

SOFTWARE APPLICATION IN DESIGN OF RCC MULTISTORIED RESIDENTIAL BUILDING

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Abstract : A multi-storey, multi-paneled frame is a complicated statically intermediate structure. A design of R.C building of G+6 storey frame work is taken up. The vertical load consists of dead load of structural components such as beams, columns , slabs etc and live loads. In order to compete in the ever growing competent market it is very important for a structural engineer to save time. as a sequel to this an attempt is made to analyze and design a Multistoried building by using a software package staad pro rather than manual method. For analyzing a multi storied building one has to consider all the possible loadings and see that the structure is safe against all possible loading conditions. There are several methods for analysis of different frames like kani's method cantilever method portal method Matrix method. The present project deals with the analysis of a multi storied residential building of #\$\$%consisting of & apartments in each floor. The dead load 'live loads are applied and the design for beams columns footing is obtained.

Index Terms - Base Shear, Response Spectrum Method, Shear Wall, Static Method Analysis, a seismic design, beam-column joints, building codes, earthquake, multi-storied buildings, reinforced concrete, structural collapse

I. INTRODUCTION

In the seismic design of buildings, reinforced concrete structural wall, or shear wall, acts as a major earthquake Resisting member. Structural walls provide an efficient bracing system and offer great potential for lateral load resistance. Shear wall systems are one of the most commonly used lateral-load resisting systems in high-rise buildings. Shear walls have very high in-plane stiffness and strength, which can be used to simultaneously resist large horizontal loads and support gravity loads, making them quite advantageous in many structural engineering applications. The properties of these seismic shear walls dominate the response of the buildings, and therefore, it is important to evaluate the seismic response of the walls appropriately. In this study the main focus is to compare the dynamic responses of frame structure with and without shear wall.

Three models are generated with varying height with and without shear wall. G+5, G+10 and G+15 R-C frame models with and without shear walls are generated with varying structural member dimensions according to height. The models are analysed by Static Method and Response Spectrum Method considering seismic zone V in STAAD. Pro V8i. Parameters like lateral displacement, story drift, base shear and mode shapes are determined for all the models (with and without shear walls) by the three methods and are compared and the effectiveness of shear walls is enumerated. Also, comparisons are made based on some studies previously done by the other authors.

II. RCC MULTISTORIED RESIDENTIAL BUILDING:

A low-rise building is a building with up to four stories. A mid-rise building is generally between four to eleven or twelve stories. And a high-rise building is anything twelve stories or greater. Some contend that there sure be an ultra or super high-rise to classify those buildings which are incredibly high. Most of these terms are associated to the International Building Code (IBC), as well as local jurisdictions' own interpretations. But not all definitions will hold true across all disciplines, sectors, and countries.

III.APPLICATIONSOFREINFORCEDCONCRETE (RCC):

Reinforced concrete is ideally suited for the **construction of floor and roof slabs**, columns and beams in residential and commercial structures.

The present trend is to adopt **reinforced concrete for bridges** of small, medium and long spans resulting in aesthetically superior and economical structures in comparison with steel bridges. Due to development of modern concrete, the desired properties of concrete such concrete strength and durability can be achieved for any type of construction.

Benefits of multi storey buildings

Cost effective: When the building is under construction, the expenditure to the labor and equipments being used is lesser than that for other conventional buildings.

Light in weight: By the use of light weight Slabs and steel, floors of **Multi storey steel Building** are very light in weight, make these buildings impressive and keep them overall lighter in weight than other conventional buildings.

Designing freedom: One of the crucial features of multi storey building is its freedom of geometry, which make them more creative than other conventional buildings.

Well Mechanized construction: Since steel is not only a construction material but also delivers technical prowess, the steel components used in the installation of multi storey buildings are made with well mechanized practice and high precision software to achieve accuracy in construction.

Access to fire Safety: These buildings are designed and constructed to ensure that adequate fire safety provisions are incorporated to avoid threat to lives.

Natural light and ventilation: Exposure to Natural light and adequate ventilation enhances productivity. Multi storey building provides a good scope to natural light and Ventilation.

Sturdy Structure: **Multi storey PEB building** are engineered to cater a sturdy structure that even exhibit an excellent earthquake resistant behavior.

IV. HISTORY

STRUCTURAL ANALYSIS

A structure refers to a system of two or more connected parts use to support a load. It is an assemblage of two or more basic components connected to each other so that they serve the user and carry the loads developing due to the self and super-imposed loads safely without causing any serviceability failure. Once a preliminary design of a structure is fixed, the structure then must be analyzed to make sure that it has its required strength and rigidity. To analyze a structure a structure correctly, certain idealizations are to be made as to how the members are supported and connected together. The loadings are supposed to be taken from respective design codes and local specifications, if any. The forces in the members and the displacements of the joints are found using the theory of structural analysis. The whole structural system and its loading conditions might be of complex nature so to make the analysis simpler, we use certain simplifying assumptions related to the quality of material, member geometry, nature of applied loads, their distribution, the type of connections at the joints and the support conditions. This shall help making the process of structural analysis simpler to quite an extent. Methods of structural analysis When the number of unknown reactions or the number of internal forces exceeds the number of equilibrium equations available for the purpose of analysis, the structure is called as a statically indeterminate structure. Most of the structures designed today are statically indeterminate. This indeterminacy may develop as a result of added supports or extra members, or by the general form of the structure. While analyzing any indeterminate structure, it is essential to satisfy equilibrium, compatibility, and force-displacement requisites for the structure. When the reactive forces hold the structure at rest, equilibrium is satisfied and compatibility is said to be satisfied when various segments of a structure fit together without intentional breaks or overlaps. Two fundamental methods to analyze the statically indeterminate structures are discussed below.

Force methods-

Originally developed by James Clerk Maxwell in 1864, later developed by Otto Mohr and Heinrich Muller-Breslau, the force method was one of the first methods available for analysis of statically indeterminate structures. As compatibility is the basis for this method, it is sometimes also called as compatibility method or the method of consistent displacements. In this method, equations are formed that satisfy the compatibility and force-displacement requirements for the given structure in order to determine the redundant forces. Once these forces are determined, the remaining reactive forces on the given structure are found out by satisfying the equilibrium requirements.

Displacement methods-

The displacement method works the opposite way. In these methods, we first write load-displacement relations for the members of the structure and then satisfy the equilibrium requirements for the same. In here, the unknowns in the equations are displacements. Unknown displacements are written in terms of the loads (i.e. forces) by using the load-displacement relations and then these equations are solved to determine the displacements. As the displacements are determined, the loads are found out from the compatibility and load- displacement equations. Some classical techniques used to apply the displacement method are discussed. Slope deflection method- This method was first devised by Heinrich Manderla and Otto Mohr to study the secondary stresses in trusses and was further developed by G. A. Many extend its application to analyze indeterminate beams and framed structures.

The basic assumption of this method is to consider the deformations caused only by bending moments. It's assumed that the effects of shear force or axial force deformations are negligible in indeterminate beams or frames. The fundamental slope-deflection equation expresses the moment at the end of a member as the superposition of the end moments caused due to the external loads on the member, while the ends being assumed as restrained, and the end moments caused by the displacements and actual end rotations. A structure comprises of several members, slope-deflection equations are applied to each of the member. Using appropriate equations of equilibrium for the joints along with the slope-deflection equations of each member we can obtain a set of simultaneous equations with unknowns as the displacements. Once we get

the values of these unknowns i.e. the displacements we can easily determine the end moments using the slope-deflection equations.

Moment distribution method-

This method of analyzing beams and multi-storey frames using moment distribution was introduced by Prof. Hardy Cross in 1930, and is also sometimes referred to as Hardy Cross method. It is an iterative method in which one goes on carrying on the cycle to reach to a desired degree of accuracy. To start off with this method, initially all the joints are temporarily restrained against rotation and fixed end moments for all the members are written down. Each joint is then released one by one in succession and the unbalanced moment is distributed to the ends of the members, meeting at the same joint, in the ratio of their distribution factors. These distributed moments are then carried over to the far ends of the joints. Again the joint is temporarily restrained before moving on to the next joint. Same set of operations are performed at each joints till all the joints are completed and the results obtained are up to desired accuracy. The method does not involve solving a number of simultaneous equations, which may get quite complicated while applying large structures, and is therefore preferred over the slope-deflection method.

Kani's method-

This method was first developed by Prof. Gasper Kani of Germany in the year 1947. The method is named after him. This is an indirect extension of slope deflection method. This is an efficient method due to simplicity of moment distribution. The method offers an iterative scheme for applying slope deflection method of structural analysis. Whereas the moment distribution

method reduces the number of linear simultaneous equations and such equations needed are equal to the number of translator displacements, the number of equations needed is zero in case of the Kani's method. This

method may be considered as a further simplification of moment distribution method wherein the problems involving sway were attempted in a tabular form thrice (for double story frames) and two shear coefficients had to be determined which when inserted in end moments gave us the final end moments. All this effort can be cut short very considerably by using this method.

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