Seismic Influence of Homogeneous Soil on RCC Building

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ABSTRACT

Soil stiffness plays an important role in static as well as dynamic response of structure. Hence evaluation of the site specific effect of soil stiffness on structure becomes important to understand behavior of structure. G+3 story building is analyzed considering soil base. Soil data of 6 areas of Ahmedabad are collected and classified as hard, medium and soft soil. Three earthquake time history are used and linear time history analysis is carried out. Roof displacement, bending moment and torsion of column of structure is compared. ABAQUS is used for the analysis tool.

Keyword: - *RCC Frame, Homogeneous soil, SSI, ABAQUS*

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1. INTRODUCTION

Structure is usually analyzed and designed assuming fixed support at the foundation level and by assuming fixed base the effect of compressibility of soil under the foundation is ignored. The structure designed and analyzed in such a way does not present the actual or realistic behavior. In reality the structure is supported on compressible soil mass. There is interaction between structure and soil mass below foundation. The flexibility of foundation and the compressibility of soil mass play an important role in the redistribution of moments and shear forces in the superstructure because of differential settlement of soil mass.

2. SOIL PROPERTY AND BUILDING DIMENSION

2.1 Elastic properties of soil and density.

TABLE 1 SOIL PROPERTIES

Soil	Density (kN/m^3)	Modulus of elasticity (kN/m^2)
Hard	22.31	24469472.27
Medium	18.00	5003388.19
Soft	17.36	1644208.42

2.2 Building dimension

Height of building above GL	: 12 m
Plan dimension	: 20m in X
	15m in Y
Column dimension	: 0.45m x 0.45m
Typical storey beam dimension	: 0.575m x 0.23m
Ground level beam	: 0.45m x 0.23m

Dead load, live load and earthquake loads are considered according to IS: 875 and IS: 1893.Also soil is classified in Hard, Medium and Soft according to SPT corrected N value. N value less than 10 is considered as soft soil. N value from 10 to 30 is considered as medium soil. N value greater than 30 is considered as hard soil.

3. MODELLING

Soil is modeled as homogeneous elastic half space. For homogeneous elastic half space modulus of elasticity and density of soil is used as shown in table 1. For the modeling soil depth is considered 30m which is 1.5 times the total width of building. The width of soil is 50m which is 2.5 times of total width of building. Fix boundary condition is used.

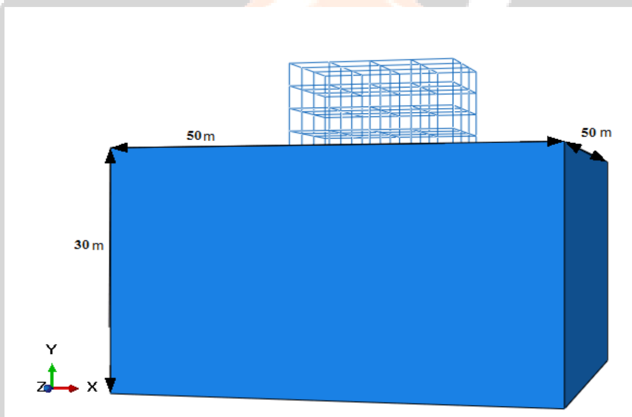

Figure 1 Soil-building model

Modal time history analysis carried out using ABAQUS with fixed base, homogeneous soil base building. Earthquake records used in time history analysis are Bhuj (2001), Kobe (1995) and LomaPrieta (1989). Direction for earthquake force is positive x. PGA for LomaPrieta, Kobe and Bhuj are 0.3341g, 0.2668g and 0.11g respectively.

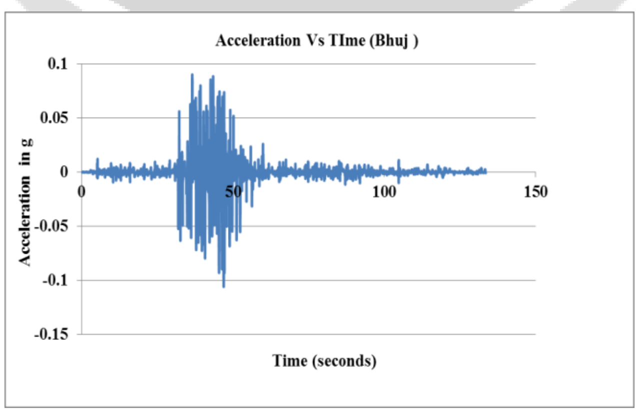

Figure 2 Ground acceleration for Bhuj

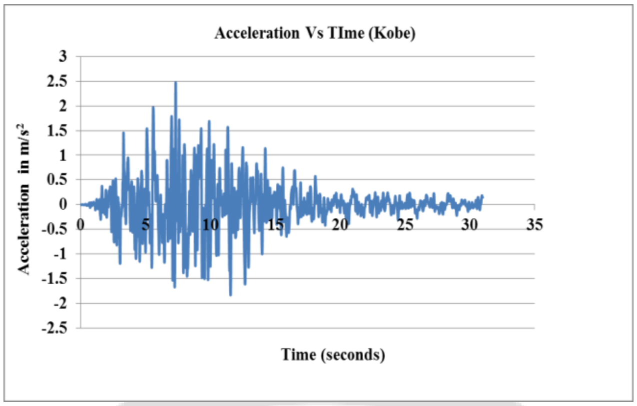

Figure 3 Ground acceleration for Kobe

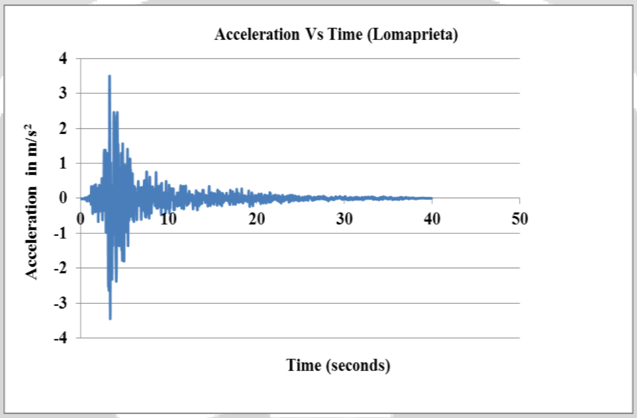

Figure 4 Ground acceleration for Lomaprieta

4. RESULTS AND DISCUSSION

Modal time history analysis carried out using ABAQUS with fixed base, homogeneous soil base building. Earthquake records used in time history analysis are Bhuj (2001), Kobe (1995) and LomaPrieta (1989). Direction for earthquake force is positive x.

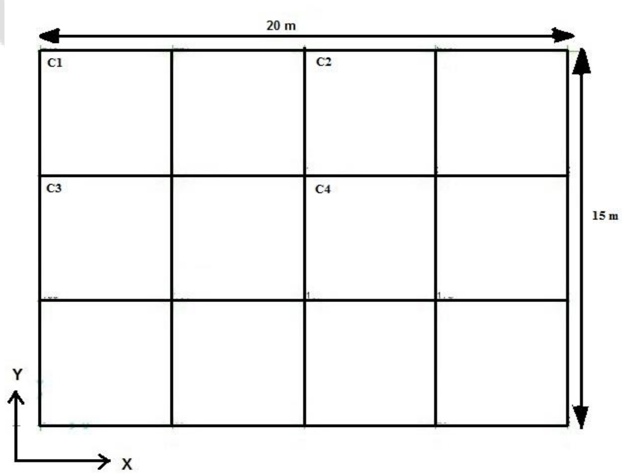

Figure 5 Plan of building

4.1 Maximum moments in column C1 and C4

Two columns are selected as shown in figure 5 for comparison.

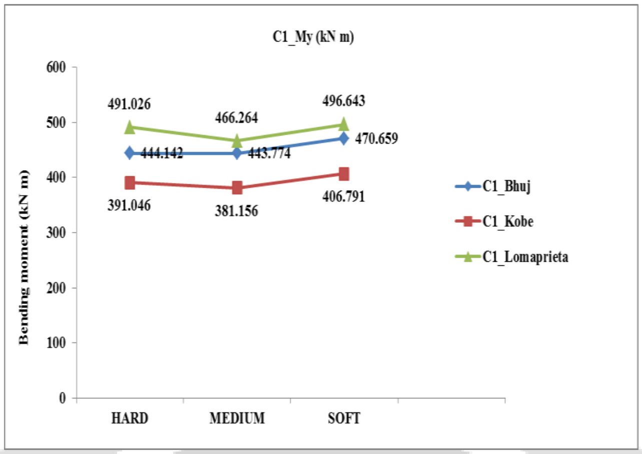

Figure 6 C1 column BM in kN m

Bending moment of column C1 is decreased 5.04% for medium soil and increased 1.14% in soft soil for Lomaprieta earthquake compare to hard soil. Bending moment of column C1 is decreased 0.08% for medium soil and increased 5.97% in soft soil for Bhuj earthquake compare to hard soil. Bending moment of column C1 is decreased 2.52% for medium soil and increased 4% in soft soil for Kobe earthquake.

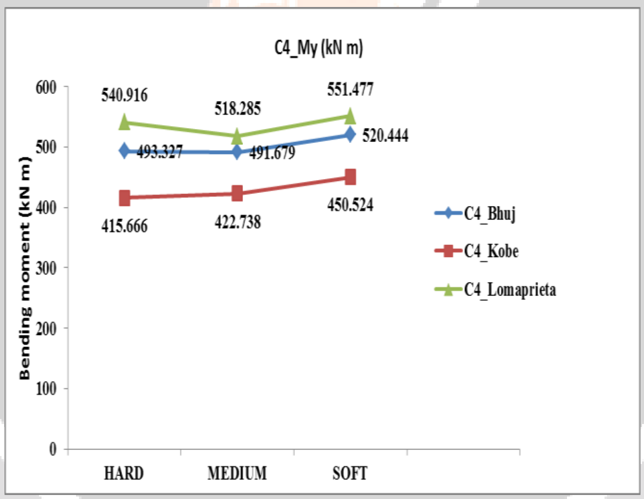

Figure 7 C4 column BM in kN m

Bending moment of column C4 is decreased 4.18% for medium soil and increased 1.95% in soft soil for Lomaprieta earthquake compare to hard soil. Bending moment of column C4 is decreased 0.33% for medium soil and increased 5.49% in soft soil for Bhuj earthquake compare to hard soil. Bending moment of column C4 is increased 1.70% for medium soil and increased 8.38% in soft soil for Kobe earthquake compare to hard soil.

4.2 Torsion of column C1 and C4

Torsion in column C1 is decreased 74.87% for medium soil and decreased 72.44% in soft soil for Lomaprieta earthquake compare to hard soil. Torsion in column C1 is decreased 37.15% for medium soil and decreased 33.45% in soft soil for Bhuj earthquake compare to hard soil. Torsion in column C1 is increased 65.80% for medium soil and decreased 63.26% in soft soil for Kobe earthquake compare to hard soil.

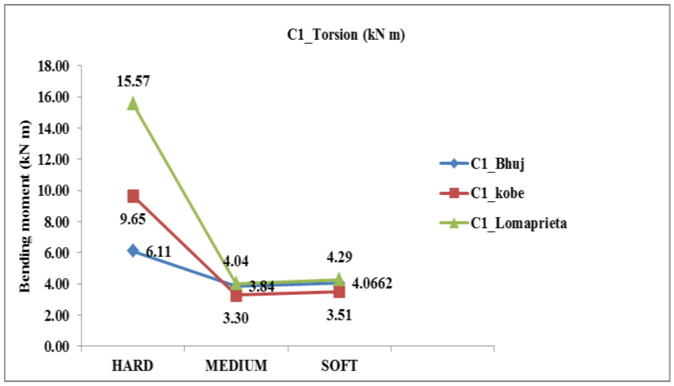

Figure 8 Torsion in C1 column in kN m

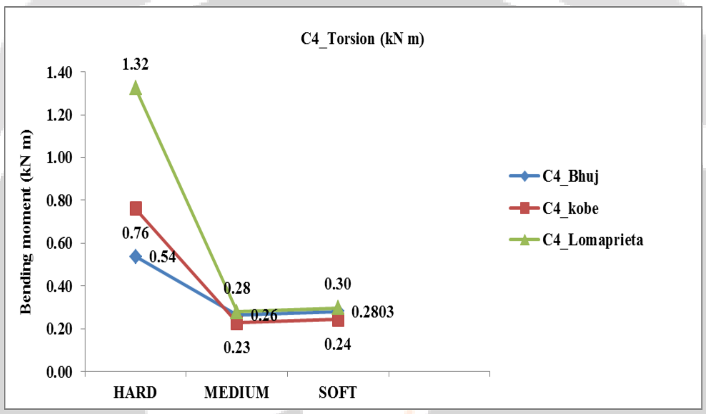

Figure 9 Torsion in C4 column in kN m

Torsion in column C4 is decreased 78.78% for medium soil and decreased 77.27% in soft soil for Lomaprieta earthquake compare to hard soil. Torsion in column C4 is decreased 51.85% for medium soil and decreased 48.09% in soft soil for Bhuj earthquake compare to hard soil. Torsion in column C4 is increased 72.60% for medium soil and decreased 68.42% in soft soil for Kobe earthquake compare to hard soil.

4.3 Maximum roof displacement

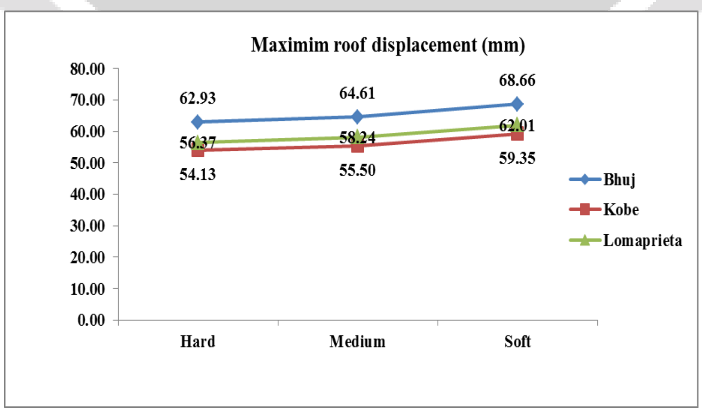

Figure 10 Roof Displacements in mm

Roof displacement is increased 3.31% for medium soil and increased to 10% in soft soil for Lomaprieta earthquake compare to hard soil. Roof displacement is increased 2.66% for medium soil and increased 9.1% in soft soil for Bhuj earthquake compare to hard soil. Roof displacement is increased 2.53% for medium soil and increased 9.64% in soft soil for Kobe earthquake compare to hard soil.

5. CONCLUSION

- Bending moment in corner and central columns is highest in soft soil. But the increment is more in corner column than central column.
- Torsion in corner column is highest in hard soil. But between medium and soft soil the torsion is higher in soft soil.
- Roof displacement is highest in soft soil.

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