



e-ISSN: 2319-8753 | p-ISSN: 2347-6710

IJIRSET

International Journal of Innovative Research in
SCIENCE | ENGINEERING | TECHNOLOGY



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

Volume 10, Issue 8, August 2021

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.569

 9940 572 462

 6381 907 438

 ijirset@gmail.com

 www.ijirset.com

Comparative Study of Seismic Behavior of G+15 Storey Building Using Lightweight Concrete and Normal Weight Concrete

Himanshu Divekar¹, Prof. Trupti Narkhede², Prof. P.J.Salunke³

P.G. Student, Department of Civil Engineering, M.G.M.'S College of Engineering and Technology, Navi Mumbai, Maharashtra, India¹

Professor, Department of Civil Engineering, M.G.M.'S College of Engineering and Technology, Navi Mumbai, Maharashtra, India^{2,3}

ABSTRACT: Concrete to be considered as a lightweight concrete, with density less than 2000 kg/m^3 . The primary use of structural lightweight concrete (SLWC) is to reduce dead load of concrete structure which allow structural designer to reduce the size of structural member which results in reduction of earthquake forces of structure. The purpose of this study is to develop and compare the results of structural lightweight concrete by admixing with perlite. The concrete is targeted to have a density of less than 2000 kg/m^3 . In this paper, a G+15 storeyed building is analysed by using Response Spectrum method with the use of Structural Lightweight Concrete and Normal Weight Concrete. Bending moments, shear forces, storey drift and Displacement, Time period are considered and comparison of results of both NWC and SLWC is been done. The structure is modelled with standard software, and analysis is carried out with normal weight and light weight concrete under different zone. The final results and conclusion will be based on the behaviour of building to the seismic forces and the comparative parameters like base shear, lateral storey drift, displacement, cross section area of steel and reducing in size of structural member etc. of both the cases. After analyzing both the two cases it was concluded that the bending moment reduced to 29.17%, 29.44%, 44.6% in LWC under seismic zone 3, zone 4 & zone 5, where as the shear force reduced to 29.41%, 29.67%, 37.84% in SLWC under seismic zone 3, zone 4 & zone 5. The density difference was observed to be 25% lower when compared NWC to SLWC. It has also absorbed that storey drift differs by 16.92%, 1.396% & 20.15% under zone 3, 4 & 5 and storey displacement by 13.67%, 3.905% & 12.47% under zone 3, 4 & 5. It has also found that seismic force on the structure got reduced considerably.

KEYWORDS: Structural Lightweight Concrete, Density of Concrete, Expanded Perlite, Response Spectrum Method, Base Shear, Lateral storey drift, Displacement.

I. INTRODUCTION

Earthquake engineering has developed a lot since the early days, and some of the more complex designs now use special earthquake protective elements either just in the foundation (base isolation) or distributed throughout the structure. A shear wall is a structural component provided to multi-storeyed or tall buildings or ordinary buildings in high wind velocity areas. These walls usually begin from the foundation level, along the length and width of buildings. Their thickness can be above 150 mm or below 400 mm in tall buildings; they are like vertical-oriented wide beams that carry the earthquake load towards the foundation. A braced frame is a structural system commonly used in structures subject to lateral loads such as wind and seismic pressure. The members in a braced frame are generally made of structural steel, which can work effectively both in tension and compression.

II. LITERATURE REVIEW

The present work is aimed at comparative study of analysis of Multi-Storeyed Buildings with Shear walls and Bracing Systems and combination of both. Various studies have been carried out till date for buildings with shear wall and bracing system but none of them compared them using both in the building.

Athira & Vineetha (2018) analysed a (20x20)m, G+19 building with shear wall at all four corners. The aim of this work was to find out the effect of lateral loads on building having shear wall with prismatic and non-prismatic

coupled beam. Non prismatic beam used are stepped haunch cubical, haunch and parabolic haunch, then compare the behaviour these beams on the buildings are studied They analysed two similar bldgs., With shear wall but in case 1 they used only shear wall, and in case 2 they used only coupling beam to connect shear wall (stepped, linear, & parabolic coupling beam). They concluded linear and parabolic beam are more efficient in terms of stiffness, storey drift, displacement and time period.

Donthi Reddy & Sreenivasa (2019) carried out Structural Analysis of G+14 building with shear wall of W,U,H and T shape in all four-zone using ETABS. In this work a high rise building with different shapes of shear walls is considered for analysis. The multi store building with G+14 storey's are analysed for storey drift story displacement and base shear using ETABS software. For the analysis of these building for seismic loading with all Zones (Zone-II, III, and IV & V) is considered. The analysis of these building is done by using dynamic method (Response spectrum analysis). The result shows W and U shape shear wall shows better performance on storey drift. H was better on storey drift in Y direction & T shows better result in base shear value.

Abdul Karim & Srinivasa (2015) carried out analysis of G+20 structure in E-TABS. This work contains a comparative study on regular building with and without outrigger and irregular building with and without outrigger with centrally rigid shear wall and steel bracings as outrigger. The modelling of the structure is done using "ETABS" program. The analysis of the model is carried out by equivalent static method and response spectrum method. They used four structures, two structure with and without shear wall and two structure with and without outrigger bracing in vertically irregular building. They carried out following analysis, 1. Equivalent static analysis 2. Dynamic analysis method (Response spectrum) and found that there was reduction in time period, Overall stiffness, minimized story drift due to outrigger system and also found that comparatively outrigger is more effective than steel x-bracing.

Diliprao & Kalurkar (2020) Used an existing structure and made it seismic resistant by application of methods like FRP, Jacketing etc. The computer software program E-TABS is utilized for dynamics analysis strategy is applied to look at the functionality of a reinforced concrete building. The various retrofitting techniques including steel and concrete application and jacketing of fibre reinforced polymer (FRP) composites that happened to be utilized to enhance the load bearing capacity of specific structure elements are highlighted and techniques including shear wall space plus shear cores that enables you to improve general balance of buildings. Most retrofitting techniques are going to result a rise in stiffness as well as somewhat enhance in mass that causes in return a shorter period. Shortening in period of vibration quite often results an increased ductility and strength of retrofitted structure. They analysed a 12-storey building in E-TABS and based on the analysis result they provided a suitable retro fitting method. After providing retrofitting with enhanced strength, they analysed the same building and compared the result in the terms of base shear story drift, (Intermediate and top), deflection.

III. METHODOLOGY

The following steps are undertaken within the present study are as follows: 1. In present research 2 different model G+15 structure building using perlite lightweight concrete and normal weight concrete is done. 2. Modelling of the structure is done using ETABS. 3. Seismic analysis as per IS 1893-2016. 4. Design and analysis of structure using IS 456-2000, IS 875. 5. Result for the perlite as a lightweight concrete targeted to have a density of less than 2000 kg/m³ and result for normal weight concrete taken from IS 10262-2019. 6. Design and analytical work is been carried out by method using response spectrum analysis. 7. Interpretation of result and conclusion will be based on comparison of behaviour of structure and changes in size parameters, bending moment, storey displacement and drift, base storey and time period of both the building.

IV. STRUCTURAL MODELLING

In this study, structure will be model for the following cases: 1. G+15 storeyed building with structural lightweight concrete and normal weight concrete. 2. Analysis and conclusion of same structure by using response spectrum method 3. Analysis and conclusion by using response spectrum method. 3. The frame structure will be modelled using ETABS software with storey height of 3m, the member size is varied as per the design requirements. 4. The model is analysis with 2 different material properties one is structural lightweight concrete and other is normal weight concrete. 5. Model is design as according to IS 456-2000. 6. The material properties required for the structure is density, elastic modulus, poissons ratio, compressive strength, coefficient of thermal expansion and shear modulus can be calculated. 7. Density

of structural lightweight concrete of perlite mix design can be taken as less than 2000 kg/m^3 and density of normal weight concrete is taken as 2500 Kg/m^3 .

V. PRELIMINARY DATA

Following are the data assumed for carrying out this study, 1. Length in X direction=20m. 2. Length in Y direction=20m. 3. Typical storey height=3m. 4. Ground storey height=3.5m. 5. No. of storey =G+15. 6. Height of bldg. =48.5m. Load consideration are as follows: 1. Dead load: as per calculation of changes in density, compressive strength, Poisson's, modulus of elasticity. 2. Live load: 3 kN/m^2 . 3. Wind load: as per IS 875 part 3. 5. Seismic zones: III.

VI. MODELS

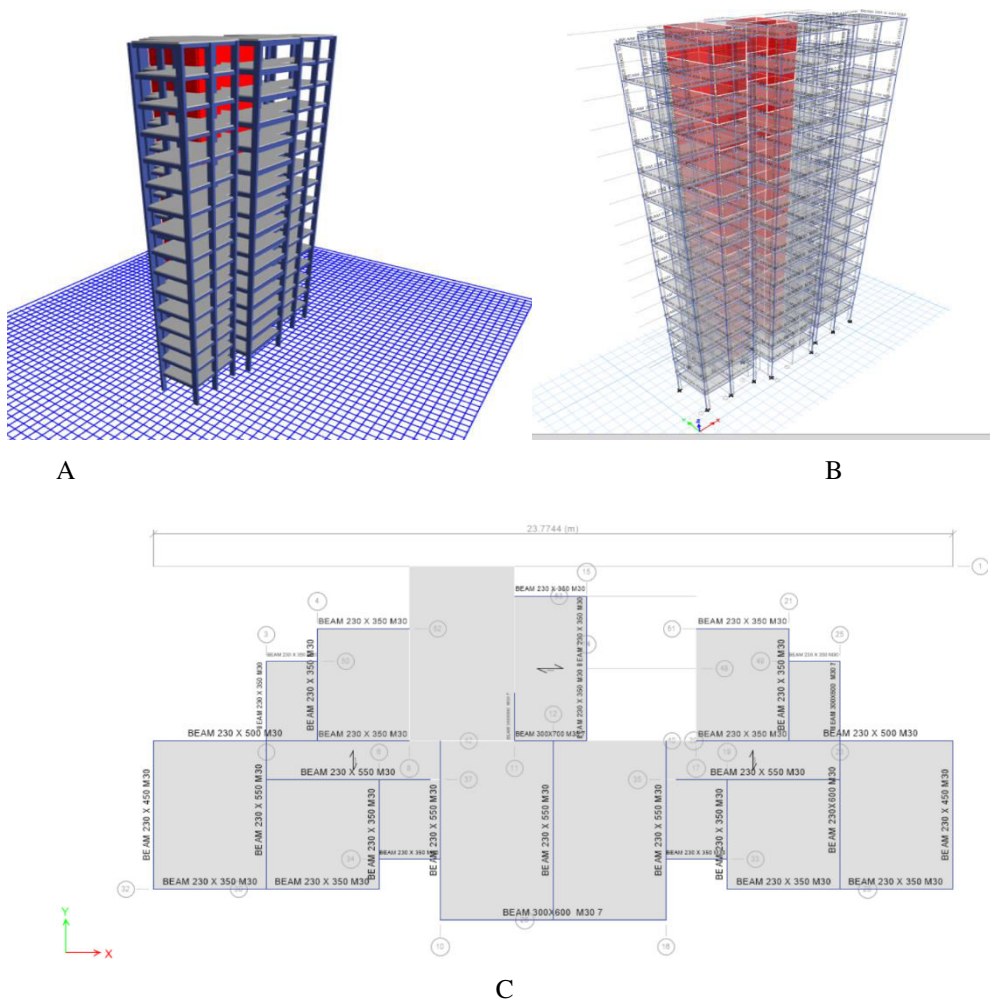


Fig.1: Model (a) 3-D Rendered View, (b) 3-D View, (c) Plan view

VII. RESULTS AND DISCUSSIONS

After running both the models on ETABS 2017 their analytical results were obtained and following observation were made: 1. After comparison, it was observed that the maximum bending moments and shear forces obtained for NWC under seismic zone 3 are 48.39 KN-m & 37.66 KN respectively, whereas for SLWC structures the maximum bending moment and shear force was observed to be 34.26 KN-m & 26.59 KN. It is observed that percentage of bending moment and shear force is 29.17% & 29.41% under seismic zone 3. 2. Whereas comparison of bending moment and shear force under zone 4 & 5 was absorbed to be 48.58 KN-m & 37.79 KN for NWC, and 34.28 KN-m &



26.59 KN for SLWC under seismic zone 4, whereas the bending moment and shear force are 61.91 KN-m and 42.96 KN for NWC and 34.29 KN-m & 26.69 KN for SLWC under seismic zone 5. It is observed that percentage of bending moment and shear force is 29.44% & 29.76% under seismic zone 4 and 44.6% & 37.84% under seismic zone 5. 3. Seismic done by response spectrum method (linear dynamic), structural responses like lateral displacement, story drifts and base shear for both SLWC and NWC are identified.

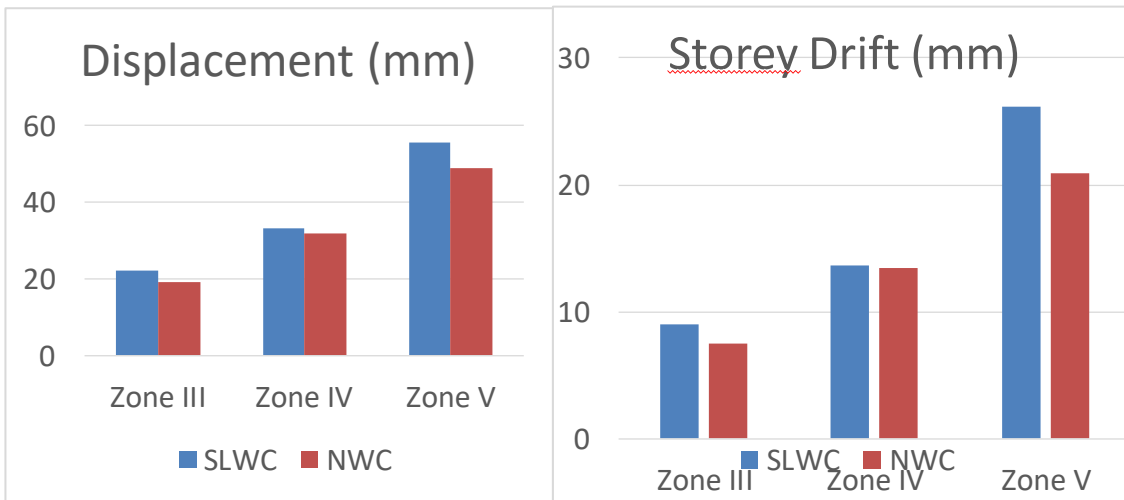


Fig 2: Maximum Displacement of SLWC & NWC

Fig 3: Maximum Drift of SLWC & NWC

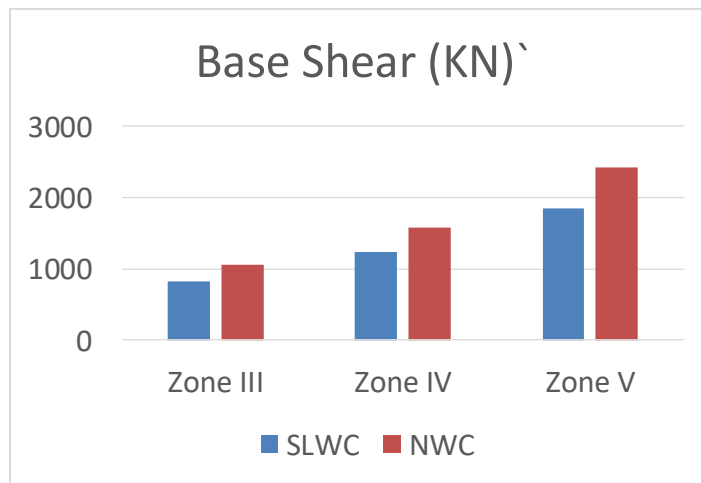


FIG 4: BASE SHEAR OF SLWC & NWC

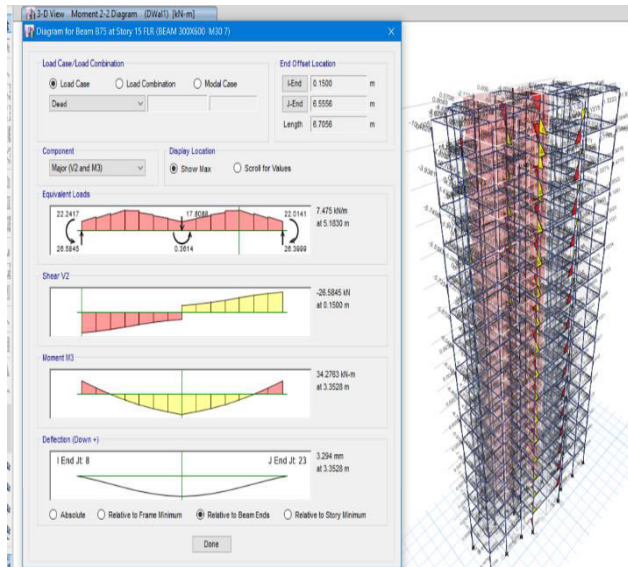


Fig 5: Bending Moment and Shear Force for SLWC Zone 3

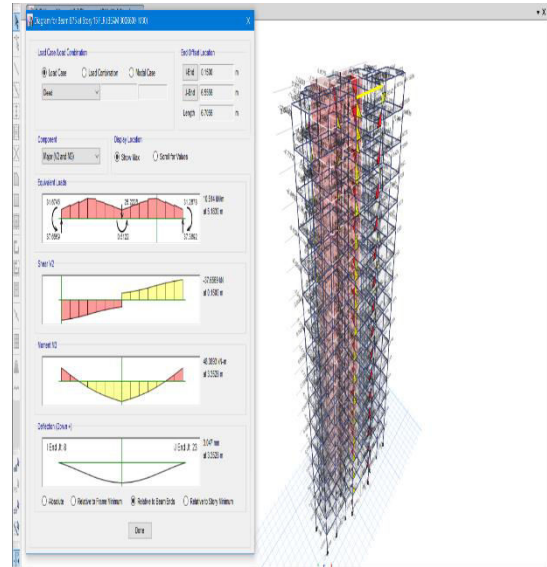


Fig 6: Bending Moment and Shear Force for NWC Zone 3

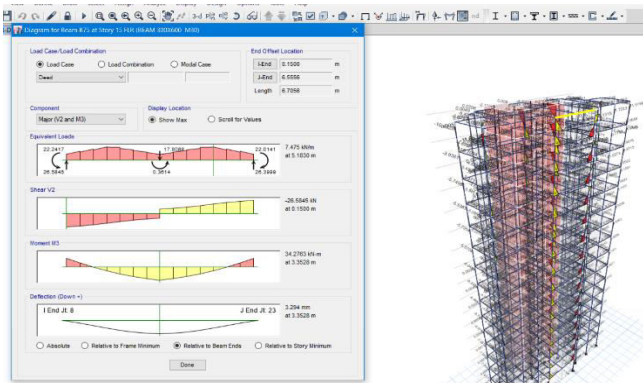


Fig 7: Bending Moment and Shear Force for SLWC Zone 4

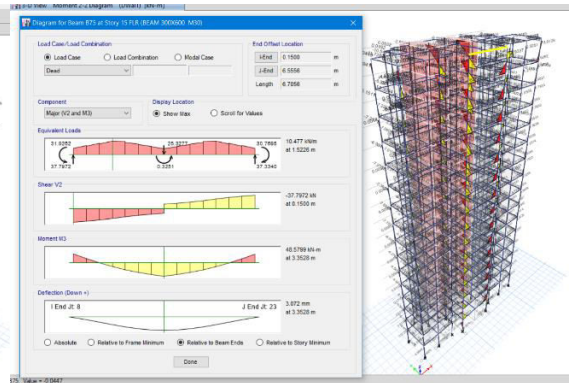


Fig 8: Bending Moment and Shear Force for NWC Zone 4

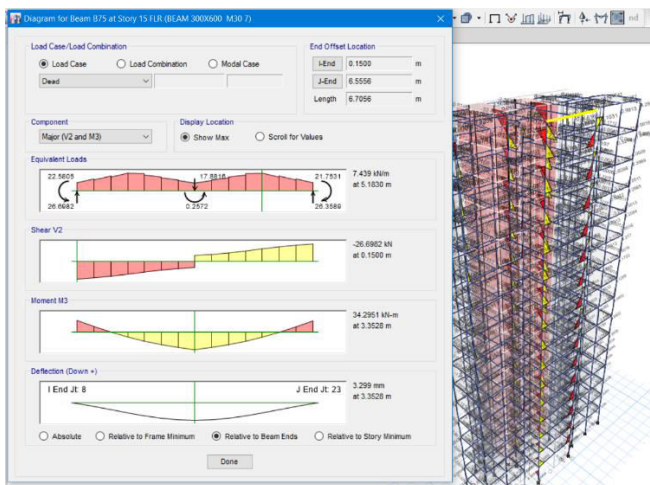


Fig 9: Bending Moment and Shear Force for SLWC Zone 5

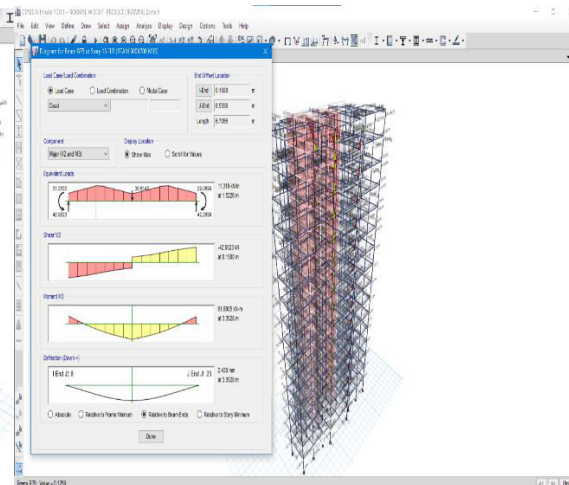


Fig 10: Bending Moment and Shear Force for NWC Zone 5



Zone 3	Bending Moment (KN-m)	Shear Force (KN)
SLWC	34.277	26.585
NWC	48.389	37.657

Table 1: Bending Moment and Shear Force for SLWC& NWC Zone 3

Zone 4	Bending Moment (KN-m)	Shear Force (KN)
SLWC	34.277	26.585
NWC	48.579	37.797

Table 3: Bending Moment and Shear Force for SLWC& NWCZone 4

Zone 5	Bending Moment (KN-m)	Shear Force (KN)
SLWC	34.296	26.699
NWC	61.900	42.953

Table 5: Bending Moment and Shear Force for SLWC& NWCZone 5

VIII. CONCLUSIONS

Based on the analytical results of all the models, following conclusions are made: 1. The seismic analysis of structure is functionally depending on dead load and earthquake forces acting on that. 2. By using structural lightweight aggregate concrete results shows that shear force and bending moment reduced considerably in seismic analysis of high-rise structure which may result to reduce the cross section of members or to reduce the steel in moment and shear resisting sections. 3. Due to less modulus of elasticity for SLWC structure the lateral displacement and storey drift was found to be more compared to normal weight concrete buildings. 4. Structure design with lightweight concrete under seismic zone IV shows less reduce in storey drift and storey displacement in compare with structure design with normal weight concrete, which we can conclude that seismic behaviour of lightweight concrete structure gives best performance under seismic zone IV. 5. As performance of lightweight concrete structure under high seismic zones shows more increase in percentages ratio in comparison with structure design with normal weight concrete, which can be enhance by providing bracing to the structure. 6. From the above result it can conclude that base shear of structure design with light weight concrete comes out to be less in compare with normal weight concrete. 7. The decrease in the percentage of base share are 22.09%, 22.19% & 23.7% under seismic zone III, IV & V. 8. Above result shows that structure design with structural light weight concrete under seismic zone 4 gives less reduce in percentage of storey drift, storey displacement, base shear, shear force and bending moment in compare with structure design with normal weight concrete. 9. It also shown that under high seismic zone the structure with SLWC structural response like storey drift, displacement and base shear show increase in percentage with increasing height in comparison to NWC.

IX. FUTURE SCOPE

Various studies can be carried for design of structure with SLWC under different seismic zone. The study can be carried for horizontally as well as vertically irregular building. The study can be carried by increasing height of buildings. Loading of different levels of the building could be changed. Structure design with SLWC under high seismic zone gives more increase in structural response like storey drift, storey displacement and base shear can be reduced by assigning bracing to the structure and their results can be compared with NWC structure. Introduction of other lateral load resisting like bracing, belt, truss and outrigger system can be done and their results can be compared. Seismic analysis of multistorey building design with SLWC with design position & location of share wall, with or without share wall can be done and their results can be compared with structure design with NWC.

REFERENCES

[1] Bharat Diliprao & L.G. Kalurkar “Seismic Retrofitting of RC Structures with Exterior Shear Walls and Bracing” International Journal of Engineering Research and Applications, Vol. 9 Issue 08, August-2020

[2] Ayaanli Ali & Erdal Coskun “The Performance Analysis of the Difference Types of Steel Bracing for the Reinforced Concrete Building “International Journal of Engineering Research and Applications, Vol. 9 Issue 07, July-2020



- [3] Mustafa Hussini&SandeeoNasier “A Review Paper on Seismic Performance of High-Rise Building using Bracing, Diagrid and Outrigger System “International Journal of Engineering Research and Applications, Vol. 9 Issue 06, June-2020
- [4] Ashish Kumar Gupta,Dr.SaleemAkhtar,Dr.Asam Hussain “Analysis of A Tall Building with Shear Wall of RCC and Steel Plate” International Journal of Engineering Research and Applications, Vol. 9 Issue 01, January-2020
- [5] D.Sirisha&M.Divya Tejaswi “Seismic Analysis and Design of Multistoried Building with and without Bracing According to is Code and Euro Code by using ETABS” International Journal of Engineering Research and Applications, Vol. 8 Issue 09, September-2019
- [6] Jonty Choudhary & Dr. G.P Khare “Comparative Study andAnalysis of Unbraced RCC Frame Structure with Steel Braced RCC Framed Structure using Response Spectrum Method” International Journal of Engineering Research and Applications, Vol. 7 Issue 08, Aug-2019
- [7] Karrativ V. &Dr.B. Pandu “Comparative Study of Shear Walls and Bracings for a high-rise Structure Under Seismic Loading “International Journal of Engineering Research and Applications, Vol. 8 Issue 07, July-2019
- [8] Donthi Reddy Raja Shekar & Joshi Sreenivasa “The Seismic Analysis of Multi Storied Building with Shear Walls of Different Shapes in all Zones” International Journal of Engineering Research and Applications, Vol. 8 Issue 07, July-2019.
- [9] KarnatiVijetha& Dr. B. Panduranga Rao “Comparative Study of Shear Walls and Bracings for A Multistoried Structure Under Seismic Loading” International Journal of Engineering Research and Applications, Vol. 8 Issue 07, July-2019
- [10] Athira KB &Vineetha Guruprasad “Seismic Analysis on Shear Wall with Non-Prismatic Coupling Beam” International Journal of Engineering Research and Applications, Special Issue – 2018.



**Impact Factor:
7.569**



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN SCIENCE | ENGINEERING | TECHNOLOGY

 9940 572 462  6381 907 438  ijirset@gmail.com



www.ijirset.com

Scan to save the contact details