Planning Analysis And Structural Design Of Hospital Building

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Abstract- *This report covers the structural analysis, design, and planning of a G+3 multi-storey hospital building in [Shirpur], designed to provide good healthcare services. The plan includes important areas like outpatient clinics, patient rooms, emergency rooms, operating theaters, labs, and offices. The layout makes it easy to move around, keeps patients safe, and follows the National Building Code and hospital design rules. The structure was analyzed using STAAD Pro and drawn with AutoCAD. The building is built to handle its own weight, people, wind, and earthquakes, according to IS 875 and IS 1893 standards. Reinforced concrete is used for the main structure, making it strong, stable, and long-lasting. Fire safety, natural light, air flow, space for future growth, and ways to move up and down the building are also included. The approach focuses on making sure the hospital works well, is safe, doesn't cost too much, and is good for the environment. This leads to a complete and realistic design for a modern hospital.*

Keywords: A complete and useful design for a modern hospital building.

I. INTRODUCTION

GENERAL:

We plan to build a multi-specialty hospital near Shirpur, close to the road between Shirpur and Kalamasare.

1.1.1. SOIL INVESTIGATION: The soil can support up to 200 KN/m². The foundation will be 1.5 meters deep, and we'll design a rectangular footing.

1.1.2. SPECIFICATION OF STRUCTURES:

The roof of the building is made of reinforced concrete.

All the structural parts like columns, foundations, beams, lintels, and roofs are designed using the working stress method and IS 456:2000. The concrete used is M20 grade, and the steel is Fe 415 grade.

The floor made of plain cement concrete with broken stone will be covered with marble.

All the walls will be covered with plaster, and all the ceilings will be finished.

\Weathering coarse will have brick jelly and lime concrete, then a flat tile roof on top.

All the joineries like doors, windows and ventilators are designed to meet the standard code provisions.

A lump sum has been set aside for bathroom facilities, electricity, building height, water supply, furniture installation, and small supervision costs.

1.1.3. CODE PROVISIONS:

- IS 456:2000
- NATIONAL BUILDING CODE 1970

OBJECTIVE AND METHODOLOGY

- The objectives of our project are
- To prepare architectural and structural drawings.
- To analyze a multi-specialty hospital building (three stories) using STAAD Pro.
- To design a multi-specialty hospital building, it's (G+2) floors.

A.Aim:

The aim of the study is to use the precast housing technique under the which is provided the Pucca

House shelters to the houseless beneficiaries in the rural area.

B.Objective:

To achieve the aim of "Structural Design Of Hospital Building" the target number of houses to be constructed by the. In the first phase, houses were taken up for construction in 3 years, i.e. The remaining houses was to be completed by 2024. were constructed in the FY of 2024 and additionally approved for construction till the . envisaged that the beneficiaries themselves will be constructed the quality houses using locally available construction materials, using appropriate house design typologies and through trained rural mason [8].

METHODOLOGY

Analytical and qualitative methodology was adopted in this study. Field visit and interaction with beneficiaries through questioner methods was adopted to collect the data. This study comprises analysis of the schemes, precast housing materials and cost of the project. Detailed study on the , Traditional Construction method with its cost analysis of the materials, Precast construction, cost analysis of the material etc. which is needed for the research in detailed for the proper result and findings.

- To make architectural and structural drawings.
- To analyze a multi-specialty hospital building (three stories) using STAAD Pro.
- To design a multi-specialty hospital building, it's (G+2).

The method is shown in the flow chart belowFollowing points were considered during the analysis:

- Analysis of the Traditional Construction Method
- Detailed study on the Precast Construction Technique.
- Compare the traditional construction method and precast construction technique to identify the suitability of scheme for the beneficiaries.
- Analysis the Results of construction method after comparison.

A. Structural Design Of Hospital Building:

In the , I made changes because the CAG's audit report had some problems, like beneficiaries who didn't qualify for help, unclear selection of people getting aid, no proper check on housing shortages, and not enough coordination between different groups. it was crucial need to reform in the scheme and the aim was government to provide housing to all was made an independent program with effect .

B. Impact of the COVID-19 on the construction sector:

Inflation in India is rising rapidly, placing significant strain on the construction industry. The prices of key materials like timber and steel have gone up a lot. At the same time, supply chain problems and shortages are making it harder to get these materials. These problems started because of disruptions from the COVID-19 pandemic, but they've gotten worse because of ongoing conflicts around the world and more government projects that require more building materials.

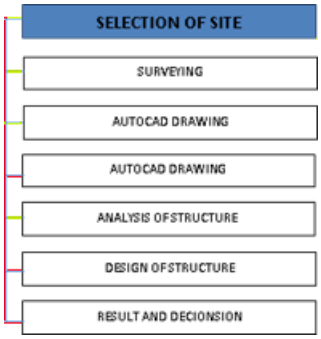


Fig1.

At the same time, the construction workforce is shrinking because skilled workers are retiring, can't move around easily, or are going into other jobs that pay better. Higher fuel prices are making things more expensive by raising transportation costs and the cost of running big machines. Since labor makes up more than half of construction costs, rising wages really hurt how much profit a project can make. Contractors, who already have little room for error, find it hard to set bid prices when costs are uncertain, projects are delayed, and contracts have fixed prices. Because of this, more companies are struggling financially, facing cash flow problems, losing ground to competitors, and having trouble getting money for new projects [6].

C. **Analysis of The Traditional Construction Method :**

Traditional construction methods are used to build houses, mainly using Load Bearing Structures (LBS) and Reinforced Concrete Structures (RCC). These methods are commonly used for rural housing in India, including under the PMAY-G program. The process involves building structures on-site with traditional techniques and materials.

D. **Key steps involved in the traditional construction method in HOSPITAL BULDING**

1. Site Preparation:

Site preparation is the first step in traditional construction, getting everything ready for a successful project. It involved:

- Clearing: The site is cleared by taking away plants, trash, and other things that might get in the way to get ready for building.
- Grubbing : The soil is cleaned by removing roots, stumps, and other organic material to create a solid and clean base.
- Grading : The ground is smoothed out and shaped to the correct heights and slopes based on the project plan and what's needed on site.
- Excavation: Trenches and pits are dug for foundations, pipes, drainage, and other parts of a building based on the construction plans.
- Soil Testing: Soil Testings are done to find out how strong and stable the soil is, making sure the foundation is safe and right for the location.
- Compaction : The soil is packed down with the right equipment to make it denser and stronger, which helps prevent sinking later and makes the foundation more stable.

2. ***Foundation Work:***

Foundation work is really important for making sure a building stays strong and lasts a long time. It involved,

- Excavation: Dig trenches for footings and foundations.
- Footings: Pour concrete for support.
- Foundation Walls: Build walls using Brick or stone masonry, Concrete blocks, Reinforced concrete (RCC).
- Placing Reinforcement: Add steel bars (rebar) for strength.
- Concrete Pouring: Fill foundation with concrete.
- Curing: Allow concrete to set and cure.

3. Wall Construction:

Wall construction involves building vertical structures using various materials and techniques. It involved,

- Brickwork: Lay bricks with mortar (cement-sand mix), ensure proper bonding and alignment, use plump and level checks.
- Blockwork: Use concrete blocks or AAC blocks, similar to brickwork with mortar joints.
- RCC Walls: Build formwork and place reinforcement, pour concrete and cure.
- Masonry: Use stones or bricks with mortar, ensure interlocking and stability.

4. Roofing:

It involved,

- Roof Structure: Beams, rafters, and purlins.
- Roofing Material: Tiles, sheets (GI, asbestos, etc.), or concrete slab.
- Waterproofing: Apply waterproofing layers
- (membranes, coatings).
- Drainage: Ensure proper slope and gutter systems.

5. Finishing Work:

It involved,

- Plumbing and Electrical: Install fixtures and fittings.
- Flooring: Lay tiles, stones, or other materials.
- Doors and Windows: Install frames and fittings.
- Painting and Finishing: Apply paint, varnish, or other finishes.
- Fixtures and Fittings: Install hardware (handles, locks, etc.).

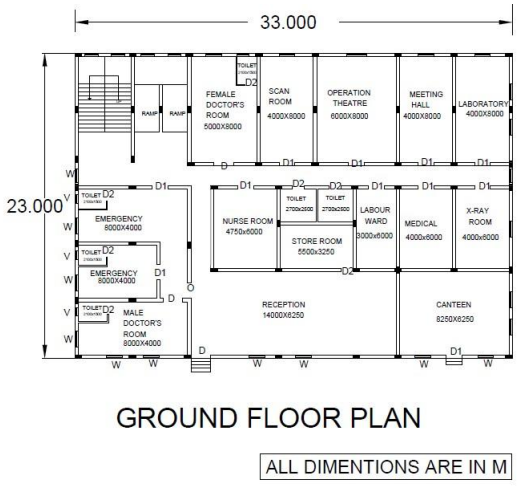
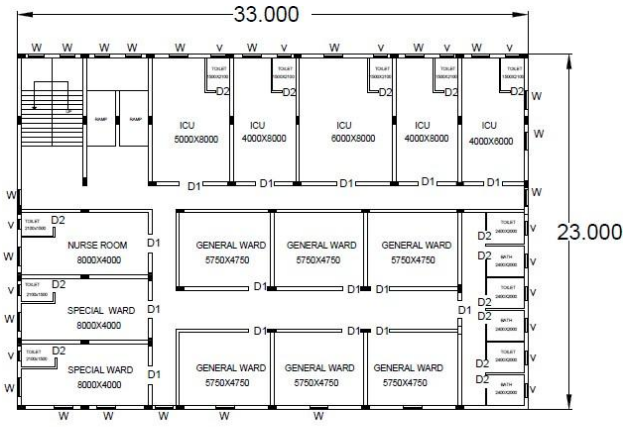
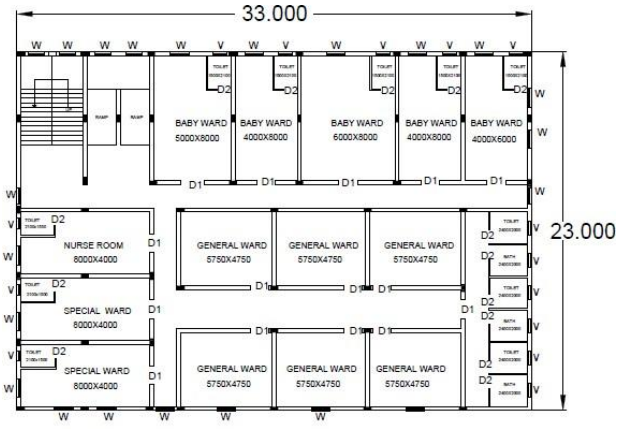


Fig. 2 Plan of Hospital Building



FIRST FLOOR PLAN

Fig. 3 Plan of Hospital Building



SECOND FLOOR PLAN

Fig. 4 Plan of Hospital Building

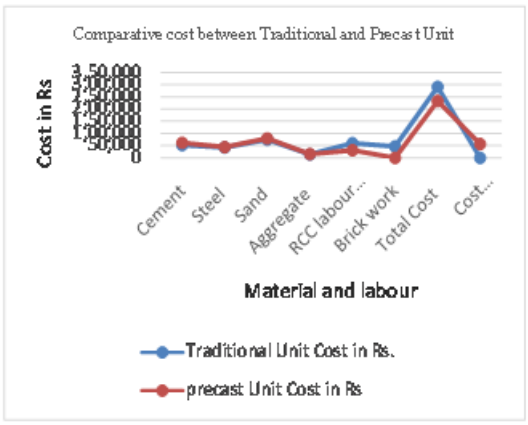


Fig3 Comparative between Traditional and Precast unit

Table 1 : Estimation for the LBS and RCC Adopted in Hospital Building

Material	Quantity	Rate(unit)	Cost in Rs.
Cement(in Bags)	1500	350	5,25,000
Steel(in Kg)	8500	50	4,25,000
Sand(in Brass)	1000	5000	5,00,000
Aggregate(in Brass)	200	3000	6,00,000
Precast labour Cost(as per Days)	365	1500	5,47,000
Brick Work (Days)	365	14500	5,29,000
Total Cost			**7,251,250**

Table 2 : Precast Concrete Estimation

Material	Quantity	Rate(unit)	Cost in Rs.
Cement(in Bags)	1500	350	5,25,000
Steel(in Kg)	8500	50	4,25,000
Sand(in Brass)	1000	5000	5,00,000
Aggregate(in Brass)	200	3000	6,00,000
Precast labour Cost(as per Days)	365	1500	5,47,000
Brick Work (Days)	365	14500	5,29,000
Total Cost			**7,251,250**

1. ***Study of hospital building, Background and Current Scenario***

Precast concrete construction has become an integral part of modern and contemporary architecture due to its efficiency, speed, and cost-effectiveness. Using precast methods helps save resources and cuts down on construction time and total costs. The idea of precast concrete started with the Romans, who made a type of early concrete by mixing limestone, sand, and water and pouring it into wooden molds. This method helped make parts more accurate in size and stronger. In the early 1900s, British engineers improved the process, leading to the modern precast systems we use today. Now, precast concrete is commonly used in building structures and includes different parts and ways to connect them. Depending on how they're made, precast pieces can be tilt-up elements like columns, beams, walls, balconies, stairs, and cladding, or hollow-core slabs. These slabs can be solid or have empty spaces inside, which makes them lighter and better at insulating. Precast columns and beams are joined with corbels. The connections are made to handle loads, keep the structure strong and lasting, and keep everything working together as a single unit.

2. ***Current Scenario***

i.Maharashtra Housing Project: Maharashtra Police Mega City, Pune
Contractor: BE Billimoria & Company

Precast Contractor: Ingenious Quality Buildings Pvt Ltd Project Details 4.5 M.sq. ft
G+14 buildings, 60 towers

1BHK, 2BHK, 3BHK, 3.5/4.5 BHK Apartments

ii.Structural system:

The building's structure uses walls that support both the weight of the building and forces from wind and earthquakes. These walls are mostly on the outside and also form the building's exterior, which will be painted. The system uses prestressed solid slabs that span about 6 meters. These slabs are strong enough to hold floor finishes and internal walls, adding up to 3 kN/m². They also need to handle moving loads like people and furniture, which adds another 2 kN/m². Using these slabs makes it easier to design the building, speeds up construction, and uses less steel, making the whole system efficient and cost-effective .

iii.The following precast elements are used in the project:

Load-bearing walls, solid prestressed slabs, and staircases are built to last 50 years, as required by the design standards for RCC structures in IS codes. Precast products can easily last longer than 50 years because they're made in a controlled environment, which ensures better quality.

Equipment :

Mechanical tilting tables, three 120-meter slab beds with a slip former, battery mold (original and cold shutter)

Services :

Full project design and engineering, setting up the plant, overseeing production and installation, annual maintenance service

iv. Mohanpur Vertical 1 (AHP) Project, Deoghar, Jharkhand

Location: Ward No 25, Mohanpur, Deoghar, Jharkhand
Builder: Deoghar Municipal Corporation.
Units: 522+ apartments (1 BHK , 2 BHK 3 BHK)
Status: The project is currently under construction, with possession anticipated by the second quarter of 2025.
Amenities: The project includes nicely designed gardens, safe and fun spaces for kids, parking areas, systems to collect rainwater, energy-saving lights, and up-to-date fire safety measures to make the place comfortable and safe to live in.
Sustainability Features: The project includes eco-friendly features like rainwater collection, energy-saving lights, and strong fire safety plans. It's meant for people in the EWS, LIG, and MIG income groups.

v.350 acres in the Kumbhari area of South Solapur

Total Capacity: The project aims to provide 30,000 houses for Economically Weaker Sections (EWS), including handloom workers, bidi workers, and vendors. Total Project Area: Spans approximately 350 acres in the Kumbhari area of South Solapur.
Individual Unit Area: Each tenement has a carpet area
Configuration: Includes a living room, bedroom, kitchen, individual bathroom, WC, and a balcony.
Construction: Uses precast technology and conventional methods for rapid development

The largest concentrated project is the Ray Nagar Housing Society in the Kumbhari area, which was inaugurated in 2024 to provide 15,000 houses. Other specific locations with multiple building permits and occupation certificates include: K This is a major hub for AHPPPP projects.

III. FINDINGS

The findings indicate that the use of precast concrete technology is highly suitable for the as it supports faster, more economical, and sustainable housing delivery. Precast concrete lets parts of a building be made off-site in a controlled environment. This speeds up construction and helps keep quality steady. It also cuts costs by reducing waste, using resources better, and needing less on-site workers. The buildings are strong, can handle bad weather, and need less upkeep, which makes them good for long-term housing in rural areas. Plus, it's safer for workers and better for the environment. The design can also be adjusted to fit local needs.

Using a Public–Private Partnership (PPP) model helps make projects stronger. The government provides land, permits, and some money, while private companies handle the design, building, funding, running, and keeping things in good shape. Using precast technology in these partnerships speeds up work, makes quality better, and brings in new ideas from the private sector. Sharing risks between the public and private sides makes projects more likely to succeed and work better. Common PPP models like BOT and DBFO help build homes that last, grow easily, and get done on time

IV. CONCLUSION

In this project, we planned, analyzed, and designed the structure of a hospital building to make sure it works well

and is safe. During planning, we focused on using space efficiently, setting up different areas properly, and following the rules for healthcare buildings. We paid close attention to how people move through the building, making sure patients are comfortable, the place stays clean, and there's easy access in emergencies—things that matter a lot in hospital design. For the structural analysis and design, we used IS codes and considered different types of forces like the weight of the building, people, wind, and earthquakes. We used modern software to check and design each part of the structure, making sure it's safe, strong, and lasts a long time. Every part—beams, columns, floors, and the foundation—was built to handle real-life conditions and stay strong over time.

This project shows how important it is to combine good building design with solid engineering. It makes it clear how a hospital can be built to meet medical needs while also being eco-friendly, sturdy, and safe for the long term. This outcome can serve as a good foundation for future projects in building healthcare facilities.

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