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FEASIBILITY OF RAPID CONSTRUCTION IN HOSPITAL BUILDING

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Abstract - *In the modern era, there has been increasing interest in the rapid construction techniques for buildings. The population is increasing day by day, so in the pandemic situation, many people were not getting proper treatment due to a lack of hospital facilities and treatments. Building hospitals and other treatment centres is a time-consuming process. So the construction of hospitals is very difficult and time taking to provide proper treatment to the public. Light gauge steel framing (LGSF) is a construction technology using cold-formed steel as the construction material. This method gradually gained in popularity due to its low cost and less time for erection. Polyurethane foam panels is a thermally insulating panel with a multiple layered sheet metal structure in which insulating core materials are placed.*

Thus, the underlying focus of this paper is to analyse the two different methods of construction; the above-mentioned LGSF technology and the traditional method of construction (RCC). The comparison of these two methods is done based on two criteria. Namely, cost and time for construction. A study into these aspects can provide a good idea regarding the feasibility of LGSF technology in building construction.

Key Words: Rapid construction, LGSF, PUF panel

1. INTRODUCTION

The outbreak of COVID-19 has declared a public health emergency of international concern and has raised the risk assessment of regional level, and global levels to very high. The need for rapid structures for treatment in such situations is very essential. Here comes the role of civil engineering and more precisely the role of planning and designing economical and rapid construction structures. Here in this project we are introducing a hospital building using rapid construction techniques (LGSF technology and PUF panels) and studying its feasibility.

Governments and corporations are primarily concerned with ensuring the safety of their citizens as COVID-19's impacts expand over the entire world. While this concentration will remain, the effects on corporate profits and economic growth must cause a significant sell-off in equities markets around the world. The testing and treatment of patients with known or suspected COVID-19, as well as staff safety, were cited as hospitals' two biggest concerns. The capacity of hospitals to treat COVID-19 patients has been significantly challenged, according to these institutions. Regarding personal protective equipment (PPE), testing, staffing, supplies, and durable equipment; maintaining or increasing facility capacity; and financial issues, hospitals described unique challenges, mitigation techniques, and requirements for support. Hospitals worried about being overrun by a flow of patients who could need specific beds and rooms to treat and limit infection as a result of capacity issues. Many hospitals discovered that some patients who no longer needed acute care were occupying beds while waiting to be discharged because post-acute care facilities needed negative COVID-19 tests before accepting patients discharged from hospitals. Some hospitals were offering ambulatory care for patients with less severe symptoms, offering telehealth services when possible, and setting up alternative facilities like fairgrounds, vacant college dorms, and closed correctional facilities as additional spaces for patient care to manage patient flow and hospital capacity. These all situations indicate that the need for a rapid and economical structure for the accommodation of patients is necessary.

This project aims to assess the feasibility of constructing hospital buildings using LGSF technology by incorporating hospital rules and preparing cost and time compared with the traditional building and making it effective for pandemic situations.

1.1 Scope

In the present scenario, rapid construction technology has a great role in the field of civil engineering. Several rapid construction techniques have emerged in the modern era. Among them, building construction using Light Gauge Steel Frame (LGSF)technology and PUF panels are gained popularity due to their lightweight and ease of construction. Hence during emergencies like war, flood, pandemics, etc., these techniques can be used for effective and rapid construction of the building.

2. METHODOLOGY

To accomplish the objective of our project, primarily conducted studies on hospital requirements and rules by referring to KMBR, IPHS and NBC. Also studied rapid construction methods; LGSF technology and PUF panels. Selected a site in a nearby location and calculated the design population in that city. Prepared a single-storied hospital building as per rules and requirements. Taken the cost estimate of traditional buildings and LGSF buildings by manual calculations. The time estimate of both types of the

building was calculated by using Suretrack software. A comparison of traditional buildings and LGSF buildings was conducted by taking time and cost as the main criteria.

2.1. Light Gauge Steel Frame

Cold-formed steel is used as the main building material in the Light Gauge Steel Frame (LGSF) building technique. LGSFs have several advantages, like strength, design flexibility, sustainability, and lightweight, which makes them easier to handle and hence increases speed, safety, and construction quality.

Channel sections (ISMC 350 and ISMC 400) are used to join PUF panels with the foundation. ISMB 350 and ISMB 300 are the other steel sections used in the steel framework. 40 mm thick PUF wall panels are connected by bolts and nuts in the steel framework. The roofing system is also done by 40mm thick PUF panels. A central ridge is provided in the roof system.

2.2.Polyurethane foam (PUF) panels

PUF panels consist of a polyurethane inner core covered with a galvanized sheet on both faces.PUF panels have a wide range of applications in roofing, wall system, etc.PUF panels are available in different colours, sizes and thicknesses. The thickness and density of PUF insulated sandwich panels vary depending on the application. These panels have excellent thermal insulation properties, which makes them extremely useful. PUF panels are highly structurally durable and long-lasting. These are modular in design. They are simple to disassemble and transport from one location to another as needed. They are all-weather resistant. Because of the thermal insulation, these save energy. They are water, fire, and termite resistant.

2.2.1.Properties

- Density – 48 kg/m3
- Thermal Conductivity at 10 0C Mean Temperature (W/m0K)- 0.0203/0.024
- Water vapour transmission (max)-5.5 NG/PASM
- Corethickness (mm)-20,30,40,50,60,80,100,120,150
- Bending Strength-4 kg/cm2
- Fire resistant

2.2.2.Wall Panels

wall panels feature tongue-and-groove joinery for airtight, effective panel-to-panel interlocking that creates a strong seal. There are two types of panels produced: single groove and double groove systems. Single groove panels are appropriate for general use and application in buildings and shelters, whereas double groove panels are appropriate for cold room and cold chamber applications. The use of a double groove ensures precise interlocking, dimensional accuracy, and the elimination of air gaps and thermal bridging. Wall panels are self-supporting and free standing up to 6 metres thick. Flashings are used to cover all joints. These panels are available in thicknesses of 30, 40, 50, 60, 80 & 100mm.

2.2.3.Roof panel

Roof panel with a trapezoidal profile on the top surface and a ribbed liner tray on the underside and a sandwiched insulation cover. These panels are available in thicknesses of 30, 40, 50, 60, 80 & 100mm. Surface finish: Metallic, solid colours, Polyvinylidene fluoride (PVDF) & super polyester coatings.

2.3. Bed Calculations

The size of a hospital depends upon the number of bed requirements in the hospital which further depends on the population in the city. So, the population forecasting was done by using the arithmetic mean method by referring to the past population data in the year 2001,2011 and 2021. From the calculations, the design population in the city was obtained as 40900.

Using IPHS (Indian public health standards) code,

- Avg. length of stay in hospital =5 days
- Annual rate of admission = 1/50(population)
  = 1/5(400900)=8018
- No . of beds per year =8018x5=40090
- No . of beds needed per day =40090/365=110
- No . of beds required with 20% capacity
  = 110x0.2=22beds

This is a Group C building which comes under category; category A(25-30 Beds).

2.4.Hospital building

A 30-cent (1213.95m2) site was selected in the city and analysed the soil profile in the site. Based on the ground data the N value (19)of the soil obtained from the standard penetration test is less than the SBC (30 t/m2) of the soil. The total dead weight of the LGSF structure on the soil is a low value. Even though a small footing was considered.

The proposed building has a total area of 429.4 m2, single-storied and has 26 beds. Figure 1 shows the plan for the proposed hospital building.

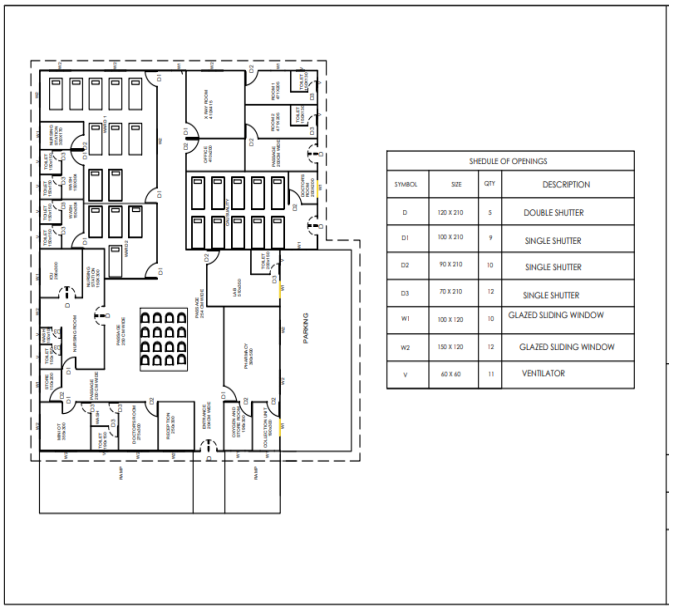

Fig -1: Plan of building

Figure 2 shows the section and figure 3 shows the elevation of the building. Figure 4 indicates the 3D modelled building using Revit software.

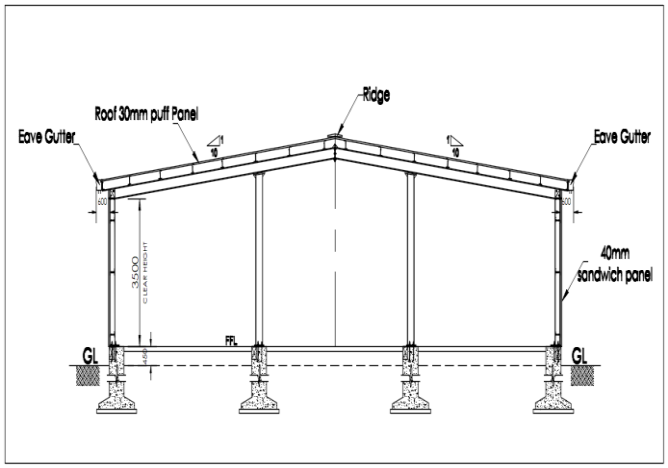

Fig -2: Section

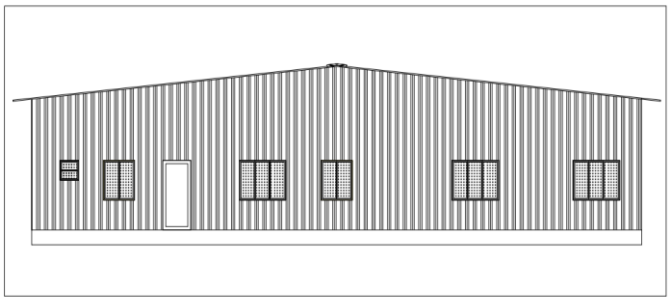

Fig -3:Elevation

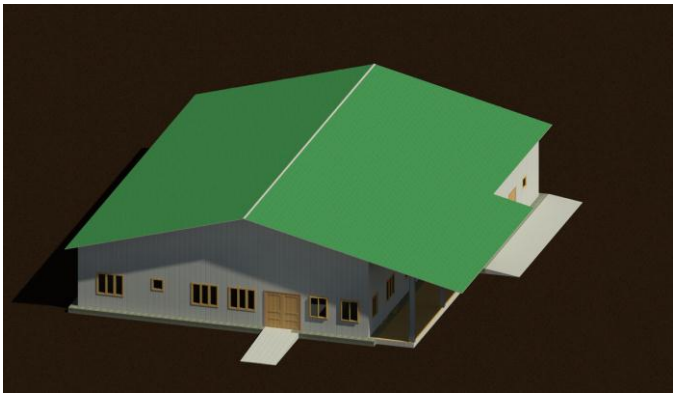

Fig -4:3 D Modelling

3. RESULTS

From the cost and time estimation of traditional buildings and LGSF buildings, found that the cost and time for LGSF buildings are lesser than that of traditional buildings. Based on a comparison of both buildings, the following conclusion shown in table 1 can be reached.

Table -1: Comparison of LGSF building and Traditional building (RCC building)

LGSF BUILDING	TRADITIONAL BUILDINGS
The cost for the project is forty-six lakh only	The cost for the project is sixty-eight lakh only
The time for the completion of the project is 57 days	The time for the completion of the project is 94 days
Plastering and painting are not required	Plastering and painting required
The fieldwork of labours is less	The fieldwork of labours is more
Less waste generation on the site	More wastes are generated on the site
Lightweight material and so easy to handle	Heavyweight materials and so lifting is difficult

The LGSF buildings can be removed from the site after the emergency if necessary. It is easy to unscrew the materials on the site and can be constructed in another location.

4. CONCLUSION

This paper briefly concludes that in an emergency the construction of LGSF buildings is more favourable than traditional buildings(RCC buildings) because it takes less construction time and is easy to handle. In the present

scenario, LGSF technology has been developing in different sectors with innovations. This method is used not only for temporary buildings but also for permanent buildings. By adopting this technology the use of stones and bricks can be reduced which further supports an environment-friendly construction method.

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