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Study of Linear and Non Linear Behavior of In filled Frame

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ABSTRACT
Reinforced concrete frame buildings often incorporate masonry infill panels as partitions to separate spaces within a building or as cladding to complete the building envelope. However, the properties and construction details of infilled panels can have a significant influence on the overall behavior of a structure. An infilled frame typically consists of a steel or reinforced concrete frame with plain or reinforced brick masonry, block-work infilling which restraint against lateral loads is provided by the composite action of the infill and the frame. With the advancement of computational technology and ever going increasing trend of research activities, the demand for inelastic design is increasing day by day. Since the brick masonry wall possesses highly heterogeneous, non-linear studies are inevitable. In this work, a study of non-linear behavior of reinforced concrete infilled frame with brick masonry are carried out under lateral and combined loads using ANSYS software.
***Keywords* -** *Brick masonry, Displacement, Infilled frame, Lateral and combined loads, nonlinear analysis*

I. INTRODUCTION

The tremendous pace of urbanization of rural areas and ever increasing population in urban areas has necessitated the increase in the construction of multistoried buildings in order to optimize accommodation in vertical direction and there by minimize the space in horizontal direction. Added to this, introduction of high strength materials, new design concepts, new structural systems and modern construction methods have made possible to construct sky scrapers by reinforced concrete frames with infill panels.

The infilled frame, a structure combining the frame with the infill within the frame, has better lateral resistance potential and therefore, attracted the investigator's attention since the fifties of the present century. They are widely constructed using brick masonry infill walls. Studies on non-linear behavior of infilled frames are limited. In present study an attempt has been made to understand the linear and non-linear behavior of one-bay multistoried reinforced concrete frames with brick masonry infill.

II. OBJECTIVE

The objective of the present study is to compare the linear and nonlinear behavior of single bay four storey reinforced concrete infilled frames for different relative stiffness of frame with infill subjected to lateral load and combined load up to the ultimate load resisted by the infilled frame. Lateral deformation of infilled frames are compared and discussed.

III. MODELLING APPROACH

In the present study, finite element method of analysis has been used to take care of surface contact between masonry infill and the members of the bounding frame consisting of beams and columns. A typical finite element idealization of infilled frame is presented in fig 1 (a) & (b) Based on dimensions of bounding frame members and the thickness of infill considered, four relative stiffness values of 3.52, 7.04, 11.85 and 14.69 have been chosen for the study representing very rigid, rigid, flexible and very flexible frames. The details of frame members are given in table 1.

Sl. No.	Relative Stiffness (λh)	Beam/Column cross sectional dimension (mm)		Flexibility of frame
		b	d	
1	3.52	400	400	**Very Rigid**
2	7.04	200	200	**Rigid**
3	11.85	200	100	**Flexible**
4	14.69	200	75	**Very Flexible**

Table 1. Relative stiffness and corresponding member sizes of the bounding frame

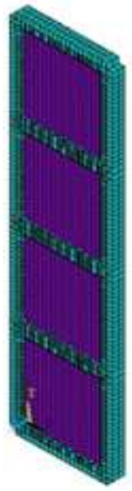


Fig. 1 (a)

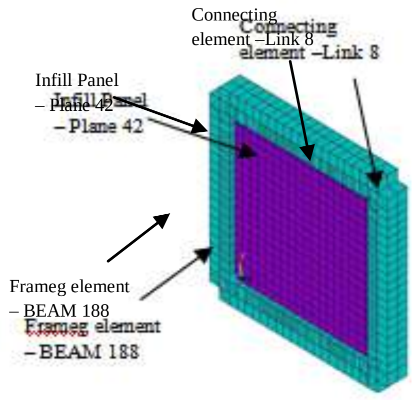


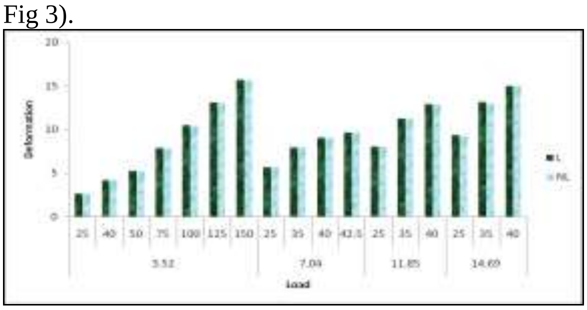
Fig. 1 (b)

IV. ANALYSIS AND RESULTS

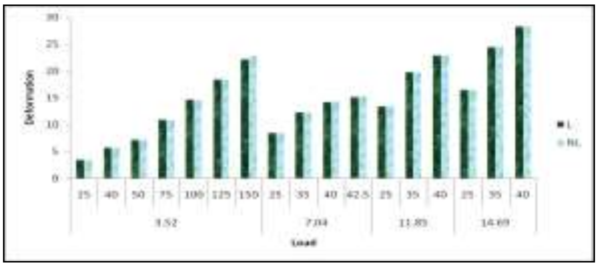
Lateral deformation of infilled frame of different relative stiffness [i.e., for relative stiffness 3.52 , 7.04, 11.85 and 14.69] are shown in figure for the cases of i) Full contact and ii) Separation subjected to lateral load and combined loads.

Lateral deformation under lateral load and combined load is observed to be same in both the case of linear and nonlinear analysis in case of full contact, however in case of separation the lateral deformation in non-linear analysis is observed to be higher than the linear analysis for higher loads. It is observed that in a very rigid frame of RS = 3.52 for a higher load case of 150 kN the deformation is higher by 2.68% under lateral load and 2.77% under combined load in case of nonlinear analysis when compared with linear analysis. Hence the material non linearity effect is seen when the infilled frame is subjected to load of higher magnitude (150kN) resulting in larger deformations.

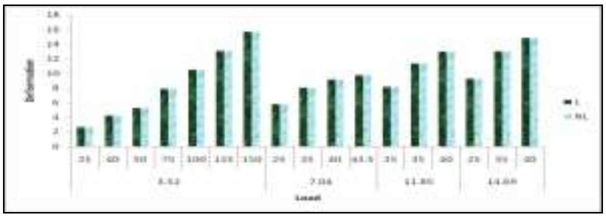
It is also observed that in case of full contact addition of imposed load along with the lateral load (combined load) do not show any reduction in the lateral deformation in both linear and nonlinear analysis. However in case of separation lateral deformation gets reduced due to combined load compared to the infilled frame subjected to only lateral load in both the types of analysis (Fig 2 and Fig 3).



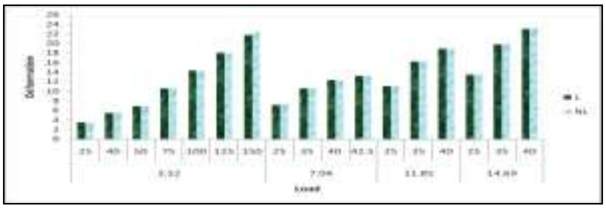
A) Full Contact



b) Separation
Fig 2. Variation of Load v/s Deformation of infilled frame subjected to Lateral Load

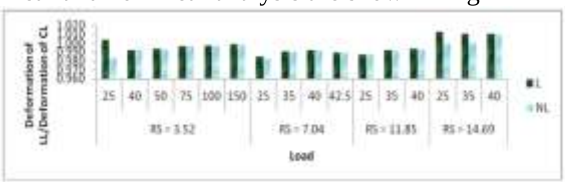


a) **Full Contact**

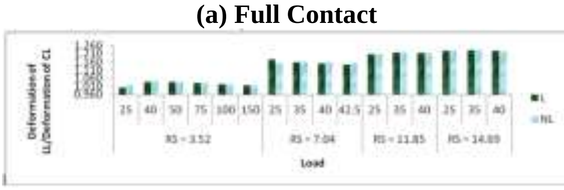


b) **Separation**
Fig 3. Variation of Load v/s Deformation of infilled frame subjected to Combined Load Effect of lateral load on combined load

The ratio of lateral deformation of lateral load by combined load for different relative stiffnesses in case of full contact and separation and in both case of linear and nonlinear analysis are shown in fig 4



(a) Full Contact



(b) Separation
Fig 4. Ratio of deformation of lateral load by combined load v/s relative stiffnesses

In case of full contact it is observed that for λh = 3.52, 7.04 and 11.85 (very rigid to flexible frame) deformation due to combined load is higher i.e., the ratio of lateral deformation of lateral load by combined load is less than 1, this indicates that the deformation due to combined load is higher than

lateral load but in case of very flexible frame λh = 14.69 the deformation due to lateral load is higher (ratio is >1).
In case of separation from fig 4(b) it is observed that the ratio of deformation in infilled frame λh =
3.52 (very rigid frame) the ratio is found to be 1 and with the increase in relative stiffnesses λh = 7.04 to 14.69 the ratio of deformation is about 1.1 which indicates that the combined load reduces the lateral deformation compared that due to lateral load.

V. CONCLUSION

1. The magnitude of lateral deformation was found to be higher in case of nonlinear analysis compared to linear analysis for higher loads (greater than 50 kN) for separation, however in case of full contact the lateral deformation remains same in both in linear and nonlinear analysis irrespective of the intensity of load.
2. In both linear and nonlinear analysis in case of full contact the effect of combined load in reduction of lateral deformation is lesser compared to lateral load, however it shows a marginal increase for higher relative stiffnesses.
3. In case of separation the lateral deformation remains same when subjected to either lateral load or combined load for lower relative stiffness (λh = 3.52), but with the increase in relative stiffness λh =
7. 04, 11.85 and 14.69 combined load reduces the deformation (where ratio of deformation of lateral load by combined load > 1).
4. The lateral deformation increases with increase in relative stiffness in both case of contact under lateral load and combined load and in both types of analysis.

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