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Evaluation of Non-Infilled and Infilled Framed Structure Using E-Tabs

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ABSTRACT

Structural planning and design requires sound knowledge of science of structural engineering practical aspects, such as recent design codes, bye laws, backed up by ample experience, intuition and judgment. The purpose of standards is to ensure and enhance the safety, keeping careful balance between economy and safety. In the present study 5 story typical residential building of area 210 m2 is considered and analyzed with using E-Tabs 2015 Software. In this project the in-filled and non in-filled frame structures are analyzed and compared. The Infilled frame structures are provided with bricks in between beams and column It is emphasized to show the benefits of providing the brick element before analysis of structure or portal frame. This project has different details of the loads distributions and the amount of loads distributed in different beams as well as the bending moments, deflections in beams are studied for the comparative study of In-filled and Non In-filled structures. The various values of bending moment and deflection between In-filled and non in-filled structures are compared after analysis and concluded that which is more economical. Generally the non in-filled frame structures are preferred in the market but from this project it is emphasized to use infilled frame structures for the analysis as it is economical. Here after this analysis the deflection in non in filled frame is found to be 4 time than the deflection in beam of in-filled frame structure.

Keywords: Multi Storeyed Building, E-Tabs Software, Infilled And Non Infilled Frame Structure

I. INTRODUCTION

A Multi-Stored is a building that has multiple floors above ground in the building. Multi-storey buildings aim to increase the floor area of the building without increasing the area of the land the building is built on, hence saving land and in most cases money. In this project the in-filled and non in-filled frame structures are analyzed and compared. The Infilled frame structures are provided with bricks in between beams and column while analysis It is emphasized to show the benefits of providing the brick element before analysis of structure or portal frame. The present project deals with the analysis of a multi storeyed residential building of 5 storeys. The dead load &live loads are applied and the design for beams, columns, footing is obtained.

II. LITERATURE REVIEW

Francisco J CRISAFULLI[1], Athol J CARR[2] And Robert PARK

Infilled frames are commonly used for low and medium-height buildings all over the world in regions of high seismicity, especially in developing countries where the labour costs are not very high or where masonry structures are used for traditional reasons. It is believed that the development of rational design procedures is a critical issue not only to reduce the loss of life and property damage, but also to obtain a safe end economical solution.

Mircea Barnaure/ Daniel Nicolae Stoica

Partition walls are often made of masonry in Romania. Although they are usually considered non-structural elements in the case of reinforced concrete framed structures, the infill panels contribute significantly to the seismic behavior of the building. Their impact is difficult to assess, mainly because the interaction between the bounding frame and the infill is an intricate issue. This paper analyses the structural behavior of a masonry in filled reinforced concrete frame system subjected to in - plane loading. Three numerical models are proposed and their results are compared in terms of stiffness and strength of the structure. The role of the openings in the infill panel on the behavior is analyzed and discussed. The effect of gaps between the frame and the infill on the structural behavior is also investigated. Comparisons are made with the in-force Romanian and European regulations provisions.

Study of Masonary Infilled R.C. Frame With & Without Opening

Rahul P. Rathi 1 , Dr. P.S. Pajgade 2

A large number of buildings in India are constructed with masonry infills for functional and architectural reasons. Masonry infills are normally considered as non-structural elements and their stiffness contributions are generally ignored in practice. However, infill walls tend to interact with the frame when the structure is subjected to lateral loads, and also exhibit energy-dissipation characteristics under seismic loading. Masonry walls contribute to the stiffness of the infill under the action of lateral load. The term 'infilled frame' is used to denote a composite structure formed by the combination of a moment resisting plane frame and infill walls.

III. DETAILS OF THE STRUCTURE

The structural details of the structure are as follows
Type of building, Multi storied residential building
Floor to floor height = 3 m
Depth of foundation = 1 m
Bearing capacity of soil = 200KN/mm²
External wall thickness = 230mm
Column Size = 380mmX 300mm
Floor Beam Size = 300mmX 230mm
Plinth Beam = 300mmX 230mm
Typical Slab Size = 5mX3.5m
The total area of the built up area of the structure = 12m X 20m = 240 m2

STRUCTURE GEOMETRY

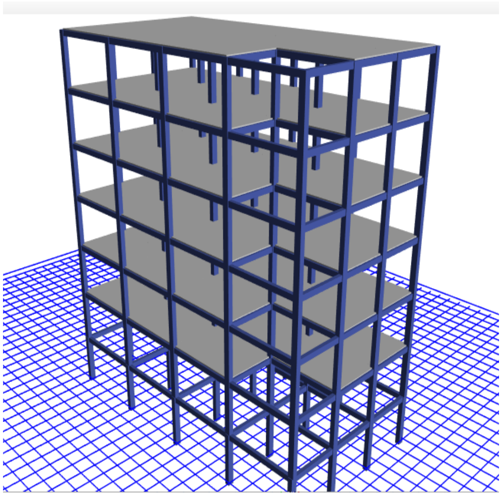


Figure 3.1. 3 D view of structure.

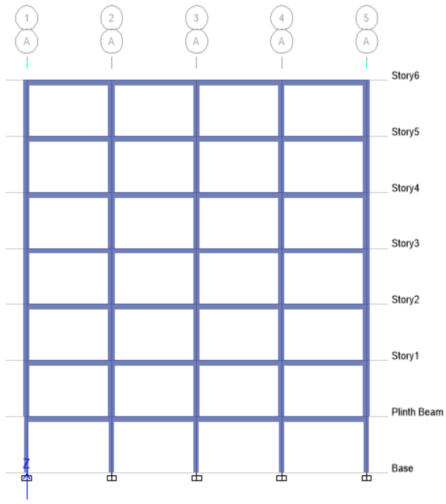


Figure 3.2. Elevation

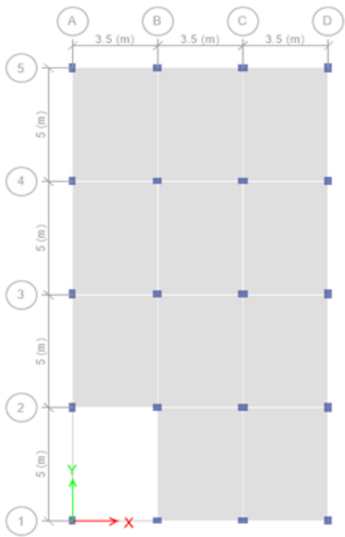


Figure 3.3. Location of Columns

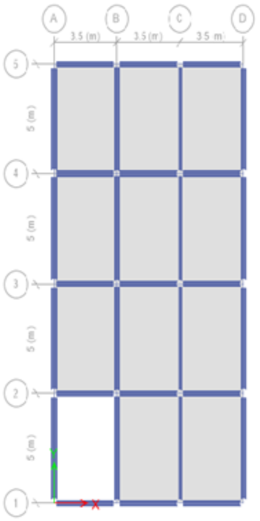


Figure 3.4. Location of Beams

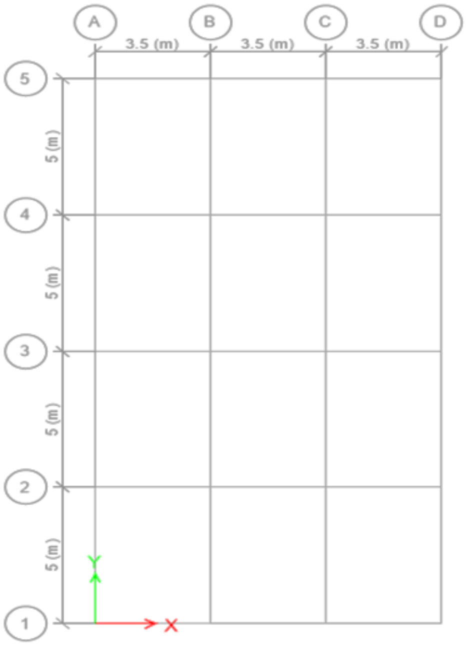


Figure 3.5. Grid Plan

IV. MATERIAL PROPERTIES

As per Is 456:2000

Grade of concrete=M20, M25, M30

As per Is 456:2000

Characteristic compressive strength of M20 grade :20N/mm²

Grade of steel: Fe 415

Density of concrete: 25 KN/m³

Assumed load : (as per Is 875:1987)

live load=2KN/m

dead load=3KN/m

floor finish=1KN/m²

factored load=10.5KN/ m²

LOAD CALCULATION:

Thickness of slab = 120mm

Dimension of beams = 300mm X 230mm

Dimension of Column = 380mm X 300mm

Dead load = 0.12 X 25 =3 KN/m²

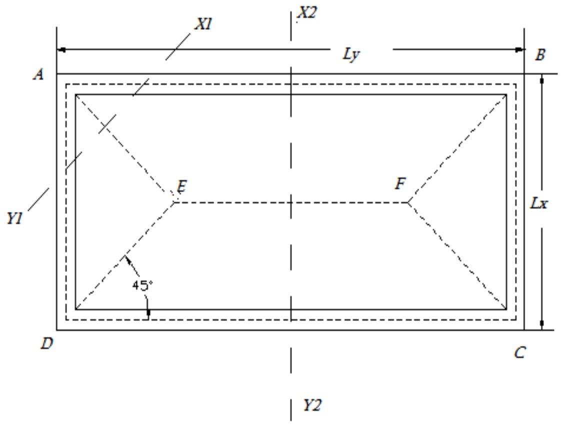
Sla Panel considered is 5mX 3.5m

Live Loads = 2 KN/m²

Floor finish = 0.05X 20

= 1 KN/m²

Total Load = 3+2+1 = 6 KN/m²



Ly = LONG SPAN, Lx = SHORT SPAN.

SIMPLY SUPPORTED SLAB SPANNING IN TWO DIRECTION

S1 is the slab numbering.

Self weight of beam= 0.3 X 0.23 X 25

= 1.725 KN/m

Load due to Brick wall = 0.23 X 3 X 20

= 13.8 KN/m

The loading is equivalent to uniform load per Unit length of the beam of the following amounts.

This calculation includes self wt. of beam also.

Load on $S_1B_1 = (\frac{wlx}{3})$ + self wt of beam + Load due to brick wall

= ((6X3.5)/3) + 1.725 + 13.8

= 7 + 1.725 + 13.8

= 22.525 KN/m

Load on $S_1B_2 = \left(\frac{wlx}{6}\right)(3 - (\frac{lx}{ly})^2)$ + self wt of beam + Load due to brick wall

$= \left(\frac{6X3.5}{6}\right)(3 - (\frac{3.5}{5})^2) + 1.725 + 13.8$

= 18.515 + 1.725 + 13.8

= 34.04 KN/m

Load on $S_1B_3 = (\frac{wlx}{3})$ + self wt of beam + Load due to brick wall

= ((6X3.5)/3) + 1.725 + 13.8

= 7 + 1.725 + 13.8

= 22.525 KN/m

Load on $S_1B_4 = \left(\frac{wlx}{6}\right)(3 - (\frac{lx}{ly})^2)$ + self wt of beam + Load due to brick wall

$= \left(\frac{6X3.5}{6}\right)(3 - (\frac{3.5}{5})^2) + 1.725 + 13.8$

= 18.515 + 1.725 + 13.8

= 34.04 KN/m

Similarly loads on all the slabs are calculated.

TABLE 4.1.Load distribution on beams for sixth storey

LEVEL	SLAB	D.L.	L.L.	F. L.	L_x	L_y	BEAM1	BEAM2	BEAM3	BEAM4
	S1	3	2	1	3.5	5	11.125	22.64	8.725	20.24
	S2	3	2	1	3.5	5	8.725	22.64	8.725	20.24
	S3	3	2	1	3.5	5	8.725	22.64	8.725	20.24
	S4	3	2	1	3.5	5	20.24	20.24	8.725	20.24
STOREY6	S5	3	2	1	3.5	5	8.725	20.24	8.725	20.24
	S6	3	2	1	3.5	5	8.725	20.24	8.725	20.24
	S7	3	2	1	3.5	5	8.725	20.24	11.125	20.24
	S8	3	2	1	3.5	5	11.125	20.24	8.725	22.64
	S9	3	2	1	3.5	5	8.725	20.24	8.725	22.64
	S10	3	2	1	3.5	5	8.725	20.24	8.725	34.04
	S11	3	2	1	3.5	5	8.725	20.24	11.125	22.64

V. Structure Results

Table 5.1. Structure results from E Tabs

LOAD CASE	FX KN	FY KN	FZ KN	MX KN-M	MY KN-M	MZ KN-M
Dead	0	0	20266.3751	204455.403	-107525	0
live	0	0	2310	24675	-123567	0
Comb1	0	0	33864.5626	343695	-18016	0
Dcon1	0	0	30399.5626	306683	-160552	0
Dcon2	0	0	33864.5626	343695.604	-105846	0

VI. MODEL WITH IN-FILLED FRAME STRUCTURE

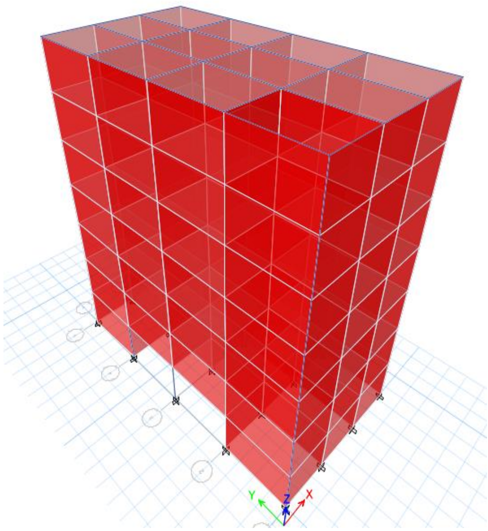
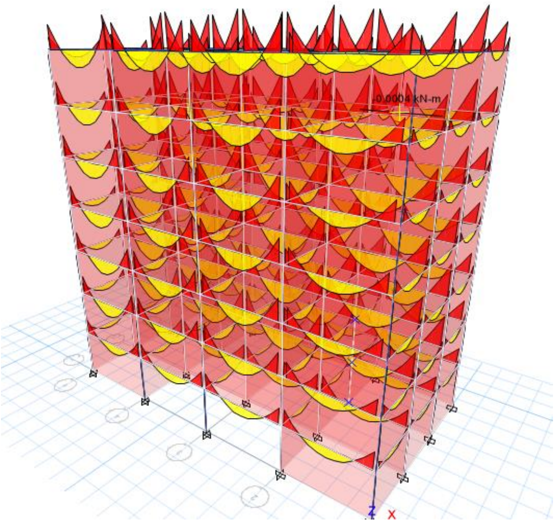
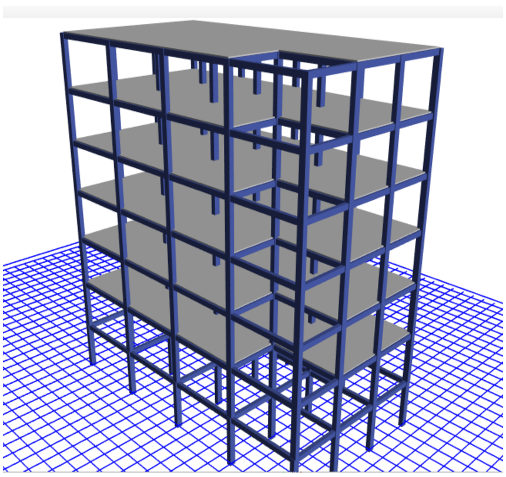


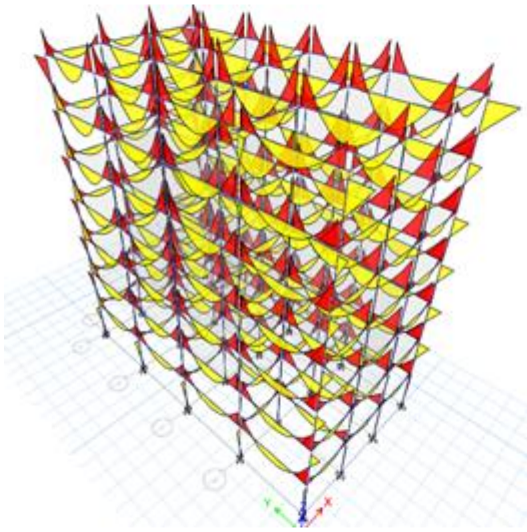
Figure 6.1 In-filled frame structure



The Bending Moment Distribution of The Infilled Frame Structure



Non Infilled Frame Structure



Bending Moment Distribution of Non Infilled Structure

Figure 6.2. Bending moment distribution of the in-filled frame structure)

VII. Summary

The comparative data of In-filled frame structure and the non In-filled frame structure is observed as shown in table given below.

The amount of deflection in beams is very less in In-filled frame structures as compared to non In-filled frame structure.

Table. 6.1 Comparison of deflection in both frames)

BEAM	IN-FILLED	NON IN-FILLED
B1 at story 5	2.8mm	7.14mm
B14 at story 4	2.87mm	6.8mm
B13 at story 3	2.05mm	5.9mm
B13 at story 5	2.05mm	6.3mm

VIII. CONCLUSION

- The brief discussion about the analysis and the comparative study is done in chapter 1
- The location of beam and column and the details of structure ,structure geometry, elevation, grid line marking, material property are explain in chapter

2with different figure from the software the entire work is done on E-TABS 2015

- The gravity loads analysis has been done using the software and the different factors like shear force, bending moment, deflection are calculated manually and obtained from software using the yield line method the distribution of loads from slab to beam is done and the distribution of loads in various beams is shown by using portal frames the tabular data is arranged on the basis of various loads in different beams in at different storey.
- Comparative study of filled and non infilled structure we have taken the different beams randomly from the frames after the analysis of the frame the magnitude of bending moment and magnitude of deflection and magnitude of shear force are compared and the results are shown
- As the deflection is found four times less in In-filled frame structure compared to that of Non In-filled frame structure which is conventional, The amount of reinforcement consumed is also less in in-filled frame structure which is cost consuming and economical

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