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Effectiveness of Shear Wall-Frame Structure Subjected to Wind Loading in Multi-Storey Building

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ABSTRACT:

This paper represent the shear-wall frame behavior in a multi-storey building subjected to wind loading. The different cases are prepared with different configuration of shear wall. Comparative graphical representation of different models (cases) on the basis of different parameters such as lateral deformation, storey drift index, maximum bending moment and shear forces are also discussed.

KEYWORDS: *Multi-storey building, lateral load. lateral deformation, storey drift index, maximum bendina moment. maximum shear forces. wind behavior.*

I. INTRODUCTION

A multi-storey building is subjected to lateral loads due to wind loads and earthquake loading. In this paper we analyzed the eight storey multi-storey building with different configuration of shear wall subjected to wind loading. Shear wall-frame is known as the combination of shear wall and rigid frame, which tend to deflect in shear mode as well as flexural mode. We analyzed the wall-frame structure for determining the different parameters- maximum lateral deformation, storey drift index, maximum bending moment , maximum shear forces.

II. PROBLEM FORMULATION

The bare frame of 8-storey R.C.C. structure in medium soil has a ground plan of 20m x 18m the maximum height of the structure is 25.6m.

Analyze the wind load on the frame.
The size of the beam is = 300mm x 400mm
Exterior column size = 400mm x 550mm
Interior column size = 400mm x 600mm

The height of the floor is 3.2m . Assuming wind pressure 1.5KN/m^2. Assuming special moment resisting frame is used. A structure is without in-fill walls.
Analysis is done with bending axis in XX- direction.
There are 3 different models are prepared with different different position of shear wall the cases are as follows:
MODEL-1 Exterior wall-frame case
MODEL-2 Middle Interior wall-frame case
MODEL-3 Core shear wall case

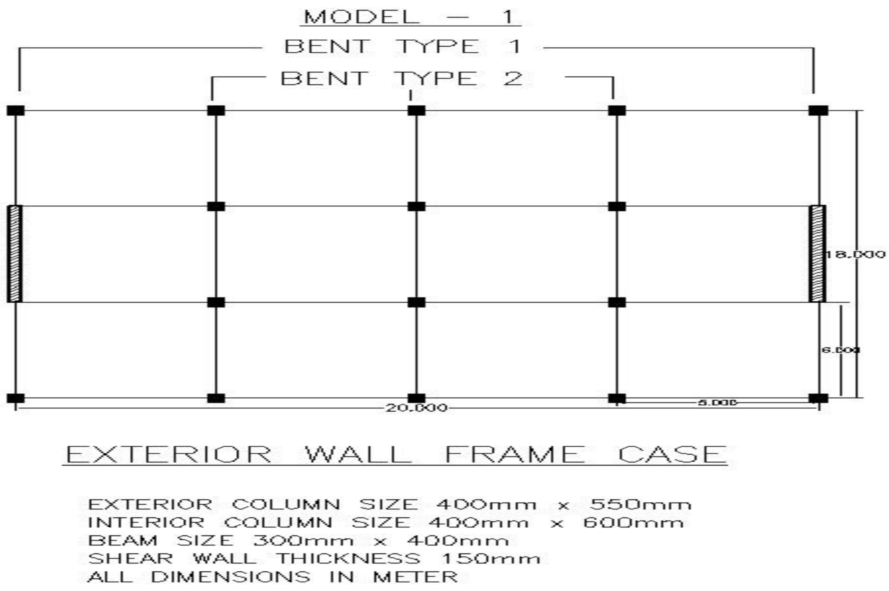


Figure -1 Exterior wall frame case

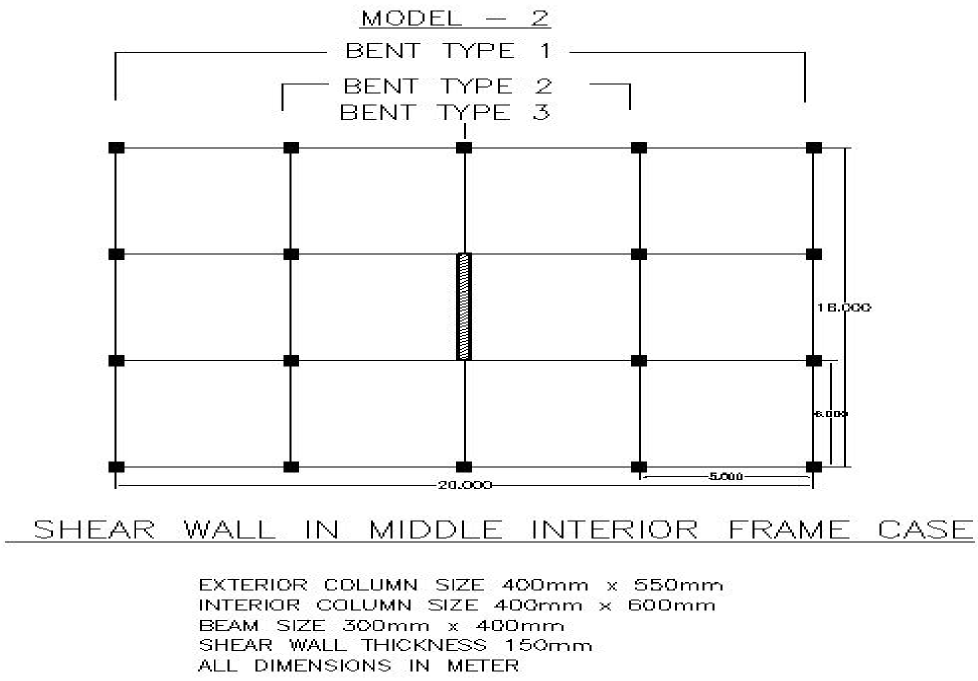


Figure-2 Shear wall in middle interior frame case

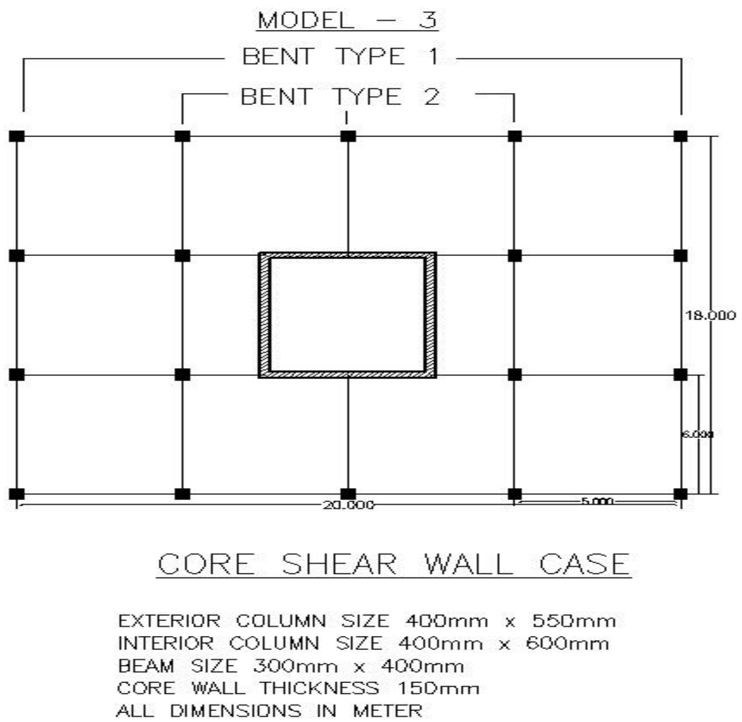


Figure 3 Core shear wall case

III. RESULT & DISCUSSIONS

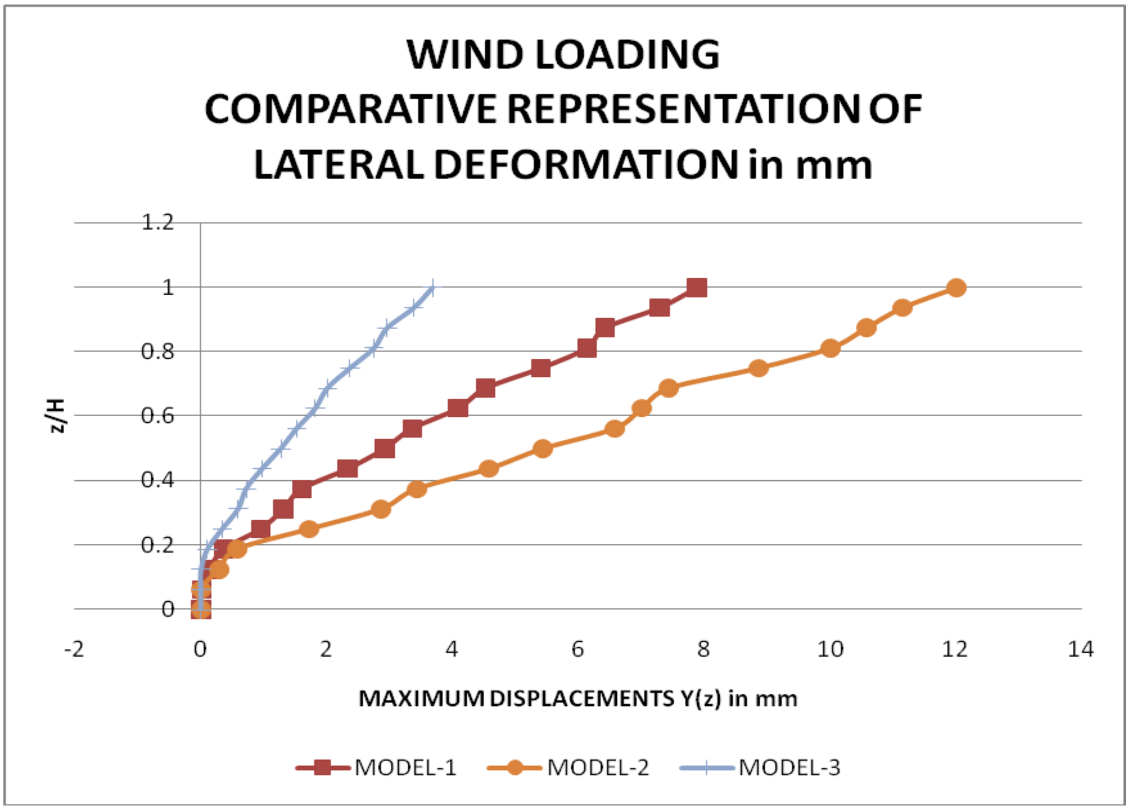
(i)Method adopted for the analysis as per reference[2]. After the analysis of the problem we calculate the different values structural parameters as tabulated below:

Table 1

COMPARATIVE RESULTS OF DIFFERENT PARAMETERS OF DIFFERENT CASES WHICH IS SUBJECTED TO WIND LOADING								
S.NO.	MODEL NO.	MODEL NAME	TOTAL $(EI)_t$ in KN-m^2	TOTAL SHEAR RIGIDITIES $(GA)_t$ in KN	MAXIMUM LATERAL DEFORMATION at TOP in mm	MAXIMUM STOREY DRIFT INDEX at TOP	MAXIMUM MOMENT AT BASE in KN-m	MAXIMUM SHEAR AT BASE in KN
1	MODEL-1	EXTERIOR WALL-FRAME CASE	11,01,68,000	3,63,346.12	7.894	0.000369	5505.024	721.92
2	MODEL-2	SHEAR WALL IN ONLY MIDDLE INTERIOR FRAME CASE	5,63,19,200	3,20,200	12.011	0.000536	4915.2	652.8
3	MODEL-3	CORE SHEAR WALL CASE	38 x 10^7	21.778 x 10^4	3.687	0.000187	8060.928	706.56

(ii) Comparative graphical representation of different parameters as shown in figure-

Figure 4 Comparative representation of maximum displacement wind loading



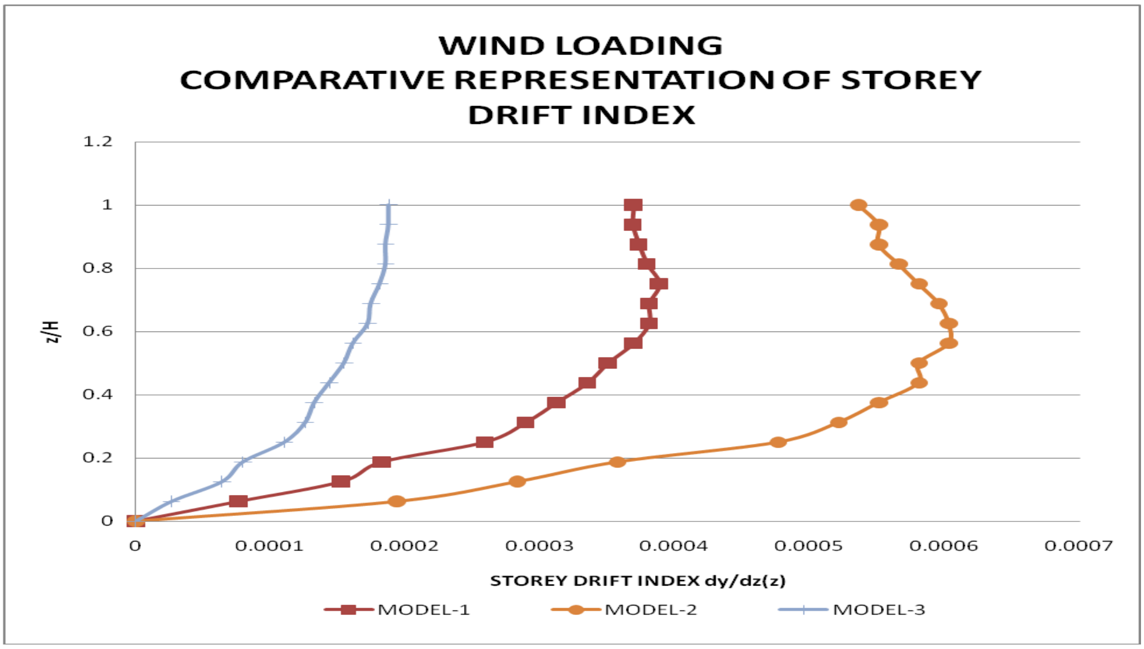
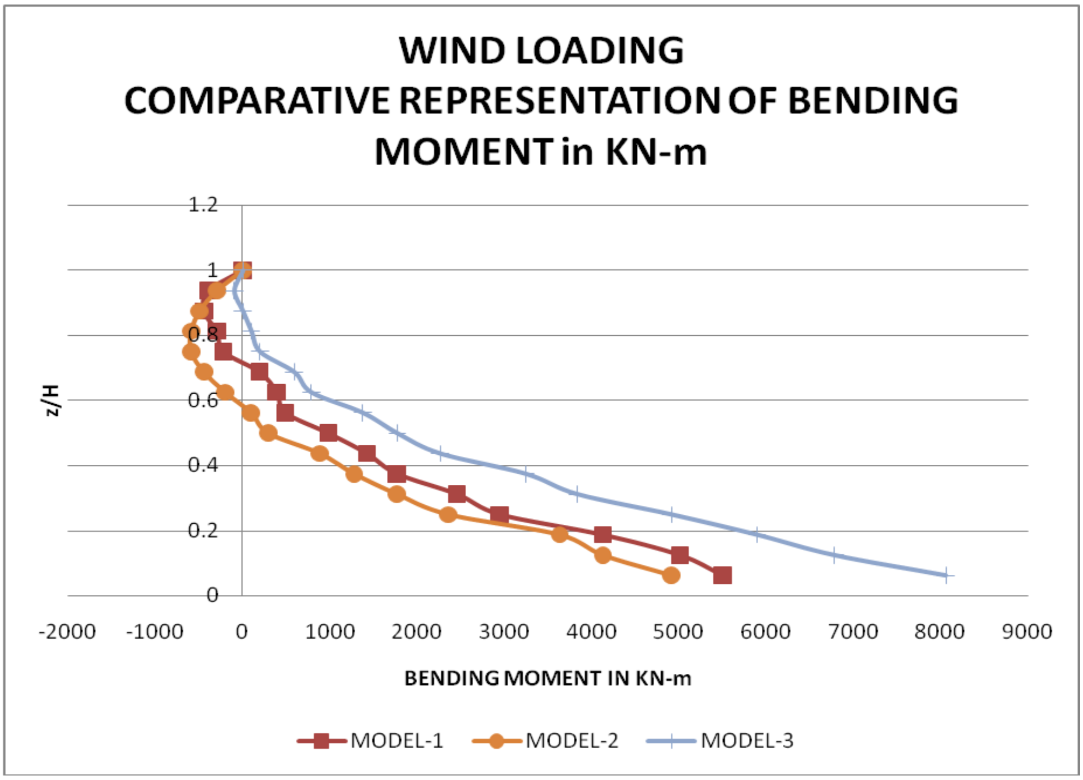


Figure-5 comparative representation of storey drift index due to wind loading

Figure-6 Comparative representation of bending moment in KN-m



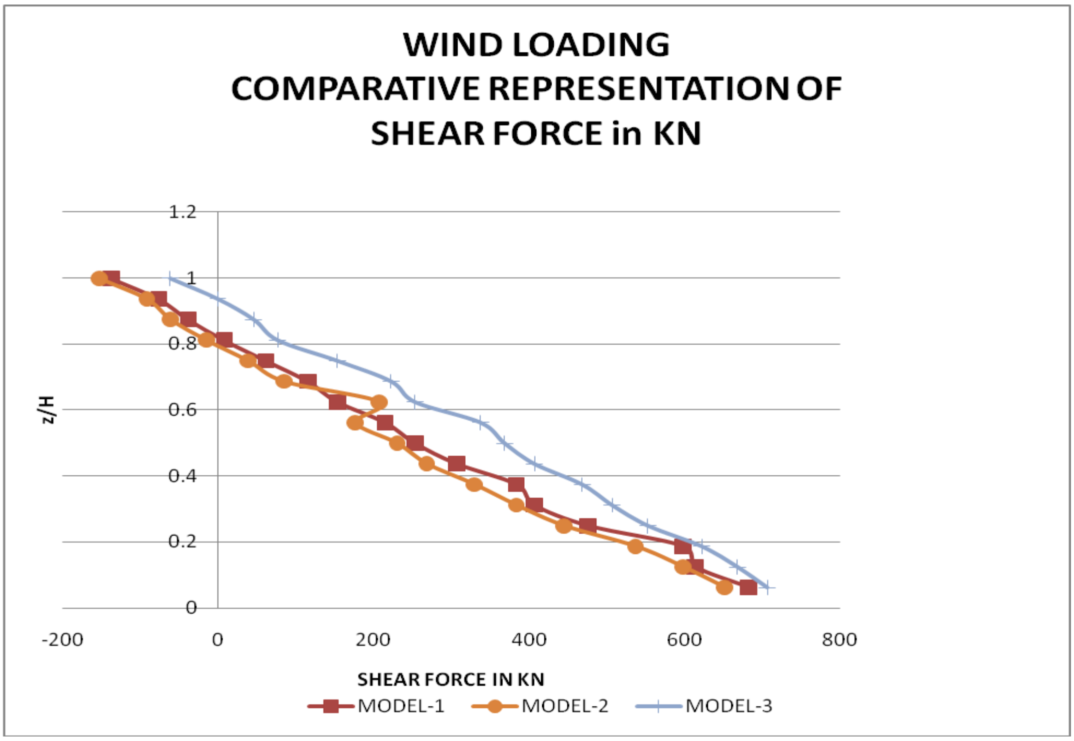
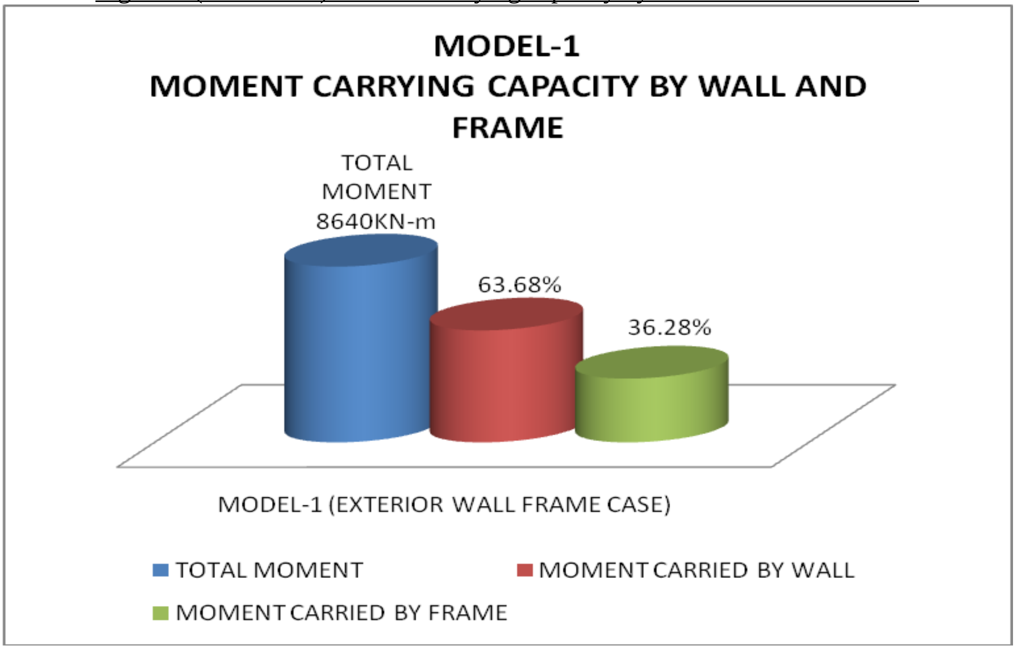


Figure-7 Comparative representation of shear forces inKN

(iii) Moment carrying capacity by shear wall and frame as shown in figure-

Figure-8 (MODEL-1) Moment carrying capacity by wall and frame in KN-m



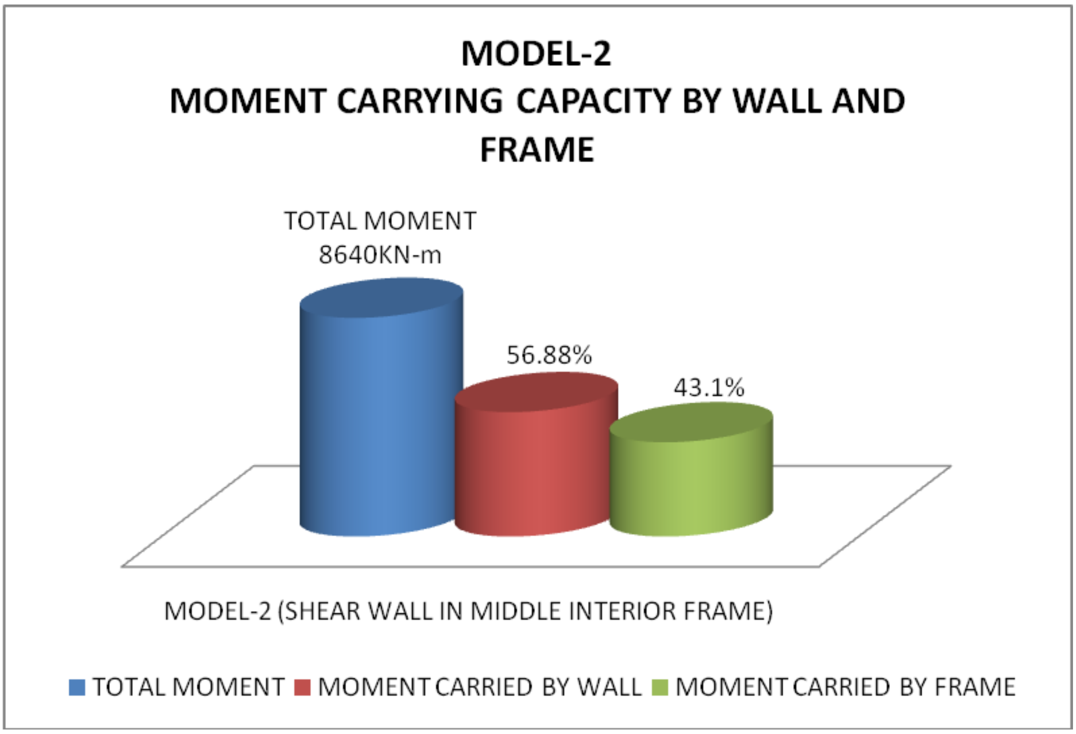
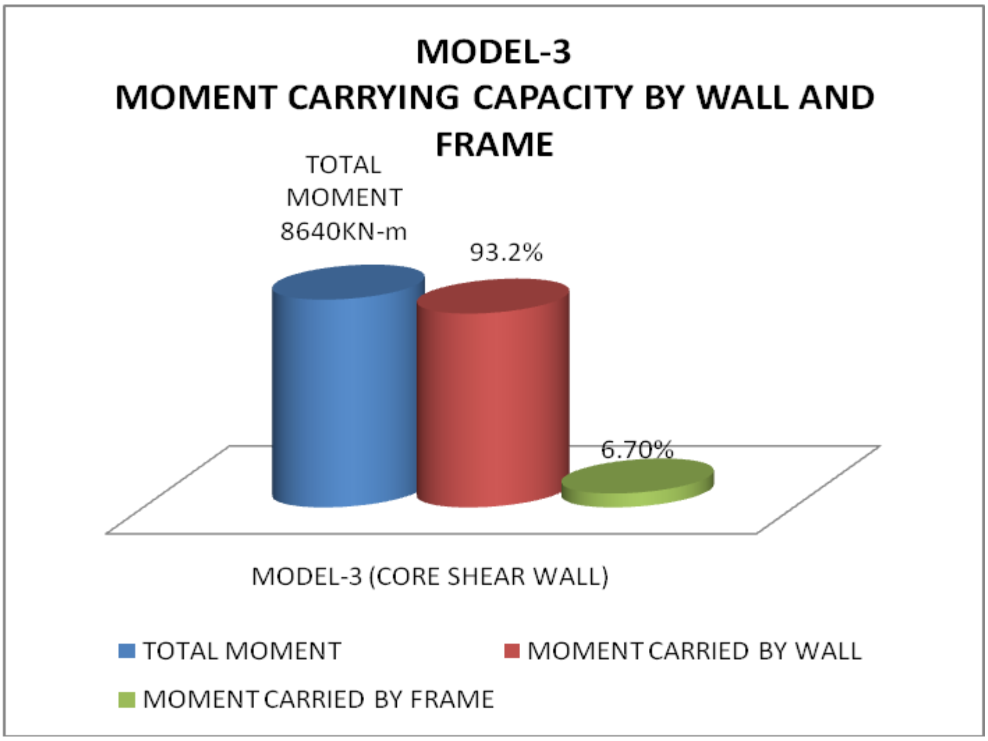


Figure-9 (MODEL-2) Moment carrying capacity by wall and frame in KN-m

Figure-10 (MODEL-3) Moment carrying capacity by wall and frame in KN-m



(iv) Shear force carrying capacity by Shear wall and frame as shown in figure

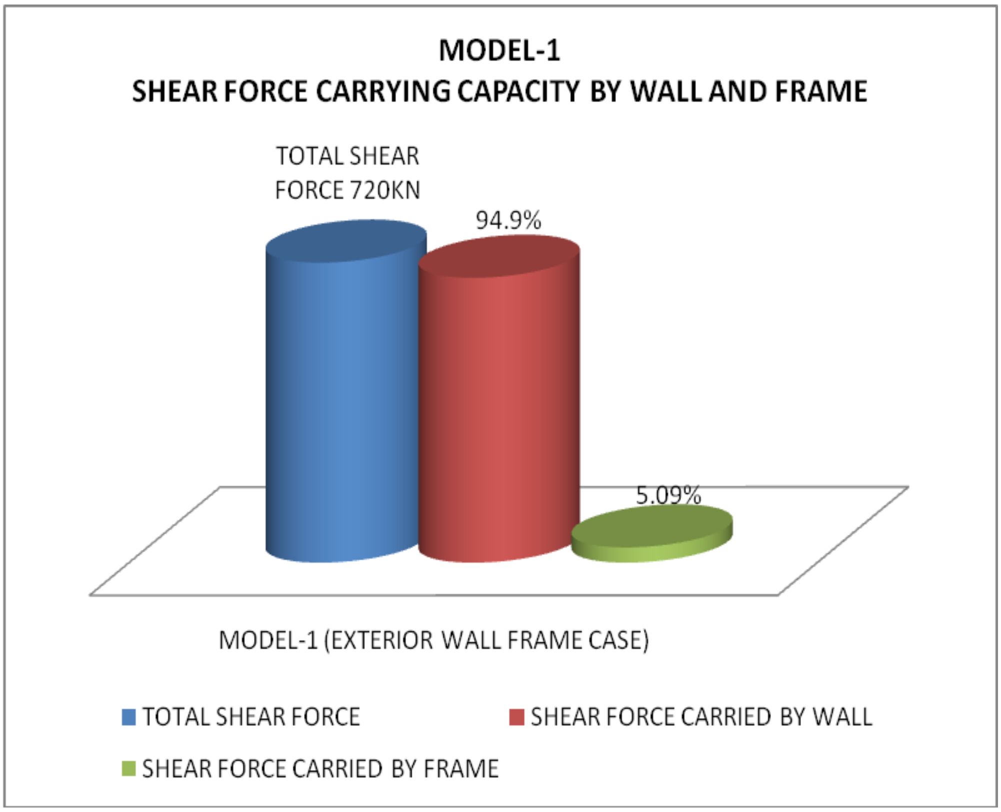
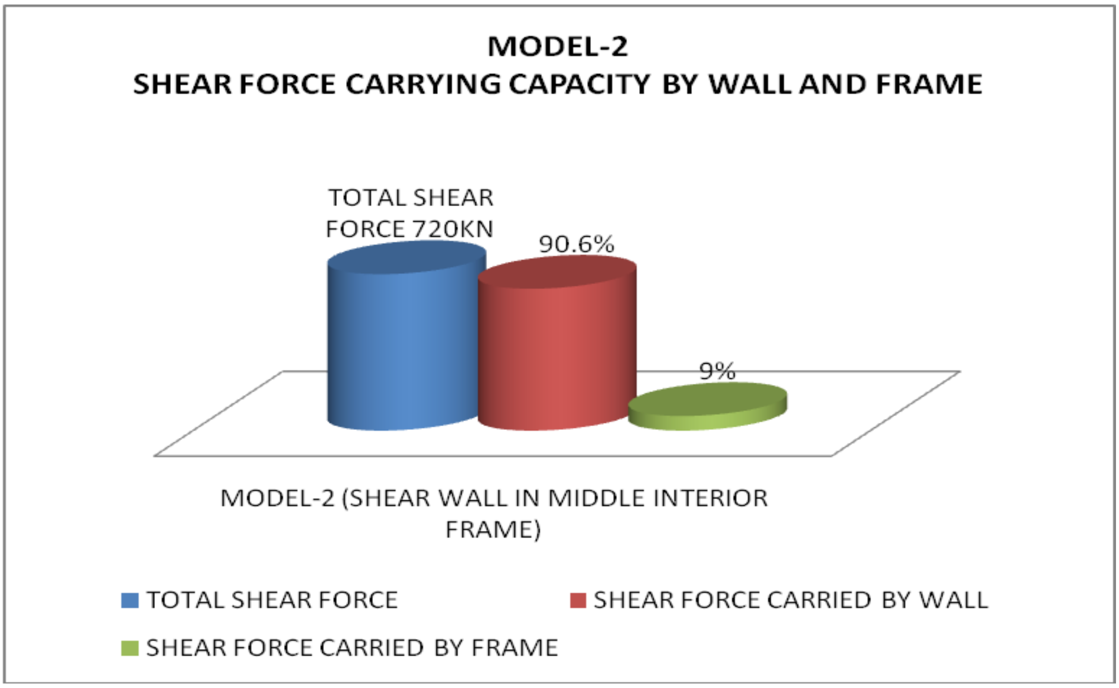


Figure-11 (MODEL-1) Shear force carrying capacity by wall and frame in KN-m

Figure-12 (MODEL-2) Shear force carrying capacity by wall and frame in KN-m



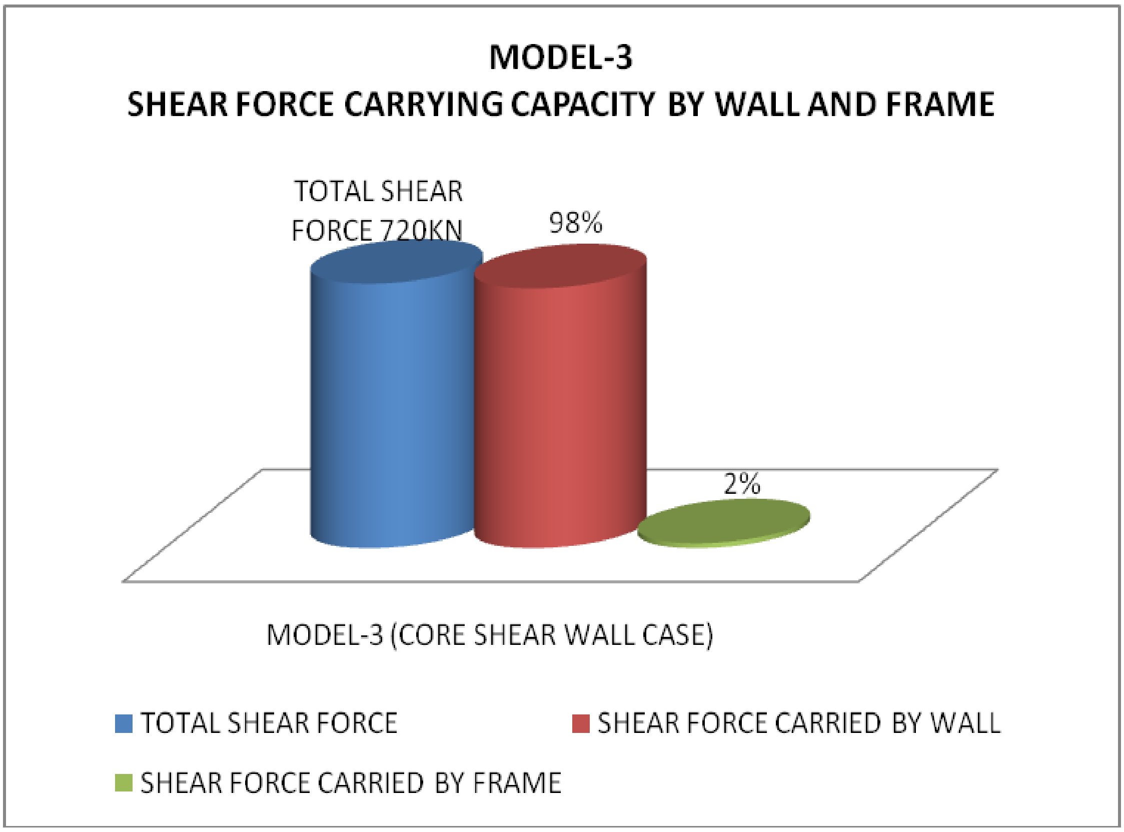


Figure-13 (MODEL-3) Shear force carrying capacity by wall and frame in KN-m

IV.CONCLUSION

1. As from result the maximum lateral deformation in MODEL-2 is 12.011mm, in MODEL-1 it is 7.894mm and in MODEL-3 it is 3.687mm. This indicated that the MODEL-3 is stiffer structure against the lateral loads.
2. The drift index is minimum in MODEL-3 the drift index is minimum (table-1) which will be more useful for taller buildings preventing the damage of internal partition and outer cladding and architectural fitting.
3. As from figure-10 (MODEL-3) the wall shares 93.2% of the total moment and the frame shares only 6.7%, while in MODEL-1 (figure-8) the wall shares 63.68% of the moment and frame takes 36.28% and in MODEL-2, 56.88% in wall and 43.1% in the frame. It is concluded that the MODEL-3 (with core wall) is providing more rigidity consequently bearing large moments and distributing a small share to frame which is relatively flexible.
4. As from figure -13 MODEL-3 the wall shares 98% of the total shear but in model-2 it is about 90.6% in MODEL-1 and is about 94.9% inspite the total base shear of the each model is roughly same.
5. It is concluded that effectiveness of the core wall is not helping too much in reducing the base shear. Effectiveness of the shear wall frame is providing more lateral stiffness; Rigidness to the structure against lateral loads minimizing the maximum lateral deformation , drift index, taking maximum share of the moment full filling it's purpose for which it is provided for.

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