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Analysis Two Approaches: Considering and Not Considering Substitute Frame

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Abstract: Structural design of RCC framed structure is totally based on results of structural analysis. Structural Analysis is of various type and different approaches are available for one type of structural analysis. In this paper, I want to know the variation in the analysis results when I do the analysis by two different approaches. In first approach I divide my structure in substitute frame (as per clause 22.4 of I.S. 456:2000) and analyze by moment distribution method, while in second approach I analyze whole structure by using Finite Element Method.
Keywords: Frame Structure, Structural Analysis, Substitute Frame

I. Introduction

For the comparative study, I choose a simple frame ground storey building and analyze it for gravity loading only. For determining the moments and shears at any floor or roof level due to gravity loads, the beams at that level together with columns above and below with their far ends fixed may be considered as substitute frame. 4.5 meter is the distance between ground floor roof and footing top. I choose two substitute frames to analyze ground floor roof.

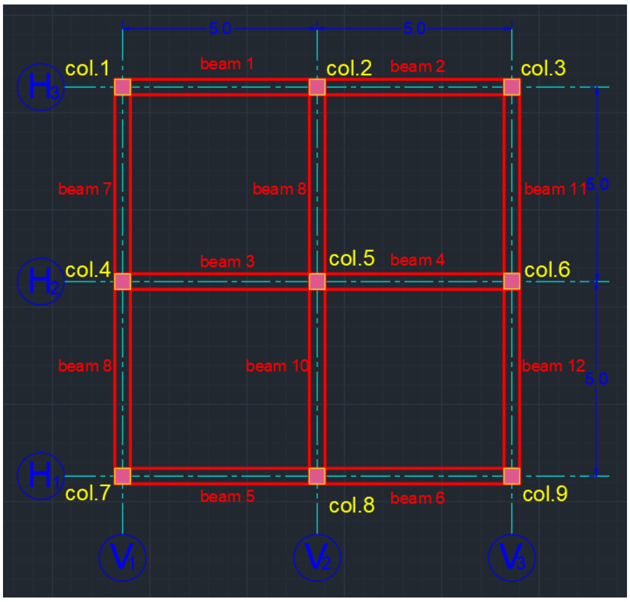


Fig. 1 Ground Floor Framing Plan

'13R' represent node of roof level which lie at the intersection of the vertical grid V_1 and horizontal grid H_3.
Let Load on beam 1 & 2 / beam 5& 6 / beam 7 & 8/ beam 11 & 12 of ground floor roof

= 15.975 KN/m (DL) + 2.5 KN/m (LL)

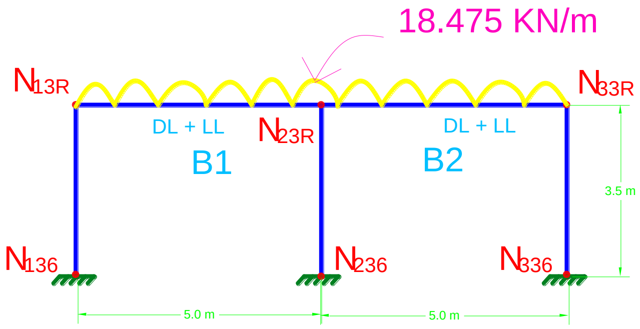


Fig. 2 Substitute Frame for Beam 1 & 2

And Load on beam 3 & 4 / beam 9 &10 of ground floor roof slab per meter length
= 22.85 KN/m (DL) + 5.0 KN/m (LL)

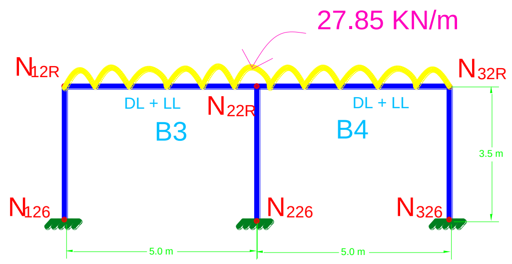


Fig. 3 Substitute Frame for Beam 3 & 4

TABLE 1
ANALYSIS OF SUBSTITUTE FRAME BY MOMENT DISTRIBUTION METHOD

MEMBER	136-13R	13R-136	13R-23R	23R-13R	23R-236	23R-33R	33R-23R	33R-336	236-23R	336-33R
D.F	**0.588**	**0.588**	**0.412**	**0.2917**	**0.4166**	**0.2917**	**0.412**	**0.588**	**0.4166**	**0.588**
F.E.M.			**-38.49**	**+38.49**		**-38.49**	**+38.49**			
BALANCING		+22.632	+15.858				-15.858	-22.632		
C.O.	+11.316			+7.929		-7.929				-11.316
	+11.316	+22.632	-22.632	+46.419		-46.419	+22.632	-22.632		-11.31

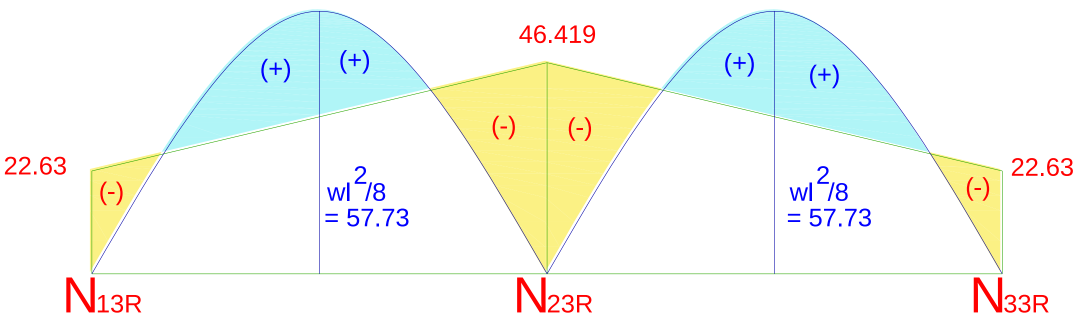
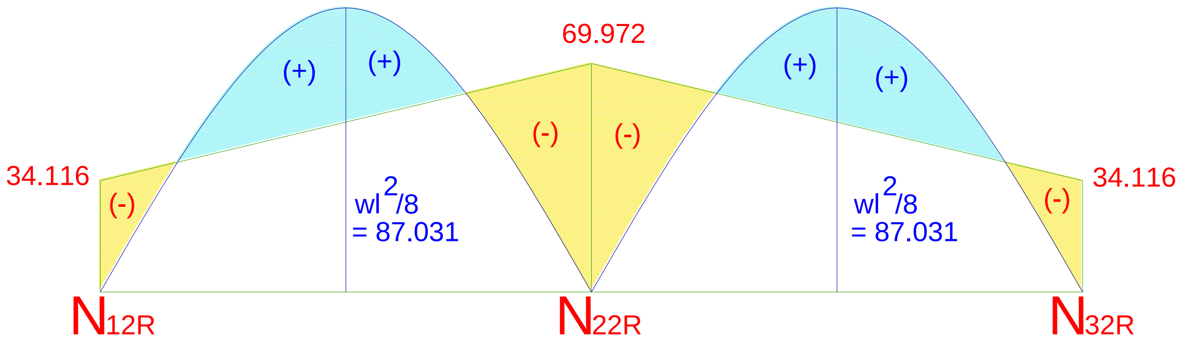


Fig. 4 B.M.D of Roof Beam 1 & 2

TABLE 2
ANALYSIS OF SUBSTITUTE FRAME – 2 SUBJECTED BY MOMENT DISTRIBUTION METHOD

JOINT	N126	N12R		N22R			N32R		N226	N326
MEMBER	126-12R	12R-126	12R-22R	22R-12R	22R-226	22R-32R	32R-22R	32R-326	226-22R	326-32R
D.F	**0.588**	**0.588**	**0.412**	**0.2917**	**0.4166**	**0.2917**	**0.412**	**0.588**	**0.4166**	**0.588**
F.E.M.			**-58.02**	**+58.02**		**-58.02**	**+58.02**			
BALANCING		+34.116	+23.904				-23.904	-34.116		
C.O.	+17.058			+11.952		-11.952				-17.058
Total	+17.058	+34.116	-34.116	+69.972		-69.972	+34.116	-34.116		-17.058

Fig. 5 B.M.D of Roof Beam 3 & 4



2.5 ANALYSIS RESULTS IN TABULAR FORM

TABLE 2.11

ANALYSIS RESULTS DONE BY MOMENT DISTRIBUTION METHOD USING SUBSTITUTE FRAME ASSUMPTION

BEAM	PARTICULARS	Loading-1
B1/B5/B7/B11	Moment at left support N_{13R}	- 22.63 KN m
	Maximum span moment	+23.82 KN m
	Moment at right support N_{23R}	- 46.42 KN m
B2/B6/B8/B12	Moment at left support N_{23R}	- 46.42 KN m
	Maximum span moment	+23.82 KN m
	Moment at right support N_{33R}	- 22.63 KN m
B3/B9	Moment at left support N_{12R}	- 34.11 KN m
	Maximum span moment	+35.91 KN m
	Moment at right support N_{22R}	- 69.97 KN m
B4/B10	Moment at left support N_{22R}	- 69.97 KN m
	Maximum span moment	+35.91 KN m
	Moment at right support N_{32R}	- 34.11 KN m

ANALYSIS RESULTS DONE BY STAAD PRO SOFTWARE TOOL

BEAM	PARTICULARS	Loading-1
B1/B5/B7/B11	Moment at left support N_{13R}	- 42.80 KN m
	Maximum span moment	+25.40 KN m
	Moment at right support N_{23R}	- 22.10 KN m
B2/B6/B8/B12	Moment at left support N_{23R}	- 22.10 KN m
	Maximum span moment	+25.40 KN m
	Moment at right support N_{33R}	- 42.80 KN m
B3/B9	Moment at left support N_{12R}	- 65.10 KN m
	Maximum span moment	+37.80 KN m
	Moment at right support N_{22R}	- 33.80 KN m
B4/B10	Moment at left support N_{22R}	- 33.80 KN m
	Maximum span moment	+37.80 KN m
	Moment at right support N_{32R}	- 65.10 KN m

3.3 COMPARISION OF RESULTS OBTAINED FROM TWO DIFFERENT APPROCHES

TABLE 3.2
COMPARISON IN RESULTS OF MOMENT DISTRIBUTION METHOD (USING SUBSTITUTE FRAME ASSUMPTION) AND STAAD PRO

BEAM	PARTICULARS	ANALYSIS BY MOMENT DISTRIBUTION METHOD USING SUBSTITUTE FRAME ASSUMPTION AS PER CLAUSE 22.4 I.S.CODE 456:2000	ANALYSIS BY STAAD PRO SOFTWARE TOOL BASED ON F.E.M.
B1/B5/B7/B11	Moment at left support N_{13R}	- 22.63 KN m	- 42.80 KN m
	Maximum span moment	+23.82 KN m	+25.40 KN m
	Moment at right support N_{23R}	- 46.42 KN m	- 22.10 KN m
B2/B6/B8/B12	Moment at left support N_{23R}	- 46.42 KN m	- 22.10 KN m
	Maximum span moment	+23.82 KN m	+25.40 KN m
	Moment at right support N_{33R}	- 22.63 KN m	- 42.80 KN m
B3/B9	Moment at left support N_{12R}	- 34.11 KN m	- 65.10 KN m
	Maximum span moment	+35.91 KN m	+37.80 KN m
	Moment at right support N_{22R}	- 69.97 KN m	- 33.80 KN m
B4/B10	Moment at left support N_{22R}	- 69.97 KN m	- 33.80 KN m
	Maximum span moment	+35.91 KN m	+37.80 KN m
	Moment at right support N_{32R}	- 34.11 KN m	- 65.10 KN m

5.1 CONCLUSION

When we compare the analysis results obtained from Staad and moment distribution method using substitute frame assumption, we observe that there is huge difference (nearly 50 percent) in the magnitude of hogging moment and slight variation in the sagging moment value. This much of approximation in the analysis of building frame is useless because this severely affect the design and designed structural component with these approximate value may be failed and cause loss of life and money. As we get nearly 50 percent less value of negative moment and slight less value of positive moment when we do analysis with using substitute frame assumption thus, It is not fruitful to analyze any building frame with substitute frame assumption, even I suggest that remove this assumption from I.S. code 456 also.

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