Behavior of Soft Stories Building in Earthquake

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Abstract- *Multi storey building, soft store construction is a typical feature because of urbanization and the load resisting system and a progressive collapse becomes unavoidable in a severe earthquake to provide an adequate shear resistance, hence damage and collapse are most often observed in soft story buildings during the earthquake. In the current study the focus is on the investigation in high rise building space occupancy considerations. These provisions reduce the stiffness of the lateral for such buildings due to soft storey.*

Keywords- Earthquakes, High-rise building, Soft story, STADD-PRO Designing, Size of Elements, Properties of material. Seismic loads, soft storey, static and dynamic analysis. Capacity curve, open ground storey, performance point,

I. INTRODUCTION

In the present study, seismic performance of 3D building frame with intermediately infill frame was studied. Performance of R.C. frame was evaluated considering different models for the soft storey. The main objective of the study was to investigate the behavior of high rise, multi-bay soft storey building with and without infilled frames and to evaluate their performance levels when subjected to earthquake loading.

II. BEHAVIOR OF SOFT STOREY UNDER EARTHQUAKE

Many building structures having soft stories, suffered major structural damage and collapsed in the recent earthquakes. Large open areas with less infill and exterior walls in ground floor compared to upper floors are the cause of damages. In such buildings, the stiffness of the lateral load resisting systems at those stories is quite less than the stories above or below.

III. ANALYSIS PROCEDURES SELECTION

Seismic analysis is a subset of structural analysis and is the calculation of the response of the building structure to earthquake and is a relevant part of structural design where earthquakes are prevalent. The seismic analysis of a structure involves evaluation of the earthquake forces acting at various level of the structure during an earthquake and the effect of such forces on the behavior of the overall structure. The analysis may be static or dynamic in approach as per the code provisions.

Thus, broadly we can say that linear analysis of structures to compute the earthquake forces is commonly based on one of the following three approaches:

1. An equivalent lateral procedure in which dynamic effects are approximated by horizontalstatic forces applied to the structure.
2. The Response Spectrum Approach in which the effects on the structure are related to the response of simple, single degree of freedom oscillators of varying natural periods to earthquake shaking.
3. Response History Method or Time History Method in which direct input of the time history of a designed earthquake into a mathematical model of the structure using computeranalyses.

IV. SOFT OR FLEXIBLE STORY

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: flexible story. It is commonly generating unconscientiously due to the elimination or reduction in number of rigid non-structural walls in one of the floors of a building, or for not considering on the structural design and analysis, the restriction to free deformation that enforces on the rest of the floors, the attachment of rigid elements to structural components that were not originally taken into consideration.

Because of the effects produced by nonstructural components on the seismic performance of the building. If the soft story effect is not foreseen on the structural design, irreversible damage will generally be present on both the structural and nonstructural components of that floor.

This may cause the local collapse, and in some cases even the total collapse of the building. The soft first story is the most common feature of soft story irregularity. It usually is present in modern frame buildings when a large number of nonstructural rigid components, such as masonry walls, are attached to the columns of the upper floors of a reinforced concrete frame structure while the first story is left empty of walls or with a reduced number of walls in comparison to the upper floors.

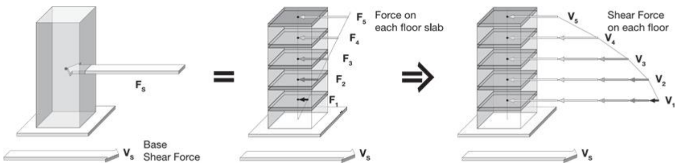

Fig Lateral forces and shear forces generated in buildings due to ground motion

The total displacement (T) induced by an earthquake tend to distribute homogeneously in each floor throughout the height of the building. Deformation in each floor (n) would be similar. When a more flexible portion of the lower part of the building supports a rigid and more massive portion, the bulk of the energy will be absorbed by the lower significantly more flexible story while the small remainder of energy will be distributed amongst the upper more rigid stories, producing on the most flexible floor, larger relative displacement between the lower and the upper slab of the soft story (interstudy drift) and therefore, the columns of this floor will be subjected to large deformations.

V. WEAK STOREY

This irregularity refers to the existence of a building floor presenting a lower lateral structural resistance than the immediate superior floor or the rest of the floors of the building. The building's weakest part would suffer severe damages due to its inability to withstand the different types of loads (lateral, vertical and moments) produced by the ground motion. Current seismic regulations at the beginning of the 21st Century in most seismic countries.

Weak story configuration is often generated in hotel and hospital buildings, in which not only the first floor is designed less walls than the other floors, but generally, due to its importance, it also has a greater height than the rest of the floors. Weak story can be generated by: (1) elimination or weakening of seismic resistant components at the first floor; (2) mixed systems: frames and structural walls, with wall interruption at the second floor or at intermediate floors.

VI. PROPOSED WORK

The plan layout of 3D reinforced concrete moment resisting frame building studied here is shown in Fig.3.7. The building is kept symmetric in both orthogonal directions in plan to avoid torsional response under pure lateral forces. Columns are taken to be square to keep the discussion focused only on the soft story effect, without being distracted by issues like orientation of columns. In this study soft story is generated only at ground level by providing no infill in that level, where the other storeys have proper infill effect. The effect of unreinforced masonry infill is modeled with equivalent strut model as per FEMA-273, 1997. Nine storied building modeled with equivalent strut as shown in Fig3.8 (Elevation as well as 3D view) is selected for this study. 70% infill is provided (also shown in Fig. 1) during model generation and the remaining 30% is kept for functional purpose such as doors and windows.

In this study linear elastic analysis are performed with the help of finite element software, ETABS using equivalent static method. Earthquake and wind load are selected in form of lateral load as per rules of Bangladesh National Building Code, BNBC, 1993. Different building models (cases) are used to represent various ways to prevent soft story irregularities as shown in Fig. 3.8 All these buildings models are generated using equivalent strut to represent masonry infill at every floor (where masonry infill is used) according to FEMA-273, 1997. Strut is placed along one diagonal direction as lateral loading in X direction (Fig. 3.8 (a)) is considered. Descriptions of different building cases are described below:

VII. LITERATURE REVIEW

Hired of Suchitra and Top-grade Ganga,2014, Discussed the performance of a building with soft storey at different levels along with ground level. The past earth quacks have manifested that if in a building there are concentration of forces and deformation due to discontinuity in the stiffness and mass may causes the failure structural members which eventually causes the collapse of the building. The nonlinear static pushover

VIII.CONCLUSION

From the above it is seen that, when the effect of soft storey is considered then the deflection has increase at that particular floorer frame buildings with open first storeys are known to perform poorly during in strong earthquake shaking. The measures should take to improve capacities of the columns in the soft first story. Since the behavior of the soft storey is different during a quake, the structural member undergoes damage and to provide member to withstand that additional forces due to soft storey heavy or bulky member need to be provided. This increase financial input. Thus, proper care, expert design and detailing are needed in soft story buildings

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REFERENCES

[1] Bureau of Indian standards, National building code of India 2005

[2] FEMA-356/November:2000, Federal Emergency Management Agency, PR standard and Commentary for The Seismic Rehabilitation of Buildings

[3] Dr. Saraswathi Setia and Vineet Sharma, Seismic Response of R.C.C Building with Soft Storey International Journal of Applied Engineering Research, ISSN 0973-4562 Vol.7 No.11 (2012) © Research India Publications.