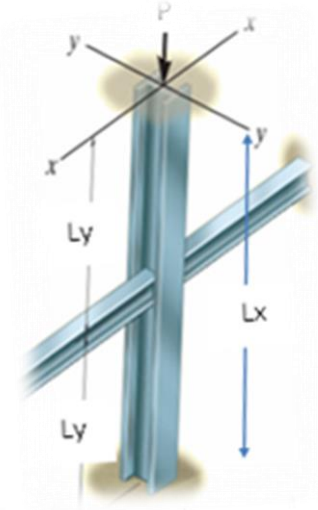
COMPRESSION MEMBERS

Compression Members: are Structural elements that are subjected to axial compressive force only, that is, the loads are applied along a longitudinal axis through the centroid of the member

The stress in the compression member cross-section can be calculated as



$\sigma = f_{cr} = P/A$

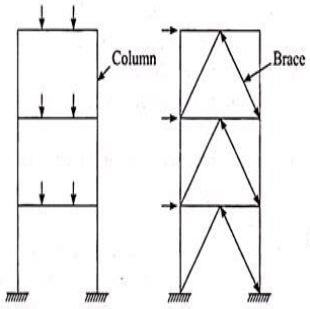
$\sigma = f_{cr}$= normal compressive stress

P= axil compressive force.

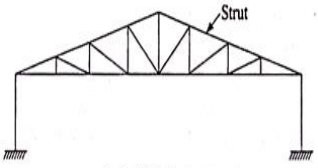
A= gross sectional area

Column is a vertical member whose primary function is to support vertical loads.

In many cases compression members are also resisting bending, and in these cases the member is a beam column.



Multi-storeyed structures



Industrial structure

Smaller compression members not classified as column are sometimes referred as Struts or posts.

Thus Compression members are found as:-

1- Columns in buildings .

2- Piers in bridges .

3- Trusses (Top chords) .

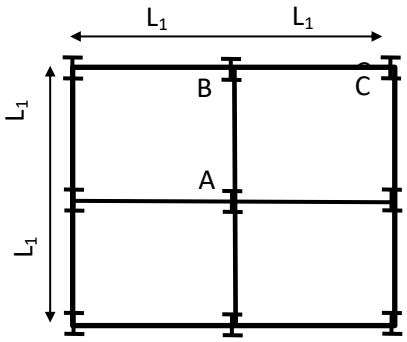
4- Bracing members .

The most common type of compression member in building and bridges is the column.

Column can be classified according to:

1- Type of Loading

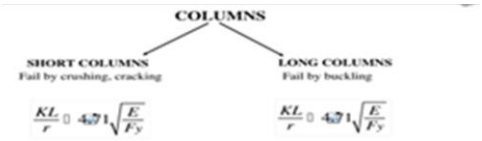
- Axially Loaded (Column), Like col. (A).
- Eccentrically Loaded like (Beam Column)
- Beam Col. with Uniaxial moment, Like col.(B)
- Beam Col. with Biaxial moment, Like col.(C)

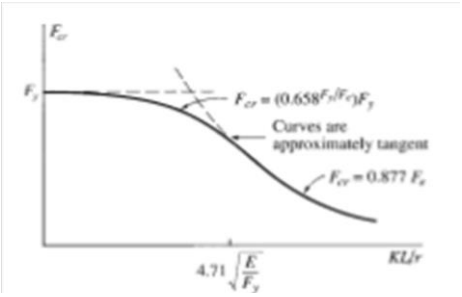


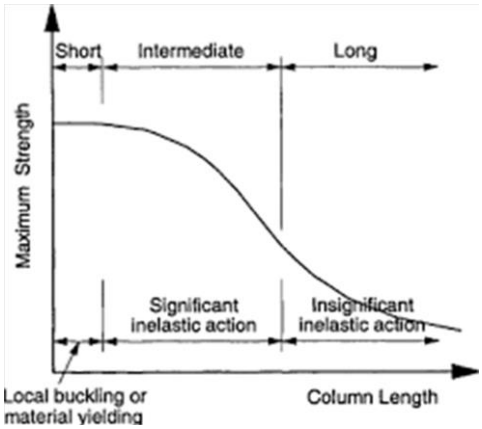
2- Slenderness Ratio for column (Kl/r)

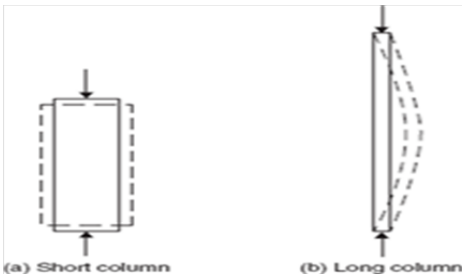
- Long Column
- Short Column
- Intermediate Column

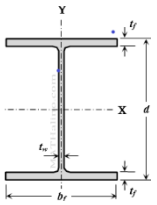
Short Column	Long Column
A column is considered to be short if the ratio of effective length to its least lateral dimension (kl/r) is less than or equal to $4.71\sqrt{E/fy}$.	A column is considered to be long if the ratio of effective length of column to its least lateral dimension (kl/r) is greater than $4.71\sqrt{E/fy}$.
Buckling tendency is very low.	Long and slender columns buckle easily.
The load carrying capacity is high as compared to long column of the same cross sectional area.	The load carrying capacity is less as compared to short column of the same cross sectional area.
The failure of the short column is by yielding.	The column generally fails in buckling.











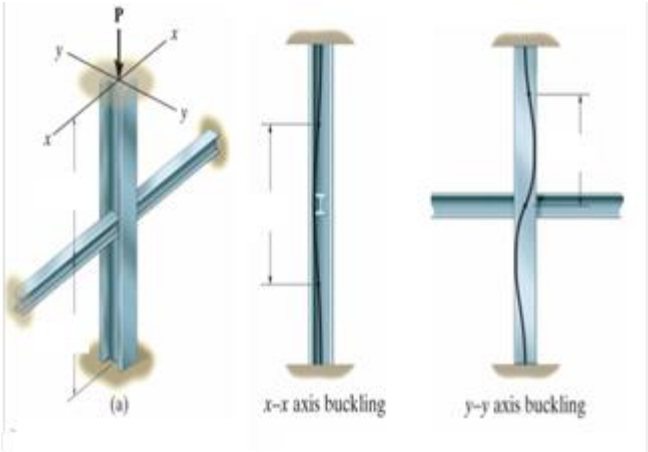
EFFECTIVE LENGTH OF COLUMNS IN FRAMES

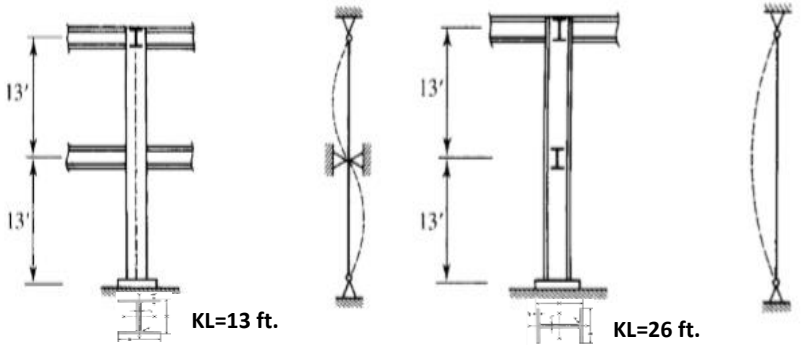
The effective length (KL) of a column is defined as the distance between successive inflection points or zero point moment.

Where

K: depending on the end condition of the ends and sway condition (brace or not brace)

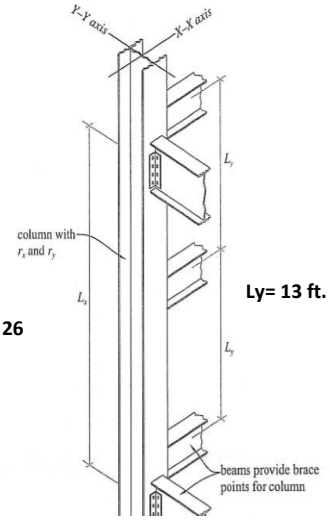
L: refers to the length between the brace points, it's divided in two parts according to X axis and Y axis and the number of brace points in each direction





(a) Minor Axis Buckling

(b) Major Axis Buckling



Note

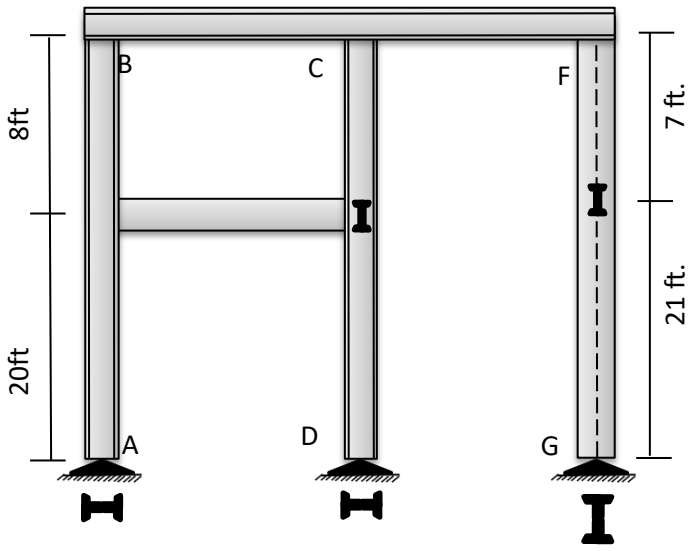
If the web was bracing then (Ly) will be divided, then take the larger value

If the flange was bracing then (Lx) will be divided, then take the larger value

If both web and flange were bracing then (Ly&Lx) will be divided, then take the larger value

Homework

Find the length of each column for the frame shown below?



Where K is usually determined by one of two methods:

1. **AISCM, Table C-C2.2: This table is used for isolated columns that are not part of a continuous frame. In Table C-C2.2, P.P 240 part Two**

a through c represents columns in braced frames; while d through f represent columns in unbraced frames.

240 CALCULATION OF REQUIRED STRENGTHS [Comm. C2.

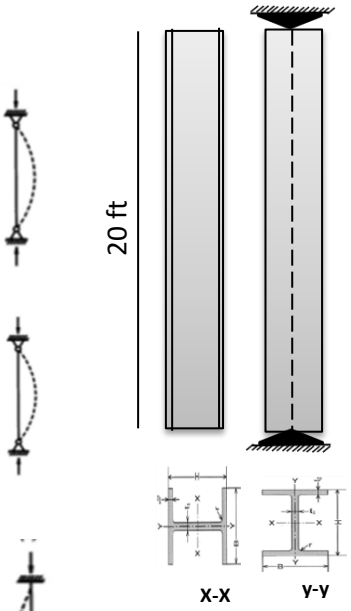
TABLE C-C2.2
Approximate Values of Effective Length Factor, *K*

Buckled shape of column is shown by dashed line.	(a)	(b)	(c)	(d)	(e)	(f)
						
Theoretical *K* value	0.5	0.7	1.0	1.0	2.0	2.0
Recommended design value when ideal conditions are approximated	0.65	0.80	1.2	1.0	2.10	2.0
End condition code	 *Rotation fixed and translation fixed* *Rotation free and translation fixed* *Rotation fixed and translation free* *Rotation free and translation free*					

Example

Find the effective length factor of (W 12 x 50) columns has length is equal to 20 ft. Assume the column is pin- pin the weak direction (For minor axis) and the two ends connections for strong direction (Major axis) are:

1-Pin-pin contention in both directions
2-Fixed in -fixed contention
3 - Fixed in -pin contention
4-Fixed-free to translate and rotated (rotation free and translation free)



Solution

Since the Y_Y axis (weak axis) is pin-pin in both direction
Ky=1
Kx = according to the conditions of the ends

1- (pin - pin end connection)

Kx = 0.1 (pin - pin end connection
Ky =1.0 (pin - pin end connection
Lx =ly (the unsupported length for two axis is 20 ft)

Klx=Kly=1x20= 20 ft

2- (fixed - fixed end connection)

Kx = 0.65 (pin - fixed end connection)
Ky =1.0 (pin - pin end connection)
Lx =ly (the unsupported length for two axis is 20 ft)
Klx=0.65x20 =13 ft
Kly=1x20= 20 ft)

3- (fixed - pin end connection)

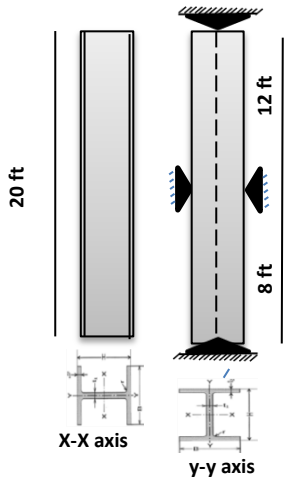
Kx = 0.8 (pin - fixed end connection
Ky =1.0 (pin - pin end connection)
Lx =ly (the unsupported length for two axis is 20 ft)
Klx=0.8x20 =16 ft
Kly=1x20= 20 ft

4 (-Fixed-free to translate only (rotation fixed and translation free)

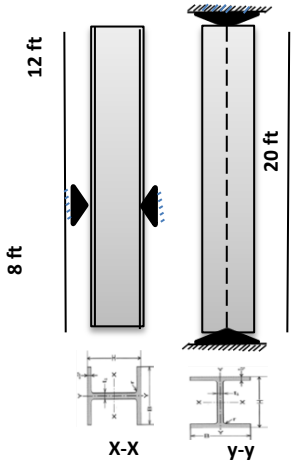
Kx = 1.2 (pin - fixed end connection) in the X-X axis
Ky =1.0 (pin - pin end connection) in the y-y axis
Lx =ly (the unsupported length for two axis is 20 ft)
Klx=1.2x20 =24 ft
Kly=1x20= 20 ft

Homework 1

Re solve the above example if
The col. has supported at 12 ft in the weak direction



Homework 2
Re solve the above example if
The col. has supported at 12 ft in the strong direction



Homework 3
Re solve the above example if
The col. has supported in both directions