WWW.IJRPR.COM

International Journal of Research Publication and Reviews

Journal homepage: www.ijrpr.com ISSN 2582-7421

Structural Analysis of Multistory Steel Setback Building

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Abstract

Sliding wall systems are one of the most commonly used side loads that resist in a high-rise building. The shear wall has high rigidity and plane strength, which can be used to simultaneously resist with a large horizontal load and maintain gravitational loads. Sliding walls designed to withstand the lateral loads of earthquakes and wind. The steel plate wall shear system has become an effective alternative to other side load-resistant systems, such as reinforced concrete walls, different types of spring frames, and so on. SPSW is preferred because of the different advantages they have over other systems, primarily significant plasticity and high initial rigidity, fast construction, light weight, provides more space inside due to the minimum thickness, which is another advantage for the architect and a reduction in seismic mass. From horizontal displacement (X) for all models and maximum displacement is obtained in the model- 4, which has a value of 58,432 mm. From vertical displacement (Y) for all models and maximum displacement is obtained in the model - 5 to 8, which has a value of 9.6 mm. From the vertical reaction (Fy) for all models and maximum movement is obtained in model-10, which has a value of 49308.1 kN. From the moment (Mx) for all models and the maximum movement is obtained in the model - 8, which has a value of 1077.66 kNm.

Keywords- Steel plate shear walls, ETABS, High-rise buildings, lateral displacement and drift

INTRODUCTION

This is the most popular way to model thin, non-compact sliding walls. It is based solely on the action of the diagonal tension field developed immediately after the plate fastener [7]. This type of modeling is recommended by the Canadian code, CAN / CSA-S16-01 in the SPSW analysis and design procedure. In the analysis software, the steel plate on the wall panel should be replaced with a series of farm elements (piece) or strips along the voltage field. There are two ways to model this method [8]. The first is the stripes inclined at a uniform angle with a horizontal, and the second is a model with several stripes.

As a rule, seismic renovation and modernization of such buildings to meet the requirements of modern codes always make a great effort for design engineers. To help owners clearly understand all the modernization processes, it is very important for engineers to know what seismic capabilities and shortcomings of the existing RC-MRF [11].

LITERATURE REVIEW

N. Gaur et al [6] presented a method of studying the seismic behavior of a multi-storey building, subject to strong ground movements at the previous stage of practical design. The accuracy of the method was assessed taking into account asymmetrical tall buildings with mass or rigidity of unevenness. Dynamic reactions of elastic multi-storey building systems were obtained by analyzing a simple (equivalent) single-storey system. The behavior of the building was also investigated in the aftermath of the elastic phase, given the strength depending on the rigidity of the various stands and gaps. Hemal J shah et al [7] presented a seismic approach for irregular space steel frames for Eurocodes 8 and 3. The approach used an advanced static and dynamic finite element method, taking into account geometric and material nonlinearities, as well as imperfections of elements and frames. The pushover analysis was performed by dividing the multimodal load along with the height of the building, which combines the first few modes. Nonlinear dynamic analysis was performed in the time area using accelerograms derived from real earthquakes to be compatible with the elastic design spectrum of Eurocode 8.

METHODOLOGY

The following models are to be prepared

1) Model 1: Setback building with bracings on front side (EQ-4)
2) Model 2: Setback building with bracings on front side (EQ-5)
3) Model 3: Setback building with bracings & Shear wall on front side (EQ-4)
4) Model 4: Setback building with bracings & Shear wall on front side (EQ-5)
5) Model 5: Setback building with bracings on other side (EQ-4)
6) Model 6: Setback building with bracings on other side (EQ-5)
7) Model 7: Setback building with bracings & Shear wall on other side (EQ-4)
8) Model 8: Setback building with bracings & Shear wall on other side (EQ-5)
9) Model 9: Setback building with shear wall at core (EQ-4)
10) Model 10: Setback building with shear wall at core (EQ-5)

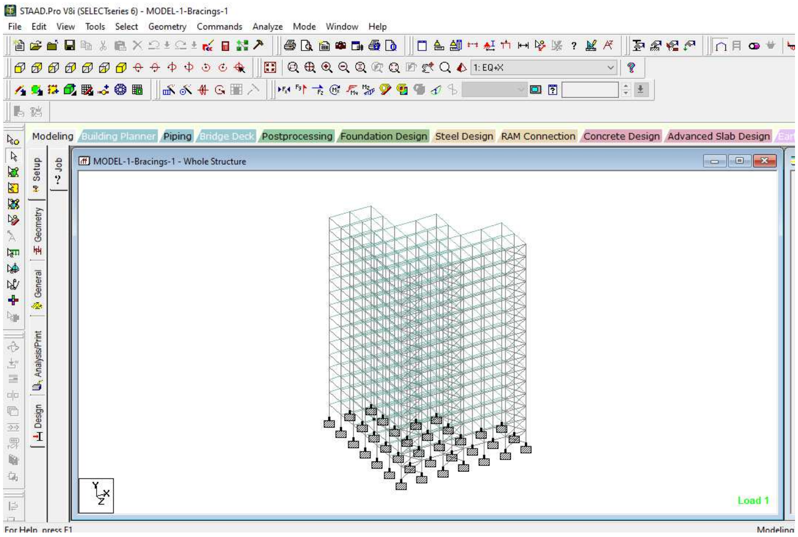

Figure 1: Geometry of the model-1

The above figure gives the details about the Geometry of the model-1 as obtained from the STAAD-PRO software.

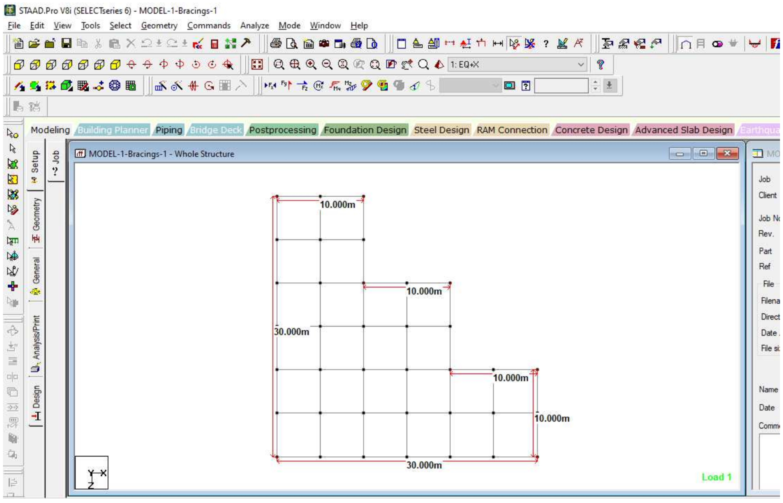

Figure 2: Plan of the model-1

The above figure gives the details about the Plan of the model-1 as obtained from the STAAD-PRO software.

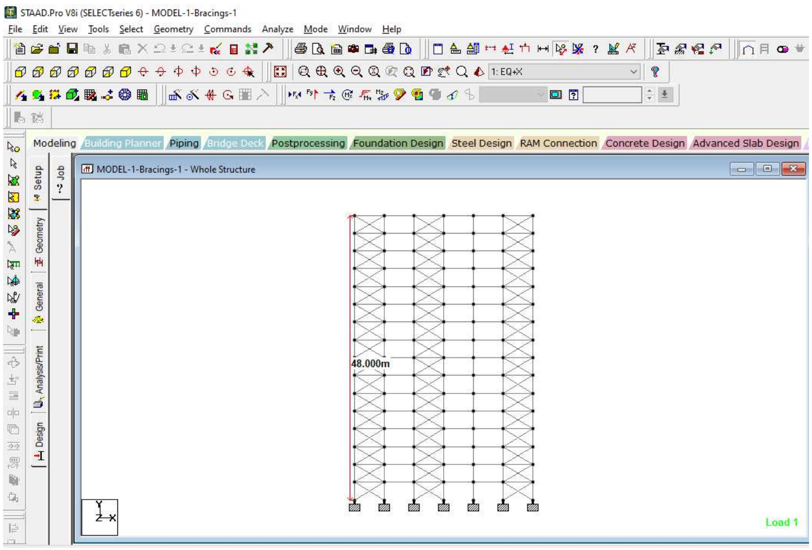

Figure 3: Elevation of the model-1

The above figure gives the details about the Elevation of the model-1 as obtained from the STAAD-PRO software.

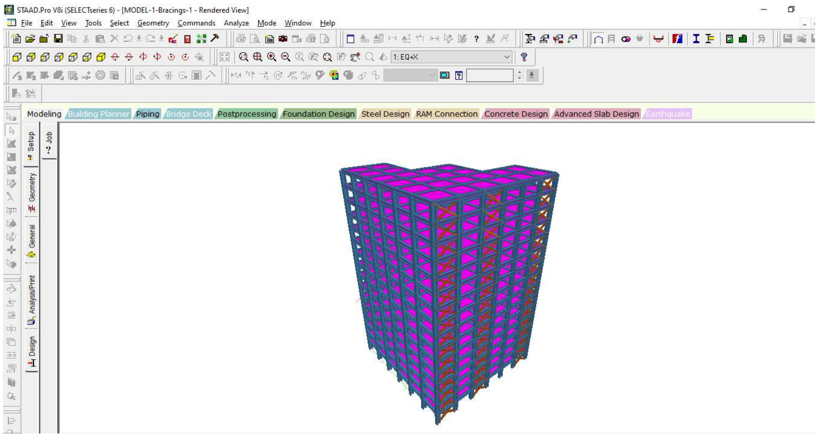

Figure 4:3D View of the model-1

The above figure gives the details about the 3D View of the model-1 as obtained from the STAAD-PRO software.

RESULTS

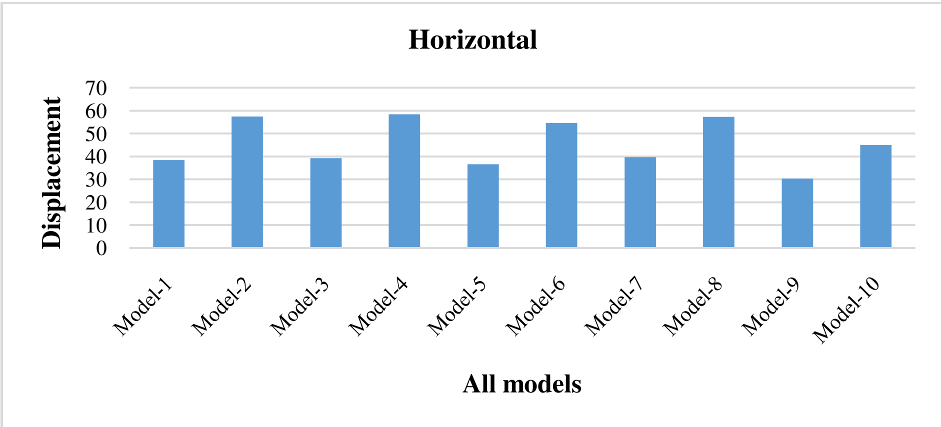

Figure 5: Horizontal Displacement (X) for all the models

The above graph is related to the Horizontal Displacement (X) for all the models and the maximum displacement is obtained in the model-4 having value of 58.432 mm.

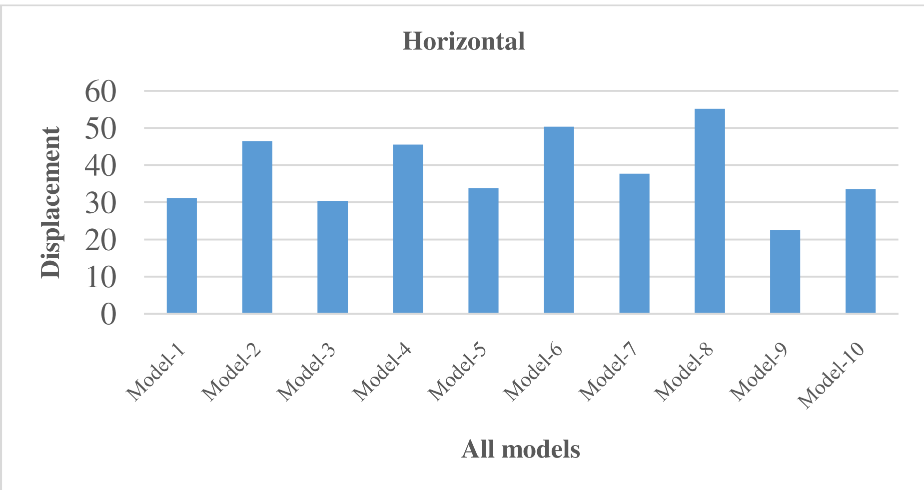

Figure 6: Horizontal Displacement (Z) for all the models

The above graph is related to the Horizontal Displacement (Z) for all the models and the maximum displacement is obtained in the model-8 having value of 59 mm.

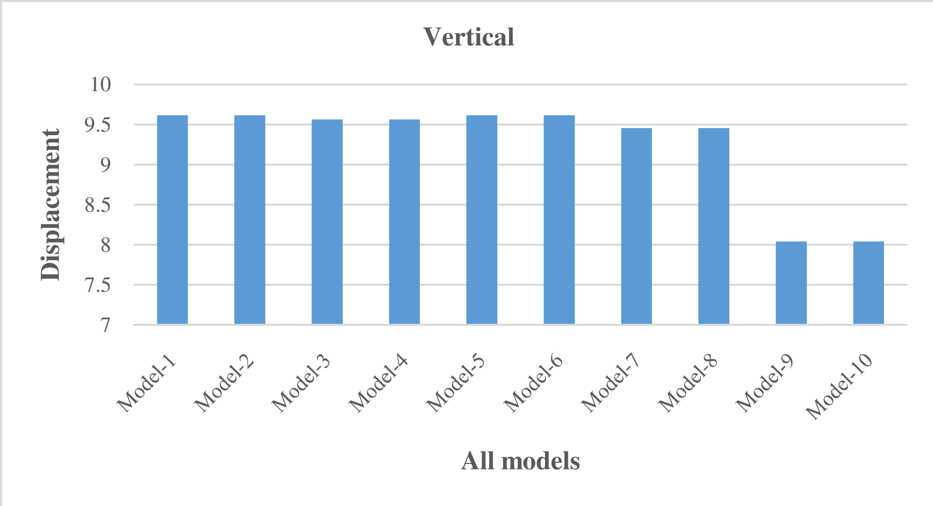

Figure 7: Vertical Displacement (Y) for all the models

The above graph is related to the Vertical Displacement (Y) for all the models and the maximum displacement is obtained in the model-5 to 8 having value of 9.6 mm.

Figure 8: Resultant Displacement for all the models

The above graph is related to the Resultant Displacement for all the models and the maximum displacement is obtained in the model-4 having value of 59.8 mm.

Table 1: Reactions for all the models

	Horizontal	Vertical	Horizontal	Moment		
	FxkN	FykN	FzkN	MxkNm	My kNm	MzkNm
Model-1	784.671	15557.1	361.155	670.206	4.971	1187.11
Model-2	1089.22	15720.2	537.584	1000.49	7.217	1761.92
Model-3	1374.82	15491.6	364.739	674.213	4.974	1196.46
Model-4	1753.24	15491.6	542.41	1006.51	7.23	1775.57
Model-5	340.907	15560.5	793.423	681.331	9.061	1160.11
Model-6	508.144	15560.5	1084.2	1021.67	13.283	1717.43
Model-7	350.249	20474.1	5161.47	720.213	10.859	1239.9
Model-8	520.67	23481.8	5941.4	1077.66	15.76	1828.27
Model-9	7411.55	41762.6	8413.57	725.814	8.959	1327.22
Model-10	8888.39	49308.1	10455.2	934.97	13.347	1819.63

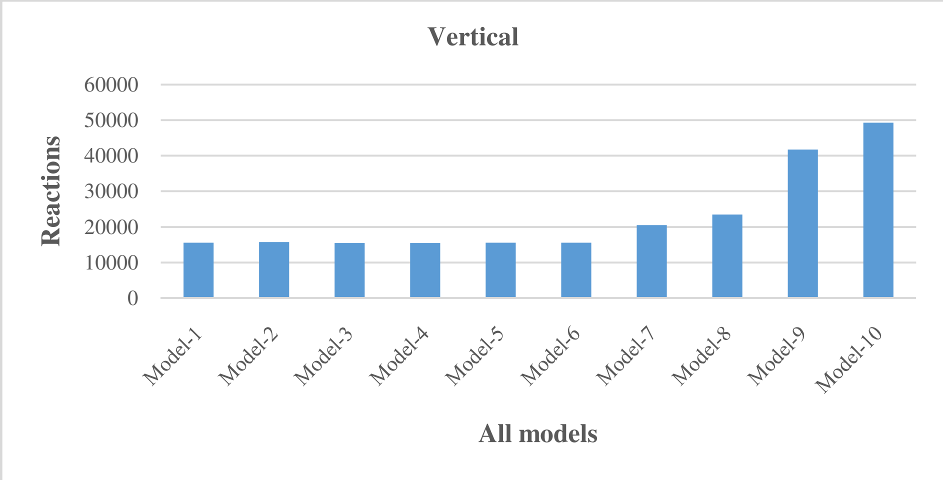

Figure 9: Vertical Reaction (Fy) for all the models

The above graph is related to the Vertical Reaction (Fy) for all the models and the maximum displacement is obtained in the model-10 having value of 49308.1kN.

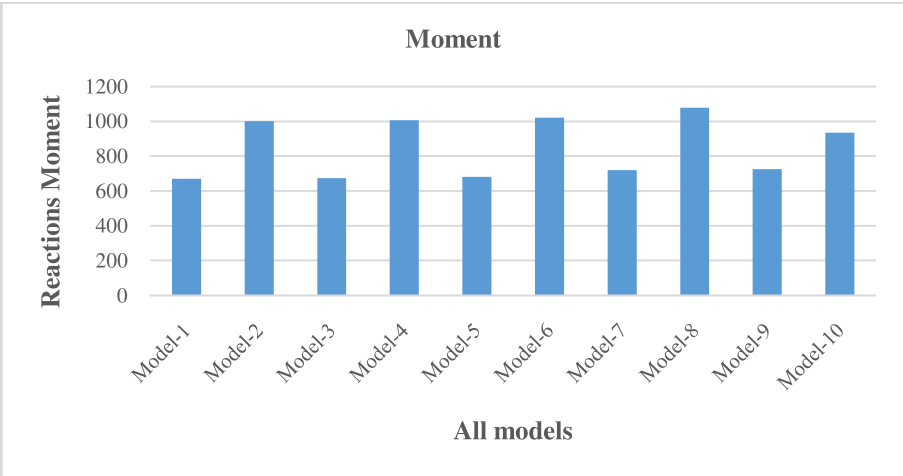

Figure 10: Moment (Mx) for all the models

The above graph is related to the Moment (Mx) for all the models and the maximum displacement is obtained in the model-8 having value of 1077.66kNm.

Table 2: Beam forces for all the models

	FxkN	FykN	FzkN	MxkNm	My kNm	MzkNm
Model-1	15557.1	370.222	433.014	3.96	670.206	1187.11
Model-2	15557.1	541.378	622.644	5.724	1000.49	1761.92
Model-3	15491.6	364.028	448.412	4.128	677.159	1196.46
Model-4	15491.6	530.812	635.771	5.963	1006.51	1775.57
Model-5	15560.5	411.346	399.074	3.556	681.331	1160.11
Model-6	15560.5	593.225	584.929	5.121	1021.67	1717.43
Model-7	15349.4	476.038	396.397	4.044	720.213	1189.29
Model-8	15349.4	656.407	591.684	5.466	1077.66	1753.41
Model-9	13502.7	444.907	485.287	4.393	752.478	1005.83
Model-10	13502.7	621.898	672.112	5.756	1039.29	1280.39

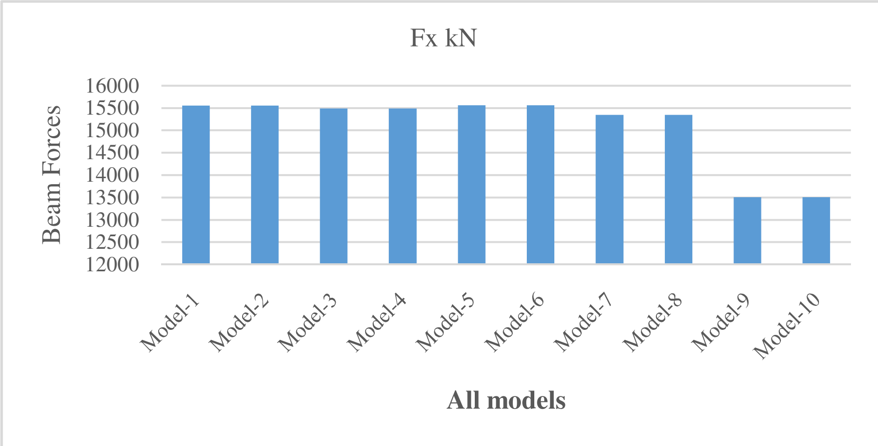

Figure 11: Beam Forces (Fx) for all the models

The above graph is related to the Beam Forces (Fx) for all the models and the maximum displacement is obtained in the model-1 & 2 having value of 15557.1kN.

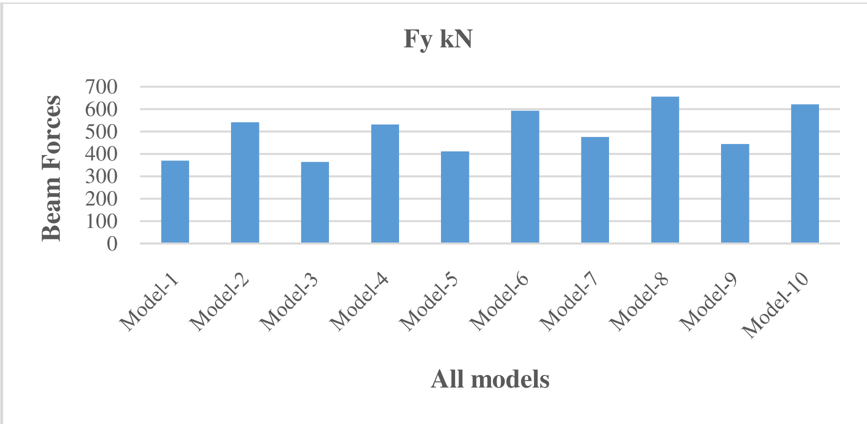

Figure 12: Beam Forces (Fy) for all the models

The above graph is related to the Beam Forces (Fy) for all the models and the maximum displacement is obtained in the model-8 having value of 656.407kN.

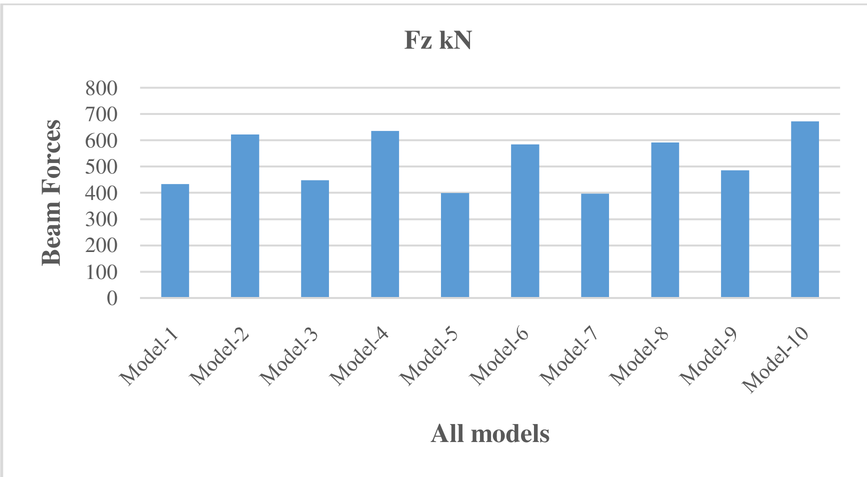

Figure 13: Beam Forces (Fz) for all the models

The above graph is related to the Beam Forces (Fz) for all the models and the maximum displacement is obtained in the model-10 having value of 672.112kN.

CONCLUSIONS

The different models are analyzed using STAAD-PRO software, the following conclusions are made

i. From the Horizontal Displacement (X) for all the models and the maximum displacement is obtained in the model-4 having value of 58.432 mm.
ii. From the Vertical Displacement (Y) for all the models and the maximum displacement is obtained in the model-5 to 8 having value of 9.6 mm.
iii. From the Vertical Reaction (Fy) for all the models and the maximum displacement is obtained in the model-10 having value of 49308.1kN.
iv. From the Moment (Mx) for all the models and the maximum displacement is obtained in the model-8 having value of 1077.66kNm.
v. From the Shear Stress (SQY) for all the models and the maximum displacement is obtained in the model-10 having value of 0.298kNm.

REFERENCES

1. Ajamy, A., Asgarian, B., Ventura, C.E., Zolfaghari, M.R. (2018), “Seismic fragility analysis of jacket type offshore platforms considering soil-pile-structure interaction”, Engineering Structures, 174, 198-211.
2. AnojSurwase, Sanjay K. Kulkarni, and ManojDeosarkar, “Seismic Analysis and Comparison of IS 1893(Part-1) 2002 and 2016 of (G+4) Regular and Irregular Building” International Journal of Innovative Research in Science, Engineering and Technology, vol.7 (6), 2018.
3. Ashvin G. Soni, D. G. Agarwal and A. M. Pande, “Effect of Irregularities in Buildings and their Consequences” International Journal of Modern Trends in Engineering and Research, 2015.
4. BhosleAshwiniTanaji and Shaikh A.N, “Analysis of Reinforced Concrete Building with Different Arrangement of Concrete and Steel Bracing System” IOSR Journal of Mechanical and Civil Engineering, vol. 12 (5), 2015.
5. Dr. S. A. Halkude et al “Seismic Analysis of Buildings Resting on Sloping Ground With Varying Number of Bays and Hill Slopes” International Journal of Engineering Research and Technology ISSN:2278-0181,Vol.2 Issue 12, December-2013
6. H. Gaur, R. K. Goliya, K. Murari, A. K. Mullick, A Parametric Study of Multi-Storey Reinforced Concrete Building with Horizontal Irregularity, International Journal of Research in Engineering and Technology, vol. 3, issue 4, 2014, pp. 360-364.
7. Hemal J shah, Dr.S and S.S Gandhy (2014) “Seismic Time History Analysis Of Building On Sloping Ground Considering Near/Far field Earthquake” (2014)
8. IS 1893:2016 (Part 1) – Criteria for Earthquake Resistant Design of Structures.
9. IS 456:2000 – Code of practice for Plain and Reinforced Concrete.
10. IS 875:1987 (Part 1) – Code of practice for Design loads for Buildings and Structures (Dead Load).
11. IS 875:1987 (Part 2) – Code of practice for Design loads for Buildings and Structures (Live Load).
12. IS 875:1987 (Part 3) – Code of practice for Design loads for Buildings and Structures (Wind Load).
13. K.S.L Nikhila, Dr. B Pandunangrao “Static Linear and Nonlinear analysis of R.C Building on Sloping Ground with Varying Hill Slope” American Journal of Engineering Research (AJER) e-ISSN:2320-0847 p-ISSN :2320-0936 Volume-03. Issue-11 (2014).
14. Kannan R. Seismic Analysis and Design of Cargo Berth. International Journal of Civil Engineering and Technology, 8(6), 2017, pp. 411-422.
15. Kiran Y. Naxane, Mr. Laxmi Kant Vairagade and Gitadevi B. Bhaskar, “Construction Sequence Analysis of Multistoried RCC building” International Research Journal of Engineering and Technology, Vol.4, Issue 7, 2017.
16. Lakshmi Subash, “Seismic Behaviour of Vertically Irregular Reinforced Concrete Building with P-Delta Effect” International Research Journal of Engineering and Technology, Vol.4, Issue 4, 2017.
17. M. S. Naidu and R. Kannan, Numerical Optimization of Shoring Towers for Slab Formwork Systems, International Journal for Trends in Engineering & Technology, vol. 5(1), 2015, 114-120.
18. MasoumehGholipour, Mohamad Mehdi Alinia, 2016, Behaviour of multi-story code designed steel plate shear wall structures regarding bay width, Elsevier, Vol 122, pages 40-56.
19. Meghana. B.S and T.H. Sadashiva Murthy, “Comparison of Linear Static Analysis and Construction Sequence Analysis on Multi-storey Building with RC floating column resting on RC and Composite Transfer Girders” International Journal of Engineering Trends and Technology, Vol.36, No.7, 2016.
20. MitanKathrotiya, Yogendra K. Tandel and Ajit R. Darji, “Construction Stage Analysis of Flat Slab Structure with respect to Non-linear Time History Analysis using Software Aid” International Journal for Research in Applied Science & Engineering Technology, Vol.6, Issue 4, 2018.
21. Mohammad Anwar-Us-Saadat, Mahmud Ashraf, Shameem Ahmed, 2016, Behaviour and design of stainless steel slender cross-sections subjected to combined loading,Elsevier, Vol 104, pages 225-237.
22. Mohammad hossein, Akhavan, AbdolrezaJoghataie, Nader K.A.Attari, 2016, Analysis and design recommendations for diagonally stiffened steel plate shear walls, Elsevier, Vol 103, pages 72-80.
23. Pandey A.D , Prabhat Kumar , Sharad Sharma3 “Seismic soil structure interaction of buildings on hill slopes” Volume 2, No 2, 2011
24. Pundkar R. S, Alandkar P. M, 2013, Influence of steel plate shear wall on multi-storey building, International journal of Engineering Research and Applications (IJERA).
25. Rajesh. B, Sadat Ali Khan, Mani Kandan and S. Suresh Babu, “Comparison of both Linear static and dynamic analysis of multi-storey buildings with plan irregularities” International Journal of Scientific Engineering and Applied Science, Vol.1, Issue 7, 2015.
26. Ravindra N. Shelke and U.S. Ansari, “Seismic Analysis of Vertically Irregular RC Building Frames” International Journal of Civil Engineering and Technology, Vol.8, Issue 1, 2017.
27. Santosh Panigrahi, VikramPatil, Madan S.H and SomanagoudaTakkalaki, “Importance of Construction Sequence Analysis in design of High-Rise Building” International Journal of Innovative Science, Engineering & Technology, Vol.6, Issue 4, 2019.
28. Shaikh Abdul Aijaj Abdul Rahman and Ansari UbaidurrahmanSalik, “Seismic Response of Vertically Irregular RC frame with Mass Irregularity” International Journal of Recent Scientific Research, Vol.9, Issue 2, 2018.
29. Suresh M R and S AnanthShayanaYadav, “The Optimum Location of Shear Wall in High Rise R.C Building under Lateral Loading” International Journal of Research in Engineering and Technology, Vol.4, Issue:06, 2015.
30. Umamaheshwara. B and Nagarajan. P, “Design Optimization and Analysis of Shear Wall in High Rise Building using Etabs” International Journal for Research in Applied Science & Engineering Technology, vol.4, Issue 8, 2016.
31. Yousuf Dinar, Munshi Md. Rasel, MuhamadJunaidAbsarChowdhary and Md. Abu Ashraf, “Chronological construction sequence effects on reinforced concrete and steel buildings” International Journal of Engineering and Science, vol. 3,pp. 52-63, 2014.