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STUDY OF PREFABRICATED SUSTAINABLE HOUSE

Niraj Kumar[1], Devendra Kumar Sharma[2], Rohit Soni[3], Chetan Kumar[4]

[1]*Assistant Professor, Department of Civil Engineering, Aryanbhatta College of Engineering & Research Center, Ajmer*

[2]*Assistant Professor, Department of Civil Engineering, Aryanbhatta College of Engineering & Research Center, Ajmer*

[3]*Assistant Professor, Department of Civil Engineering, Aryanbhatta College of Engineering & Research Center, Ajmer*

[4]*Assistant Professor, Department of Civil Engineering, Aryanbhatta College of Engineering & Research Center, Ajmer*

1. INTRODUCTION

India needs 50 million houses by the year 2022 and more than 90 smart cities are being planned. In order to achieve such a huge feat in a short span of time, industry experts say that offsite manufacturing and pre-fabricated modular units will play an important role. While such offsite technologies are at a nascent stage in the Indian market, the demand for them is gaining momentum.

With developers changing their focus to mass housing, this technology is an ideal solution for affordable homes and mass housing schemes, due to its fast, accurate, efficient and cost-effective process. For an industry that often suffers from mounting debt and limited cash flow, completing projects saves interest costs.

Keywords: *Sustainable building, modular design, pre-fabrication, renewable*

2.0 WHY PREFABRICATION

2.1 Housing Need in India

By 2040, real estate market will grow to Rs. 65,000 crore (US$ 9.30 billion) from Rs. 12,000 crore (US$ 1.72 billion) in 2019. Real estate sector in India is expected to reach US$ 1 trillion in market size by 2030, up from US$ 200 billion in 2021 and contribute 13% to the country's GDP by 2025. Retail, hospitality, and commercial real estate are also growing significantly, providing the much-needed infrastructure for India's growing needs.

India's real estate sector saw over 1,700 acres of land deals in the top 7 cities in 1 year. Foreign investments in the commercial real estate sector were at US$ 10.3 billion from 2017-21. As of February 2022, Developers expect demand for office spaces in SEZs to shoot up after the replacement of the existing SEZs act.

As per ICRA estimates, Indian firms are expected to raise >Rs. 3.5 trillion (US$ 48 billion) through infrastructure and real estate investment trusts in 2022, as compared with raised funds worth US$ 29 billion to date.

The office market in the top eight cities recorded transactions of 22.2 msf from July 2020 to December 2020, whereas new completions were recorded at 17.2 msf in the same period. In terms of share of sectoral occupiers, Information Technology (IT/ITeS) sector dominated with a 41% share in the second half of 2020, followed by BSFI and Manufacturing sectors with 16% each, while Other Services and Co-working sectors recorded 17% and 10%, respectively.

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Figure: 1

2.2 Disadvantages of Current Construction Methods

Both traditional and modern construction methods have the same basic process planning, design, approvals, site preparation and development. From that point forward, however, the differences begin. According to the materials used and on the basis of their way of application to the construction process.

1. Security risks for handling components at the construction site.
2. Initial cost in MMC is very high.
3. Multiple Transportation materials are required.
4. For handling MMC components, specialized types of equipment are required
5.

2.3 Considering Housing Sustainability

According to the 2011 census, there are 246 million households in India. There are a lot of vernacular architectural techniques used in rural India which are quite sustainable. The bigger problem, however, is not the lack of permanent housing, but progress towards a single brick-and-mortar or RCC model that is relatively unsustainable. With the increase in the development of new housing projects, the discussion on sustainable housing is expanding, but is often limited to environmental and economic aspects, ignoring the social aspect. Planners and architects should adopt a holistic framework that also includes social equity.

Diversity – forms of habitat that are flexible and Adjust to different needs and uses of society

Affordability - provision of accommodation which is Suitable for all incomes

Sustainability - provision of housing that has minimal impact on the environment.

3.0 MOVING TOWARDS MANUFACTURED HOUSING

3.1 Toward Industrialization

World War II created unprecedented demand for some manufactured goods, leading to a buildup of productive capacity. After the war, reconstruction in Europe coincided with massive population expansion in North America. This provided further catalysts that kept capacity utilization high and spurred further growth of industrial activity. The causes and effects of industrialization in this period were innovation, specialization and wealth creation. The turn of the 20th century was notable for rapid industrialization in other parts of the world, especially East Asia. Asian tigers (Hong Kong, South Korea, Taiwan and Singapore) are known for their country/district transformative economic growth. China famously experienced its own industrial revolution after moving towards a more mixed economy and moving away from heavily centralized planning.

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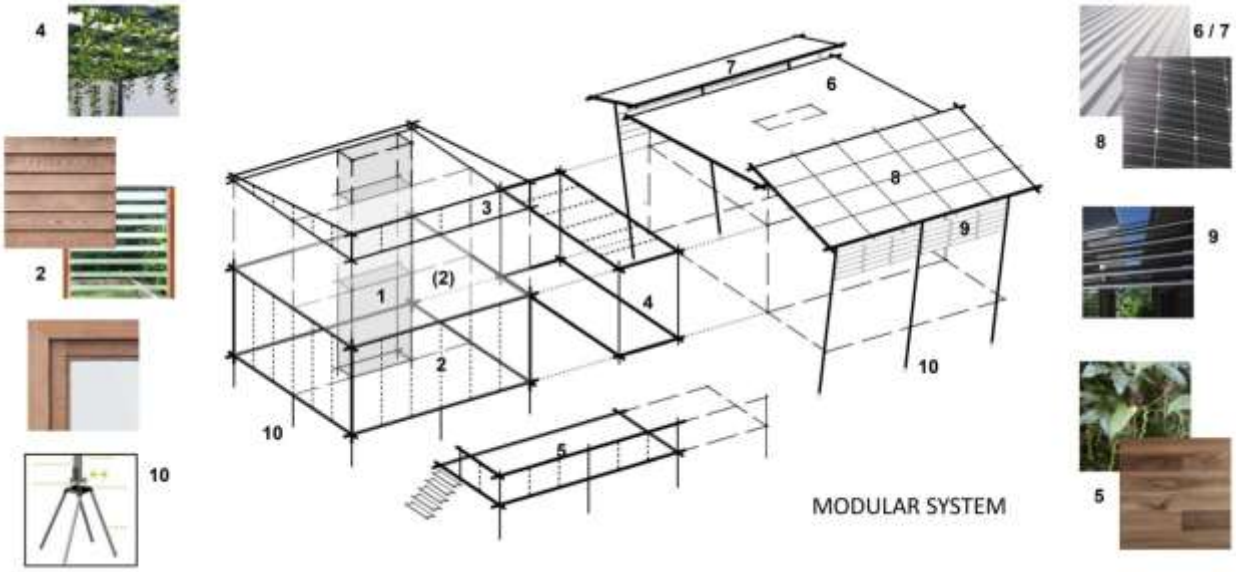

Figure: 2 Modular Systems

3.2 The Industrial Revolution

The Industrial Revolution, in modern history, the process of change from an agricultural and handicraft economy to an economy dominated by industry and machine manufacturing. These technological changes introduced new ways of working and living and radically changed society. This process started in Britain in the 18th century and from there spread to other parts of the world. Although previously used by French writers, the term Industrial Revolution was first popularized by the English economic historian Arnold Toynbee (1852–83) to describe the economic development of Britain from 1760 to 1840.

Since Toynbee's time the term has been applied more broadly as a process of economic change than as a period of time in a particular setting. This explains why some regions, such as India and China, did not begin their first industrial revolutions until the 20th century, while others, such as the United States and Western Europe, underwent "second" industrial revolutions by the end of the 19th century started.

3.3 Benefits of Automated Manufacturing

- Increased Workplace Safety
- Reduced Labor Cost
- Increased Labor Productivity
- Reduced Manual Tasks
- Accomplish Impossible Manual Tasks
- Enhanced Product Quality
- Avoid Higher Costs of Not Automating
- Reduced Manufacturing Lead Time

4.0 MODULAR PREFABRICATED BUILDING

Prefabricated buildings, or prefabs, are buildings with components (walls, ceilings and floors) that are manufactured in a factory or manufacturing plant. These components may be fully or partially assembled in a factory which is then transferred to the construction site. This method of building construction is preferred because of its cost efficiency, rapid turnaround and reusability.

Common applications of prefabricated buildings are temporary construction facilities, office spaces, medical camps, evacuation centers, schools, apartment blocks and single-detached homes.

Prefabrication is more efficient than traditional on-site manufacturing because manufacturing is more controlled through the production line. Since most buildings have repeating sections of walls, ceilings and floors, a construction process can be developed by putting together a sequence of operations. These functions can be studied and improved to make the manufacturing process more efficient.

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4.1 Categorizing Modular Prefabricated Systems

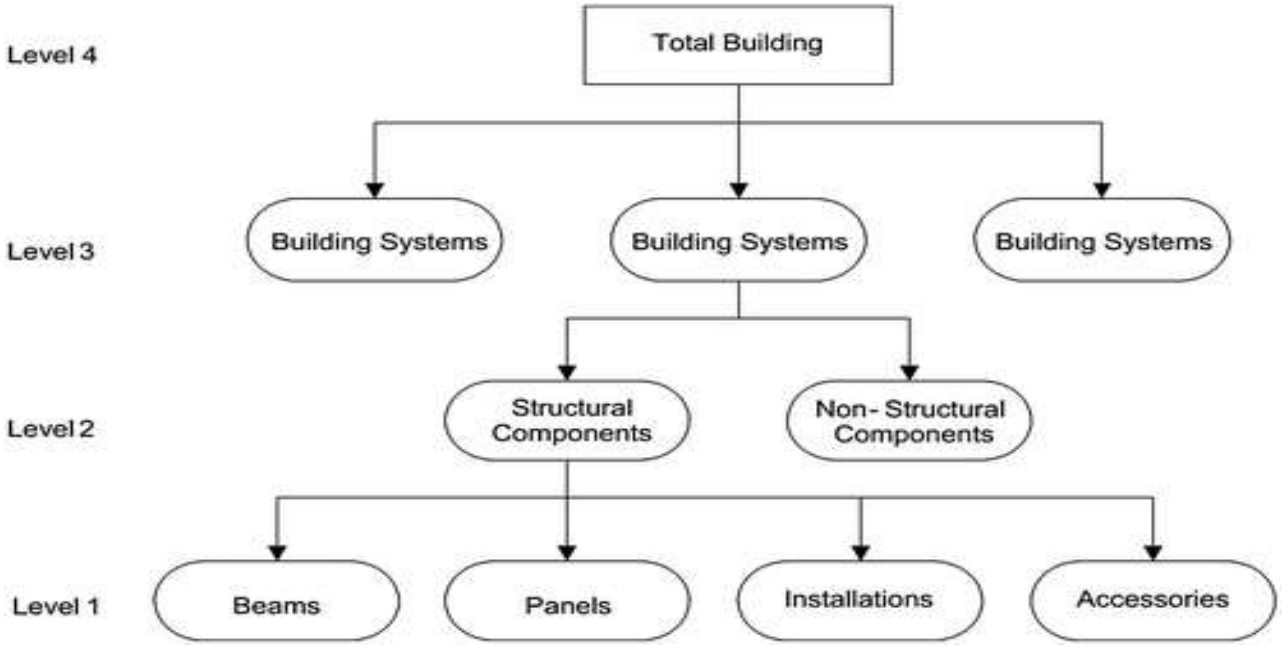

Figure 3: A categorization of modular pre-fabrication systems and construction methods

4.2 Modular Building Categories

4.2.1Panel Systems

A panel system is defined here:

• Construction based on a single integrated unit.

• Outer cover, structure, insulation, interior can be design for lining, fenestration and ventilation
can be included in the unit, diversify it and Unique

• A system that may extend from floor to ceiling (wall panel) or floor to ceiling.

• A system that can reduce the elements of a building as well as providing an integrated structural stability.

Panels can comprise the entire envelope and structure as seen in Tropical House by Jean Prouvé.

Prouvé designed Tropical House as a prototype cheap, easy-to-assemble housing that can be easily transported to the African colonies in France. Manufactured in Prouvé's French workshops, the components completed and disassembled to Africa. The house sits on a simple one meter grid Fork shaped portico support system made of bent steel. All but the largest structural elements are aluminum. No piece is longer than 3.96m (13 ft), which corresponds to the capacity of the rolling machine, or over 100 kg (220 lb) for easy handling by two men.

The volume of the house is defined as the multiples of the original Modular component "wall panel" that integrates a complete prefabricated envelope system; structure, exterior cladding, interior lining, solar inlet, ventilation and insulation. The Lightweight Aluminum Clad insulated sandwich panels can act as secondary main structure or elements such as doors, walls and windows.

Skeletal Systems

A skeletal system is defined as:

• Assembled the individual components to provide structural frame, foundation or structural system

• A system that acts as an independent element envelope elements that are attached.

• Skeletal systems can be designed to integrate services within.

Manufactured in Swindon England between 1980 and 1982, The Renault Center by Foster Associates stands as a Example of modular system building (Figure 6). The concept uses an umbrella structure as the "modular unit". To expand the standard bay dimension of 24 meters.

The system consists of self-sustaining modules capable of Grouping and reacting to different configurations for the demand of the Site and its internal use, to FL Accessibility requirements, construction speed and lower cost. It allows incremental bi-directional increase for future change or expansion with minimum obstacles to the current work of the building.

4.2.2 Cellular Systems

A cellular or 'volumetric' system is defined as:

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• The components that make up the entire singular space, who together make up or form a building Prefabricated as a complete cellular building.

• Envelope, internal, mechanical and structural systems can be incorporated within a single entity, that is ready to be delivered to site as seen in Figure 4.

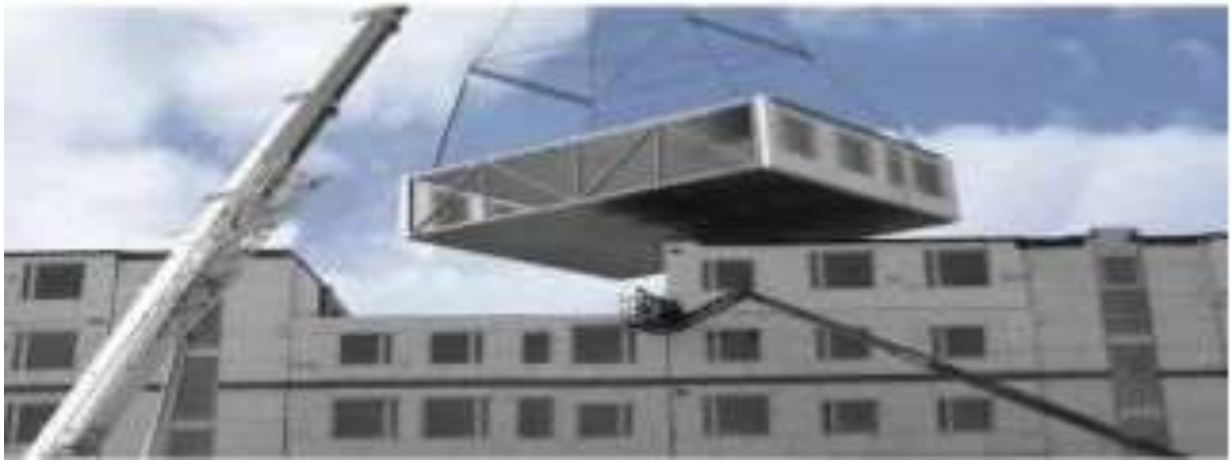

Figure: 4 A Cellular Systems

4.3 Modular Design Systems

Beyond the three categories of panels, skeletal, cellular, another breakdown in four different modular designs System types can be defined as shown in Figure 4. Describe Modular Building Methods unit is built.

4.3.1 Element or Component System

An element or component system is:
• Based on a single modular component
• Can be easily built or assembled into a system
• Can produce a skeleton or panel building typology

4.3.2 Fill-in System

A 'fill-in' system can be defined as:
• Elements structurally spaced between two complete units.
• Any combination of modular pre-fabricated systems: Panel, Skeletal or Cellular Units.

4.4 Construction Stages

The last part of Figure 4 deals with how we consider manufacturing phases of modular pre-fabricated design: Foundation System, Sub-Floor, Building envelope or roof. May be each of these steps composed of various prefabrication building categories (ie floors as panels, walls as 'kits of parts') and a roof/roof structure that is distributed to the site as a complete unit).

What is missing from modular prefabrication have a better organization of service integration

Plumbing, electrical connections, and ducting. Like this Figure 6 Renault Centre, Swindon, England The building was designed by Foster & Partners, and built in 1982 (Photo by Richard Davis, courtesy of Fosters & Partners, 1983)

CONCLUSION

This paper provides an organized approach understanding the Different types of Pre-fabricated modular building. The author is not saying that the proposed method of investigation is fixed on modular prefabricated building diagnostics, but rather a possible approach. This paper explains how manufactured modular prefabricated systems can hold the key to providing sustainable housing needs for India. Although this does not prove necessary. The case of the three proposed criteria to achieve Sustainable Housing: Automated Manufacturing, Integrated Building Services and Environment Standing theory, the view that stipulates that such norms there will be proper effect. Another important aspect, which is not covered in much depth.

This paper is of cost any newly introduced system is bound to cost more by the time it is originally manufactured more in quality and becomes the norm. Although, several studies of cost reduction have been studied. The need for environmentally sustainable housing better building service is imperative with integration. In developing countries, home is required along with both the increasing illegal settlements, they also those who have benefited from the recent economic boom. In industrialized countries, there is a need for Current resource and energy-intensive alternatives Accommodation. The author hopes to write a paper which will address automated manufacturing processes and integrating building services and the environment more stability.

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