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A Modelling and Analysis Multistory Building Load Analysis Using Staad Pro Software

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Abstract- 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. 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 FEM method, cantilever method, portal method, and Matrix method. The present project deals with the design & analysis of a multi storied residential building of consisting each floor. The dead load &live loads are applied and the design for beams, columns, footing is obtained STAAD Pro with its new features surpassed its predecessors and compotators with its data sharing capabilities with other major software. We conclude that staad pro is a very powerful tool which can save much time and is very accurate in Designs. Thus it is concluded that staad pro package is suitable for the design of a multistoried building.

Keywords- STAAD.Pro, Multi-storey building, Autocad, Concrete mix, Steel strength, Limit state method.

I. INTRODUCTION

In every aspect of human civilization, we needed structures to live. The structures should be built in an efficient manner so that it canserve people and save money. In simple words, the building means anempty surrounded by walls and roofs, in order to give shelter forhuman beings. In early times humans have lived in caves to protectthemselves from wild animals, rain etc. Then, humans developed andbuilt their homes using timbers and lived. Nowadays the recent homesare developed into individual and multi-storey buildings. Buildings arethe necessary indicator of social progress of the county. At currentsituation, many new techniques have been developed for constructions.

So, that the buildings are built economically and quickly to fulfil theneeds of the people. A building frame is a three-dimensional structurewhich consists of column, beams and slabs. Because of growing population, high rise buildings are coming into demand. Buildings constitute a part of the definition of civilizations, a way of lifeadvanced by the people. The buildings should be constructed forhuman requirements and not for earning money. Buildings are built indifferent sizes, shapes and functions.

II. RESEARCH MOTIVATION

Our project involves analysis and design of multi-storeyed using a very popular designing software STAAD Pro. We have chosen STAAD Pro because of its following advantages: easy to use interface, conformation with the Indian Standard Codes, versatile nature of solving any type of problem, Accuracy of the solution. STAAD.Pro features a state-of-the-art user interface, visualization tools, powerful analysis and design engines with advanced finite element and dynamic analysis capabilities. From model generation, analysis and design to visualization and result verification, STAAD.Pro is the professional’s choice for steel, concrete, timber, aluminium and cold-formed steel design of low and high-rise buildings, culverts, petrochemical plants, tunnels, bridges, piles and much more.

III. LOADS CONSIDERED

1. Dead Loads:

All permanent constructions of the structure form the dead loads. The dead load comprises of the weights of walls, partitions floor finishes, false ceilings, false floors and the other permanent constructions in the buildings. The dead load loads may be calculated from the dimensions of various members and their unit weights. the unit weights of plain concrete and reinforced concrete made with sand and gravel or crushed natural stone aggregate may be taken as 24 kN/m” and 25 kN/m” respectively.

2. Imposed Loads:

Imposed load is produced by the intended use or occupancy of a building including the weight of movable partitions, distributed and concentrated loads, load due to impact and vibration and dust loads. Imposed loads do not include loads due to wind, seismic activity, snow, and loads imposed due to temperature changes to which the structure will be subjected to, creep and shrinkage of the structure, the differential settlements to which the structure may undergo.

3. Wind Load:
Wind is air in motion relative to the surface of the earth. The primary cause of wind is traced to earth's rotation and differences in terrestrial radiation. The radiation effects are primarily responsible for convection either upwards or downwards. The wind generally blows horizontal to the ground at high wind speeds. Since vertical components of atmospheric motion are relatively small, the term 'wind' denotes almost exclusively the horizontal wind, vertical winds are always identified as such. The wind speeds are assessed with the aid of anemometers or anemographs which are installed at meteorological observatories at heights generally varying from 10 to 30 metres above ground.

IV. LITERATURE REVIEW

AndrewAcred, Stack ventilation in multi-storey atrium buildings: A dimensionless design approach: Using a simplified mathematical model, a preliminary design strategy for steady stack ventilation in multi-storey atrium buildings is developed. By non-dimensionalising the governing equations of flow, two key dimensionless parameters are identified – a ventilation performance indicator, λ, and atrium enhancement parameter, E – which quantify the performance of the ventilation system and the effectiveness of the atrium in assisting flows. Analytical expressions are determined to inform the vent sizes needed to provide the desired balance between indoor air temperatures, ventilation flow rate and heat inputs for any distribution of occupants within the building, and also to ensure unidirectional flow. Dimensionless charts for determining the required combination of design variables are presented with a view to informing first-order design guidance for naturally ventilated buildings.

EwaGrabska, New visual languages supporting design of multi-storey buildings: This paper deals with designing multi-storey buildings with the use of a knowledge-based visual design support system. In this system two visual languages for creating design solutions by the designer are proposed. The first one allows the designer to design 2D floor layouts, while the second one is dedicated to creating 3D building structures. The generated design solutions in the form of drawings are internally represented as hierarchical hypergraphs gathering design knowledge on which reasoning about designs can be based. The approach is illustrated by example of designing a three-storey house.

AlexKaisera, From file to factory: Innovative design solutions for multi-storey timber buildings applied to project Zembla in Kalmar, Sweden: A "file-to-factory" process of computer technology is a way to both maximize efficiency throughout the building process, increase a building's performance, and be able to add interesting architectural possibilities throughout the design phase. The authors investigate a novel approach that produces a set of buildingtrajectories rather than a set of buildings yet yields a series of build-able examples of those trajectories. This paper evaluates how this series of stacked multi-storey timber buildings can be both incorporated within a file-to-factory process, and give rise to creating new innovative solutions throughout the entire design and manufacturing process.

This process is applied to a real Swedish project called Zembla. It redefines the notion of sprawl, turning it into a progressive tactics for linking the city fabric to rural areas. It is a post-sustainable file-to-factory-produced timber ground-scraper; soaring above ground and water, suggesting a new way of making city-sized buildings for the future.

AnnaKrtschil, Structural development of a novel punctually supported timber building system for multi-storey construction: Though capable of allowing multi-directional spans, timber products such as cross-laminated timber are primarily utilized uni-directionally using linear supports like walls or beam elements. Recent building designs increasingly show punctual supports but with narrow column grid layouts. Support beams and narrow grids limit the design space for multi-storey timber buildings. To overcome these design limits, an integrative design concept for punctually supported timber slabs is being developed that allows for large spans and irregular column layouts. Therefore, engineering methods are integrated in the architectural design of the building components, such as plates, columns, and their connections. The developed slab system combines hardwood and softwood materials in a sandwich construction. The plates have a tailored internal topology considering the force flow in the slab. A plate-to-plate connection design is evaluated through mechanical tests, which also serve as calibration for the global structural model. The research findings are validated through the design and construction of a large-scale demonstrator: the ITECH Campus Lab.

Georgios S.Papavasileiou, Seismic design optimization of multi–storey steel–concrete composite buildings: This work presents a structural optimization framework for the seismic design of multi–storey composite buildings, which have steel HEB-columns fully encased in concrete, steel IPE-beams and steel L-bracings. The objective function minimized is the total cost of materials (steel, concrete) used in the structure. Based on Eurocodes 3 and 4, capacity checks are specified for individual members. Seismic system behavior is controlled through lateral deflection and fundamental period constraints, which are evaluated using nonlinear pushover and eigenvalue analyses. The optimization problem is solved with a discrete Evolution Strategies algorithm, which delivers cost-effective solutions and reveals attributes of optimal structural designs.

M.Fragiacomo, Elastic and ductile design of multi-storey crosslam massive wooden buildings under seismic actions: The paper discusses the seismic design of multi-storey buildings made from cross-laminated timber panels ('crosslam'). The use of seismic analysis methods such as the modal response spectrum and the non-linear static (push-over) analysis is discussed at length, including issues such as the modelling of crosslam walls and connections, the evaluation of the connection stiffness, and the schematization of floor panels. It was found that it is crucial to account for the flexibility of the connections (hold-downs and angle brackets) between upper and lower walls, since otherwise the vibration periods of the building would be underestimated. The basics of capacity design to ensure the attainment of ductile mechanisms in crosslam timber structures under seismic actions are presented. The ductile failure mechanism is characterized by plasticization of connectors (hold-downs, angle brackets and screws) between adjacent wall panels and between panels and foundations. The crosslam panels and the connections between adjacent floor panels must be designed for the overstrength of the connectors to ensure that they remain elastic during the earthquake and the ductile failure mechanism is attained. Based on the results of preliminary quasi-static cyclic tests, a value of 1.3 was found for the overstrength factors of hold-downs and angle brackets.

A case study multi-storey crosslam massive wooden building was then analyzed using the non-linear push-over analysis as implemented in the N2 method recommended by the Eurocode 8. The building was modelled using shell elements and non-linear links to schematize the hold-downs and angle brackets. The building ductility, calculated from the bilinear curve equivalent to the actual non-linear push-over curve, was then investigated. Such a quantity, defined as the ratio of the displacement at the near collapse state and the maximum elastic displacement of the top floor, was found to rise from 1.7 to 2.5 when ductile instead of brittle hold-downs and angle brackets are used. Furthermore, the maximum peak ground acceleration the building can resist raised from 0.2g to 0.4g, demonstrating the importance of using ductile connectors in seismic design.

Sreeshna K.S (2016) this paper deals with structural analysis and design of B+G+4 storied apartment building. The work was completed in three stages. The first stage was modelling and analysis of building and the second stage was to design the structural elements and the final was to detail the structural elements. In this project STAAD.Pro software is used for analysing the building. The IS: 875 (Part 1) and (Part 2) were referred for dead load and live load. Design of structuralelements like beam, column, slab, staircase, shear wall, retaining wall, pile foundation is done according to IS Codes. Amar Hugar et al., (2016) has been discussed that the Computer Aided Design of Residential Building involves scrutiny of building using STAAD.Pro and a physical design of the structure. Traditional way of study shows tedious calculations and such tests is a timeconsuming task. Analysis is made quickly by using software's. This project completely deals with scrutiny of the building using the software STAAD.Pro. Finally, the results are compared with physical calculations. The elements are created as per IS: 456-2000. Bandipati Anup et al., (2016) this paper deals with evaluate and plan a multi-storeyed building [G + 2 (3- dimensional frame)] adopting STAAD Pro. The technique used in STAAD.Pro is limit state technique. Initially they have created 2-D frames and cross checked with physical calculations.

The exact result should be proved. We tested and created a G + 2 storey building [2-D Frame] instantly for all feasible load combinations. The work has been finished with some more multi-storeyed 2-Dimensional and 3-Dimensional frames beneath various load combinations Aman et al., (2016) has discussed that the point of the structural engineer is to model a guarded structure. Then the structure is subjected to various types of loading. Mostly the loads put in on the building are considered as static. Finite part analysis that exhibit the result of dynamic load like wind result, earthquake result, etc. The work is conducted using STAAD.Pro software.

Madhurivassavai et al., (2016) he says that the most common problem country facing is the growing population. Because of the less availability of land, multi-storey building can be constructed to serve many people in limited area. Efficient modelling is performed using STAAD.Pro and AutoCAD. Manual International Journal of Pure and Applied Mathematics Special Issue 2798 calculations for more than four floor buildings are tedious and time consuming. STAAD.Pro provides us a quick, efficient and correct platform for analysing and coming up with structures Borugadda Raju et al., (2015) has been designed and analysed G+30 multi-storey building adopting STAAD.Pro in limit state methodology. STAAD.Pro contains an easy interface that permits the users to produce the mount and the load values and dimensions are inputted. The members are designed with reinforcement details for RCC frames.

V. RESULTS AND SIMULATIONS

STAAD or (STAAD.Pro) is a structural analysis and design software application originally developed by Research Engineers International in 1997. In late 2005, Research Engineers International was bought by Bentley

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Systems. [1][2] STAAD stands for STructural Analysis And Design.[3]

STAAD.Pro is one of the most widely used structural analysis and design software products worldwide. It can apply more than 90 international steel, concrete, timber and aluminium design codes.

It can make use of various forms of analysis from the traditional static analysis to more recent analysis methods like p-delta analysis, geometric non-linear analysis, Pushover analysis (Static-Non Linear Analysis) or a buckling analysis. It can also make use of various forms of dynamic analysis methods from time history analysis to response spectrum analysis. The response spectrum analysis feature is supported for both user defined spectra as well as a number of international code specified spectra.

Additionally, STAAD.Pro is interoperable with applications such as RAM Connection, AutoPIPE, SACS and many more engineering design and analysis applications to further improve collaboration between the different disciplines involved in a project. STAAD can be used for analysis and design of all types of structural projects from plants, buildings, and bridges to towers, tunnels, metro stations, water/wastewater treatment plants and more.

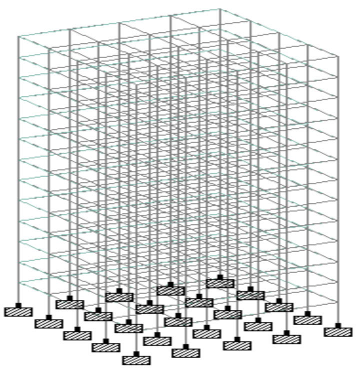

Fig 1. 3D modelling View.

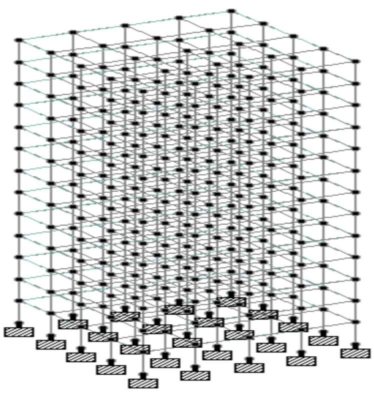

Fig 2. Node Points.

VI. CONCLUSION

Planning, analysis and design of multi-storey residential building was done. It’s a storied building with parking in the basement and the rest of the floors are occupied with apartments. All the structural components were designed manually and detailed using STAAD. The analysis and design were done according to standardspecifications using STAAD.Pro for static and dynamic loads.

The dimensions of structural members are specified and the loads such as dead load, live load, floor load and earthquake load are applied. Deflection and shear tests are checked for beams, columns and slabs. The tests proved to be safe. Theoretical work has been done. Hence, I conclude that we can gain more knowledge in practical work when compared to theoretical work.

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