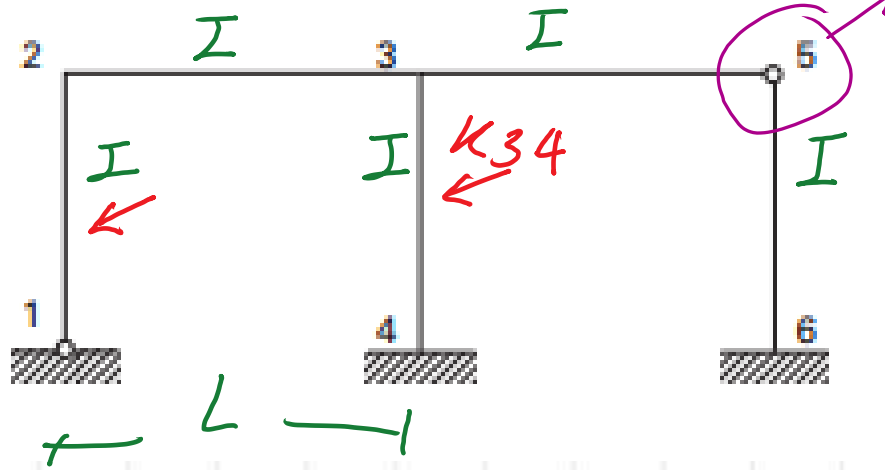
ALAN williams
Structural engineering
Reference
Manual

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.



Pinned

unbraced Frame

h ?

L = h

Joint - 2
No - hinged
No Fixed
m = 1

Solution

For Column 1-2

$$G_2 = \frac{\Sigma(EI/L)\text{Column}}{m\Sigma(EI/L)\text{Girder}}$$

① $G_2 = \dfrac{(EI/L)_{1-2}}{(1)[EI/L]_{2-3}}$

m = 1

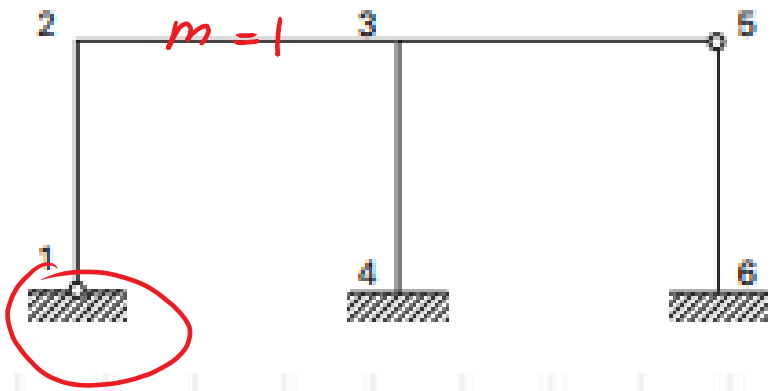
L = h

$$G_2 = \frac{EI}{L} \cdot \frac{1}{\frac{EI}{L}} = 1$$

G_1 : hinged support

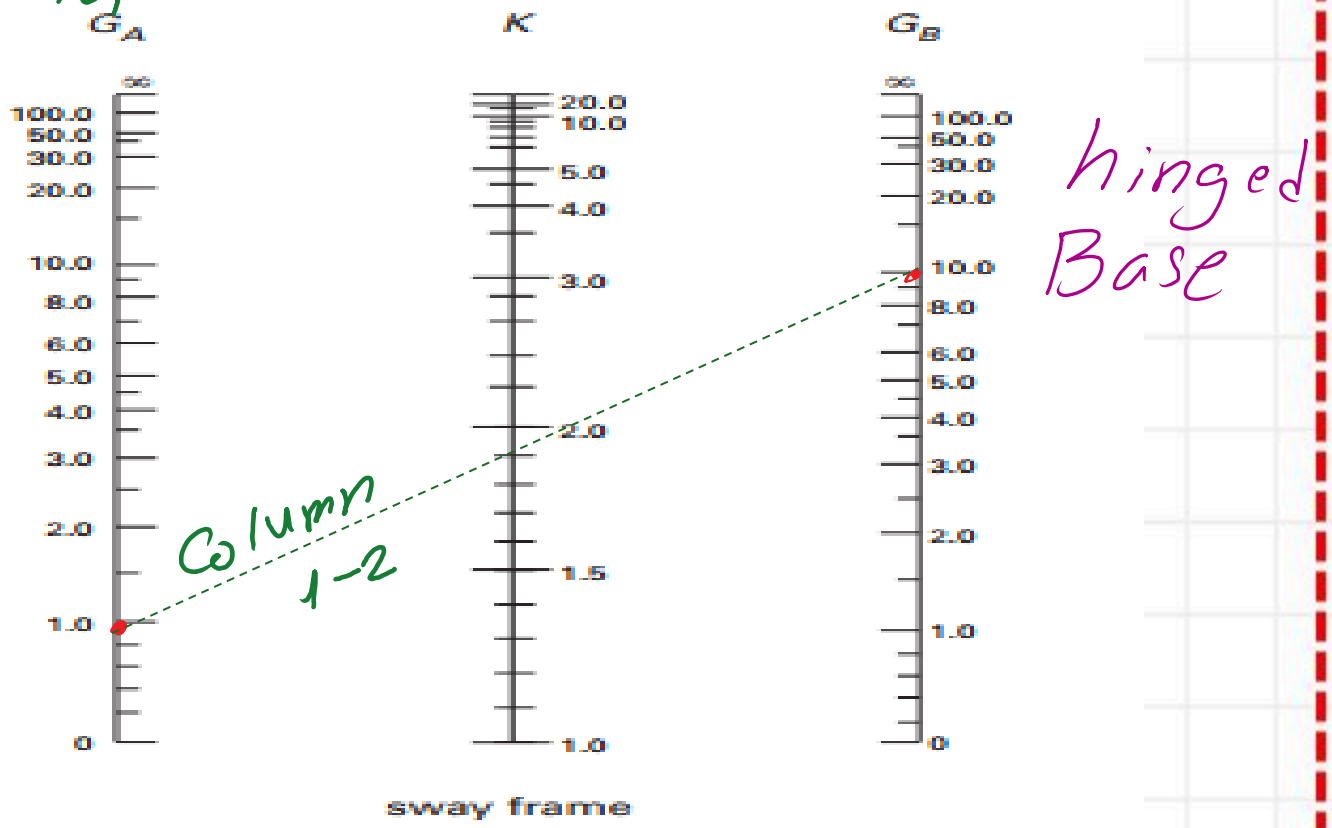
$= 10$

$K = 1.90$



hinged

Column 1-2



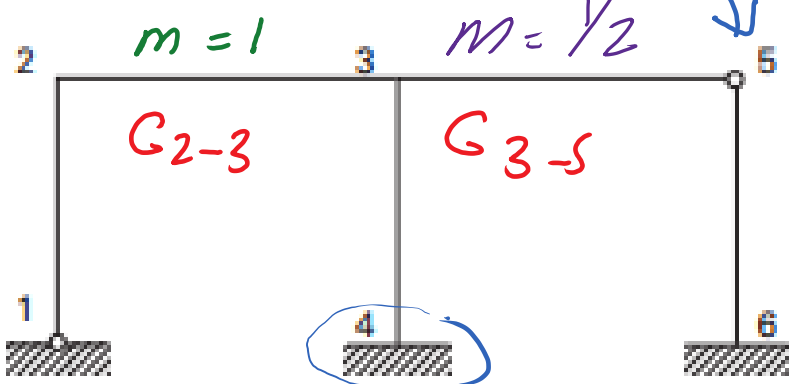
Unbraced Frame

$$G_3 = \frac{\Sigma (EI/L)_{3-4}}{m \Sigma \left(\frac{EI}{L}\right)_{3-2} + m \Sigma \left(\frac{EI}{L}\right)_{3-5}}$$

$m = \frac{1}{2}$

$$= \frac{EI/L}{1\left(\frac{EI}{L}\right) + \frac{1}{2}\left(\frac{EI}{L}\right)}$$

$$= \frac{1}{1.5} = 0.67$$



$G_4 = 1$ Fixed support

For hinged ↘

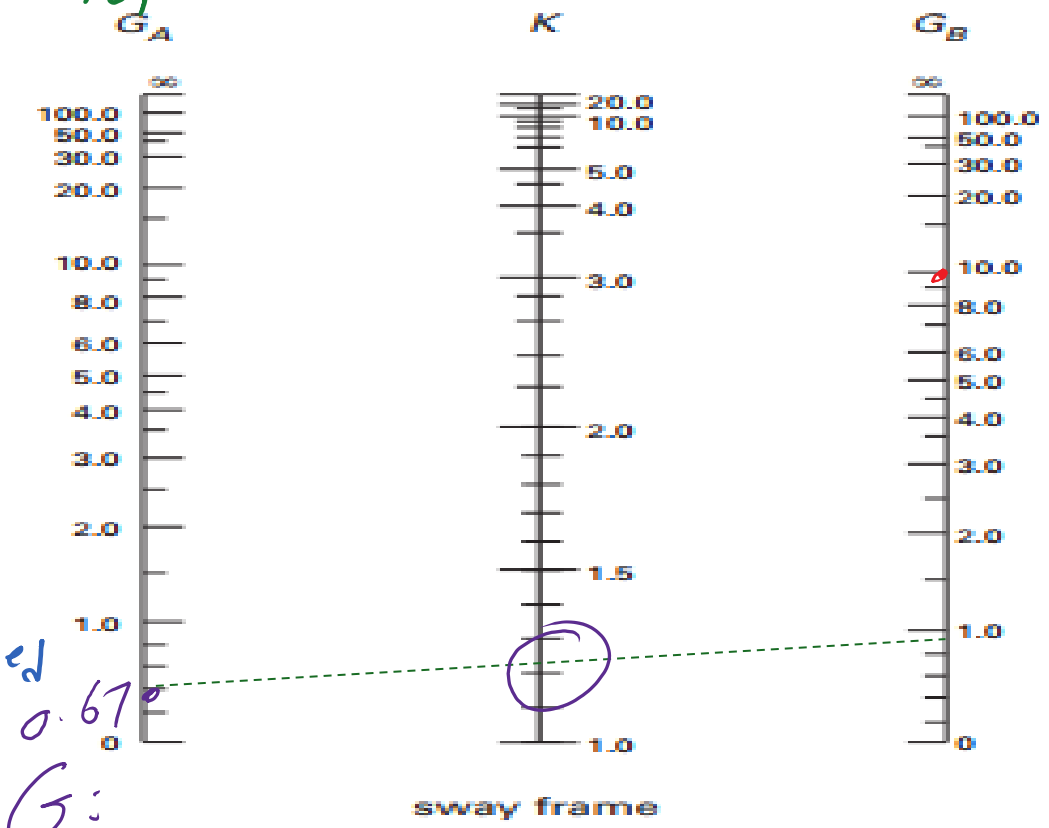
0.67

G:

Column 3-4

Column Top

Column bottom



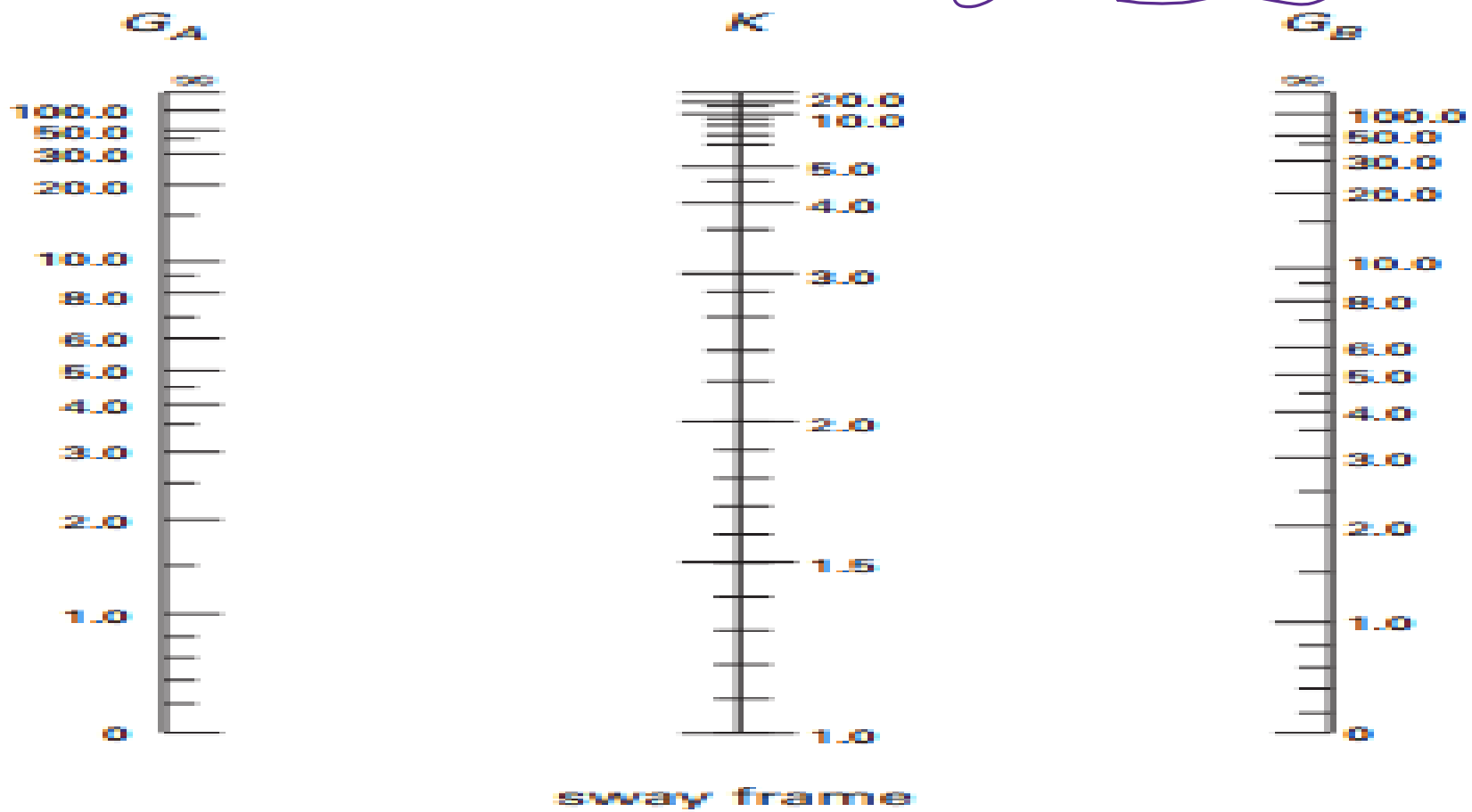
G = 1

Fixed

$K = 1.27$

For Column 3-4

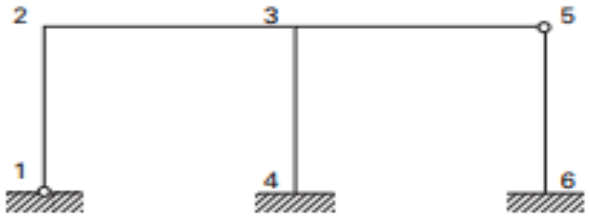
Alignment chart



Author's Solution.

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.



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

$$K_{34} = 1.27$$

Prepared by Eng.Maged Kamel.