

# Design of Modular Housing

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**Abstract** - This project report is about the modular house design that is a house constructed in a factory but assembled on site. The present day methods for the construction of modular homes prove to be efficient but are found to be of typical design and for one of many reasons the popularity of modular homes has gone down in many places on the planet. The project focuses on the development for the design of modular homes which allows the user to interchange spaces of the house as and when required. This concept allows the user to invest valuable resources like time and money to the flexibly to the capacity and needs of the user.

**Key Words:** *Modular homes, Interchange Spaces, Flexibility.*

## 1. INTRODUCTION

Across the spectrum of off-site products, modular, is the most complete in factory finish, up to 95% in some cases, shipped and assembled as 3D volumetric units that are service or structural units to be joined on-site.

The modular industry consists of two distinct industry segments: re-locatable modular and permanent modular. Re-locatable modular, sometimes referred to as temporary modular, are structures which meet temporary space needs and can be leased in a short-term agreement or purchased outright. Job site trailers, temporary classrooms, communication pods, and show rooms are some examples. Although permanent modular construction (PMC) has been flourishing for a decade or more in Europe, it is an emerging market in North America. PMC is comparable to site built structures meeting the International Building Code, the difference being that it is simply manufactured in chunks within a factory. PMC is deployed for multi-storey multi-family structures, government buildings, health care facilities, hotels, and any other building types found in traditional on-site construction. Whereas three to four years ago PMC only constituted 25% of the market share in the modular industry, today it represents over 50%.

### 1.1 Modular House

In The modular industry is host to both manufacturers, manufacturer direct, and dealers. Manufacturers produce modules to service general contractors or modular dealers. Manufacturer direct may manufacture for general contractors and dealers, but also contract directly with owners to provide modular solutions, acting as a general contractor. Both manufacturers and manufacturer direct organizations may be specifically focused on a particular building type, residential or commercial for example, or focus on re-locatable and/or permanent construction. Increasingly, however, manufacturers are becoming knowledgeable and skilled across the array of building types, markets, and industry segments.

### 1.2 Sustainability

For centuries people have been relatively unaware of the harm and strain that their levels of resource consumption put on the global environment. Only recently have people been searching for ways to slow or reverse this resource-depleting trend. The problem is so immense that isolated, small-scale efforts will not be enough to combat it. Therefore, in order to achieve any significant results, conservation must be incorporated into the everyday lives of consumers. To maximize the impact of this conservation movement, strategies should target an element within people's lives that is responsible for high energy and resource consumption. The prime candidates for this attention are private homes. The residential sector consumes over 20% of the energy in the United States (Energy Information Administration, 2009), and in response to this statistic, new designs and efforts are being developed in order to lower it. Most traditional homes were designed and built long before anyone was concerned about the impact they would have on the environment. Natural resources have been greatly depleted due to short-sighted construction practices, over-extraction, and the long period of time required for them to regenerate. In addition to the unsustainable extraction of natural resources, many established construction materials have a high embodied energy, meaning that they require large amounts of energy to manufacture. Others are often treated with chemicals that are harmful to human health as well as the environment. These are the three principle issues with traditional materials that the development of new, environmentally friendly materials is attempting to address. Environmentally friendly housing has been around for quite some time, especially in California, but its popularity has increased in recent years. Throughout the past few decades, new research has helped consumers to understand their impacts on the environment and the harm they are causing. This has created a consumer demand for the construction industry to incorporate more responsible practices, to which they have responded with increased

efforts in efficient resource use. This renewed interest has also inspired the ingenuity to find new sustainably produced materials that can be incorporated into the construction of homes.

## 2. Problem Statement

To generate awareness about modular type construction and attack skeptical mindset about prefabricated buildings. To provide customization in house designs to the customers so that uniqueness is maintained

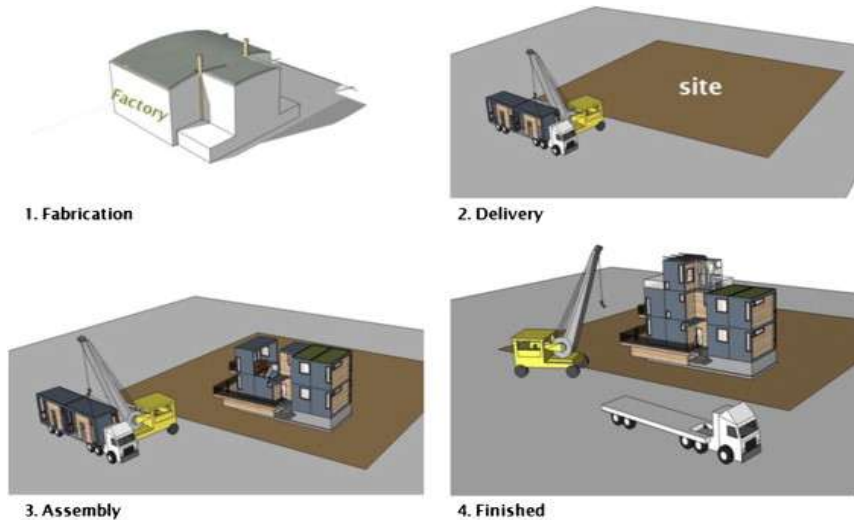
Modular building systems in India are slowly getting a hand on with many builders and construction companies now adopting the methodology in India. As far as the world is concerned, this system has already been accepted and has gained a lot of popularity. Currently, prefabricated modular buildings comprise of merely 1% of India's total \$100 billion real estate market. However, given the extended fall in the residential real estate, with inventories at an all-time high, developers believe that its popularity will rise. The reason behind this is the much faster completion of projects due to prefabrication which further decreases the overall costs. In India, the government currently aims to provide housing for all by 2022, which requires constructing 30 million low cost houses along with building 98 smart cities. Both these proposals are expected to provide a boost to the modular system.

## 3. Why the move to Off Site Construction Types/ Modular Housing?

- Off-site manufactured (OSM) accommodation provides a way to make timely and cost effective use of land such as brownfield sites, small sites, or in-fill sites such as those previously used for garage blocks which may not otherwise be developed on, or might sit vacant for years awaiting permanent development.
- OSM homes outperform energy use of traditional homes, reducing utility bills by up to 25% up to 80% on gas bills and 30% on water.
- It is suitable for all tenures and is particularly suited to the rental sector (either short or long term), due to the delivery of a fast rental stream it enables.
- They can be adapted to suite any potential development site, at a range of densities that can be adapted to suit a range of local priorities.
- With OSM being lighter, it requires considerably less obtrusive foundation preparation, and uses less concrete and steel in its construction.
- OSM has the potential to be installed over existing buildings or even added on top of blocks of flats. One idea, launched in 2016 would enable modular homes to be built on stilts above car parks. The homes would be designed to almost 'Passivhaus' status, with a highly insulated timber frame pod. The properties would sit under a solar-panelled roof, which would provide 90% of the homes' energy
- A fundamental advantage of OSM is that the units are relocatable and reusable on future sites. With the units having a life of between 40 and 60 years, there is great potential for long term savings.
- Using pockets of land to build modular homes utilises vacant land that might have been at risk of anti-social behaviour activities, reduces potential negative environmental impacts and fits with local authorities' civic pride objectives, e.g. 'Encouraging Civic Pride' and 'Growing the Borough' as in Barking & Dagenham.
- Unless construction components are sourced domestically, imported parts add air miles, thereby cancelling out any positives gained through energy efficiency.
- Off-site construction could be key to allowing a construction industry facing a skills shortage to grow. Off-site specialists have a permanent and highly-skilled workforce and a robust, long established supply chain, thus reducing the reliance on sub-contracted labour driven pipes. The water hammer effect as mentioned previously occurs in this section. The pressure chamber was also designed of PVC (poly-vinyl-chloride) material.
- Construction in a controlled factory environment provides the advantage of being more reliable, predictable and strong.

#### 4. Production Process

In general, more than 70% of construction processes in modular construction method such as structure, wall and equipment's are produced in factory through standardized design drawing while its processes are completed in a way that completed modulars are lifted on site and then assembled as shown in figure below



#### 5. Design Approach

The goal was to offer pre-designed homes which can be customized to an extent to suit your individual requirements. The process of customizing your home is coordinated by the developer and usually consists of choosing a preferred internal layout and some minor exterior changes or upgrades to the external facade. Custom building your own home can open you up to a world of choice and decision making. Understand how custom build can benefit you in so many ways and be inspired by some of our great design ideas and guides.

The enteral idea of the mass customization approach is to deliver products that have some degree of customization while striving to meet the standards of efficiency, cost, and quality of mass production. Therefore, it seeks to simultaneously achieve two seemingly conflicting goals, high product variety and high volume, by delivering products that fulfil the specific requirements of different customers through flexible processes and organizational structures. In house building, mass customization has been linked to environmental and social sustainability, as it can potentially eliminate waste resulting from changes carried out by occupants after moving in, and provide an opportunity for increasing their sense of identity and ownership.



Fig: Interior plan 1 for modular house

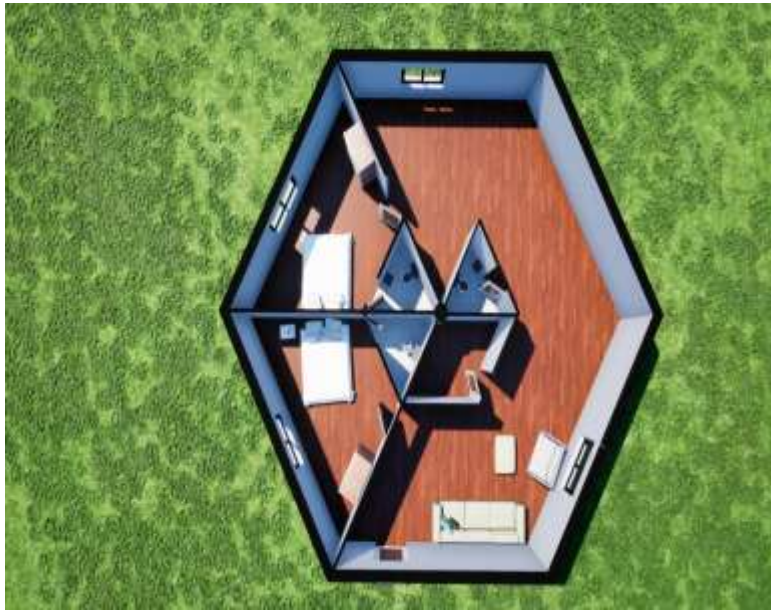


Fig.5.4 Interior plan 3 for modular house

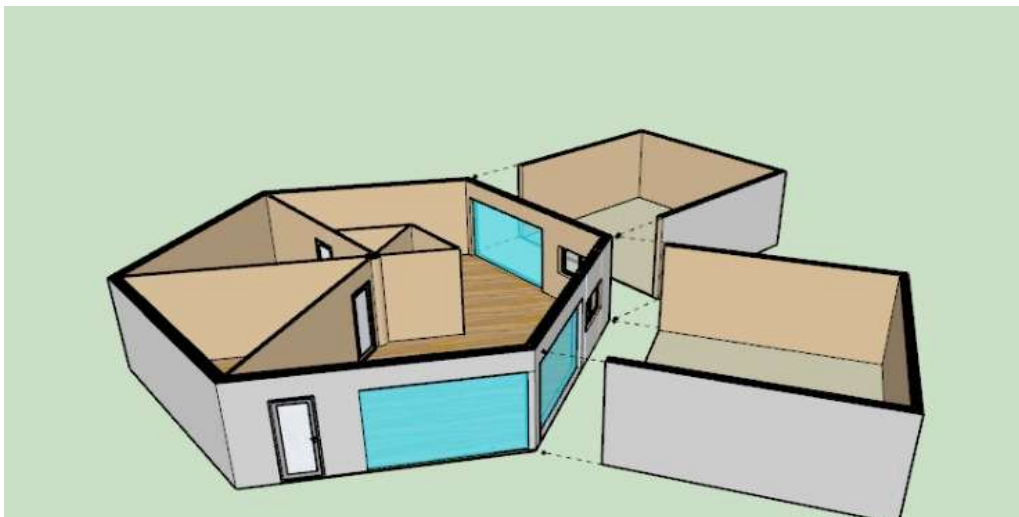


Fig.5.7 Customization in modular housing

#### 4. CONCLUSION

The adoption of product modularity in house-building design can contribute to the implementation of the mass customization approach in this industry, despite the differences between manufacturing and construction. The main theoretical contribution of this investigation is the adoption of two different Sustainability perspectives on product architecture that should be considered in the design of house-building projects, namely the component perspective and the special perspective. While the first perspective is widely adopted in the manufacturing industry, the spatial perspective is necessary due to the fact that the primary functions of buildings are performed by people in spatial voids, rather than by solid mass.

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