Shear and Bending Response of RC Captive Columns from the Lateral Load

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Abstract

For functional or aesthetic reasons a huge number of Reinforced Concrete (RC) structures are built with workmanship infill. For architectural necessities sometimes window or ventilator openings introduced in the wall. Due to these openings captive-column effect is formed in RC developments with such halfway brick work infill prompts genuine quake shear harms in sections. To reduce the potential for captive-column damage induced by partial infill and the RC frames behaviour with partial masonry infill under lateral loading is studied in present work. The instance of short sections subjected to seismic tremor impacts is incorporated. A RC portal frame of span 5m and 3.5m height having opening percentages of 0.1%, 0.33% and 0.55% were introduced. It has been observed from the results that, there is a linear variation in the displacement up to 85%. There is an increase in the Bending moment of Leeward column curve shows the strut action. Also, there is a decrement in lateral stiffness ratio curve with respect to increase in opening area ratio curve which shows the sudden variation in opening area ratio. There is an increment in shear force up to 45% of H0/H ratio.

Keywords- *Captive column, portal frame, masonry infill, lateral load*

I. INTRODUCTION

A. *General*

It is a general practice in developing countries to provide brick masonry infill walls between the columns and beams of reinforced concrete frame structures. Such composite structures formed by the combination of a moment resisting plane frame and infill walls is termed as "in-filled frames" When subjected to gravity loads only, the infill walls only contribute their self-weight to overcome loads. However, an infill wall will also participate in resisting load through interaction with adjacent structural elements under lateral loads. These infill walls when compressed will carry a part of the load by providing strut action to the frame. Therefore, the infill walls contribute a surplus benefit during the times of earthquakes and their effect needs to be considered during analysis of in-filled frames.

In majority of hospitals, academic institutions and commercial complexes, partial in-fills are provided to attain light within the rooms. Partial in-fills are provided in some of the cases like high narrow windows on tall window sills; where openings are provided at the top level of the panel for lighting and ventilation generally in institutional class rooms, store rooms, doctor's consulting rooms (hospitals) and so on. Such gaps provided for light and ventilation purposes result in captive column effect as shown in fig. 1. It can be seen that the captive columns created damages by breakage of the column on the unsupported height.

Fig. 1: Failure Pattern Due to Captive Column Effect

B. *Objectives*

It can be seen from various past structure, that captive column could cause a serious damage to the structure if it is not considered during design of the structure. In order to avoid the consequences of captive column, it is required to know the behaviour of structure with captive column. Keeping this in view the objectives for the present work are chosen as follows:

- To find the effect of length and size of captive columns when it is subjected to lateral load
- Finding the Shear force and Bending moment of the column based on various heights, arrangements and opening of non-structural masonry walls, by using analysis software called SAP2000
- To find the effect of position and percentage of opening in masonry infill to captive columns.

1) *Methodology*

In this unit the methods which have been used in this topic are explained. There is some basic information about the software (SAP2000) which is used in this thesis. In this chapter macro model and micro model are the two types of methods are followed. Macro and micro model procedures are explained here and also loading details, material properties, section properties are designed here auto cadd drawings are drawn. Modelling procedure have done by keeping Wo/W ratio 0.1 as constant and height Ho/H ratio are varied . Same procedure is repeated by keeping Wo/W ratio 1 as constant. There will be decrease in the diagonal strut action when the percentage of opening increases in the wall.

*2) **Result and Discussion***

In this chapter the numerical result values are tabulated and discussed. The result values are graphically represented, the failure of strut action can be easily determined. 1) Displacement, 2) Shear force, 3) Stiffness, 4) Lateral stiffness, 5) Shear force of Leeward columns, 6)Bending moment of Leeward column, 7)Bending moment of windward column, 8)Bending moment of windward column and Leeward column, these are the result parameters which have been used in this chapter

*3) **Conclusion***

It contains the general conclusions they are drawn from the present investigation using different models and suggestions for the future work.

II. METHODOLOGY

A. Model Description

In the last two decades it became clear that one single strut element is unable to model the complex behaviour of the infilled frames. As reported by many researchers (Reflak and Faijfar 1991; Saneinejad and Hobbs 1995; Buonopane and White 1999), the bending moments and shearing forces in the frame members cannot be replicated using a single diagonal strut connecting the two loaded corners. More complex models are called micro mode are too proposed.

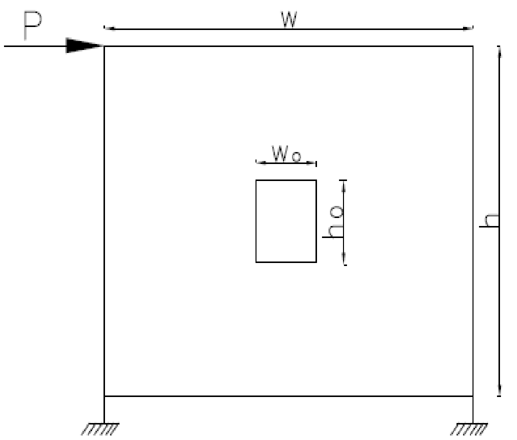

Fig 2: Infill Frame with Opening

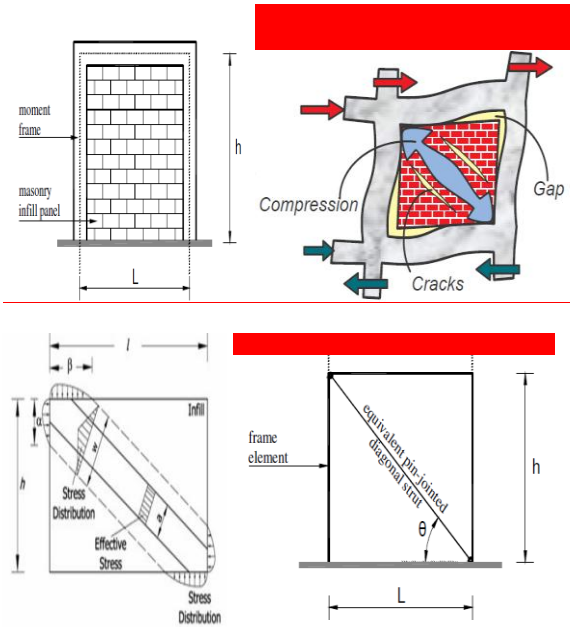

Fig.3: Diagonal Strut Model Showing the Influence of Infill Wall in a Frame

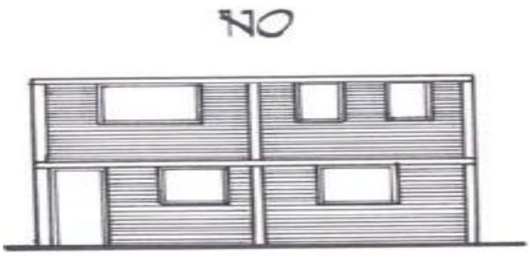

Fig.4: Poor Location of Windows and Door Opening

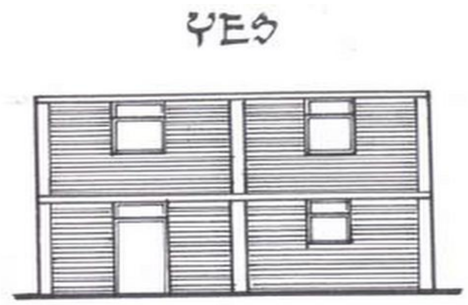

Fig.5: Good Location of Windows and Door Opening

The frame members of the RC frame are modelled with two dimensional elements having three degree of freedom at each node. A masonry infill panel is represented by two dimensional four node rectangular plane stress elements having two degree of freedom at each node. The contact between infill and corresponding bounding frame is represented by short and very stiff three dimensional elements known as link elements. After running the analysis, the axial forces in the link elements are checked and link elements that are in tension are identified and removed. This iteration process is continued till no link elements are in tension. The final stiffness of the frame is calculated for the frame with no tension link elements.

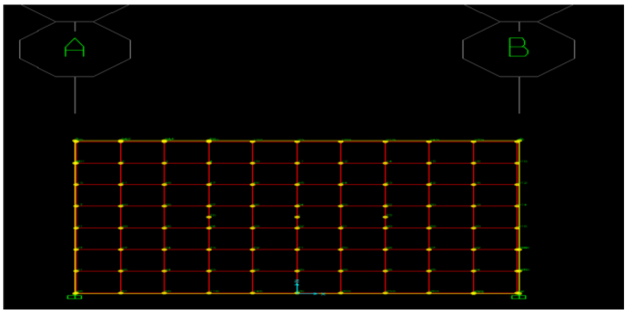

Fig.6 Full Infill Frame Model

B. Structural Model Frame Details

Table I: Details of the Frame Model

Sl. No	Type Of Structure	Frame
1.	Frame Height	3.5m
2.	Frame Width	5.0m
3.	Wall Thickness	200mm thick
4.	Design Member	All members of the frames are rigid jointed.
5.	Model Type	Shell thick

1) Load Patterns

Load case name and load case type are tabulated in below tabular column

Table II : Defining Load Cases by Entering Load Case Type of Dead Load and Lateral Load as Linear Static, Modal Load as Modal Type by Setting the Scale Factor Equal to Unity.

SL. NO	Load Case Name	Load Case Type
1.	Dead	Linear Static
2.	Modal	Modal
3.	Lateral	Linear Static

C. Frame Structure Modelling

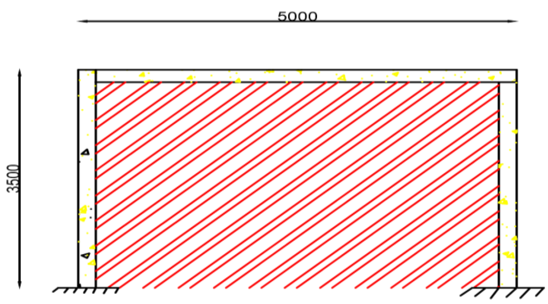

Fig.7: Shows Full Infill Frame

1) Structural Frame Model by Keeping Wo/W Ratio As 1 Constant

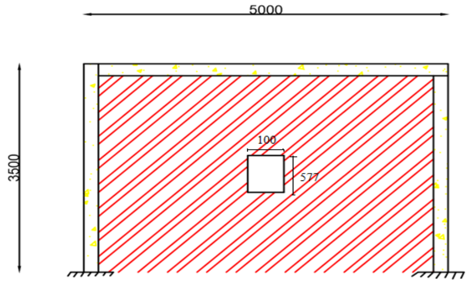

Fig.8: Shows Opening Ratio is 0.165 Ho/H

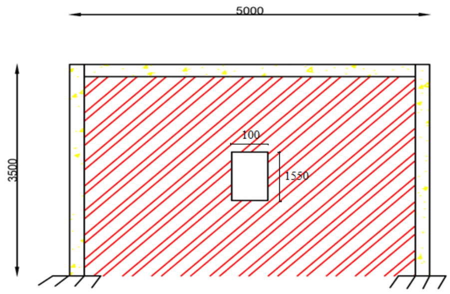

Fig.9: Shows Opening Ratio is 0.33 Of Ho/H

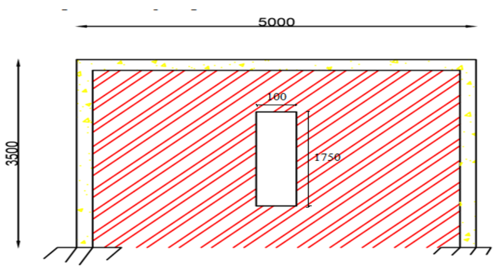

Fig.10: Shows Opening Ratio is 0.50 Of Ho/H

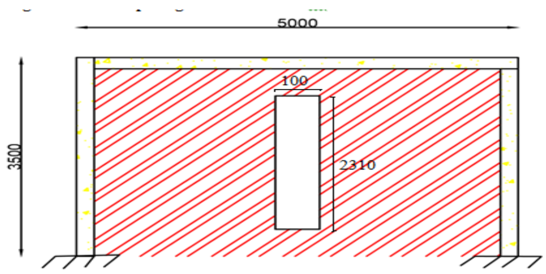

Fig.11: Shows Opening Ratio is 0.66 of Ho/H

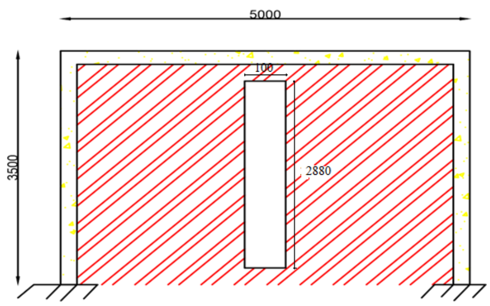

Fig.12: Shows Opening Ratio is 0.66 Of Ho/H

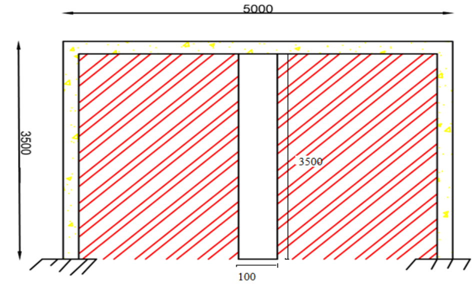

Fig.13: Shows Opening Ratio is 0.825 of Ho/H

2) ***Structural frame model by keeping Wo/W=1 as constant***

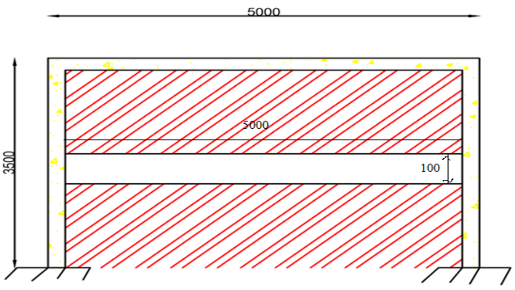

Fig.14: Shows Opening Ratio is 0.165 Of Ho/H

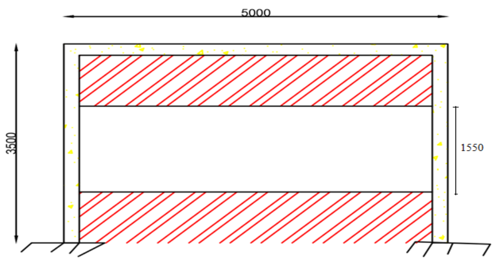

Fig.15: Shows Opening Ratio is 0.33 Of Ho/H

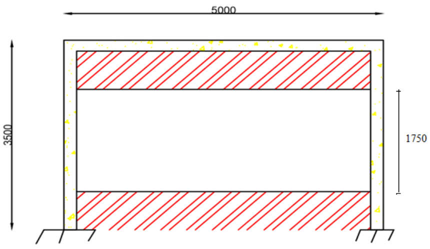

Fig.16: Shows Opening Ratio is 0.50 Of Ho/H

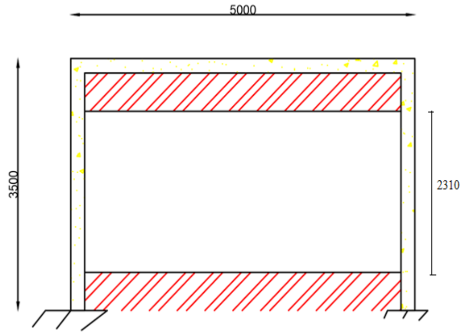

Fig.17: Shows Opening Ratio Is 0.66 Of Ho/H

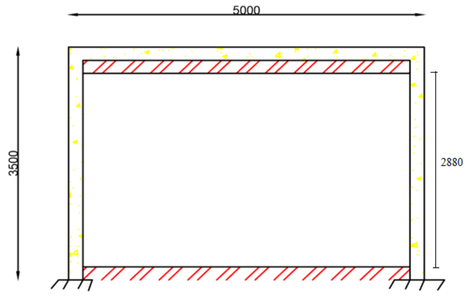

Fig.18: Shows Opening Ratio is 0.825 of Ho/H

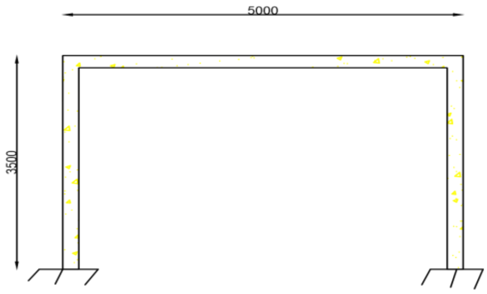

Fig.19: Shows Opening Ratio Is 0.66 of Ho/H

III. RESULTS AND DISCUSSIONS

A. General

In this unit, a portal frame spanning 5m to a height of 3.5m is analysed using SAP2000 software by using linear static method of analysis. Displacement, Lateral Stiffness, Shear force and Bending Moments are determined by varying the H_o/H ratio from 0.165 to 1.0.

The position of openings is determined by varying the Ho/H ratio to corresponding W_o/W as 0.1 and 1.0. The shear force and bending moment effects on Leeward column and Windward column by varying H_o/H between 0.165 and 1.0.

Analysis and results of different parameters are considered as follows-

- Displacement
- Shear force
- Stiffness
- Lateral stiffness ratio
- Shear force of Leeward column
- Bending moment of Leeward column
- Bending moment of Windward column
- Bending moment of Leeward and Windward column
- Stress distribution

B. Results

1) ***Displacement values for Ho/H ratios from 0.165 to 1.0***

Table III
Displacement Values For Ho/H Ratio From 0.165 To 1.0

H_0/H	Displacement (mm)
0.165	0.31
0.330	0.35
0.550	0.39
0.660	0.40
0.825	0.57
1.000	6.48

This graph represents the variation of displacement along x-axis and H_0/H ratio along y-axis. There is a linear variation in the displacement from A to B. There is a slight variation in the displacement from B to C H_0/H ratio. It shows there is a linear variation in displacement from C to D H_0/H ratio and it acts like a bare frame

2) *Shear Force Values for Ho/H Ratios from 0.165 to 1.0*

Table IV
Shear Force for Ho/H Ratio from 0.165 to 1.

H0/H	SHEAR FORCE
0.165	4.35
0.330	7.35
0.500	7.59
0.660	3.18

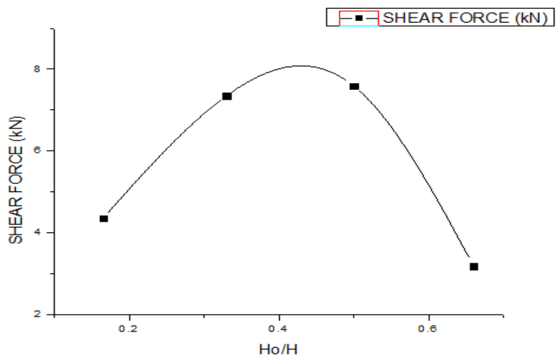

Fig.20: Shear Force for Ho/H Ratio from 0.165 to 1.

This graph shows the variation of shear force (kN) along y-axis and H_0/H ratio along x-axis. There is increment in shear force from points A to B of H_0/H ratio. There is a drastically decrement in the variation of shear force from points B to C H_0/H ratio. It shows the strut action from point A to B H_0/H ratio. From point C it moves to bare frame action as shown in above graph

3) *Stiffness Values for Ho/H Ratios from 0.165 to 1.0*

Table V
Stiffness Values for Ho/H Ratios from 0.165 to 1.0

H_0/H	STIFFNES (kN/mm)
0	88.65
0.165	79.28
0.330	70.02
0.500	63.16
0.660	58.00
0.850	43.55
1.000	3.85

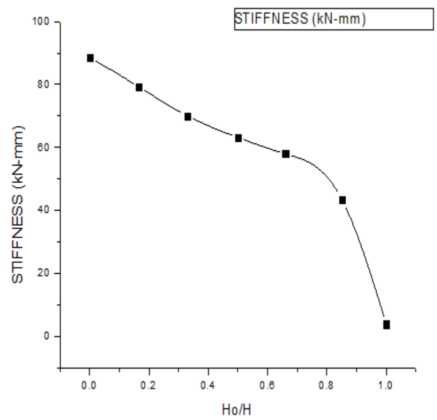

Fig.21: Stiffness Values for Ho/H Ratios from 0.165 to 1.0

This graph shows the variation of stiffness (kN/mm) along y-axis and H_O/H ratio along x-axis. There is a decrement in stiffness curve with respect to increase in H_0/H ratio. This graph shows sudden variation in H_0/H ratio after the F point of H_0/H ratio. It shows the strut action up to point F and after that it acts as a bare frame

4) *Lateral Stiffness Ratio Values for Ho/H Ratios from 0.165 to 1.0*

Table VI : Lateral Stiffness Values for Ho/H Ratios from 0.165 to 1.0

A_0	LATERAL STIFFNESS RATIO
1.650	89.43
3.300	78.99
5.000	71.24
6.600	68.00
8.500	49.12
10.00	4.34

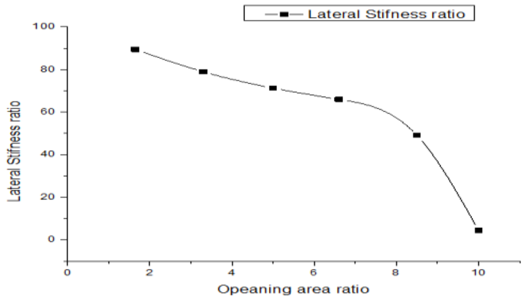

Fig.22: Stiffness Values for Ho/H Ratios from 0.165 to 1.0

This graph shows the variation of lateral stiffness ratio along y-axis and opening area ratio along x-axis. Here there is a decrement in lateral stiffness ratio with respect to increase in opening area ratio. This graph shows the sudden variation in opening area ratio at point D opening area ratio. It shows the strut action is up to point D after that there is a bare frame action as shown in above graph.

5) *Shear Force of Leeward Column Values for Ho/H Ratios from 0.165 to 1.0*

TABLE VII

Shear force of Leeward column values for Ho/H ratios from 0.165 to 1.0

H_0/H	LEE WARD COLUMN-SF (kN)
0.165	1.66
0.330	1.40
0.500	1.20
0.660	1.31
0.825	1.95
1.000	4.97

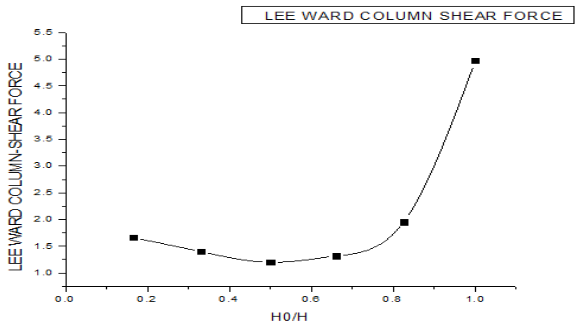

Fig. 23: Shear Force of Leeward Column Values for Ho/H Ratios from 0.165 to 1.0

This graph shows the variation of shear force in lee ward column along y-axis and Ho/H along x-axis. This graph shows there is a decrement in the shear force of leeward column up to point C. It shows the strut action from points A to D of H_0/H ratio. After the strut action there is a huge difference varying curve occurs which shows the bare frame action.

6) *Bending moment of Leeward column values for Ho/H ratios from 0.165 to 1.0*

Table VIII : Bending Moment of Leeward Column for Ho/H Ratios from 0.165 to 1.0

H_0/H	LEEWARD COLUMN – BM (KN-M)
0.165	0.350
0.33	0.500
0.50	0.600
0.66	0.520
0.825	0.630
1.00	8.540

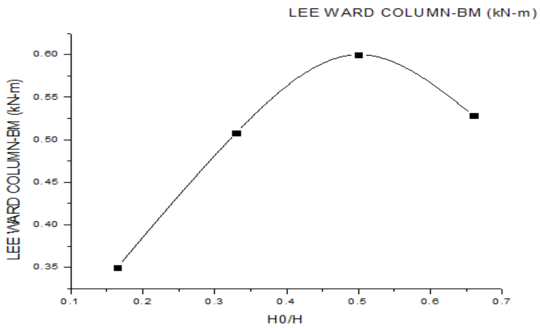

Fig.24: - Bending Moment Values for Ho/H Ratios from 0.165 to 1.0

This graph shows the variation of Bending moment of Leeward column along y-axis and Ho/H ratio along x-axis. There is increment in bending moment of Leeward column from points A to C of H_0/H. There is a drastically decrement in the variation of Bending moment of Leeward column from points C to D of H_0/H ratio shows the bare frame action. It shows the strut action from points B to D of BM of Leeward column and sudden decrement shows the bare frame action

7) *Bending Moment of Windward Column Values for Ho/H Ratios from 0.165 to 1.0*

Table IX : Bending Moment of Leeward Column Values for Ho/H Ratios from 0.165 to 1.0

H0/H	WIND WARD COLUMN -BM (KNM)
0.165	1.50
0.330	2.70
0.500	3.22
0.660	1.30
0.825	1.50
1.000	9.38

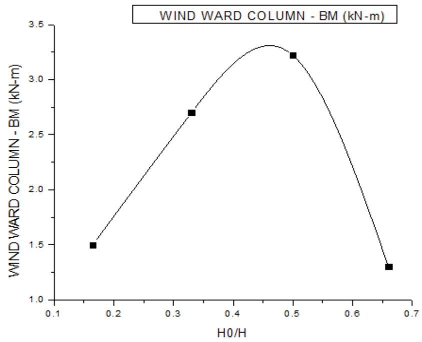

Fig.25: Bending Moment of Leeward Column Values for Ho/H Ratios from 0.165 to 1.0

This graph shows the variation of Bending moment of wind ward column along y-axis and Ho/H ratio along x-axis**.** There is increment in Bending moment of wind ward column from points A to C. It shows the strut action. There is a sudden decrement after point D of H_0/H shows the bare frame action

8) ***Bending Moment of Windward and Leeward Column Values for Ho/H Ratios from 0.165 to 1.0***

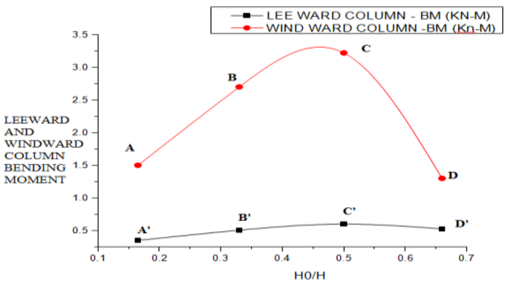

Fig.26: Bending Moment of Windward and Lee ward Column Values for Ho/H Ratios from 0.165 to 1.0

This graph indicates the variation of bending moment in leeward column and wind ward column along y-axis with Ho/H along x-axis. In this graph it shows the bending moment of windward column increases from points A' to C' of h_0/h and decreases suddenly at points C' of h_0/h as shown in graph. It indicates the strut action from points A' to C' of h0/h ratio and sudden decrease shows bare frame action. In this graph it also shows the variation of leeward column bending moment. The increase from A to C of h0/h ratio shows the strut action of leeward column of bending moment and the sudden variation indicates bare frame action

9) ***Shear Force of Lee Ward Column for w_o/w = 1***

Table X:Shear Force of Lee Ward Column Values for Ho/H Ratio from 0.165 To 1

H0/H	LEE WARD COLUMN - SF (kN)
0.165	16.69
0.330	13.66
0.500	20.95
0.660	16.84
0.825	12.27
1.00	12.5

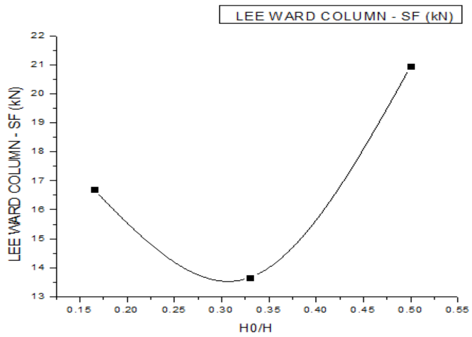

Fig.27: Shear Force of Lee Ward Column Values for Ho/H Ratio from 0.165 To 1

This graph indicates the variation of shear force of Lee ward column. X-axis in terms of H0/H ratio, Y-axis in terms of Shear force of Lee ward column. This graph varies from 0.15– 0.55 of H0/H ratio and 13 – 22 lee ward column Shear force (kN). In this graph there is decrement in Lee ward column shear force from 0.15 to 0.35 of H0/H ratio. It shows the strut action from 0.15 to 0.35 of H0/H ratio. There is a sudden increase occurs at 0.35 of H0/H ratio shows the bare frame action

10) ***Bending Moment of Lee Ward Column for wo/w = 1 as Constant***

Table XI : Bending Moment of Lee Ward Column Values For Ho/H Ratio From 0.165 To 1

H0/H	LEE WARD COLUMN - BM (Kn -m)
0.165	11.22
0.330	12.40
0.500	14.70
0.660	15.70
0.825	25.20
1.000	25.70

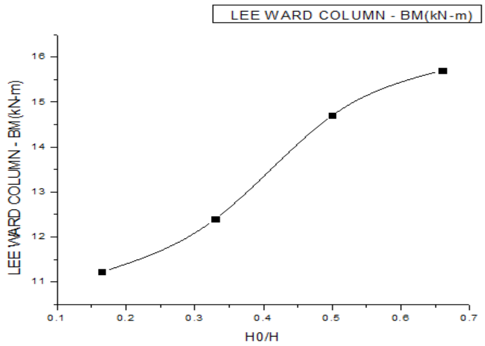

Fig.28: Bending Moment of Lee Ward Column Values For Ho/H Ratio from 0.165 To 1

This graph shows the variation of Bending moment of Lee ward column. X axis in terms of H0/H ratio. Y axis in terms of bending moment of Lee ward column. This graph varies from 0.1 – 0.7 of H0/H ratio and 10 – 16 lee ward column BM (KN-M). There is increase in the Bending moment of Lee ward column shows the strut action from 0.15 – 0.5 of H0/H ratio. The sudden variation occurs at 0.5 shows the bare action

11) *Bending Moment of Wind Ward Column for Wo/W = 1 as Constant*

Table XII : Bending Moment of Wind Ward Column Values for Ho/H from 0.165 To 1

H0/H	WIND WARD COLUMN- BM(kN-m)
0.165	17.90
0.330	19.80
0.500	24.00
0.660	24.19
0.825	25.96

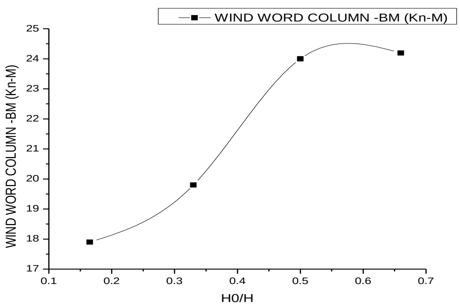

Fig.29: Bending Moment of Wind Ward Column Values for Ho/H from 0.165 To 1

This graph indicates the variation of Bending moment of wind ward column. X axis in-terms of H0/H ratio. Y axis in-terms of Bending moment of wind ward column. This graph varies from 0.1 – 0.7 of H0/H ratio and 17 – 25 wind ward column – BM (KN-M). There is increase in Bending moment of wind ward column from 0.15 to 0.5 of H0/H ratio. That shows the strut action. There is a sudden variation occurs at 0.5 of H0/H ratio it indicates the bare frame action

12) *Maximum Stress Values for Various Ho/H Ratios*

Table XIII : Shows the Stress Distribution Values for Ho/H Ratio from 0.165 to 1

Ho/H	STRESS (kN/m^2)
0.165	274.65
0.330	382.45
0.500	374.87
0.660	525.62
0.825	588.34
1.000	855.09

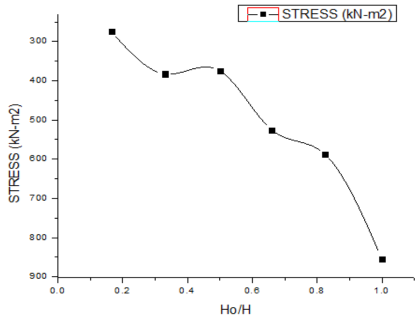

Fig.30: Shows the Stress Distribution in the Frame Values for Ho/H Ratio from 0.165 To 1

Stress distribution in the frame are plotted in the above graph. Here x axis in terms of Ho/H ratio and y axis in terms of stress. The graph is plotted Ho/H ratio Vs stress. There is a strut action from 0.165 height ratio to 0.33 height ratio. After there is variation in the stress shows the failure in strut action and the frame behaves as a bare frame

13) *Stress Distribution of Contour in the Structural Frame Model 0.165 Ho/H ratio*

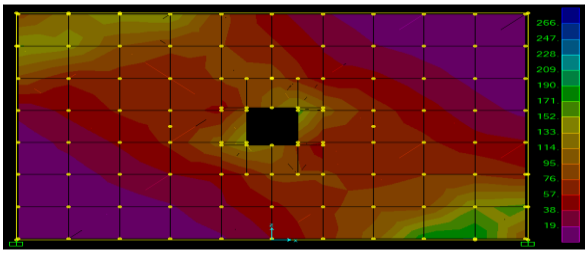

Fig.31: Stress Distribution in the Frame for 0.165 Ho/H ratio

Stress distribution in the frame is shown in the above figure for 0.165 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 276.65 kN-m^2 which is indicated in blue colour and minimum stress distribution is 1.324 kN-m^2 which is indicated in purple colour.

*14) **Stress Distribution in the Frame of 0.33 Ho/H Ratio***

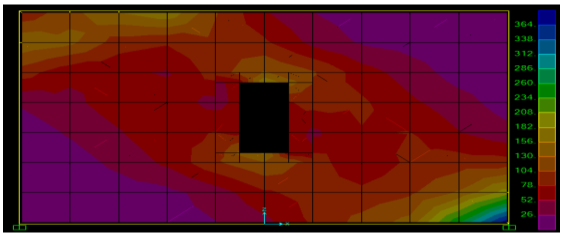

Fig.32: Shows the Stress Distribution in the Frame of 0.33 Ho/H Ratio

Stress distribution in the frame is shown in the above figure for 0.330 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 382.45 kN-m^2 which is indicated in blue colour and minimum stress distribution is 1.141 kN-m^2 which is indicated in purple colour.

*15) **Stress Distribution in the Frame of 0.50 Ho/H Ratio***

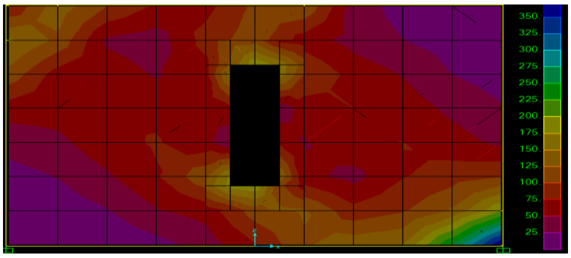

Fig.33: Shows the Stress Distribution in the frame of 0.50 Ho/H Ratio

Stress distribution in the frame is shown in the above figure for 0.50 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 374.87 kN-m^2 which is indicated in blue colour and minimum stress distribution is 0.385 kN-m^2 which is indicated in purple colour

*16) **Stress Distribution in the Frame of 0.66 Ho/H Ratio***

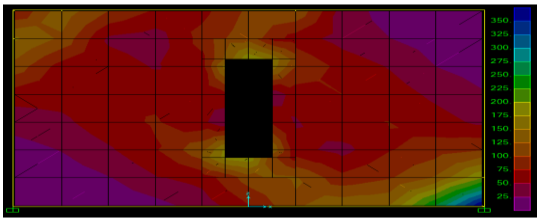

Fig.34: Shows the Stress Distribution in the Frame of 0.66 Ho/H ratio

Stress distribution in the frame is shown in the above figure for 0.66 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 525.62 kN-m^2 which is indicated in blue colour and minimum stress distribution is 1.45 kN-m^2 which is indicated in purple colour

*17) **Stress Distribution in the Frame of 0.825 Ho/H Ratio***

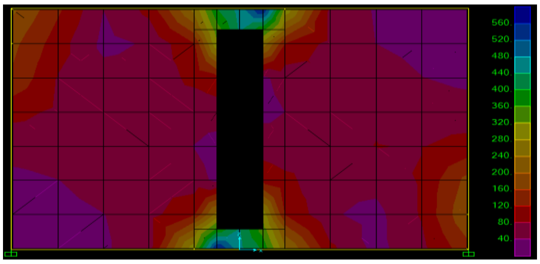

Fig.35: Shows the Stress Distribution in the Frame of 0.825 Ho/H ratio

Stress distribution in the frame is shown in the above figure for 0.825 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 588.34 kN-m^2 which is indicated in blue colour and minimum stress distribution is 3.797 kN-m^2 which is indicated in purple colour

*18) **Stress Distribution in the frame of 1.0 Ho/H Ratio***

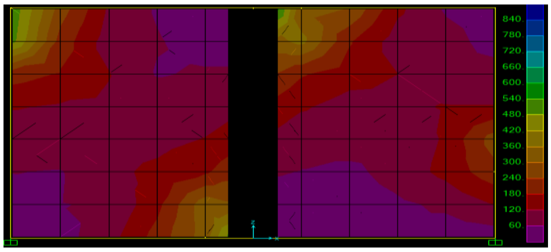

Fig.36: Shows the Stress Distribution in the Frame of 1.0 Ho/H

Stress distribution in the frame is shown in the above figure for 1.0 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 855.09 kN-m^2 which is indicated in blue colour and minimum stress distribution is 6.07 kN-m^2 which is indicated in purple colour

*19) **Stress Distribution of Contour in the Structural Frame Model by Keeping Wo/W Ratio As unity***

*a) **Stress Distribution in the frame of 0.165 Ho/H Ratio***

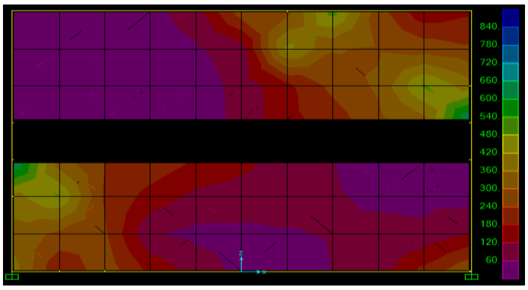

Fig.37: Shows the Stress Distribution in the Frame of 0.165 Ho/H ratio

Stress distribution in the frame is shown in the above figure for 0.165 Ho/H ratio, when Wo/W ratio is taken as 1 constant. The maximum stress distribution is 867.54 kN-m^2 which is indicated in blue colour and minimum stress distribution is 2.567 kN-m^2 which is indicated in purple colour

*b) **Stress Distribution in the Frame of 0.33 Ho/H Ratio***

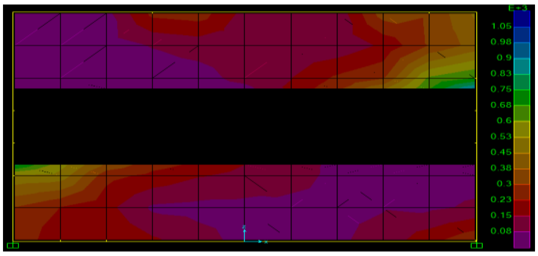

Fig.38: Shows the Stress Distribution in the Frame of 0.33 Ho/H Ratio

Stress distribution in the frame is shown in the above figure for 0.33 Ho/H ratio, when Wo/W ratio is taken as 1 constant. The maximum stress distribution is 1051.29 kN-m^2 which is indicated in blue colour and minimum stress distribution is 1.898 kN-m^2 which is indicated in purple colour

*c) **Stress Distribution in the Frame of 0.50 Ho/H Ratio***

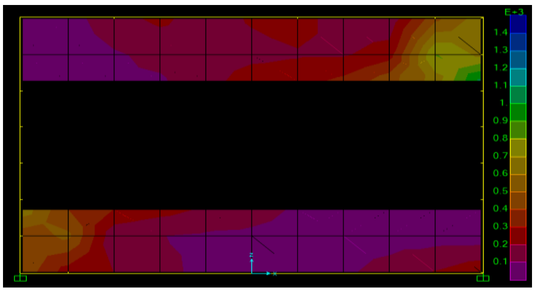

Fig.39: Shows the Stress Distribution in the Frame of 0.50 Ho/H

Stress distribution in the frame is shown in the above figure for 0.50 Ho/H ratio, when Wo/W ratio is taken as 1 constant. The maximum stress distribution is 1377.46 kN-m^2 which is indicated in blue colour and minimum stress distribution is 10.94 kN-m^2 which is indicated in purple colour

*d) **Stress Distribution in the Frame of 0.50 Ho/H Ratio***

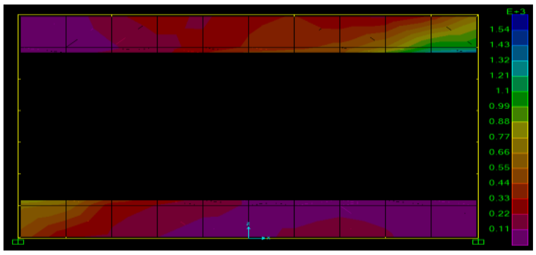

Fig.40: Stress distribution in the frame of 0.66 Ho/H ratio

Stress distribution in the frame is shown in the above figure for 0.66 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 1528.08 kN-m^2 which is indicated in blue colour and minimum stress distribution is 4.86 kN-m^2 which is indicated in purple colour

*e) **Stress Distribution in the frame of 0.825 Ho/H Ratio***

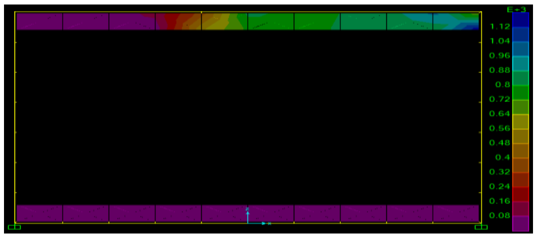

Fig.41: Stress Distribution in the Frame of 0.825 Ho/H Ratio

Stress distribution in the frame is shown in the above figure for 0.165 Ho/H ratio, when Wo/W ratio is taken as 0.1 constant. The maximum stress distribution is 1187.66 kN-m^2 which is indicated in blue colour and minimum stress distribution is zero which is indicated in purple colour

IV. CONCLUSIONS

1. It is observed that there is not much variation in lateral displacement up to 85% and thereafter a sudden increase in displacement with increase in the value of percentage of opening.
2. Shear force increases with increase in value of H0/H ratio up to 45% and there after it decreases with further increase in the value of percentage of opening.
3. There is a decrement in stiffness values with increase in H0/H ratio and the sudden variation in H0/H ratio at 85% of H0/H ratio shows that strut action up to 85% after that it acts as a bare frame.
4. There is an increment in bending moment of windward column from 0.15 to 3.25 indicating strut action. There is a sudden decrement at 0.5 of H0/H shows the bare frame action
5. The decrement in leeward column shear force from 0.15 to 0.35 of H0/H ratio. It shows the strut action from 0.15 to 0.35 of H0/H ratio. The

sudden increase occurs at 0.35 of H0/H ratio shows the bare frame

6. There is an increase in the Bending moment of Lee word column curve shows the strut action from 0.15 – 0.5 of H0/H ratio .The sudden variation occurs at 0.5 shows the bare action
7. There is an increase in Bending moment of wind ward column from 0.15 to 0.5 of H0/H ratio .That shows the strut action There is a sudden variation occurs at 0.5 of H0/H ratio it indicates the Bare frame action
8. Stress distribution of contour in the frame shows the maximum stress value 382.45 kN-m2 and minimum stress value 1.141 kN-m2 for the opening Ho/H ratio of 0.330 and Wo/W ratio is taken 0.1 constant. when the percentage of opening increases the strut action decreases
9. Stress distribution of contour in the frame maximum values are always indicated in blue colour and minimum value always indicated in purple colour
10. When Wo/W ratio is taken as unity constant, abnormal stress values are obtained

SCOPE OF FURTHER STUDY

1. The dissertation study has been carried out by selecting framed structure, in additional it can be carried with multi storey buildings

2. The dissertation study has been carried out by selecting framed structure, in additional to it , it can be carried by considering different loading.

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