Seismic Analysis Of Building Resting On PlaneAnd Sloping Ground

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Abstract

The investigation presented in this paper aimed at predicting the seismic response of RC buildings with different configuration on sloping & plain ground. A seismic analysis performed on G+6 story RC structural & steel structural building. 3-D Analysis including seismic effect have been analysis method by using STAAD PRO. Here we have four configuration rectangular RC structure on plain and sloping ground and Rectangular steel structure on plain and sloping ground building were considered for analysis and they are rested on 0˚ & 10˚ slope. From the analysis of dynamic parameters obtained and has been discussed in terms of Horizontal moments, Seismic base shear, Axial forces and Displacement.

Keywords: Sloping and Plain ground, Seismic Analysis Method, STAAD PRO, Displacement,Base Shear

1. Introduction

In some parts of world, hilly area is more prone to seismic activity; e.g. northeast region of India. The Tourism and rapid urbanization in hilly region has accelerated the real estate development. Due to this, population density in the hilly region has increased continuously. Therefore, there is demand for the construction of multi-storey buildings on hill slope in and around the cities. Hill buildings aredifferent from those in plains; they are very irregular and unsymmetrical in horizontal and vertical planes, and torsionally coupled.

1.1 Aim

To study the behavior of RCC and steel building resting on Plain and sloping ground.

1.2 Objectives

The objectives of project are as follows:-

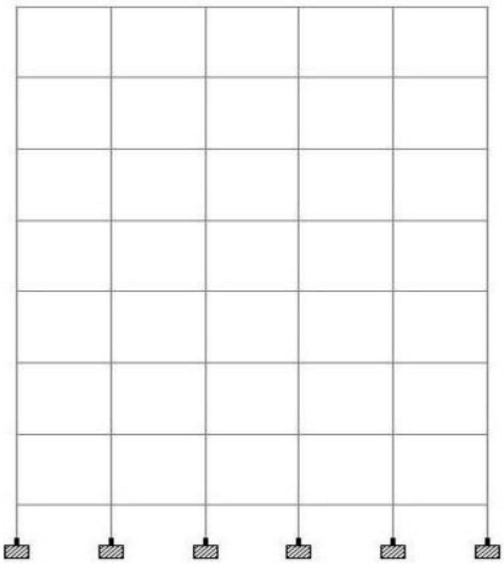
- To compare various structural parameters for buildings resting on plain ground.
- To study behavior of RCC and Steel frame in various seismic zones.
- To study the variation in material requirement for framing material.
- To find the most vulnerable framing system amongst all frames conditions.
- To find various parameters for all frames Such as, Axial forces, Bending Moments, Displacements and compare them.

1.3 Need of Study

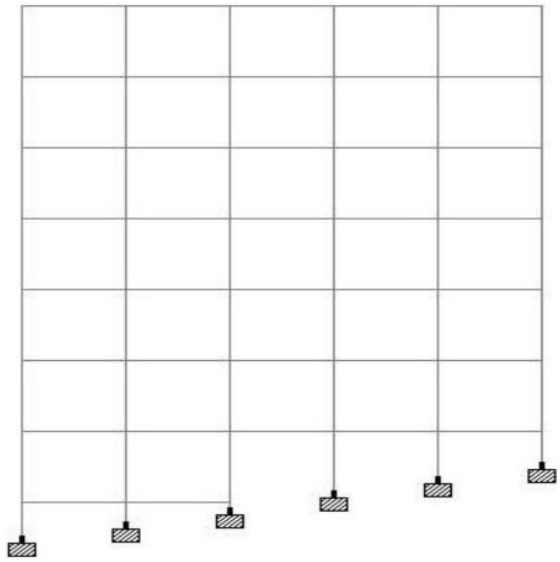
Hill buildings are different from those in plains; they are very irregular and unsymmetrical in horizontal and vertical planes, and torsionally coupled. Hence, they are susceptible to severe damagewhen affected by earthquake ground motion. Past earthquakes [e.g. Kangra (1905), Bihar- Nepal (1934 & 1980), Assam (1950), Tokachi-Oki-Japan (1968), Uttarkashi-India (1991)][1], have proved that buildings located near the edge of stretch of hills or sloping ground suffered severe damages.

Such buildings have mass and stiffness varying along the vertical and horizontal planes, resulting the center of mass and center of rigidity do not coincide on various floors. This requires torsional analysis; in addition to lateral forces under the action of earthquakes. Little information is available in the literature about the analysis of buildings on sloping ground. The investigation presented in this paper aimed at predicting the seismic response of RC buildings with different configuration on sloping and plain ground

2. Configuration of Building on Plane and slopping ground.



i) Regular building on leveled ground



(ii) sloping ground building

3. Methodology

3.1 Work Process

The methodology for present work is as mentioned below:-

1) In the first phase general parameters of project will be finalized Such as, Aim,Objectives and need of this work.

2) Then Various Literatures will be studied regarding the process of work.

3) Detail step by step procedure will be then decide for easy going of work

4) Detail information will be collected regarding sloping ground types of framing materialand loading and their combinations.

5) All general parameters regarding material, their constants, and loading intensities willbe decided at this step.

6) Now after doing all above steps No of models and their shapes patterns will be nowfixed.

7) Suitable method of analysis (Seismic Co-efficient Method) will now be selected.

8) Suitable type of software (STAAD PRO.) Will be selected for Analysis.

9) After Analyzing all models comparative results will be plotted.

10) Based on obtained results final conclusions will be drafted.

11) At last all references will be made available for future work.

3.2 Design Data:-

Live load : 3.0 kN/m2 at

Typical floor : 1.5 kN/m2 on terrace

Floor finish : 0.50 kN/m2

Location : Zone II and Zone V

Earthquake load : As per IS-1893 (Part 1) - 2002

Depth of foundation below ground : 1.5 m (Regular Case)

Type of soil : Type II, Medium as per IS:1893

Storey height : Typical floor: 3.05 m,

Floors : G.F. + 6 upper floors

Walls : 230 mm thick brick masonry walls.

Beam size :- 230mm x 300mm, **Column size :-** 300mm x 400 mm,**Slab thickness :-** 130mm

Unit weight of concrete :- 25 Kn/m3

Unit weight of brick masonry :- 19 Kn/m3

4. Model Nomenclature

In the present work the model combination will be done as follow:-

Total 08 models will be analyzed 04 of RCC and 04 of Steel Frame. Labeling of models will be doneas:-

MODEL	ZONE II	ZONE V
Regular Concrete Structure	RC1	RC2
Regular Steel Structure	RS1	RS2
Sloping Concrete Structure	SC1	SC2
Sloping Steel Structure	SS1	SS2

The angle for sloping ground will be taken as 10˚.

4.1 Plan of Model

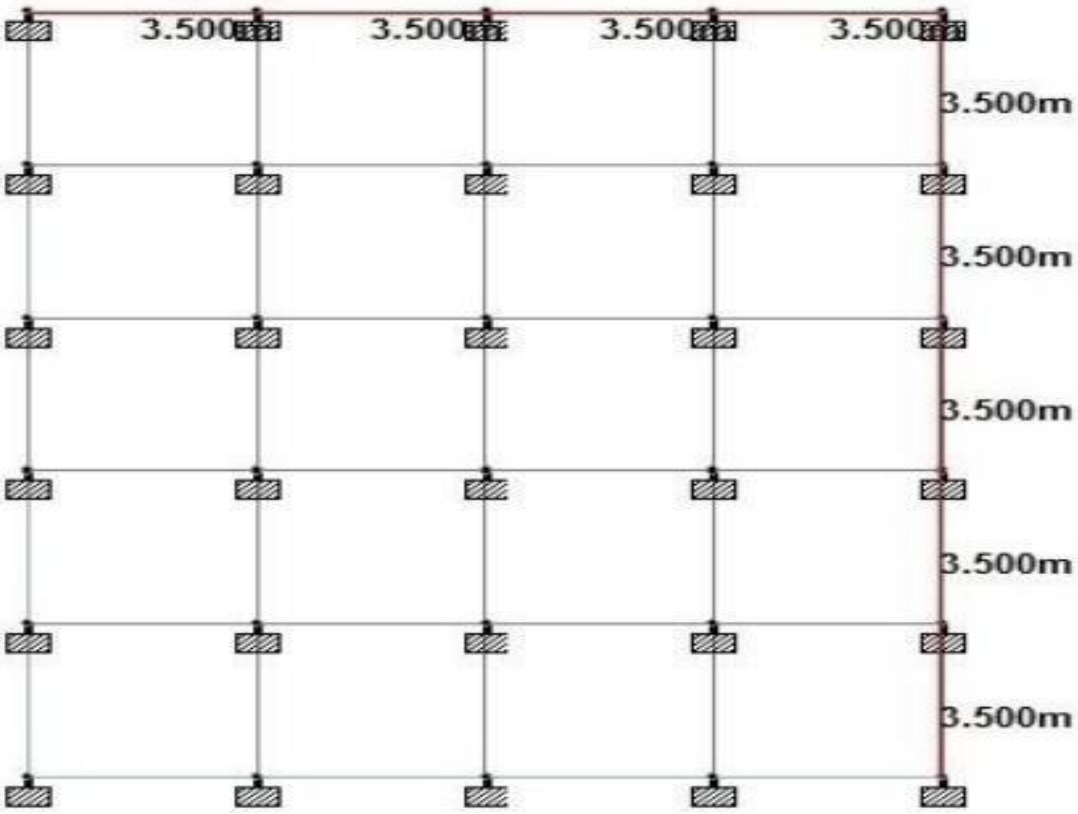
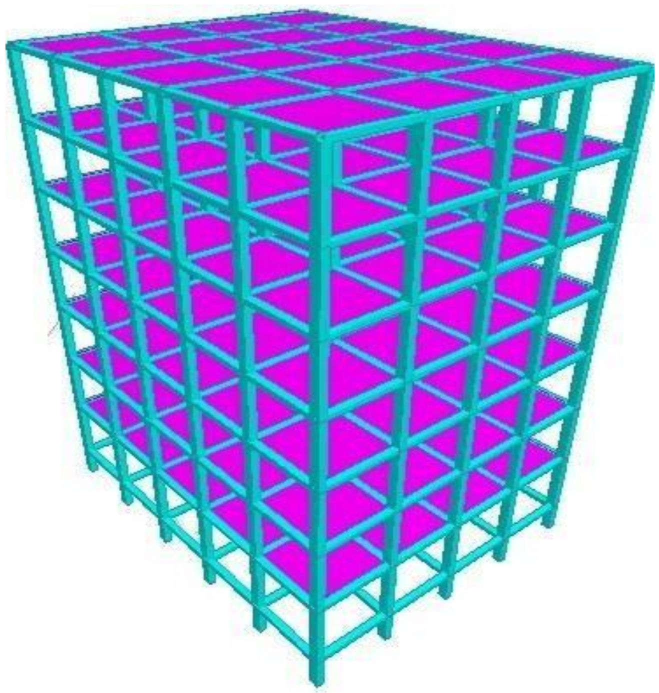


Fig. 4.1 Plan of Model

4.2 3D Views of Models



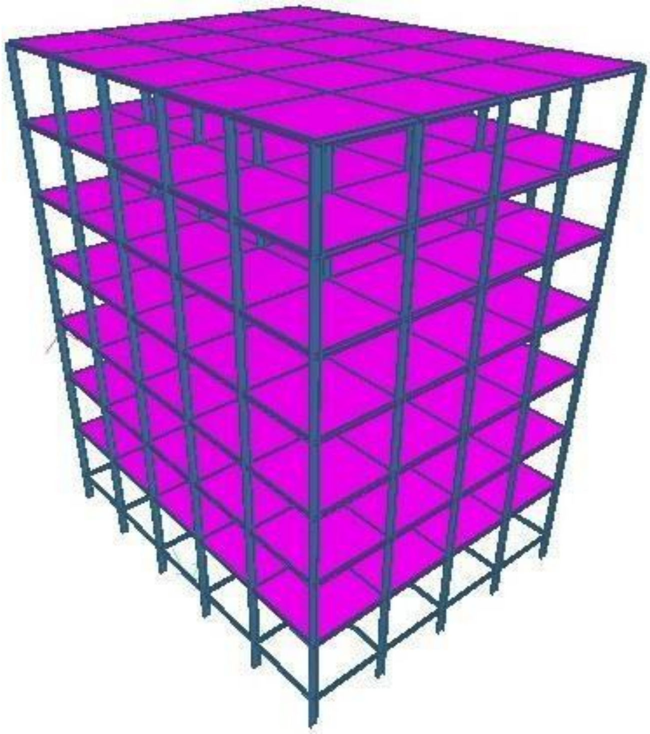


Fig.4.2 (i) 3D View of RCC Regular building

Fig. 4.2 (ii) 3D View of STEEL Regular building

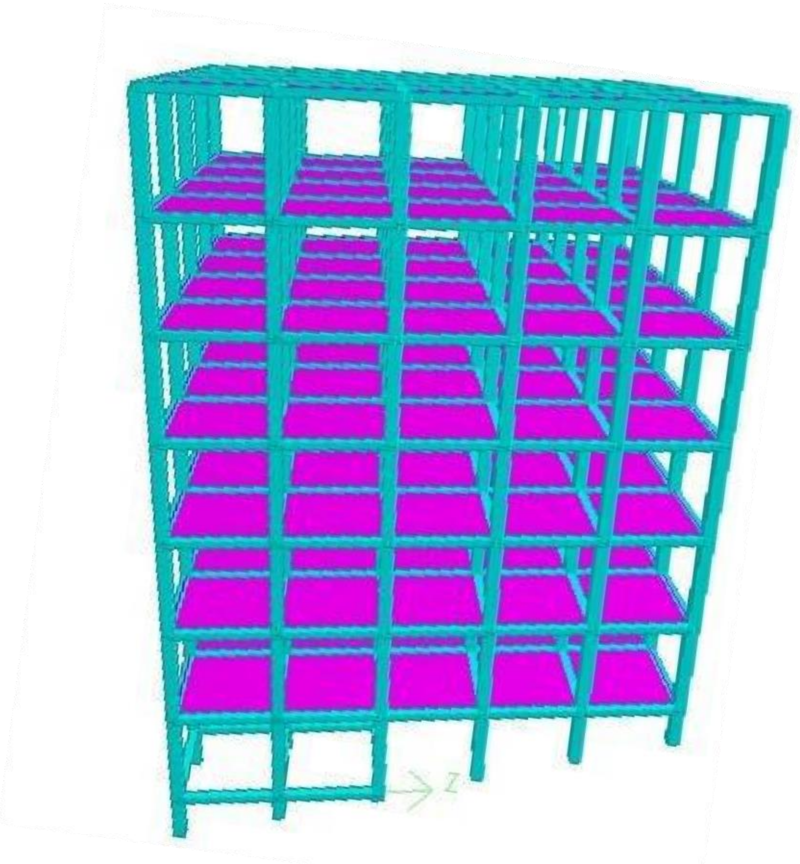


Fig. 4.2(iii) 3D View of RCC sloping building

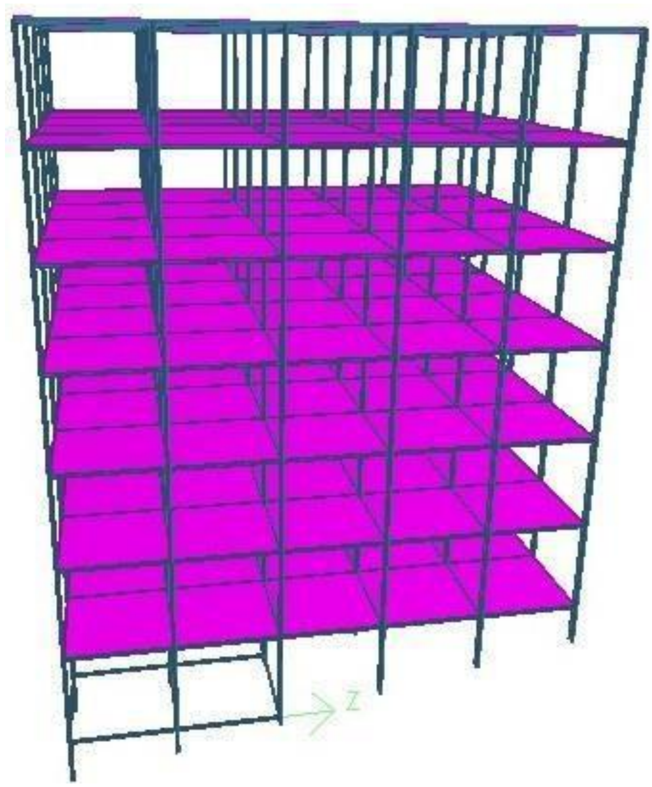


Fig. 4.2(iv) 3D View of STEEL sloping building

5. RESULTS AND DISCUSSION

5.1 Results for all models in Zone-2

5.1.1 Reactions for all models in zone-2

From below graph it can be observed that RCC structure has maximum values of forces in all direction on sloping ground meanwhile it has lowest values in case of plane ground.

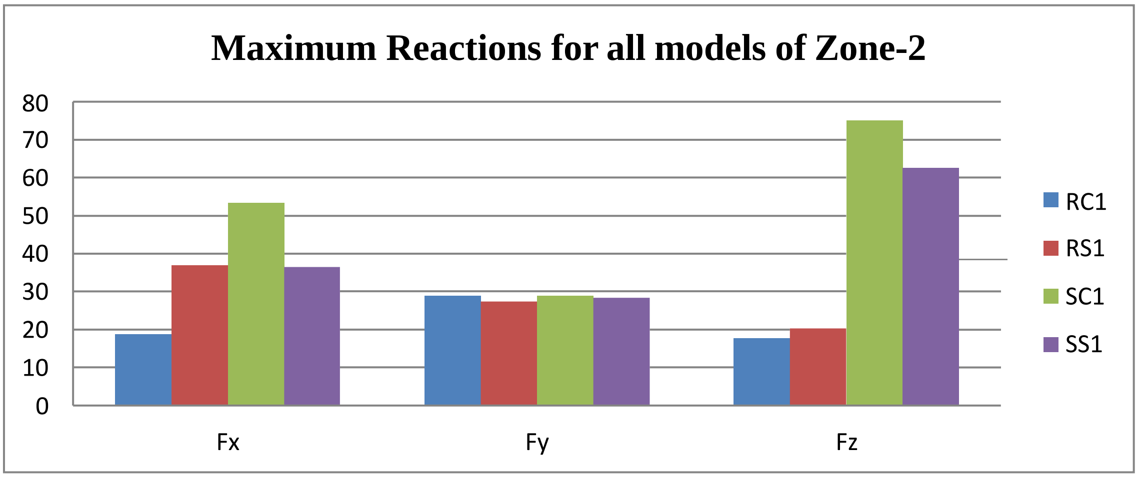


Fig. 5.1.1 Comparison of reactions for all models of zone 2

5.1.2 Mode Frequency and Time Period for all models in zone-2

The graph shows that frequency requirement for steel structures on sloping ground and on plane ground requires less whereas RCC structure has values on higher sides.

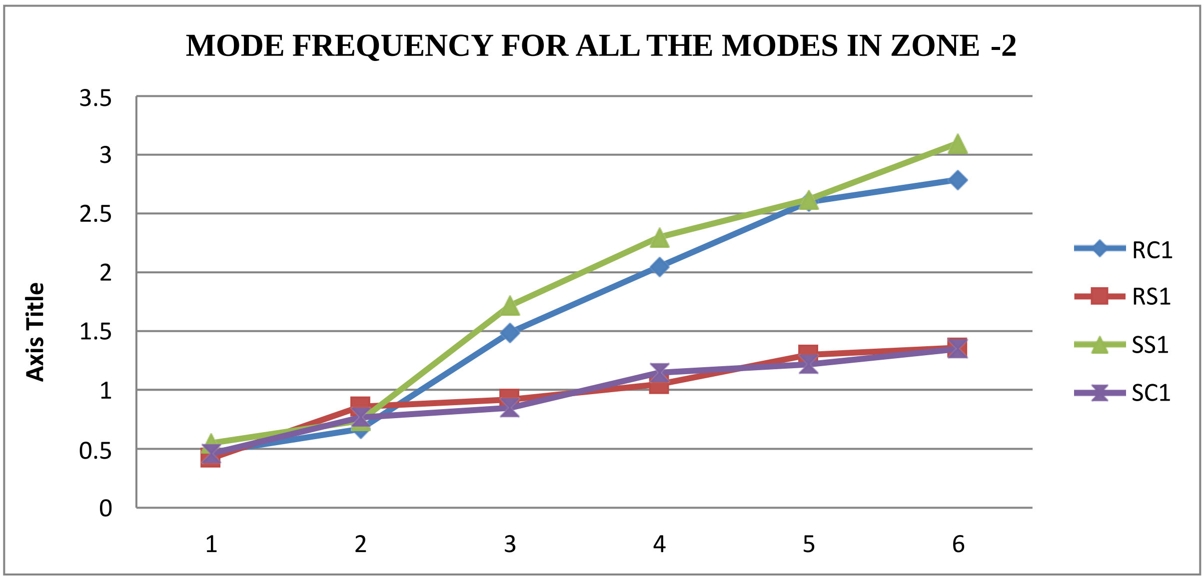


Fig. 5.1.2(a) Comparison of mode of frequency for all models of zone 2

Below graph shows that time period required for RCC structure is less than all others and also shows a linear decrement in requirement of time period from mode 1 to 6. The graphalso shows that steel structures on plane and sloping ground has the high time period thanRCC structures.

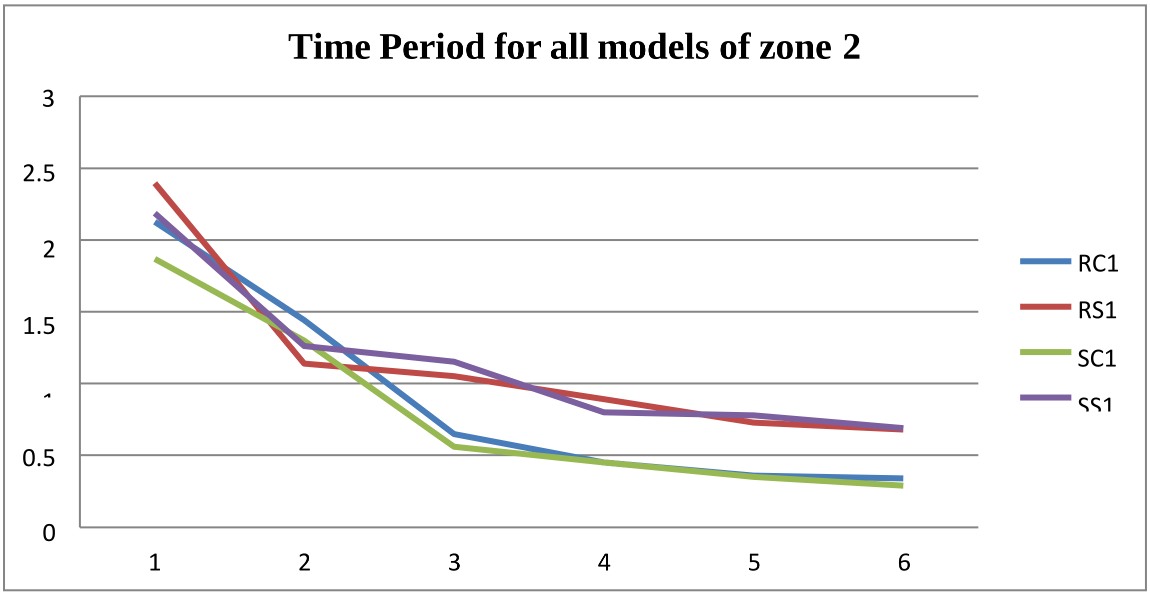


Fig. 5.1.2(b) Comparison of Time Period for all models of zone 2

5.1.3 Displacement for all models in zone-2

Graph shows that steel structures has less displacement in X direction but shows maximum values in Z direction and resultant values. Whereas steel structures on sloping ground has higher values of displacement in but direction but minimizes in Z direction from all this discussion it can be conclude that steel structures are better than RCC structure from displacement point of view.

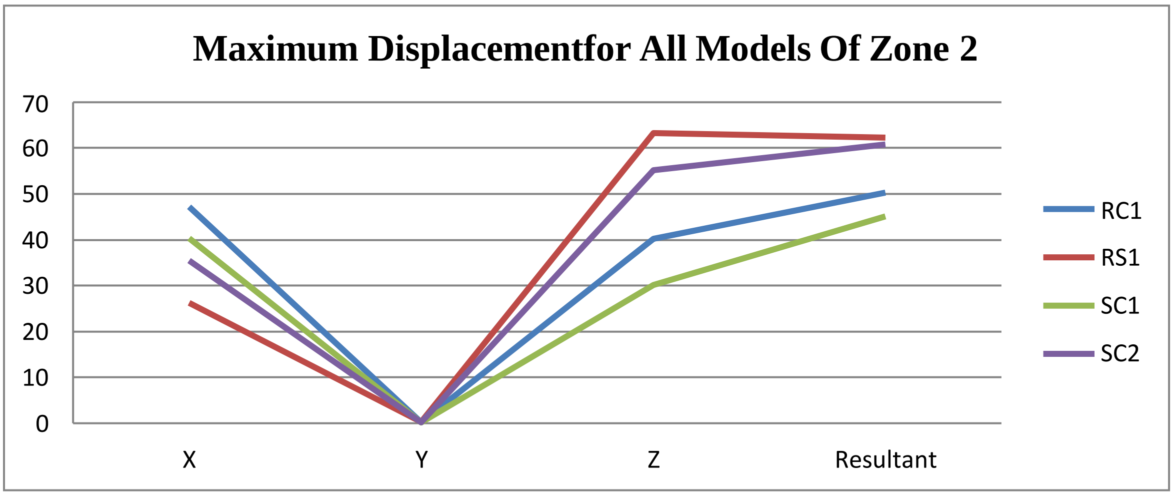


Fig. 5.1.3 Comparison of Maximum Displacement for all models of zone 2

5.1.4 Beam End Forces for all models in zone-2

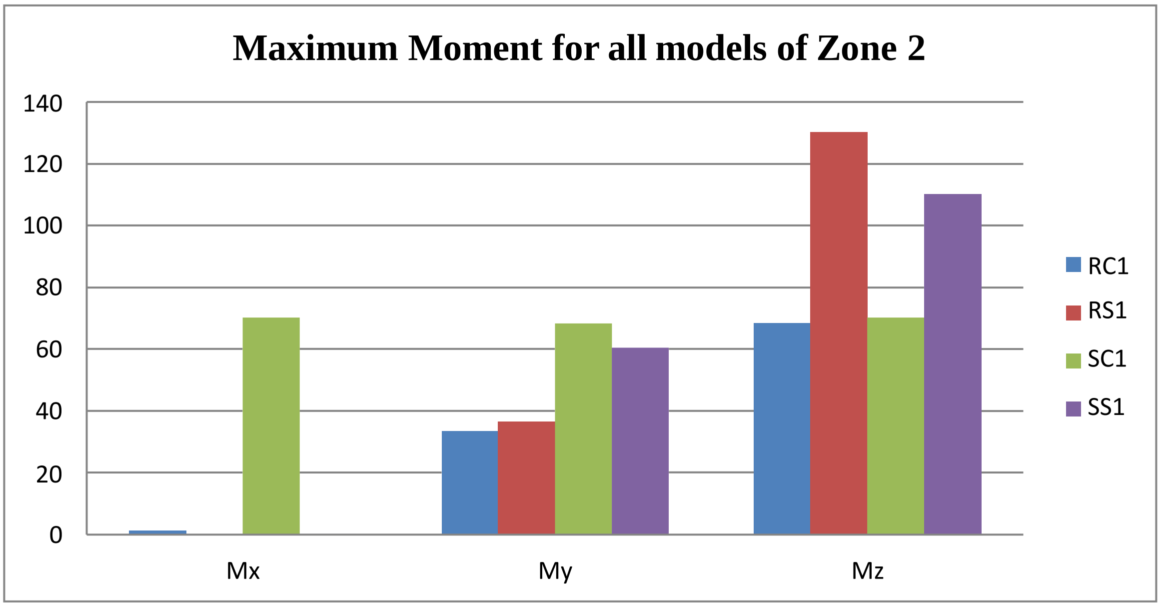


Fig. 5.1.4 Comparison of Maximum Moment for all models of zone 2

Above graph shows that Steel Structures on plane ground and Concrete structures on sloping ground attains maximum values of moment in X, Y, and Z direction all models have negligible values of Mx caused by Mx moment at a particular point.

5.1.5 Base Shear and Storey Shear for all models of Zone-2

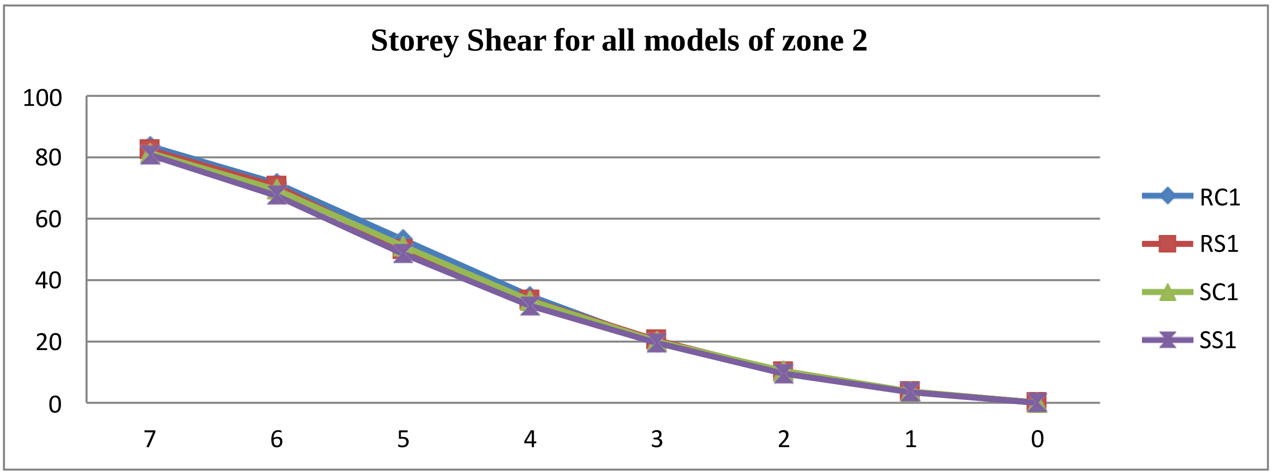


Fig. 5.1.5 Comparison of Storey Shear for all models of zone 2

Though there is variation in Base shear values of all models but Graph of storey shear represents the similar pattern of storey shear and for bottom 3 storey's they are almost coinciding with each others. It can also be seen that base shear are storey shear values are less for steel structure on both plane and sloping ground.

5.1.6 Reactions for all models in zone-5

While comparing reactions in severe zone RCC structures shows higher values of reactions on sloping ground whereas on plane ground Steel structures shows lower values.

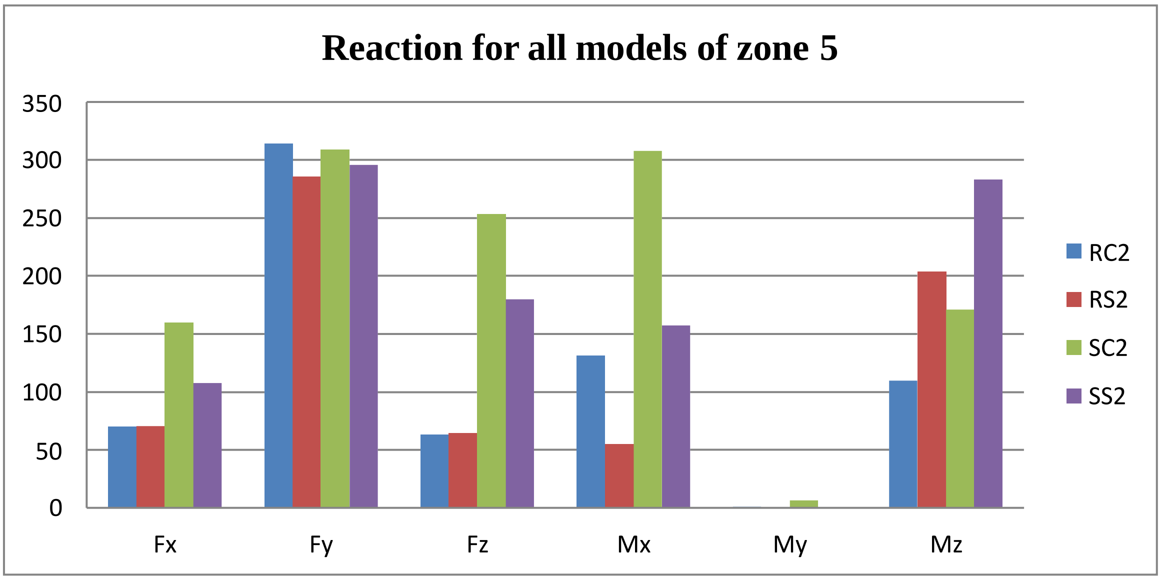


Fig. 5.1.6 Comparison of reactions for all models of zone 5

5.1.7 Mode Frequency and Time Period

Though frequency requirement for RCC structure is same for structures on plane and sloping ground it changes it values for steel structures on plane and sloping grounds. In both case steel structures has lower frequency than RCC structures.

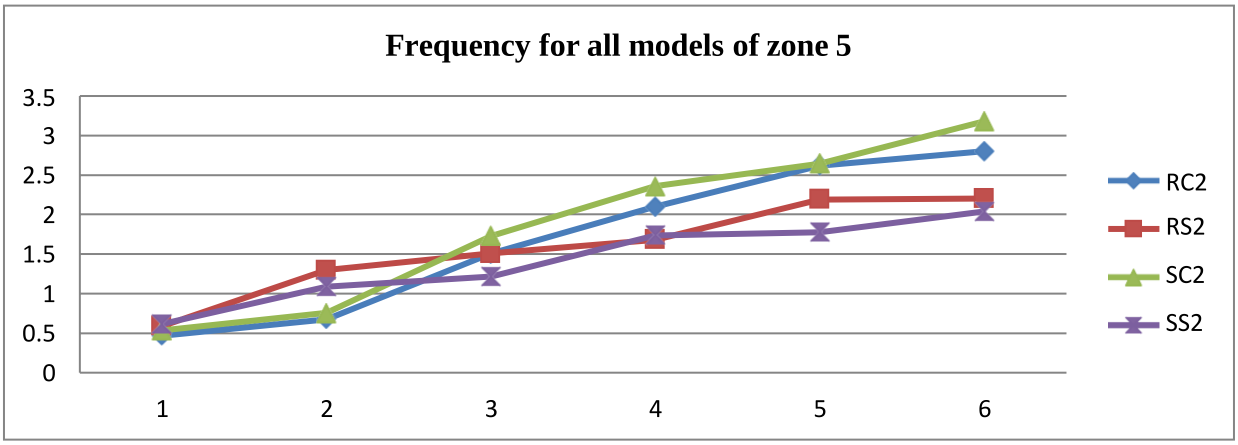


Fig. 5.1.7(a) Comparison of Frequency for all models of zone 5

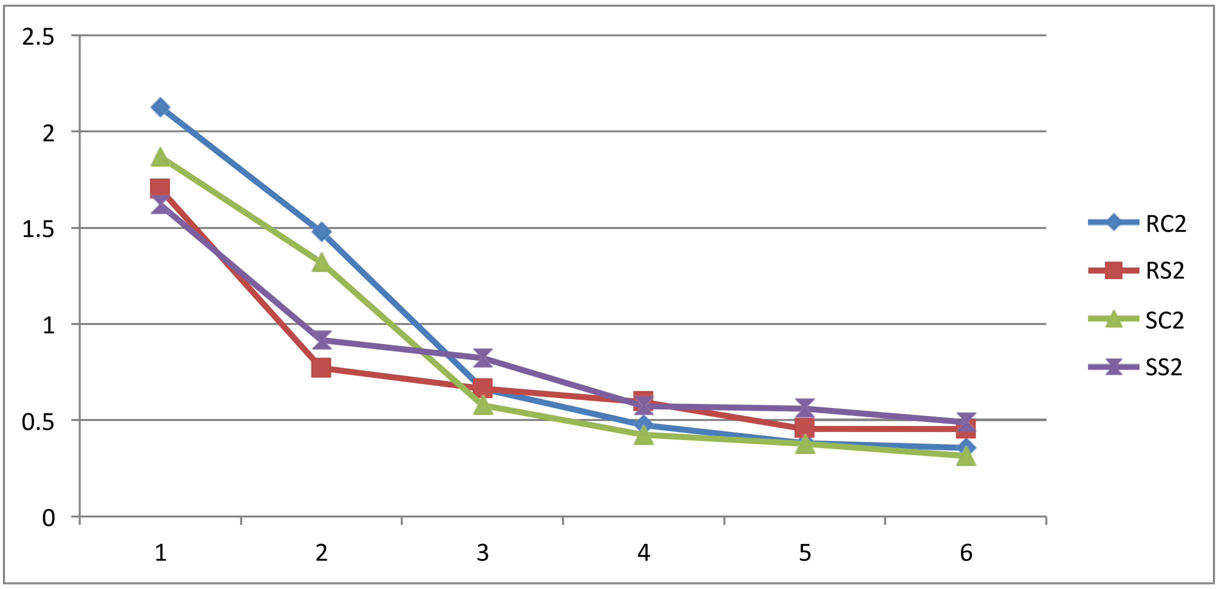


Fig. 5.1.7(b) Comparison of Time Period for all models of zone 5

In above comparative graph time period for steel structures and RCC structures in respective cases are same. RCC structure shows less time period than steel structures. This is might be because of material properties of steel and concrete.

5.1.8 Displacement for all models of Zone-5

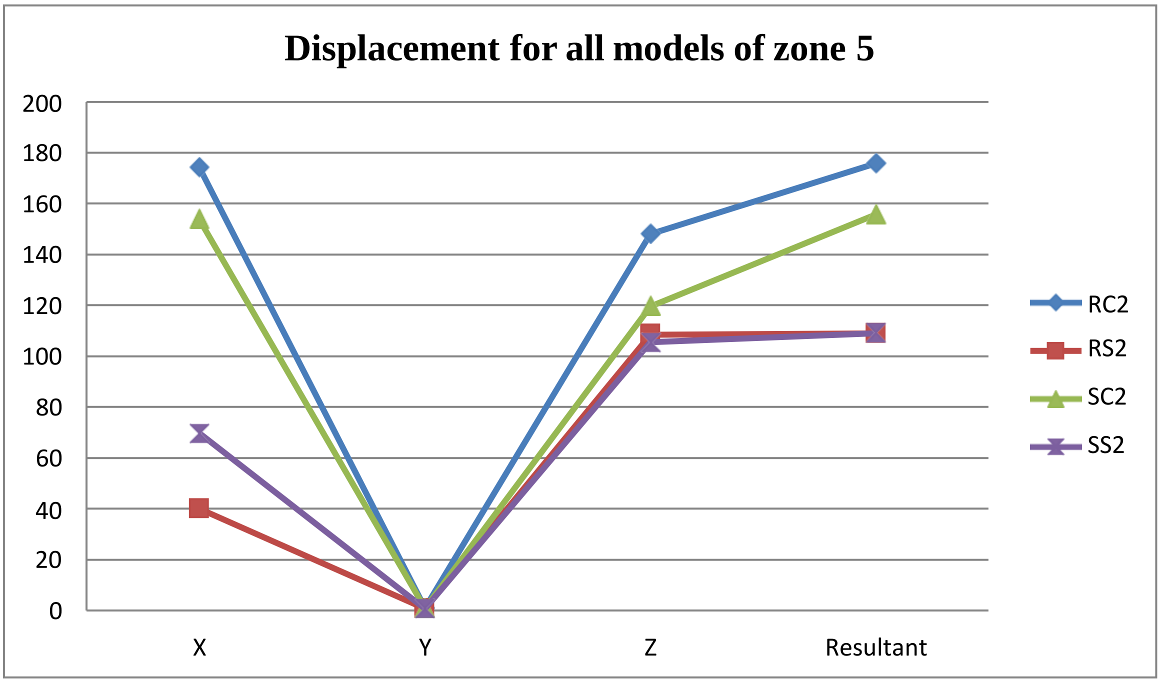


Fig. 5.1.8 Comparison of Displacement for all models of zone 5

In case of displacement values for zone 5 steel structures show comparatively lower values than RCC structures from this it can be concluded that steel structures behaves good in severe zones than RCC structures.

5.1.9 Beam End Forces for all models of Zone-5

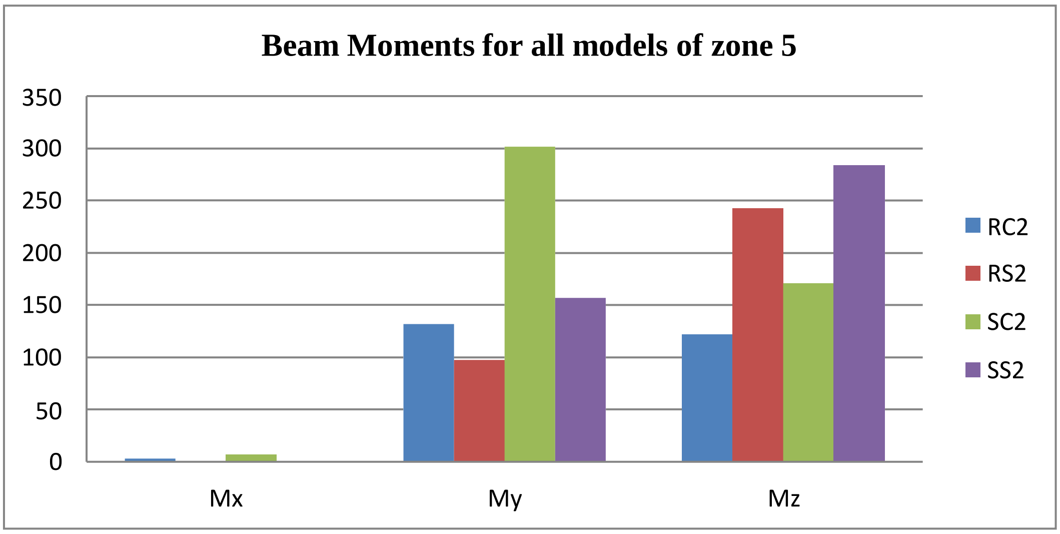


Fig. 5.1.9 Comparison of Beam Moments for all models of zone 5

Moment comparison in severe zone represents higher values of Mx, My for concrete structures on sloping ground while lower values Mz on plane ground. While steel structureshas lowest values on plane ground and highest values for Mz on Sloping ground.

5.1.10 Base Shear and Storey Shear

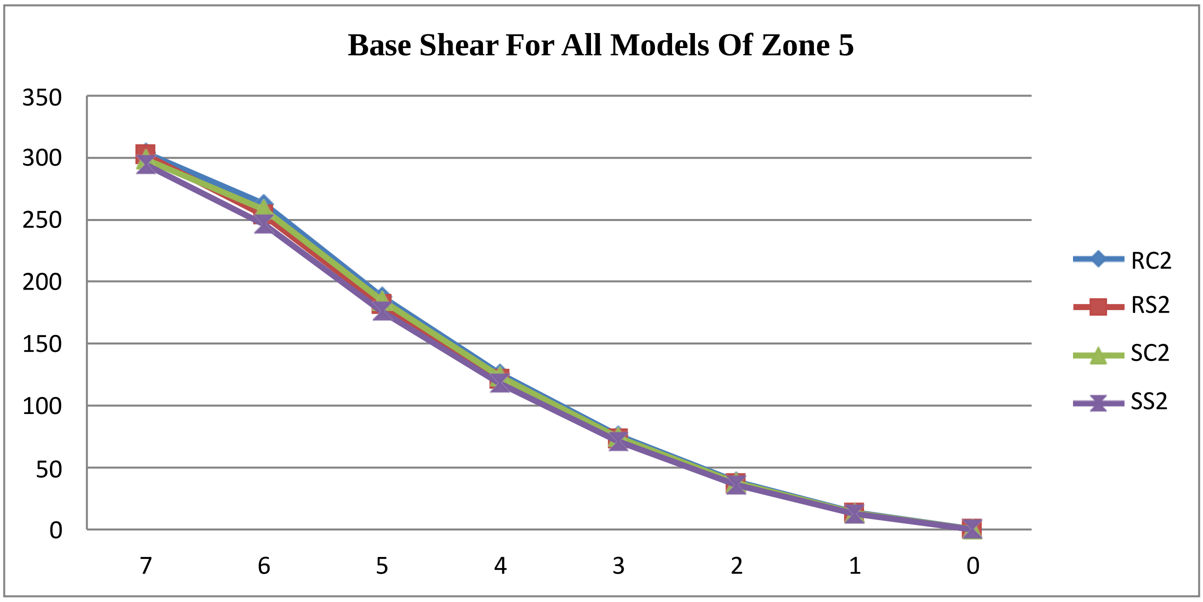


Fig. 5.1.10 Comparison of Base Shear for all models of zone 5

While RCC structure on plane ground shows highest values of Base shear and because of this it is the highest curve amongst all models. So that it can be conclude that steel structures behaves good in both plane and sloping ground in severe zone.

6. CONCLUSION

(a) In low intensity zone and in very severe seismic zone steel structure reduces axial forces than RCC structures on plane ground and also on sloping ground.

(b) In concern with modal frequency and time period RCC structure behave better than steel structures on both plane and sloping ground in low seismic zone but in severe seismic zones steel structure behaves excellent than RCC structure.

(c) In both low and very severe seismic zones steel structures have less displacement values than RCC structures on both plane and sloping ground.

(d) In both low and very severe seismic zones steel structure reduces the intensity of vertical moments than RCC structures but has high values of Horizontal moments.

(e) In both low and very severe seismic zones for the same structural configurations and load- ing conditions steel structure can be designed efficiently and has comparatively lowervalue of Seismic base shear.

(f) At last from all above conclusions it can be concluded that steel structures are efficient and better in both low and very severe seismic zones in any type of ground conditions.

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