Dynamic Analysis of Open Ground Multistorey Building Using Response Spectrum Analysis in STAAD.Pro for Different Seismic Zone

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ABSTRACT

In these advanced days the Buildings are made to satisfy our essential perspectives and better Serviceability. Presence of infill walls within the frames refers the behavior of the building under lateral loads. However, it's a common experience, observe to ignore the stiffness of the infill frame for analysis of framed building. The infill strut provides the ability to reduce the lateral load in structures. In this work, the infill strut has been replaced at open first storey building to provide the maximum stiffness to the structure as compared to bare frame or normal OGS frame structure. The present work is done in STAAD. Pro software, which is a good agreement for seismic structure analysis. In this research work the analysis of seismic effect on residential building of G+4, G+7 and G+10 stories supported on a raft foundation for three seismic zones i.e. III, IV and V in India and obtained the storey shear, base shear, maximum deflection and base moment by using software. The dynamic analysis of structure is carried out using Response Spectrum Analysis as per the procedure read down in IS 1893:2002. The various results are obtained during analysis and these results are compared to bare frame and infill OGS frame and improve the design for future application.

Keywords: Open Ground Storey, Bare frame, Infill Frame, STAAD.Pro, Response Spectrum Analysis, Base Shear, Deformation, Base Moment.

1. Introduction

Reinforced concrete (RC) frame buildings are becoming increasingly common in urban India. Many such buildings constructed in recent times have a special feature – the ground storey is left open for the purpose of parking (Figure 1), i.e., columns in the ground storey do not have any partition walls (of either masonry or RC) between them. Such buildings are often called open ground storey buildings or buildings on stilts.

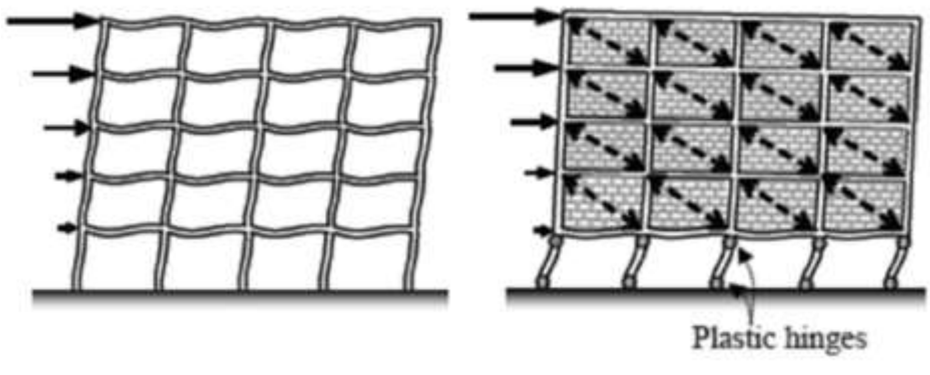


Fig 1.1 Typical Bare and Infill OGS Building Structure

An open ground storey building, having only columns in the ground storey and both partition walls and columns in the upper storeys, have two distinct characteristics, namely:

(a) It is relatively flexible in the ground storey, i.e., the relative horizontal displacement it undergoes in the ground storey is much larger than what each of the storeys above it does. This flexible ground storey is also called soft storey.

(b) It is relatively weak in ground storey, i.e., the total horizontal earthquake forces it can carry in the ground storey is significantly smaller than what each of the storeys above it can carry. Thus, the open ground storey may also be a weak storey.

2. Problem Identification

In this present work, three types of multi storey structure can be considered i.e. G+4, G+7 and G+10 with seismic zone III, Iv and V. It is analysed by Response Spectrum Analysis method and some response are determined like, base shear, storey shear, maximum deformation and base moment in structure. This work is an effort to obtained the effect of infill stiffness, storey height and plan irregularity in open ground storey (OGS) buildings and in order to predict a more realistic value of responses by considering different seismic zone and structure height.

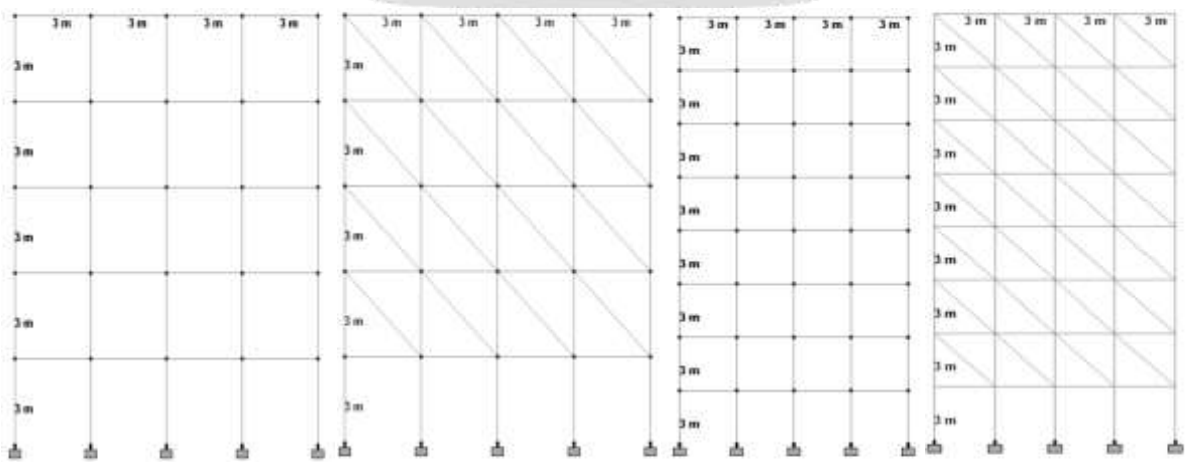
3. Methodology

The work is carried out on a (G+4), (G+7) and (G+10) Bare frame building and Infill open ground structure (OGS) building having rectangular shape plan with same plan area configurations. The building is considered to be located in Zone III, IV and V as per IS 1893:2002. The building is modeled using the software STAAD.Pro v8i. The dimensions of the beams, columns and slabs also the loads applied are summarized in the Table 1.

S. No.	Content	Detail
1	Type of Structure	Multi-storey rigid jointed plane frame (SMRF) Length of building = 12m, Width of building = 12m
2	Seismic Zone	III, IV and V
3	Number of stories	G+ 4, G+7 and G+10
4	Floors Height	3.0m
5	Type of soil	Medium
6	Size of column	400 mm X 400mm
7	Size of Beam	230 mm X 450mm
8	Live load	3.0 KN/ m^2
9	Floor Finishes Loading	1.0 KN/ m^2
10	Material	M 25 Grade concrete & Fe 415 Reinforcement
11	Unit weights	a) Concrete = 25KN/m^3, b) Masonry = 20KN/m^3
12	Total Height of Building	G+4= 15m, G+7= 24m, G+10= 33m
13	Thickness of Brick wall	230mm
14	Thickness of Slab	150 mm
15	Damping in Structure	5%
16	Importance factor	1.5
17	Density of Concrete	25 KN/m^3
18	Density of Brick Masonry	20 KN/m^3

3.1 Design and Analysis of Building

In the present investigation, a multi storey reinforced concrete frame building has been considered in order to project the seismic performance with an application of reinforced concrete frame.



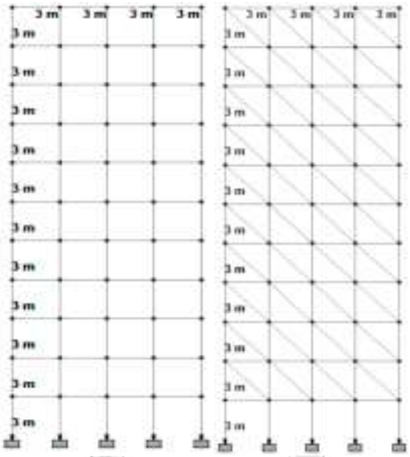
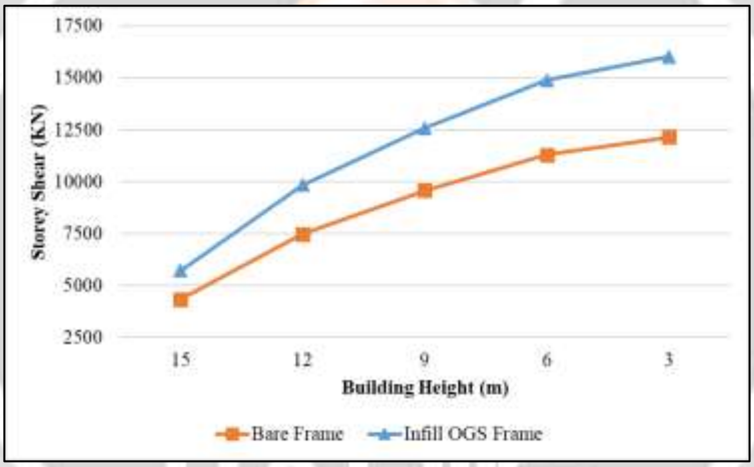


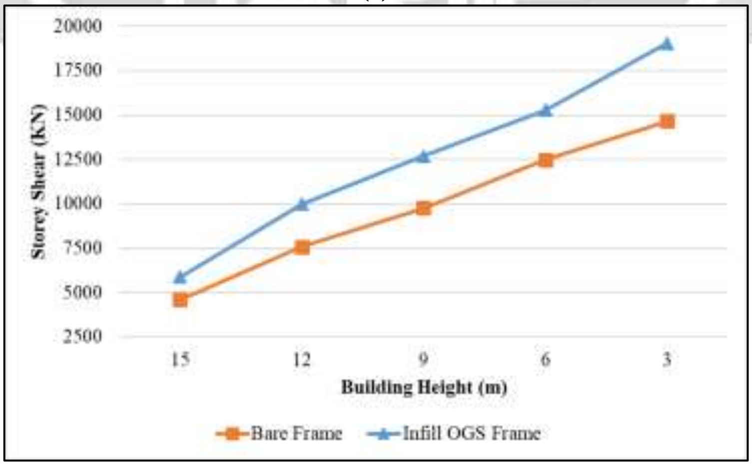
Fig 2. Bare Frame and Infill OGS Frame G+4, G+7 and G+10 model (basic frame model)

4. Results and Discussions

This work deals with the comparison of base shear, storey shear, deformation and base moment of G+4, G+7 and G+10 RCC structure. The comparison of static base shear for a structure with bare frame and infill open ground structure (OGS) frame in different seismic zones is carried out.



(a)



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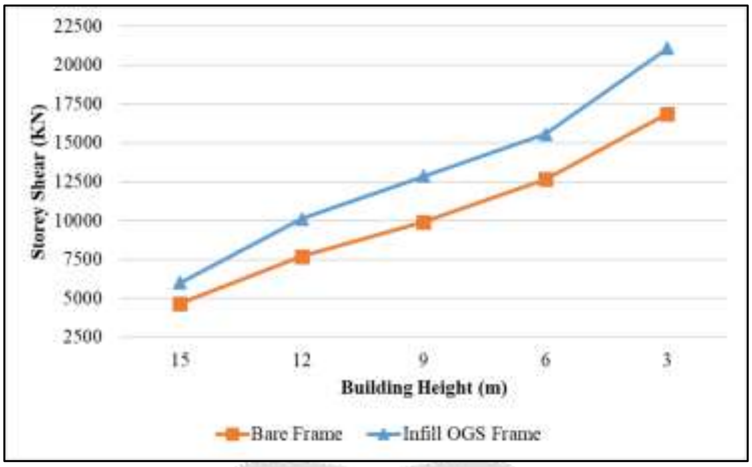
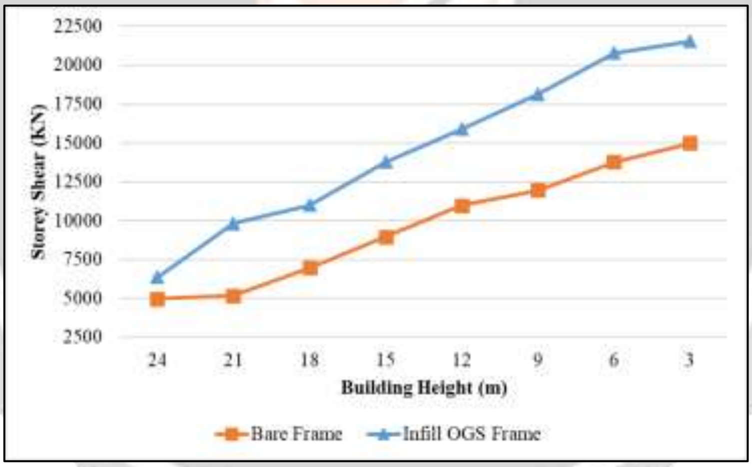
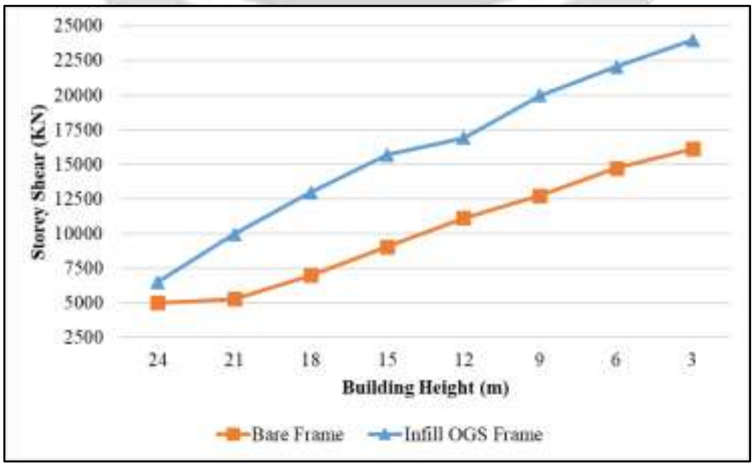


(c)

Fig 3. Graphical representation of storey shear formed in G+4 structure according to different height levels (a) For Zone III, (b) For Zone IV and (c) Zone III



(a)



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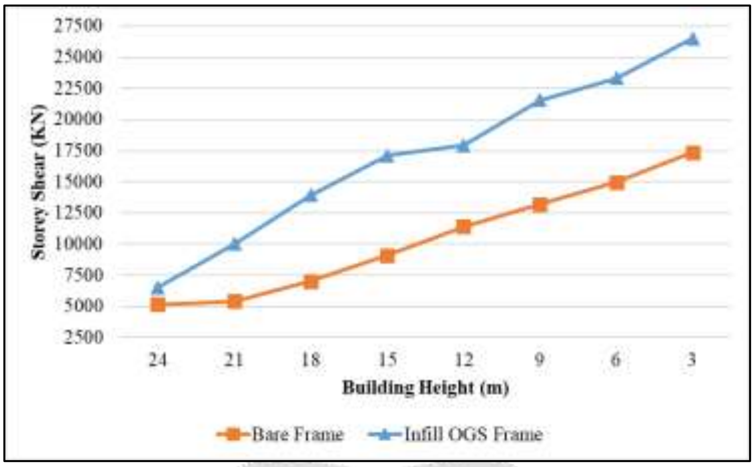
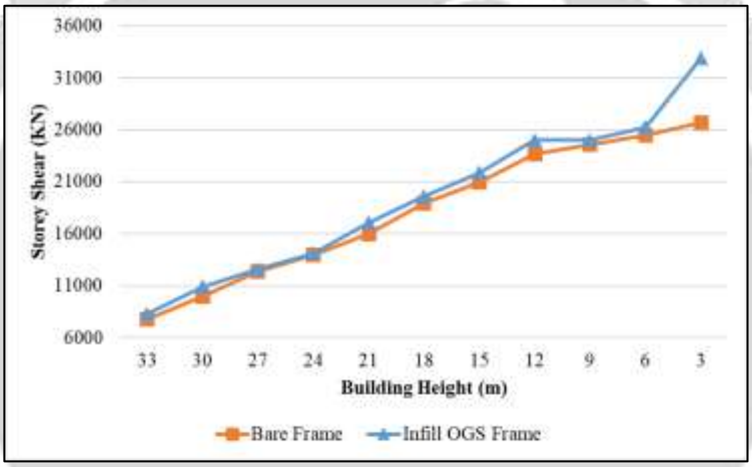
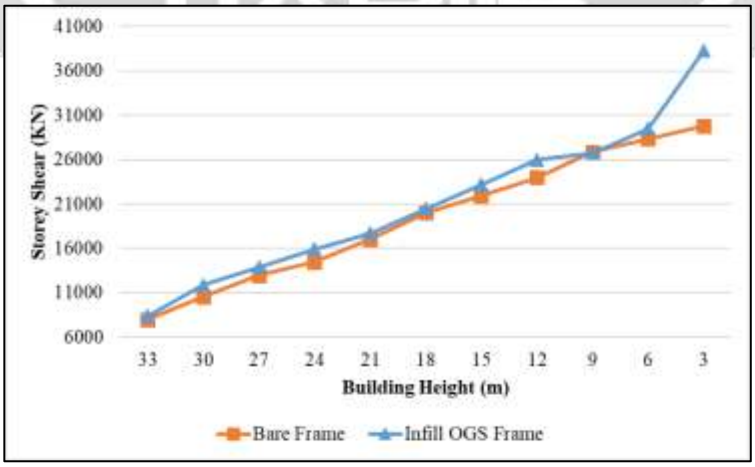


(c)

Fig 3. Graphical representation of storey shear formed in G+7 structure according to different height levels (a) For Zone III, (b) For Zone IV and (c) Zone IV



(a)



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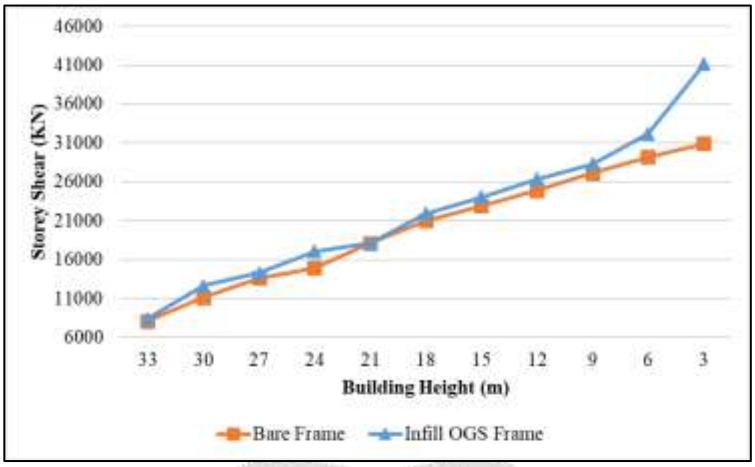

(c)

Fig 4. Graphical representation of storey shear formed in G+10 structure according to different height levels (a) For Zone III, (b) For Zone IV and (c) Zone V

5. Conclusion and Future Work

Conclusion

- Through various literatures it is clear that there is a possibility to enhance the quality of structure with the help of proposed model (Infill OGS Frame Structure).
- There is a good agreement to the Response spectrum analysis was carried out to gives effect of bare and infill frame on seismic behaviour of building and find the storey shear, base shear, maximum deformation and base moment for different seismic zone and storey structure.
- After discussion of the results, it is observed that, as the seismic zone of the structure rise up, the storey shear, base shear and base moments has been increases and maximum deformation should be minimum.
- From the above table, it can be concluded that the percentage improvement by using infill OGS frame has been gives more satisfactory values of base shear as compared to the bare frame with 32%, 44% and 23% for Zone III, 30%, 49% and 19% for Zone IV, 25%, 53% and 21% for Zone V respectively.
- From the above table, it can be concluded that the percentage improvement by using infill OGS frame has been gives more satisfactory values of maximum deformation as compared to the bare frame with 32%, 34% and 37% for Zone III, 22%, 27% and 32% for Zone IV, 21%, 24% and 27% for Zone V respectively.
- Also, it can be concluded that the percentage improvement by using infill OGS frame has been gives more satisfactory values of base moment as compared to the bare frame with 16%, 20% and 23% for Zone III, 16%, 19% and 21% for Zone IV, 18%, 20% and 9% for Zone V respectively.
- For base shear, the magnification factor of infill OGS frame are range from 1.319, 1.300 and 1.249 for G+4 structure under Zone-I, 1.438, 1.489 and 1.527 for G+7 structure under Zone -IV, and Finally 1.044, 1.054 and 1.067 for G+10 structure under Zone -V respectively.
- From collecting information of the above discussions, it should be concluded that the infill OGS frame gives maximum performance as compared to the bare traditional frame.

Future Work

- Open ground storey (OGS) buildings have been most common nowadays and are constructed heavily in high populated countries like India since they provide much needed parking space in an urban environment.
- The future work can involve changing the type of building (irregular building) and carry out future research by other software or methods.
- In future for below 10 storey buildings can be designed without shear wall and for upper 10 storey can apply shear walls.

- In future it should be work in the area of magnification factor (better design less than 2.5).

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