COMPARATIVE ANALYSIS ON SEISMIC BEHAVIOUR OF MULTI-STOREYED RCC BUILDING IN DIFFERENT SOIL STRATA CONSIDERING THE POSITION OF SHEAR WALL

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Abstract - *Earthquakes are caused generally by rupture of geological faults inside the earth, but also by other events such as volcanic movement, landslides, mine blasts, and atomic tests. India is prone to strong earthquake shaking and hence earthquake resistant design is essential, engineer do not attempt to make earthquake proof building that will not get damaged even during the rare but strong earthquake, shear walls are structural members used to elongate the strength of R.C.C. structures. Irregularities are characterized by vertical discontinuities in the geometry, distribution of mass, rigidity and strength. In this work a high rise building with different places of shear walls is considered for analysis. The multistory building with 15 stories are to be analyzed for its displacement, strength and stability using ETABS-2016 software. For the analysis of the building for seismic loading with Zone-II is considered with a soil I, soil II & soil III types (hard, medium and soft soil) the analysis of the building is done by using equivalent static method and dynamic method. The results from the analysis obtained from both methods are presented in tabular form and the results are compared using graphical form.*

***Key Words*: Shear wall, High rise building, Asymmetry, Dynamic analysis, ETABS-2016, Soil type.**

1. INTRODUCTION

Earthquake is known as natural hazard that arise on the earth. Severe damage to structures that are built on the earth from past earthquakes, for suitability and safety is main aim of the earthquake resistance design. Seismic activity never kills the people, but less resistant structure will do.At one point of view, the horizontal sections along 2 perpendicular axes and vertical sections are known as ground accelerations. In some examples the building ground motion is considered responsive to the horizontal sections if building is not effective to the lateral motions. High rise buildings that are built in the earthquake prone area has high risk of lateral forces that causes the building to overturn or collapse so as to counter act those force building should designing according to the earthquake resistance by increasing the stiffness of the building by providing shear wall.

1.1 Plan Irregularity

Plan Irregularity is the even inconsistency in the design of vertical parallel drive opposing components, in this way creating a differential between the focal point of mass and focus of Inflexibility, that ordinarily result in huge torsional requests on structure. In other word the state of being no uniform, or quickly fluctuating, rather than steady.

- Torsional Irregularity
- Re-entrant Corners
- Diaphragm Discontinuity
- Out of Plane Offsets
- Non Parallel Systems

1.2 Vertical Irregularities are mainly of five types

- Stiffness Irregularity
- Mass Irregularity
- Vertical Geometric Irregularity
- In-Plane Discontinuity in Vertical Elements Resisting Lateral Force
- Discontinuity in Capacity

2. OBJECTIVES

- The analysis of a high raised reinforced cement concrete structure having Ground+15 Storey is analyzed with varying soil types with zone V.
- To Model asymmetric building plan in Etabs v.16 Software.
- To analysis the asymmetric building models with dynamic analysis method in seismic zones V with varying soil type.
- To compare the conventional building with shear wall and building with shear wall placed at core of building and corner of the building for base shear, storey drift, storey displacement and storey stiffness.
- To compare the performance of the structures that varies in soil type and with different locations of the shear with zone V.

3. METHODOLOGY

- An extensive literature review is carried out to establish the above objectives for the project work.
- G+15 storey structure is chosen for the present investigation.
- ETABS software is chosen for modelling and analysis of the selected structure.
- To understand the behavior of structure, nine models are considered with asymmetric plan configuration in different soil strata's and in zone V.

3.1 Modelling

Table-1: Geometrical Property of validation model

Sl. No.	Description	Value (m)
1.	Typical story height	3.0
2.	Bottom story height	1.5
3.	No of storey	16 no's
4.	Dimensions of building	18.05 x 22.14

Table-1: Asymmetric building configuration without shear wall and core shear wall.

Number of stories	G+15
Foundation level to ground level	1.5 m
Floor to floor height	3 m
Live load on all floors	3 kN/m^2
Live Load on Roof	1.5 kN/m^2
Floor Finish	1.0 kN/m^2
Concrete	M20 and M25
Steel	Fe 415 and Fe 500
Size of column	300x600 mm
Size of beam	300x450 mm
Depth of slab	150 mm
Thickness of shear wall	200 mm
Seismic zone V	0.36
Soil Type	Soft, Medium and Hard

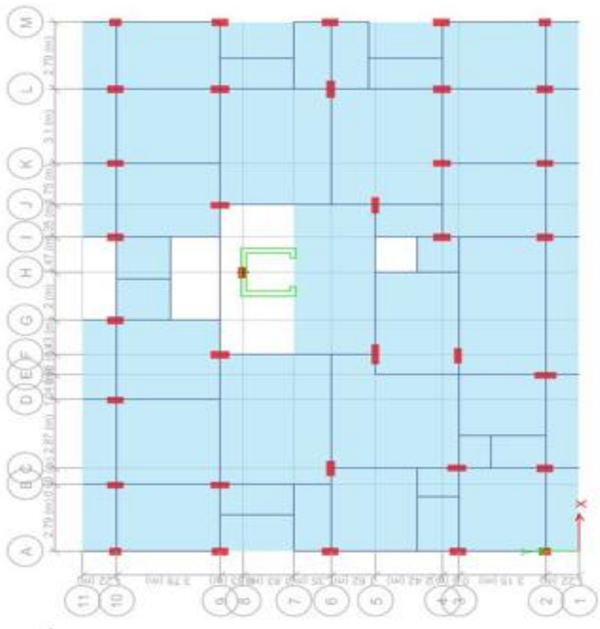

Fig-1: Structural Plan of Regular Model

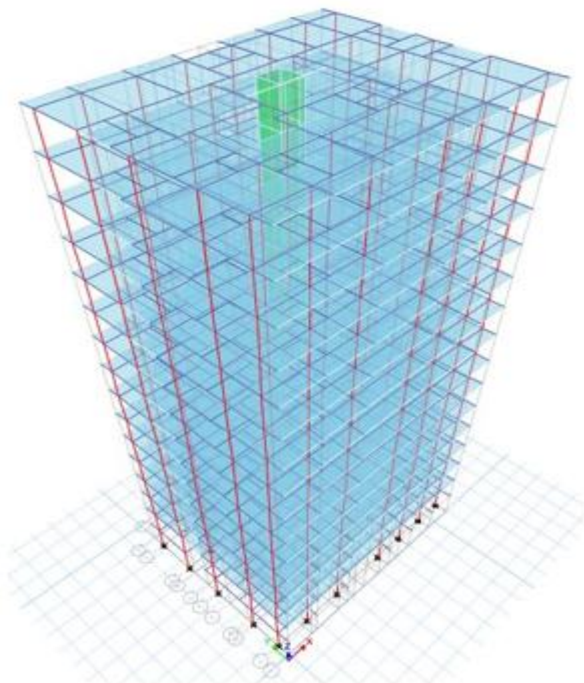

Fig-2: 3D Elevation of Model

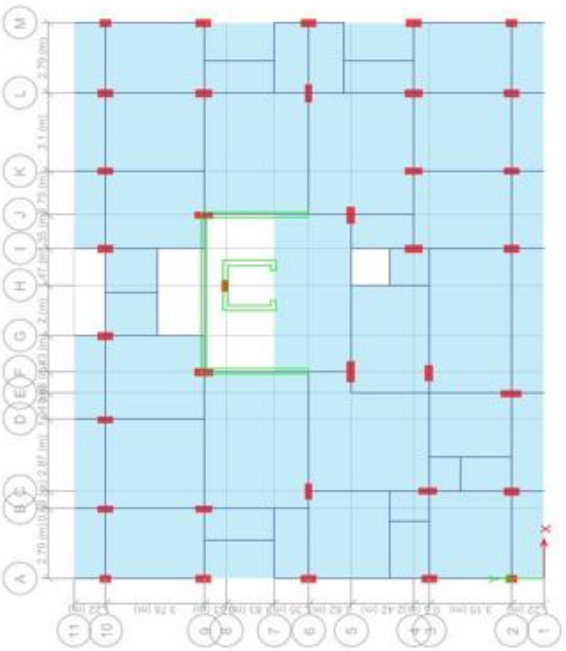

Fig-3: Plan of Regular Structure with core shear wall

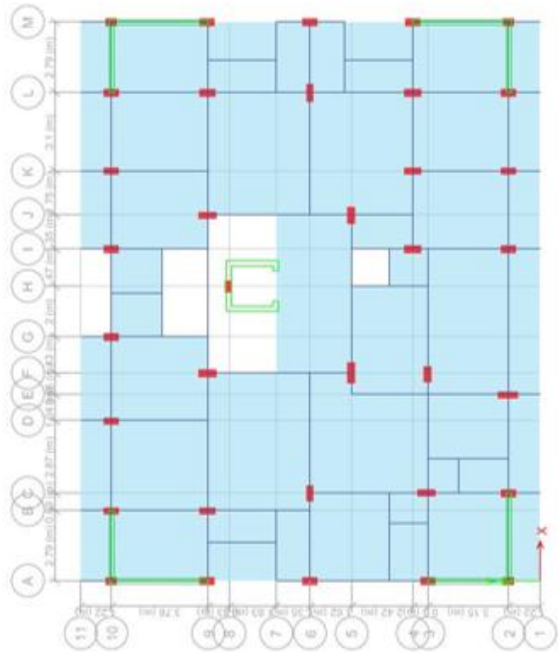

Fig 5: Plan of Regular Structure with corner shear wall

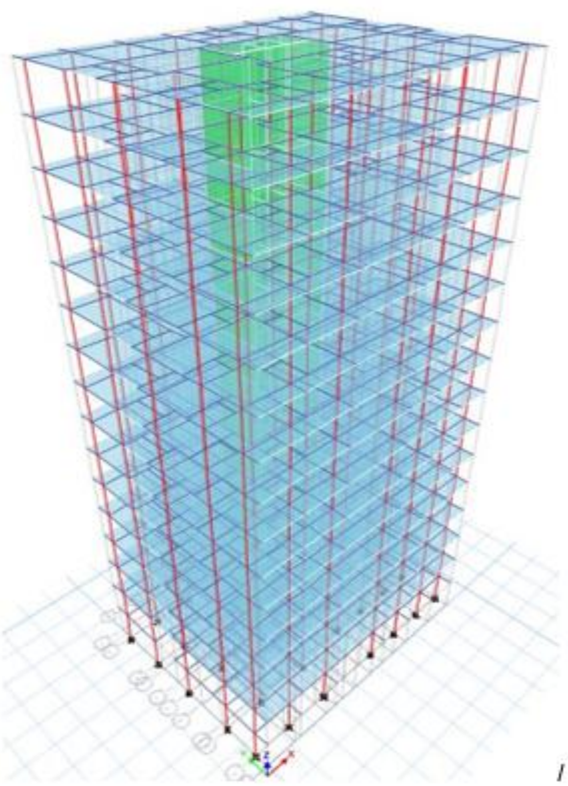

Fig-4: 3D Elevation of Regular Structure with core shear wall

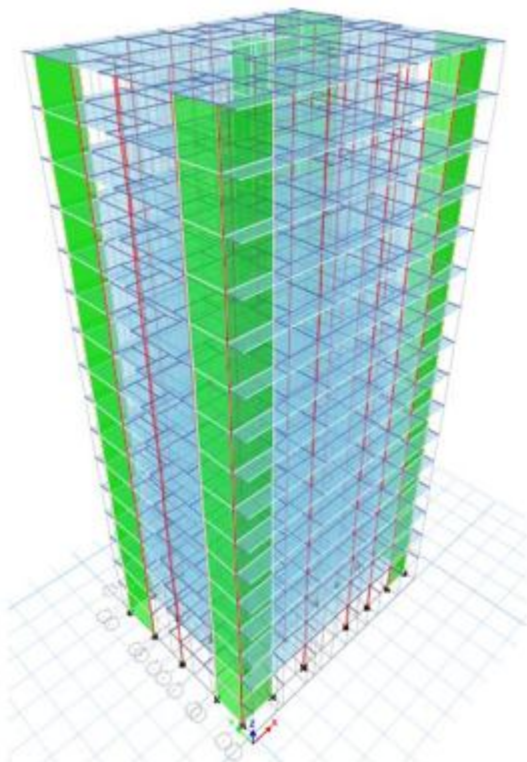

Fig 6: 3D Elevation of Regular Structure with corner shear wall

4. Analysis Results

This chapter deals with the results and discussion of highly elevated building with shear wall positioned in three different soil terrains at the core and corner of the building.

1. Model 1- High raised building without shear wall in soft soil
2. Model 2- High raised building without shear wall in soft medium soil
3. Model 3- High raised building without shear wall in hard soil
4. Model 4- High raised building with core shear wall in soft soil
5. Model 5- High raised building with core shear wall in soft soil
6. Model 6- High raised building with core shear wall in soft soil
7. Model 7- High raised building with corner shear wall in soft soil
8. Model 8- High raised building with corner shear wall in medium soil
9. Model 9- High raised building with corner shear wall in hard soil

Discussions are made based on following parameters

- Storey Displacement
- Storey drift
- Storey acceleration
- Storey forces
- Storey stiffness
- Base shear

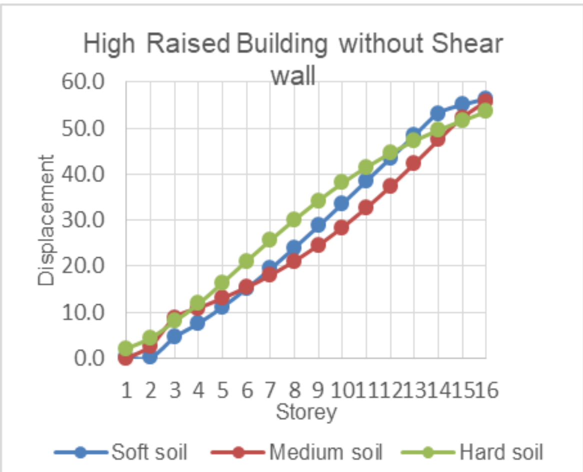

Chart-1: Storey Displacement due to Seismic Load in X Direction

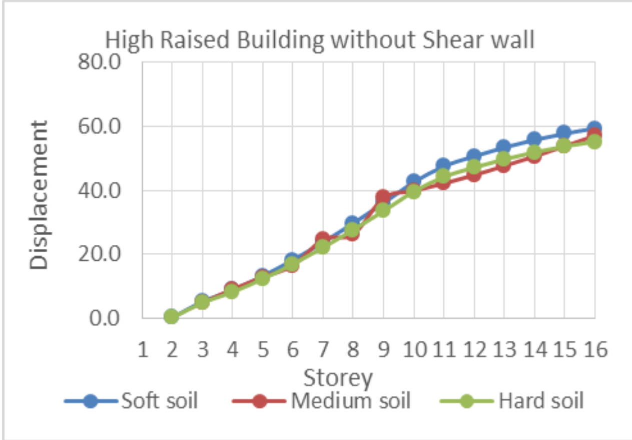

Chart-2: Storey Displacement due to Seismic Load in Y Direction

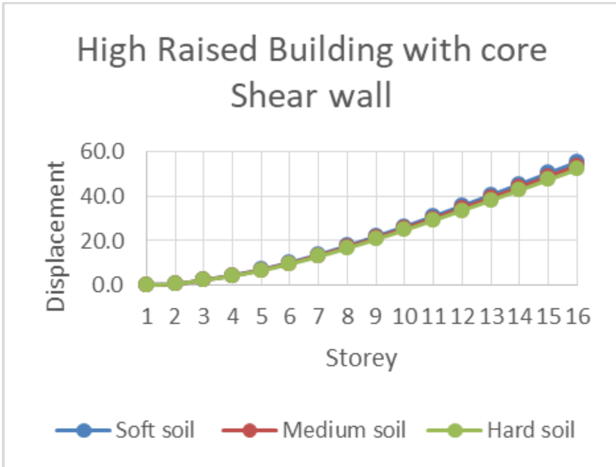

Chart-3: Storey Displacement due to Seismic Load in X Direction

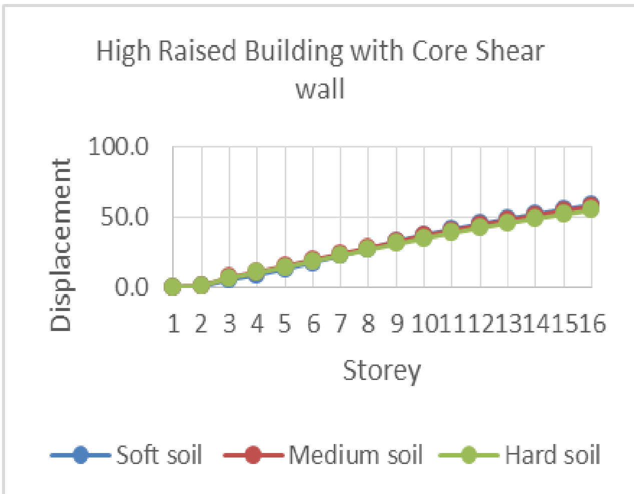

Chart-4: Storey Displacement due to Seismic Load in Y Direction

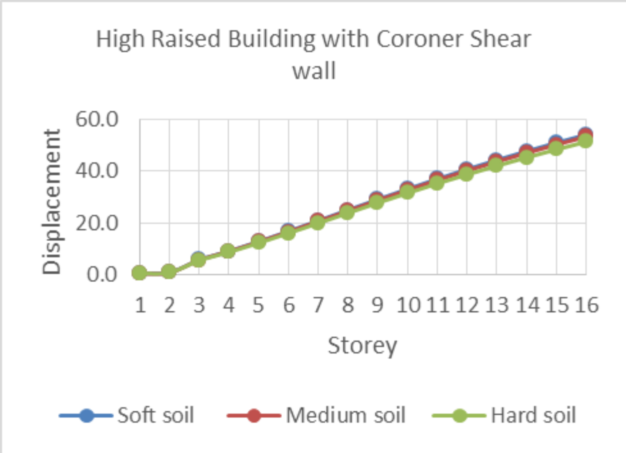

Chart-5: Storey Displacement due to Seismic Load in X Direction

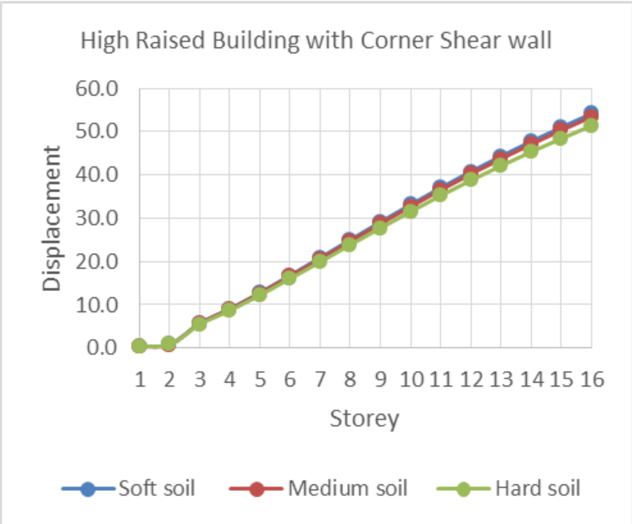

Chart-6: Storey Displacement due to Seismic Load in Y Direction

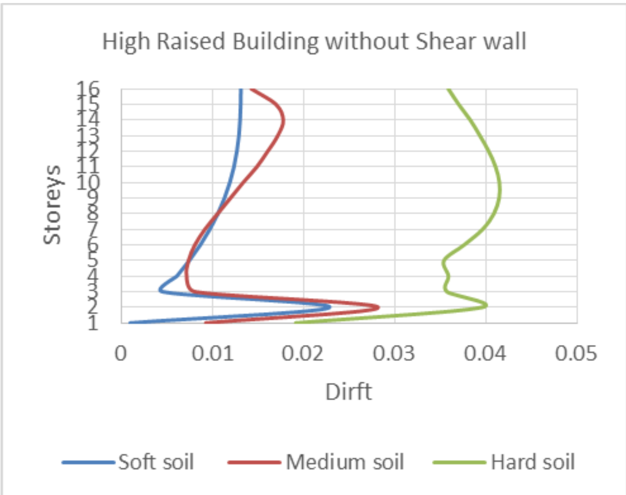

Chart-7: Storey Drift due to Seismic Load in X Direction

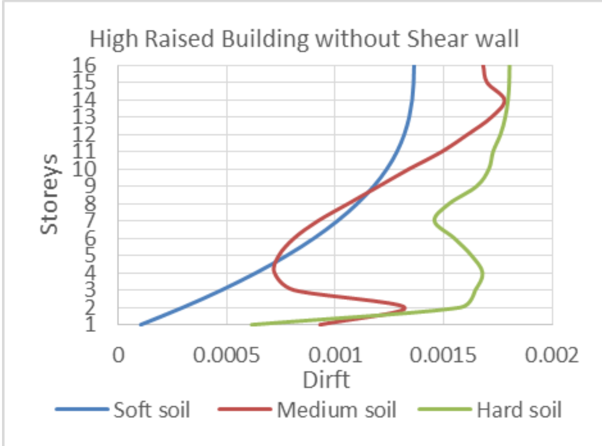

Chart-8: Storey Drift due to Seismic Load in Y Direction

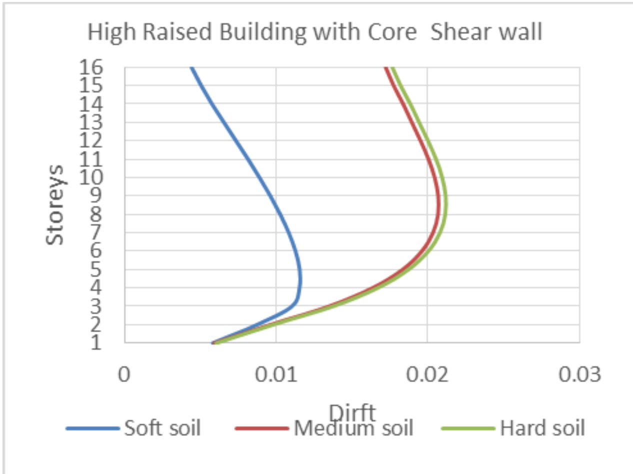

Chart-9: Storey Drift due to Seismic Load in X Direction

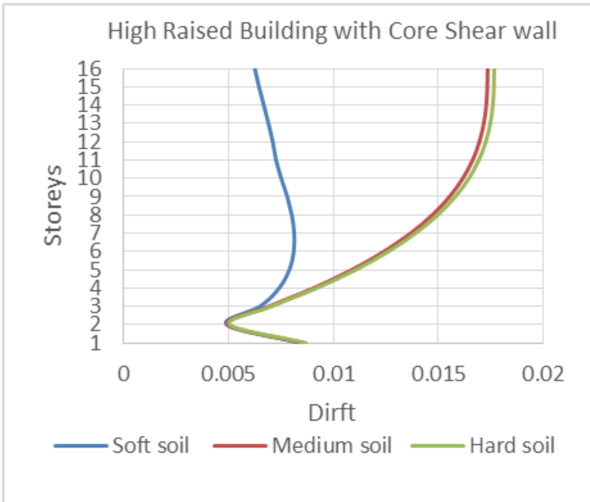

Chart-10: Storey Drift due to Seismic Load in Y Direction

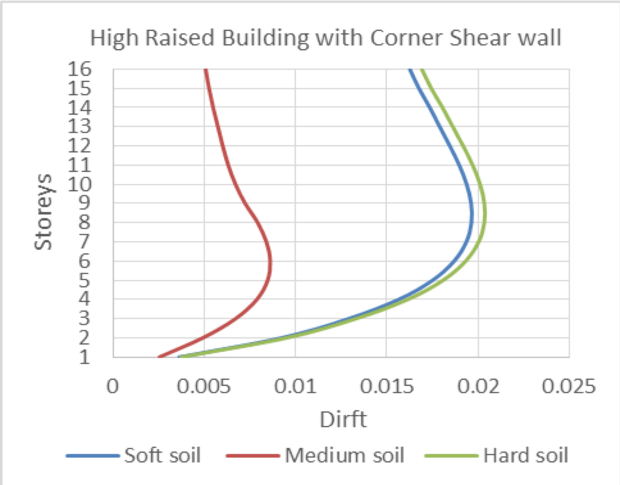

Chart-11: Storey Drift due to Seismic Load in X Direction

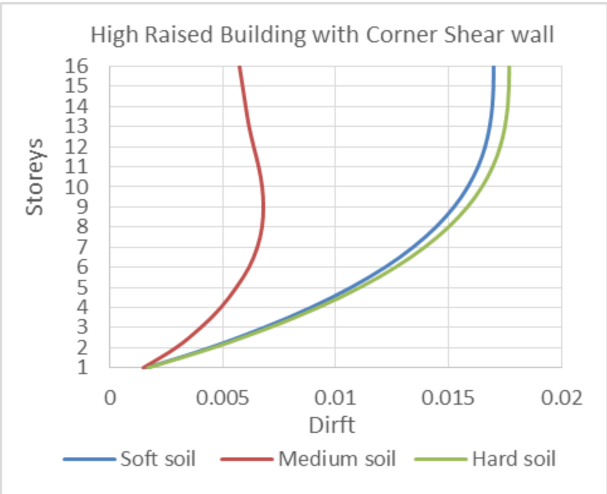

Chart-12: Storey Drift due to Seismic Load in Y Direction

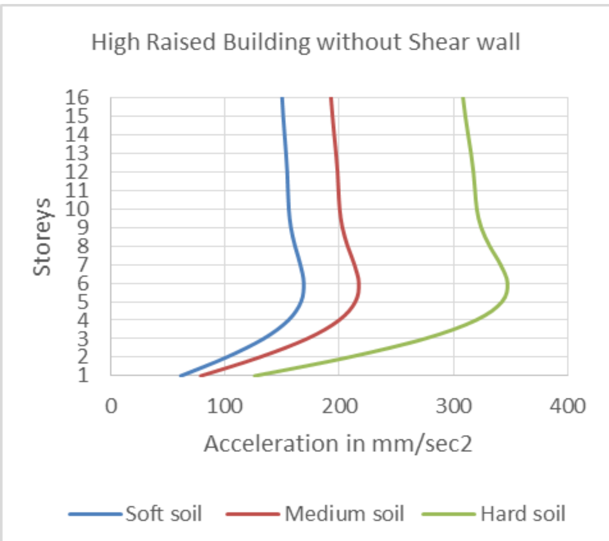

Chart-13: Storey Acceleration in X Direction

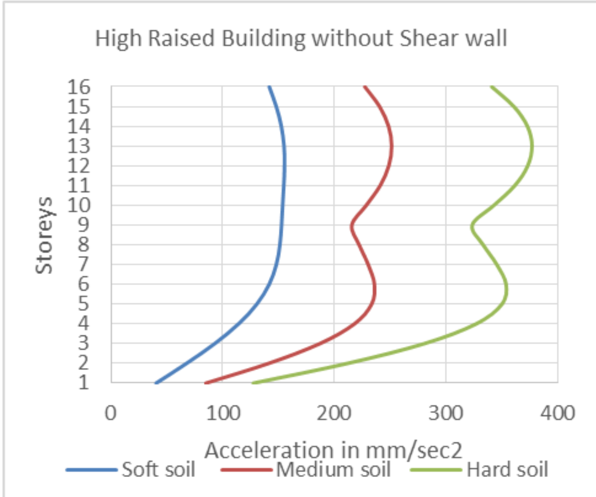

Chart-14: Storey Acceleration in Y Direction

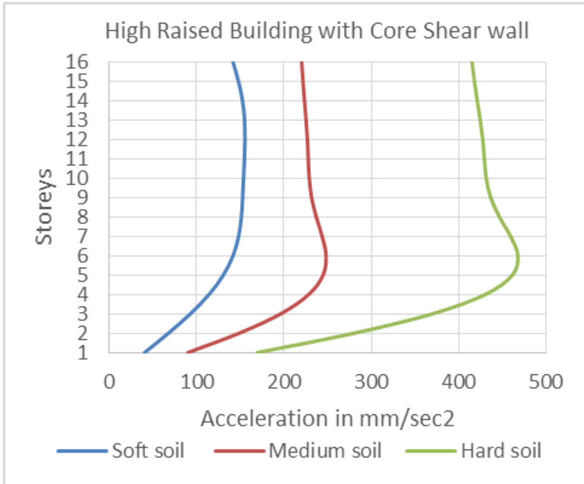

Chart-15: Storey Acceleration in X Direction

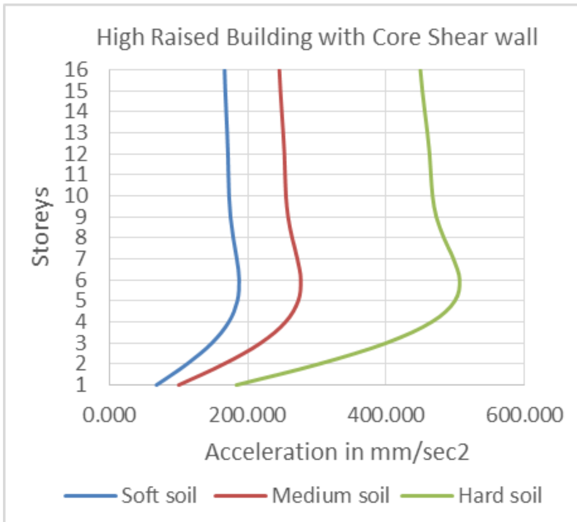

Chart-16: Storey Acceleration in Y Direction

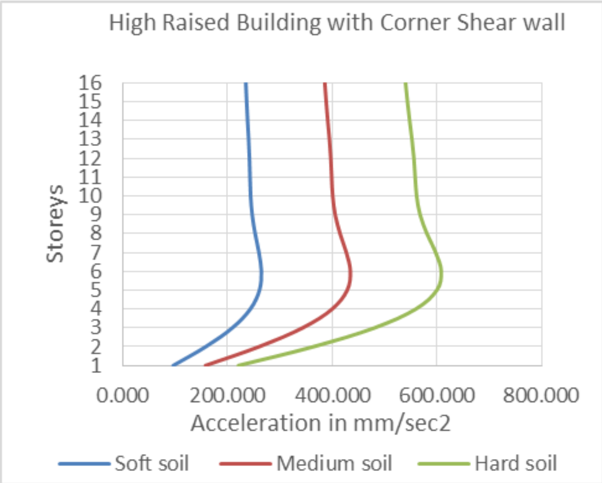

Chart-17: Storey Acceleration in X Direction

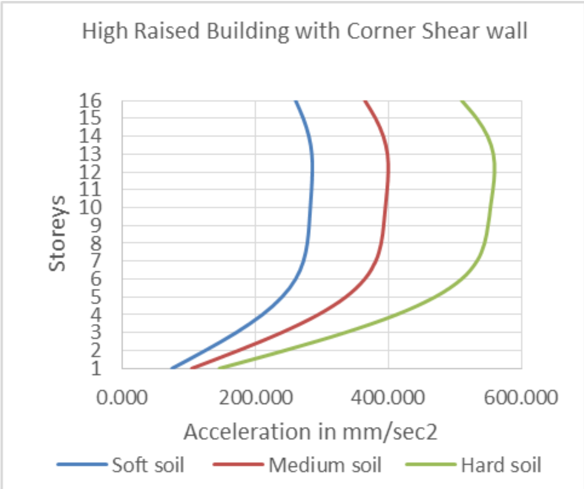

Chart-18: Storey Acceleration in Y Direction

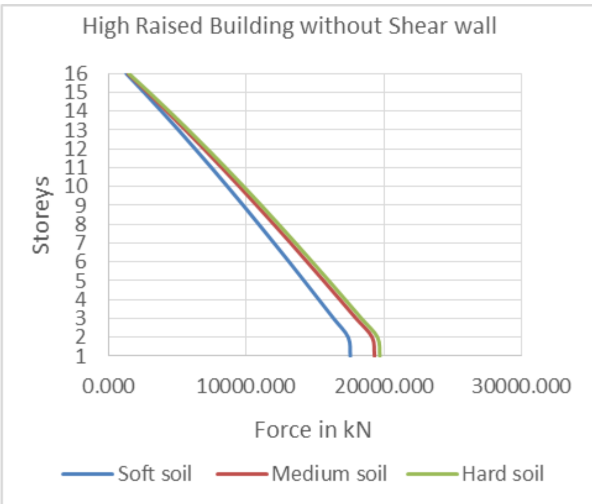

Chart-19: Storey Force in X Direction

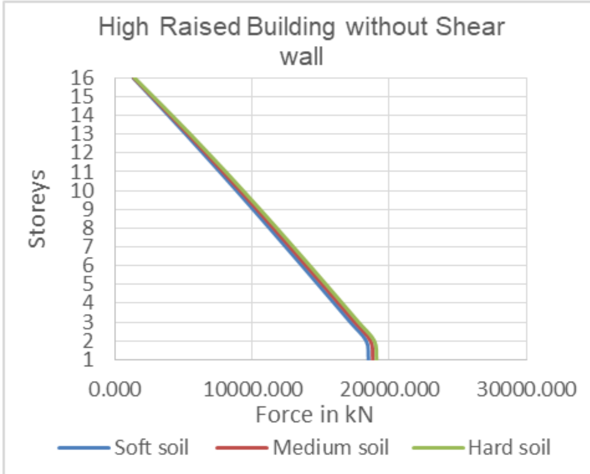

Chart-20: Storey Force in Y Direction

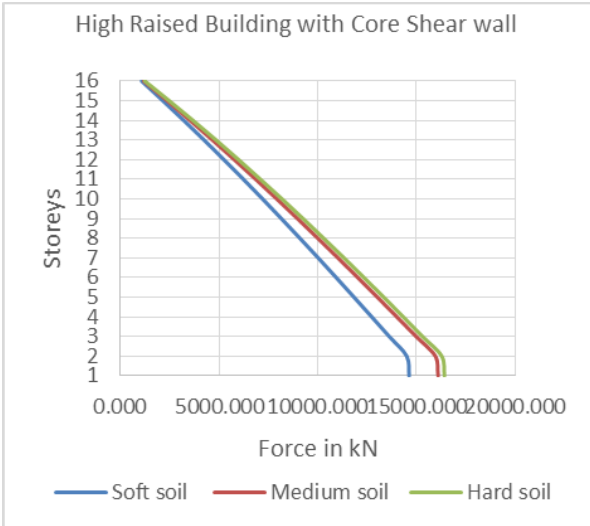

Chart-21: Storey Force in X Direction

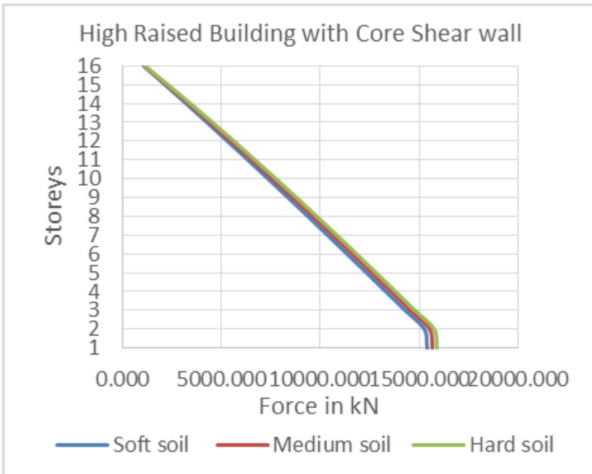

Chart-22: Storey Force in Y Direction

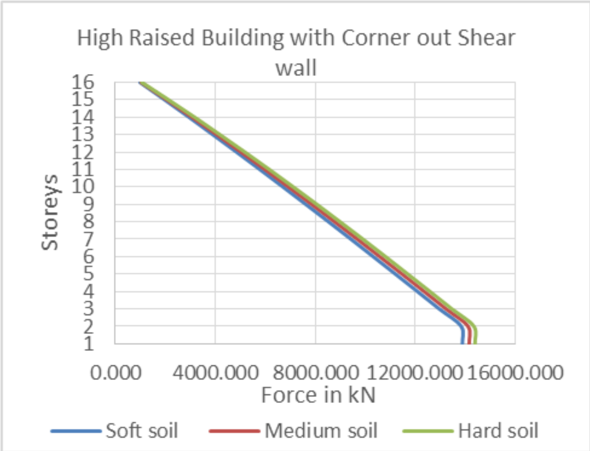

Chart-23: Storey Force in X Direction

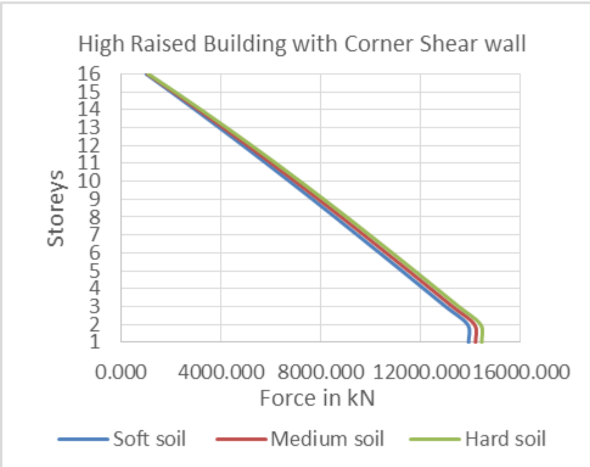

Chart-24: Storey Force in Y Direction

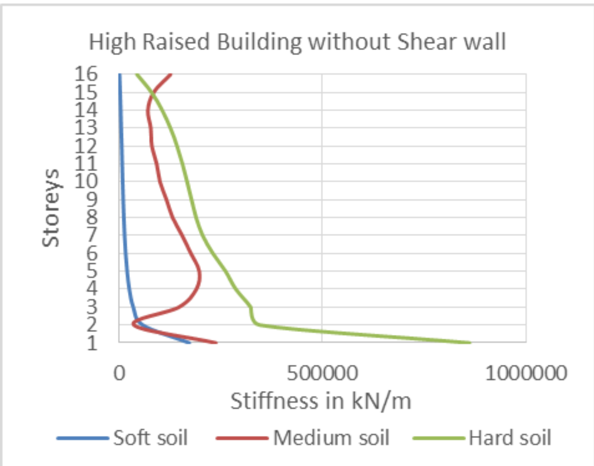

Chart-25: Storey Stiffness in X Direction

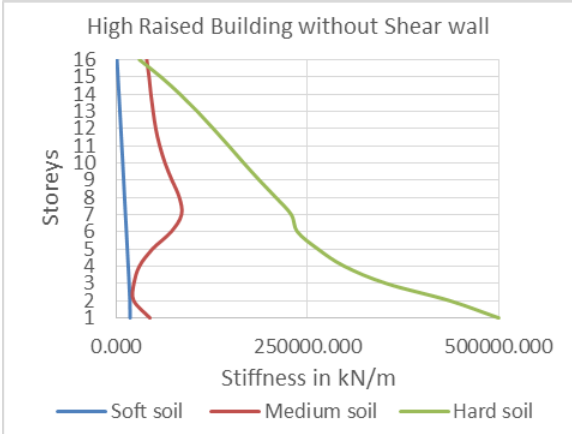

Chart-26: Storey Stiffness in Y Direction

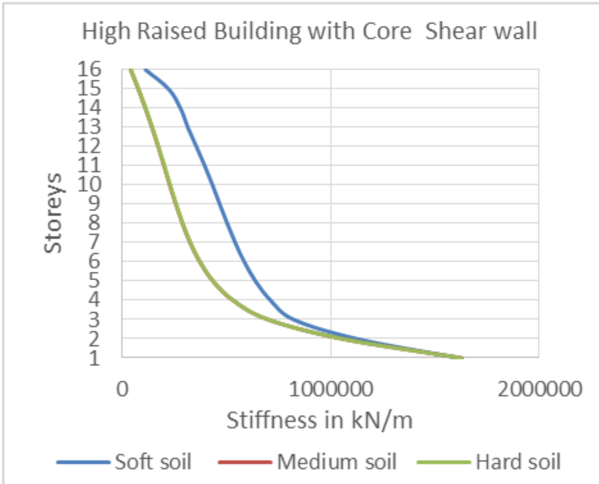

Chart-27: Storey Stiffness in X Direction

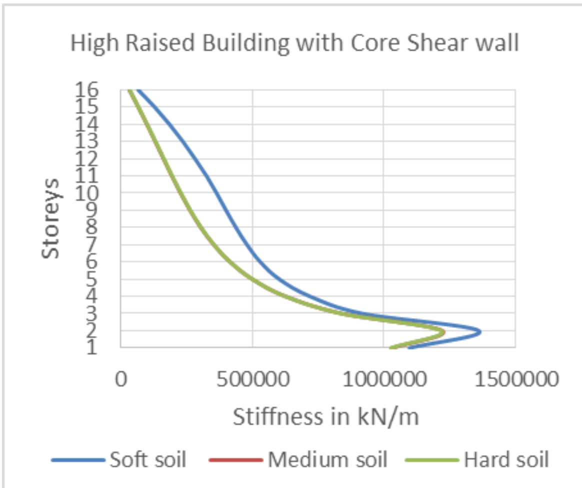

Chart-28: Storey Stiffness in Y Direction

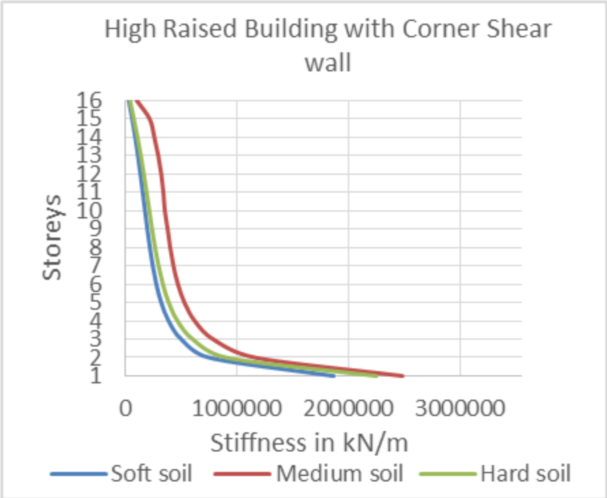

Chart-29: Storey Stiffness in X Direction

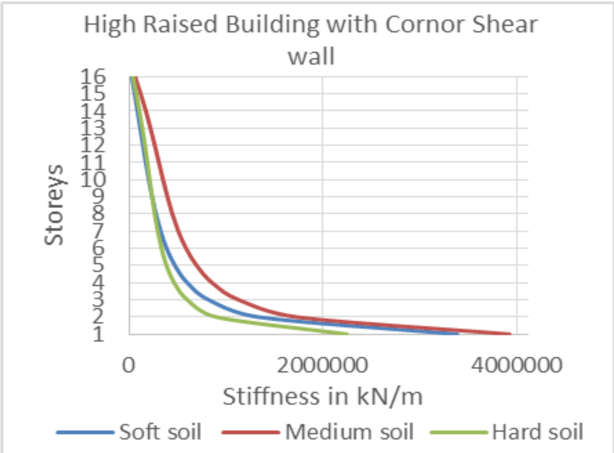

Chart-30: Storey Stiffness in Y Direction

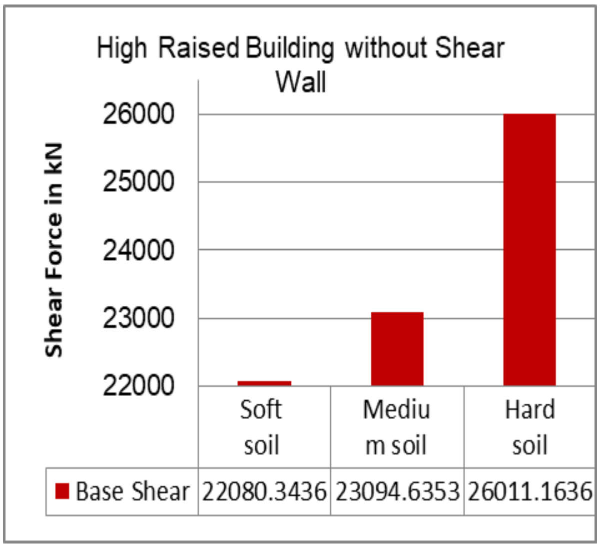

Chart-31: Base Shear in X Direction

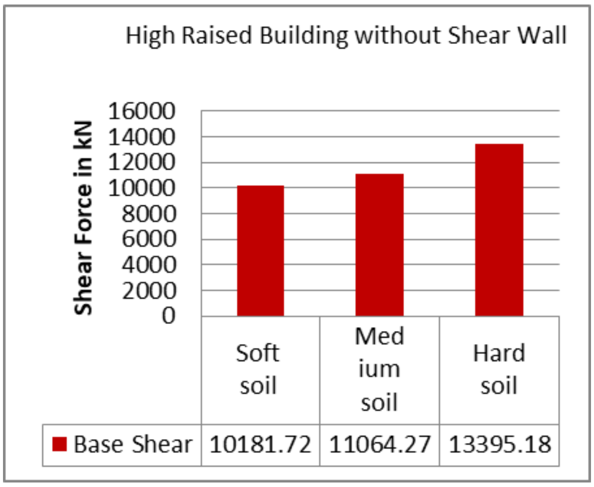

Chart-32: Base Shear in Y Direction

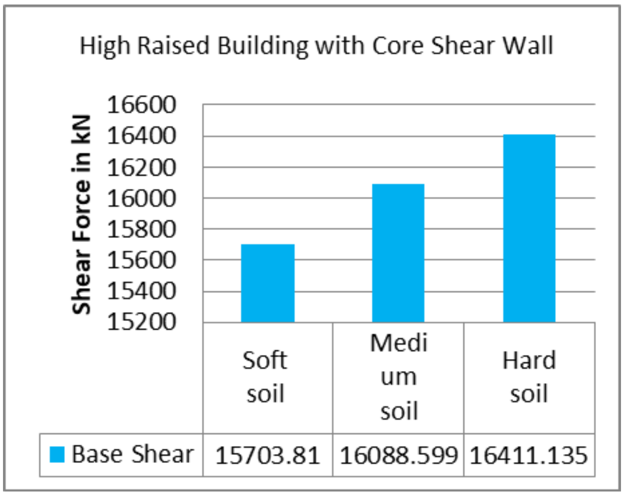

Chart-33: Base Shear in X Direction

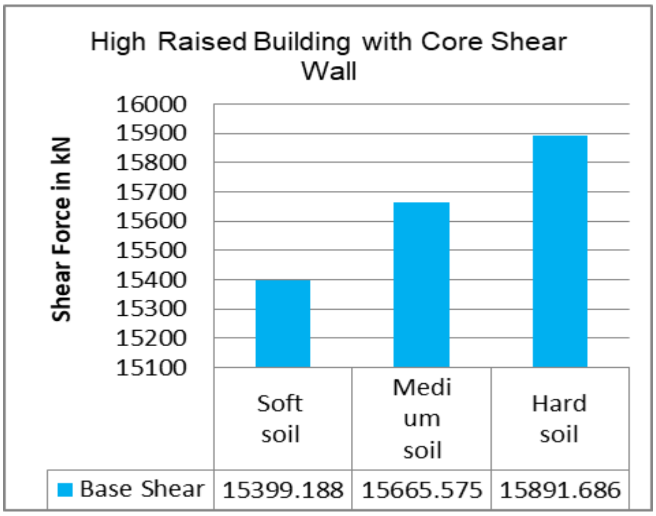

Chart-34: Base Shear in Y Direction

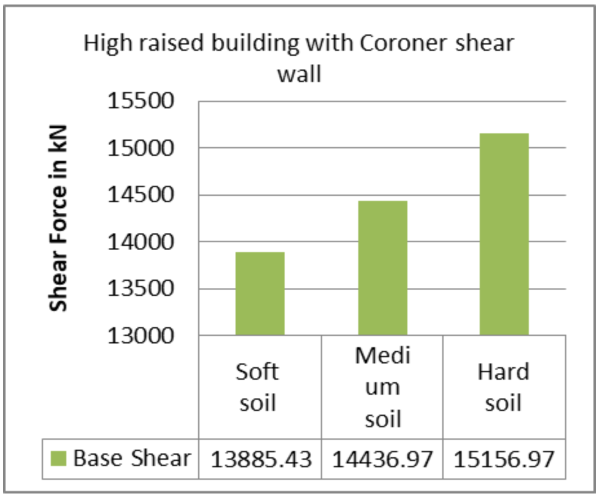

Chart-35: Base Shear in X Direction

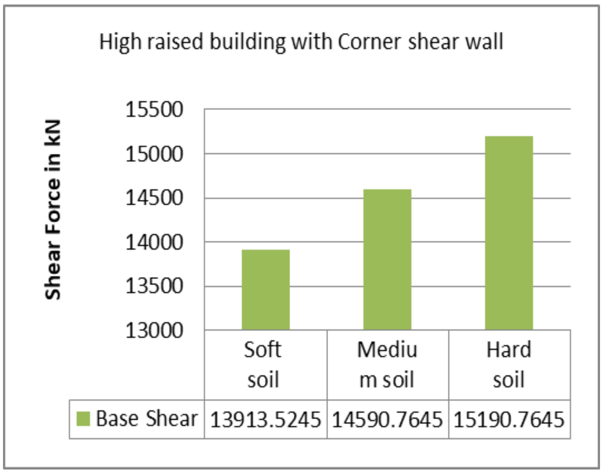

Chart-36: Base Shear in Y Direction

5. CONCLUSIONS

In successive sections of tests and discussions, the effects on models were shown in the form of a graph by analysing different factors such as displacements, storey drifts, storey acceleration, storey force, storey rigidity, and base shear. Hence the following conclusions are drawn from the findings obtained,

1. Considering the effect of lateral displacement on structure. It has been observed that, building without shear wall displaced more in comparison to core and corner shear wall simple shaped building.
2. The lateral displacement is compared with conventional building to the building with shear wall placed at core and corner, in soft, medium and hard soil has decreased rate of displacement observed about 4.01%, 4.0% and 4.33% respectively
3. The storey drifts are the significant parameter for understanding the structure's drift demand. Building model in hard soil and medium showed greater drift than model of soft soil building without case of shear wall.
4. Building model with core shear wall to the shear wall placed at corner of the building the drift ratio is increased in the three different soil cases at the rate of 11.67% in soft soil 5.58% in medium soil and 4.24% in hard soil.
5. The storey force in the type soil i.e., for soft, medium and hard showed that building with core shear wall model has a lower force than that for the building with corner shear wall the reduction forces are about 16.89% in soft soil, 13.0% in medium soil and 14.04% in hard soil.
6. The storey stiffness is more in the building with the corner shear wall in hard soil gives more resistance to the lateral load, compare to all other type soil and building with core shear wall.
7. The stiffness of the corner shear wall building with the core shear wall building in three different soil type is calculated the increased stiffness in the corner shear wall is 27.45% in soft soil 28.56% in medium soil and 34.76% in hard soil.
8. The acceleration of the building with shear wall placed along the building's corner of the structure has higher values is about 55.53 per cent in soft soil 75 per cent in medium soil and 30 per cent in hard soil.
9. The base shear of the high elevated building with shear wall positioned at the corner of the building has decreased base shear relative to the shear wall positioned at the core of the building, taking into account three different types of soil that are 11.58 percent in soft soil, 10.27 percent in medium soil and 7.64 percent in hard soil.
10. As the storey force decreased and an increase in storey stiffness and base shear for the corner shear wall building, which give a clear indication that corner shear wall building perform better then that the core shear wall structure.
11. Corner shear wall increases the structure's stiffness and strength, and affects the structure's seismic behaviour.
12. The presence of corner shear wall increase the lateral stability in irregular building and thus help in safe guarding the structure to some extent then the core shear wall.
13. From the above results so obtained from all the graphs is clear that building with corner shear wall give a better resistance against earthquake forces and offer a stable structure.

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