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Seismic Analysis of Multistorey Building Having Different Plan Configuration

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Abstract— The rapid increase of the urban population in developing countries such as India, has forced the revaluation of the importance of high rise buildings with different size and Building which leads to different aspect of the buildings. The structural systems of high rise buildings are usually sensitive to the effects of earthquake forces. It has been study that the change in plan configuration of building affects the earthquake forces on building. These thesis study the different plan configuration of the building and effect of earthquake forces on building. For this study each regular and irregular plan configuration such as rectangular, square, plus, tee ,L are considered having G+15 storey analyzed and designed by exploitation structural analysis computer code tool ETABS-2015.

Keywords— ETABS, Reinforcement, Displacement, Drift, seismic forces

INTRODUCTION

In the world everyone is aware that many natural disasters such as earthquakes, flood, tornadoes, hurricanes, drought and volcanic eruption occur of all natural disasters the most destructive are earthquakes. The destruction caused due to earth quake are too many in the world they not only cause great destruction in terms of human loss but also have a huge economic impact on the affected area. There is a crucial need to provide safety against terrible natural disasters. By experiencing all these disasters, it is not possible to build an earthquake proof structure. The seismic analysis and the design of buildings focuses on reducing the risk of life in the most severe earthquake. Building codes have developed their provisions on the historic performance of buildings and their deficiencies. They have developed provisions for life safety concerns, to prevent collapse under the most intense earthquake expected at a site during the life of structure. The irregularity in the building structures may be due to irregular distributions in their mass, strength and stiffness along the height of building. When such buildings are constructed in high seismic zones, the analysis and design becomes more complicated. Decisions made at the planning stage on building configuration are more important or are known to have made grater difference, than the accurate determination of code specified design forces on structure. The Building and proportions of the building have a major effect on the distribution of earthquake forces as they work their way through the buildings. Earthquake resistant design of reinforced concrete building is a continuing area of research. Geometric configurations, type of structural members, details of connections, and materials of construction all have a profound effect on the structural dynamic response of building in spite of all the weakness in the structure, either code imperfection or error in analysis and design, the structural configuration has played a vital role in catastrophe.

METHODOLOGY

Analysis building having configuration such as rectangle square ,tee, plus, L is generally done using the specifications provided by the code of practice.
For earthquake forces analysis of building the method used is
1.Static Method Equivalent Static Lateral Force Method (Pseudo static technique):It is a simplified technique to substitute the effect of dynamic loading of an unexpected earthquake by a static force distributed laterally on a structure for design purpose. The total applied seismic force is generally evaluated in two horizontal directions parallel to the main axes of the building, it assumes that the building responds in its fundamental lateral mode. To design and analysis of a structure capable to withstand the effect of earthquake, the forces upon the structure must be first specified. This method is simplest one and it requires less computational attempts and based on the formula given in the code of practice.

i)STRUCTURAL SPECIFICATION

For modelling of structures E- Tabs V 15.0.0 is used, for analysis purpose Equivalent static method is used. The Properties of the models are given below :

i] Plan Configuration of Building to be considered for analysis :

1)Tee Building
2) L Building

3)Plus Building
4)Square Building
5)Rectangular Building

ii] Material Properties:

Grade of concrete : M40
Grade of Steel : Fe500
Modulus of Elasticity of Steel, Es: 20,0000 Mpa
Modulus of Elasticity of Concrete Ec: 40,000 Mpa
Building Geometrical Properties:
Height of typical story: 3 m
Height of ground story: 3 m
Height of building: 48 m
Number of stories: G+15
Column Size:

I. **Table No.1Sizes Of Column**

Column level	Sizes of column
Foundation to second floor	750X750
Third floor to sixth floor	725 X725
Seventh to ninth floor	700 X 700
Tenth to Twelveth floor	675 X 675
Thirteenth to Fifteenth floor	650 X 650

Beam Size: 230 mm x 450mm
Thickness of Slab: 150 mm
Thickness of Wall: 230 mm

iv] Design Spectrum: (Source IS:1893:2016)

Type of Soil:
Soil type 1: Soft,
Soil type 2:Medium
Soil type 3: Hard
Earth quake Zone: III
Zone Factor, Z : 0.16
Importance Factor: 1
Response Reduction Factor: 5
iii] Loading to be considered:
Live Load on Roof: 1.5 KN/m^2 (Source: IS 875(part II)-1987)
Floor Finish Load: 2 KN/m^2 (Source: IS 875(part I)-1987)

iv]Load Combinations considered for the building analysis :

I]Static equivalent method:
1)1.5(DL+LL)
2)1.2(DL+LL+EQX)
3)1.2(DL+LL-EQX)
4)1.2(DL+LL+EQY)
5)1.2(DL+LL-EQY)

III RESULT

1) DISPLACEMENT OCCURED IN BUILDING:

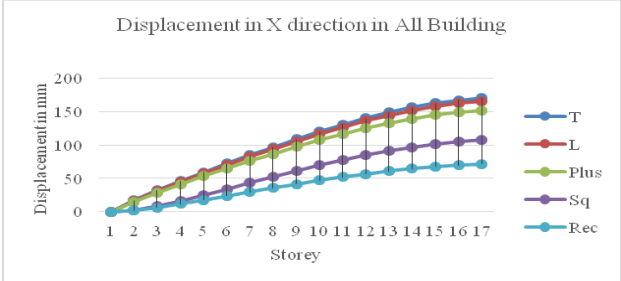

Figure No.1 Displacement in Y Direction for all building for soil type 1

Figure No.11 shows the graph plotted of displacement against No of storey for all building in X direction for Soil type 1.graph shows displacement increase as we go for higher storey. Tee building shows maximum storey displacement and it is minimum for Square and rectangular building respectively.

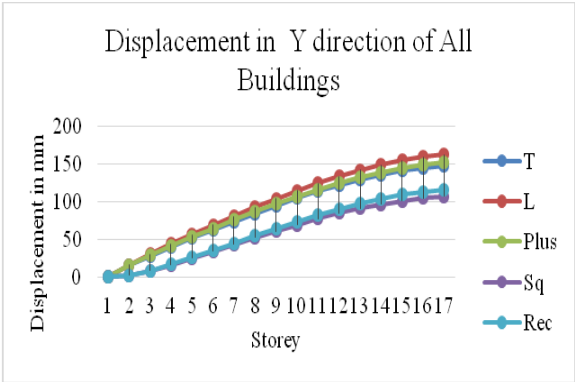

Fig. No.2 Displacement in Y Direction for all building for soil type 1

Figure No.12 shows the graph plotted of displacement against No of storey for all building in X direction for Soil type 1.graph shows displacement increase as we go for higher storey. L- building shows maximum storey displacement and it is minimum for Square and rectangular building respectively.

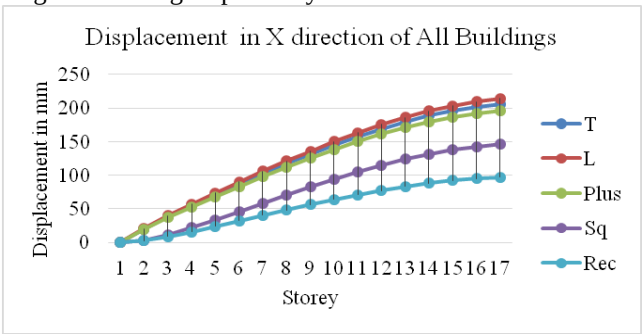

Figure No.3 Displacement in X Direction for all building for soil type 2

Figure No.13 shows the graph plotted of displacement against No of storey for all building in X direction for Soil type 2.graph shows displacement increase as we go for higher storey. L- building shows maximum storey displacement and it is minimum for Square and rectangular building respectively

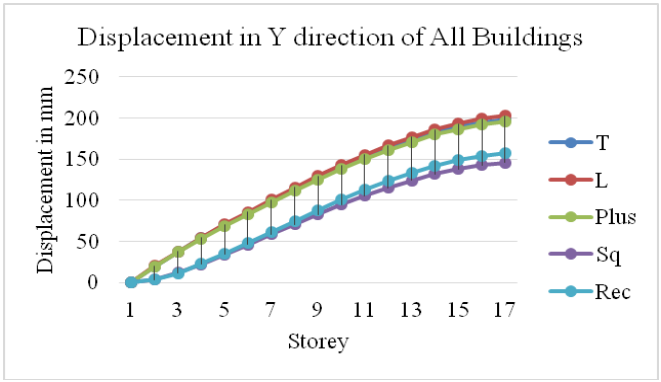

Figure No.4 Displacement in Y Direction for all building for soil type 2

Figure No.4 shows the graph plotted of displacement against No of storey for all building in Y direction for Soil type 1.graph shows displacement increase as we go for higher storey. L- building shows maximum storey displacement and it is minimum for Square and rectangular building respectively

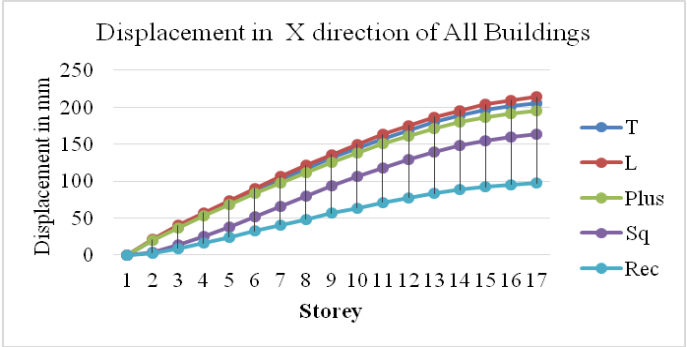

Figure No.5. Displacement in X Direction for all building for soil type 3

Figure No.15 shows the graph plotted of displacement against No of storey for all building in X direction for Soil type 3.graph shows displacement increase as we go for higher storey. L- building shows maximum storey displacement and it is minimum for Square and rectangular building respectively

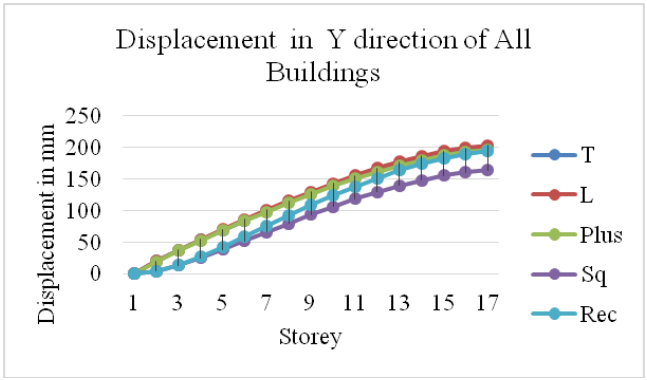

Figure No.6 Displacement in Y Direction for all building for soil type3

Figure No.16 shows the graph plotted of displacement against No of storey for all building in Y direction for Soil type 3.graph shows displacement increase as we go for higher storey. L- building shows maximum storey displacement and it is minimum for Square and rectangular building respectively

2) DRIFT OCCURED IN BUILDING

Modelling of Multi-storeyed building for different plan configuration is done by using ETABS software. Study of model carried and comparing changes in structural member, such as change in storey drift is carried out

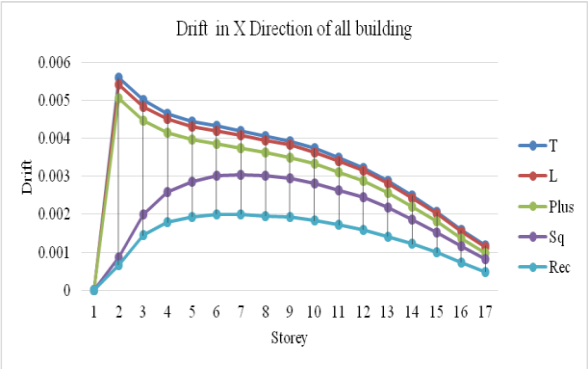

Figure No.7 Drift in X Direction of All Buildings

Figure No.7 shows storey drift in X direction for all buildings. Tee shaped building shows maximum storey drift. this value is in maximum permissible limit.

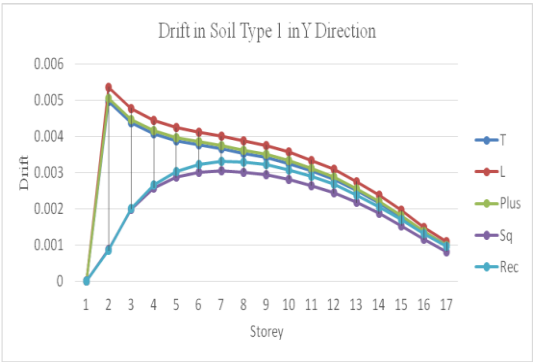

Figure No.8 Drift in in Y Direction of All building for Soil Type 1

Figure No.8 shows storey drift in X direction for all buildings. L shaped building shows maximum storey drift. this value is in maximum permissible limit.

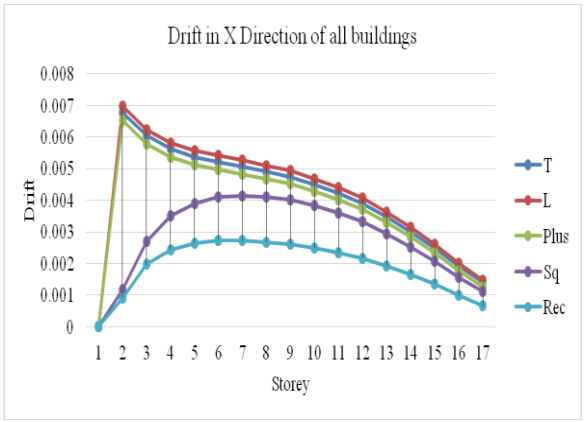

Figure No.9 Drift for in X Direction of All Buildings Soil type 2

Figure No.9.shows storey drift in X direction for all buildings. L shaped building shows maximum storey drift. this value is in maximum permissible limit.

Figure No.10 Drift in Y Direction of All Buildings for soil type 2

Figure No.10.shows storey drift in Y direction for all buildings. L shaped building shows maximum storey drift. this value is in maximum permissible limit.

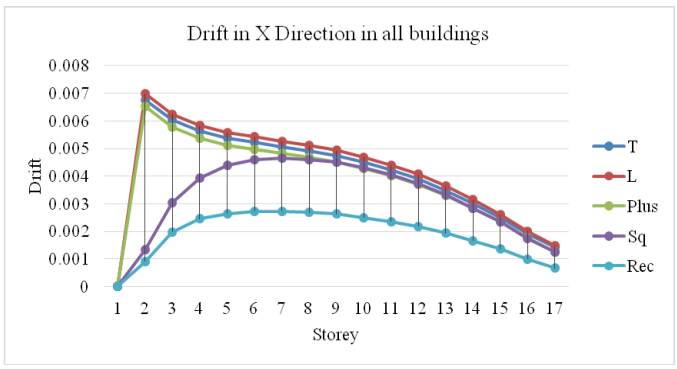

Figure No.11 Drift in X Direction of All Buildings for soil type 3

Figure No.5.20 shows storey drift in X direction for all buildings. L shaped building shows maximum storey drift. this value is in maximum permissible limit.

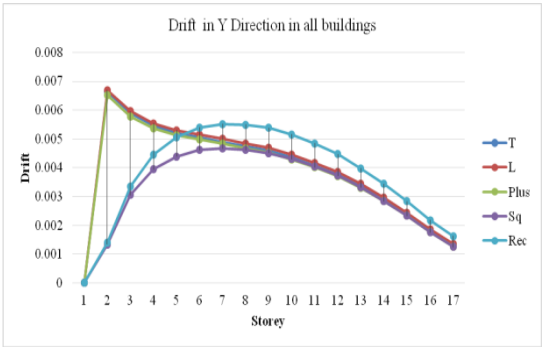

Figure No.12.Drift in Y Direction of All Buildings for soil type 3

Figure No.5.21shows storey drift in Y direction for all buildings. L shaped building shows maximum storey drift. this value is in maximum permissible limit lowest in square.

CONCLUSIONS

- From the detailed analysis and all the work, this thesis has been give following points as:
- From displacement point of view, among all the models the rectangle mode gives very less value in x- direction, for all the soil condition; where in y- direction, square model give less value..
- In case of site condition, as the condition changes, major variation in displacement has been observed.
- For soil type 1, most of the models have displacements are within permissible limit as per IS 1893-2016; whereas for site type 2 and 3 these exceeds the limit.
- For all the models with any site condition, the drift is in limit as per IS 1893-2016.
- Reaction at the base is less for response spectrum as compare to equivalent static analysis.

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