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PERFORMANCE BASED ON EVALUATION OF RC MULTI-STORIED BUILDING CONSIDERING DIFFERENT TYPES OF SHEAR WALL

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Abstract: We know that in the present scenario buildings with shear wall are gaining more popularity than buildings without shear wall in earthquake prone areas, due to its capability to the resistance during earthquake. In this Project G+10 Storey RC building is considered to check the optimum location of the shear wall in the building. Several models are considered for the analysis out of which one is bare frame model and remaining models are structures with different type of shear wall at various positions. The modeling and analysis is done using ETABS-2016 software package. An attempt is made to study and compare the parameters such as Storey drift, Storey Displacement, Story Shear and Story Stiffness. In This research study describes the design of structure using Response Spectrum analysis and is been validated in ETABS using Indian Standard codes.

Keywords: Shear wall, SWP (Shear Wall Positions), Story Displacement, Story Drift, Story Stiffness, Story Shear, Response Spectrum, Bare frame.

INTRODUCTION

Shear wall are one of the excellent means of providing earthquake resistance to multistoried reinforced concrete building**.** The structure is still damaged due to some or the other reason during earthquakes. Behavior of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building. To reduce the effect of earthquake reinforced concrete shear walls are used in the building. These can be used for improving seismic response of buildings. Structural design of buildings for seismic loading is primarily concerned with structural safety during major Earthquakes, in tall buildings, it is very important to make sure correct lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity has been found effective and economical. Whenever the buildings are tall, beam and column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and place them in the correct position is difficult and vibrating concrete at these place are quite heavy. Shear walls are usually used in tall building to avoid collapse of buildings. When shear wall are positioned in advantageous places in the building, they can form an potent lateral force resisting structure. In this present paper one model for bare frame type residential building and three models for dual type structural system are generated with the help of ETAB and effectiveness has been checked.

ETABS is a sophisticated, yet easy to use, special purpose analysis and design program developed specifically for building systems. ETABS 2016 features an intuitive and powerful graphical interface coupled with unmatched modeling, analytical, design, and detailing procedures, all integrated using a common database. Although quick and easy for simple structures, ETABS can also handle the largest and most complex building models, including a wide range of nonlinear behaviors necessary for performance based design, making it the tool of choice for structural engineers in the building industry.

OBJECTIVES

I. A G+10 Storey structure with different position of shear wall is considered for the study purpose and the models are analyzed and the results are compared.

II. To study the behavior of the structure under different location of shear wall.

III. To analyze the Story Displacement, Story Drift, Story Shear and Story Stiffness.

IV. To compare the response spectrum analysis method on various models for above parameters.

V. To determine the optimum location of the structure.

OUTCOME AND REVIEW OF LITERATURE

Nowadays due to the rapid urbanization construction of tall buildings for both residential and commercial as

increased greatly and so only scope for construction of tall and slender structures is emphasized in the present modern trend and therefore study of the seismic effect on this structure has become very much crucial. And nowadays problem is faced by every designer in providing strength and stiffness to the structure against lateral loads. To determine the effect of seismic loading on tall buildings, various experimental studies have also been carried out. Few historical studies that have greatly contributed in understanding of seismic loading on building are given below:

Based on our study we arrived to an outcome from the research papers which we have referred.

Thus research papers have analytical methods in determining the seismic effects on multistoried buildings and attempts are made to involve software. In all the papers the area of concrete provided at various position of shear wall is different therefore this concept is included in this paper. In this paper the concept of some area of concrete is used i.e total area of concrete provided in shear wall is same for all models and it has included decision of the effect of seismic load using Response Spectrum method on multistoried building models in zone II with different position for location of shear wall as been incorporated by making use of Etabs software for some area of concrete.

MODELING AND ANALYSIS

ETABS software is used for modeling and analysis of the structures. Etabs is structural engineers software which helps in model analyses and design multistoried building, It involves modeling tools, analysis techniques, code based load data, all coordinated with like geometry. Basics as well as advanced structural systems with static or dynamic conditions and the sophisticated assessment of seismic performance can be evaluated in this software. This software offers a flexible environment for structure modeling with various material specification and views in consideration and after which it generates and assigns several loading conditions such as gravity, wind, seismic forces as prescribed by the codes.

A capabilities of this software in analysis offer advanced non-linear and linear methods, time history, the dynamic considersations include modal, response spectrum analysis. The output such as Story displacement, story drift, story shear and story stiffness are presented with corresponding data sets which can be organized into customizable reports.

Modeling:

For this present study, a RCC bare frame of 10 story structure with floor to floor height of 3m is considered. The plan dimensions of the structure are 45m at X - direction and 39m at Y-direction, for this structure shear wall is adopted at different position and also different loading conditions are taken into consideration. The structure is modeled using ETABS software.

Four different positions of shear wall namely SWP-1(Shear wall position-1)tp SWP-4 and BARE condition i.e bare frame structure which possess no shear wall, and different loading condition namely shear displacement, shear drift, story shear and story stiffness. Each model has the following specifications.

- Number of bays along X axis : 6
- Number of bays along Y axis : 6
- Spacing from one column to another in X-directions : 7.5m
- Spacing from one column to another in Y-directions: 6.5m
- Each Story height :3.0m

Materials

The material properties considered are as follows.

- Concrete:M30 concrete is used, the modulus of elasticity Ec is taken as Ec=5000√fck as prescribed by IS 456:2000.
- Rebar:The steel used for rebar is HYSD 500, which has yield strength of 500Mpa

Table 1 Material property data

Characteristics strength of concrete, fck	30Mpa
Modulus of elasticity of concrete, Ec	27388.2Mpa
Yeild strength of Rebar Fy	500Mpa
Modulus of elasticity of Rebar E	20000Mpa

Structural elements

The various structural elements used and their dimensions are as follows.

- Column: Dimensions of the columns are 850 X 850 mm.
- Beams: Dimensions of the beams are 400 X 400 mm.
- Slab: Thickness of the slab panel is 120 mm.

- Shear wall: Thickness of shear wall is taken as 200mm.

The columns are considered as fixed at the foundation level; hence the restraints given are for fixed condition.

Table 2 Structural Property Data

Dimension of Column	850mm x 850mm
Dimension of Beam	400mm x 400mm
Slab thickness	120mm
Shear wall thickness	200mm

Loads

Table 3 Loads

Live load on floors	3kN/m^2
Live load on roof	1.5kN/m^2
Floor finishes on floor	1kN/m^2
Floor finish on roof	1kN/m^2

Seismic Load Data

Table 4 Seismic loads

Seismic zone	II
Zone Factor	0.36
Importance factor	1
Response reduction factor	5
Soil type	Medium
Total height of the building	33m

Model-1 [Bare frame model] :- Plan and 3D Plan

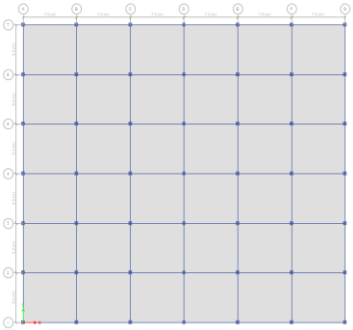


Fig 1 : Plan showing the bare frame model, it's a building without shear wall.

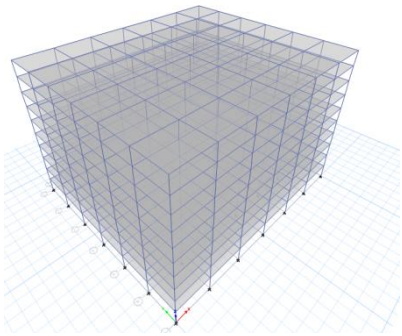


Fig 1.2 :- 3D Plane of Model-01

The above 3D view of a Model-01 when subjected to Response Spectrum Analysis with various load applied to plan .

Model-02 [SWP 01] :- Plan and 3D Plan

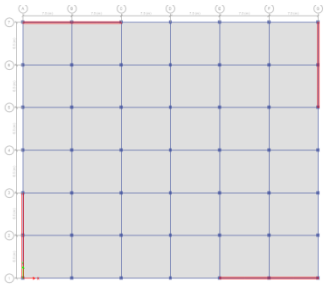


Fig 2 : Plan shown with SWP-1[Shear wall position-01] . It's a building plan with shear wall at alternative corners.

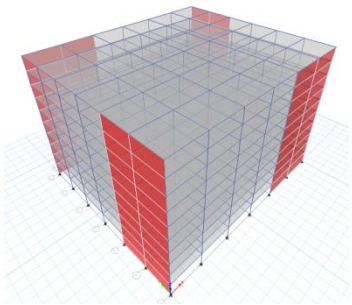


Fig 2.1 :- 3D Plane of Model-02[SWP-01]

The above 3D view of a Model-02[SWP-01] with shear wall at alternative corner when subjected to Response Spectrum Analysis with various load applied to plan.

Model-03 [SWP 02]:- Plan and 3D Plan

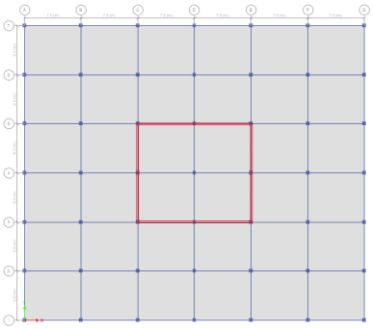


Fig 3:- Plan shown with SWP-02[Shear wall position-02] . It's a building plan with shear wall at core.

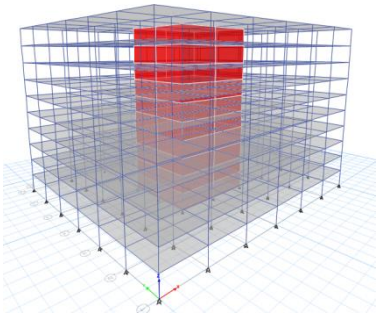


Fig 3.1:- 3D Plane of Model-03[SWP-02]

The above 3D view of a Model-03[SWP-02] with shear wall at core when subjected to Response Spectrum Analysis with various load applied to plan.

Model-04 [SWP 03] :- Plan, Base reaction and 3D Plan

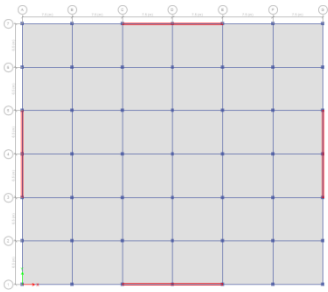


Fig 4:- Plan shown with SWP-03[Shear wall position-04] . It's a building plan with shear wall at core.

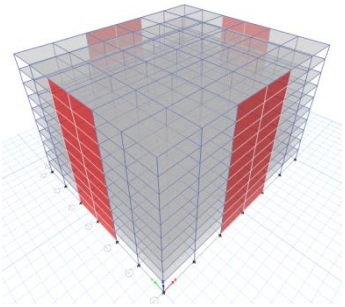
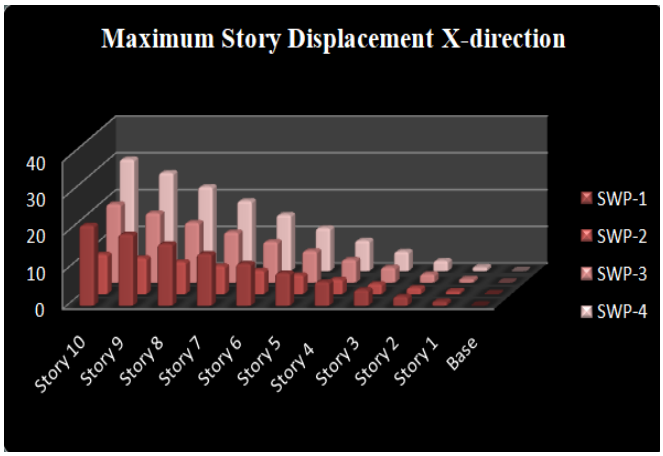


Fig 4.1:- 3D Plane of Model-04[SWP-03]

The above 3D view of a Model-04[SWP-03] with shear wall at middle periphery when subjected to Response Spectrum Analysis with various load applied to plan

Model-05 [SWP 04] :- Plan and 3D Plan



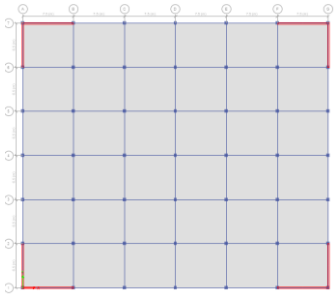


Fig 5: Plan shown with SWP-04[Shear wall position-04] . It's a building plan with shear wall at core.

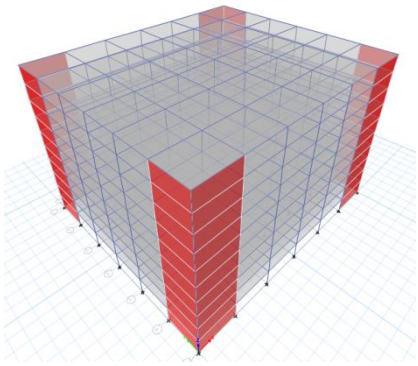


Fig 5.1:-3D Plane of Model-05[SWP-04]

The above 3D view of a Model-05[SWP-04] with shear wall at corners when subjected to Response Spectrum Analysis with various load applied to plan.

RESULTS AND DISCUSSIONS

4.1 Results for Maximum Story Displacement for both the directions are compared.

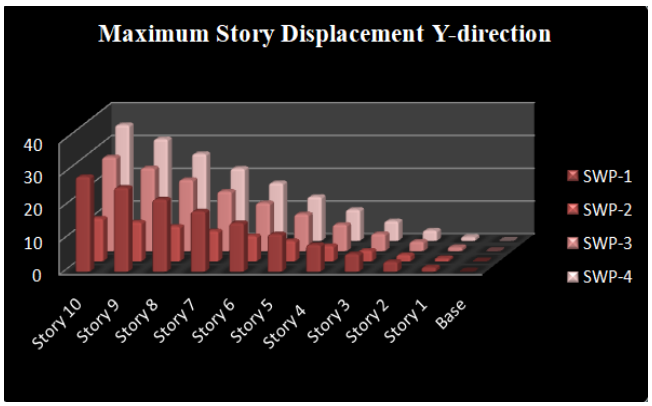


Fig 6:- Comparing Maximum Story Displacement at X and Y Direction V/s No of stories

Observations from the Graphs and Results:

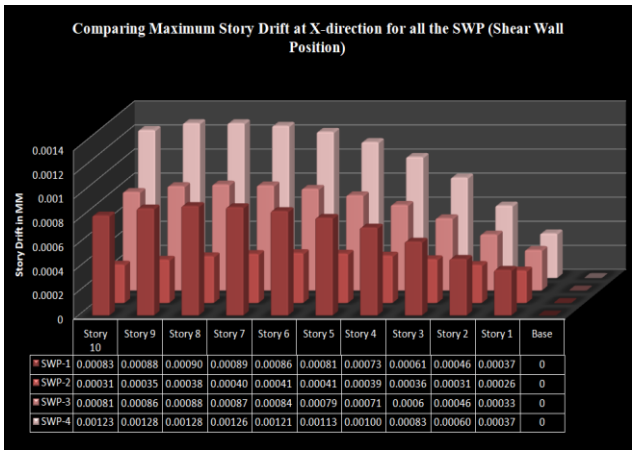
i. An increase in story displacement has increase in story height for all the compared models under zone II for Shear walls at different positions along both the X and Y direction.

ii. Story displacement is more for a model wit out shear wall (i.e. model 1). When compared with all models with shear wall in both X and Y direction and the value of each.

iii. The model with lesser displacement comparably is the SWP-2[Shear Wall Position-2]. When shear walls are located at core of the building respectively along X and Y direction as a result to the displacement offered by the building is more as compared to all other models along both direction.

iv. Location of the shear wall is at the core of the building along both X and Y direction, so as the above results of story displacement at SWP-2 is reduced.

Results for maximum Story Drift for both directions are compared.



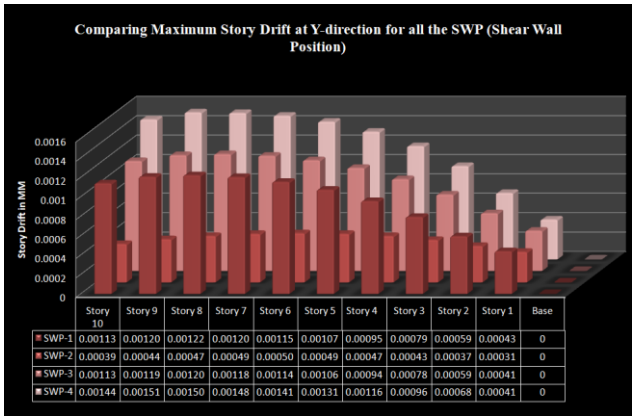


Fig 7:- Comparing Maximum Story drift at X and Y direction V/s No of stories

Observations from Graphs and Results:

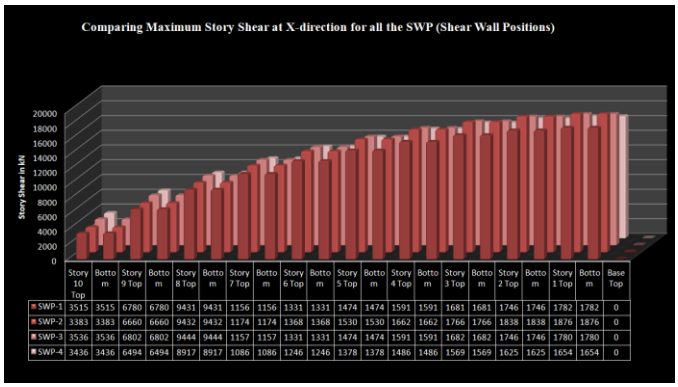
i. An increase in Story drift has increase in story height for all the compared models under zone II for shear walls at different positions along both the X and Y Direction.

ii. Story Drift is more for a model without shear wall(i.e model 1). When compared with all models with shear wall in both X and Y Direction and the value of each.

iii. The model with lesser displacement comparably is the SWP-2[Shear Wall Position-2]. When shear walls are located at Core of the building respectively along X and Y Direction as a result to the displacement offered by the building is more as compared to all other models along both direction.

iv. Location of the shear wall is at the core of the building along both X and Y direction, So as the above results of story drift at SWP-2 is reduced.

Results for Maximum Story Shear for both directions are compared.



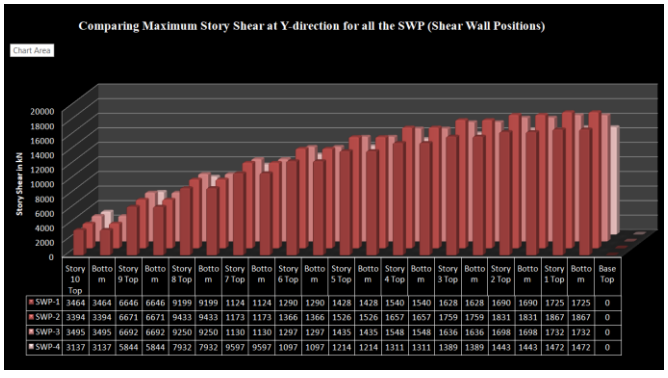


Fig 8:- Comparing Maximum Story Shear at X and Y Direction V/s No of Stories

Observation from Graphs and Results:

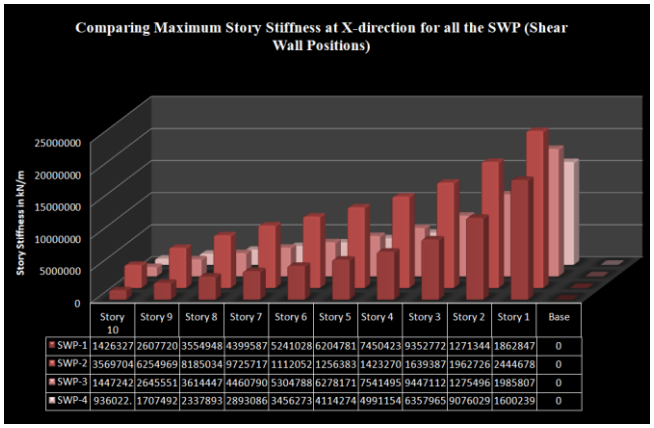
i. An increase in Story Shear has increase in story height for all the compared models under zone II for shear walls at different positions along both the X and Y Direction.

ii. Story Shear is more for a model without shear wall (i.e. model 1). When compared with all models with shear wall in both X and Y Direction and the value of each.

iii. The model with lesser shear comparably is the SWP-4[Shear Wall Position-4]. When shear walls are located at Corners of the building respectively along X and Y Direction as a result to the shear offered by the building is more as compared to all other models along both direction.

iv. Location of the shear wall is at the corners of the building along both X and Y direction, so as the above results of story Shear at SWP-4 is reduced.

Results for Maximum Story Stiffness for both the directions are compared.



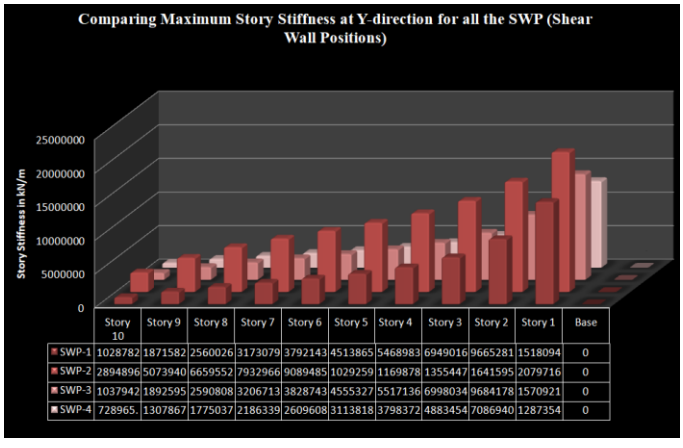


Fig 9:- Comparing Maximum Story Stiffness at X and Y Direction V/s No of Stories

Observation from Graphs and Results:

i. An decrease in Story drift has increase in story height for all the compared models under zone II for shear walls at different positions along both the X and Y Direction.

ii. Story Drift is less for a model without shear wall (i.e model 1). When compared with all models with shear wall in both X and Y Direction and the value of each.

iii. The model with lesser displacement comparably is the SWP-1 and SWP-4 [Shear Wall Position-1 and 4]. When shear walls are located at alternative parallel Corners and corners of the building respectively along X and Y Direction as a result to the displacement offered by the building is more as compared to all other models along both direction.

iv. A drastic reduction is seen from Story-1 to Story-3 and later, it gradually decreases till Story-10

v. A Model having lesser story stiffness comparly is SWP-4 structure will be more flexible if the stiffness will be lower.

DISCUSSION AND CONCLUSIONS

Based on the work carried in this project the conclusions are drawn. Further the scope for work is also been discussed.

I. The results for various models it is observed that shear wall to the structure increases the performance of the respective building, and provides lateral stability.

II. Story Displacement is maximum for top story and a structure without shear wall. Comparing all the results from above using response spectrum method the effective shear wall position is SWP-2. The shear wall at the core as box type, which is not suitable the next best positioned shear wall is SWP-1 where shear wall are located at alternative corner.

III. Story drift is effective and has least value at SWP-2, Maximum story drift value are seen in bare frame. The shear wall at the core as box type, which is not suitable the next best positioned shear wall is SWP-3 where shear wall are located at middle periphery.

IV. Story shear is effective and has least value at SWP-4, Maximum Story shear value are seen in bare frame.

V. Story stiffness is effective and has least value at SWP-1 and SWP-4, Maximum story stiffness value are seen in bare frame.

VI. The results obtained from response spectrum method for Story displacement, Story drift, Story shear, Story stiffness are compared for all the shear wall position.

REFERENCES

- [1]. “Effect of change in shear wall location on storey drift of multistorey building subjected to lateral loads” by Ashish S.Agrawal, in International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 3, May-Jun 2012, pp.1786-1793.
- [2]. “Effect of Shear Wall on Seismic Behavior of Unsymmetrical Reinforced Concrete Structure” by Gaikwad Ujwala Vithal in International Journal of Research and Scientific Innovation (IJRSI) | Volume IV, Issue X, October 2017 | ISSN 2321–2705.
- [3]. Saleem, M.U. (2017) “Effect of Eccentric Shear Stiffness of Walls on Structural Response of RC Frame Buildings” Open Journal of Civil Engineering, 7, 527-538. https://doi.org/10.4236/ojce.2017.74035
- [4]. “Comparative Study of Equivalent Static Analysis and Response spectrum analysis on conventional slab & Flat Slab with or without shear wall Using STADD. PRO” by Yogita Tripathi, in International Research Journal of Engineering and Technology (IRJET) Volume: 05 Issue: 06 | June-2018.
- [5]. IS: 1893 (Part 1) 2002 – Indian standard – “Criteria for earthquake resistant design of structures”, Bureau of Indian Standards, New Delhi.
- [6]. Bureau of Indian Standard, IS – 456 (2000), “Plain and reinforced concrete code of practice”.