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Evaluation of RC Framed Structures with Strut Using Response Spectrum Analysis

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Abstract - The usual practice of analyzing the reinforced concrete framed structure is to analyse it as skeleton members which has columns, beams and slabs. But in reality structures also comprises masonry infill. Due to its complexity of modeling it has excluded. Most of the research works have proved that the masonry infill possess strength and stiffness to the structure. In this present study, the reinforced concrete frames with masonry infill are modeled and analysed using ETABS. The models are analysed using ETABS for one aspect ratio by using the equivalent strut width formula given by past researchers. By replacing the masonry infill with this equivalent strut which has same properties that of masonry infill, models are modeled and Response spectrum analysis is carried out. The strut width is reduced by using reduction factor and same analysis has been repeated. The analytical results such as storey drift, storey displacement and storey stiffness are obtained and compared with different relative stiffness. Response spectrum analysis is performed by using ETABS by replacing the masonry by equivalent strut for G+8 reinforced concrete frames for varying relative stiffness and for one aspect ratio. The strut width is reduced upto 50% and behaviour of the structure is observed. The parameters such as storey displacement, storey drift and storey stiffness are obtained and compared. It is observed that as the reduction in strut width increases the displacement is more which leads to decrease in stiffness.

Keywords –Strut width, Reduction factor, Response Spectrum analysis.

1. INTRODUCTION

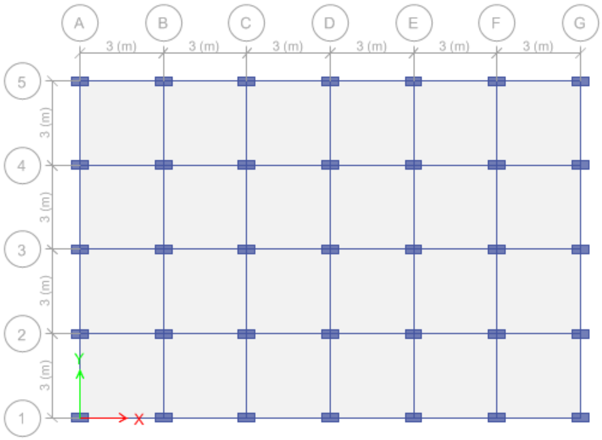
Reinforced concrete frame structures strut mainly used in commercial and industrial purpose. This infill's constructed masonry or concrete blocks. This structure can be consisting of in between columns and beams. This infill mainly consisting of bricks, stones, marbles, granites, lime stones and glass blocks.

Provides brick and stone blocks it increases the thermal mass of structures. Provide masonry walls it gives good fire protection. This masonry or concrete blocks requires skilled supervision and labour.

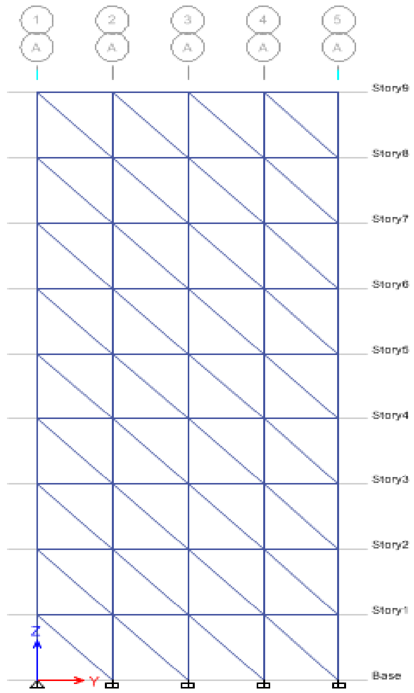
In present design practice in India the infill panels are non structural member because of strength and stiffness is ignored. The infill increases the axial forces in column and it decreases the displacement, lateral deflection and bending moment of the reinforced concrete framed structure.

2. METHODS OF ANALYSIS

2.1 RESPONSE SPECTRUM ANALYSIS

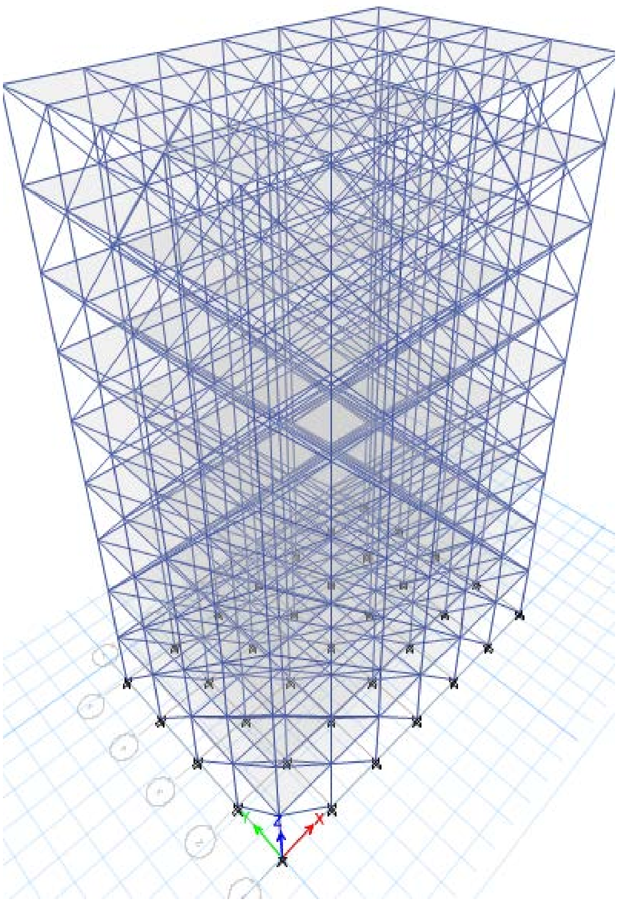


PLAN OF THE BUILDING



ELEVATION OF BUILDING

The use of response spectrum in seismic analysis. It is representation of effect of maximum response (maximum velocity, acceleration and displacement) with the natural period of a single degree of freedom system to a forcing function. The natural period of system plotted against by maximum response. In response spectrum we need natural period and to find the maximum response .once the response spectrum corresponding to a specified forcing function available. The response spectrum most commonly used in earth quake engineering.



3-D VEIW OF THE BUILDING

3. PREVIOUS WORK

Bharath H K and Sanjay S J (2015) have proposed formulae for width of the strut and reduction factor for different aspect ratio .for

ASPECT RATIO=1

W=exp [-1.26524+0.13996-0.04627*(λh) ²]*d*R

R= exp [0.02229-6.54515+1.26224*(A) ²]

ASPECT RATIO=1.5

W=exp [-1.46907+0.24469-0.07601*(λh) ²]*d*R

R= exp [-0.01185-4.8321-1.08327*(A) ²]

ASPECT RATIO=2

W=exp [-0.77016-0.78968=0.11449*(λh) ²]*d*R

R= exp [-0.01801-3.67749+0.58963*(A) ²]

They have obtain this formula by comparing micro and macro models with varying opening ratios. They have conducted response spectrum analysis for column size 230mmx500mm by selecting randomly. As per their work frames having high aspect ratio have maximum storey displacement.

4. PROPOSED METHODOLOGY

In this present study, the reinforced concrete frames with masonry infill are modeled and analysed using ETABS. The models are analysed using ETABS for one aspect ratio by using the equivalent strut width formula given by past researchers. By replacing the masonry infill with this equivalent strut which has same properties that of masonry infill, models are modeled and Response spectrum analysis is carried out. The strut width is reduced by using reduction factor and same analysis has been repeated. The analytical results such as time period, base shear, storey drift, storey displacement and storey stiffness are obtained and compared with different relative stiffness.

5. EXPERIMENTAL RESULTS

5.1 RESPONSE SPECTRUM MODELS

A G+8 storey, 6-bay by 4-bay reinforced concrete building is considered.

COLUMN AND BEAM SIZES	
C1	300X600
C2	200X600
C3	230X500
C4	300X450
C5	200X450
C6	300X300

Floor height	:	3m
Slab thickness	:	150 mm
Concrete grade	:	30
Zone factor	:	0.10
Soil type	:	II
Live load	:	3KN/m²

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ASPECT RATIO=1

W=exp[-1.26524+0.13996-0.04627*(λh)²]*d*R

W= Width of strut

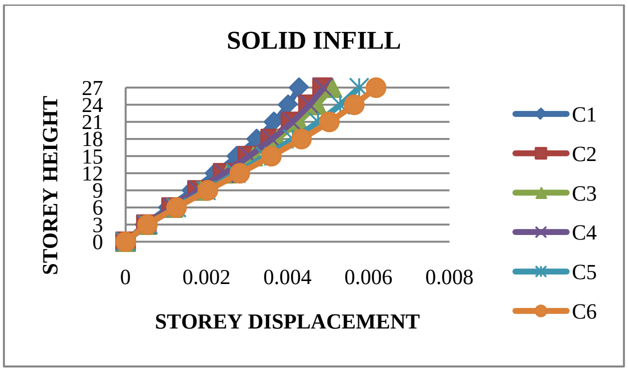
λh= Relative stiffness

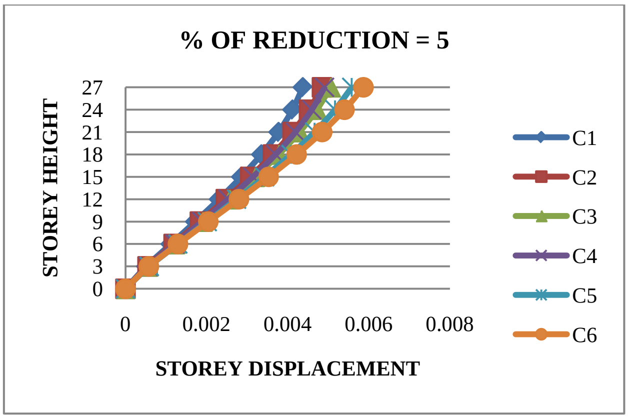
d= Length of diagonal strut

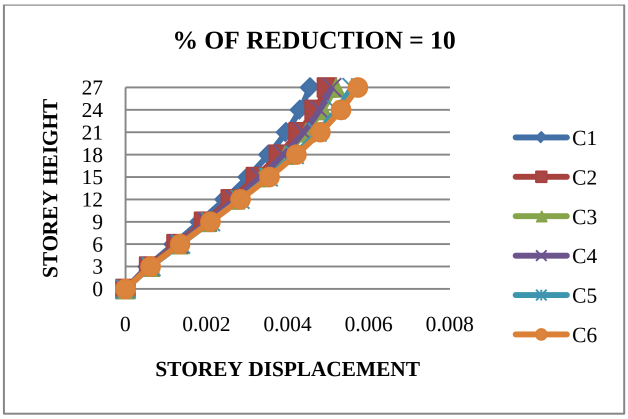
R= Reduction factor which is as below,

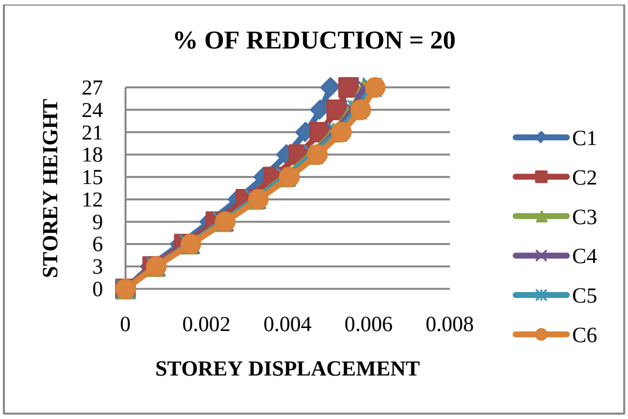
R=exp[0.02229-6.54515+1.26224*(A)²]

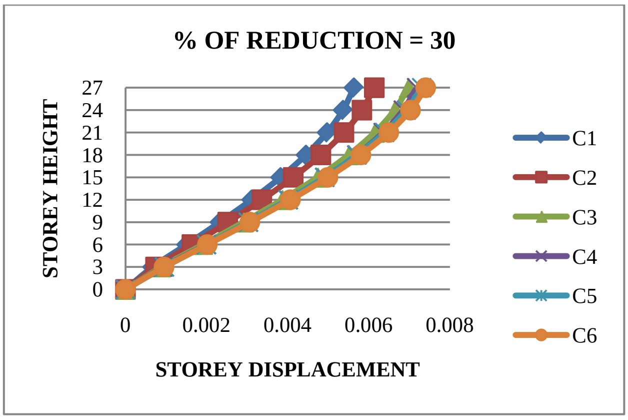
5.2 COMPARSION OF STOREY DISPLACEMENT WITH RESPECT TO STRUT WIDTH REDUCTION IN RSX

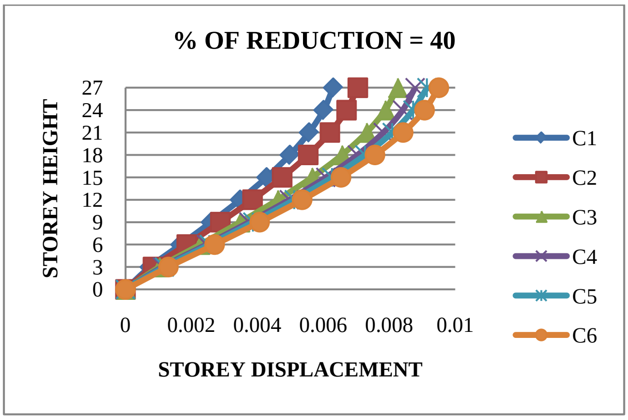


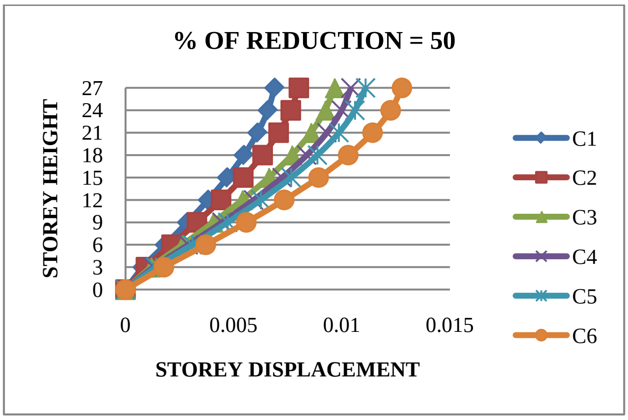




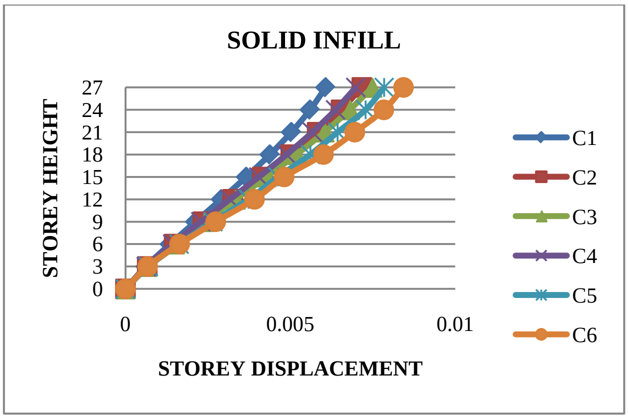


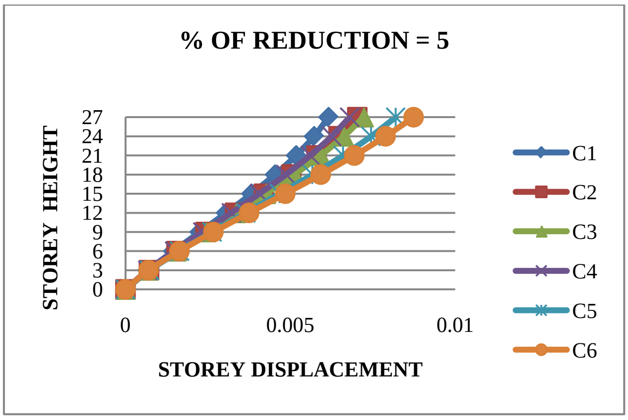


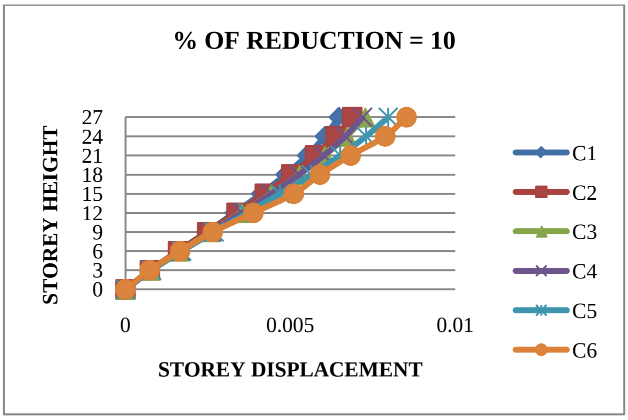


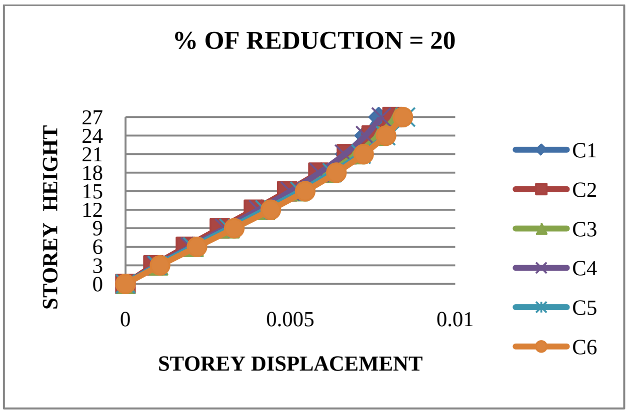


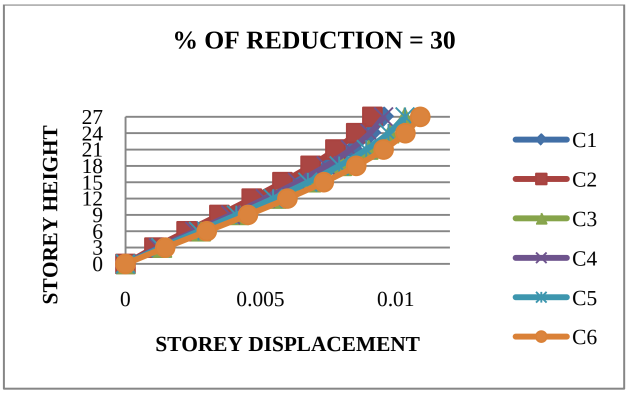
5.3. COMPARSION OF STOREY DISPLACEMENT WITH RESPECT TO STRUT WIDTH REDUCTION IN RSY

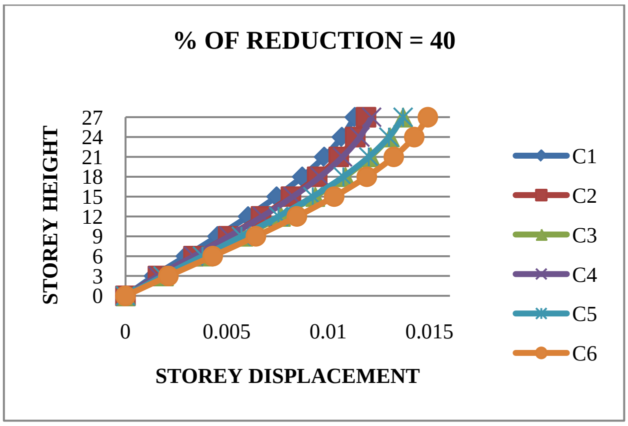


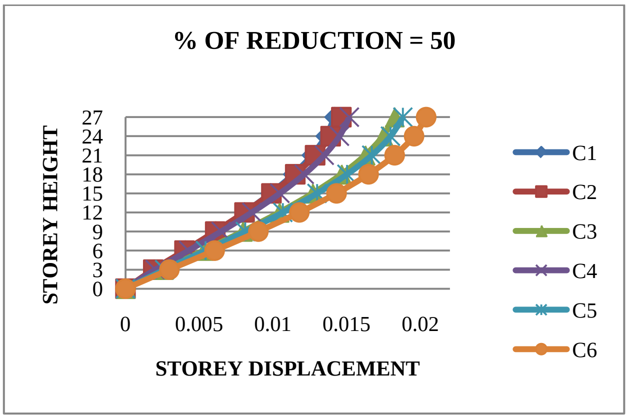




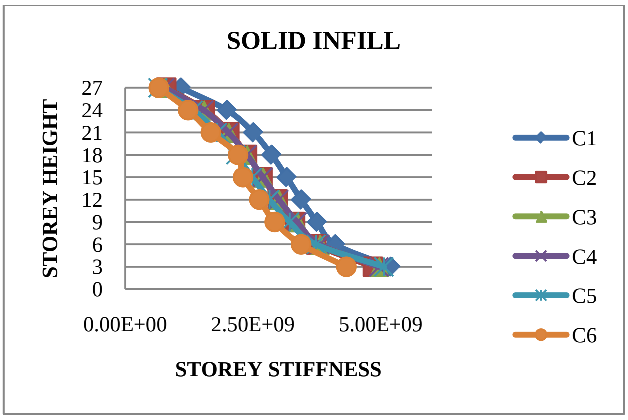


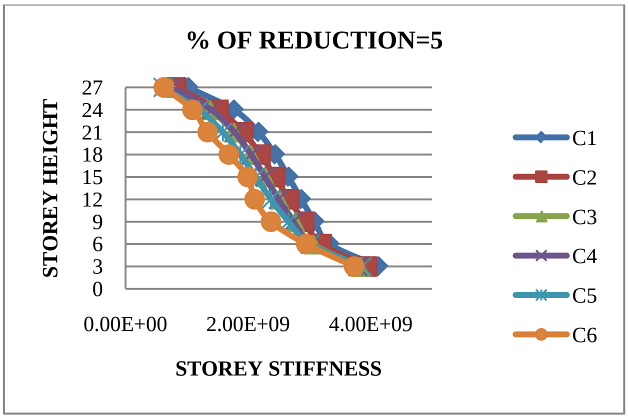


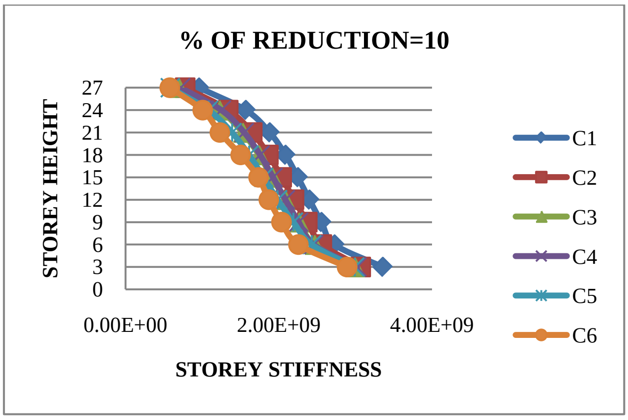


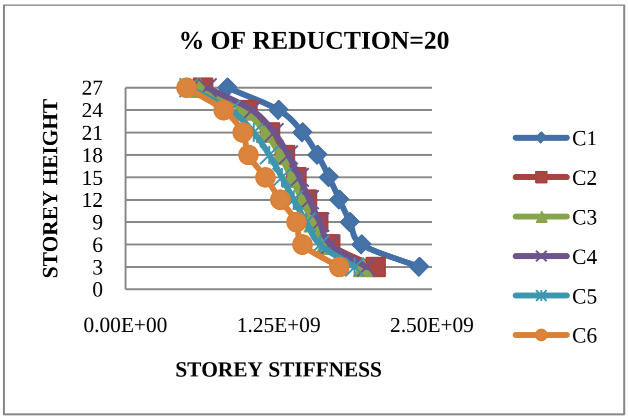


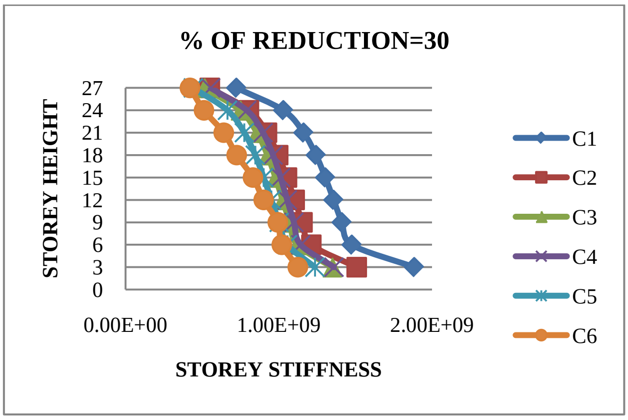
5.4 COMPARSION OF STOREY STIFFNESS WITH RESPECT TO STRUT WIDTH REDUCTION IN RSX

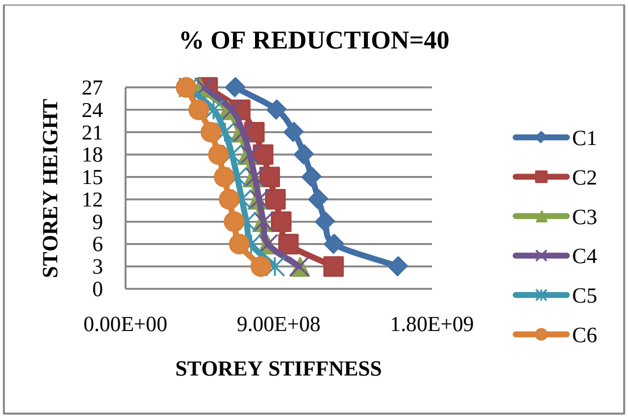


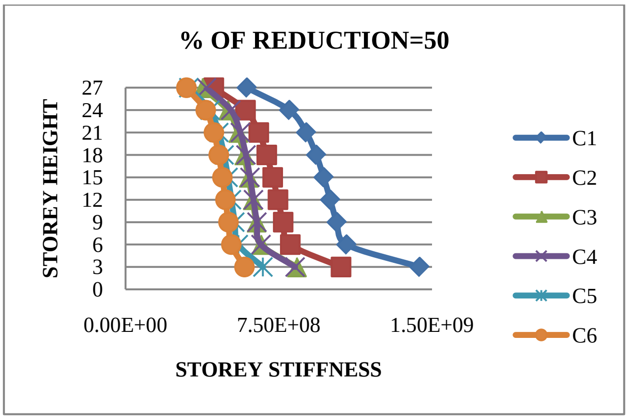




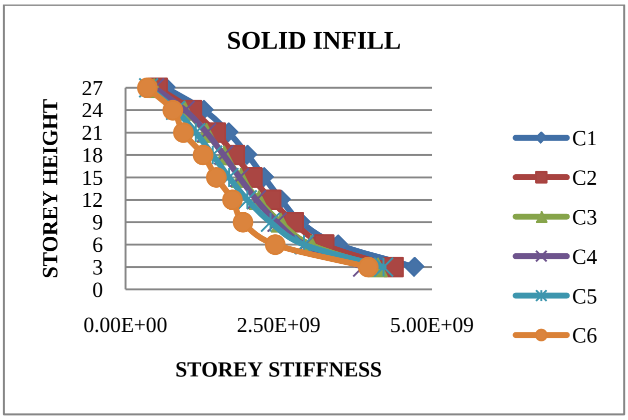


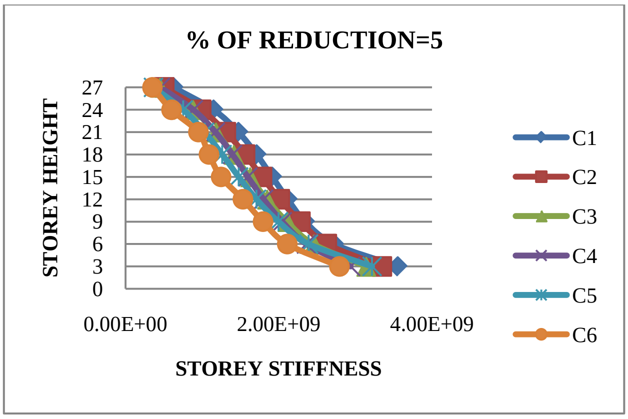


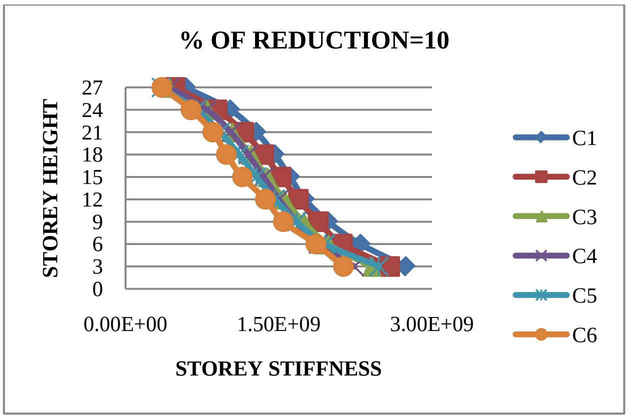


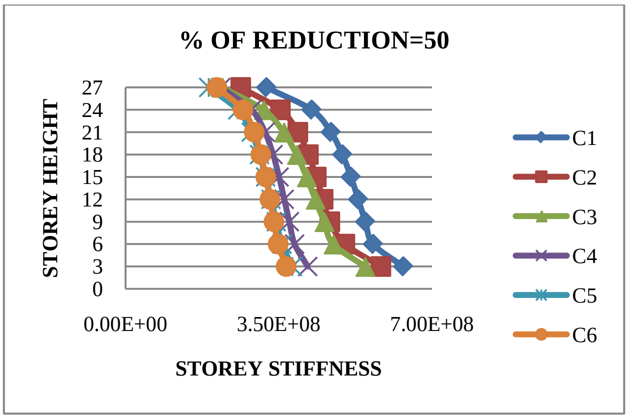


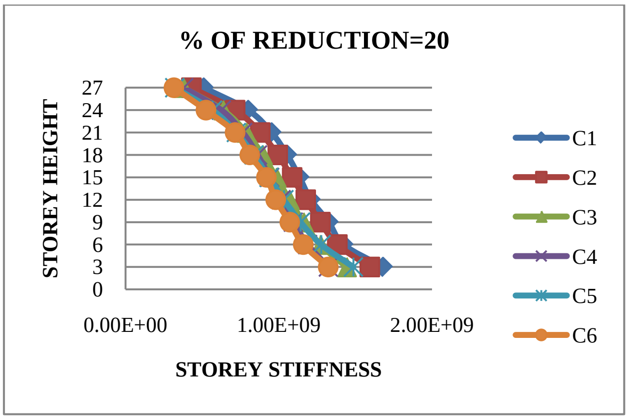
5.5 COMPARSION OF STOREY STIFFNESS WITH RESPECT TO STRUT WIDTH REDUCTION IN RSY

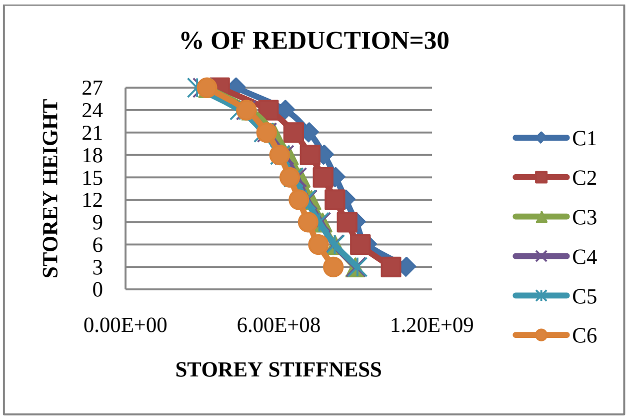


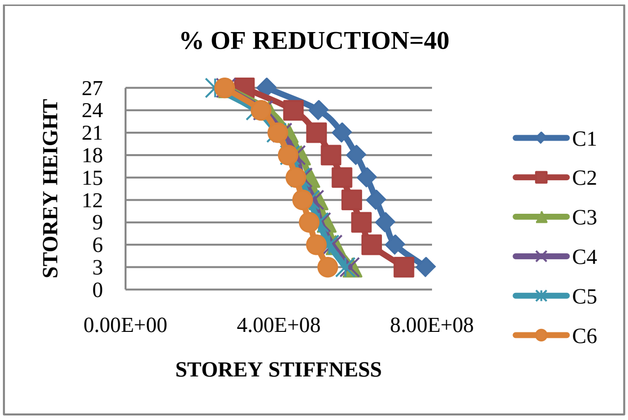












6. CONCLUSION

- From this study column having high relative stiffness posses maximum storey displacement.
- Storey displacement gets increased as the reduction in strut width increases.
- Column having high relative stiffness that is C6 has maximum storey displacement in both RSX and RSY condition.
- Column having low relative stiffness will have minimum storey drift.
- As the reduction in strut width increases storey drift gets increased.
- Storey drift in x–direction is more compare to Y-direction in both RSX and RSY condition.
- Column having high relative stiffness posses minimum storey stiffness.
- Storey stiffness gets decreased as the reduction in strut width increases.
- Column having high relative stiffness that is C6 has minimum storey stiffness in both RSX and RSY condition.
- Frames having solid infill has minimum storey displacement hence it posses maximum storey stiffness when compared to other frames.

7. FUTURE SCOPES

- Same analysis can be conducted for varying aspect ratios.
- Different size of columns can be adopted.
- Time history analysis can be conducted.

- Push over analysis can be conducted.
- Different varying storey heights can be adopted.
- Analysis can be conducted by adopting different grades of concrete and steel.
- Double strut can be adopted

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