Evaluation of Soil-Structure Interaction Effects on Multistory RCC Building Considering Static and Dynamic Analysis

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Abstract - *As the world move to the accomplishment of Performance Based engineering philosophies in seismic design of Civil Engineering structures, new seismic design provisions require Structural Engineers to perform both static and dynamic analysis for the design of structures. While Linear Equivalent Static Analysis is performed for regular buildings up to 90m height in zone I and II.Dynamic Analysis should be performed for regular and irregular buildings in zone IV and V. Dynamic Analysis can take the form of a linear Response Spectrum Analysis. In present study, Multi-storey regular buildings with 11 stories have been modeled using software packages ETABS for seismic zone IV and V in India. This paper also deals with the effect of the variation between rigid base and flexible base for different parameters. This paper highlights the effect of rigid base and flexible base considering Response Spectrum Analysis and Equivalent Static Analysis on bare frame is studied.*

Key Words: **bare frame, rigid base (fixed base), flexible base, natural period, base shear etc.**

1. INTRODUCTION

STRUCTURAL design of buildings for seismic loads is Primarily concerned with structural safety during major ground motions, but serviceability and the potential for economic loss are also of concern. Seismic loading requires an understanding of the structural performance under large inelastic deformations. Structural design of buildings for seismic loads is primarily concerned with structural safety during major ground motions, but serviceability and the potential for economic loss are also of concern. Seismic loading requires an understanding of the structural performance under large inelastic deformations. Behavior under this loading is fundamentally different from wind or gravity loading, requiring much more detailed analysis to assure acceptable seismic performance beyond the elastic range. Some structural damage can be expected when the building experiences design ground motions because almost all building codes allow inelastic energy dissipation in structural systems. The first step in dynamic analysis is to Develop a mathematical model of the building, through which estimates of strength, stiffness, and mass and inelastic member properties are assigned. In general, for a multistory building it is necessary to take into account contributions from more than one mode.

Soil-structure interaction (SSI) effect is analyzed by considering flexible (spring based base) and effects are compared with rigid base (considering fixed base effect). SSI is nothing but the soil-structure interaction refers to the effects of the supporting foundation medium on the motion of structure. This effect is mostly considered in severe seismic zones and foundation lying on soft soil.

The main objective of this paper is to study the seismic Behavior of concrete reinforced building and also, analysis of structure by using equivalent static method and response spectrum method has been surveyed for rigid base and flexible base.

The storey displacements, natural period, base shear, axial forces in column result have been obtained by using both static and dynamic analysis. The pertaining structure of 11 stories residential building has been modeled. The storey plan is symmetric in the floors. The building has been analyzed by using the equivalent Static, response spectrum analysis based on IS codes; the results obtained are compared eventually to determine the structural performance.

1.1 METHOD OF ANALYSIS OF STRUCTURE

A. Equivalent Static Analysis

All design against seismic loads must consider the dynamic nature of the load. However, for simple regular structures, analysis by equivalent linear static methods is often sufficient. This is permitted in most codes of practice for regular, low- to medium-rise buildings. It begins with an estimation of base shear load and its distribution on each story calculated by Using formulas given in the code. Equivalent static analysis can therefore work well for low to medium-rise buildings without significant coupled lateraltorsional modes, in which only the first mode in each direction is considered. Tall buildings (over, say, 75 m), where second and higher modes can be important, or buildings with torsional effects, are much less suitable for the method, and require more complex methods to be used in these circumstances.

B.Responce Spectrum Method

The representation of the maximum response of idealized single degree freedom system having certain period and damping during earthquake ground motions. The maximum response plotted against of undamped natural period and for various damping values and can be expressed in terms of maximum absolute acceleration, maximum relative velocity or maximum relative displacement. For this purpose response spectrum case of analysis have been performed according to IS 1893.

2. DETAILS OF THE MODEL

The pertaining structure of 11 stories of residential building with general form of plan and Isometric view shown in the figure no-1 and 2.the height of first floor is 1.5m and other floor is 3m .the plan dimensions in the X and Y directions are 3.2mX3.2m respectively and it is of 3 bays. The loading which applied in this structure including dead, live and earthquake loads are according to IS 875 part I and II and IS 1893 respectively. The floor slab is taken as 150 mm thick .the wall are 150mm thick. The seismic zones are IV and V.The foundation soil is Soft soil.

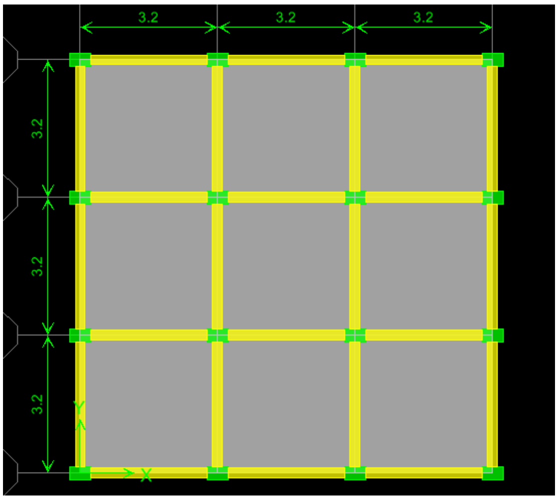

Figure no 1: Plan of the Model

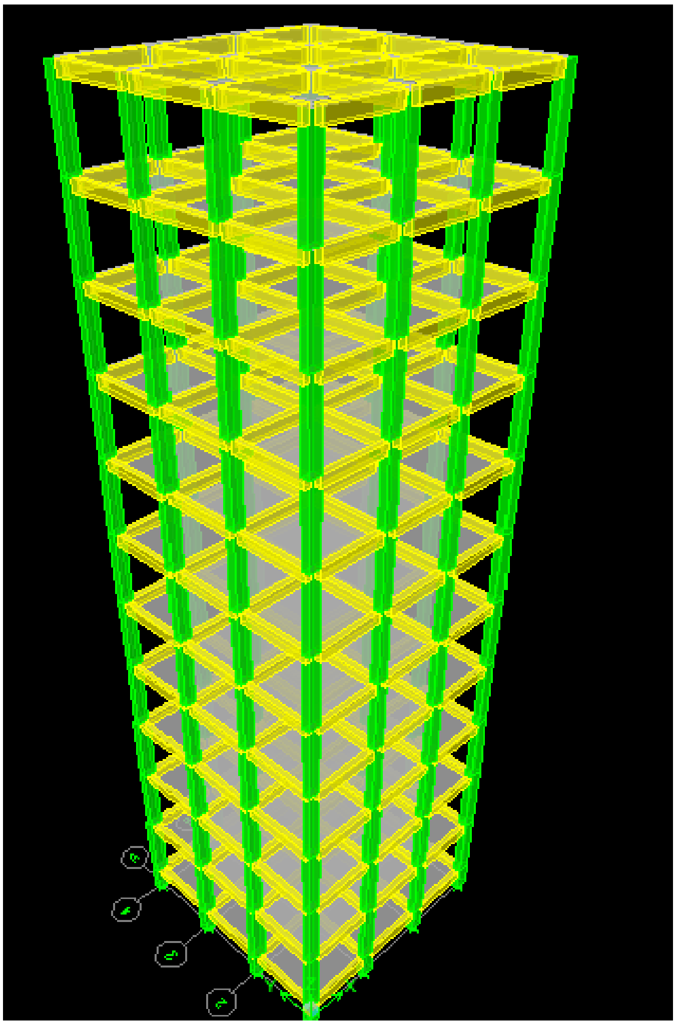

Figure No-2: Isometric view of the Model

3. Analysis result

As the results trend remains same for both seismic zones IV and V for soft soil.
We have presented results for only seismic zone V in following table for different parameters.
Table No-1: Analysis Results for G+11 Span 3.2m

		Static analysis		Dynamic analysis	
		FIXED	FLEXIBLE	FIXED	FLEXIBLE
Natural Period(Sec)		2	2	2.01	2.34
Base Shear In (KN)	EQ_X	822	668	651	562
	EQ_y	667	568	552	502
Top storey Displacement(mm)		50	60	30	50
Corner Column	(P_u) KN	2171	2272	401	2076
	(M_u) KNm	154	204	9.5	178
Center Column	(P_u) KN	2492	2392	2270	2221
	(M_u) KNm	58	71	53	66

4. CONCULSION

We have performed both static and dynamic analysis on fixed and flexible base and then we made comparison in between them.

A) Comparison Between Fixed And Flexible Base

1) The natural period for flexible base is increases than fixed base (rigid base).
2) The base shear for flexible base decreases as compared to fixed base.
3) The values of storey displacement in case of flexible base it increases than fixed base.
4) The axial forces and bending moment in corner column is increases for flexible base as compared to fixed base.
5) In case of center column axial forces and bending moment in column are less in case of flexible base as compared to fixed base.

B) Comparison Between Static and Dynamic analysis for Fixed And Flexible Base

1) The value of natural period is increases for fixed as well as flexible base for dynamic analysis than static analysis.
2) The values of base shear is reduces for fixed and flexible base for dynamic analysis than static analysis.
3) By performing dynamic analysis the values of top storey displacement is reduces for both fixed and flexible base than by doing static analysis.
4) By performing dynamic analysis the values of axial forces and bending moment in column for both corner and central reduces for both fixed and flexible base than by performing static analysis.

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