

Comparative Analysis of Different Lateral Load Resisting System for RCC Structure

Shubham P. Dhoke¹, Bhavini V. Ukey², Amol V. Gorle³

B.E. Student, Department of Civil Engineering, J.C.O.E.T., Yavatmal, Maharashtra, India¹

B.E. Student, Department of Civil Engineering, J.C.O.E.T., Yavatmal, Maharashtra, India²

Assistant Professor, Department of Civil Engineering, J.C.O.E.T., Yavatmal, Maharashtra, India³

ABSTRACT: Due to development in construction technology and structural systems growth of high rise building increases. Now-a-days in modern tall buildings, lateral loads induced by earthquake or wind are often resisted by a various lateral load resisting system (viz., Beam Column System, Frame Tube System, Shear Wall & Frame System and Diagrid System, etc.). This paper contains comparative analysis of various lateral load resisting system (i.e., Beam Column System, Frame Tube System and Diagrid System). Modelling and analysis of different lateral load resisting system done in ETABS-2015 software. This paper gives information about various lateral load resisting system and which of them is more beneficial. Lateral load plays an important role while designing any multi-storey building, so study & analyse the lateral load resisting system. The comparison of lateral load resisting systems is done by using Response Spectrum Method on the basis of various parameters such as storey displacement, storey drift, storey forces and modal time period.

KEYWORDS: Storey displacement, Stiffness, Bracing, Frame Tube, Diagrid, Shear Wall, Dynamic, Response Spectrum Analysis, ETABS.

I. INTRODUCTION

Now a day, India moving towards the developing country through an economy, huminite for that infrastructure places plays an important role. Bhuj Earthquake, Killari Earthquake, Chamoli Earthquake, Jabalpur Earthquake and Uttarkashi Earthquake etc. this type of earthquake cause casualties and damages in higher quantity. This type of moment move India to lack behind from become developed country. In the earthquake occurrence area, random rubble stone masonry structure, cement concrete block construction, earthen building has been observed mostly. It is important to construct the structure resistant to earthquake. So, we start to construct these types of building. For constructing such a structure resistant to earthquake requires higher construction cost. But, according to the architecture point of view we must check the building for all the type of loading (viz., seismic load, lateral loads, wind load, etc.). So, that the building is withstand in proper manner & the life span of building becomes more than other and providing safety to peoples.

Seismic zone plays an important role in design of earthquake resistant structures, because the zone factor changes as the intensity of earthquake changes from low to very severe. For the occurrence of earthquake mainly two types of lateral forces act on structure i.e. wind force and seismic force. For protecting structure from these forces and damages, lateral load resisting system is design in earthquake prone areas. Some of lateral load resisting structures are Diagrid System, Frame Tube System and Beam Column System, etc.

OBJECTIVE

- ✓ To determine Story displacement, Modal time period, Story forces in both vertical and horizontal direction.
- ✓ To determine the economical and convenient lateral load resisting system.
- ✓ To observe performance of different lateral loads resisting system under seismic loading.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

II. LITERATURE SURVEY

These are some literature reviews while preparing this paper.

Rasool Owais and Tantray Manzoor Ahmad “Comparative analysis between different commonly used lateral load resisting systems in reinforced concrete buildings.” In this paper, they studied different cases of lateral load resisting systems. They check efficiency by comparing nodal displacements, relative displacement, maximum moments and shear forces. They use square grid of 12m in each direction in seismic zone 5. They made analysis on the basis Staad-proV8i software. They found nodal displacement both transitional and rotational for shear wall is least, bending moment and displacement is comparatively less in bracing system than other systems.

Abhijeet Baikerikar, Kanchan Kanagali, “Study of lateral load resisting systems of variable heights in all soil types of high seismic zone.” In this paper, they studied shear wall, bracing, moment resistance frame & lateral loads act on higher rise building. They describe how to overcome from earthquake loading and which system is best among other. They mentioned performance of bracing system is better than other system in earthquake prone area.

III. SYSTEM DEVELOPMENT

In this paper, comparison of different lateral load systems is done. Following lateral load resisting systems are considered 1] Beam Column System 2] Frame Tube System and 3] Diagrid System and these systems are discussed in short.

1] Beam Column System: -In Beam Column system, the structural members are made of beam and column. Beam is the horizontal member of structure & it transfers the load to column. Column is a vertical structural member composed to transmit a compressive load to hard stratum foundation of the structure.

2] Frame Tube System: -In Frame Tube System, the combination shear wall and of beam column is provided while designing the structure. Sometimes the shear wall is provided internally in core of the structure, it makes the tube of high strength it forms the frame tube system.

3] Diagrid System: -Diagrid System is nothing but the grids of RCC or Steel provided in structure diagonally with the specific geometry.

This is general information about the various lateral load resisting system. Now moving to the main work of this paper, for achieving economy in construction material and material constant in all lateral load resisting system. Calculating material in such a way that the quantity of material in every system is same. The details of material and dimensions of structural members are given Table-1.

In this paper three models are constructed in ETABS software and they are i) Beam Column System, ii) Frame Tube System and iii) Diagrid System with varying orientation of column. For analysis of different lateral load resisting system adopt Response Spectrum Method. The plan and elevation of various system is given in following figures.

The following figures shows the plan of various lateral load resisting system.

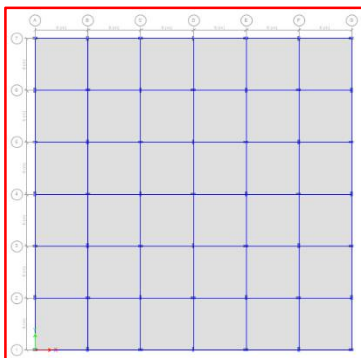


Fig.1) Beam Column System

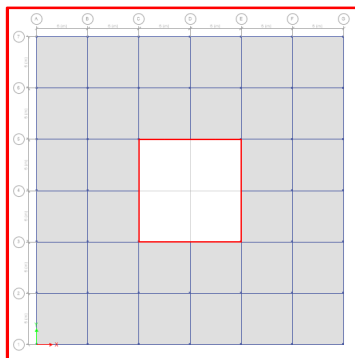


Fig.2) Frame Tube System

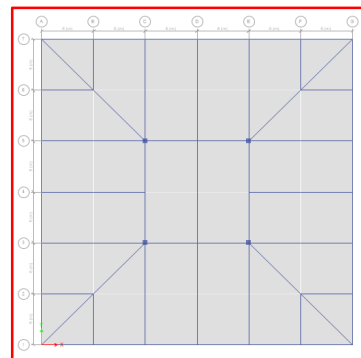


Fig.3) Diagrid System

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

The following figures shows the Elevation of various lateral load resisting system.



Fig.4) Beam Column System



Fig.5) Frame Tube System

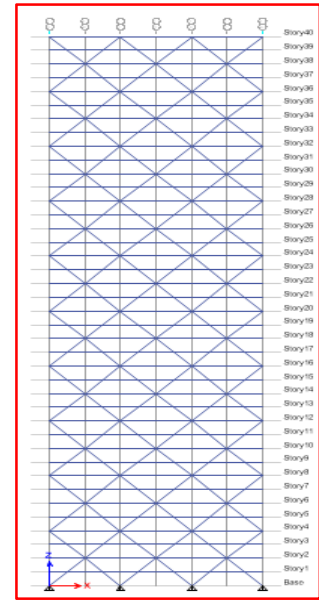


Fig.6) Diagrid System

Table 1: - Details of Materials for Modelling

IV. PERFORMANCE AND ANALYSIS WITH EXPERIMENTAL RESULTS, TABLES AND GRAPHS

Data Required for Modelling				
Number of Storey	Data	Beam Column System	Frame Tube System	Diagrid System
40	Beam Size bXd (in mm)	300X450	300X450	350X490.9
	Column Size bXd (in mm)	300X550	230X248.89	609.3X609.3
	Bracing bXd (in mm)	No	No	350X555.6
	Slab Thickness (in mm)	130	146	130
	Shear Wall Thickness (in mm)	No	110	No
	Concrete Grade	M30	M30	M30
	Grade of Steel (in N/mm ²)	415	415	415
	Live Load (in kN/m ²)	3	3	3
	Floor Finish (in kN/m ²)	1.5	1.5	1.5
	Roof Live Load (in kN/m ²)	1.5	1.5	1.5
	Zone (City-Nagpur)	II	II	II
	Zone Factor (Z)	0.1	0.1	0.1
	Response Reduction Factor (R)	5	5	5
	Importance Factor (I)	1	1	1
Each Storey Height (in m)	3	3	3	
Plan (in meter)	36X36	36X36	36X36	

International Journal of Innovative Research in Science, Engineering and Technology

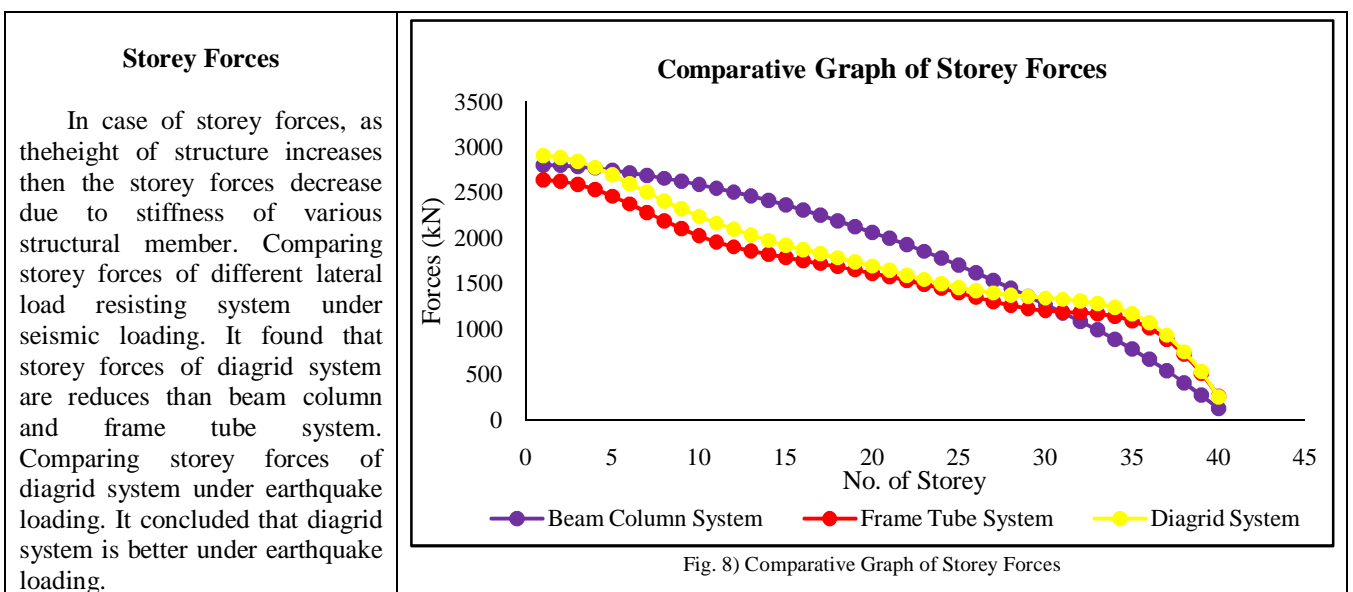
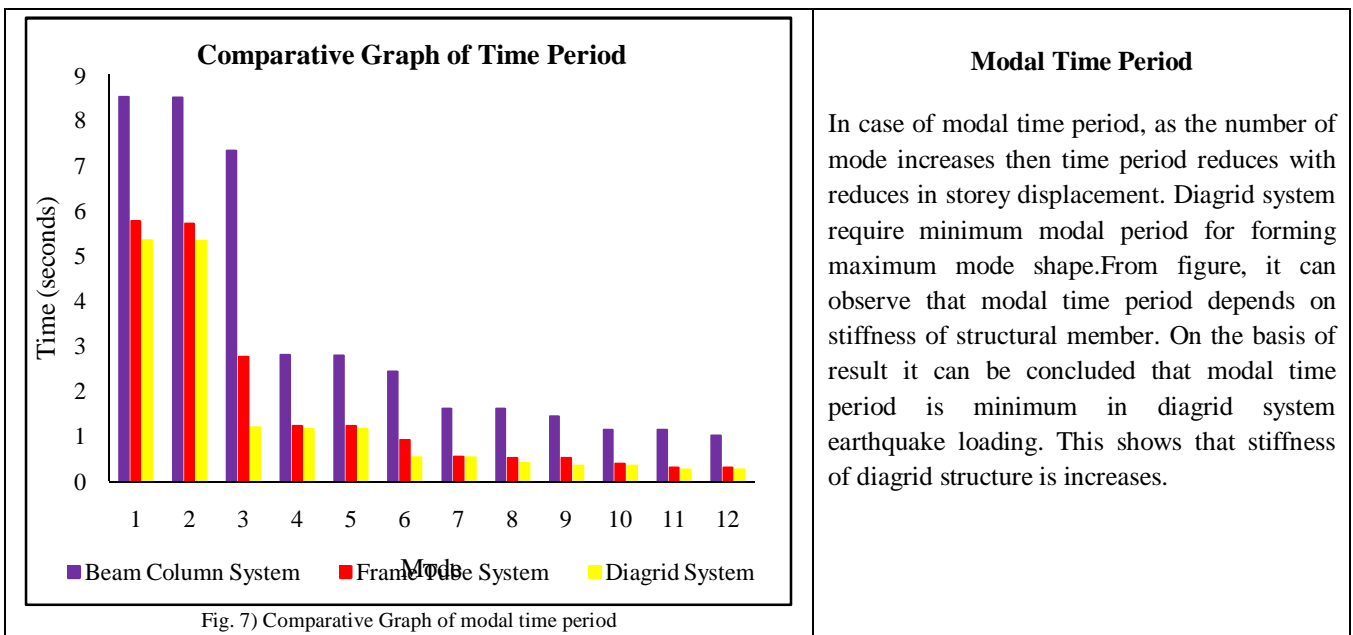
(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

Computer & structures Inc. (CSI) ETABS 2015 software is used for dynamic analysis and determine the response of structures. The comparative analysis of different lateral load resisting system of G+39 storey of RCC structure has been done in ETABS-2015 software. The comparison of performance G+39 storey of different lateral load resisting system is carried out. Comparison based on parameters like story displacement, storey forces and modal time period & storey stiffness.

Following figure shows the comparative result of different lateral load resisting system.

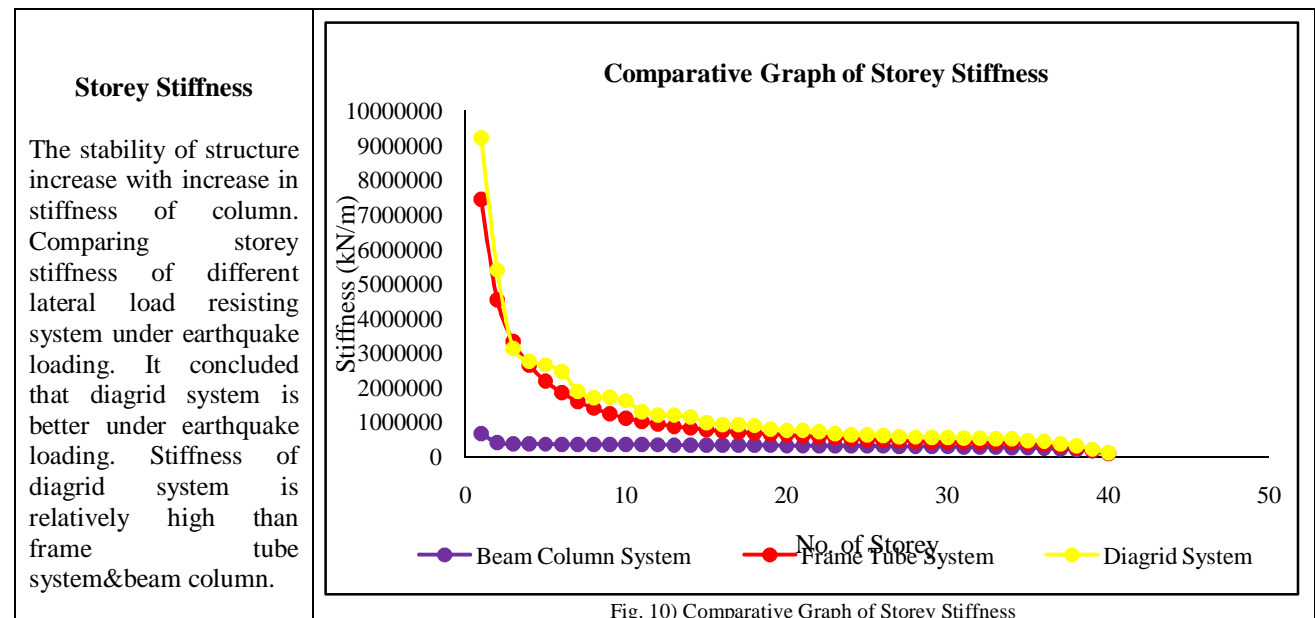
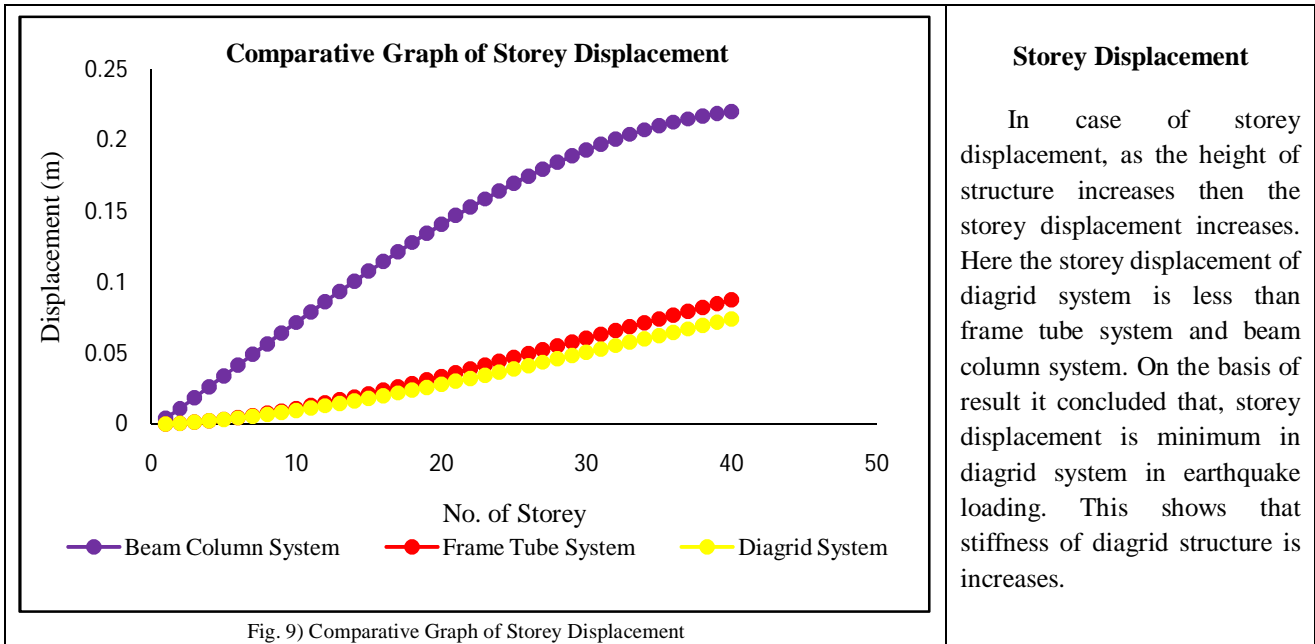


International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017



V. CONCLUSION

The stability of structure increase with increase in stiffness of column. As the stiffness of column increase, it reduces the displacement of structure. On the basis of result, it may conclude that diagrid system is more beneficial than other lateral load resisting system.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Website: www.ijirset.com

Vol. 6, Issue 4, April 2017

On the basis of result, it can be concluded that stiffness of diagrid system is increase than beam column and frame tube system. Due to stiffness increases, storey displacement and modal time period are reduces, that means damping of structure is increases. Hence, stresses induced due to displacement is reduces.

On the basis of above results, it is found that structure with diagrid system gives better performance than others with same material consumption of lateral load resisting system. Diagrid system has good aesthetic appearance as well as effective in performancethan Frame Tube System and Beam Column System. On the basis of results provided by ETABS-2015 it may conclude that the diagrid system gives good results than others as in case of time period, displacement, storey forces and storey stiffness.

REFERENCES

- [1] IS-1893 (Part 1): 2002, "Criteria for earthquake resistant design of structures, part 1-general provisions and buildings", fifth revision, Bureau of Indian Standards, New Delhi, India.
- [2] Khushbu Jani, Paresh V. Patel, "Analysis and design of diagrid structural system for high rise steel buildings", ELSEVIER, page no. 92- 100, 2013.
- [3] Rasool Owais, Tantray Manzoor Ahmad, "Comparative analysis between different commonly use lateral load resisting system in reinforcement concrete building", Global Journal of Researches in Engineering: E, Civil and Structural Engineering, Volume 16, Issue 1, Version 1.0, page no. 47-53, 2016.
- [4] Abhijeet Baikerikar, Kanchan Kanagali, "Study of lateral load resisting system of variable heights in all soil types of high seismic zone", International journal of Engineering Research & technology, Volume 03, Issue 10, page no. 109-119, Oct-2014.
- [5] Ajinkya P. Gadkari, N. G. Gore, "Review on behavior of outrigger structural system in high rise building", International journal of Engineering Development of Research, Volume 4, Issue 2, page no. 2065-2073, 2016.
- [6] Venkata S. Kumar, Surendra Babu, Usha Kranti, "Shear wall-A review", International journal of innovative research in science, Engineering and Technology (IJIRSET), Volume 3, Issue 2, page no. 9691-9694, February-2014.
- [7] M. D. Kevadkar, P. B. Kodag, "Lateral load analysis of RCC building", International journal of Modern Engineering Research (IJMER), Volume 3, Issue 3, page no. 1428-1434, May-June-2013.
- [8] Tanha B. Shah, "Literature Survey on Analysis of Multi-Storey building considering hybrid structure", International journal of innovative research and development, Volume 1, Issue 2, page no. 1-9.
- [9] Tejaswini R. M., Rashmi A. R., "Analysis and comparison of different lateral load resisting structural forms", International journal of engineering research and technology (IJERT), Volume 4, Issue 07, page no. 827-833, July-2015.
- [10] Kiran Parmar, Mazhar Dhankot, "Comparative study between dual system for lateral load resistance in buildings of variable heights", International Engineering Research journal of & Technology (JIKRCE), Volume 02, Issue 02, page no. 303-306, Nov-12 to Oct-13.
- [11] Akshay A. Khanorkar, S. V. Denge, Dr. S. P. Raut, "Belt truss as lateral load resisting structural system for tall building.", International Journal of Science Technology & Engineering (IJSTE), Volume 2, Issue 10, page no. 658-662, April-2016.
- [12] Piyush Gupta, Dr. Neerja, "Analysis of various RCC lateral force resisting system and their comparison using -ETABS", International journal of latest trends in engineering and technology, Volume 6, Issue 4, page no. 175-182, March-2016.
- [13] Prathith Hedge, Dr. Aakshatha Shetty, "Seismic analysis of RC frames using lateral load resisting system", International journal of technical research and applications, Volume 04, Issue 03, page no. 197-200, May-June-2016.
- [14] Kiran Kamath, Sachin Hirannaiah, Jose Camilo Karl, Barbosa Noronha, "Diagrid structure square in plan-pushover", International journal of innovative research in science, engineering and technology (IJIRSET), Volume 05, Issue 09, page no. 48-52, May-2016.
- [15] Dr. H. M. Somasekharaiah, Mr. Madhu Sudhana, Y. B., Mr. Md. Muddasar Basha S., "A Comparative Study on Lateral Force Resisting System for Seismic Loads", International Research Journal of Engineering and Technology (IRJET), Volume 03, Issue 08, page no. 1138-1144, August-2016.
- [16] Hou Guangyu, Chen Binlei, Miao Qisong, Liu Xiangyang, Huang Jia, "Design and research on composite steel and concrete frame-core wall structure", The 14th world conference on earthquake engineering October 12-17, 2008, Beijing, China.