Study on Seismic Analysis And Design Of R.C.C. Building With Soft Storey At Different Level In Different Zones

Mr. Shubham Andhare[1], Prof. Suryawanshi Y.R.[2]
[2] Lectuter
[1, 2] JSPM's ICOER, Wagholi, Pune, India.

Abstract- *Now a day's growth of Multi-story building is very high because of rapid urbanization all over the world. Availability of land is minimum due to population, so people tends to construct the multi-story building in earthquake prone area also. In soft-story buildings the relative stiffness of the soft-story, typically the bottom story, is significantly less than upper stories due to the presence of large openings which reduce the available space for lateral force resisting system components such as shear walls. Due to increase in population, parking spaces is big issue for the apartments in the cities. Hence new trend for utilize the ground storey for a parking. Also for office spaces or conference hall etc, soft story at different levels of structure are constructed. In the past earthquake has shown that the buildings with simple and uniform configurations are subjected to less damage. Regularity and continuity of stiffness in the horizontal planes as well as in vertical direction is very important from earthquake safety point of view. A building with discontinuity is subjected to concentration of forces and deformations at the point of discontinuity which may leads to the failure of members at the junction and collapse of building. Open first storey is a typical feature in the modern multistory constructions in urban India.*

In this paper an investigation has been made to study the seismic behavior of soft storey building with different arrangement in soft storey building. This analysis is with consideration of strength and stiffness in the upper storey and with and without consideration of braces in the ground storey. Different seismic parameters like time period, story shear, story displacement and story drift are checked out. . For that, G+6(Reinforced cement concrete) RCC model is selected.

Keywords- Earthquake & Wind effects, Time History method, soft story.

I. INTRODUCTION

Buildings are classified as having a "soft storey", if that level is less than 70% as stiff as the floor immediately above it, or less than 80% as stiff as the average stiffness of the three floors above it. Often, openground-storey buildings are called soft-storey buildings, even though their ground storey may be soft and weak. Generally, the soft or weak storey usually exists at the ground storey level, but it could be at any other storey level. Soft storey buildings, having first storey's much less rigid than the storey's above are particularly susceptible to earthquake damage because of large, unreinforced openings on their ground floors. Behavior of soft storey building to seismic forces has to be critically examined considering various geometrical and seismic parameters. An earthquake is the result of a sudden release of energy in the earth's crust that creates seismic waves. The seismic activity of an area refers to the frequency, type and size of earthquake experienced over a period of time. At the earth's surface, earthquake occurs itself by shaking and sometimes displacement of the ground. When the epicenter of a large earthquake is located offshore, the sea bed may be displaced sufficiently to cause a tsunami. Earthquakes can also trigger landslides and occasionally volcanic activities.

An earthquake is measured by seismometers. An earthquake having magnitude of less than 5 are generally measured by Richter magnitude scale & that of magnitude upto 9 or more then 9 is measured by modified Mercalli scale. In its most general sense, the word earthquake is used to describe any seismic event, whether natural or caused by humans that generate seismic waves. Earthquakes are caused mostly by rupture of geological faults, but also by other events such as volcanic activities, landslides, blasts and nuclear tests. An earthquake's pint of initial rupture is called its focus or hypocenter. The epicenter is the point at ground level directly above the hypocenter.

At the time of earthquake occurrence certain waves are generated which causes destruction of human life & property. Waves generated from earthquake are of two types body waves (P-waves & S-waves) & surface waves (Rayleigh waves, Love waves, Stoneley waves). As these waves are destructive in nature causing damages or destruction of structures, therefore it is necessary to provide effective provision to resist an earthquake waves.

In this study the 3D analytical model of G+6 storey building is to be generated for different zones and with soft storey at various locations Building models are analyzed and designed by STAAD.Pro software.

We are analyzing the these structures for seismic load i.e. equivalent static lateral for time history methods all four zones using STAAD.Pro.

II. LITERATURE REVIEW

Bhagwat et al.2014 : studied dynamic analysis of G+12 multistoried practiced RCC building considering for Koyna and Bhuj earthquake is carried out. The Time History Analysis and Response Spectrum Analysis and seismic responses of the building are comparatively studied. The modeled with the help of ETABS9.7.2 software. Two time histories (i.e. Koyna and Bhuj) have been used to develop different criteria (base shear, storey displacement, storey shear), and concluded that, the value of base shear for Bhuj earthquake is 49.11% more than the Koyna earthquake, and Response Spectrum method gives 50% more result than Time History Analysis.

Dubey 2015: presented design of multistoried irregular building with 20 stories and modeled it using software STAAD-PRO for seismic zone IV in India, dynamic response of building under actual earthquake, DELINA (ALASKA)2000 have been considered. This paper highlights the comparison of Time History Method and Response Spectrum Method. The story displacement result has been obtained by using both method of dynamic analysis, and Concluded that Time History Analysis is found to be 2 to 8% higher than that of Response Spectrum Analysis in both type of building i.e. regular and irregular, For high rise building it is necessary to provide dynamic analysis because of nonlinear distribution of force.

Rampure. 2016: studied the dynamic time history analysis and response spectrum analysis of a concrete gravity dam by using STAAD-PRO. Finite element approach is used to analyze the dam and a concrete gravity dam model is prepared in STAAD-PRO to perform the time history analysis and response spectrum analysis and comparison is done between both these methods. They concluded that STAAD-PRO is most convenient and less tedious for dynamic analyses and it provides a computing environment to investigate modelling assumption and computational processes related to the static and seismic structural stability of gravity dam.

Prakriti Chandrakar , Dr. P. S. Bokare made an attempt has been made to study the dynamic behavior of G+10 multistoried building frame for two distinct plan geometries one bisymmetric regular rectangular frame and another frame with T shaped plan using IS1893-2002 recommended response spectrum method and time history analysis. In time history analysis, two earthquake data from previous earthquakes corresponding to (Nepal 2015) and (EL Centro 1940) is taken. Study focuses to evaluate two important parameters which are (a) Base shear and (b) maximum deflection. Analysis has been carried out using ETABS software. Based on result it is found that the base shear obtain from RSM is slightly higher compared to THM, and also storey deflection is more in response spectrum method than time history method.

SOFT STOREY CONCEPT

The soft story irregularity, refers to the existence of a building floor that presents a significantly lower stiffness than the others, hence it is also called soft story. Due to increasing population since the past few years car parking space for residential apartments in populated cities is a matter of major concern. Hence the trend has been to utilize the ground story of the building itself for parking. These types of buildings having no infill masonry walls in ground story, but in filled in all upper story, are called Open Ground Story (OGS) buildings. There is significant advantage of these category of buildings functionally but from a seismic performance point of view such buildings are considered to have increased vulnerability. Due to the presence of infill walls in the entire upper storey except for the ground storey makes the upper storeys much stiffer than the open ground storey. Thus, the upper storeys move almost together as a single block, and most of the horizontal displacement of the building occurs in the soft ground storey itself. In other words, these types of buildings sway back and forth like inverted pendulum. During earthquake shaking, and hence the columns and beams are heavily stressed. Therefore it is required that the ground storey columns must have sufficient strength and adequate ductility. The vulnerability of this type of building is attributed to the sudden lowering of lateral stiffness and strength in ground storey, compared to upper storeys with infill walls.

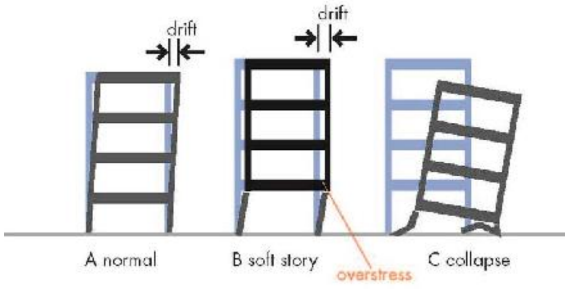

Figure. Soft story failure

III. AIM AND SCOPE OF PROJECT

1. To study seismic capacity of reinforced concrete framed multistory buildings with soft storey at different levels.
2. To obtain displacement, storey drift, storey shear, time factor, maximum movement, maximum shear force, maximum area of steel in columns at various locations of building for different configurations.
3. .To obtain maximum area of steel at top and bottom, maximum movement, maximum shear force in beams at various locations of building for different configurations.

PRESENT STUDY

Present study involves finding the optimum location of a single and a multi-soft story in a G+6 RCC tall building. The project is been carried out using the software STAAD – Pro, AutoCAD

In total, 16 models are created namely T1 to T16, out of which, T1, T2, T3, T4 are the models without soft story in different zones.T5, T6, T7, T8 are the models with soft story at bottom of building in different zones.T9, T10, T11, T12 are the models with soft story at G+3 of building in different zones.

T13, T14, T15, T16 are the models with soft story at top of building in different zones. Analysis of each of the models were done and the results were compared with each other and the respective graphs were been obtained.

IV. METHODOLOGY

TYPES OF MODEL

T1: Modal without soft story in Zone 2.
T2: Modal without soft story in Zone 3.
T3: Modal without soft story in Zone 4.
T4: Modal without soft story in Zone 5.
T5: Model with soft story at bottom of building in Zone 2.
T6: Model with soft story at bottom of building in Zone 3.
T7: Model with soft story at bottom of building in Zone 4.
T8: Model with soft story at bottom of building in Zone 5.
T9: Model with soft story at G+3 of building in Zone 2.
T10: Model with soft story at G+3 of building in Zone 3.
T11: Model with soft story at G+3 of building in Zone 4.
T12: Model with soft story at G+3 of building in Zone 5.
T13: Model with soft story at Top of building in Zone 2.
T14: Model with soft story at Top of building in Zone 3.
T15: Model with soft story at Top of building in Zone 4.
T16: Model with soft story at Top of building in Zone 5.

MODELLING

A. Model Defination

In the this study we take a G+6-storey RC building the geometrical parameters of the multi-story frame are as follows:

Number of storey:-G+6
Floor Height:-3m
Soft story height:- 5m
No of bay in X direction:-4
No of bay in Z direction:-5
Spacing in X direction:-5m
Spacing in Y direction:-5m
Slab Thickness:-125mm
Live load:- 2kN/m² at typical floor
1 kN/m² at terrace floor
5 kN/m² at soft story floor
Floor finish Load:-1.5 kN/m²
Concrete grade:-M25
Steel:-Fe500

Earthquake parameters:-

Type of frame:-SMRF
Seismic zone:-II, III, IV, V
Response reduction factor:-5
Importance Factor:-1

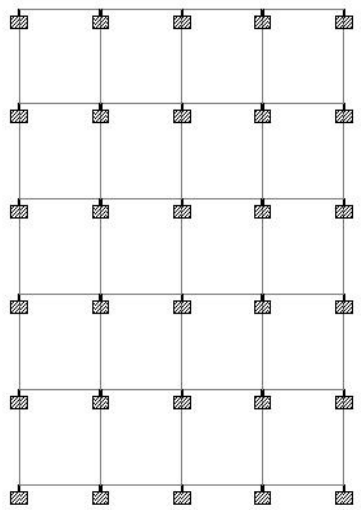

Fig. 3.1 Plan of the building

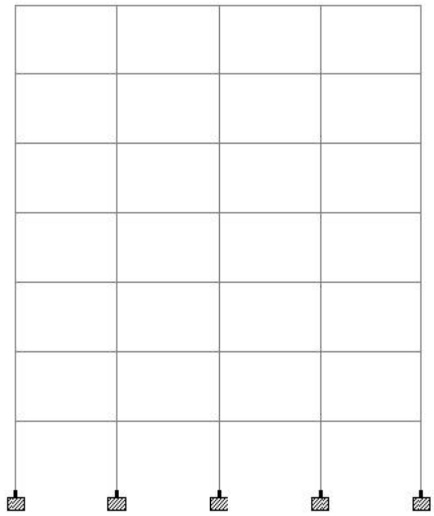

Fig. 3.2 elevation of view of building Without soft story in STAAD.Pro

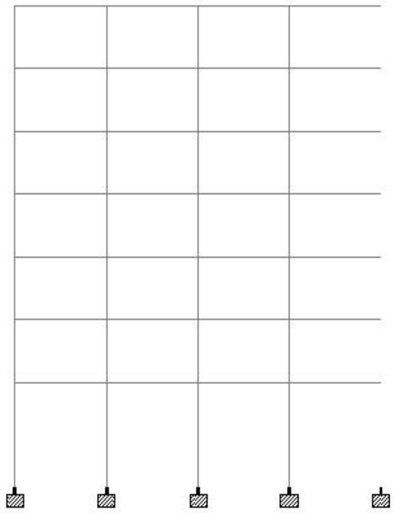

Fig. 3.4 elevation view of building with soft story at bottom in STAAD.Pro

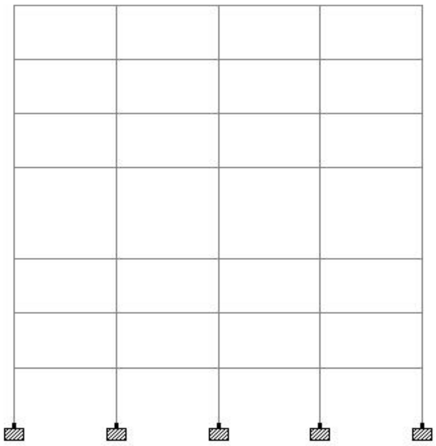

Fig. 3.5 elevation view of building with soft story at middle in STAAD.Pro

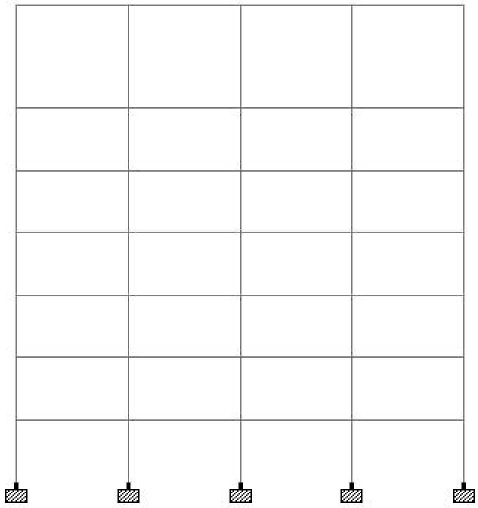

Fig. 3.6elevation view of building with soft story at top in STAAD.Pro

V. ANALYTICAL ANALYSIS

Seismic Analysis of Buildings Using IS 1893(Part 1) – 2002
The analysis process can be categorized on three factors – 1. Externally applied loads 2. Structural behavior 3. Structural model type

A) Equivalent static method of analysis :-For the buildings having low to medium heights with a regular conformation.

B) Dynamic analysis:-The dynamic analysis is of two types
a) Time history analysis.
Following are the load combinations considered in this analysis

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)
6) DL+1.5EQX
7) DL-1.5EQX
8) DL+1.5EQY
9) DL-1.5EQY

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