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ARTICLES

Prefabricated Housing Units and Interior Design Priorities for Kuwaiti Citizens

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Abstract:

Prefabricated buildings are built in factory-like setting and then transported to and assembled in the defired location rather than being constructed on the site itself. They have many advantages, including speed and cost of construction and reduced envrionmental impact. As such, prefabricated houses are a potential solution to Kuwait's long-standing and growing housing problems - if people can be persuaded to live in them.

This paper describes research to investigate Kuwaiti people's attitudes toward prefabricated houses and their requirements for their interior design. The results of a questionnaire admininstered to a representative sample of Kuwaiti adults show that there is a general lack of understanding about the nature and benefits of prefabricated buildings, and in particular the potential for their interiors to be customized to their owners' whishes. Many indicated that they would consider living in a prefabricated house if it met their requirements for a conforaable, well-designed and stylish home.

Given the general lack of knowledge about prefabricated houses, the authors conclude that the government has a role to play in raising the Kuwaiti people's awareness of the benefits of modern and well-designed prefabricated houses.

Introduction

Kuwait suffers from a serious housing crisis, while the obsession with owning a house remains the main concern for both middle- and

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low-income Kuwaiti families. Although the government strives to cope with the continuous substantial increase in demand for government housing, over time, responding to these increasing demands will be difficult, if not impossible, especially with the current laws, which stipulate that the land area for a government house should not be less than 400 square meters.

Due to the limited supply of land, the growth of the metropolitan urban area and the great challenges facing the establishment of new cities, decision-makers and planners need to seek innovative solutions that contribute to solving the problem while being acceptable to members of the society.

In this paper, the researchers discuss prefabricated houses, in particular the provision of non-traditional prefabricated apartments or houses that meet society's requirements through higher standards of interior design. This paper aims to shed light on prefabricated houses, to test the public's impression of them, and determine the elements that would be most likely to make people choose or be reluctant to live in prefabricated homes. This paper focuses on the opinion of the public in the State of Kuwait.

One of the most important tools that will help in the search for proper solutions to the housing crisis is to explain the prefabricated house to Kuwaiti people and to understand their attitudes towards it. At the same time, it is necessary to identify the preferences, specifications and standards that Kuwaitis want in their houses, while also studying the suitability of various design solutions, and interior design in particular, to achieve the requirements of the inhabitants and make housing more practical, functional, economic, and aesthetic. Through this study, the researchers sought answers to all the above, thus resulting in a set of conclusions and valuable ideas that we hope will contribute to the development of possible solutions to the housing problem. In addition, some of the research outputs may provide indicators for planners, architects and designers about the most important criteria and elements in dwelling for Kuwaiti society.

Research Objectives

This research aims to identify the important characteristics of the interior design of prefabricated homes in the views of the Kuwaiti community and understand their impressions about prefabricated housing. The research focused on the following priorities:

1 - To clarify the concept of prefabricated homes among the Kuwaiti community;

2 - To investigate Kuwaitis' impressions about prefabricated homes; and

3 - To identify Kuwaiti citizens' interior design priorities for prefabricated homes.

Research Problem

One of the main motivations for writing this paper is that, through my work in the field of interior design, I have seen the worsening of the housing problem in the State of Kuwait and the search for adequate solutions, both temporary and permanent, for both small and large families.

I have observed both the continued suffering of citizens in trying to achieve the desired level of convenience and the constant changes that they make to the interior spaces of their houses to match their lifestyle, tastes and social needs. The high cost of construction of additional units in existing homes and the time and hassle that come with complicated construction projects lead to many negative psychological, social and physical effects.

Historically, the Kuwaiti government has paid great attention to the housing welfare case. Since the 1950s, it has succeeded in offering alternatives to citizens and has issued many housing regulations to cope with these demands, which culminated in issuing the Housing Welfare Law Number 47 in 1993 and Law Number 27 in 1995 alongside its amendments.

The housing problem has become very complicated because it has been engraved in the mentality of the Kuwaiti citizen over the years that he has the right to have a separate house with all necessary services. This in turn has become a burden on the government's

shoulder as it has been accused of failing to fulfill this need, and people consider that it is the government's role to find alternative solutions (Al Obaid & Salamh Ramzi, 2009)[1].

Al Obaid and Ramzi (2009:5) describe the main features of the housing problem in Kuwait as follows:

1 - The growing gap between supply and demand - 174,000 requests have been submitted to the housing welfare institution to obtain a housing unit (house, land, apartment), but only 91,600 units were delivered between 1974 and 2009, which means 83,000 Kuwaiti families are still on the waiting list.

2 - The waiting period (average 10-17 years) is considered to be too long, exposing Kuwaiti families to unpleasant circumstances such as:

   a - poor psychological conditions, especially for low-income people;

   b - some families having to live with their relatives and parents, causing more burdens and overcrowding in the housing units;

   c - physiological and social suffering for some families living in rented units or unsuitable areas; and

   d - inflation in expenses resulting from rent allowances incurred by the government for Kuwaiti families, which amounted to KD 810,412,890 between 1991 and 2009.

Therefore, this research attempts to investigate the prefabricated home as an alternative solution to current trends in the provision of both temporary and permanent housing in Kuwait. To this end, the concept and ideas behind the prefabricated house should first be defined.

Definition of Prefabricated Homes and Units

Prefabricated buildings are those that are built indoors rather than constructed on the site itself. These homes are constructed in factory-like settings and the completed project is then covered and

(1) Salamh Ramzi is an economic advisor and Mariam Al Obaid is a social researcher at the National Assembly in the state of Kuwait.

transported to the desired location, where it can be assembled by the contractor. Modular homes are not mobile homes; they are simply built off-site rather than on the property. These manufactured homes are built in accordance with local regulations and housing laws and upon assembly are affixed to a foundation, unlike mobile properties. Because modular homes are constructed indoors, they can be completed in their entirety within a matter of weeks, as opposed to multiple months. Construction indoors alleviates the risk of on-site delays caused most predominantly by weather and other uncontrolled circumstances. Modular homes conform to guidelines and building codes that often surpass those of traditional homes. These structures vary in terms of their style and size and can be customized to the owner's requirements. They are permanent structures that can be used for residential or commercial applications, and they can be built on existing basements or other forms of foundation. They are valued the same as on-site buildings and do not depreciate. The structures are considered green or environmentally friendly and are built for accessible living.

There is a popular misconception that modular homes are all structured the same with the same appearance. However, there are no design limitations to modular homes, which enables property owners to work with their designer to cultivate an interior or architectural design that truly conforms to an ideal "dream home." Prefabricated homes generally save property owners money because they are constructed at a faster rate, something which saves a great deal of direct labor costs. Extreme weather cannot interfere with construction time, ensuring that there are no delays. Furthermore, throughout each phase of construction in the factory, third-party inspectors ensure that all home components adhere to building codes and high-quality standards prior to being transported to their final location.

The History of Prefabricated Houses from the Nineteenth Century to the Present

The key point about prefabricated houses is that they are designed and constructed in one place and reassembled in another location.

Prefabrication techniques have been in use for a long time, during which they have always been seen as the next big idea. Clearly, the adoption of prefabricated houses throughout history is due to necessity, thus it can be said to be led by demand and supply in the housing sector.

Throughout history, people have been constructing buildings in one place and reassembling them in another location. H. Manning, a London carpenter, built the Manning Portable Cottage in the 1830s, which is the first documented prefabricated house (Zarroli, 2008:1). In 1833, the first "balloon frame" building, St. Mary's Church, was constructed in Chicago (Davies, 2005:34). This technique of building houses was preferred for constructing much-needed housing in the mushrooming urban centers. In 1834, the methodology advanced so that it took less than a week to build, or rather to assemble, a house, and this mode of constructing houses spread to other parts of the world (Davies, 2005:36). In 1853, in Australia, there was mass importation of portable buildings, marking the peak of prefabricated buildings there. During this period, hundreds of such houses arrived in Australia from Boston, Liverpool, and Singapore.

The Gold Rush and Crimean War

As already stated, the use of prefabricated houses was due to necessity. In 1849, more housing kits were transported by train to provide convenient shelter for prospectors during the gold rush. Quick constructions were needed due to time constraints. Fabricated homes were therefore in tremendous demand (Peterson, 1965:318). During the Crimean War in 1855, another need for immediate housing emerged. This prompted Florence Nightingale to contact The Times by letter, resulting in Isambard Kingdom Brunel being appointed to design assembled hospitals. A hospital unit that could hold 1,000 patients, with innovative ventilation, sanitation, and flushing toilets was designed in five months (Silver, 2007:19).

The Industrial Revolution and World War I

New machines powered the factory production that was growing rapidly in America during England's industrial revolution in the mid

eighteenth century. Companies offered prefabricated homes to clients through catalogs. In 1906, Aladdin Ready-Cut Houses became the first to offer prefabricated houses on the market. By the mid twentieth century, engineers and architects were pondering how to build houses substantially and efficiently for a quickly growing populace. At the onset of World War I, leading innovator Le Corbusier's Domino House of 1914 proposed a basic strengthened stable structure bolstered by thin shafts.

World War II

World War II saw a major rise in the use of pre-assembled structures, which had the capacity to replace housing lost in the bombing. Up to the end of the 1940s, there were around 160,000 pre-assembled homes manufactured in the United Kingdom, with the biggest number in a single area being based on a domain in Liverpool. The United Kingdom utilized pre-assembled structures that included Bellman Hangars and Nissen cabins, while the United States used Quonset cottages as military structures. Although these prefabricated buildings were intended to be a temporary solution, the houses lasted for a long time. In fact, the Liverpool houses were eventually demolished in the 1960s, much against the occupants' wishes (Wallis, 1991:64).

The proliferation of prefabricated homes across the UK was a consequence of the Housing (Temporary Accommodation) Act, 1944 and the Burt Committee. Under the Ministry of Works (MoW) Emergency Factory Made Housing Programme, a description was drafted and tendered on by various manufacturing companies and private construction firms. After endorsement by the MoW, organizations could provide Council-driven improvement plans, bringing about the building of entire prefabricated estates to give accommodation to those made destitute by the War and to progress slum clearance (Wallis, 1991:100).

The 1960s to 1990

During the period between 1960 and 1990, prefabricated houses regained their popularity. Moshe Safdie's Habitat '67, which was

constructed for the Montreal World Fair in 1967, marked this reawakening. In 1963, Carl Koch designed the Techbuilt House, a panelized system and wooden frame structure (Silver, 2007:21). These houses were meant to be assembled in any place. The same period also saw many low-income families purchase prefabricated houses that were much cheaper compared to building conventional housing. The 1980s brought a renewed interest in urban applications for prefabricated building practices since they offered a high-design and low-income solution. By 1985, the prefabricated method was used to rebuild the destroyed cities that had been uninhabited in the 1960s and 1970s (Marquit & LiMandri, 2013:7).

During the 1980s, plans for prefabricated houses were modified to allow spatial set-ups that were not restricted in size by road transport considerations; the single-story structures associated with fabricated housing were no longer the main alternative. In the 1990s, developers and even consumers started to take to prefabricated construction for its efficiency, low cost, and convenience (Marquit & LiMandri, 2013:8). In Japan, manufactured housing began around the 1960s. During World War II, numerous houses were destroyed, and after the baby boom, interest in the private house was keen. Keeping in mind the end goal of developing more homes without sacrificing quality, Japanese organizations employed the prefabricated housing methodology (Xu & Zhao, 2010: 7). In Hong Kong, housing industrialization started in 1953 when a major fire broke out and numerous houses were burned to the ground. About 53,000 individuals became homeless. Prefabricated housing was used to shelter these homeless people (Xu & Zhao, 2010:8).

The environmental movement of the 1970s ended the excitement concerning innovation and engineering dreams. At that time, profoundly innovative construction materials that did not appear to be in congruity with the environment, for example aluminum or plastic, fell into disfavor. This was further exacerbated by the way that prefabricated components had regularly been used to assemble high-density housing, which was seen at the time to be detrimental. Consequently, the prefabricated building came to be connected with

social failure and the aesthetic of egotist, de-individualized, prefabricated section housing pieces grouped on the periphery of huge urban areas. Therefore, in vast parts of Europe, acknowledgment of the prefabricated house stayed low up until the 1990s (Gössel, Cobbers, & Jahn, 2012:2).

Prefabricated Houses Today

The use of modern prefabricated structures has progressed from the more utilitarian ideas of their antecedents. The use of ecologically friendly materials and refined styles of development means they can be redone to adjust to the area and the clients' needs. There have been instances of some of this expansion on different house-building projects, which demonstrates the assortment of extensive-scale structures that are accessible on the market.

The business segment has seen a significant development in the use of prefabricated structures in recent decades. Such structures have numerous advantages over customary block-and-mortar structures, including the ability to be set up and work in a short time. This is why there has been a rise in their use in fast-food restaurants and general stores, for example, as well as for warehouses and manufacturing plants. As a case in point, McDonald has used a prefabricated structure and set a record of developing a building and opening it for business in no more than 13 hours on pre-prepared ground.

Prefabricated structures for businesses generally use either steel or aluminum casing. Both materials have commendable qualities: steel is solid yet corrodes easily, while aluminum is lighter but has a high resilience to corrosion. With these materials as sub-casings in a building, an extensive variety of choices of roofing and walling can be used to suit the operational necessities. The greatest business benefit of a prefabricated building over an assembled one is the speed with which it can be developed, which means that a degree of profitability can be seen much faster than for a customary structure (Xu & Zhao, 2010:8).

In conclusion, prefabricated houses have evolved over time, fueled by the need to provide people with efficient, low-cost, and

convenient housing. Prefabrication is a procedure used in an assortment of businesses, as segments are fabricated in an industrial facility, which may be collected into a completed unit and transported as an aggregate bundle or dispatched in parts for final assembly on location. The construction procedure is especially useful in the development segment, where prefabricated structures are used when a quick, dependable arrangement is required. The prefabricated structure is not, as may be thought, a new idea and the use of such construction as a building technique indeed goes back to the nineteenth century.

Design and Construction of Prefabricated Homes and Housing Units

Around the world, prefabricated and modular homes have grown in popularity. While the construction technology behind the idea is quite old, housing kits have amassed a large following, particularly in North America and Europe. In the city of Sofia, Bulgaria, one estimate states that, in 2009, over 60% of the entire population resided in prefabricated homes (United Nations TV, 2009:2). That same year, over $72 million was spent by the United Nations on prefabricated buildings across Europe (United Nations TV, 2009:2). These units are constructed on an assembly line inside an indoor factory, and upon completion, they are transported to the construction site. Such units bring with them many advantages compared to on-site construction, primarily due to the fact that they are constructed indoors; there are no delays because of bad weather and construction on multiple sites can take place simultaneously. The result is that construction speed is increased and overall costs are decreased through improved efficiencies. The elements constructed in factories are under scrutiny and regular quality assurance inspection by third parties to ensure that each component follows precise standards. With coordination and detailed planning, the construction of modular homes provides a sustainable housing solution.

This is not to say, however, that they are without some challenges. In some cases, the prefabricated home or modular unit must travel a considerable distance to the final destination, which can result in damage en route or costly transportation fees. Additional challenges may be faced as the finished unit is integrated into the existing

foundation at the delivery site. The labor required to compensate for poor planning or unforeseen damage during transportation can eat away at the other savings afforded by the modular units. In addition, in some cases, the standard modular designs are not appropriate for particular climates, which can bring with it a dire need to hire skilled labor to rectify climate-related issues, something for which there is not an existing supply sufficient to meet the large demand.

Different Materials of Prefabricated Houses

Since the rise in popularity of modular buildings, research has been conducted into what materials best improve the quality, sustainability, affordability, and performance of each unit. Prefabricated houses can be made from multiple material types. The most common materials include mixtures of wood, steel, and concrete. Many methods use composite wood materials in conjunction with steel frames to provide faster on-site construction, and in some cases, these bring financial benefits resulting from the accelerated construction schedule. Challenges associated with the use of newer materials include locating trained labor, ensuring all new systems connect properly, and managing the complexity of coordinating new systems throughout the construction process.

Panels

Structurally insulated panels were used throughout the 1930s in an effort to conserve wood across North America. Further development took place throughout the 1940s, and by the 1970s and 80s, the use of structurally insulated panels had grown significantly. Panelized building systems reduce construction time, increase structural and thermal performance, and reduce labor costs. Laminated veneer lumber is also utilized for wooden curtain walls in lieu of conventional items, which reduces the overall environmental footprint of the building and, in turn, supports local economies where the unit is constructed (Tejchman, 2014:1071).

Some of the challenges that arise from the use of structural insulated panels include the increased capital cost, something which

often balances out the long-term savings that result from the reduced energy cost. Another challenge is referred to as "creep", defined as the materials shrinking or changing over time. Other considerations include sound performance and the construction precision needed for installation of the panels, which requires specific training. The sealed joints must be appropriately structured to alleviate condensation build-up under the roof or inside the wall membranes. In spite of these challenges, panelized building systems bring with them many positive attributes and long-term cost savings, such that the current impediments to overall efficiency are outweighed. In fact, any new panelized building materials conform to LEED certification (Leadership in Energy and Environmental Design). Structural panels have been incorporated into high-performance and world-renowned projects, including the Avalon Discovery 3 project located in Alberta, Canada, and the Bertschi living building science wing in Seattle, Washington (International Living Future Institute, 2013).

Wood

Heavy timber refers to large wood columns and beam structures integrated into wood-paneled systems. Wood-framed modular units remain among the most common forms of modular unit throughout North America (University of British Columbia, 2015). Dimensional wood (lumber cut to standardized width and depth) can be used in tandem with composite wood for overall construction. Wood construction provides the structure for many prefabricated buildings. It is used for single-family homes, as well as multistory residential and commercial properties (Green & Karsh, 2012). In spite of being combustible, panelized wood products and heavy timber are designed to withstand fire by means of a char layer. The black and char layer is an innovative design that allows the materials to conform to building codes (Teixeira et al., 2012:516).

Composite wood materials

Composite wood materials are those that are composed of different woods mixed with other materials. They can be used for

beams, joists, floor systems, and wall systems. Composite wood materials increase the strength of the structure, provide faster building times for the overall construction, and reduce carbon emissions. In spite of being combustible, the paneled wood products can be designed to withstand fire well because of the char-level protection of the wood. They are popular due to their ability to replace steel products and the increased strength they provide. There are three key types of engineered wood products used for prefabricated homes (Velamati, 2012:27).

Cross-laminated timbers are panels constructed from composite wood boards which are pressed and dried, then glued together with non-toxic adhesives. Glued laminated lumber is another composite wood product where the boards are pressed and dried and glued together in a similar fashion to the cross-laminated timber. The difference is that cross-laminated timber is glued together with every other layer at a 90ºangle, whereas the glued laminated lumber uses dimensioned lumber. Finally, there is laminated veneer lumber, which is dried 3mm-thick softwood panels glued together. The use of composite wood structures and prefabricated modular units around the world has increased over the last few years; they are now found in buildings such as the CSH (Case Study Hamburg) building (Ryder, 2013). The CSH building is a house built in Hamburg, Germany and used prefabricated elements made of wood that are easily constructed, transported, and assembled on site. The use of these systems affords higher performance and accelerated construction schedules, which minimizes overall cost and increases reliability. Perhaps most promising is the fact that such materials have the potential for use in mid- and high-rise buildings.

Steel

Steel-frame modules increase durability and have been incorporated into more recent projects where the modules are not identical. Steel framing is typical of on-site construction in which the steel columns and beams form the grid for the building. Steel frames are often used for prefabricated construction due to their light weight,

recyclability, and ease of transportation. Some of the key challenges associated with using steel include the fact that it has increased energy intensity throughout its lifetime, which also increases thermal conductivity and bridging. Steel frames have been used for modular multifamily residential buildings throughout the United States, the United Kingdom, Australia, China, and Japan. In all cases, the use of steel frames significantly reduced the construction time and allowed construction to greater heights (Lawson, Ogden, & Goodier, 2014:41).

Concrete

Concrete is also common for on-site construction, but the trend is now shifting toward modular and prefabricated housing. Concrete offers compressive strength and durability but it brings with it the disadvantage of being very low in tensile strength. Precast concrete and concrete blocks can be used for prefabricated construction.

Recycled Materials

There has been an increased demand for the use of agricultural and landscaping material, such as green wall panels and modular green roofs in order to improve the indoor air quality and reduce greenhouse gas emissions. At the same time, the use of recycled content in prefabricated homes increases standards of sustainability and durability.

Hybrid Systems

There are, of course, many hybrid systems used for prefabricated units which are composed of the aforementioned materials such as steel framing, concrete cores, and wood paneling. In some cases, the hybrid system is designed to rectify outstanding issues existing in one particular material by incorporating another. Mitigating such risk can help to make a larger modular story more structurally stable or add support against seismic or wind problems (Hnilova et al., 2012:1123).

The Design and Construction Process

The design and construction process for prefabricated homes has many steps. The first step is to design the structure. This takes place

almost entirely prior to the start of construction. Having a strong and comprehensive design helps to organize the work within the modular factory. Upfront designs also help to provide property owners with a comprehensive pricing structure and timeline. Full mock-ups are traditionally scheduled prior to construction and give the property owner the opportunity to review the projected design and construction of the modular unit (Garrison & Tweedie, 2011:26). Mock-ups are produced at a significantly lower price for modular units compared to on-site construction units and the total time required for a mock-up to be constructed from start to finish is around one month. This allows for a prototype which then begets faster construction for prefabrication.

During the design phase, it is important to take into consideration the interior openings. It is also important to consider the mechanical, electrical, and plumbing systems. All hook-ups must be connected after the module has been placed on site, which in some cases requires the removal of specific floor or wall panels, something which needs to be integrated into the design of the home as well as the exterior finishes.

Once the design has been agreed on between designers and property owners, and after the mock-up has been approved, construction begins in the prefabrication factory. This level of construction requires meticulous coordination and management by the builders.

Factory-built homes begin as sections which are built inside a climate-controlled area, and upon completion, they are transported to the building site and assembled using labor and cranes. Once set up on a foundation, the prefabricated home cannot be moved. Each manufacturer operates in accordance with a different set of guidelines, so when designing a home it is imperative to speak with the manufacturer about the personalized features and unique interior designs available, including cabinet styles, type of wood, plumbing fixtures, ceramic floors, countertops, and exterior finishes. Inside the factory, there is typically an assembly line as well as static production. The assembly line is where the product moves through various stations while fabrication is being completed. In the static production, the workers are moving the module itself (Cameron & Di Carlo, 2007:63). The goal of all modular construction is to complete as much of the

structure as possible within the factory setting. Most units are shipped at 60 to 70% complete. There is still a requirement for some on-site construction, such as attaching the units and completing flooring finishes, ceiling finishes, exterior cladding, and casework.

Transportation

Upon completion of indoor construction, the modular unit must be transported safely to the property, whereupon it will be affixed to the foundation. Units may be damaged during transport, and transport itself might be a considerable expense, depending on the distances involved. There are many modes of transportation used for modular units, although the method tends to be specific to individual geographic locations. Barges can also be used to transport multiple units along coastal regions. This is ideal for temporary housing such as resource-developing workers. Prefabricated homes can be moved with the barge to new areas as the demand for temporary housing in the original location shifts toward a secondary location.

Modular construction does not necessarily involve completely finished units. Some prefabricated panels and folding structures are more efficiently transported separately, to be attached to the unit itself on site. Panelized construction allows designers and builders to transport the panels or folding modules in a large truck (Quale et al., 2012:251). Items such as roofs are particularly challenging to transport depending on how they were sealed and finished. In many cases, they can be transported by truck, especially for single-family and multi-family developments.

After transportation is complete, the logistics of affixing the modular unit to the foundation begins. All of this needs to be coordinated ahead of time in order to avoid any problems or delays. A modular construction project requires a staging area where the module itself can be unwrapped and prepared for fixing to the foundation. If the site itself does not have room for this, a separate staging area is required. At this point, cranes are utilized to place the modular units in their approved locations on the foundation. In some situations, an airbag lift system can be used to lower a module onto a foundation.

This method is typically reserved for single-story structures where a crane is not necessary. Direct labor is then required to set up all final construction as well as complete all electrical and plumbing fixings in accordance with local building codes. In some countries, factory-built modular units are required to undergo inspection at local government levels and in some cases even at state levels. Upon completion of the inspection and approval by the inspectors, the buildings can be properly affixed at the destination.

Advantages and Disadvantages of Prefabricated Homes

Taking into account the wide array of materials available, one of the key advantages associated with modular and prefabricated housing units is that most of the components can be constructed inside a factory, which results in reduced construction times and avoids all influence of negative weather conditions. Shorter construction times mean lower costs, specifically labor costs. It also makes modular units ideal for emergency housing or temporary housing solutions with tight deadlines. With more means of transportation and improvements to existing materials such that modular units can be broken down into flattened components easily transported by trucks, the cost of transportation by truck and rail means that modular units can be used in more geographic areas. The decreased cost of materials and labor currently helps to offset the logistical cost of transportation, and improvements to transportation will in future help to outweigh this issue as well. While there are some downsides associated with specific materials, as discussed earlier, the reduced environmental impact of using recycled or composite materials outweighs the short-term cost through long-term savings and benefits. These units adhere to mechanical, electrical, and plumbing codes, and upon completion of simple inspections, they provide regional manufacturing jobs while at the same time improving housing options and reducing costs.

The current market conditions show a greater demand for modular units, indicating that the benefits are being acknowledged by more of the population. Modular units originally intended for

residential purposes are now expanding to provide commercial options.

There are, however, some disadvantages currently associated with the use of modular and prefabricated units. One of the biggest obstacles is the logistics and coordination required. The majority of the design and coordination must take place ahead of time. As long as this is done properly, it mitigates the potential downfalls and risks in the future. However, if it is not done properly, it can result in delays and increased cost. In certain areas with limited means of transport, the key issue is getting the unit from the prefabricated factory to the property itself. Certain geographic regions do not have the road infrastructure to allow for wide load transportation, which can interfere with the most common transportation method, transportation by large trucks. In some areas, rail or coastal routes might be used, but this is not an option for all regions. Logistically, there are also site considerations which can increase the cost. All prefabricated homes need a staging area where they can be taken off the transportation unit and prepared for placement onto the foundation. Not all properties have enough space for this, so an additional staging area needs to be set up on another property, incurring additional transportation costs. In certain cases, reaching the destination area may bring its own physical impediments, such as a narrow driveway or dangerous private road with gradient problems that prohibit large truck access. Additionally, in some areas, the crane and rigging set-up designed to affix the finished model to the property might be a problem. Some additional issues include the lack of skilled labor necessary for particularly unique projects. Today it is quite common for modular and prefabricated homes to be designed in a custom fashion, which means that cookie-cutter components are no longer viable and unique design specifications must be met with skilled labor and project team. However, in certain areas, supply cannot meet the demand for the necessary skilled labor.

The Quality of Interior Space within Prefabricated Houses

The quality of interior space provided by prefabricated houses is equal to that found in houses constructed on site. The amount of

thermal insulation and soundproofing afforded by the structure is contingent upon the materials used, as mentioned above. However, aside from this, quality is also affected by the design choices made by the property owner. With modular construction, most of the design takes place prior to the start of construction and property owners have a great deal of influence in terms of what components and features they want to integrate into the interior of their home.

Perhaps one of the most appealing features of modular homes is that they offer superior energy efficiency. In addition to the existing efficiency built into the original construction of the unit, there are possibilities for property owners in the United States to work with their designer to enhance existing components with Energy Star specifications. Similar programs are offered across other countries that provide conventional builders with multiple steps by which they can reduce energy consumption while simultaneously making the interior of the modular homes more comfortable (Gianino, 2005:114). Higher levels of insulation in the modular units, in tandem with lower air infiltration, will make the home warmer and quieter inside, keeping out colder air during the winter months and hotter air during the summer months, as well as limiting the sounds that enter through the walls. Mechanical ventilation systems can be used to improve the quality of air in the home. This reduces the build-up of air pollutants. It also alleviates the accumulation of pet dander, carbon monoxide released by heating systems, dust, carpet adhesives, or build-up from household cleaners. These systems will mitigate poor air quality resulting from showering, cooking, and breathing humidity as well (Gianino, 2005:114). Modular units have tighter sealing to block exterior drafts, and the controlled continuous ventilation improves breathing indoors. Some examples of the more popular installations for such ventilation systems include bathroom fans that are connected to variable-speed timers (Gianino, 2005:114).

Many homes enjoy additional interior comfort because of air-sealing techniques applied to the exterior modular shell. Recessed lights can be specially rated for low air infiltration, vented range hoods can be installed over gas ranges, bathrooms can enjoy new fans, low-

emissivity windows can be installed, and insulation can be added to basement stairwells and ceilings (Gianino, 2005: 114). For additional comfort and cost savings, modular and prefabricated units can enjoy energy-efficient heating systems and air-sealing steps that make the interior air more comfortable at all times and keep the temperature at an ideal level.

Summary of Prefabricated Construction

There is great potential for modular construction as a way of delivering high-quality residential and commercial buildings at a lower cost, with the additional benefits of reduced environmental impact. In many areas of the world, there is a strong demand for multifamily housing units, but there remain issues associated with improving existing materials and increasing transportation methods to mitigate current obstacles. There is also a need to explore larger projects with minimal financing, shorter construction schedules, and reduced crew sizes.

In light of this potential, this research attempts to investigate the prefabricated home as an alternative solution to the housing crisis in Kuwait. In particular, it will investigate Kuwaiti people's attitudes toward prefabricated home and their requirements for its design.

Research Methodology

The descriptive approach has been chosen to investigate the Kuwaiti public's preferences for prefabricated buildings. This approach seeks to describe the phenomena clearly and define them using qualitative descriptions and features. It also applies quantitative methods using numbers and tables to explain the extent of each phenomenon and its association with other phenomena.

Scholars have developed a variety of research tools and means of collecting and analyzing information, including direct interviews, telephone interviews, sending questionnaires by fax, mail or email, and publishing a questionnaire on the internet. The researchers chose to carry out this research by conducting in-person questionnaires through a group of guided research assistants. The researchers aimed

to keep the questionnaire short in order to encourage participants to complete it and answer the questions with focus and honesty.

Study Procedures

There are certain procedures that need to be followed when using research questionnaires (Gall, 1996: 291). First, it is necessary to define the research problem, and then the following steps should be taken:

1 - Choose the pilot sample.
2 - Design the questionnaire.
3 - Conduct an initial test to check the level of questions.
4 - Pre-contact participants.
5 - Distribute the questionnaire with a simple introduction on the subject of the research.
6 - Analyze the questionnaire's answers.

Based on the above, the researchers defined the research problem and listed the research objectives by first setting out the general idea and gradually defining the objectives. Considering the research objectives, the pilot sample was taken from Kuwaiti adults (over 18 years old). The researchers also recognized the importance of designing the questionnaire so that it would be interesting for the participants. It is well known that the design of a questionnaire and its questions plays a significant role in motivating participants to respond honestly. In this context, the researchers followed the guidelines below in designing the questionnaire.

- Keep the questions as short as possible.
- Avoid words and terms that might confuse participants.
- Design the questionnaire in an attractive way.
- Organize the questionnaire elements in a logical way that helps participants to interact positively and read it more easily.
- Provide an initial description that explains the purpose of the research.
- Provide a brief explanation when using any term to help the participants to answer correctly. (In this research, the researchers explained the term "population density," as it is difficult for some people to understand.)

- Avoid criticism or offensive words, because they can stimulate mental chaos and may affect participants' sequence of ideas, possibly leading to inaccurate or incorrect answers.
- Avoid the use of positive or negative words that would affect the neutrality, hence the integrity and objectivity of the questionnaire.
- Avoid the use of words that do not convey a clear and precise meaning.
- Avoid asking questions that need two separate ideas in one answer.

After preparing the questions, the researchers tested the questionnaire in a pilot test by distributing a number of copies to a group of respondents. Spaces were provided to enable the participants to write their comments or criticize questions. The questionnaire was tested several times to ensure the correct understanding of the questions. This study also showed that pre-contact with participants increased the effective serious participation, thus obtaining positive honest results.

The Field Study

The questionnaire was distributed randomly by hand to a sample of Kuwaitis living throughout the metropolitan area. A total of 113 correctly completed questionnaires were received. Table 1 describes the sample according to the different study variables.

The responses to specific questions are shown in Tables 2, 6, 10, 14, and 18, and are discussed below.

Table (1)
Sample responses according to various variables.

Variable	%	Number
Gender		
Male	46	52
Female	53	61
Age		
18-30	60	68
31-50	40	45

Cont| Table (1)
Sample responses according to various variables

Variable	%	Number
Education		
Higher education	13	15
University graduate	39	45
Diploma	34	38
High school	11	13
Intermediate school	2	3
Social status		
Married	66	75
Single	27	31
Divorced	0.06	7
Governorate		
Capital	30	33
Hawalli	30	34
Al Farwaniya	19	21
Al Jahra	.01	1
Al Ahmadi	11	13
Mubarak Al Kabeer	.9	11

Question 1: Do you know what buildings made from prefabricated materials are?

Table (2)
Question 1: Do you know what buildings made from prefabricated materials are?

Response	%	Frequency
Yes	33	37
No	40	45
Maybe	30	31

From Table 2 we can see that 40% of respondents do not know what a prefabricated building is. Of the rest, 30% have chosen Maybe, while only 33% have indicated that they know what a prefabricated building is.

Table (3)
Analysis of responses to Question 1 according to gender

	Yes	No	Maybe	
Male	20	19	13	52
Female	18	24	20	62

Table (4)
Analysis of answers to Question 1 according to age group

Selection	18-30		31-50	
	Frequency	%	Frequency	%
Yes	16	24	21	47
No	29	43	15	33
Maybe	23	33	9	20

Table (5)
Analysis of answers to Question 1 according to educational level

Education	Yes	No	Maybe
Postgraduate	6	5	4
Graduate	16	17	12
Diploma	11	14	13
High school	2	8	3
Intermediate	2	0	1

Question 2: Check below the image that you think represents a prefabricated building.

Respondents were provided with two images of an interior space and asked to try to indicate which image they thought was of a prefabricated building. In their responses, 42% chose Image (1) and 58%

chose Image (2). The two responses are quite close and confirm that the sample could not firmly determine the difference between the two images.

Image (1)

Image (2)

Table (6)
Question 2: Check below the image that you think represents a prefabricated building

Response	%	Frequency
Image 1	42	45
Image 2	58	68

Table (7)
Analysis of responses to Question 2 according to gender

	Male		Female		Total responses
	Frequency	%	Frequency	%	
Image 1	20	52	25	48	45
Image 2	33	42	35	58	68

Table (8)
Analysis of responses to Question 2 according to age group

	18-30		31-50		Total responses
	Frequency	%	Frequency	%	
Image 1	24	53	21	47	45
Image 2	44	65	24	35	68

Table (9)
Analysis of answers to Question 2 according to educational level

	Image 1	%	Image 2	%
Postgraduate	4	10	11	16
Graduate	18	40	25	37
Diploma	15	33	24	35
High school	7	15	6	9
Intermediate	1	2	2	3

Question 3: If this was the look of the interior design of the prefabricated house, would you agree to live in it?

In Question 3. the sample group were asked if they would agree to live in a nicely designed space within a prefabricated building.

Table (10)
Question 3: If this was the look of the interior design of the prefabricated house, would you agree to live in it? Why?

Response	Ë	Frequency
Yes	60	69
No	40	45

As can be seen in Table 10, a majority (60%) of the respondents indicate that they would agree to live in a well-designed prefabricated home.

Table (11)
Analysis of answers to Question 3 according to gender

	Male	Female	Total responses
Yes	29	37	66
No	23	25	48

Table (12)
Analysis of answers to Question 3 according to age group

	18-30		31-50		Total responses
	Frequency	%	Frequency	%	
Yes	39	57	30	43	69
No	29	64	16	36	45

Table (13)
Analysis of answers to Question 3 according to educational level.

	YES		NO		Total Responses
	Frequency	%	Frequency	%	
Postgraduate	5	8	9	20	14
Graduate	29	42	17	38	46
Diploma	27	39	11	24	38
High school	5	7	8	18	13
Intermediate	3	4			3

Question 4: Those who answered 'Yes' to Question 3 chose the following top reasons.

Table (14)
Question 4: Those who answered 'Yes' to Question 3 chose the following top reasons

Selection	Frequency	%
Speedy construction	46	28
Suitable price	29	22
Beautiful	33	20
Flexible	17	12
Durable	15	0.9
Don't know	9	0.5
Other	6	0.4

Table (15)
Analysis of 'Yes' answers to Question 3 according to gender

	Male	Female	Total response
Speedy construction	17	29	46
Suitable price	10	21	31
Beautiful	12	20	32
Flexible	4	13	17
Durable	5	8	12
Don't know	5	2	7
Other	0	6	6

Table (16)
Analysis of 'Yes' answers to Question 3 according to age group

	18-30	31-50	Total response
Speedy construction	22	22	44
Suitable price	13	20	33
Beautiful	13	19	32
Flexible	11	6	17
Durable	7	9	16
Don't know	6	2	8
Other	3	4	7

Table (17)
Analysis of 'Yes' answers to Question 3 according to education level

	Total responses	Post-graduate	Gradu-ate	Diploma	High school	Inter-mediate
Speedy construction	46	3	20	19	1	3
Suitable price	29	3	13	10	1	1
Beautiful	33	4	11	16		2
Flexible	17	1	10	3	2	1

Cont| Table (17)
Analysis of 'Yes' answers to Question 3 according to education level

	Total responses	Post-graduate	Gradu-ate	Diploma	High school	Inter-mediate
Durable	15	3	5	5		2
Don't know	9	3	4	1	1	
Other	6	1	3	2		

Question 4: Those who answered 'No' to Question 3 chose the following top reasons

Table (18)
Question 4: Those who answered 'No' to Question 3 chose the following top reasons

Selection	Frequency	%
Durability	23	28
Unsafe	16	18
Expensive	11	17
Unavailable in local market	9	15
Inflexible	11	11
Ugly	10	11

Table (19)
Analysis of 'No' answers to Question 3 according to gender.

	Male	Female	Total responses
Durability	9	12	21
Unsafe	6	10	16
Expensive	8	4	12
Unavailable in local market	3	5	8
Inflexible	4	6	10
Ugly	3	8	11

Table (20)
Analysis of 'No' answers to Question 3 according to age group.

	18-30	31-50	Total responses
Durability	15	8	23
Unsafe	12	4	16
Expensive	7	4	11
Unavailable in local market	5	3	8
Inflexible	6	5	11
Ugly	10	1	11

Table (21)
Analysis of 'No' answers to Question 3 according to education level.

	Total Responses	Postgradu-ate	Graduate	Diploma	High school
Durability	23	6	6	4	6
Unsafe	16	1	6	3	6
Expensive	11	1	5	1	4
Unavailable in local market	9	3	2	2	2
Inflexible	11	1	5	3	3
Ugly	10	1	5	3	1

In the second part of Question 3, we can see that those who answered 'Yes' justified their answers by the speedy construction of prefabricated homes, suitable price, and beauty of design. On the other hand, those who answered 'No' justified their answers with lack of durability, unsafety, and high construction price.

Recommendations for official Authorities:

Based on the above, Kuwaiti government should consider prefabricated houses as a permanent residential solution for the present housing crisis. Nowadays, prefabricated modules are consid-

ered an ideal residential unit around the globe. Further considerations should be taken into account as follows:

- The findings from this study show that Kuwaiti people are in need for comprehensive awareness regarding prefabricated housing. This awareness can be increased through lectures, workshops, seminars, and printed materials, which should be distributed to those who are about to build their homes or are eligible for governmental housing.
- A real size prefabricated modular unit should be made available on site to allow Kuwaiti people to visit and experience the module space layout, materials, scale and proportion, in addition to demonstrating the building and interior design process.
- The government should promote prefabricated housing by the provision of financial and technical assistance.
- Special attention should be given to cultural, environmental, and sustainable adaptation represented in code building designated for prefabricated modules that they goes in harmony with Kuwaiti lifestyle and daily activity.

Findings

This research demonstrates that prefabricated homes can be a suitable solution to the housing problem in the State of Kuwait because they can allow the expansion of existing homes vertically with minimum cost and time.

The collected survey samples demonstrate the public's lack of understanding of the true nature of prefabricated buildings. The answers show that a large proportion of the respondents reject the idea of prefabricated buildings. Males and females expressed the same level of understanding of prefabricated buildings.

Analysis of the questionnaires shows that the older age group (31-50) expressed a higher level of understanding of prefabricated buildings, while the majority of the 18-30 group (43%) admitted that they did not know much about them. Across educational level, the majority of respondents mentioned that they did not know what a prefabricated building was.

When presented with two images of interior spaces, the majority

of respondents thought that Image 2 represented a prefabricated building, while, in fact, a prefabricated house does not have to confirm to a specific design style. The answers did not vary according to gender or age group.

The majority of respondents who said they would agree to live in a prefabricated home chose speedy construction, suitable price and beauty of design as the main three reasons for their choice. In contrast, the majority of respondents who said they would refuse to reside in a prefabricated house chose lack of durability, lack of safety, high price, and lack of flexibility as the main reasons.

The answers demonstrate that the quality of interior design and interior finishes could promote the acceptance of prefabricated buildings. A small majority of the population would thus agree to live in a prefabricated building.

This research also confirms that a large proportion of the population would consider living in a prefabricated building if their concerns about quality, cost, and design were addressed.

This research illustrates the importance of construction duration to many homeowners, as a small majority of the respondents indicated that they would favor a prefabricated building because it was faster to construct.

One of the most important insights that we can get from this research is that design matters, and people could be encouraged to choose a prefabricated house if they understood more about the benefits and if the exterior and interior were well designed and of high quality.

This research clearly shows that there is a general lack of understanding about the nature and benefits of prefabricated buildings. The government and other professional organizations can, therefore, play a major role in promoting this form of construction, as improving awareness about the benefits of prefabricated buildings would contribute to their increased acceptance among the public. This would help to ease demand on housing and solve some of the practical and environmental issues associated with conventional housing construction.

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