COLUMN EFFECTIVE LENGTH FACTOR CALCULATION

DESIGN CALCULATIONS FROM RCDC

Sway Calculation (Stability Index)

For Global-X Direction

Level	Load Name	Story Height (m)	Gravity Load P (kN)	Relative Displacements (mm)
		A	B	C
12.058m to 16.25m	EQ-X	4.2	23613.072	1.986

Story Shear (kN)	Stability Index	Sway Condition
D	B x C / (A x D)	
1788.302	0.006	Non Sway

For Global-Y Direction

Level	Load Name	Story Height (m)	Gravity Load P (kN)	Relative Displacements
		A	B	C
12.058m to 16.258m	EQ-Y	4.2	23613.072	2.253

Story Shear (kN)	Stability Index	Sway Condition
D	B x C / (A x D)	
1545.608	0.008	Non Sway

General Data

Column No.	:	C1	
Level	:	12.058m to 16.258m	
Design Code	=	IS Code	
Grade Of Concrete	=	M25	N/Sqmm
Grade Of Steel	=	Fy415	N/Sqmm
Column B	=	700	MM
Column D	=	700	MM
Clear Floor Height @ B	=	3300	MM
Clear Floor Height @ D	=	3300	MM
No Of Floors	=	1	
No Of Walls In Group	=	1	
Column Type	=	UnBraced	
Minimum eccemtricity check	=	Simultaneously (Both Axis)	

VALIDATION

TITLE : DESIGN OF Column
SUB -TITLE : COLUMN EFFECTIVE LENGTH CALCULATION.
CODE OF PRACTICE : IS-456 :2000
BUILDING CODE REQUIREMENTS FOR STRUCTURAL CONCRETE (IS 456)

Calculation of Stability Index

User Input

PARAMETERS :	SYMBOL	USER INPUT	UNITS	
Column		C1		
Width of Column	B	700	mm	
Depth of Column	D	700	mm	
Grade of Concrete	M25	25	N/Sqmm	
Grade of Steel	Fe415	415	N/Sqmm	
Sway Calculation (Stability Index)				
Story Level		12.058m to 16.25m		
Story Height	hs	4.2	m	
Gravity Load (DL + LL) (From STAAD File)	Pu	23613.072	kN	From STAAD
Relative Displacement (Load Case Eqx-From STAAD File)	Δ_{ux}	1.986	mm	From STAAD
Relative Displacement (Load Case Eqy-From STAAD File)	Δ_{uy}	2.253	mm	From STAAD
Story Shear (Load Case Eqx-From STAAD File)	Hux	1788.302	kN	From STAAD
Story Shear (Load Case Eqy-From STAAD File)	Huy	1545.608	kN	From STAAD
Stability Index in Global-X direction	Qx	0.006		Annex E
Sway Condition for Global-X direction	Qx <= 0.04	No Sway		IS 456
Stability Index in Global-Y direction	Qy	0.008		
Sway Condition for Global-Y direction	Qy <= 0.04	No Sway		

E-2 To determine whether a column is a no sway or a sway column, stability index Q may be computed as given below :

$$Q = \frac{\Sigma P_u \Delta_u}{H_u h_s}$$

where

ΣP_u = sum of axial loads on all column in the storey,
Δ_u = elastically computed first order lateral deflection,
H_u = total lateral force acting within the storey, and
h_s = height of the storey.

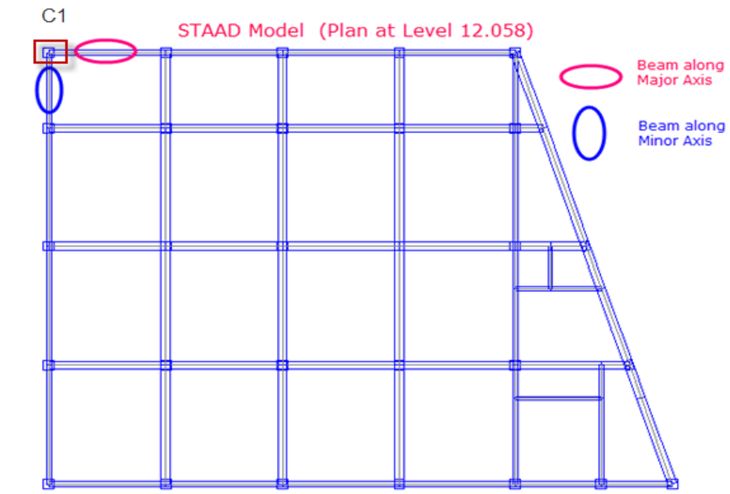
If $Q \leq 0.04$, then the column in the frame may be taken as no sway column, otherwise the column will be considered as sway columnn.

Note

Gravity load is the summation of axial force 'PU' kN at floor level fro STAAD for Dead plus Live load
Story Shear is the summation of shear force in column at floor level in global direction for lateral load case.
for Column having beta angle, RCDC resolve the shear along Global direction to get the total shear

Load Data

Analysis Reference No.	=	1
Load Combination	=	[7] : 1.5 (LOAD 1: LOAD CASE 1) - 1.5 (LOAD 3: (LOAD CASE 3 EQ-X)
Critical Location	=	Bottom Joint
Put (top joint)	=	356.11 KN
Muxt (top joint)	=	399.53 KNM
Muyt (top joint)	=	109.68 KNM
Vuxt (top joint)	=	47.73 KN
Vuyt (top joint)	=	-160.07 KN



Plan showing column considered for calculaion

Effective Length Calculation

Calculation Along Major Axis Of Column

Joint	Column	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	476.39	8000 x 350 x 900	No Beam	265.781	-	0.782
Top	476.39	8000 x 350 x 900	No Beam	265.781	-	0.642

Sway Condition (as per Stabilit	=	Non Sway
Effective Length Factor along M	=	0.81

Step 2)

Calculation of Effective Length

Along Major Axis

Column Stiffness at Bottom Kc	4EI / L	476.389	N-M
Beam B1 Stiffness at Bottom Kb (B1-8000 x 350 x 900)	4EI / L	265.781	N-M
Beam B2 Stiffness at Bottom Kb	No Beam	0	
Beta Ratio at Bottom	∑Kc / (∑Kc + ∑Kb)	0.782	
Column Stiffness at Top Kc	4EI / L	476.389	N-M
Beam B1 Stiffness at Top Kb (B1-8000 x 350 x 900)	4EI / L	265.781	N-M
Beam B2 Stiffness at Top Kb	No Beam	0	
Beta Ratio at Top	∑Kc / (∑Kc + ∑Kb)	0.642	
Sway Condition (as per Stability Index)	Non Sway		
Effective Length Factor along Major Axis	0.81		

Calculation Along Minor Axis Of Column

Joint	Column	Beam Sizes		Beam Stiffness		Beta
		Beam 1 (Length x Width x Depth)	Beam 2 (Length x Width x Depth)	Beam 1	Beam 2	
	N/m	mm	mm	N/m	N/m	
Bottom	476.39	5710 x 350 x 900	No Beam	372.373	-	0.719
Top	476.39	5710 x 350 x 900	No Beam	372.373	-	0.561

Sway Condition (as per Stabilit = Non Sway

Effective Length Factor along M = 0.76

Annex E- Fig 26
IS 456

2 In Figs. 26 and 27, β_1 and β_2 are equal to $\frac{\Sigma K_c}{\Sigma K_c + \Sigma K_b}$

where the summation is to be done for the members framing into a joint at top and bottom respectively; and K_c and K_b being the flexural stiffness for column and beam respectively.

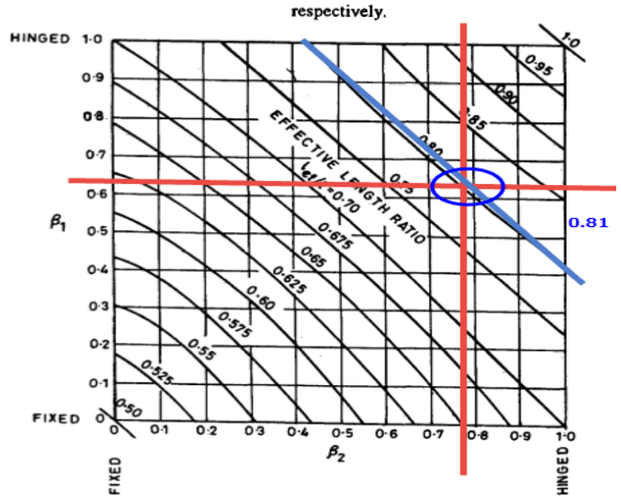


FIG. 26 EFFECTIVE LENGTH RATIOS FOR A COLUMN IN A FRAME WITH NO SWAY

Along Minor Axis

Column Stiffness at Bottom Kc	4EI / L	476.389	N-M
Beam B1 Stiffness at Bottom Kb (B1-5710 x 350 x 900)	4EI / L	372.373	N-M
Beam B2 Stiffness at Bottom Kb	No Beam	0	
Beam B1 Stiffness at Top Kb (B1-5710 x 350 x 900)	4EI / L	372.373	N-M
Beam B2 Stiffness at Top Kb	No Beam	0	
Beta Ratio at Bottom	∑Kc / (∑Kc + ∑Kb)	0.719	
Column Stiffness at Top Kc	4EI / L	476.389	N-M
Beta Ratio at Top	∑Kc / (∑Kc + ∑Kb)	0.561	
Sway Condition (as per Stability Index)	Non Sway		
Effective Length Factor along Major Axis	0.76		

Annex E- Fig 26
IS 456

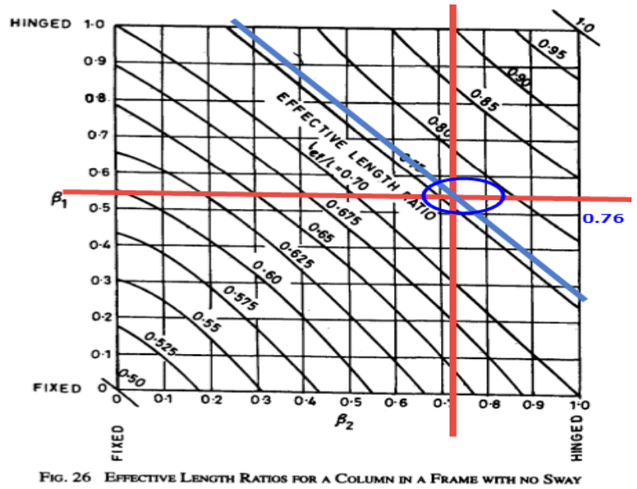


FIG. 26 EFFECTIVE LENGTH RATIOS FOR A COLUMN IN A FRAME WITH NO SWAY