RESPONSE SPECTRUM ANALYSIS OF SOFT STOREY IN RC BUILDING

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Abstract : In this analytical study of subject it is required to search different existing cases and the available study material regarding that subject. In order to collect the necessary and valuable information, the literature survey To implement performance assessment, it is necessary to develop adequate and representative performance indicators. Good performance indicators can specify the measurable evidence that is necessary to document the achievement of a goal. Open first storey is a typical feature in the modern multistorey constructions in urban India. Such features are highly undesirable in buildings built in seismically active areas; this has been verified from strong shaking during the past earthquakes.

I. INTRODUCTION

The draft Indian seismic code classifies a soft storey as one whose lateral stiffness is less than 53% of the storey above or below [Draft IS:1893, 1997]. Interestingly, this classification renders most Indian buildings, with no masonry infill walls in the first storey, to be “buildings with soft first storey.

The Jabalpur earthquake of 22 May 1997 also illustrated the handicap of Indian buildings with soft first storey. This earthquake, the first one in an urban neighborhood in India, provided an opportunity to assess the performance of engineered buildings in the country during ground shaking.

Reinforced concrete framed buildings are adequate for resisting both the vertical and the horizontal loads acting on them. However, when the buildings are tall, say, more than twelve storey’s or so, beam and column sizes work out large and reinforcement at the beam-column junctions works out quite heavy, so that, there is a lot of congestion at these joints and it is difficult to place and vibrate concrete at these places, which fact, does not contribute to the safety of buildings.

Fig shows Damage to Column

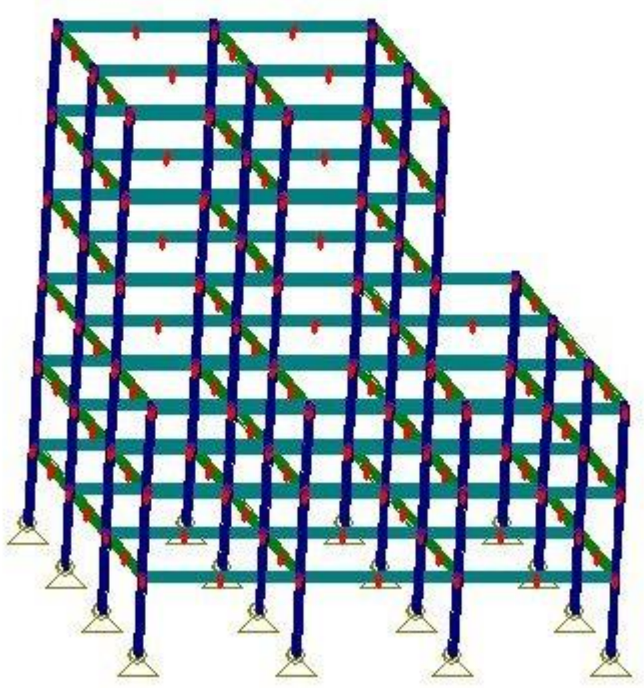
Methods of Analysis:

RFEM provides deformations, internal forces, stresses, support forces, and soil contact stresses. The corresponding add-on modules facilitate data input by automatic generation of structures and connections or can be used to perform further analyses and designs according to various standards.

The modular software concept allows you to compile a program

Elastic analysis deals with the study of strength and behavior of the members and structure at working loads. Frames can be analyzed by various methods. However, the method of analysis adopted depends upon the types of frame, its configuration (portal bay or multibay) multistoried frame and Degree of indeterminacy.

It is based on the following assumptions:
1. Relation between force and displacement is linear. (i.e. Hook’s law is applicable).
2. Displacements are extremely small compared to the geometry of the structure in the sense that they do not affect the analysis.



The methods used for analysis of frame are:

1. Flexibility coefficient method.
2. Slope displacement method.
3. Iterative methods like
a. Moment distribution method(By Hardy Cross in 1930’s)
b. Kani’s method (by Gasper Kani in 1940’s)
4. Approximate methods like
a. Substitute frame method
b. Portal method
c. Cantilever method

1. FLEXIBILITY COEFFICIENT METHOD:

This method is called as force method or compatibility method. In this Redundant forces are chosen as unknowns. Additional equations are obtained by considering the geometrical conditions imposed on the formation of structures. This method is used for analyzing frames of lower D.O.R.

· **Limitations:**
1. This method involves long computations even for simple problems with small D.O.R.
2. This method becomes intractable for large D.O.R. (>3), when computed manually especially because of simultaneous equations involved.
This method is not ideal for computerizing, since a structure can be reduced to a statically determinate form in more than one way.

2. SLOPE DISPLACEMENT METHOD:
It is displacement or equilibrium or stiffness method. It consists of series of simultaneous equations, each expressing the relation between the moments acting at the ends of the members is written in terns of slope & deflection. The solution of slope deflection equations along with equilibrium equations gives the values of unknown rotations of the joints. Knowing these rotations, the end moments are calculated using slope deflection equations.

· **Limitations:**

1. This method is advantageous only for the structures with small Kinematic indeterminacy.
2. The solution of simultaneous equation makes the method tedious for annual computations.

The formulation of equilibrium conditions tends to be a major constraint in adopting this method.
Hence flexibility coefficients & slope displacement methods have limited applications in the analysis of frames. While other methods like iterative or approximate methods are used for analyzing frames containing larger indeterminacy.

3. APPROXIMATE METHODS:

Approximate analysis of hyper static structures provides a simple means of obtaining quick solutions for preliminary designs. It is a very useful process that helps to develop a suitable configuration for final (rigorous) analysis of a structure, compare alternative designs & provide a quick check on the adequacy of structural designs. These methods make use of simplifying assumptions regarding structural behavior so as to obtain a rapid solution to complex structures. However, these techniques should be applied with caution & not relied upon for final designs, especially complex structures.

The usual process comprises reducing the given indeterminate configuration to a structural system by introducing adequate number of hinges. It is possible to check the deflected profile of a structure for the given loading & there by locate the points of inflection.

Since each point of inflection corresponds to the location of zero moment in the structure, the inflection points can be visualized as hinges for purpose of analysis. The solution of the structure is rendered simple once the inflection points are located. In multistoried frames, two loading cases arise namely horizontal & vertical loading.

The analysis is carried out separately for these two cases:

· **VERTICAL LOADS:**

The stress in the structure subjected to vertical loads depends upon the relative stiffness of the beam & columns. Approximate methods either assumes adequate number of hinges to render the structure determinate or adopt simplified moment distribution methods.

· **HORIZONTAL LOADS:**

The behavior of a structure subjected to horizontal forces depends on its height to width ratio. The deformation in low-rise structures, where the height is smaller than its width, is characterized predominantly by shear deformations. In high rise building, where height is several times greater than its lateral dimensions, is dominated by bending action. There are two methods to analyze the structures subjected to horizontal loading.

3.1. PORTAL METHOD:

Since shear deformations are dominant in low rise structures, the method makes simplifying assumptions regarding horizontal shear in columns. Each bay of a structure is treated as a portal frame, & horizontal force is distributed equally among them.

The assumptions of the method can be listed as follows:

1. The points of inflection are located at the mid-height of each column above the first floor. If the base of the column is fixed, the point of inflection is assumed at mid height of the ground floor columns as well; otherwise it is assumed at the hinged column base.
2. Points of inflection occur at mid span of beams.
3. Total horizontal shear at any floor is distributed among the columns of that floor such that the exterior columns carry half the force carried by the inner columns.

Improved Design strategies of Soft stories

Reinforced concrete (RC) frame buildings are very common in the world. In such types of structure for functional requirements of parking space under the buildings no masonry in fill are provided resulting a construction with stilts.

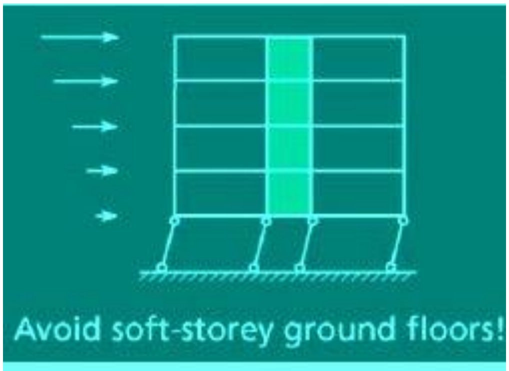
Design Approaches

Open ground storey building is inherently poor systems with sudden drop in stiffness and strength in the ground storey. In the current design practice, stiff masonry walls are neglected and only bare frames are considered in design calculations. Thus, the inverted pendulum effect is not captured in design.

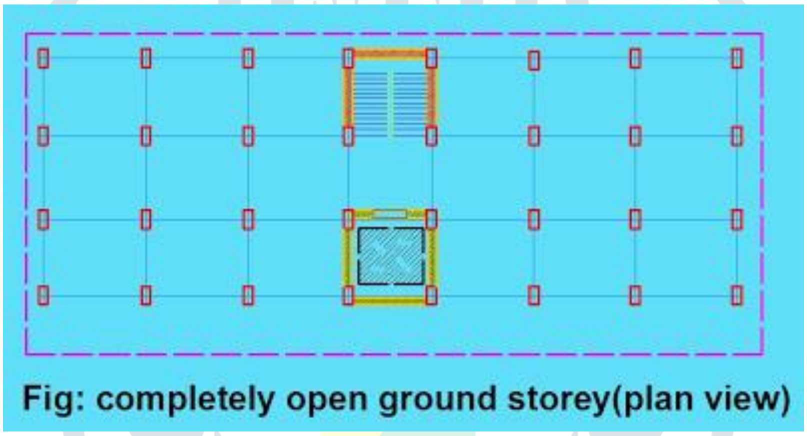
Safeguard Against Failure

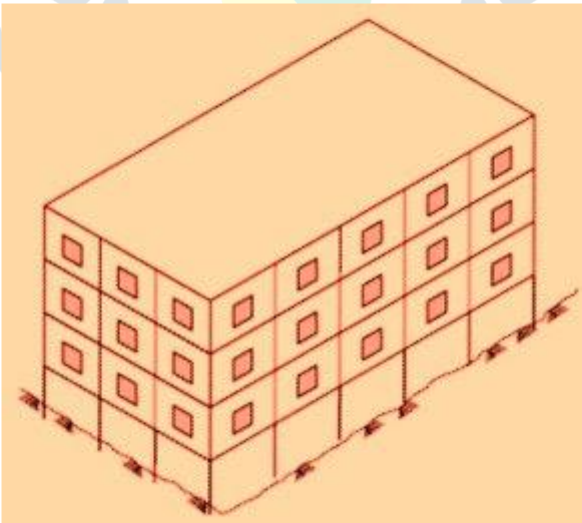
The failure can be avoided following two considerations in structural proportioning:

a) To avoid soft storey



b) When soft storey cannot be avoided, providing special design provision in designing such





How to Avoid Soft Storey

Architects and structural designers can use the following conceptual design strategies to avoid undesirable performance of open ground storey buildings in earthquake:

Ø Provide some shear walls at the open ground story level : this should be possible even when the open ground story is being provided to offer car parking

Ø Select an alternative structural system (e.g., RC shear walls) to provide earthquake resistance: when the number of panels in the ground storey level that can be filled with masonry walls is insufficient to offer adequate lateral stiffness and resistance in the ground storey level, a ductile frame in not an adequate choice. In such cases an alternative system, like a RC shear wall, is required to provide earthquake resistance. Some remedial measures to counter the bad performance are shown in fig:

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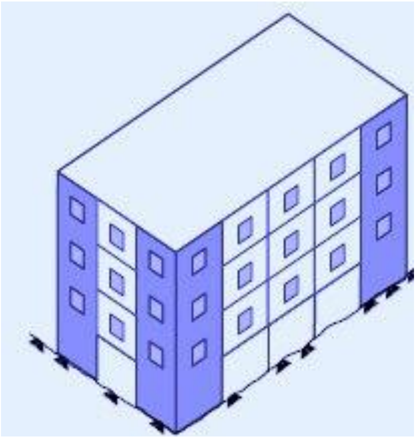
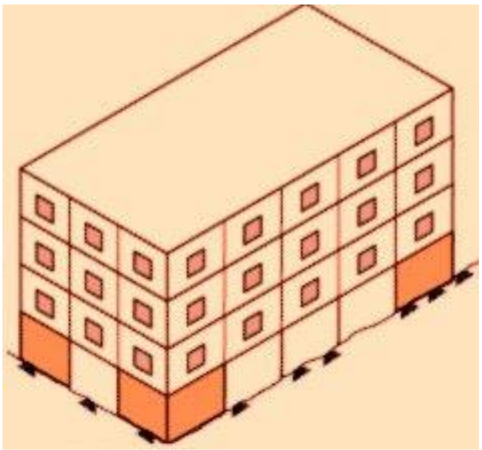




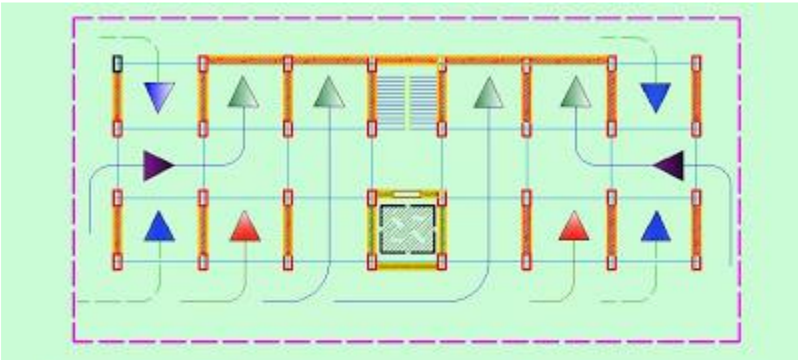
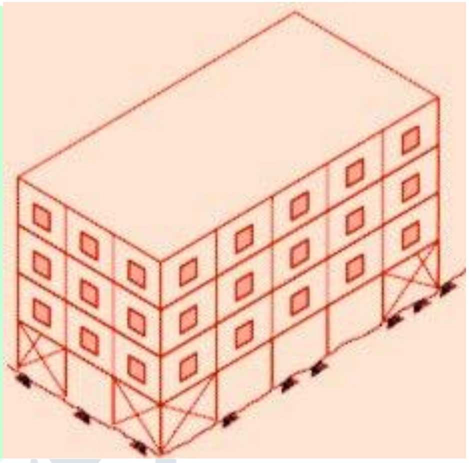


Fig: Ground storey with infill wall(plan view), triangles indicates parking for cars.



Special Design Provision

To safeguard the soft first storey from damage and collapse code provides two alternative design approaches:

1) The dynamic analysis of the building is to be carried out which should include the strength and stiffness effects of infills as well as the inelastic deformations under the design earthquake force disregarding the reduction factor R.

2) The building is analysed as a bare frame neglecting the effect of infills and, the dynamic forces so determined in columns and beams of the soft (stilt) storey are to be designed for 2.5 times the storey shear and moments: or the shear walls are introduced in the stilt storey in both directions of the building which should be designed for 1.5 times the calculated storey shear forces.

II. CONCLUSION:

1) RC frame building with open first story performed week in strong earthquake motion. In this paper we focus on better performance of soft story building during earthquake.

2) We analyse the soft story building model near about 10 to 13 story building by using software like as Etab/Sap/Stadpro etc.

III. REFERENCES:

[1] Chopara A. K. “Dynamic of structure”
[2] Demonstration of lateral tensional coupling in building structure by UCIST
[3] IS:13935, 1993, Repair and strengthening of building – Indian standard guideline.
[4] Criteria for Earthquake Resistance Design of structures IS Code 1893:2002.
[5] http://www.world-.
[6] Niveditha M P and Sunil “Seismic Analysis of Regular and Irregular Buildings with and without Shear Wall”. International Research Journal of Engineering and Technology (IRJET). ISSN: 2395-0056, www.irjet.net Vol: 05 Issue: 07,July 2018, pp.ISSN: 2395-0072.