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COMPARATIVE STUDY OF SEISMIC ANALYSIS OF 3-STOREY RC FRAME

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***Abstract*— This paper deals with the study of static and dynamic analysis of 3 Storey RC Frame, to study various parameters involved in seismic analysis. Structure on earth is generally subjected to two types of load: Static and Dynamic. Static loads are constant with time while dynamic loads are time varying. In general, the majority of civil engineering structures are designed with assumption that all applied loads are static. The effect of dynamic load is not considered because the structure is rarely subjected to dynamic loads; more so, its consideration in analysis makes the solution more complicated and time consuming. The present report represents the analysis of structure by equivalent static method and response spectrum method for finding out the seismic loads using SAP-2000. For validation of SAP-2000 the comparison between manual analysis results of equivalent static method is made with SAP-2000 result for base shear. The building consists of 4@5m each bay in X-Direction and 3@5m bay in Y-Direction. The seismic forces are calculated as per IS:1893(part 1):2002.The main objective of this paper is to study the seismic behavior of reinforced concrete building.**

***Index Terms*—Response spectrum method, Equivalent static method.**

I. *Introduction*

At present people are facing problems of land scarcity, cost of land. The population explosion and advent of industrial revolution led to the exodus of people from villages to urban areas i.e. construction of multi-storied buildings has become inevitable both for residential and as well as office purposes. Thus due to spiralling rise in cost of land, tall structures are being constructed in present day. These multi-storey high structures require a small size of costly land and provide required floor area. The analysis of high rise building is quite complicated in view of large number of redundant involve. There are different methods by which a frame of multi-storey can be analysed, and the design of such frame is affected more by lateral loads than by gravity forces. Tall buildings are generally those buildings whose lateral dimension are less than or comparable to height of structure. If the high raised structures are not properly designed for the resistance of lateral forces. It may cause to the complete failure of the structures and may loss human life also.

1.1 What earthquakes do?

loss of life and injury, Loss of housing, Damage to infrastructure, Disruption of transport and communications, Breakdown of social order, Loss of industrial output, Loss of business, Disruption of marketing systems, Deaths and injuries. Because of all difficulties mention above it is necessary to design structure earthquake resistant.

2. METHODS OF ANALYSIS OF STRUCTURE

The seismic analysis should be carried out for the buildings that have lack of resistance to earthquake forces. Seismic analysis will consider dynamic effects hence the exact analysis sometimes become complex. However for simple regular structures equivalent linear static analysis is sufficient one. This type of analysis will be carried out for regular and low rise buildings and this method will give good results for this type of buildings. Dynamic analysis will be carried out for the building as specified by

code IS 1893-2002 (part1). Dynamic analysis will be carried out either by Response spectrum method or site specific Time history method. Following methods are adopted to carry out the analysis procedure.

2.1 Equivalent static analysis

The seismic design of buildings fallows the dynamic nature of the load. But equivalent static analysis would become sufficient for simpler, regular in plan configuration and it will give more efficient results. This analysis will flow in a manner with the calculation of design base shear and its distribution to all storey's by using the formula as given in code.

2.2 Response spectrum method

The representation of maximum response of idealized single degree freedom system having certain period and damping, during earthquake ground motions. This analysis is carried out according to the code IS 1893-2002 (part1). Here type of soil, seismic zone factor should be entered from IS 1893-

2002(part1). The standard response spectra for type of soil considered is applied to building for the analysis in SAP2000 software.

3.Objective Of Studies

To analyze the building as per code IS 1893-2002 part I

To study the response of the structure such as base shear and lateral displacement.

To study metods of earthquake analysis
(Equivalent static and Response spectrum method)
To study seismic analysis of frame by SAP

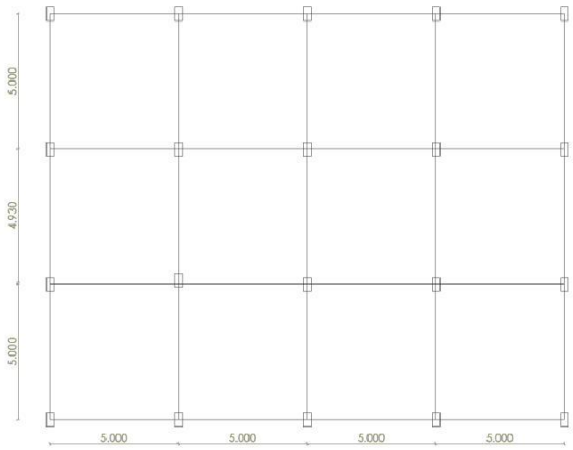
4.DETAILS OF THE MODELS

The buildings that are considered for the analysis have been modeled inSAP2000 software.

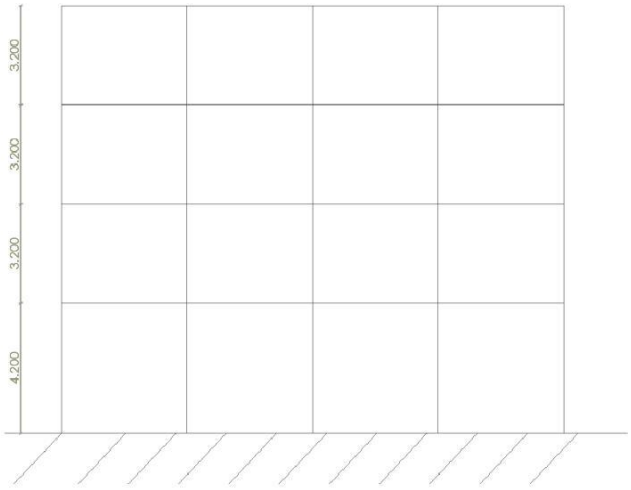
For the present work, 3 storey building with storey height 3 m is taken.

Building has 4 bays of 5 m in X and 3bays

of 5m inY directions. For buildings the modeling has been made according to IS code.



PLAN



ELEVATION

5. Building Description

SR.No.	Particulars	Reinforced concrete building
1.	Plan dimension	20mx15m
2.	Height of building	3m
3.	Grade of steel	Fe415
4.	Gradeof concrete	M25
5.	No. of storey	3
6.	Beam size	230mmX350mm
7.	Column size	300mmX500mm
8.	Soil type	Medium(II)
9.	Seismic zone	V

RESULTS

TABLE I: COMPARISON OF STOREY DISPLACEMENT BT ESM

Comparison of story displacement in each floor by equivalent static method is as follows:

Story level	Displacement (Manual in mm)	Displacement (SAP in mm)	Displacement (%)
4	0.052469	0.050533	0.036897
3	0.044383	0.042554	0.041209
2	0.0131142	0.024788	-0.890164
1	0.015023	0.014306	0.0477268

TABLE II: COMPARISON OF BASE REACTION IN ESM

Comparison of base reaction in equivalent static analysis is as follows:

Sr No.	Manual Shear (KN)	Base Shear in SAP (KN)
1	1269.64	1282039

TABLE III: COMPARISION OF STORY DISPLACEMENT IN ESM & RSM

Comparison of Equivalent static method and Response spectrum method with respect to story displacement are given below:

Story Level	Displacement by ESM in mm as per SAP	Displacement by RSM in mm as per SAP
4	0.050533	0.043112
3	0.042554	0.037057
2	0.029788	0.026739
1	0.014306	0.013248

TABLE IV: COMPARISON OF BASE REACTION IN ESM & RSM

Comparison of Equivalent static and Response spectrum method with respect to base reaction are given below:

Sr.No	Base shear by ESM in SAP (KN)	Base shear by RSM in SAP (KN)
1	1282039	1275.628

7. CONCLUSION

From the above study, following conclusion are made:

- Equivalent static method is simpler than Response Spectrum method.
- SAP results by Equivalent static and Response spectrum method are nearly same.
- The results obtained from static analysis method shows lesser storey displacement values as compared to response spectrum analysis.
- Manual and SAP result of story displacement,base reaction of Equivalent Static method are approximately same.
- Response spectrum of irregular and multistory buiding is very tedious work but for the analysis of any type of building this method can be preffered to get better results.
- Response spectrum method results are more accurate than Equivalent static method.
- As result of comprising between two mentioned analyses it is observed that the displacement obtained by static analysis & is nearly equal to results of dynamic analysis.
- Static analysis is not sufficient for high-rise building and it is necessary to provide dynamic analysis.

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