SECEIMIC RETOFITTING

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I. ABSTRACT

A retrofit programme for a building refers to the complete process of retrofitting. For a systematic approach, it is necessary to be aware of the steps of a retrofit programme before undertaking the retrofit project. The implementation of each step requires a certain time schedule and finance. All the listed steps may not be applicable for all projects. Similarly, there may be detailed sub-divisions of one step for a particular project.

II. INTRODUCTION

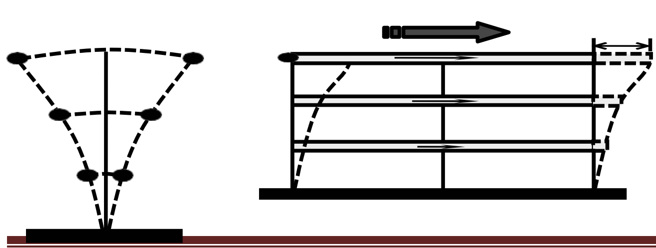
India is one of the most earthquake prone countries in the world and has experienced several measure /moderate earthquake during the last 15-20 years. About 50-60% of the local area of the country is vulnerable to seismic activity of varying intensities. The earthquakes at Latur (1993),Jbalpur (1997),Chamoli (1997) and Bhuj (2001) had exposed the vulnerability of buildings in India. The codes of practice on earthquake resistance design (IS 4326:1993), earthquake resistance of earthen buildings (IS:13827-1993), earthquake resistance of low strength masonry buildings (IS:13828-1993),ductile detailing of reinforced structures (IS:13920-1993) and revised ductile detailing of reinforced structures (IS:13920-2016) and seismic strength of buildings (IS:13935) were published almost simultaneously to meet the urgency of seismic design of buildings. IS 1893 code of practice for earthquake resistance design and construction of buildings was first prepared in 1962 and subsequently revised in 1966,1970,1975,2002 and sixth revision was published 2016.

In India almost 85% of total building is non engineered buildings made up of earthen walls, stone walls, brick masonry walls etc. These buildings are more vulnerable, and in the event of the major earthquake, these are likely to be substantial loss of lives and property.

For evaluation of the vulnerability of any building, some rapid visual methods and preliminary evaluation are to be carried out first. On the basis of this study, one can arrive at a conclusion as to whether the building is safe or needs further detailed evaluations to assess its adequacy.

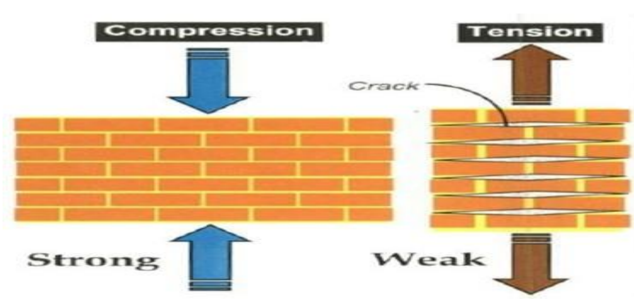
III. Effect of Mass and Height

The earthquake as well as wind load acting on the buildings are termed as 'lateral loads' since their effect is felt mainly in the horizontal direction. This is in contrast to the weights of the building (and occupants), which act vertically down due to gravity. Forces due to earthquake, called *seismic forces*, are induced in a building because of the heavy masses present at various floor levels. Such forces are called inertial forces, is calculated by the products of the masses and their respective accelerations. If there is no mass, there is no inertial force. Accelerations generated by the seismic waves in the ground get transmitted through the vibrating structure to the masses at various levels, thereby generating the so-called horizontal seismic forces. The building behaves like a vertical cantilever, and swings horizontally almost like an inverted pendulum, with masses at higher levels swinging more (Figure a). Hence, the generated seismic forces are higher at the higher floor levels. Because of the cantilever action of the building (fixed to the ground and free at the top), the forces accumulate from top to bottom. The total horizontal force acting on the ground storey columns is a sum of the forces (seismic loads) acting at all the levels above. This is termed as the *base shear* and it leads to highest stresses in the lowermost columns.



Effect of stiffness

The stiffness of structural elements (columns, beams, and slabs) significantly contributes to the overall stiffness of reinforced concrete (RC) high-rise buildings (H.R.B.s) subjected to earthquake. In order to investigate what percentage each type of element contributes to the overall performance of an H.R.B. under seismic load, the stiffness of each type of element is reduced by 10% to 90%. A time history analysis by E-tabs was performed on thirteen 3D models of 12-story RC buildings in order to illustrate the contribution of column stiffness and column cross sections (rectangular or square), building floor plans (square or rectangular), beam stiffness and slab stiffness, on building resistance to an earthquake. The stiffness of the columns contributed more than the beams and slabs to the earthquake resistance of H.R.B.s. Rectangular cross-section columns must be properly oriented in order for H.R.B.s and slender buildings to attain the maximum resistance against earthquakes.



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IV. Capacity Design Concept for Increased Ductility of Structures

The above explained criteria is defined as a capacity design method, the phenomenon of ductility incorporation in building elements. This considers the problem of determining the failure mechanism of members. The idea is to force the member to undergo failure in a ductile manner by making the capacity of the member in other possible failure modes greater. Consider two bars of the same length and cross-sectional area. Here one of them forms a ductile material and other one forming brittle. Pulling these two bars on either side as shown in figure 2, will make them break under extreme load. It is observed that the ductile material elongates for a larger amount and the brittle material breaks for a small elongation. Hence among the materials used steel is more ductile than concrete which is brittle.

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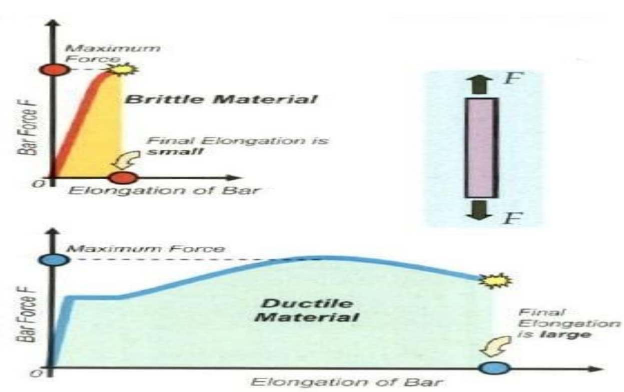
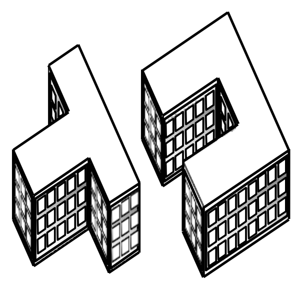
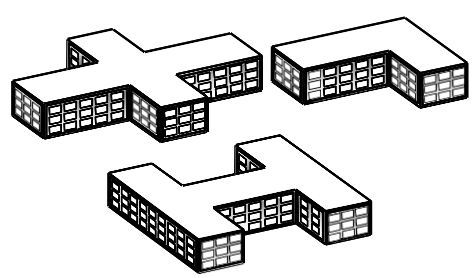


Effect of Layout and Configuration

Providing earthquake resistance to buildings is primarily the responsibility of civil engineers. But architects also have a major role to play. Some architectural features, relating to overall size and shape, are unfavorable and invite potential seismic disaster. It is desirable that the client also knows something of these features, if the building is located in a high seismic zone. Prevention is always better than cure. In such situations, safety is preferable to fancy looks. Otherwise, structural design has to be done carefully and competently. In general, if the basic architectural features favoring good seismic resistance are adopted, the cost of making the building earthquake proof is less and even an incompetent engineer cannot do much damage.





CONCLUSION

The analysis of G+ 4 RCC framed structure with soft storey retrofitted by Column Jacketing is done using E-tabs. From the Static analysis, the percentage of reduction in Storey drift for Column Jacketing is 70% as compared to the ordinary column. Storey displacement for Column Jacketing is 67% as compared to the ordinary column. Hence, for retrofitting the existing building, Jacketing column techniques are effective to reduce storey drift value and displacement value.

Jacketing of Columns Jacketing of columns consists of added concrete with longitudinal and transverse reinforcement around the existing columns. This type of strengthening improves the axial and shear strength of columns while the flexural strength of column and strength of the beam-column joints remain the same. It is also observed that the jacketing of columns is not successful for improving the ductility. A major advantage of column jacketing is that it improves the lateral load capacity of the building in a reasonably uniform and distributed way and hence avoiding the concentration of stiffness as in the case of shear walls. This is how major strengthening of foundations may be avoided. In addition the original function of the building can be maintained, as there are no major changes in the original geometry of the building with this technique. The jacketing of columns is generally carried out by two methods: (i) reinforced concrete jacketing and (ii) steel jacketing.

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