Seismic Analysis Of Structural Building With Reinforced Concrete Shear Walls According To The European Standards

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***Abstract*— Seismic analysis is a major tool in earthquake engineering which is used to understand the response of buildings due to seismic excitations. This research work is intended to look into how structural buildings can be protected against seismic forces with the introduction of reinforced concrete shear walls. A five storey model was analysed using CSI Etabs version 15 and StaadPro version 8I using response spectrum method and the maximum lateral displacement using Etabs software is 30.8mm and 12.613mm using StaadPro. while the maximum storey drift in x-direction was 0.00181 and 0.001814 in y-direction.**

Keywords—seismic analysis, models, Etabs, StaadPro.

I. INTRODUCTION

Seismic analysis is a major tool in earthquake engineering which is used to understand the response of buildings due to seismic excitations in a simpler manner. In the past the buildings were designed just for gravity loads and seismic analysis is a recent development. It is a part of structural analysis and a part of structural design where earthquake is prevalent [1].

Seismic waves reasons arbitrary ground motions in all possible directions, transmitting from the epicentre. If the structure has not been designed to resist these additional forces it may fail causing loss of life and property [2].

Shear wall are one of the excellent means of providing earthquake resistance to multi-storeyed reinforced concrete building. The structure is still damaged due to some or the other reason during earthquakes. Behaviour of structure during earthquake motion depends on distribution of weight, stiffness and strength in both horizontal and planes of building [3]. 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 ensure adequate lateral stiffness to resist lateral load. The provision of shear wall in building to achieve rigidity has been found effective and economical. When buildings are tall, beam, column sizes are quite heavy and steel required is large. So there is lot of congestion at these joint and it is difficult to place and vibrate concrete at these place and displacement is quite heavy. Shear walls are usually used in tall building to avoid collapse of buildings. When shear wall are situated in advantageous positions in the building, they can form an efficient lateral force resisting system. During an earthquake, failure of structure starts at points of weakness. Generally weakness is due to geometry, mass discontinuity and stiffness of structure. The structures having this discontinuity are termed as Irregular structures. These structures contain a large portion of urban
infrastructure. Hence structures fail during earthquakes due to vertical irregularity [1]. Adequate stiffness is to be ensured in high rise buildings for resistance to lateral loads induced by wind or seismic events. Reinforced concrete shear walls are designed for buildings located in seismic areas, because of their high bearing capacity, high ductility and rigidity. In high rise buildings, beam and column dimensions work out large and reinforcement at the beam-column joins are quite heavy, so that, there is a lot of clogging at these joints and it is difficult to place and vibrate concrete at these places which does not contribute to the safety of buildings. These practical difficulties call for introduction of shear walls in High rise buildings [4].

II. METHODOLOGY

To determine the basic components like displacement and base shear this analysis has been carried out using the software ETABS version 15 and STAADPRO version 8I and comparing both results for the analysis purpose, Response spectrum method was adopted.
Building model RC multi storied structures of 5 stories is considered with shear walls at different locations (L shape). It was modelled using Autodesk Revit and analysed using ETABS, While STAADPRO was used for both modelling and analysis. The height of each storey is kept constant as 3m for the building models. Properties of the considered building models are detailed below here.

The materials used for analysis of building models construction is reinforced concrete with C25grade of concrete and 415 grade of steel and the stress-strain relationship is used as per Euro code 8 [5].
The material properties, section properties and geometry of the model used are given in tables I, II, and III.

TABLE I: MATERIAL PROPERTIES

Material Properties	Values
Characteristic strength of concrete, fck	25MPa
Yield stress for steel, fy	415Mpa
Modulus of Elasticity of steel, E_s	199947.98MPa
Modulus of Elasticity of concrete, E_s	31000MPa

TABLE II: SECTION PROPERTIES

Thickness of slab	0.15m
Beam size	0.30 m
Column size	0.45×0.45m
Thickness of shear wall	0.225mm
Load intensities	
Additional dead load on beam	10kN/m2
Live load on slab	2kN/m2

TABLE III: GEOMETRY OF THE CONSIDERED MODEL

No. of Storeys	No. of Bays in X direction	Bay width in X direction	No. of Bays in Y direction	Bay width in Y direction	Storey Height
5	5	3m	5	2.8m	3m

Plans and 3D models from both Etabs and StaadPro are shown below:

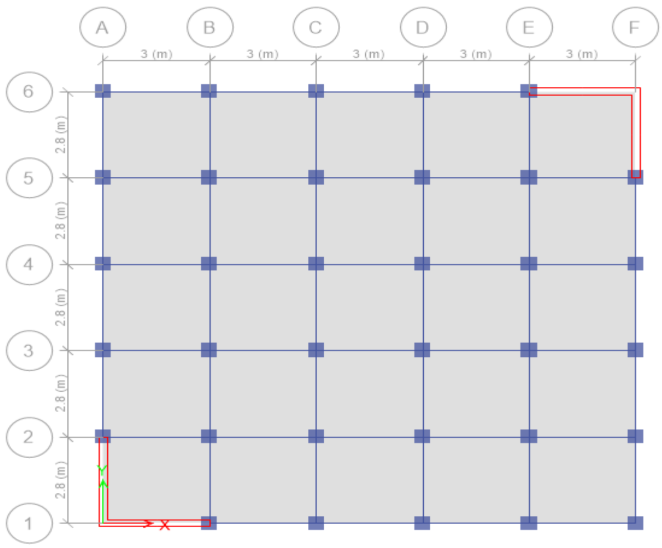

Fig. 1. *Plan view of the model with shear walls at opposite corners*

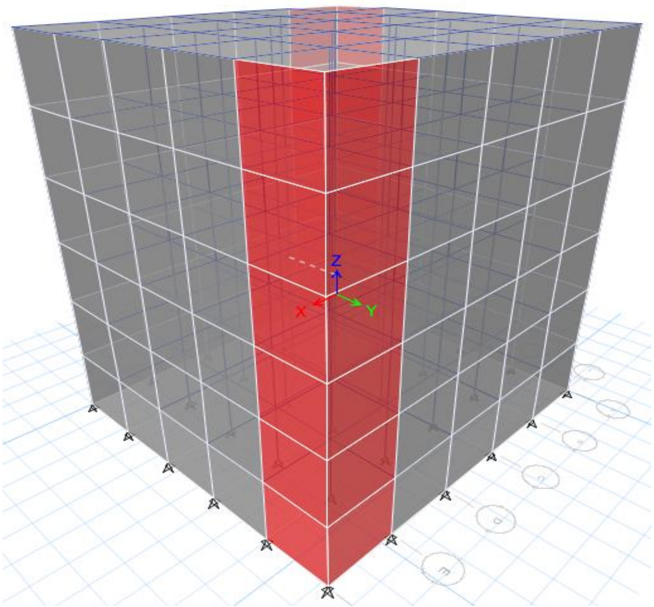

Fig. 2. *3D view of the model with shear walls at opposite corners using Etabs Software*

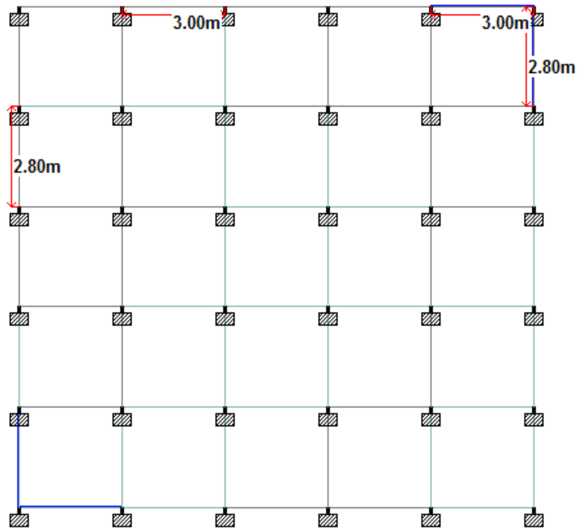

Fig. 3. *Plan view of the model with shear walls at opposite corners using StaadPro Software*

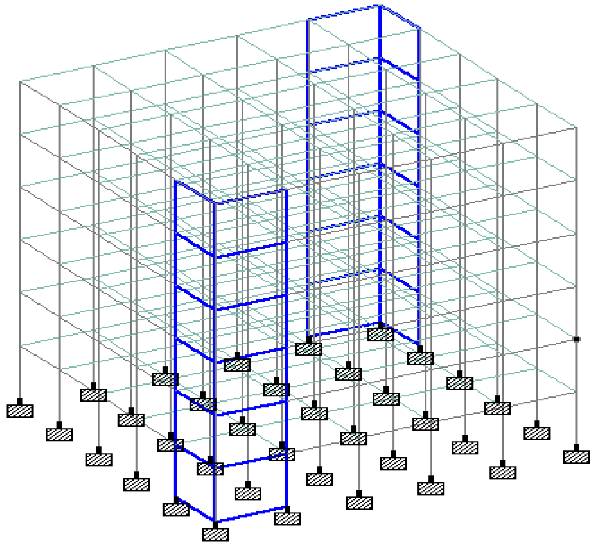

Fig. 4. *3D view of the model with shear walls at opposite corners using StaadPro*

III. RESULTS

Lateral displacements and story drifts for the building model obtained from the response spectrum method from both Etabs and StaadPro are shown in figures below.

TABLE IV: MAXIMUM STOREY DISPLACEMENT (ETABS)

Storey	X-Direction (mm)	Y-Direction (mm)
Roof	30.1	30.8
Storey 5	25.1	25.7
Storey 4	19.2	19.8
Storey 3	13.1	13.6
Storey 2	7.3	7.6
Storey 1	2.7	2.8
Base	0	0

Maximum storey displacement was 30.1 mm in x-direction and 30.8 mm in y-direction

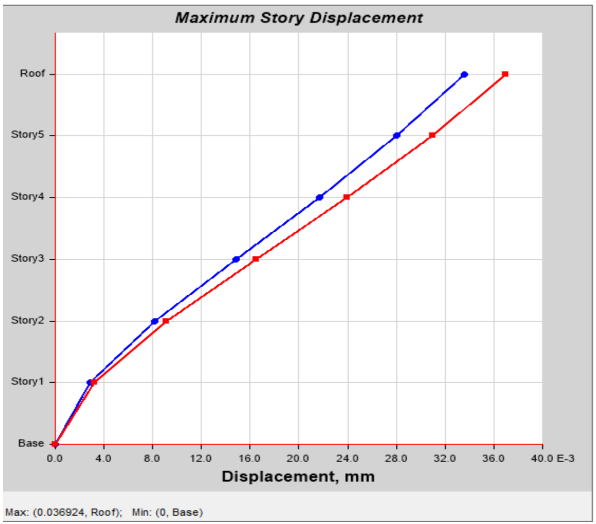

Fig. 5. *Maximum Storey displacement (Etabs)*

TABLE V: MAXIMUM STOREY DRIFTS (ETABS)

Storey	X-Direction	Y-Direction
Roof	0.00181	0.001814
Storey 5	0.001986	0.002006
Storey 4	0.00205	0.002093
Storey 3	0.001936	0.001995
Storey 2	0.001562	0.001628
Storey 1	0.000904	0.000944
Base	0	0

The maximum storey drift in x-direction was 0.00181 and 0.001814 in y-direction. The graph showing the maximum storey drifts is given below.

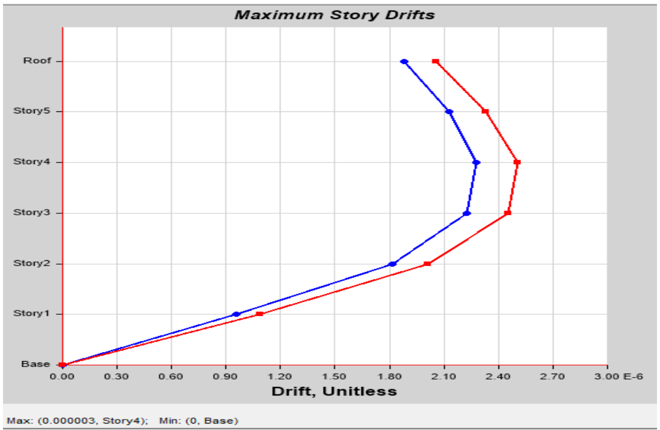

Fig. 6. *Maximum storey drifts (Etabs)*

TABLE VI: STOREY DISPLACEMENTS (STAADPRO)

Storey	X-Direction (m)	Y-Direction (m)	Z-Direction (mm)	Absolute (mm)
Roof	8.892	0.253	8.943	12.613
Storey 5	7.55	0.245	7.617	10.727
Storey 4	5.899	0.224	5.977	8.401
Storey 3	4.163	0.188	4.235	5.942
Storey 2	2.475	0.139	2.525	3.539
Storey 1	0.962	0.075	0.985	1.379

The maximum storey displacement was 12.613mm.

The chart showing the absolute displacement against storey is shown below.

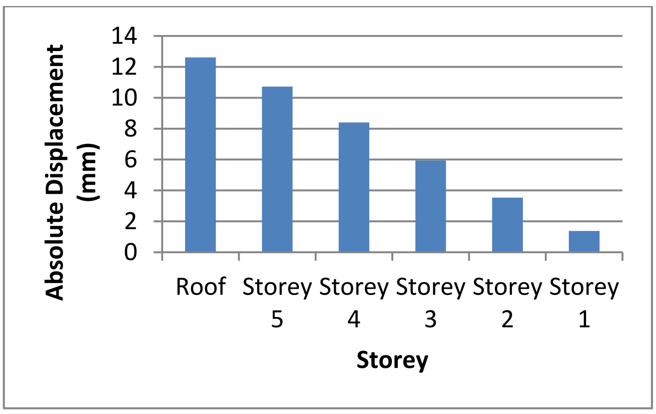

Fig. 7. *Absolute displacement (StaadPro)*

IV. CONCLUSION

The maximum lateral displacement using Etabs software is 30.8mm and 12.613mm using StaadPro. While maximum storey drift in the x-direction was 0.00181m and 0.001814m in the y-direction using Etabs.

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