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Planning and Designing of a Precast Green House

Sneha M ¹, Mufeedha N ², Shone Sundar K ³, Mohammed Maneesh C ⁴, Karthika MR ⁵,
Fathima Fayiza Elachola ⁶

U.G. Student, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India¹Orcid Id: 0009-0005-1592-995X

U.G. Student, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India²OrcidId: 0009-0008-3855-3424

U.G. Student, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India³OrcidId: 0009-0008-9150-5114

U.G. Student, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India⁴Orcid Id :0009-0003-8197-2900

Assistant Professor, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India⁵ OrcidId: 0009-0001-2212-7593

Assistant Professor, Department of Civil Engineering, Eranad Knowledge City Technical Campus,
Manjeri, Malappuram, Kerala, India⁵ Orcid Id: 0009-0008-3614-6817

ABSTRACT: This paper examines the technical, economic, and environmental aspects of a precast greenhouse which links two innovative construction methods for more efficient sustainable construction. The project comes under the category of residential building. The objective of this project includes functional planning and construction schedule of a precast greenhouse with a ground floor plus one story, located at Kottakkal near Maravattam. Precast construction systems & green building systems are two innovative construction technologies. Precast structures gain up to 23 potential points of green building LEED certification under the categories of innovation and design process, sustainable sites, materials and resources, indoor environment air quality, energy, and atmosphere which make it an ideal choice for green building. Through this project, we try to improve the quality of green buildings by using the advantages of precast construction. Various precast elements of buildings such as walls, beams, slabs, columns, foundations, etc. will be used in this project. Green buildings are eco-friendly and sustainable buildings that ensure that waste is minimized at every stage during operation & construction. Detailed study of precast construction system by visiting ICON PRECAST CONCRETE PRODUCTS Co Pvt Ltd, Kottakkal- Maravattam, site selection, reconnaissance survey, and architectural drawings of the precast structure, detailed study & application of green building features, Estimation & rate analysis done. The main objective of this greenhouse project is to design a residential precast greenhouse including maximum open space with cost-effective design & eco-friendly materials, improve indoor air quality by natural cross ventilation design, implement solar panels for energy generation & reducing power consumption of the building, providing biogas system for fuel energy, implementing rainwater harvesting system.

KEYWORDS: Precast construction system, green building, cost-effective & sustainable design, rainwater harvesting system, solar panel, biogas

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I. INTRODUCTION

Buildings are an important indicator of the social progress of the country. Precast technology is a proven environment-friendly method of construction. This project deals with the analysis and design of a precast greenhouse. The proposed plot is located at Maravattam, Kottakkal. It is a residential complex with an area of 20 cents. It is a G+1 residential house. This is an innovative project which links two innovative construction methods for more efficient sustainable construction. The main objectives of this greenhouse project are to design a residential precast greenhouse including maximum open space with cost-effective design & eco-friendly materials, improve indoor air quality by natural cross ventilation design, implement solar panels for energy generation & reducing power consumption of the building, provide biogas system for fuel energy, implementing rainwater harvesting system. The paper is organized as follows. Phase I discusses the implementation of a precast structure by minimizing the environmental impact. Precast Construction Technology consists of various precast elements such as walls, beams, slabs, columns, staircase, landing, and some customized elements that are standardized and designed for stability, durability, and structural integrity of the building. Precast residential building construction involves the design, strategic yard planning, lifting, handling, and transportation of precast elements. Implementation of green building features such as biogas plants, rainwater harvesting tanks, solar panel systems, sewage treatment, etc. is given in phase II.

II. CASE STUDIES

The Chinese government strongly encouraged the construction of prefabricated buildings as a result of rapid urbanization. China's prefabricated construction systems are included in the investigation. This moves China's development industry in a more reasonable heading and further advances the nation's green urbanization plan [1]. Green building design complexity necessitates further alterations to existing project management procedures. Barriers in the green building industry are included in the study [2].

The review centers around inventive slight plans. Thermally efficient options include sandwich panels made of thin, light precast concrete. In recent years, significant innovation in the design of sandwich panels has taken place as a result of the potential for thermal efficiency and the resurgence of precast concrete in general. In this review, specific developments in the creation of high-flexural-strength concrete without steel are identified. It highlights the need for additional thermal validation of novel panel sandwich designs despite reviewing the numerous studies that have examined the structural performance of sandwich panels [3].

Manageability ramifications of involving precast cement in development: An inside and out project-level Investigation spreading over twenty years. The traditional cast is in-situ, precast, and pre-assembled development is development systems with expanding development seclusion. Modularity and construction methods, in turn, influence sustainability on-site. With various levels of prefabrication, specific indicators are developed to evaluate projects' sustainability performance. Environmental sustainability indices track projects' waste and carbon emissions. The utilization of human resources and the overall accident rate of projects are represented by social sustainability indices. Financial supportability lists signify the undertaking cost and time utilized for fulfillment. A composite sustainability index is then created at long last [4].

The work in this paper is separated into two phases. 1) A prefabricated home; 2) Green construction. In the second phase, the precast structure is limited to a green structure by incorporating a number of green building features like solar panels for energy generation, biogas systems for fuel energy, sewage treatment, rainwater harvesting systems, and other similar options. After that, the quantity for rate analysis is calculated using an estimation of the structure. MS Project was used for all of the scheduling. Finally, we will create a three-dimensional (3D) model of the project and classify our structure in accordance with green building guidelines.

III. METHODOLOGY

A detailed study of the precast construction is done by visiting ICON PRECAST CONCRETE PRODUCTS Co. Pvt. Ltd, Maravattam. The plant is situated in Marakkara Grama Panchayath Rs. No. 45/4A-52.105 in Malappuram district. It is a private limited company registered under the company act since 2009. The total unit expects to employ around

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28 personnel including managers, engineers, supervisors, and crane operators, skilled and unskilled workers. Collected details regarding the precast construction technology by interacting with senior engineer Ms. Sabetha and Studied the production & erection process of structural members by visiting the plant and site. Selection of a suitable site to build a greenhouse, reconnaissance survey, land survey, etc. Careful planning is necessary during every step of the selection site based on a survey, Reconnaissance, and protection of the landscape during construction, and, Design to include existing site features. Architectural drawings include detailed drawings of various plans such as site plans, location plans, section, elevation, service, plans, etc. is done.

Implementation of green building features such as biogas plant, rainwater harvesting tank, solar panel system, sewage treatment et,c. is done. Scheduling in the project is the listing of activities, deliverables, and milestones within a project. A schedule also usually includes a planned start and finish date, duration, and resources assigned to each activity. 3D of the structure is done by using computer modeling software to create an object within a three-dimensional space. The whole process of planning and designing a precast greenhouse has been done.

IV. OBSERVATIONS AND DISCUSSIONS

Figure 1 shows the suitable site for the implementation the of precast greenhouse se and the location of the site on the plant. The site of the proposed project is located at Paravoor- MLA Padi, near Kottakkal. The proposed sometimes under Marakkara panchayath in Malappuram district. The site is situated near the precast plant. The site is 2km away from the production plant. The total land is 20centst. Figure 2 shows the casting of various precast elements such as wall, slab, beam, footing, and column. Figure 3 shows the casting of precast walls by using thermo Cole. By using thermo Coles for wall casting energy efficiency y of the building is increased by thermal insulation and it also helps to reduce the use of concrete at the time of casting of the wall.

Precast panel for superstructure wall of thickness 15cm with two layers of thermal Cole. The internal wall of 10cm thick with one layer of thermocole. 8mm diameter bars are used generally. Thermo Cole is used in walls for cooling effects and for making lightweight panels.



(a)

(b)

Fig. 1. Production plant of ICON PRECAST CONCRETE PRODUCTS Co. Pvt. Ltd

(a) selected site (b) Production plant

There is a precast concrete component that is appropriate for each and every building component. Different production techniques are required for each component of precast concrete. There are basically two types of production: the pallet carousel system and stationary production. Toward the start of the advancement of the precast substantial creation, just the fixed creation existed. The workers moved from one working station to the next using the stationary production tables that were mounted on the floor. In stationary production, sophisticated, intricate, and sturdy construction elements can still be produced effectively.

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(a)

(b)



(c)

Fig. 2. Precast walls and connections (a) Precast slab and connection (b) Precast footing (c) Precast beam and connections

Pallet carousel systems were developed over time as a result of rising labour costs and increased quality requirements. Production tables (pallets) are moved in this method of production, but each worker stays at his or her permanent workstation. The manufacturing process for automobiles is comparable to this one. The most effective method of floor and wall production is the pallet carousel system.

These materials are devoid of emissions, contain little to no volatile organic compounds (VOCs), and resist moisture to fend against mould, spores, and other germs. Through ventilation systems and materials that regulate humidity and permit a building to breathe, indoor air quality is also addressed. A building's heating and cooling expenses will be significantly reduced by passive solar design, high levels of insulation, and energy-efficient windows. The use of natural daylighting minimizes the requirement for power while also enhancing occupant health and productivity. Additionally, energy-efficient lighting, low-energy appliances, and renewable energy technologies like wind turbines and solar panels are all included in green buildings.



Fig. 3. Casting stages of precast walls using thermocole

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The information gathered from precast companies was used to calculate the length of time it would take to erect the superstructure of a prefabrication construction project. The span of the task is displayed in three distinct stages. Because the prefab construction method is the same as conventional construction, the substructure took the same amount of time to complete. However, when compared to conventional construction, the prefab's superstructures were completed earlier.

One advantage of prefab construction is the wide range in project duration between superstructures. The superstructure lasts shorter because the walls and slabs are made in a factory and installed on-site. Because the electrical piping is already installed in the precast walls and slabs, prefab construction takes less time to finish than traditional construction. There are no precast components required for the plastering work, which looks and finishes well. The entire construction of the two-story residential building using prefabrication took 65 days.

Although it dates back to biblical times, rainwater gathering is currently experiencing something of a rebirth. In Greece and Palestine 4000 years ago, there were extensive rainwater gathering systems. In order to collect rainwater and supplement water from the city's aqueducts, homes in ancient Rainwater were constructed with individual cisterns and paved courtyards. By using non-toxic supplies, you can enhance indoor air quality and lower your risk of developing asthma, allergies, and sick-building syndrome.

V. CONCLUSION

The primary goals of the work have been accomplished. The total cost and duration of the double-story residential building have been determined for both prefab and traditional construction. Due to the survey that was carried out in businesses that were comparable to ours, we were also aware of the benefits and drawbacks of both prefabrication and conventional construction.

The comparison revealed that there is a significant cost difference between the two methods, with prefab homes costing significantly more than traditional homes of this kind. We have implemented a precast greenhouse that links two innovative efficient technologies. Precast construction helps to increase the efficiency of construction sustainably. Precast technology is a proven environment-friendly method of construction. Plant-controlled production with a clean finish eliminates on-site mortar mixing, water runoff, cement dust, sand piles, lift truck operation, and scaffolding which in turn help sustainability. In conclusion, we can say Precast Concrete is a truly green product. Contributing to various areas of sustainability but not limited to green concepts such as Energy Efficiency, Conservation of material and resources, Design Flexibility, Environmental Impact, Durability, reduce – Reuse – Recycling, and Quality of life which make it an ideal choice for green building.

You can use less water by installing water-saving equipment, such as low-flow showerheads, self-closing or spray taps, low-flush toilets, or waterless composting toilets, which reuse rainwater and greywater for irrigation and toilet flushing. By adding point-of-use hot water systems and lagging' pipes, water heating expenditures can be decreased. Rainwater Collection in Green Construction The idea behind rainwater harvesting is to collect and use precipitation from a catchment's surface. Old technology is gaining appeal in a new way.

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