RESEARCH ARTICLE OPEN ACCESS

Parametric Study of High-Rise Building with Different Shapes with And Without Belt Wall at External Boundary of Structure

Tabssum Bano [1], Mohsin Khan Agwan [2]
[1] M.Tech Scholar, Department of Civil Engineering, Arya College of Engineering and Research Centre, Jaipur, Rajasthan, India
[2] Assistant Professor, Department of Civil Engineering, Arya College of Engineering, Jaipur, Rajasthan, India

ABSTRACT
Engineers evaluated the presence of torsional irregularity, reentrant corners, and anomalies in the plan, which have the most effects on seismic reaction. L, T, U, C, and plus-shaped buildings' re-entrant corners, which were constructed in accordance with architectural specifications, have suffered significant damage. To reduce the consequences of re-entrant corners, these constructions were separated into parts. Because plus-shaped tall, multistory buildings go beyond the specified boundaries of the code, re-entrant corners are very important. Strong seismic regions necessitate special considerations for shear walls, and the placement of shear walls affects how well the building performs under dynamic loads. For this plus-shaped building, shifting the locations of the shear walls can provide amazing results without changing the shear wall's specifications. Longer wings and a ten-story plus design increase the possibility that the structure may pull away from the corner and wag its tail. Shear walls were positioned at the center core, flange edges, and re-entrant corners to see which condition performs best. The deleterious impact of these anomalies can be lessened by adding shear walls at reentrant corners. In this research study choose three different unsymmetrical structures for study like Plus, L and T. Use of belt wall on each 5th floor on unsymmetrical models. Use M40 grade of concrete and Fe550 for steel. With the help of ETABS modeling and analysis work completed. Some selected parameters like bending moment, base reaction, storey drift, joint displacement and stiffness are chosen for prepare graphs and compare their result.
Keywords: Belt wall, Unsymmetrical structures, Base reaction, Stiffness, Load Combination, etc.

I. INTRODUCTION

Humans have always wanted to build the best structures possible. In India's major developed cities, building demand is increasing. In India and other developing nations, unreinforced masonry walls are commonly used to fill reinforced concrete bending trusses. Due to its usefulness, affordability, and price, masonry is a widely used building material in different parts of the world. Masonry's primary purpose is to either isolate the internal space from the outside world or protect it from it. Frequently seen as a component of architecture. Engineers frequently disregard it. When examining building structures, interactions with bounding boxes are frequently disregarded because of the difficulty of the issue. The outer structure's angular resistance increases when the filler material interacts with it. Predictions of the structural response may be incorrect as a result of this expectation. Usually, this is done in big quantities. Numerous studies have demonstrated how fillers affect behaviour over time and influence load transfer. Studies of structures that have experienced earthquake damage have helped to advance this understanding.

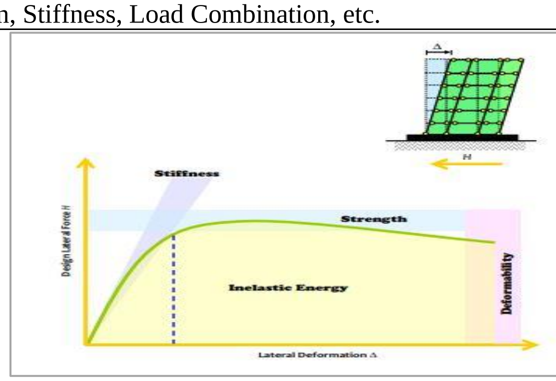

Fig. 1 Stiffness in RCC structure

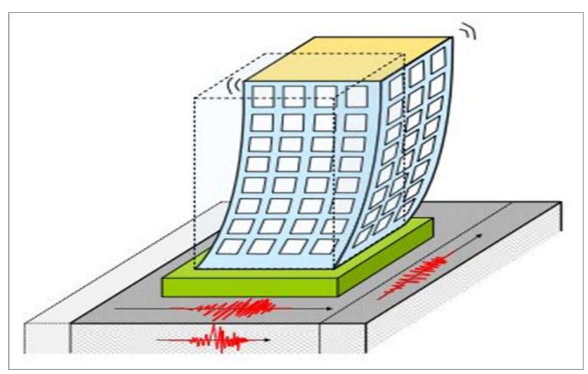

Fig. 2 Earthquake behaviour of structures

Belt Walls

Determining how the installation of ring walls may enhance the responsiveness of a structure already outfitted with a stabilizer is the goal of research into ring wall systems. The longitudinal and lateral wind reaction forces of a structure with a stabilizing system are marginally diminished by the addition of a beam wall. The acceleration torque is significantly reduced when the beam wall is included in the construction together with the anti-roll bar system, as opposed to when the anti-roll bar is solely fitted in the centre wall system. Therefore, walls can effectively reduce torsional acceleration, but not so much wind and wind reaction. Additionally, wall-to-wall flooring can be installed for purposes other than the mechanical flooring that is often done by tape wall penetration. Therefore, it is advised to research buildings with perforated curtain systems to assess how well they can lessen the building's responsiveness to wind.

II. OBJECTIVES

- High rise RCC structures with walls at the exterior edges are purposefully analyzed for linear dynamic earthquake loads.
- To examine the impact of the belt wall on the stiffness of the models, bending moment, joint displacement, narrative drift, and drift ratio.
- To receive comparative comments for symmetrical and asymmetrical constructions, belt wall included or not.
- To research L and T-shaped buildings with belt walls on each fifth storey.
- To research the parametric characteristics of tall buildings with belt walls.

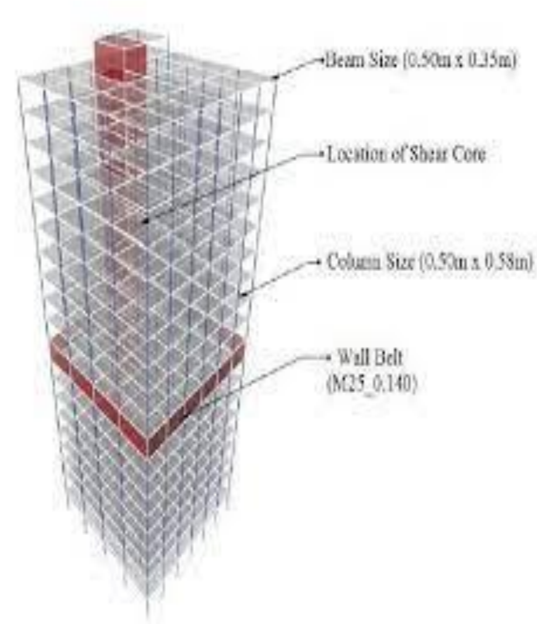

Fig. 3 Structures with Belt Wall

III. METHODOLOGY

In this section we analyses three models that is Plus, L, and T shape with bare frame or belt wall and study about it. Use software for modeling is ETABS and after that compare results from base paper. Grade of concrete M40 and grade of steel is Hysd550 and Fe-250 for study.

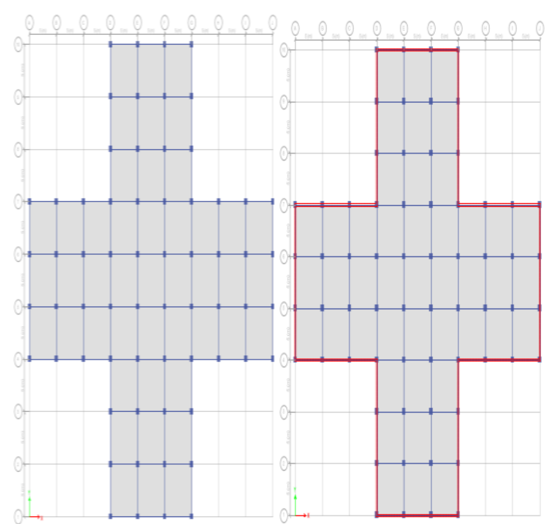

Fig. 4 Plan view of plus shape with and without with belt wall

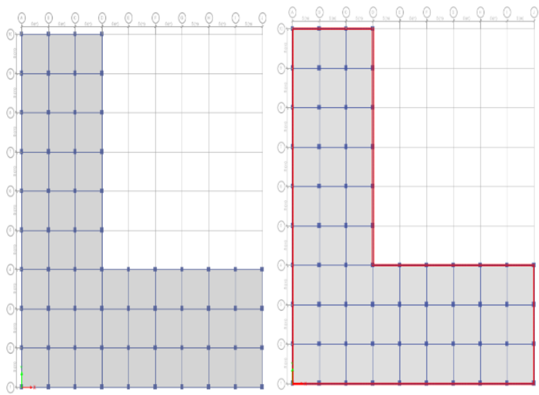

Fig. 5 Plan view of L - shape with and without belt wall

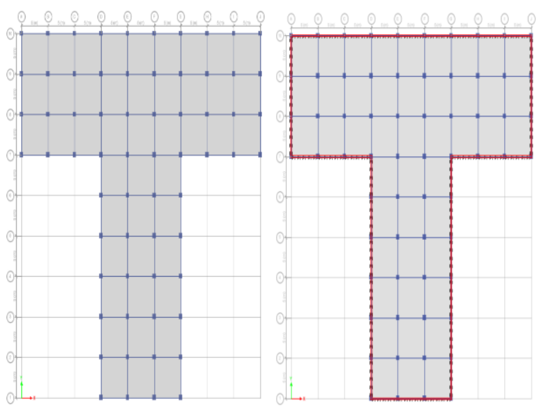

Fig. 6 Plan view of T - shape with and without belt wall

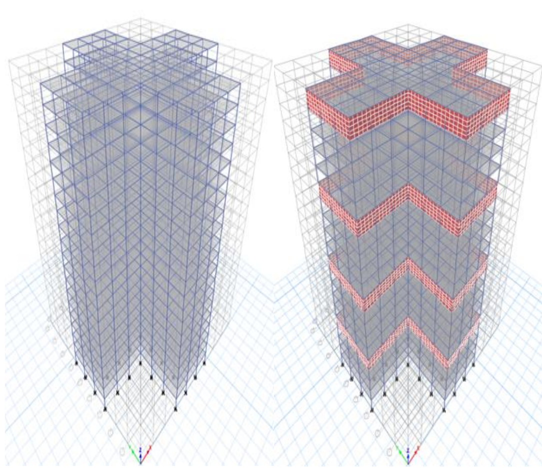

Fig. 7 3D view structure of plus shape with andwithout belt wall

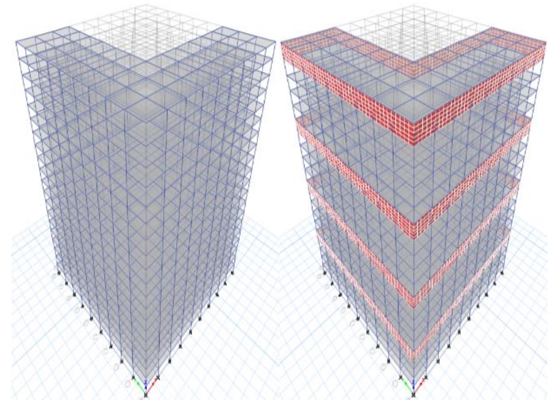

Fig. 83D view structure of L - shape with bare frame and with belt wall

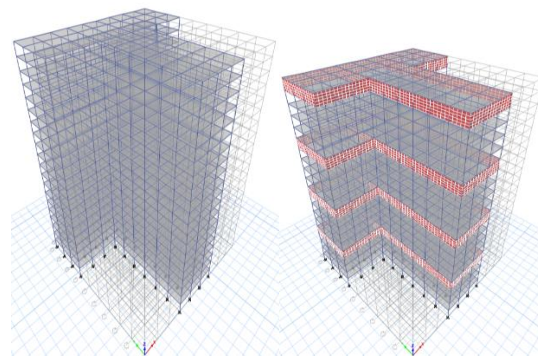

Fig. 93D view structure of T - shape with and without belt wall

Validation of Base paper

The building model adopted for the analysis is a symmetric 20 Storey commercial building having Storey height of 3m founded on medium soil.

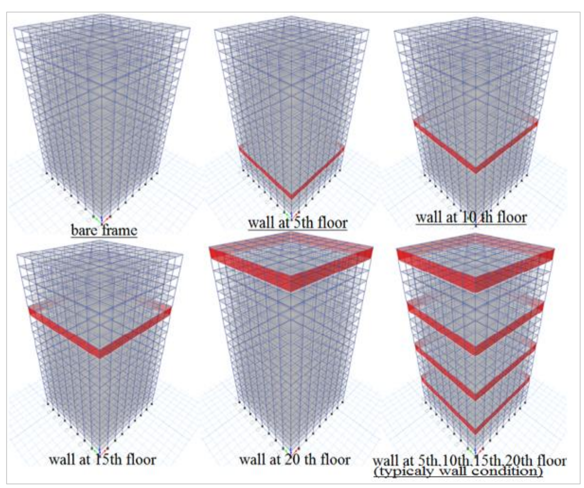

Fig. 10Different Rigidity Condition

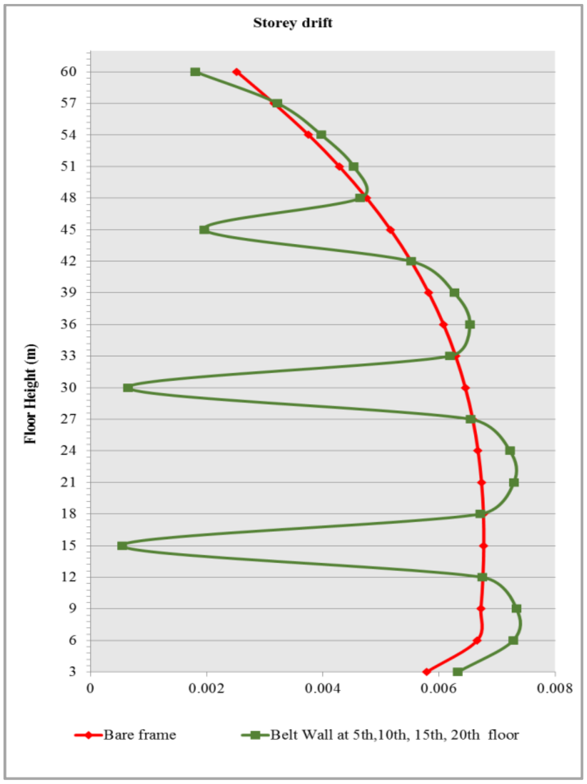

Fig. 11 Storey drift graph between bare frame and typically wall condition

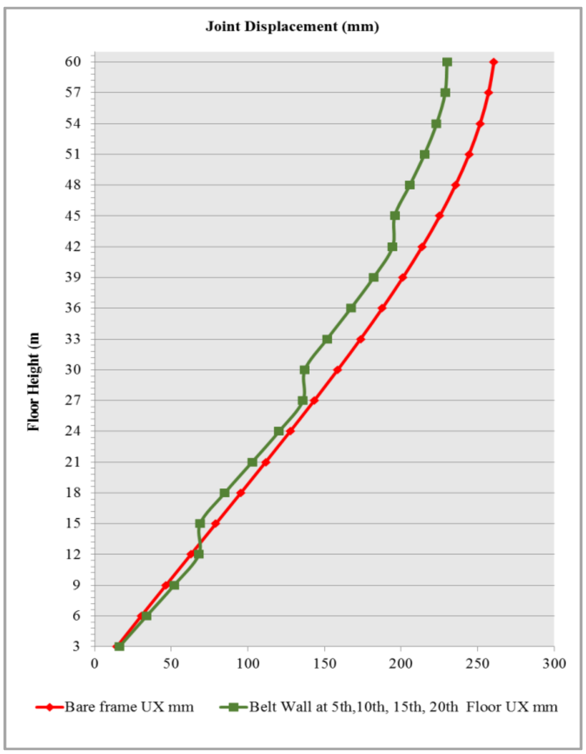

Fig. 12Joint Displacements between Bare Frame and Typically Belt Wall Condition

IV. RESULTS AND MODELLING

In this section of study determines results of joint displacement, story drift, bending moment, stiffness and base reaction in 20 floor of current three models with bare frame or belt wall and their deformed shape models analysis.

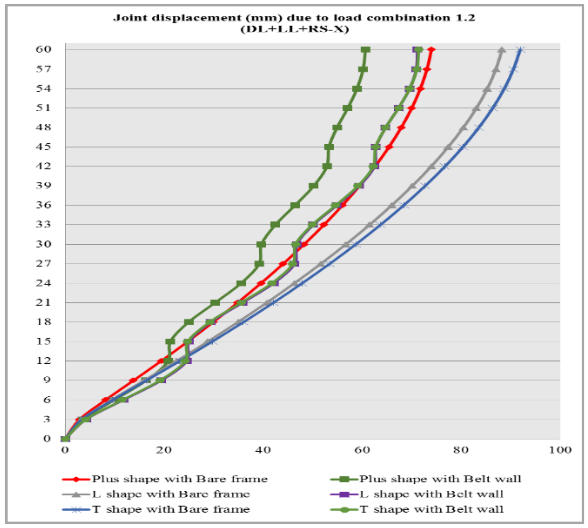

Fig. 12 Joint displacement of different shape models cause from load combination 1.2 (DL+LL+RS-X)

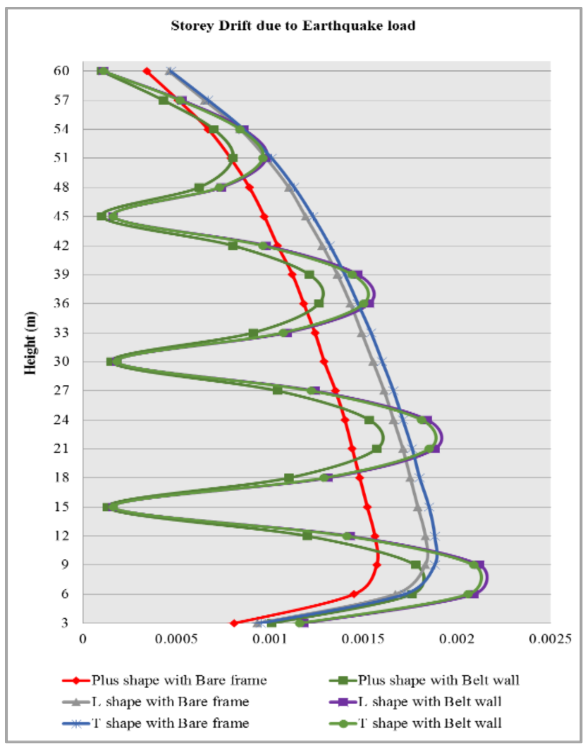

Fig. 13 Storey drift of different shape models cause from Earthquake load

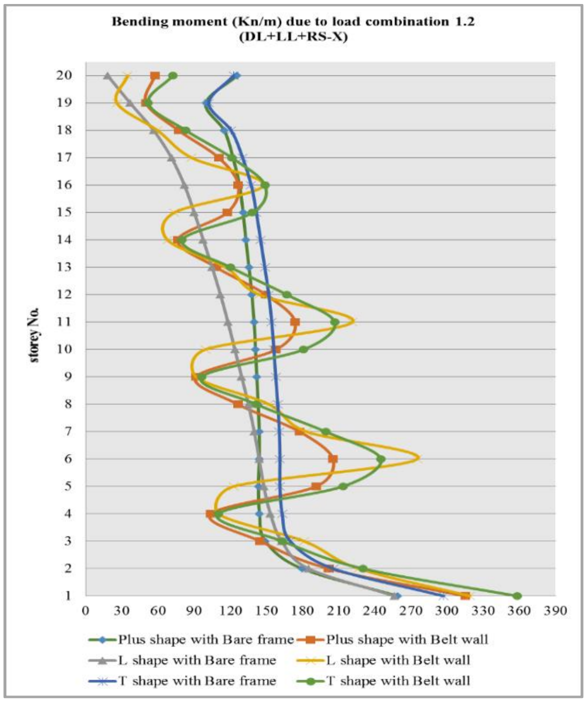

Fig. 14Bending moment of different shape modelsCause from load combination 1.2 (DL+LL+RS-X)

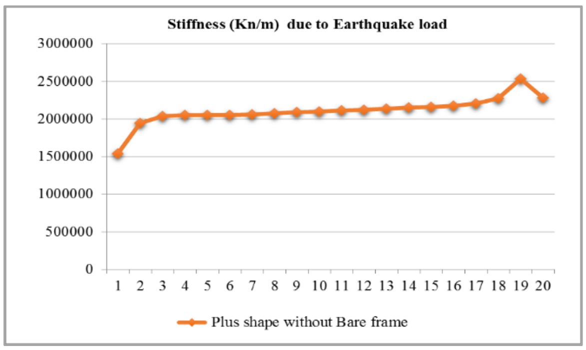

Fig. 15 Stiffness of plus shape with bare frame model due to Earthquake Load

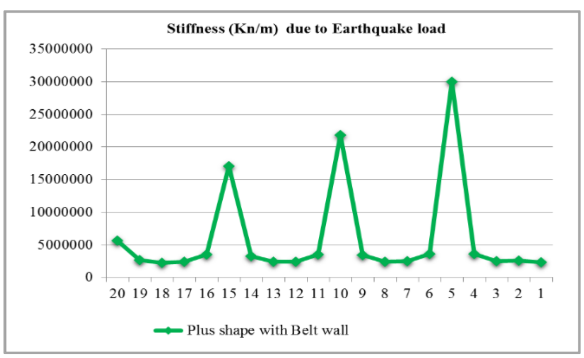

Fig. 16Stiffness of plus shape with belt wall model due to Earthquake Load

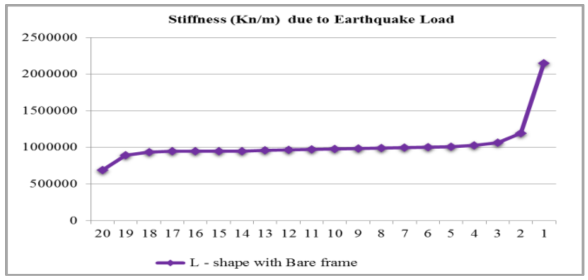

Fig. 17Stiffness of L- shape with bare frame model Cause from Earthquake Load

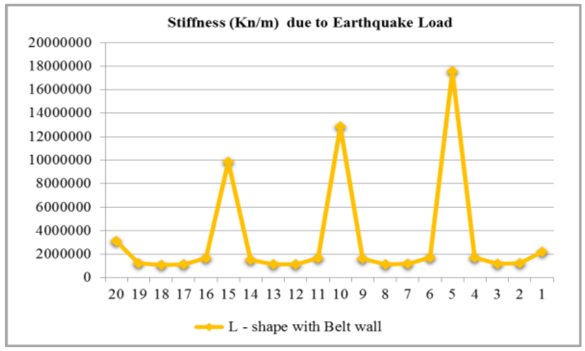

Fig. 18 Stiffness of L - shape with belt wall model Cause from Earthquake Load

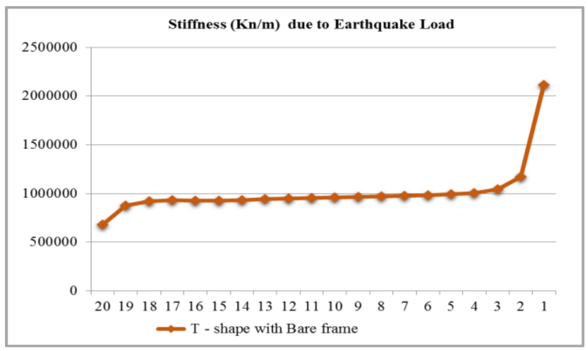

Fig. 19Stiffness of T- shape with bare frame model Cause from Earthquake Load

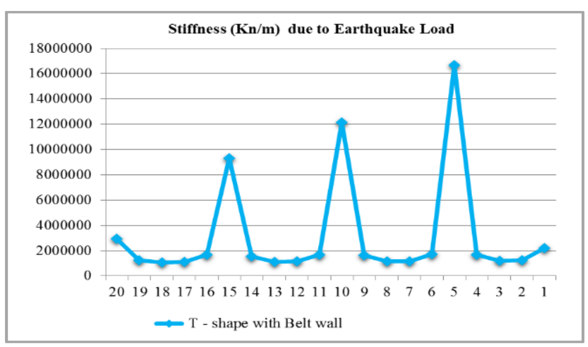

Fig. 20 Stiffness of T - shape with belt wall model Cause from Earthquake Load

Results of base reaction

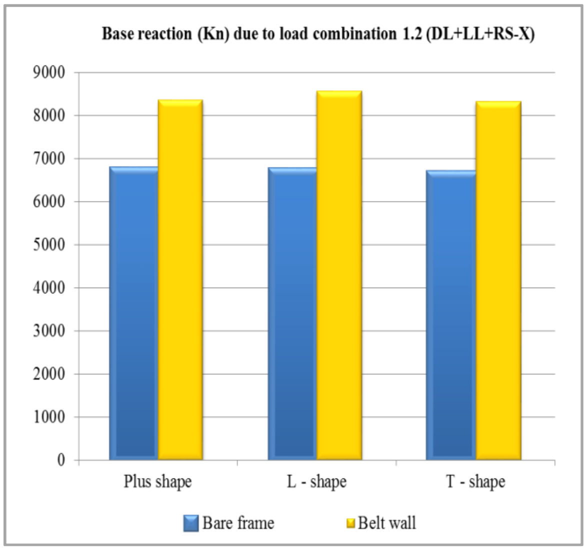

Fig. 21Base reaction of different models due to load combination 1.2 (DL+LL+RS-X)

V. CONCLUSION

Joint displacement

Joint displacement in plus shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls grows gradually as floor height increases. Use belt walls on every fifth storey until joint displacement values increase, however when belt walls are applied, displacement values decline in comparison to bare frames.

Joint displacement in L - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls grows gradually as floor height increases. Use belt walls on every fifth storey until joint displacement values increase, however when belt walls are applied, displacement values decline in comparison to bare frames.

Joint displacement in T - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls grows gradually as floor height increases. Use belt walls on every fifth storey until joint displacement values increase, however when belt walls are applied, displacement values decline in comparison to bare frames.

Storey drift

Storey drifts in plus shape models caused by earthquake in bare frame without belt walls grow gradually as floor height decreases. Due to addition of belt wall storey drift suddenly decrease but after that value of storey drift increases more as compare to bare frame.

Storey drifts in L - shape models caused by earthquake in bare frame without belt walls grow gradually as floor height decreases. Due to addition of belt wall storey drift suddenly decrease but after that value of storey drift increases more as compare to bare frame.

Storey drifts in T - shape models caused by earthquake in bare frame without belt walls grow gradually as floor height decreases. Due to addition of belt wall storey drift suddenly decrease but after that value of storey drift increases more as compare to bare frame.

Bending Moment

Bending Moment in plus shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls decrease gradually as floor height increases. Use belt walls on every fifth storey until Bending Moment values decrease, however when belt walls are applied, Bending Moment values decline in comparison to bare frames.

Bending Moment in L - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls decrease gradually as floor height increases. Use belt walls on every fifth storey until Bending Moment values decrease, however when belt walls are applied, Bending Moment values decline in comparison to bare frames.

Bending Moment in T - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt walls decrease gradually as floor height increases. Use belt walls on every fifth storey until Bending Moment values decrease, however when belt walls are applied, Bending Moment values decline in comparison to bare frames.

Stiffness

Stiffness in plus shape models caused by earthquake load in bare frame without belt walls decreases gradually as floor height increases. Use belt walls on every fifth storey until Stiffness values increase, however when belt walls are applied, Stiffness values decline in comparison to bare frames.

Stiffness in L - shape models caused by earthquake load in bare frame without belt walls decreases gradually as floor height increases. Use belt walls on every fifth storey until Stiffness values increase, however when belt walls are applied, Stiffness values decline in comparison to bare frames.

Stiffness in T - shape models caused by earthquake load in bare frame without belt walls decreases gradually as floor height increases. Use belt walls on every fifth storey until Stiffness values increase, however when belt walls are applied, Stiffness values decline in comparison to bare frames.

Base reaction

Base reaction in plus shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt wall maximum value occurs 6714.05Kn. When Use belt walls maximum value occurs 8360.79Kn.

Base reaction in L - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt wall maximum value occurs 6696.22Kn. When Use belt walls maximum value occurs 8569.86Kn.

Base reaction in T - shape models caused by 1.2 (DL+LL+RS-X) load combination in bare frame without belt wall maximum value occurs 6630.33Kn. When Use belt walls maximum value occurs 8330.12Kn.

VI. FUTURE SCOPE OF THE WORK

- To study in further about belt wall in different location of models.
- On behalf of belt wall also use dampers and bracing and compare their result.
- In this survey, we propose a concrete belt wall on the outer circumference. However, further research is needed on belt walls that have an opening effect.
- Simple beam-column-wall-string element because the complete FEM model must be included.
- The effect of curvature should be reversed by optimizing the walls of the stabilizing rope to investigate the effect on the column moment.
- For further study of belt wall are also done with only steel structures and dampers.

REFERENCES

[1]. Banerjee, Tarak, and Arya Banerjee. "A Study on Optimizing the Positioning of Shear Walls for a Plus Shaped Irregular Building." (2021).

[2]. Panjwani, Ankit, and Vipin Kumar Tiwari. "Literature Review on Analysis of Tall Buildings Subjected to Wind Loads By Using Gust Factor Method."

[3]. Jose, Sajan K., et al. "Fixed and Base Isolated Framed Structures: A Comparative Study." Journal of Physics: Conference Series. Vol. 2070. No. 1. IOP Publishing, 2021.

[4]. Pathak, Ayush, Anubhav Rai, and Vedant Shrivastava. "Seismic Behavior of RC Multistory Building Frame Structure with Different Plan Configuration." (2021).

[5]. Wael Alhaddad, YahiaHalabi, Hu Xu, HongGang Lei, "Outrigger and Belt-Truss System Design for High-Rise Buildings: A Comprehensive Review Part II—Guideline for Optimum Topology and Size Design", Advances in Civil Engineering, vol. 2020, Article ID 2589735, 30 pages, 2020.

[6]. Mohammed ArsalaanWajid, Dr. S. AmareshBabu, "Use Of Outrigger, Belt Wall And Bracing Systems In High Rise Building Subjected To Wind Loads", International Journal of Engineering Development and Research (IJEDR), ISSN:2321-9939, Vol.8, Issue 1, pp.75-81, January 2020.

[7]. Hemant Kumar Sain, Basant Kumar Meena, "An experimental analysis on concrete containing GGBFS and meta kaolin with CCR", AIP Conference Proceedings 2901(1), pp. 1-13, 2023.

[8]. Nitesh Kanwat, Hemant Kumar Sain, Mr. Kapil Karadia, "A Study Of Different Type Of Industrial Roof Truss With Applications Of Various Load Combinations", International Research Journal of Modernization in Engineering Technology and Science, Vol. 04, Issue. 11, November 2022.

[9]. Khanal, Bharat, and Hemchandra Chaulagain. "Seismic elastic performance of L-shaped building frames through plan irregularities." Structures. Vol. 27. Elsevier, 2020.

[10]. Nikhil Goyal, Hemant Kumar Sain, Mohsin Khan Agwan, A Study On Fiber Reinforced Concrete Using Different Types Of Geo-Polymer Fiber In Preparation Of Concrete Sample", Journal of Emerging Technologies and Innovative Research (JETIR), Vol. 9, Issue. 9, pp. 750-753, 2022.

[11]. Nitesh Kanwat, Hemant Kumar Sain, Mr. Kapil Karadia, "A Study Of Different Type Of Industrial Roof Truss With Applications Of

Various Load Combinations", International Research Journal of Modernization in Engineering Technology and Science, Vol. 04, Issue. 11, November 2022.

[12]. Kaul, Dheeraj, Sagar Jamle, and Lalit Balhar. "An Immense Review on Comparative Analysis between Regular and Irregular Multistoried Building under Seismic Loading." (2020).

[13]. Ahirwar, Deepak Kumar, K. Divya, and Lokesh Singh. "Design Analysis of Outrigger and Hexagrid System in High Rise Buildings: A Review." (2020).

[14]. Mithbhakare, N., and P. Kumbhar. "Review on Behavior of Outrigger System in High Rise Building." (2020): 1-5.

[15]. Fahmy, Mohammad, et al. "A review and insights for eleven years of urban microclimate research towards a new Egyptian era of low carbon, comfortable and energy-efficient housing typologies." Atmosphere 11.3 (2020): 236.

[16]. Nitesh Kanwat, Hemant Kumar Sain, Mr. Kapil Karadia, "An Advance Study On Industrial Roof Truss With Consideration Of Irc Loading", International Research Journal of Modernization in Engineering Technology and Science, Vol. 04, Issue. 11, November 2022.

[17]. Kusum Choudhary and Hemant Kumar Sain, "Seismic Behavioural Analysis of One Bay Structure With Composite Beam and RCC Columns", International Journal of Engineering Research and Generic Science (IJERGS), Vol. 7, Issue. 6, pp. 27-36, 2021.