CHAPTER -1

INTRODUCTION

1.1 PRELUDE

An earthquake is a natural phenomenon which takes place due to rapid discharge of energy in the earth's crust as a result of movement in the direction of any fault plane or due to activities of volcanic eruptions giving rise to destructive seismic waves .When earthquake occurs it leads to single or multi peaks of the ground motion caused .those peaks indicate the highest consequences of the ground motion .The nature of the movements of the ground at the region of any structure gives the critical effect on that structure ,even though the degree of the earthquake is gauged in terms of release of energy at that location. The resultant of the earthquake is influenced by the distance between the structure and the epicentre along with ground strata present below the structure.

The motion of ground caused due to the earth becomes more and more complex depending on the effect of source effect of path and the effect of the local site. Vibrations are caused in the ground due to earthquake which in turn causes motion in the structure supported on the ground. This type of loading cannot be considered as a external loading during the occurrence of the earthquake .hence a loading is developed in the structure as a result of movement of the support of the structure. The damage caused to structure due to earthquake is influenced by few factors like asymmetry in the plan and elevation of the building and non uniformity of stiffness, strength and mass of the structure.

Shaking of the ground due to earthquake can be considered as one of the most hazardous natural calamity which causes loss to life and economy majority of them are due to collapse of building there are many side effect of earthquake like landslides fire break outs and floods other than earthquake vibrations which add the losses and disasters. All factors make it inevitable to design the structure to resist any kind of earthquake .If the existing buildings are not designed for seismic forces care has to be taken to establish seismic retrofitting to those buildings.

Seismic forces are induced in the structure when the earthquake occurs. The waves generated due to ground shaking reach the structure and cause the structure to shake .this movement or motion of the structure is characterised by the nature of the vibration of the structure and the

arrangement of the structural elements in the structure .It is essential for the structure to overcome its inertia which builds up an interface linking the ground soil and the structure.

1.2 PHILOSOPHY OF SEISMIC DESIGN

The fundamental philosophy of earthquake resistant design of structures is as follows.

- The essential elements of the structure which carry vertical and horizontal loads shouldn't undergo failure when subjected to lesser and recurring ground motion.
- Under conservative but infrequent shaking, the vital members may bear reform able damage; whereas the remaining elements of the building can be deformed in a way that they may yet have to be retrieved past the earthquake.
- When subjected to active and seldom earthquake, the essential elements should bear serious damage, however the structure shouldn't disintegrate.

1.3 DYNAMIC ANALYSIS OF R.C. FRAMES

Dynamic analysis is performed to fetch the forces of seismic design along with seismic force allotment at various levels in the direction of the height of the structure. In addition to structures present in zone V, it is also essential for a huge number of various types of structural systems that are built in seismic zones II, III and IV. In this method, the lateral force is found out by any of the methods that can be used to work out the allotment of seismic forces within a structure. The big advantage of making use of forces procured with the help of dynamic analysis as the base for the design of structure is that the vertical distribution of loads can be greatly varied with the forces worked out with the help of an equivalent static load method as dynamic analysis is more definite than the static analysis.

Dynamic analysis may be performed by any of the following two methods:

1.3.1. "***Time History method"***: when Time History Analysis is made use of for the seismic design of buildings it is based on a specific ground motion and is done using basic principles of dynamics.

1.3.2.:"***Response Spectrum method":*** It is the most simple kind of Dynamic Analysis. In this method the natural period and geometry of deflection of the important modes of vibration are determined keeping in mind the linear elastic behaviour of all the parts of the structure. However, in both the methods, the calculated base shear (V_b) is correlated with a base shear (V'_b) computed with the help of an estimated fundamental time period T_a.

Indian standard code-1893:2002 (Part-I) has recommended the method of dynamic analysis of buildings in case the buildings satisfy any one of the requirements mentioned below:

1. Regular buildings higher than forty meters in height in seismic zones 4 and 5.
2. Regular buildings higher than ninety meters in height in seismic zones 2 and 3.
3. Irregular buildings greater than twelve meters in seismic zones 4 and 5.
4. Irregular buildings higher than forty meters in seismic zones 2 and 3.

1.4 IMPORTANCE OF THE PRESENT STUDY

The earthquakes which have occurred in the past have caused serious damages to the buildings and some have even collapsed .this serious issue has made it inevitable to study and gauge the adequacy of the current buildings to seismic forces. To be specific the seismic rehabilitation of aged RCC buildings in high seismic zones is a case of great apprehension as the buildings prone to damages have to be classified and fair degree of safety have to be entrenched .to predict such a opinion, linear elastic analysis is not sufficient. Consequently the association of structural engineers has advanced a latest formation of procedure and seismic design that involves the performance based design of buildings which deviates from the conventional linear analysis, in the direction of Non- Linear Analysis. Figure 1.1 shows a Reinforced Building which has undergone failure due to the occurrence of Earth quake in the past.

(a) Partial collapse of stone masonry walls during 1991 Uttarkashi Earthquake

(b) Collapse of ground storey RC columns (soft storey) during 2001 Bhuj Earthquake

Fig. 1.1: Typical failure of RC buildings during the past earthquakes

Several remarkable studies are done on the influence of irregularities, like the one outlined by "Chopra and Goel (2004)". The present study briefs out the effect of irregularities present in the structure, both in plan and elevation, the extent of irregularities in the buildings which are designed with gravity plus seismic loads, the kind of irregularities taken into consideration, the procedure used to assess the performance of the buildings having irregularities.

1.5 PROBLEM STATEMENT

Main target of this current study is performing "non-linear static (pushover) analysis" to find out the "capacity" and "performance" of RC framed structures subjected to earthquake loading especially those structures which are having an uneven allotment of structural stiffness in both plan and elevation. To establish the above said results, Firstly RC frames are modelled, analyzed and designed in ETABS v 13, with the gravity and seismic load combination for a particular seismic zone. Further, the performance under non-linear incremental loading is studied based on the capacity curves generated up to the maximum displacement. The study includes the consideration of the effect of zone, effect of type of structure, effect of number of storeys etc. on the seismic performance of the structure.