International Research Journal of Education and Technology
Peer Reviewed Journal

ISSN 2581-779

Design and analysis of G+5 residential building using E-tabs

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Abstract.

High-rise buildings often contain basements, which are often assumed in structural analysis to be at a fixed ground level. However, basements introduce flexibility, leading to larger lateral displacements, longer vibration periods, and even changes in seismic response. For example, a 20-story building with a basement had a roof displacement of 13.8 cm compared to 12.7 cm without the basement, and its vibration period increased by 10%. Seismic loads also influence member forces in basements, and their consideration in structural analysis is necessary for accuracy. A matrix condensation procedure, which employs rigid diaphragms to reduce degrees of freedom in basement floors, has been proposed to address this issue effectively. In India, many G+15 reinforced concrete (RC) structures are constructed in high seismic zones without adherence to seismic coal provisions. This lack of compliance poses great risks to occupants, as earthquakes often expose the vulnerabilities of inadequately designed structures. The most common failure mechanism in such buildings is the soft story sway mechanism, where insufficient column strength causes large lateral displacements.

1.INTRODUCTION

Recently, most of the high-rise buildings may have basement used as parking lots or shopping malls etc. Generally speaking, the analysis assumed that the building is fixed at the ground level and does not consider the basement in the analytical model. Therefore, by using this assumption, the lateral stiffness of the structure might be overestimated because the flexibility that was introduced by the basement was not considered. Therefore, the natural periods may be shortened, and the dynamic response of a building structure might be misestimated because of this inaccurate prediction of the lateral stiffness. Normally, 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. However, 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.

1.1 ETABS SOFTWARE

ETABS stands for extended three dimentional analysis of building systems. ETABS
offers a user interface to perform modelling, Analysis, Design and Reporting. ETABS
provide sophisticated analysis and design for steel, concrete, and masonary structure.

➢ Assam on 15th August,1950 with an intensity of 8.6. In ETABS beams and
columns are known as area objects.

➢ It has built in template.

➢ It has built in code books.

➢ It can calculate loads automatically on beams and columns.

➢ Easy to give floor loads for irregular panels.

1.2 SCOPE

➢ This paper deals with the analysis of reinforced concrete moment resisting open frame, open
Frame with braces and open frame with shear walls only, using the Staad Pro program. The
The effect of brick infill is ignored.

➢ This is a theoretical 12 story building with normal floor loading and no
in-fill wall

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2. LITERATURE REVIEW

1. Analysis And Design Of G+5 Residential Building By Using E-tabs:

Author: N. Lingeshwaran

Year: 2017

Journal details:

The structure is design based on the E-TABS, and the theory of LIMIT STATE METHOD

which provide adequate strength, serviceability, and durability besides economy. The displacement, shear force, bending moment variation has been shown. If any beam fails, the dimensions of beam and column should be changed and reinforcement detailing can be produced.

2. Designing and Analysis of residential building using ETABS along with Green Building concept:

Author: : : Ujjwal Bhardwaj year: 2018

Journal details:

We have tried to use renewable resources more sensibly by implementing green concepts in residential buildings for creating an eco-friendly environment, which will excel the living experience of residents and minimize the ecological footprints of the building. This paper presents stories RCC framed building analyzed and designed under the lateral loading effect of earthquake using (Extended Three Dimensional Analysis of Building system).

3 OVERVIEW :

It is very important to develop a computational model on which linear / non-linear, static/ dynamic analysis is performed. The first part of this chapter presents a summary of various parameters defining the computational models, the basic assumptions and the geometry of the selected building considered for this study.

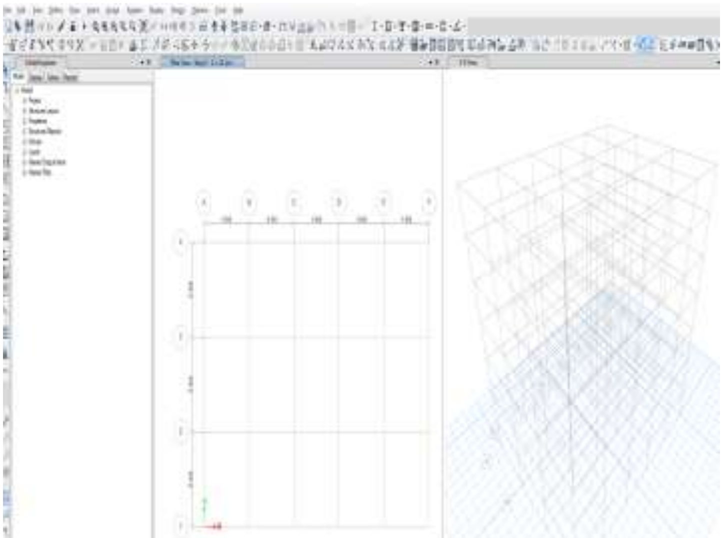
Accurate modeling of the nonlinear properties of various structural elements is very important in nonlinear analysis. In the present study, frame elements were modeled with inelastic flexural hinges using point plastic model. A detailed description on the nonlinear modeling of RC frames is presented in this chapter.

Infill walls are modelled as equivalent diagonal strut elements. The last part of the chapter deals with the computational model of the equivalent strut including modelling nonlinearity.

3.1 BUILDING DESCRIPTION :

An existing OGS framed building located at Guwahati, India (Seismic Zone -V) is selected for the present study. The building is fairly symmetric in plan and in elevation.

- \to. of Floors of Building – G+5
- \slab Thickness – 150 m
- Each Floor Height – 3m
- Total Height of the Building – 21 m
- External Wall Thick – 230 mm
- Internal Thickness – 120 mm
- For Live Load – 3.5 kN/m2
- Column Sizes – 400 x 400 mm
- Beam Sizes – 300 x 450 mm



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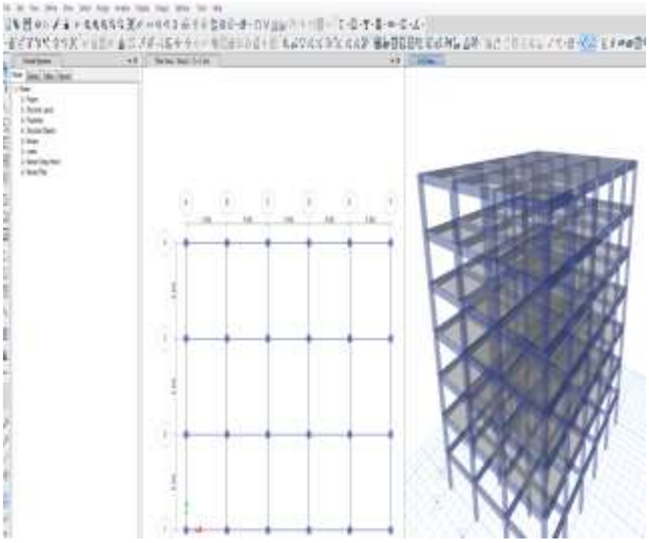


a) Dead Load (IS875-PART-1):

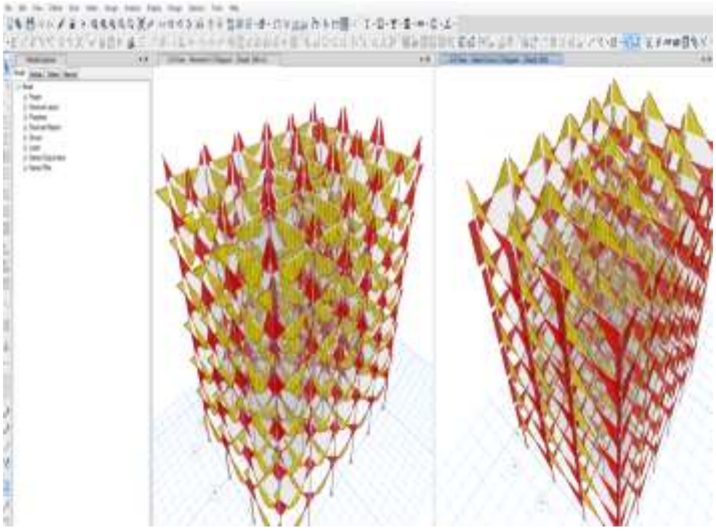
A building has to perform many functions satisfactorily. Amongst these functions are the utility of the building for the intended use and occupancy. Structural safety, fire safety; and compliance- with hygienic. Sanitation, ventilation and daylight standards. The design of the building is dependent upon the minimum requirements prescribed for each of the above functions. This code is covering the minimum requirements pertaining to the structural safety of buildings by laying down minimum design loads which have to be assumed for dead loads, imposed loads, snow loads, and other external loads the structure would have to bear.

b) Live Load (IS875-PART-2):

This standard (Part 2) deals with imposed loads* (live loads) to be assumed in the design of buildings.
The minimum loads imposed, as specified herein, shall be taken into consideration for the purpose of structural safety of buildings.
This Code does not make special provisions for loads incidental to construction and special cases of vibration, such as moving machinery, heavy acceleration from cranes, hoists and the like. Such loads shall be dealt with individually in each case

SEISMIC DESIGN FORCE:

Earthquake shaking is random and time variant. However, most of the 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 known as the Seismic Design Base Shear VB and remains the main 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). Moreover, 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.



4 DESIGN OF G+5 BUILDING

Structural Wall-Frame Systems:

Earthquake resistant buildings should possess, at least a minimum lateral stiffness, so that they do no swing too much during small levels of shaking. Moment frame buildings may not be able to offer this always. When lateral displacement is large in a building with moment frames only, structural walls, often commonly called shear walls, can be introduced to help reduce overall displacement of buildings, because these vertical plate-like structural elements have large in-plane stiffness and strength. Therefore, the structural system of the building consists of moment frames with specific bays in each direction having structural walls (Figure 3.29b). Structural walls resist lateral forces through combined axial-flexure-shear action. In addition, structural walls help reduce shear and moment demands on beams and columns in the moment frames of the building, when provided along with

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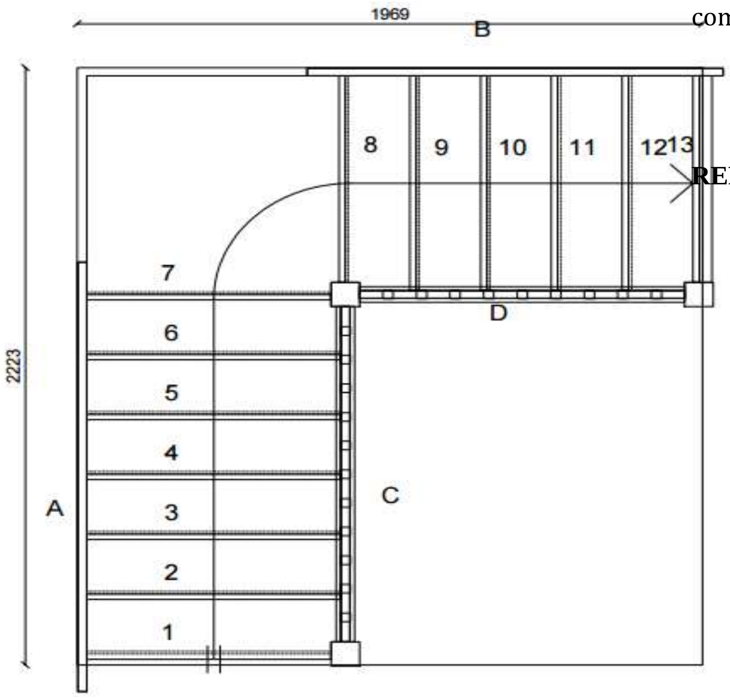
moment frames as lateral load resisting system. Structural walls should be provided throughout the height of buildings for best earthquake performance. Also, walls offer best performance when rested on hard soil strata.

Consider the five-story building, but with structural walls as shown in Figure 3.42. The first case differs from the rest in the position of the structural walls in both direction – the walls are at the building periphery in the first case, while they are placed near the center in the others. The last two examples are buildings with twice the wall area in the Y-direction; in the last case, two short (one-bay) walls combined together form one long (two-bay) wall.



3. CONCLUSIONS

The obtained static and dynamic analysis results in OMRF & SMRF structures for various columns under axial, torsion, bending moment and displacement forces. Results in graph-1 reveals that there are equal values obtained of axial forces in the static and dynamic analysis of OMRF structure. From graph-2, we can see that the values are negative in static analysis for torsion and positive in dynamic analysis. From graph-3, we can observe here that the values for bending moment at dynamic analysis values are high in the beginning for other columns it decreases gradually as compared to that of static analysis. From the graph-4 we can see that values of displacement in static analysis of OMRF values are higher as compared to the values obtained in dynamic analysis of values of same columns. Results in graph-5 reveals that values of axial forces obtained in dynamic analysis of SMRF structure

values are high as compared to that of static analysis. The results in graph-6 shows that the values are obtained for torsion in static analysis are negative and dynamic analysis values are positive with more difference. In the results graph-7, we can observe that the values for bending moment at dynamic analysis values are more as compared to that of static analysis SMRF structure.

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ISSN 2581-779

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