International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Analysis of Wall Belt Support in Multistorey Building With Higher Importance Factor

Gagan Makrani[1], Kishor Patil[2],
Department of civil engineering
(Sushila Devi Bansal College Of Engineering, Indore)
(makrani.gagan5@gmail.com)
(kishorpatiltembhi@gmail.com)

PG Student, Department of Civil Engineering, Sushila Devi Bansal College of Engineering, Indore[1,]
Associate Professor, Sushila Devi Bansal College of Engineering,Indore[2]

ABSTRACT

This paper briefs concerning purpose the effect of importance factor of structure with outrigger wall belt support system which is used in building where outrigger and wall belt supported system with the help of analytical method by design software. In this paper also brief the effects of earthquake and non-earthquake actions of multistory building with importance factor of concrete discussed in connection with outrigger and wall belt support system. The major principle of the review work is to study the effect of importance factor in outrigger and wall belt support system multistory buildings in the view of various researchers. The study can also be useful for low as well as high seismic prone areas as well. The software analysis also been referred for the analysis in the research field. This study deals with the comparative analysis of the research trend on the current topic and after the survey, comprehensive outcomes are provided in conclusions that forms the objectives of the further upcoming study.

Keywords— Importance Factor, Outrigger, Perceptional review, Seismic analysis, Wall belt supported system.

INTRODUCTION

Outriggers are the combination of members of beams or plates linked from the core to external columns in both the directions that hold the structure and act as frame connections. The core provided such as shear wall core holds the whole construction resolutely that accepts the loads and transmit the loads uniformly to the external columns. This system provides more rigidity to the structure than conservative frame systems. The outrigger and belt support framework are one of the horizontal burdens opposing framework in which the outer segments are attached to the focal center divider with hardened outriggers and belt bracket at least one dimensions. faced many disaster activity in past such as earthquake, tsunami etc.

LITERATURE REVIEW

Minu Mathew and Manjusha Mathew (2017),

Concluded in their paper that he reviewed approach for the design and development of tall building using outrigger and belt wall is useful to provide a potential solution. Recently, outrigger and belt wall system is widely used to reduce lateral drift. [1]

Prajyot A. Kakde, Ravindra Desai (2017),

Concluded in their paper that he outrigger and belt truss structural system has proved to be most promising structural system in resisting problem related to lateral stability and sway. The present study is conducted for 70 storied high rise building with core shear wall. [2]

Lekshmi Soman, Sreedevi Lekshmi (2017),

Concluded in their paper that Outrigger braced structures is an efficient structural form in which the central core is connected to the outer columns. [3]

Roslida Abd. Samat et al. (2018),

Concluded in their paper that along-wind responses are determined by employing the procedures from the ASCE 7-16 while the across-wind responses of the buildings are calculated based on the procedures and wind tunnel data available in a database of aerodynamic load. [4]

Neeraj Patel , Sagar Jamle (2019),

Concluded in their paper that his study outrigger system is take en for analysis due the fact that is found the most optimal system for high rise buildings and skyscrapers.[5]

C. Bhargav Krishna and V. Rangarao (2019),

Concluded in their paper that Tall building development has been rapidly increasing worldwide introducing new challenges that need to be met through engineering judgment.[6]

Archit Dangi and Sagar Jamle (2019),

Concluded in their paper that he, shear core outrigger and belt supported system is used on G+10 multistory residential building located at seismic zone IV. General structure compared with both wall belt and truss belt supported system using optimum location suggested by Taranath method. [7]

Jateen M. Kachchhi, Snehal V. Mevada and Vishal B. Patel (2019),

Concluded in their paper that he study mainly focuses on determining the most effective and economical system which can resist lateral load such as wind load and seismic load. [8]

Mohammad Bilal Rasheed and Sagar Jamle (2020),

Concluded in their paper that he study can also be useful for low as well as high seismic prone areas as well. The software analysis also been referred for the analysis in the research field.[9]

Donny Morris (2020),

Concluded in their paper that this research use 4 models building (A-BC-D) with 62 floors of tower and 6 floors of podium, has dual system portal combination with particular concrete shear-wall and located in the City of Jakarta which soft soil categorize. [10]

Durgesh Kumar Upadhyay and Sagar Jamle (2020),

Concluded in their paper that he introduction of wall belt supported system makes an additional effort to make the structures stiffer than before. The lateral displacement again a major parameter, obtained as less as compared without usage of the same The tall structures are preferred due to less consumption of the land area for living purpose.[11]

Chirag Singh and Mayur Singi (2020),

Concluded in their paper that he have used the outrigger system and erected as discussed in graphical representations in discussion part. In conclusion, parametric result comparison noted down. Overall it is observed that the Case TLA is very efficient among all the cases. Also, we have enhanced the property of worst case TLC which is found by our result and discussion by implementing the outrigger system. [12]

Tae-Sung Eom, Hiubalt Murmu and Weijian Yi (2019),

Concluded in their paper that he the force transfer mechanism and performance of the distributed belt walls, acting as virtual outriggers under lateral load, are investigated. For the reinforcement of the belt walls subjected to high shear

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

demand, a reinforcing method using high-strength prestressing strands (i.e. PSC belt wall) is suggested, and the shear strength of the PSC belt walls is estimated based on the compression field theory.[13]

Pankaj Patel and Prof. Rahul Sharma (2021),

Concluded in their paper that In this project a G+10 Storey structure has analyzed using seven different cases named as RA1 to RA7-OTB. 1 to 7 indicates single outrigger system, shear core outrigger system truss belt support system with optimized trusses, at various locations under seismic zone III. The built up area used for various case as 315 sq. m. [14]

METHODOLOGY AND RESEARCH OBJECTIVES

General

Methodology is an approaching way to obtain a satisfying result about any kind of analysis done in any structure. The analysis is always done in an order to compare the previous situation of a structure and by getting a new result change it accordingly. If a methodology for any structure unsatisfied the comparison then it will have a new way to find the correct approach.

Dynamic analysis

(1) Response spectrum method.

(2) Time history method.

Research Objectives

To find the most efficient for use of wall system in multistoried building with highest importance factor Multistory Building:-

1. Maximum Shear Forces in Columns for all wall belt cases
2. Maximum Bending Moment in Columns for all wall belt cases
3. Maximum Shear Forces in beams parallel to X direction for all wall belt cases
4. Maximum Shear Forces in beams parallel to Z direction for all wall belt cases
5. Maximum Bending Moment in beams parallel to X direction for all wall belt cases
6. Maximum Bending Moment in beams parallel to Z direction for all wall belt cases

Table 1: List of buildings framed with assigned abbreviation

S. No.	Buildings framed for analysis	Abbreviation
1	Wall Belt Not Provided with G+10 Configuration	WB1
2	Wall Belt Provided at foundation with G+10 Configuration	WB2
3	Wall Belt Provided at 1st floor with G+10 Configuration	WB3
4	Wall Belt Provided at 3rd floor with G+10 Configuration	WB4
5	Wall Belt Provided at 5th floor with G+10 Configuration	WB5
6	Wall Belt Provided at 7th floor with G+10 Configuration	WB6
7	Wall Belt Provided at 9th floor with G+10 Configuration	WB7

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

Table 2: Input details for Multistory Building for all cases

Building configuration	G+10
Height of building	47.92m
Concrete and Steel Grade	M 30 & FE 550

Table 3: Data taken for analysis of structure

Constraint	**Assumed data for all buildings**
Soil type	Hard Soil
Seismic zone	V
Response reduction factor (ordinary shear wall with SMRF)	4
Importance factor (Clause 7.2.3 table 8)	1.5
Damping ratio	5%
Plinth area of building	575 sq. m
Floors configuration	G + 10 (Multistory building)
Depth of foundation	4 m
Floor to floor height	GF-3.66 m, All floors-3.66 m each
Fundamental natural period of vibration (T_a)	$0.09*h/(d)^{0.5}$
Earthquake parameters	Zone V with RF 4 & 5% damping ratio
Period in X & Z direction	1.8625 sec. & 1.7874 sec. for both direction
Slab thickness	150 MM
Beam sizes	0.7 X 0.6 0.6 X 0.5 0.5 X 0.4
Column sizes	0.8 X 0.7 0.7 X 0.6 0.6 X 0.5
Wall belt thickness	150MM
Material properties	M 30 Concrete Fe 550 grade steel

RESULTS AND DISCUSSION

As per the objectives, the Response Spectrum Analysis has performed on different building models consist of building having G+10 storied structures with usage of wall belt RCC elements. The analysis results obtained using Staad pro software is shown in tabular form along with various graphs with various parameters as follows

Table 4: Maximum Shear Forces in Columns for all wall belt cases

Case	Column Shear Force (KN)	
	Shear along Y	Shear along Z
WB1	328.789	307.705
WB2	321.539	338.462
WB3	313.565	326.225
WB4	318.256	369.467
WB5	280.421	299.118
WB6	271.952	303.831
WB7	294.572	306.807

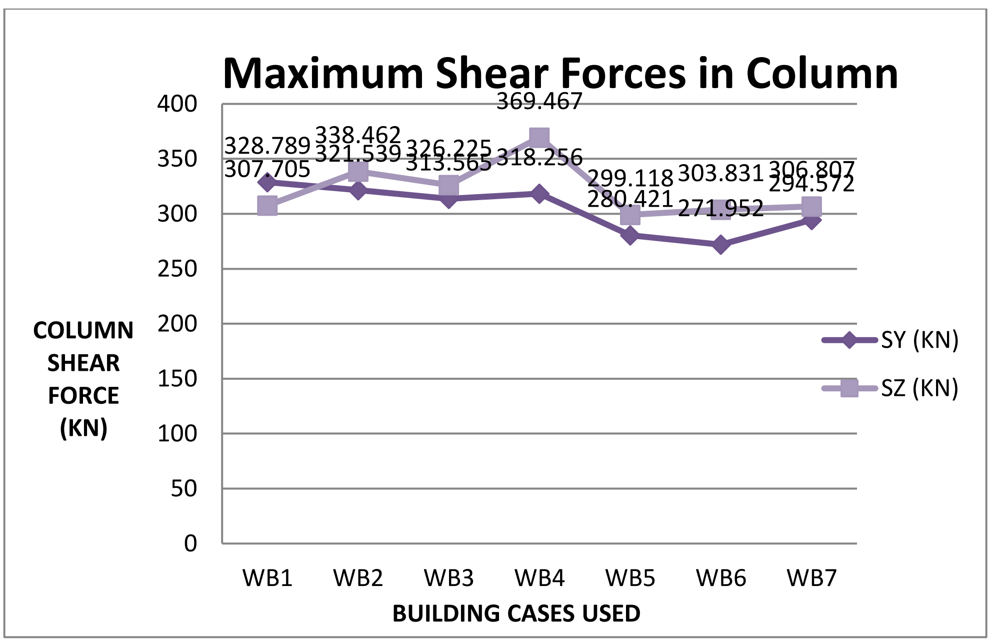

Fig. 2: Maximum Shear Forces in Columns for all wall belt cases

Comparing the column shear force for all cases, case WB6 in Y direction and WB5 in Z direction is the optimum than other cases.

Table 5: Maximum Bending Moment in Columns for all wall belt cases

Case	Column Bending Moment (KNm)	
	Moment along Y	Moment along Z
WB1	721.127	669.443
WB2	848.355	772.129
WB3	781.69	772.041
WB4	769.467	776.941
WB5	737.429	774.932
WB6	741.060	756.566
WB7	726.855	738.935

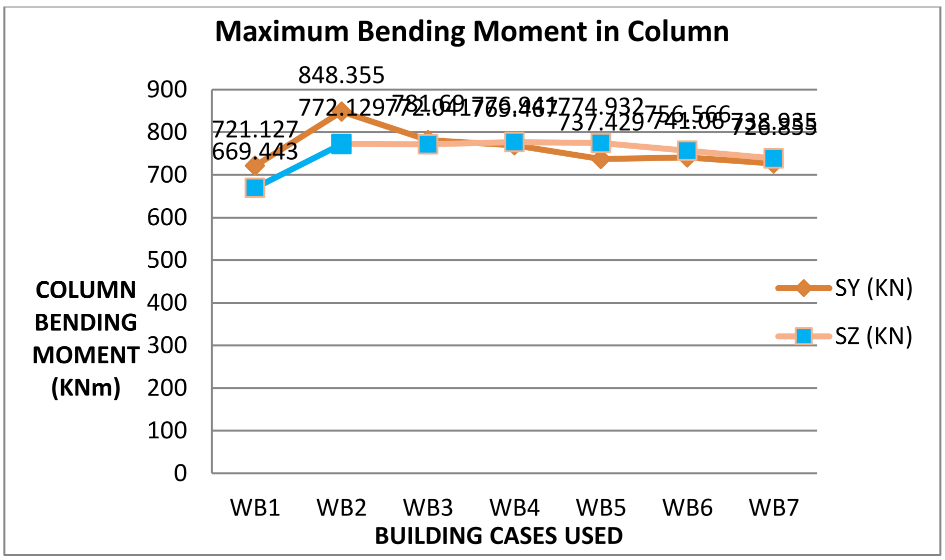

Fig. 3: Maximum Bending Moment in Columns for all wall belt cases

As per comparative results in column bending moment, case WB5 in Y direction WB7 in Z direction is very effective than other cases

Table 6: Maximum Shear Forces in beams parallel to X direction for all wall belt cases

Case	Beam Shear Force (parallel to X direction) (KN)
WB1	335.992
WB2	332.145
WB3	314.795
WB4	284.064

WB5	272.210
WB6	293.315
WB7	310.460

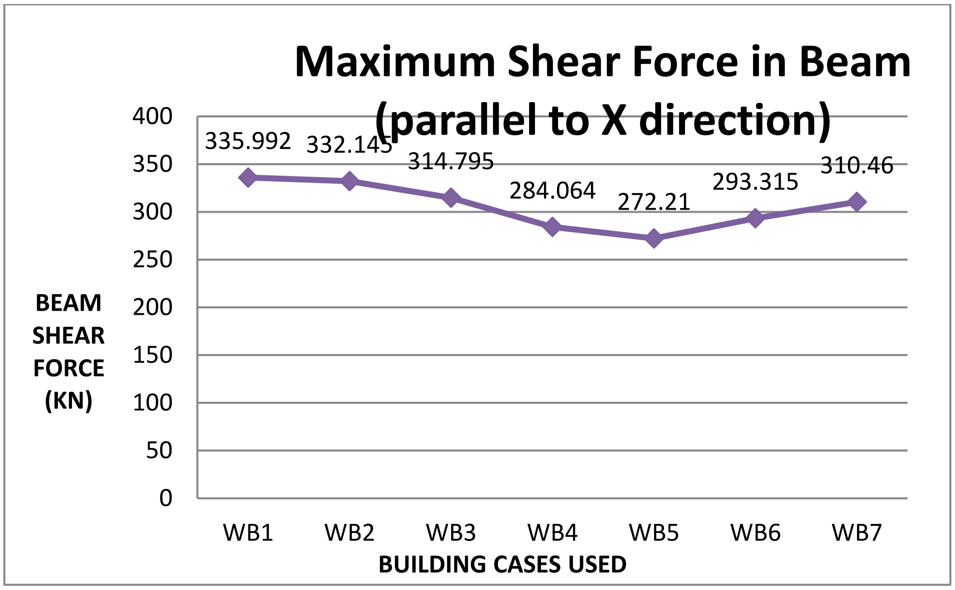

Fig. 4: Maximum Shear Forces in beams parallel to X direction forall wall belt cases

Comparing the beam shear force in X direction for all cases, case WB5 is the optimum than other cases

Table 7: Maximum Shear Forces in beams parallel to Z direction for all wall belt cases

Case	**Beam Shear Force (parallel to Z direction) (KN)**
WB1	4.399
WB2	5.748
WB3	8.570
WB4	9.864
WB5	9.517
WB6	6.680
WB7	6.608

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

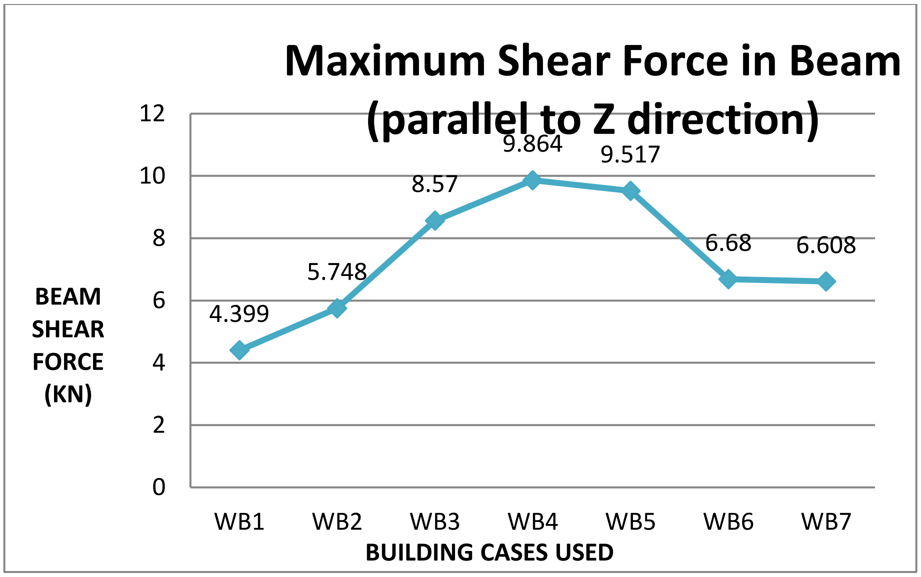

Fig. 5: Maximum Shear Forces in beams parallel to Z direction for all wall belt cases

Comparing the beam shear force in Z direction for all cases, case WB2 is the optimum than other cases

Table 8: Maximum Bending Moment in beams parallel to X direction for all wall belt cases

Case	Beam Bending Moment (along X direction) (KNm)
WB1	10.343
WB2	17.422
WB3	24.032
WB4	25.917
WB5	26.984
WB6	17.384
WB7	17.073

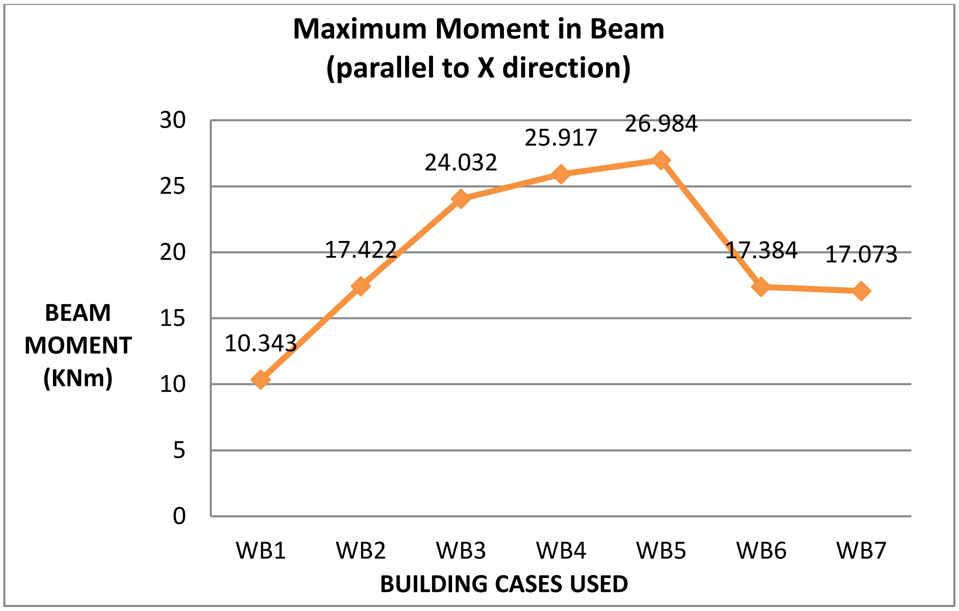

Fig. 6: Maximum Bending Moment in beams parallel to X direction for all wall belt cases

As per comparative results in beam in X direction bending moment, case WB7 is very effective than other cases

Table 9: Maximum Bending Moment in beams parallel to Z direction for all wall belt cases

Case	Beam Bending Moment (along Z direction) (KNm)
WB1	654.790
WB2	650.937
WB3	618.191
WB4	542.181
WB5	577.539
WB6	589.736
WB7	634.455

International Research Journal of Education and Technology
Peer Reviewed Journal
ISSN 2581-7795

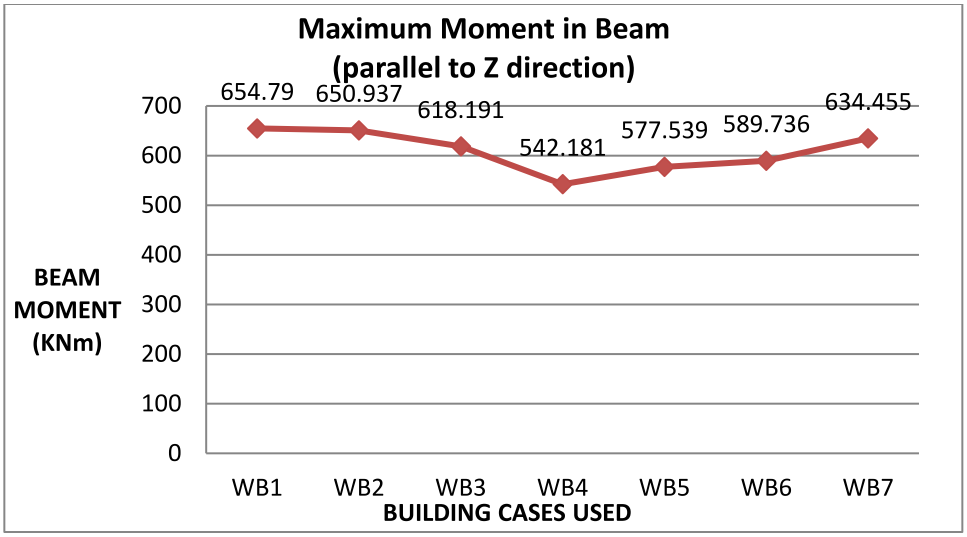

Fig. 7: Maximum Bending Moment in beams parallel to Z direction for all wall belt cases

As per comparative results in beam in Z direction bending moment, case WB4 is very effective than other cases

CONCLUSION

1. Comparing the column shear force for all cases, case WB6 in Y direction and WB5 in Z direction is the optimum than other cases.
2. As per comparative results in column bending moment, case WB5 in Y direction WB7 in Z direction is very effective than other cases
3. Comparing the beam shear force in X direction for all cases, case WB5 is the optimum than other cases
4. Comparing the beam shear force in Z direction for all cases, case WB2 is the optimum than other cases
5. As per comparative results in beam in X direction bending moment, case WB7 is very effective than other cases
6. As per comparative results in beam in Z direction bending moment, case WB4 is very effective than other cases

REFERENCES

[1] Mathew M., (June-2017) Optimum Position of Outrigger with Belt Wall International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, Issue 6, June 2017, ISSN(Online) : 2319-8753, ISSN (Print) : 2347-6710, pp 10376-10372, DOI:10.15680/IJIRSET.2017.0606033

[2] Bayati Z,, M. Mahdikhani& et.al.(Oct.-2008) "Optimized Use Of Multi-Outriggers System To Stiffen Tall Buildings" The 14th World Conference on Earthquake Engineering Beijing, China, pp- 12-17, 2008,

[3] Alhaddad W., Halabi Y. &et. al.(2020) "Outrigger and Belt-Truss System Design for High-Rise Buildings: A Comprehensive Review" Part II—Guideline for Optimum Topology and Size Design, Hindawi Advances in Civil Engineering,Volumev,Article-ID-2589735,pp-1-30, https://doi.org/10.1155/2020/2589735

[4] Mathew M., (June-2017) Optimum Position of Outrigger with Belt Wall International Journal of Innovative Research in Science, Engineering and Technology, Vol. 6, Issue 6, June 2017, ISSN(Online) : 2319-8753, ISSN (Print) : 2347-6710, pp 10376-10372, DOI:10.15680/IJIRSET.2017.0606033

[5] Herath N., Haritos N. &et. al. (2009) "Behaviour of Outrigger Beams in High rise Buildings under Earthquake Loads" Australian Earthquake Engineering Society 2009 Conference

[6] Nadh V.S., Sumanth B.H. (Feb.- 2020) Ideal Location Of Outrigger System And Its Efficiency For Unsymmetrical Tall Buildings Under Lateral Loadings, International Journal Of Scientific & Technology Research volume 9, ISSUE 02, ISSN 2277-8616, Pp 2917-2920.

[7] Gadkari A.P. , Gore N. G. (2016) "Review on Behaviour of Outrigger Structural System in High-Rise Building" IJEDR 2016 , Volume 4, Issue 2, ISSN: 2321 -9939

[8] Kogilgeri S. ,Shanthapriya B. (July-2015) "A Study On Behaviour Of Outrigger System On High Rise Steel Structure By Varying Outrigger Depth Srinivas" International Journal of Research in Engineering and Technology Volume-04 Issue: 07, e ISSN: 2319-1163, p ISSN: 2321-7308, pp 434-438.
[9] Shah N.K., Gore N.G (June-2016) "Review on Behaviour of Outrigger System in High Rise Building" International Research Journal of Engineering and Technology (IRJET), e-ISSN: 2395 -0056, Volume-03, Issue-06, p-ISSN: 2395-0072, Pp 2803-2809.
[10] Salman K. , Kim D. & et. al. (2020)Optimal control on structural response using outrigger braced frame system under lateral loads , Journal of Structural Integrity and Maintenance ISSN: 2470-5314 (Print) 2470-5322 (Online) vol. 5, no. 1, Pp 40–50
[11] Tavakoli R. ,Kamgar R. (Feb.-2019) "Seismic performance of outrigger–belt truss system considering soil–structure interaction" International Journal of Advanced Structural Engineering, pp 45-54.
[12] IS 1893:2000