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DESING AND ANALYSIS OF MULTI STORED G+2 BUILDING USING ETABS

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Abstract - Any building structure used by the industry to store raw materials or for manufacturing products of the industry is called an industrial building. Industrial buildings can be classified as Normal type industrial buildings and Special type industrial buildings. Normal types of industrial building are shed type buildings with simple roof structures on open frames. Such buildings are used as workshops, warehouses etc. These buildings require large and clear areas unobstructed by the columns. The large floor area provides sufficient flexibility and facility for later change in the production layout without major building alterations. The industrial buildings are constructed with adequate headroom for the use of an overhead traveling crane. Special types of industrial buildings are steel mill buildings used for manufacture of heavy machines, production of power, shopping malls etc. The function of the industrial building dictates the degree of sophistication

Multi storied Industrial/commercial building is selected and is well analyzed and designed. It is a Ground+2 storied building, located at Hyderabad. The analysis and designing was done according to the standard specification to the possible extend. The analysis of structure was done using the software package E-tabs. All the structural components were designed manually. Detailing of reinforcement was carried in AutoCAD 2022. The software saves time involved, taking a safer side rather than the manual work.

KEYWORDS:

- E-tabs (Extended Three-Dimensional Analysis of Building System)

- Load Combinations
- IS 456 -Plain and Reinforced Concrete
- IS 875 (Part-1) –Deal Load
- IS 875 (Part-1) –Live Load
- IS 875 (Part-1) –Wind Load
- IS 1893(Part-1) – General Provisions and Buildings

1.INTRODUCTION

Recently, most of the high-rise buildings may have basement used as parking lots or shopping malls etc. In general, it is commonly assumed that the building is fixed at the ground level in the analysis and the basement is not included in the analytical model. Using this assumption, the lateral stiffness of the structure may be overestimated since the flexibility introduced by the basement is ignored. Therefore, natural periods may be shortened and the dynamic response of a building structure may be misestimated due to this inaccurate prediction of the lateral stiffness

In general, only gravity loads are considered in designing the basement structure without the effect of lateral forces as earthquake loads applied to the super structure such. But the seismic loads applied to the super structure will affect the member forces in the basement structure. The previous researches on buildings with basement were only focused on the dynamic behavior of a structure using a simplified model and could not cover the effect of seismic loads on basement structural members. This study analyzed the seismic impact effect on the high-rise building and the member force of the basement's response due to the seismic loads. Particular concern in seismic analysis of a high-rise building structure with basement is to achieve an approximate value of the high shear forces acting on the basement structure. This study carefully investigates the shear force in the basement and develops an efficient method to analyze the effect of a basement in the case of high-rise buildings, which makes use of the partial or full rigid diaphragm and the condensation procedure in the matrix.

Earthquake has always been a threat to human civilization from the day of its existence, devastating human lives, property, and man-made structures. It is such an unpredictable calamity that it is very necessary for survival to ensure the strength of the structures against seismic forces. Therefore, there is continuous research work going on around the globe revolving around development of new and better techniques that can be incorporated in structures for better seismic performance. Obviously, buildings designed with special techniques to resist damages during seismic activity have much higher cost of construction than normal buildings, but for safety against failures under seismic forces, it is a prerequisite.

1.1 DYNAMIC ACTIONS OF BUILDING

Dynamic actions are caused on buildings by both wind and earthquakes. But, design for wind forces and for earthquake effects are distinctly different. The intuitive philosophy of structural design uses force as the basis, which is consistent in wind design, wherein the building is subjected to a pressure on its exposed surface area; this is force-type loading. However, in earthquake design, the building is subjected to random motion of the ground at its base (Figure 1.1), which induces inertia forces in the building that in turn cause stresses; this is displacement-type loading. Another way of expressing this difference is through the load-deformation curve of the building – the demand on the building is force (i.e., vertical axis) in force-type loading imposed by wind pressure, and displacement (i.e., horizontal axis) in displacement-type loading imposed by earthquake shaking.

1.2 CHARACTERISTICS OF BUILDING

There are four aspects of buildings that architects and design engineers work with to create the earthquake-resistant design of a building, namely seismic structural configuration, lateral stiffness, lateral strength and ductility, in addition to other aspects like form, aesthetics, functionality and comfort of building. Lateral stiffness, lateral strength and ductility of buildings can be ensured by strictly following most seismic design codes. But, good seismic structural configuration can be ensured by following coherent architectural features that result in good structural behavior.

2. LETERATURE REVIEW

Akbari et al. (2015) assessed seismic vulnerability of steel X-braced and chevron-braced Reinforced Concrete by developing analytical fragility curve. Investigation of various parameters like height of the frame, the p-delta effect and the fraction of base shear for the bracing system was done. For a specific designed base shear, steel-braced RC dual systems have low damage probability and larger capacity than unbraced system. Combination of stronger bracing and weaker frame reduces the damage probability on the entire system. Irrespective of height of the frame, Chevron braces are more effective than X-type bracing. In case of X-type bracing system, it is better to distribute base shear evenly between the braces and the RC frame, whereas in case of Chevron braced system it is appropriate to allocate higher value of share of base shear to the braces. Including p-delta effect increases damage probability by 20% for shorter dual system and by 100% for taller dual systems. The p-delta effect is more dominant for smaller PGA values.

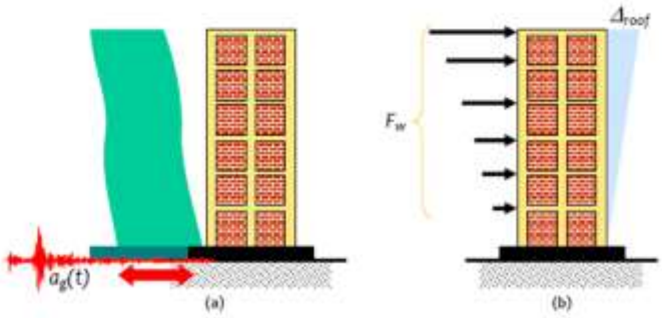

Figure 1.1: Difference in the design effects on a building during natural actions of (a) Earthquake *Ground Movement* at base, and (b) *Wind Pressure* on exposed area

Earthquake shaking is random and time variant. But most design codes represent the earthquake-induced inertia forces as the net effect of such random shaking in the form of design equivalent static lateral force. This force is called as the Seismic Design Base Shear VB and remains the primary quantity involved in force-based earthquake-resistant design of buildings. This force depends on the seismic hazard at the site of the building represented by the Seismic Zone Factor Z. Also, in keeping with the philosophy of increasing design forces to increase the elastic range of the building and thereby reduce the damage in it, codes tend to adopt the Importance Factor I for effecting such decisions (Figure 1.12). Further, the net shaking of a building is a combined effect of the energy carried by the earthquake at different frequencies and the natural periods of the building. Codes reflect this by the introduction of a Structural Flexibility Factor Sa/g. Finally, as discussed in section 1.2 of Chapter 1, to make normal buildings economical, design codes allow some damage for reducing cost of construction.

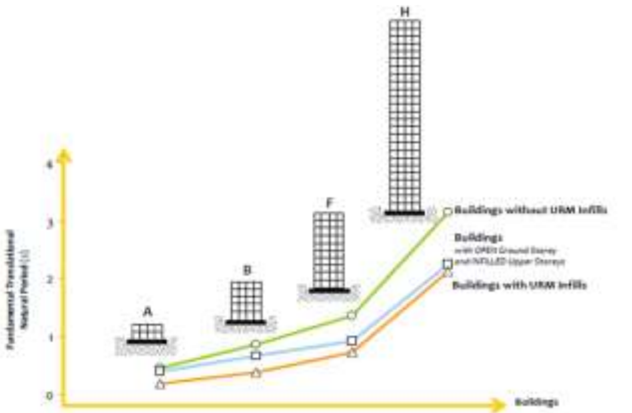

Figure 2.11: *Effect of Unreinforced Masonry infills*: Natural Period of building is lower when the stiffness contribution of URM infill is considered

3. CONCLUSIONS

The effect of the basement on the seismic response of high-rise buildings and the effect of the lateral forces applied to

the superstructure on the member forces in the basement were investigated in this study and the following conclusions could be drawn.

1. Lateral stiffness of a high-rise building structure may be significantly overestimated resulting in larger lateral displacements and shorter natural periods of vibration if the basement of a high-rise building is ignored in the analytical model. Especially in the case of the building structures with shear walls, the effect of the basement on the seismic response turned out to be more significant. Therefore, it is necessary to include the effect of basement in the analysis of high-rise building structures.

ACKNOWLEDGEMENT

. I acknowledge that the following design and analysis are based on general guidelines and may not meet specific local building codes or regulations. It is essential to consult with local authorities and experts to ensure compliance.

Building Details
- Building type: Residential/Commercial
- Number of stories: G+2 (Ground floor + 2 floors)
- Building dimensions: 30m x 20m
- Floor height: 3.5m
- Building material: Reinforced Concrete (RC)

Design Loads
- Dead load: 4 kN/m^2 (self-weight of the structure)
- Live load: 2 kN/m^2 (occupancy load)
- Wind load: 1.5 kN/m^2 (basic wind speed of 30 m/s)
- Seismic load: As per IS 1893 (Part 1): 2016

ETABS Modeling
1. Create a new model in ETABS.
2. Define the building geometry, including the number of stories, floor heights, and building dimensions.
3. Assign the design loads to the respective floors and frames.
4. Define the material properties for the RC structure.
5. Analyze the structure using the linear static analysis option.

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