Study of Analysis and Design of Multistoried Residential Building

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Abstract- ***The principle objective of this project is to analyze and design a multi-storied building [G + 7] using STAAD. Pro. 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. Structural specifications involve identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads. The primary aim of this project is to focus on the structural design aspect of multi storey building residential RCC building. The residential buildings considered for this project consist of G+ 7 storey. For the facilitation of free moment a cantilever balcony is provided on outer sides. The present project deals with the analysis of a multi storied residential building of G+7 consisting of 12 apartments on each floor. The dead load & live loads are applied and the design for beams, columns, footing is obtained STAAD Pro V8i with its new features surpassed its predecessors, and compotators with its data sharing capabilities with other major software like AutoCAD, and MS Excel. The design methods used are Limit State Design conforming to Indian Standard Code of Practice we design the residential structure with STAAD. Pro software and cross check the designs with manual calculations to check safe loading calculation of the Building.***

I. INTRODUCTION

Civil engineering is the application of physical and scientific principles for solving the problems of society. The earliest practice of civil engineering may have commenced when humans started to abandon a nomadic existence, creating a need for the construction of shelter.

Every human has a desire to own comfortable home so the person does maximum effort and spends hard earned saving in owning houses. By studying principal of planning a plan is designed for a family in which each members of family can conveniently be accommodated. A flat which contain drawing hall, kitchen cum dining room, bedroom, and porch.

Residential land use is very important to a citizen's quality of life, and the standard of housing experienced by citizens will have a significant impact on overall health. Housing provides shelter, fulfilling basic human needs, and privacy. The quality of housing is influenced by size, amenities, habitability, and general livability. The attractiveness of residential areas and the wider urban environment are important from a societal security point of view since they have an impact on resilience, at individual and collective levels. The structural engineer must design structures to be safe for their users and to successfully fulfill the function they are designed for (to be serviceable). Structural specifications involves identifying the loads which act upon a structure and the forces and stresses which arise within that structure due to those loads, and then designing the structure to successfully support and resist those loads. The loads can be self weight of the structures, other dead load, live loads, moving (wheel) load, wind load, earthquake load, load from temperature change etc.

STAAD.Pro software is used for the computations of loads, moments and shear forces. Now a day's most of the high rise buildings are designed by STAAD.Pro which makes a compulsion for a civil engineer to know about this software. This software can be used to carry RCC, steel, bridge, truss etc according to various country codes

For the construction of structures the commonly used material is reinforced cement concrete and steel. The science of proportioning the structural elements to resist the applied loads and determining the numbers and size of reinforcing bar is called design of R.C.C structure.

II. LITERATURE REVIEW

A significant amount of research work on various structural aspects of use of structure and their mechanism has been published by many investigators. Review of some of the technical papers are briefed below

3.1 "Analysis of Multistory Building considering Hybrid Structure",
Tanha B. Shah,

Hybrid Structures are often built in which the lateral resistance is provided by a mixture of structures. The most common are moment resisting frames combined either with structural walls or diagonal bracing. It is the structure which is the combination of different structural system. In the Multistory building as per our engineering demand parameter, such as floor displacement, Storey Drift, Storey Moment and shear Forces, affected to structures subjected to earthquake load. Tubular frame structure is one of the most efficient systems in tall buildings under lateral load. The analysis of these structures usually involves considerable time and effort due to large number of members and joints. Pushover analysis (PA), static & Dynamic earthquake analysis are widely accepted from the engineering point of view as a practical and computationally attractive method of estimating engineering demand parameters.

3.2 "Elastic Seismic Response Of Reinforced Concrete Frames"
Kulkarni J.G. et, al. April 2013

They have presented an elastic seismic response of reinforced concrete frames with 3 bay, 5 bay and 7 bay 9 storey structures which have been analyzed for gravity as well as seismic forces and their response is studied as the geometric parameters varying from view point of predicting behaviour of similar structures subjected to similar loads or load combinations.

From the data revealed by the analysis for the structures with various loading combinations tried following conclusions are drawn: The conventional axial force calculated on contributory area closely approximates the true load in column segment at higher levels for 3 bay 9 storey structures and the 2/3rd height of frame from bottom and larger at the topmost level for 5 bay 9 storey structures and the column segment at 1/3rd height of frame and it reduces for topmost level for 7 bay 9 storey structures. Column segments at lower level attract larger axial forces as compared to bay variation i.e. as number of bays going to increase the axial forces in the column at bottom segments increases. The same is with bending moment.

3.3 "Comparison Of Dynamic Behaviour Of Multi-Towers High-Rise Buildings And Traditional High-Rise Buildings"
Wensheng LU and Xilin LU in August 2010

Their paper summarizes tests of several scaled multi-tower high-rise building models on the shaking table. The assumption of rigid floor is obviously unsuitable for the analysis of multitower buildings. A new analytic model considering the effect of flexible transfer floor is put forward. The theoretical dynamic behaviour is compared with the test results.
The dynamic behaviour of multi- towers high-rise buildings is usually different from traditional high-rise buildings. First of all, the distribution of floor mass and the lateral stiffness change sharply at different level hence the higher order vibration modes are dominant. Secondly, the members near those areas are easily destroyed under earthquake action. The door-shaped building structure has bad earthquake resistant ability. Because the rigid and heavy conjunction block is on the top of the building, and the dynamic response of the towers under earthquake action will increase. The couple action between transfer floors of multi-tower building with large podium is significant, which will cause the damages near the transfer floors, and each tower works separately if cracks appear after higher intensity earthquake. The flexible connections between towers can significantly reduce the drift of multi-tower high-rise buildings, and they will be destroyed and act as energy dissipation members during a moderate earthquake.

3.4 "Design And Control Of Concrete Mixtures"
Steven H. Kosmatka, Beatrix Kerkhoff, and William C. Panarese
January 25, 2013

This paper presents the properties of concrete as needed in concrete construction, including strength and durability. All concrete ingredients (cementing materials, water, aggregates, admixtures, and fibres) are reviewed for their optimal use in designing and proportioning concrete mixtures. Applicable ASTM, AASHTO, and ACI standards are referred to extensively. The use of concrete from design to batching, mixing, transporting, placing, consolidating, finishing, and curing is addressed. Special concretes, including high-performance concretes, are also reviewed.

Several issues such as intelligent access to previous design experience stored in databases, automatic generation and comparison of plausible alternatives, and acquisition of new knowledge through algorithmic structural optimization are discussed.

3.5 "EARTHQUAKE ANALYSIS AND DESIGN VS NON
EARTHQUAKE ANALYSIS AND DESIGN USING STAAD.Pro"
B. Suresh, P.M.B Raj kiran Nanduri

The opinion that designing new buildings to be earthquake resistant will cause substantial additional costs is still among the constructional professionals. In a swiss survey estimates between 3 and 17% of the total building costs were given. This opinion is unfounded .In a country of moderate seismicity adequate seismic resistance of new buildings may be achieved at no or no significant additional cost. However the expenditure needed to ensure adequate seismic resistance may depend strongly on the approach selected during the conceptual design phase and the relevant design method. Regarding the conceptual design phase early collaboration between the architect and civil engineering is crucial. Concerning the design method it should be stated that significant progress has been made recently. Intensive research has improved the understanding of the behavior of a building or structure during an earthquake and resulted in the development of more efficient and modern design methods

3.6 "Earthquake Analysis of Multi Storied Residential Building using STAAD.Pro - A Case Study"
E. Pavan Kumar, A. Naresh, M. Nagajyothi, M. Rajasekhar

The obtained results of static and dynamic analysis in OMRF & SMRF are compared for different columns under axial, torsion, bending moment and displacement forces. The results shows that there is equal values obtained of axial forces in static and dynamic analysis of OMRF structure. Values are obtained for torsion in static analysis are negative and dynamic analysis values are positive. The values for bending moment at dynamic analysis values are high in initially for other columns it decreased gradually as compared to that of static analysis. We can observe that the values for displacement in static analysis of OMRF values are more compared to that of dynamic analysis values of same columns. The values obtained of axial forces in dynamic analysis of SMRF structure values are high compare to static analysis. The values are obtained for torsion in static analysis are negative and dynamic analysis values are positive with more difference. The values for bending moment at dynamic analysis values are more as compared to that of static analysis SMRF structure. The values for displacement in dynamic analysis of SMRF values are gradually increased compared to that of static analysis values of same columns. The static and dynamic analysis of OMRF & SMRF values are observed. Finally it can conclude that the results of static analysis in OMRF & SMRF values are low when comparing to that of dynamic analysis in OMRF & SMRF values. Hence the performance of dynamic analysis SMRF structure is quiet good in resisting the earthquake forces compared to that of the static analysis OMRF & SMRF.

3.7 "Computer aided analysis and design of multi-storied buildings"
Mr Bedabrata Bhattacharjee , Mr A.S.V. Nagender

STAAD PRO has the capability to calculate the reinforcement needed for any concrete section. The program contains a number of parameters which are designed as per IS: 456(2000). Beams are designed for flexure,

Beam Design Output:
The default design output of the beam contains flexural and shear reinforcement provided along the length of the beam. Shear reinforcement is calculated to resist both shear forces and torsional moments.

Column Design:
Columns are designed for axial forces and biaxial moments at the ends. All active load cases are tested to calculate reinforcement. The loading which yield maximum reinforcement is called the critical load. Column design is done for square section. Square columns are designed with reinforcement distributed on each side equally for the sections under biaxial moments and with reinforcement distributed equally in two faces for sections under uni-axial moment. All major criteria for selecting longitudinal and transverse reinforcement as stipulated by IS: 456 have been taken care of in the column design of STAAD.

3.8 “Structural Design Of Foundation”
Prof. Satish Kumar and Prof. Santha Kumar October, 1988.

CHECK FOR BEARING CAPACITY:
While calculating over weight of concrete for checking bearing capacity of soil, the position of water table should be considered at critical location i.e., which would give maximum over weight of concrete¬2¬- Thus the maximum soil pressure below the base of the foundation (toe pressure) will depend up on the vertical thrust (compression load) on the footing and the moments at the base level due to the horizontal shears and other eccentric loadings. Under the action of down thrust and moments, the soil pressure below the footing will not be uniform and the maximum toe pressure 'p' on the soil can be determined

III. OBJECTIVE AND SCOPE

- Carrying out a complete analysis and design of the main structural elements of a multi-storey building including slabs, columns, foundations.
- Getting familiar with structural softwares (STAAD.Pro, AutoCAD)
- Doing In depth study of Structural engineering practices.

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