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"A Review on Study of Soft Storey on High Rise (G+29) Cylindrical Shaped Structure Under Earthquake & Wind Effect"

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ABSTRACT

Now a days in a country like India open storeys are unavoidable feature for most of the multi-storey buildings in urban areas for vehicle parking, offices etc. Many earthquakes in the past, have demonstrated the potential hazard associated with soft first storey buildings. The open storey become soft and weak relative to the other stories, since the open storey is composed of only columns while the other stories are divided by unreinforced masonry infills. Structurally those unbalances are not safe & unhealthy and the soft stories in buildings are well known for being susceptible to collapse through past big earthquakes.

As high rise buildings are affected more by wind than the earthquake. As wind is a randomly varying dynamic phenomenon, it has significant dynamic effects on buildings and structures especially on high rise flexible structures. For preliminary design including the proportioning of a structure, the variation of wind force on a structure with variation of site parameters and structural parameters should be known. So in high rise building soft stories becomes more critical & more susceptible to collapse through high wind. In this paper, previously done investigations has been studied to understand the behaviour of various alternative models of same reinforced concrete moment resisting frame building with open stories & unreinforced masonry infills in the other stories.

Keywords: - ETABS 2016, Infill, Seismic analysis, Soft storey, Wind analysis.

I.INTRODUCTION

Codes and standards are the mainstream of information to the designers of civil engineering structure. Earthquakes and winds are natural hazards under which disasters are mainly caused by damage or collapse of buildings. Objective of seismic as well as wind analysis are stated as the structure should be able to endure minor shaking intensity without sustaining any damage, thus leaving the structure serviceable after the event. The structure should withstand moderate level of earthquake ground motion and the variation of wind force on a structure with variation of site parameters and structural parameters without structural damage, but possibly with

some non-structural damage. The structure should sustain sever earthquake ground motion and high wind loads without collapse of structural framework, but possibly with some structural as well as non-structural damage.

1.1 Soft Storey

Now a day construction of multi-storeyed high rise Reinforced Concrete (RC) frame buildings is becoming common in country like India. The most common type of vertical irregularity occurs in buildings that have an open ground story. Many buildings constructed in recent times have a special feature that some stories within the building are left open for the purpose of parking, reception, offices, service purpose etc. Such buildings are often called open storey or soft storey buildings or buildings on stilts. Such stories become soft and weak relative to the other stories, due absence of masonry walls in the storey. Structurally those unbalances are not safe and unhealthy and soft storey buildings are well known for being susceptible to collapse through past earthquakes.

1.2 Behaviour of Soft Storey

In buildings with soft stories the inter-storey drift in the soft storey is large. The strength demand on the column in such storey for these building is also large, however in the other stories the forces in the columns are effectively reduced due to presence of brick infill walls which share the forces. If the open floor is significantly less strong or more flexible, a large portion of the total building deflections tends to concentrate in that floor. The presence of walls in other stories makes them much stiffer than the open storey. Thus the other stories move almost together as a single block and most of the horizontal displacement of the building occurs in the soft storey. Thus, such building behaves like multiple units and shows irregular direction of motion. If only one open storey at ground level is present in the building, then such building behaves like an inverted pendulum with the open story columns acting as the pendulum rod and the rest of the building acting as a rigid pendulum mass during earthquake. As a consequence, large movement occurs in the ground story alone and the columns in the open ground storey are severely stressed. If the columns are weak (do not have the required strength to resist these high stresses), they may be severely damaged which may even lead to collapse of the building.

Soft storey RC frame buildings are commonly analysed and designed as bare frames. However actual behaviour of bare frames is entirely different from that of the bare frames. In soft storey buildings, ground storey is bare and open stories are infilled with masonry. Therefore, it is of interest to analyse and compare displacement, stiffness etc. of the same frame, modelling it as bare frame and as soft storey frame. Such comparison will be useful to understand how the performance of soft storey frame is different from that of the bare frame. In this paper seismic analysis and wind analysis have been studied to understand the behaviour of multi-storeyed RC frame building with four different models prepared according to IS 1893 (Part 1): 2002 using commercial software ETABS.

II.LITERATURE VIEW

Mr. Raghavendra S. Deshpande et al [1] Open first storey is now a day unavoidable feature for most of the multistory buildings in urban areas for vehicle parking, shops etc. Many earthquakes in the past, have demonstrated the potential hazard associated with soft first storey buildings. The first storey become soft and weak relative to the upper stories, since the first storey is composed of only columns while the upper stories are divided by unreinforced masonry infills. Structurally those unbalances are unhealthy and the soft first storey buildings are well known for being susceptible to collapse through past big earthquakes.

In the present paper, an investigation has been performed to examine the behaviour of various alternative models of same reinforced concrete moment resisting frame building with an open first storey & unreinforced masonry infills in the upper stories. The structural action of masonry infill panels of upper stories has been taken into account by modelling them as equivalent diagonal struts. The parameters discussed include fundamental natural periods, stiffness of open first storey in relation to the upper storey, lateral displacements, inter-storey drift by linear elastic analysis using ETABS analysis package. It is noticed that significant change in stiffness between the soft storey and upper storey is responsible for increasing the strength demand on first storey columns. The objective of this paper is to promote safety without too much changing the constructional practice of reinforced concrete structures.

Ashwini S Gudur et al [2] For preliminary design including the proportioning of a structure, the variation of wind force on a structure with variation of site parameters and structural parameters should be known. The present study is an effort to achieve the same, primarily based on proposed draft for Indian wind code considering two different wind speed zones. RC framed buildings are generally designed without considering the structural action of masonry infill walls present. These walls are widely used as partitions and considered as non-structure elements. But they affect both structural and non-structural performance of the RC buildings with lateral loads.

S. Arunkumar et al [3] The increase in urbanization for the past few years has made the vehicle parking as a major concern, Therefore the first storey of the apartment is used for parking. RC framed buildings with the ground storey open are known to perform poorly during strong earthquake shaking, due to the absence of infill wall, the presence of masonry infill wall influences the overall behaviour of the structure when subjected to lateral forces, when masonry infills are considered to interact with their surrounding frames the lateral stiffness and lateral load carrying capacity of structure largely increase. Earthquakes that occurred recently have shown that a large number of existing reinforced concrete buildings especially soft storey building are vulnerable to damage or even collapse during a strong earthquake. The first storey of the building behaved as a soft story in which the columns were unable to provide adequate shear resistance during the earthquake. So in this paper the study is carried out with various building models such as soft storey structure with shear wall, and soft storey with steel bracings at the first storey. The study includes the analysis of soft storey building with ETABS software by pushover analysis method and the results and conclusion of the analysis is to be included.

Vipin V. Halde et al [4] In high rise building or multi storey building, soft storey construction is a typical feature because of urbanization and the space occupancy considerations. These provisions reduce the stiffness of the lateral load resisting system and a progressive collapse becomes unavoidable in a severe earthquake for such buildings due to soft storey. This storey level containing the concrete columns which were unable to provide 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 of the effect of a soft storey on the behaviour of a structure and effect of masonry infill on structure.

Shiv Pratap Singh et al [5] His research represents the collection of data from various previous studies done on the importance of explicitly recognizing the presence of the open first storey in the analysis of the building. The error involved in modelling such buildings as complete bare frames, neglecting the presence of infills in the upper storeys, is brought out through the study of an example building with different analytical models. This paper argues for immediate measures to prevent the indiscriminate use of soft first storeys in buildings, which are designed without regard to the increased displacement, ductility and force demands in the first storey columns. Alternate measures, involving stiffness balance of the open first storey and the storey above, are proposed to reduce the irregularity introduced by the open first storey. The effect of soil flexibility on the above is also discussed in this paper.

Devendra Dohare et al [6] Soft first storey is a typical feature in the modern multi-storey constructions in urban India. Though multi-storeyed buildings with soft storey floor are inherently vulnerable to collapse due to earthquake, their construction is still widespread in the developing like India. Functional and Social need to provide car parking space at ground level and for offices open stories at different level of structure far out-weighs the warning against such buildings from engineering community. With the availability of fast computers, so that software usage in civil engineering has greatly reduced the complexities of different aspects in the analysis and design of projects. In this paper an investigation has been made to study the seismic behaviour of soft storey building with different arrangement in soft storey building when subjected to static and dynamic earthquake loading. It is observed that, providing infill improves resistant behaviour of the structure when compared to soft storey provided.

Ankita Pramod Shelke et al [7] There is a general practice of provision of a soft storey as a ground storey in a building for fulfilling functional requirements of community like parking lots, lobbies etc. A building with soft storey are inherently vulnerable to collapse during earthquake due to its reduced stiffness. Infill wall in frame building provides stiffness and alters the behaviour of building under lateral loads. However, introduction of siporex infill wall in building will reduce the seismic weight of building and therefore reduce the effect of lateral loads on building. This stiffness contribution of masonry infill and siporex infill will be considered and introduced by equivalent stiffness strut with fixed end conditions. Considering above requirements, the study of seismic behaviour of building in zone V. The parameters under the study are drift, frequency, base shear, and time period. The equivalent statics analysis is carried out for different finite element models to study the above parameters in ETAB software.

Teresa Guevara-Perez et al [8] "Soft story" and "weak story" are irregular building configurations that are a significant source of serious earthquake damage. These configurations that are essentially originated due to architectural decisions have long been recognized by earthquake engineering as seismically vulnerable. In terms of seismic regulations their irregular condition requires the application of special considerations in their structural design and analysis. The majority of urban zoning regulations in contemporary cities, although, at present encourages and in some cases enforces the use of them not requiring special considerations. This paper analyses the architectural reasons why these configurations are present in contemporary cities and explains in conceptual terms their detrimental effects on building seismic response. These effects are presented from a multidisciplinary perspective -engineering, architecture and urban planning- because their treatment can only be achieved by an integrated approach that recognizes the interaction between these disciplines. Examples of damage due to these effects are analyzed.

Hiten L. Kheni et al [9] After 26th January 2001, Gujarat Earthquake and other earthquake s in India, there is a nation-wide attention to the seismic vulnerability assessment of existing buildings. The fundamental design concept of earthquake resistance design of structures is to make strong column- weak beam construction to ensure safety of user means during earthquake beams yield before columns collapse. Many buildings that collapsed during the past earthquake exhibited exactly the opposite strong beam weak column behaviour means columns failed before the beams yielded mainly due to soft storey effect. The buildings with soft storey are very susceptible under earthquake load which create disasters. For proper assessment of the storey stiffness of buildings with soft storey, different models were analysed using software.

Adrian Fredrick C. Dya et al [10] Preliminary seismic risk assessment tools are used to screen existing buildings against potential seismic hazards. Buildings that perform poorly are prioritized for detailed evaluations to determine its condition. The risk of a building can be defined as the product of Hazard, Vulnerability, and Assets. Hazard is the earthquake itself. Vulnerability are building characteristics that make it more susceptible to the hazard. Assets are elements that add value to the structure such as building population. Vertical irregularities such as soft stories are considered in assessments but is much generalized. The National Structural Code of the Philippines (NSCP) defines soft story irregularities based on the reduction of stiffness in adjacent stories. Since the study is used for an ocular preliminary risk assessment of existing buildings, the soft story definition is simplified. In the study, it is assumed that the properties and number of structural members for each story is constant. Thus, soft stories may be defined by simply determining the height of the stories. The study is also limited to a single soft story at the first story. The severity of the soft story is varied by increasing the height of the soft story. A static pushover analysis is utilized to determine the performance of the building under different irregularity conditions. The output of the study may be used to improve existing level 1 seismic risk assessments. Due to the limitations of a static pushover analysis, the study only covers low-rise buildings as permitted by the NSCP. Though it is recognized that a dynamic time history is more suitable, a pushover analysis is sufficient due to the preliminary assessment nature of the objective. The study has found that one of the primary concerns in vertical irregularities is the localization of seismic demand. For soft story buildings, the

concentration of seismic demand is where the soft story is located. Data from the pushover analysis is translated into score modifiers for the varying soft story severity which may be used for preliminary risk assessment tools.

Danish Khan et al [11] Eccentric bracings are used in steel structures for long time where it serves as lateral load resisting system and improve strength and stiffness of frame along with effective energy dissipation. In the present study, eccentric bracings are used as a means to reduce soft storey effect in masonry infill reinforced concrete (RC) building. Masonry infill buildings with open first storey are usual choice for almost every general multi-storey construction in India, despite the building's palpable vulnerability to strong ground motion earthquakes. Among other strengthening methods, eccentric bracings could be an advantageous scheme as it provides lateral stiffness and ductility to structure with greater economy and also provides free space for commuting of vehicle at soft storey level. It has been seen that introduction of soft storey in building leads to concentration of damage in that storey while the building suffers only slight damage. Hence, eccentric bracings in soft storey need to be designed in such a way that they act as fuse during major earthquake events. The seismic performance of eccentric bracings for a seven storey building located in Indian seismic zone – V as per Indian standard code 1893-2002 are investigated using nonlinear static pushover analysis. A parametric study involving parameters such as shape of eccentric bracing, area of section, amount of eccentricity etc. are performed for selecting the type of eccentric bracing. The results of pushover analysis, reported in terms of storey drift demand and collapse fragility curve, showed that buildings with eccentric bracings have lower drift demand and probability of collapse

Misam Abidi et al [12] Severe structural damage suffered by several modern buildings during recent earthquakes illustrates the importance of avoiding sudden changes in lateral stiffness and strength. Recent earthquakes that occurred have shown that a large number of existing reinforced concrete buildings are vulnerable to damage or even collapse during a strongearthquake. While damage and collapse due to soft story are most often observed in buildings, they can also be developed in other types of structures. The lower level containing the concrete columns behaved as a soft story in that the columns were unable to provide adequate shear resistance during the earthquake. So, in this paper highlights the importance for immediate measures to prevent the indiscriminate use of soft first story in buildings, which are designed without regard to the increased displacement, ductility and force demands in the first story and this paper argues the importance of novel design approach which has an advantage of interaction between rigid frames and shear walls. A combination of the two structural components leads to a highly efficient system, in which the shear wall resists the majority of the lateral loads in the lower portion of the building, and the frame supports the majority of the lateral loads in the upper portion of the building**.**

III.PROPOSED WORK

From previous studies it has been seen that, soft stories in high rise building are becoming an unavoidable feature. Soft stories can be used for various purposes. So far whatever work done related to the soft stories is mostly done for only ground open storey. Again which is related to single loading system like earthquake load

or wind load. In this current project work, it has been decided to analyse a high rise building G+29 with multiple soft stories at different levels along with the ground level. Also it has been decided to analyse the same model for different loading systems like Normal loading condition, earthquake load, wind load, and earthquake + wind load. A very broad and detailed study is proposed.

IV.CONCLUSION

- From the above literature, it is seen that the researches are in interest of usage of soft storey in high rise building & strengthening of it is preferred.
- Research was carried mainly on dynamic behaviour of structure. Researchers studied the behaviour of high rise building with soft storey mostly at bottom storey kevel only.
- In proposed study a broad idea about soft storey at multiple levels under different loading system will be cleared.

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