



A Review on Analysis and Design of Multistorey Hospital Building (G+4)

Rachana Arun Giri^a, Aafreen Khan^b, Shreyas R. Shende^c, Shivani A. Khanke^d, Shradhesh R. Marve^e, Ankita Kaurase^f, Nitin Detha^g

^{a,b,f,g}Student, Shri Sai College of Engg. & Tech. Bhadrawati, Dis't Chandrapur, 442902, (MS), India

^{c,d,e}Assistant Professor, Shri Sai College of Engg. & Tech. Bhadrawati, Dist Chandrapur, 442902, (MS), India

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ABSTRACT

As we all know that civil engineering concepts have been spread all over the world. And it has been widely spreading in recent years. Development in India focuses majorly on the Civil engineering concept. As Civil Engineers, we must be able to analyse and design parts of a Building like beams, Columns, Slab, etc. We all are aware that Padoli is a small area coming in Chandrapur District. In recent years, various construction has been started here and the population is increasing accordingly. Keeping in mind, we have selected a construction site of a Hospital Building which is 7000 sq. ft. Hospital is a basic need of today's generation. For this, we have decided to make a layout plan of a Hospital Building and its Analysis and Design of structure. We are going to Draft a plan of the site and accordingly parts of a building. For this, we will be using AutoCAD 2D & 3D Software. After getting all the details about the structure, we will be analyzing and design its parts with the help of STAAD Pro Software. Using Indian Standard Codes for standard specification will be beneficial while calculating loads of different parts at a different storeys.

Keywords: Analysis, Design, Hospital Building, AutoCAD, STAAD Pro

1. Introduction

We are going to study the Multi-storey Hospital building constructed in Padoli near Kanda Petrol Pump (Chandrapur District). The structural design of the building should ensure that the building can stand safely, and operate without excessive deformation or movement that could lead to fatigue of structural elements, cracks or failure of fixtures, fitting or partitions or failure. The project work is to analyze and design a G+4 storey building for different load combinations using AutoCAD and STAAD Pro software. The building frame consists of several bays and storeys. A multi-storey, multi-panelled frame is a complicated intermediated structure. A design of the G+4 storey framework is taken up. The building is subjected to both vertical loads as well as horizontal loads. The vertical load consists of a dead load of a structural component such as a beam, column, slab etc. and a live load. The horizontal load consist of the wind forces thus the building is designed for dead load, live load, and wind load as per **IS 875**.

1.1 Aim

Padoli is a village in the Chandrapur district where the population is increasing as the growth of Schools and Colleges has increased. If a hospital is built here, people will not have to come far to Chandrapur. So we have decided to plan and design the building of a Hospital near Padoli village.

1.2 Objectives

- To create the model in AutoCAD.
- To analyze the structure of a building in STAAD Pro.
- To design the structure building in STAAD Pro

2. Literature Survey

1. *Design and Analysis of Multistorey (G+14) Residential Building Using Staad.Pro and Autocad*

Author name:-SowravSaha

In this paper, the Author dealt with the analysis and design of the multistoried building by using the 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 the analysis of different frames like Kani's method, Cantilever method, Portal method, and Matrix method. The project in this paper deals with the design & analysis of a multi-storied residential building of G+14 consisting of 2 apartments on each floor. The dead load & live loads are applied and the design for beams, columns, and footing is obtained. STAAD Pro with its new features surpassed its predecessors and competitors with its data-sharing capabilities with other major software like AutoCAD. And concluded that STAAD Pro is a very powerful tool which can save much time and is very accurate in Designs. (Saha et al., 2021)

2. *Analysis and Design of a Residential Building by using STAAD Pro*

Author Name:- Kunal Wailkar, et.al

In this paper, the Author tried to focus on a residential building. The project aims to analyse and design for constructing a structure capable of overcoming all applied loads without failure during its intended life. The process of structural design involves various stages such as computation of loads, member design, detailing and many more. The conventional method of structural design and analysis leads to a lot of complications and tedious calculations which are time-consuming. Nowadays to complete a design and analysis efficiently, fast software's used. Computer-aided design of the residential building by using STAAD PRO includes- Generating a structural framing plan, Getting a model, Analysis of the structure, and Designing of structure. (Wailkar et al., 2021)

3. *Analysis and Design of Multistorey Building G+4*

Author Name:- MohdZohair

The author tried to study, a building that has multiple floors above the ground. It can be a residential or commercial building. This project deals with the analysis and design of the multi-storey building G+4. In general, the analysis of multi-storey is elaborate and rigorous because those are statically indeterminate structures. Shears and moments due to different loading conditions are determined by many methods such as the portal method, moment distribution method and matrix method. The dead load & live loads are applied and the design for beams, columns, and the footing is obtained manually. The Analysis part of the structure is done using Kani's Method and the values are taken for design. (Zohair, 2018)

4. *Analysis and Design of (G+20) Multi-Storey Residential Building using Staad.Pro*

Author Name:- P.Leela Krishna

In this paper, the Author tried to focus to analyze and design a Multistoried building by using the software package STAAD Pro. The main objective of this project is to analyse and design a (G+20) multi-storied building using STAAD Pro. The code refers for this project are NBC, IS 456-2000, and SP16. The concrete mix used in this project is M30. (Krishna, 2020)

5. *Analysis and Design of Multi-Storied Residential Building using Staad.Pro and Manual Calculations.*

Author Name:- Pranay R. Girde, et.al

This project is based on most of the software and it is necessary to know the details. The main objective of the project is to design and analyze multi-storied buildings that include manual load calculation. This is a business choice that gives and redirects to the user visualization and result verification. It was analyzed using different load combinations. Each floor had 97 beams and 24 beams. Each floor had a height of 3 meters. (Girde et al., 2022)

6. *Analysis and design of the multistorey building by using STAAD Pro*

Author Name:- Aman, Manjunath Nalwadgi, et.al

The author explained that in the design of the structures for safe technology in the computing field; the structural engineer can dare to tackle much more large and complex structures subjected to various types of loading conditions. Earlier the loads acting on the structure were considered static, but strictly speaking, except for the self-weight (dead load) no structure load is static. Finite element analysis includes the effect of dynamic load such as wind effect, earthquake effect, etc. (Nalwadgi & Vishal, 2016)

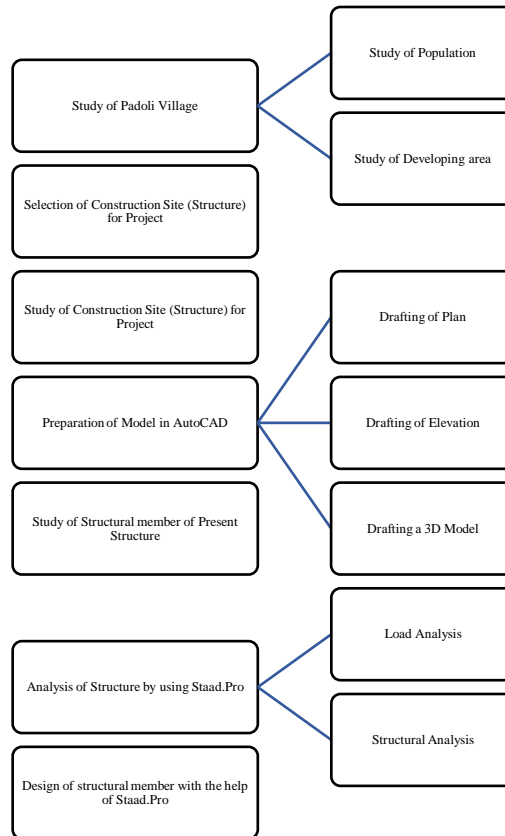
7. *Design & Analysis of Multi-Storied Car Parking Building (G+2)*

DESIGN OF MULTILEVEL CAR PARKING BUILDING A building which reduces the space for parking and also accommodates a large number of vehicles. The study presents the design of multi-level car parking for the mitigation of traffic challenges in public areas. The area of the building is 6800 m². The building is connected at one level and the levels of other floors are different. All floors are designed to accommodate 50 vehicles. The automatic car parking system enables the parking of vehicles floor after floor and thus reduces the space used. This makes the system modernized and thus space-saving. The plan for this building was prepared using Auto CAD software. The analysis of the frame was carried out for vertical and horizontal loads using STAAD. Pro software. The design has been done according to Indian standard code IS 456:2000. The structural elements like slab, beam, columns, footing, staircase and ramp have been designed and detailed. (S Jumde, Marve et al., 2020)

8. A Review of Parking Management System at SSCET Campus

Population As per research, the Population increased due to which the number of vehicles percentage is increased in the last three decades in a regular manual survey was carried out with taking help of the Municipal Council & Census town which gives clear data about the growth in the population of Chandrapur (Barde et al., 2022)

3. Methodology



Selection of Study location (Marve & Bhorkar, 2016)

1. Study of Padoli Village

For selecting any site it is necessary to study its neighbourhood area and environment. For that purpose, we have studied the Population of various nearby areas.

1) *Population in Chandrapur District:* According to the study, the population has regularly increased in last three decades. The survey done by Municipal Council & Census Towns gives a clear idea about the growth of population in Chandrapur District. In 1991, the population was 1,771,994 which increased to 2,071,101 in 2001. In 2011, it has been increased to 2,194,262. It clearly shows that the population will be increasing & goes above 3,000,000 in the coming years. The current metro area population of Chandrapur in 2022 is 361,000, a 1.4% increase from 2021. The metro area population of Chandrapur in 2021 was 356,000, a 1.14% increase from 2020. The metro area population of Chandrapur in 2020 was 352,000, a 1.15% increase from 2019.

2) *Population in Padoli Village:* According to the study, the population of Padoli was 4900 in the year 1991, in 2001 it was 5,017, further it goes to 5,275 in the year 2011, and it reached 6747 in the year 2020.

3) *Population in Bhadrawati Taluka:* According to the study, the population of Bhadrawati was 19,184 in the year 1991, in 2001 it was 56,903, further it goes to 5,275 in the year 2011, and it reached 6747 in the year 2020. Bhadrawati is Taluka whose population in 2022 is 125,678. According to the 2011 census of India, the Total Bhadravati population was 98,186 and estimated to be 129,606 in 2023.

4) *Population in Ghugus:* The Population of Ghugus was 25,002 in the year 1991, which had gone to 29,945 in the year 2001 and eventually increases to 32,654 in 2011.

As we have studied the Population of Padoli village and its nearby area; it is very clear that the Population is rising year to year and it is a need to consider the Population factor in our study of the Project.

The perpetually increasing number of two-wheelers, and four-wheelers along with public transport and pedestrians poses a serious question mark for a smooth and congestion-free movement of traffic. (Bhorkar et al., 2016)

2. Study of Developing Area:-

Padoli is a village which is on Nagpur – Chandrapur Highway (NH 930) which makes it easy for passers-by to reach the Hospital. Also, it has many shops, hotels, bus stops and auto stops.

There are several roads connecting Chandrapur District. Generally, roads are classified into 5 categories – National Highway(NH), State Highway (SH), Major District Roads (MDR), Other District Roads (ODR) and Village Roads (VR). The following are the road networks connecting Chandrapur:

1) *NH930*: The National Highway connecting Warora to Chandrapur and further from Chandrapur to Mul.

2) *MSH6*: Connecting Chandrapur to Ghugus. There are some newly sanctioned State Highways which connect Padoli to Rajura, and Warora to Shegaon Bk. (Shende et al., 2018)

3. Selection of Construction Site for Project

We have selected a construction site for Hospital Building in Padoli village which is 7000 sq. ft. Hospital is a basic need of today's generation. For this, we have decided to Analyse a Hospital Building and its Design structure. Site selection has an important bearing on the planning and designing of a building. Generally, natural defects of the site will involve considerable expenditure conditions in the neighbourhood locality will cause unhappy living conditions on one hand and the possible deterioration of the value of the property on the other.

Therefore, the following general factors should be considered while selecting a site for building construction.

- Purpose of Building
- Friendly Neighbourhood
- Available Facilities
- Government Laws
- Shape and Size
- Terrain Condition
- Type of Ground soil
- Natural light and air
- Environmental condition
- Legal and Financial Aspects

In earlier days, importance was never given to facility design which affected the functional system within the hospital and as well patient safety even though millions of money were poured into the construction of these facilities. The right components considered for the design and planning of the facility gives a very strong and positive impact and in return improve human performance and especially improve the safety of the employees, patients and their families.

Major problems affecting Chandrapur District: As discussed earlier in General Section, the major problems affecting Chandrapur District are 1. Population – Growth of population in last decades.

2. Vehicular Population – Growth of vehicles in the city.

3. Pollution – Air Pollution consists of Vehicular Pollution, Water Pollution, Sound Pollution and more.

4. Industrial growth – CSTPS, and MIDC creating major problems.

5. Traffic & Congestion – Mainly due to the growing no. of vehicles & insufficient parking area.

6. Historical monuments – Creating problems for vehicular passing. (Marve et al., 2018)

4. Preparing a Model in AutoCAD

While preparing a 2-D or 3-D Model of any building in AutoCAD we have to follow some basic steps which are listed below-

- Measurement of the area on Site.
- Selecting the Front Side.
- Taking linear measurements of various rooms and marking them on paper.

Also, while preparing a model of a structure it is always important to draft

- Plan
- Elevation
- Section
- 3-D Model

A. Drafting a Plan in AutoCAD

A Plan is a Top View of any given model, which is two- dimensional and made with an X-Y Plane in AutoCAD. A Plan of a Building shows the Layout of a Building consisting of Doors, Windows, and Ventilations with wall thickness and location of columns and beams.

B. Drafting Elevation in AutoCAD

An Elevation is a Front View of any given model showing the Exterior or Interior Portion of a Building, which is two- dimensional and made with a generally X-Y Plane in AutoCAD. An Elevation of a Building generally shows the front view of doors, windows and textures on the wall, if any.

C. Drafting 3-D Model in AutoCAD

3D modelling is the process of using software to create a mathematical representation of a 3-dimensional object or shape. The created object is called a 3D model and these 3-dimensional models are used in a variety of industries. In this Project, we are going to draft the Plan, Elevation and 3-D Model of the Hospital Building in AutoCAD by using all the details of the structure.

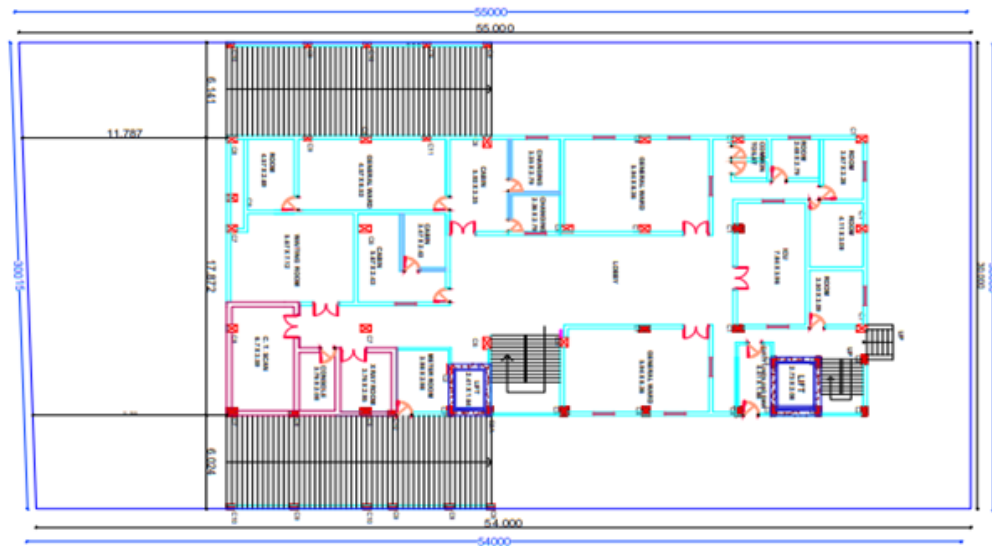


Fig. No. 1 shows the Proposed Ground Floor Plan for the Hospital Building

5. Analysis of Structure by using Staad Pro

While analyzing any structure, it is important to have IS 875 with us. Various Parts of IS 875 describe Dead Load, Live Load, and Wind Load acting on the structure.

Analysis of Structure mainly requires Load Analysis and Structural Analysis

A. Load Analysis:-

Structural Load Analysis is the verifying process of the loads on physical structures and their members including fitnesses that analyses the internal forces (axial force, shear force, moment), stress, strain, deflection, etc., in the structure under applied load conditions.

B. Structural Analysis:-

Structural analysis is the prediction of the response of structures to specified arbitrary external loads. During the preliminary structural design stage, a structure's potential external load is estimated, and the size of the structure's interconnected members is determined based on the estimated loads.

Analysis of Structure can be done in two ways

- 1) By Manual Calculation
- 2) By using Software

For the Analysis of any structure, various software is used. Which, the most common software is as follows:-

- ETABS
- SAP 2000
- STAAD PRO

In this Project, we are going to use the STAAD Pro Software for the analysis of Structure.

4. Future Work

- Analysis of Structure using STAAD Pro
- Design of structure using STAAD Pro

5. Conclusion

After going through all the research papers, we found out that it is very necessary to have structural details of all components of the building. For selecting a site, it is very important to check where the location is and what environment it is in. For the layout plan, it is necessary to have all the measurements properly. Details like the size of the column, the size of the beam, and their centre-to-centre distance play a vital role in our study. Adding further, the Size of bars, No. of bars, its spacing is required for the Designing of any components like columns and Beams. Live Load, Dead Load, and Wind Load acting on any span will help us in analysing a particular frame of the structure.

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