

Cheap and high quality housing with emphasis on modular building

Abstract

Housing as one of the most basic needs of human being has received much attention. As a physical shelter, it is a fundamental need in each family. The need to housing has been increased based on the population increase in cities and its high density and it is a big problem in cities. High price of housing and lack of quality including construction materials to form and cultural quality is one of the greatest concerns of most of families. The study to create methods or types of design is necessary to provide comfort and many suitable housing indices and quality indices. Quality issue in housing increases the price. To reduce construction time and improvement of construction operation, modular building is used in the world. This method is a good model in construction for housing mass production. It should be considered that housing as living place of human being should be mostly regarding cultural issues than a symbol for the life and survival of human being. The study design is descriptive-analytic. The data is collected via existing articles and resources to present a strategy to eliminate the problem of cheap housing. The problem of cheap housing gives some feedbacks regarding the materials or climatic and cultural patterns of society and also it creates problems in society and people as low-income class. The present study aimed to approach two paradoxes of cheap price and quality (including materials and culture).

Keywords: housing, quality, cheap housing, modular building, mass production

Volume 1 Issue 2 - 2017

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Received: July 22, 2017 | **Published:** September 11, 2017

Introduction

Shelter is a fundamental need and right of residents everywhere-it is hard to argue otherwise. But housing is more than shelter. Decent and affordable housing provides access to education for children and access to jobs for adults. People who live free from the fear of sudden eviction are able to invest in improvements in their homes and livelihoods and increase their economic prospects.¹ The main aim of housing is creating an adaptable environment with human life. In other words, besides providing personal needs of residents (e.g. Sleep, food, resting, protection against climate and nature), their qualitative and social needs should be also fulfilled.^{2,3} However, Rapoport considered social and cultural factors as important in the form of house and said: housing is created based on a complex series and it is not merely a building. As building a house is a cultural phenomenon, the form of house, organizing and its spatial order are affected by cultural environment to which house is dedicated.⁴ Rapoport considers cultural interaction as effective factor on house and doesn't consider it as only providing living conditions and he believes that house is a life creature, talking; it is effective and can be affected. Sometimes, it is raised as a symbol.

The term "settlement" doesn't mean merely economic relationship; it is an existential concept referring to the symbolization of meaning. If human-made environment is significant, human is "at house".⁵ Schulz considers merely expression of pure economy as no unique index in production⁶ and considers quality based on meaning. Schulz is inspired by Heidegger regarding being/residing.⁷ He states that: "Existential space" and "being" are equal and "being" is in existential concept of architecture purpose. Human being settles if he is adapted with the environment, or briefly when he experiences the environment as meaningful (Figure 1).⁵



Figure 1 Diagram of view of Heidegger to settlement concept.

The concept of meaning and thought in house are based on quality of building and existing basics in society and culture. Schulz considers this existential concept in being and settlement as acquired by environment and this is a type of interpretation of quality of building.

The factor considering cheap housing as macro policy of countries is the urgent need for people in society. One of the most important issues is the unresolved problem of housing. Indeed, this issue was less considered by urbanization in 19th century and population explosion and migration to cities as the result of industrial revolution. Great Britain, Germany, France and Soviet Union were some parts of these countries as encountering housing shortage for households.⁸ These factors increased housing problem in Europe and modern style with its own simplicity and minimalistic views helped the manufacturers and the most important aim here was cheap price of building and by pre-fabrication, a suitable construction quality was achieved at shortest period.

The adoption⁹ of new technology usually begins prior to an official decision made by the organizations. Most local and international organizations decide to adopt technology based on the benefits or competitive advantage that they will gain through the push factors such as regulations, policy and industry standards.¹⁰ These technologies in 20th decade led into the systems that not only were effective in terms of price but also in terms of reduced construction time and increased labor output as modular building that was applied in pre-fabrication and was a good strategy in mass production.

Review of literature: unsuccessful examples of cheap houses

Tall buildings of Pruitt-Igoe (Figure 2) in Saint Louis in US and Site hill in Edinburg of Britain were built for low-income people. They couldn't afford the maintenance of buildings and after residing, due to their big scale and high population, the control of spaces by residents and distinguishing residing and non-residing people was impossible and violence, delinquency and social problems were increased in these buildings.



Figure 2 The apartment complexes of Pruitt-Igoe in Saint Louise of US, before destruction. Source: Authors.

But apartment complex of Unit Doheplision with equal socio-economic families, the condition was better. In these complexes, the residents could afford the costs of maintenance and management. They applied manager to manage the building, guards to control the common spaces and control of people, hired some people to clean the open spaces, etc.²

In low-income complexes, financial affordability of owners is of great importance and only establishing a house with good quality cannot guarantee the quality as the owners cannot afford the financial resources for needs of residential complexes and this is a gap reducing the quality.

Schoenauer in the book "Cities, Suburbs, Dwellings" states that "Construction of High-rise buildings for low-income class was unsuccessful not only in US (northern and southern) but also it failed in most European countries. This failure was mostly due to the insecurity and weakness of maintenance of their public services. Because security, comfort and maintenance of public services in high-rise buildings were not only dedicated to high and average-income people.¹¹ Low income of these dwellings was a great problem as external factor being imposed on quality of building. Another factor is also important and it is making urban regions as classified and this imposes racial thoughts on residents.

In a paper, Dr. Qasem Matlabi considered the reason of destruction of residential areas as Pruitt-Igoe as social and psychological abnormalities of this residential complex as designed by various modern patterns. According to the psychologists, architects mostly emphasized on aesthetic issues of designed spaces than their functional issues.¹²

Schulz considered functionalism as human-based and stated that "fundamental forms and basic functional architecture rules are protest...Functionalism mostly had obligatory goal as based on human and architecture.¹³ This pure dualism in Schulz writings is due to his training before modern architects. If the reality form is based on Schulz statement, the concept of reality indicates failure of

functionalism. In general, QOL (Quality of life) is a subjective matter that involves a person's emotional state and personal life. To achieve any of the perceive QOL, adoption of new technology is inevitable.¹⁰

Impacts of housing estates on quality of life

When speaking of housing estates one usually refers to large residential complexes in suburbs or on the edge of cities. Housing estate planning focuses on introducing buildings with regard to built public spaces, green spaces and traffic areas. The abovementioned urban planning elements are denoted by the term "open space", in its current sense, which is playing an increasingly important role in housing estate development in terms of space morphology along with identity and quality of life.

Open space is a common term for parks and recreation areas, green spaces and promenades. Open space is designed for leisure time, recreation, sport, assembly, socializing etc., whereby the offer and accessibility of it are vital as they facilitate the well-being of different age groups. It is important that it facilitates several activities and related experiences, which, in terms of their location in the area and the diversity of the programmers, are decisive factors in satisfying human needs in a well-arranged and maintained environment. Consequently, residents can spend their active and passive leisure time in the immediate vicinity of their homes and satisfy their socializing needs with other dwellers, all of which considerably influences their attitude to the housing environment.¹⁴ The concept of control and security in open spaces at urban or residential scales can increase quality. Quality should be observed not only in structure of building and materials, but also in understanding as significant and a basic role should be explained by it.

Theoretical basics

In the book "The lessons of History", Will Durant considers war as unifying people, creating competition and war-based thought. He believes that "War is a nation's way of eating. Co-operation is "a tool and form of competition. Thus, "the first biological lesson of history is that life is competition. Competition for living, trade and collecting capital.¹⁵ Sometimes, war is based on thoughts and ideology and even this ideology continues after war and it affects art and architecture. Like Fascism thoughts and even the modernism as inspired by Second World War.

After war, Europe was inclined to construct houses for low-income classes in society. In the early 20th century, Netherland was a pioneer in this regard. In 1901, a law was laid down by which various states of country were obliged to construct house for low-income people via giving loans and state financial aids.¹⁶

Schulz states that "after the second world war most places have been subjected to profound changes. The qualities which traditionally distinguished human settlements have been corrupted or have got irreparably lose. Reconstructed or new towns also look very different from the places of the past.⁵ He considered this destruction as the cause of loss of forms that increased the quality before but were excluded on that time. It is worth to mention that war created much great destruction in cities and after the population increase after war, rapid and low quality construction was a necessity. In Athens charter of CIAM conference, it was found that after second world war, management of country decided to respond two great problems at the same time: Unemployment and the need to residential house (Figure 3).¹⁷

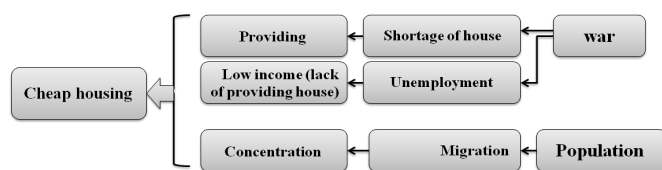


Figure 3 The Causes of Understanding Cheap Housing in Countries. Source: Writers.

The urgent need to house was serious due to destructions but over time, housing need was a serious problem and it was due to the increase of population and increasing migration to cities and a solution was presented to solve the problem. According to the predictions in 2000-2010 decade, developing countries required 21 million houses and during 2010-2020 they required 25 million houses for extra urban households.¹⁸

In the last few decades the issue of the renewal of existing housing estates has in many European countries, regions and cities been at the forefront of endeavors to implement sustainable development principles. Developmental documents and strategies focus on the quality of the living environment which is an important factor in efforts of individual areas and city districts to compete with other locations in terms of the work and living opportunities and advantages they offer. The urban-planning and architectural¹⁹ characteristics of the housing

Table 1 Various models of human needs in providing housing

Alexander Leighton	1957	House should provide natural inclinations of human being. ²
Atkinson	2006	Personal identity in each stage of life of human being is his basic need. ²¹
Amos Rapoport		1-Housing should have social and cultural value. Thus, the traditional housing is the best one. 2-House should be cheap as many people can buy it (in local environments, most people should have a house). 3-House should make the residents healthy. From climatic issues and regarding climate, traditional house is a success but from sanitary aspects, it is a failure. 4- House should need the minimum maintenance in its life service. ⁴
Abraham Harold Maslow		The basic hierarchy needs are introduced in five groups and house is a shelter providing the needs of human being as rest, sleep, etc. and he is protected against climatic and environment risks. ²

Housing has close consistency with life qualities as security, interaction with other people or avoiding the influence of people in their private life. The role of housing is providing qualitative needs of human life and providing good conditions for family and fulfillment of family activities. Providing qualitative needs of human being not as a shelter but as a secure place consistent with Iranian²² identity and climate is one of the most important strategies as considered.

Feature and meaning in concepts of dwelling

The feature and meaning are two basic concepts in increase of quality and meaning in residential buildings showing the structuring and meaning in architecture. Schulz believes that feature and meaning, feature is determined by form structure, thus we should ask how the ground we walk on is, how the sky is or how the boundaries are defining place.⁵ These two concepts promote the concept of place specifically. Housing is one of the most important architectural spaces with direct relationship with human being. The ground form of house fulfills the performances of human being and human dimensions and its spiritual²³ trend fulfills the beliefs of its residents.

Meaning is fundamental need of human being and aim of architecture is revealing the meaning as the system of places and fields.¹³ To give meaning to environment²⁴ and increasing quality of

stock, which dates to the post-WW2 period, mainly fail to meet contemporary residents' expectations and needs.¹⁴ While architectural design ultimately deals with the configurations, connections, shapes, and orientations of the physical forms, flexibility in architectural design is predominantly related to spatial design and building "forms". As such, architects are often inclined to develop varied and unusual architectural forms.²⁰ Therefore, further investigation is required to improve the form flexibility in both architectural design practice and construction.

Technologies are non-neutral and are an artifact of peculiar materials and ideological interests and reinforce the marginalization of the poor (Johnson, 2011). The findings of these researches and the practical products and processes have little or no effect on housing supply for the low income. Private housing production by all segments of society especially by the low income outpaces commercial and public authority provision.

In the second half of 20th century, the theories in design not only emphasized on providing qualitative and quantitative needs of people, it was believed that family is the smallest social unit and his residential unit is the main component of residential complexes in cities.² Housing should fulfill fundamental needs of people. In recent years, various scientists have presented various models for human needs as shown in Table 1.

people, considering the needs of people in various levels is necessary.

Feature of current environment is uniform. If there is any variety, it is the result of past elements. "Presence" of most of new buildings is weak, mostly "partition walls" are used with loose and abstract features or they don't have any feature. The lack of feature indicates low motivation.⁵ Schulz here questions applied materials in new and modern buildings and considers them as dull as there is no place for discovery as all structures of building are similar in terms of dimensions and size and it is dull and monotonous (Figure 4).

The main goal of second period of modern architecture is giving individuality to buildings based on space and feature. It means that instead of considering design based on general principles, we consider environmental conditions of building and place.⁵ The architects with past attitude and traditional architecture consider open spaces and independent houses as following the climate and culture of region. But in this regard, we should consider that cities are encountered with the high density of population and these issues cause that urban planners and architects mostly focus on providing house and improving life conditions and public health.

Housing is the main factor of sociability of people to world and is a major factor in social organization of space as important in

individual identity, social relations and collective goals of people.²⁵ The character of nature is no mere poetic metaphor. It is a specific morphological character, a geometric character, which happens to be common to all those things in the world which are not man-made. To make this character of nature clear, let me contrast it with the character of the buildings being built today.²⁶ Like Alexander, Rapoport finds this feature in old buildings and natural buildings and says that: Four thousands of years, the main feature of buildings is stone, brick, dried mud, soil and wood.⁴

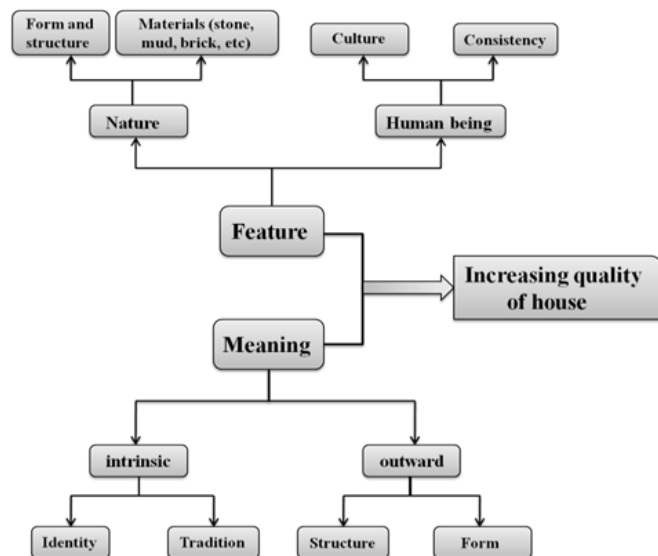


Figure 4 The increasing factors of quality of building from the view of Schulz. Source: Authors.

Housing and underlying culture

Indeed, in CIAM conferences, urbanization was a modern knowledge by public or residing with all its complexities and problems was challenged in architecture or historical cities were recognized to achieve the culture of architecture of human being in the history.¹⁷ Rapoport considers culture as a set of thoughts, institutes and activities for a nation or tribe as contract power.⁴ Formation of housing depends upon cultural, climatic, economic-living factors and society construction techniques.²⁷

By a deep expression, Schulz considers construction as a cultural issue and says: Visualization, gathering and symbolization are aspects of the general processes of settling, and dwelling in the existential sense of the world, depends on these functions. The purpose of symbolization is freeing meaning of its immediate situation to be turned into a cultural issue.⁵ Schulz considers the concept of settlement in its real term to achieve the main meaning of dwelling and turning the building to a symbol and only in this case, it is manifested and can manifest the cultural aspects. This cultural issue in housing is a necessary item. Giving much importance to cultural aspects of form leads to complete relativism and leads to it as a culture of definite life style is changed; dependent forms of culture lose their meaning.

We know that most of the produced values and productions by a culture don't lose their value as the culture is destroyed and we know that residential forms and relevant living complexes of culture are used even after its elimination,⁴ (Figure 5). In these complexes, close relations with others improve space and urban environments can be tolerable even at high density.

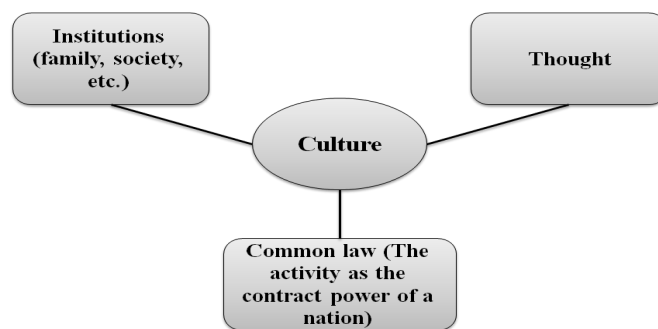


Figure 5 The view of Rapoport to culture, Source: Authors.

But should say the social interactions of citizens take place in the public urban spaces which will bring about the superiority of the society's culture in its own context. In order to interact in the city, we should create public pedestrian places, presence of people in the city is the requisite of the public spaces vivacity; but nowadays for different reasons the street is not considered as a place for passing leisure times, and spending a lot of time on the street would be abominable in a way that adolescents are prohibited from this activity; however, if the street provides a secure and optimal space, and safe activities and recreations are provided in an organized way and according to social values, lively presence of population and consequently, livelihood and livability will increase.²⁸

Definition of cheap housing

Cheap houses and settlement for poor families have been raised for the first time in a global conference and modern architecture got familiar with this problem, Frankfurt, 1939.¹⁷ Cheap housing is used for low-income people who cannot buy a house and as living right is beyond economic assets and can provide identity and political power, it is a basis to encourage other rights.

In the definition of cheap housing, we can say that although this house is low in terms of price but we try to use old architecture and traditions showing our Iranian identity.²⁹ As saving and long-term aids are the sources of funding of housing, those without house cannot afford it by saving and even they cannot rent a house and they include average income groups with low work experience. In housing market, one of the effective factors in demand is income and saving of household or affordability of household. As shown in Pruitt-Igoe complexes, affordability of household in terms of quality and security plays important role in these buildings. About half of the world's urban population lives in poverty and about 600- 800 million people occupy substandard housing.³⁰

In Germany, industry with suitable assembly lines reduced costs. Modernization of construction methods and logical designs of cheap houses with other advancements were important regarding the solution of shortage of housing.³¹ The current equipment in the world for buildings construction play important role in production and improvement of housing as consistent with the needs of society form qualitative and identity aspects. Dr. Falamaki by criticism of the housing built in Iran namely in the margin of cities stated that "The cheap houses and townships in margin of Iranian cities in recent decades had form, technical, applied and environment alternative features not belonging to the past residency culture nor the modern construction-urbanization forms in our country. Also, they were not based on the construction modeling in third world countries and

not based on specific spatial visualization as ideal.³² The housing industry is a major contributor to climate change, resource depletion and pollution at a global level. Therefore, environmental protection should be thought of and be important. Environmental sustainability prevents harmful and irreversible effects on the environment by the efficient use of natural resources, encouraging renewable resources, as well as protecting the soil, water and air from contamination.³³

Housing and poverty

Poverty is often estimated by income levels and consumption levels and the income based poverty lines used to make these estimates set too low in relation to the cost of basic needs in most urban centers.³⁴ Regarding housing poverty, one of the measures in Iran (indices) is household density in residential unit. This type of poverty reduces individual capabilities to improve skills and the members of poor families keep others poor. Indeed, unsuitable housing is turned into a “spatial trap” (Figure 6).

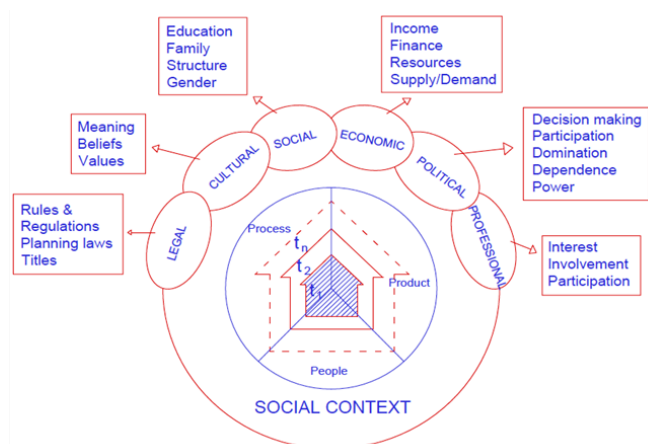


Figure 6 Conceptual framework for low income housing study, source.⁶

It means that as a person is born in low-income classes, he cannot be included in high-income group and this is called class trap of poverty.³⁵ Financing low income housing and the financial value of the end product of the housing process has been an area of interest to researchers. In a contemporary economy, what is obtainable is a series of distinctive housing sub markets in the highly complex urban housing market to cater for the needs and aspirations of different socio-economic groups.³⁶ Low income and financial resources for residents in cheap houses can make some behavioral problems in society. Non-maintenance reduces health and security and many problems in public places in these buildings.

Modern technologies with industrialized building systems have the potential to erase all quantitative problems in housing. The technology of low income housing should be acceptable, economically sustainable and tailored to the means and resources of low income people in different contexts. The factor of economic viability is what led to the suggestion that home ownership should be ruled out for the low income. Using these technologies and pre-fabrication methods namely modular building can reduce housing price that low-income class can buy house. We should consider that good quality of housing reduces the damages and maintenances imposed on building and this factor in current time is the main index in building.

The quality costs are important because these costs can be extensive and could be 20% of the total sales turnover.³⁷ Previous

studies in North America have indicated that the costs of quality are typically at 20-30% of the total sales.³⁸⁻⁴⁰ In construction, Lam (1994) has claimed that quality costs can make up from 8 to 15% of the total construction costs. In 1978, these costs were estimated by the UK Government to be 10% of the UK's gross national product.⁴¹ Low & Yeo⁴¹ further stated that in the USA, direct costs incurred for rework alone have been estimated to be greater than 12% of any project costs. Hagan (1986) has warned that the lack of knowledge regarding quality costs will likely lead to unbalancing the inter-relationship of quality, schedule, and cost. This imbalance will continue to exist as long as the real cost of quality remains hidden among total costs.⁴²

In the book “death and life of great cities in US”, Jacobs states that “The buildings of low-income class are turned into crime center and are worse than the dirty townships in which people were living and average-class houses are dull, uniform and there is no spirit in them.”⁴³

Poverty involves a class of people increasing it by false policy of governments and only by providing house and shelter; we cannot fulfill the needs of this class. Providing the shelter and a good income for people is one of the issues that authorities should consider in the promotion of their goals. Suitable economy is the basis of each healthy city without any violence but it is not complementing. It should be considered that the building constructed for low-income people should be based on Islamic-Iranian approach in terms of decoration and the main concept of decoration should be associated.

Ornaments in Iranian architecture has a history of several thousand years that is shared with the nature of Iran's architecture, from wall drawings which is created by combination of iron oxide and juice of fruits to brickwork, tiling, and the acme of molding in different Islamic ages which was marvelous.⁴⁴ Pirniya says that: “the philosophy of ornament in art is creation of beauty that sometimes had been on the basis of recreation of nature in an exemplary, allegoric and fantastic way and sometimes is based on the basis of longings, wishes and imaginations of artists that reflects his people and society's wishes.”⁴⁴

Concept of quality

Architecture transpires when boundless space gets restricted by architectural elements. When visual sculptures implying different places with applications differing from each other are put together the absolute and unbounded space which had no specific definition assume a definite form and thereby the city is defined.⁴⁵

Quality is formed by encountering of a person, issue, building or place and it includes features of an individual, goal and situation. The architectural history with the changes in aesthetic styles didn't have any fixed answer to this question that “What is quality?”¹⁷ The term architectural quality is limited on one hand and it includes a wide range on the other hand. Quality of architecture is regarding the combinational and visual quality and cultural or symbolic meaning.⁴⁶ Christopher Alexander explains about quality: The first place I think of, when I try to tell someone about quality without name is a corner of an English country garden, where a peach tree grows against a wall.²⁶ Christopher Alexander considers the difference between good and bad building as objective and it is a postmodern view to building and qualitative issue is relative not absolute. The spirit in a rural garden is above modern and modular building. The qualities as the most important values of residents in an environment are general concepts and it is not considered easily in design of housing for life. These qualities are affected by many issues as people life style, various types of house, different arrangement of units in sets, action and advantage

of each of types and arrangements or providing qualities in design and in various cultures on the behavior method of human and his interaction with environment.

Frank lloyd wright says “Seeing the fire burning deeply in hard structure of house is comforting for me”. Thus, the plans are organized around a big fireplace to turn the position of fire to a great center. His application of natural materials should be understood as the manifestation of returning to objective phenomena, “deep sense of reality”²⁵ and this quality without name causes that the viewer sees the fire and be motivated. Human being is entangled with his loneliness in winter and the fire flames can make him comfortable.

This quality is not similar everywhere as it gets its shape from specific place as occurred in it. Thus, place is effective on quality of building and building is affected by it and this quality is comfort in one place and in another place order and carelessness. This quality is a tender type of being released of internal contrasts.²⁶ Alexander calls it timeless quality and it is based on personality and mental changes as people consider it doesn't accept specific time and place, quality is inner and outside as formed and accepting.

As a system has internal unity, it is qualified and if it has no rule, its quality is lost to be adaptable with internal forces and this quality (quality without name) is called and if it is inconsistent with internal forces, it is lost.²⁶ We can be alive as the buildings and cities were live are alive. Quality without name is timeless and it exists in us, if it is in our buildings and if it is in our buildings, we can be in it.²⁶ This quality leads to life in buildings and people are inclined to establish social interactions with each other. The thoughts of people are different based on income and their awareness to the surrounding world (Figure 7).

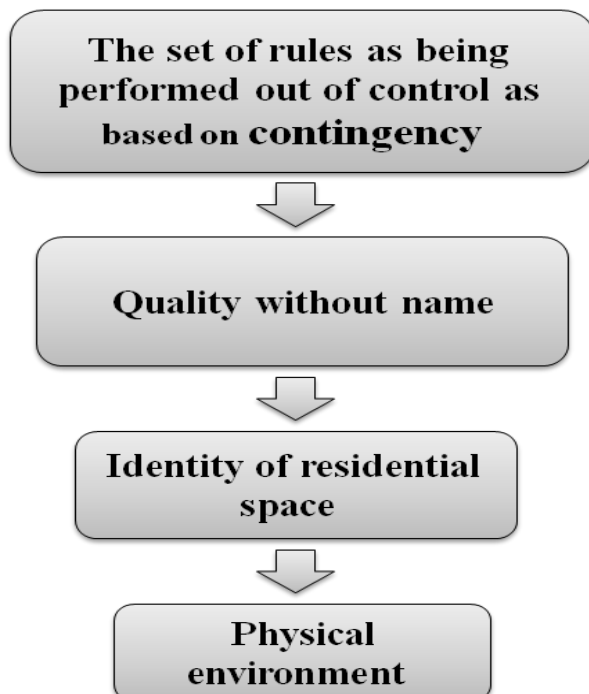


Figure 7 Diagram of Alexander attitude to residence concept: Source: Okhovat et al.²³

Rudolf Arnheim in the book “The Dynamics of Architectural Form” says here again it is easy to dismiss the problem by maintaining that

the average man in the street and in the house does not care about the psychological needs that architects and other creatures of luxe, calme ET volupte attribute to him. Ask the average person, and he will talk about radiators and drafts, staircases and the laundry, not about color schemes and modules. But he many not talk about light and air, either, and yet be profoundly influenced by their quality. Explicit responses to questionnaires and interviews do not exhaust the factors that determine a person's state of mind, of many of them; he is not consciously aware.⁴⁷ They show the different thoughts as among beliefs of people depending upon the capacity of thoughts and as by which view, quality is thought and giving a unified and independent view in this regard is hard. Jirred Dijkstra divides quality in architecture⁴⁸ into various forms as in graph of Figure 8.

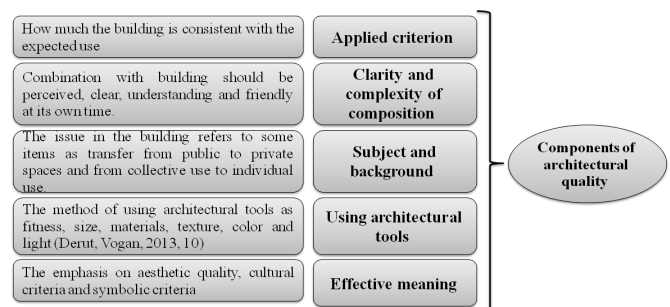


Figure 8 Components of architectural quality, Jirred Dijkstra, Source: Authors.

By this classification, Dijkstra considers architectural components based on principles following specific quality and most indices have great role. Giving this quality to pre-fabricated and modular buildings should be as it has identity and it has new mental power to create new sense in the spirit of modular buildings.

Modular building

It seems that mass producers in our country don't believe in modular design and consider the effect of this factor on construction costs as ignored. The advantage of modular design based on Table 2 is as followings: Modular construction is an architectural system whose fundamental technologies are developed from USA and Europe and this method is a production and construction method for buildings in a way that combines each box-type module produced from factory and laminates them. When it comes to construction, this method makes it possible to shorten construction period by minimizing works on site and enhance the construction quality based on as much of factory production as possible.⁴⁹ As shown in Figure 9, the providing and transportation to workshop is done easily and this increases work output and reduces costs of project.

The Modular Building Institute (MBI) is the only international,⁵⁰ non-profit trade association representing the commercial modular construction industry and was founded in 1983. The primary benefits of modular buildings are fast delivery, reduced environmental impact, ease of relocation, low-cost reconfiguration, and enormous flexibility. Commercial modular buildings are non-residential structures, 60 to 90 percent completed “off-site” and designed to be constructed at one location then used by occupants at another destination.

The word “modular” describes a construction method or process where individual modules, stand-alone or assembled together, make up larger structures. Contrary to popular belief, the term does not connote the temporary or permanent nature of the building itself. It is simply another means of construction-off site, constructed in

“modules.” While many are two, three and four stories high, modular designs have been created for buildings much higher. Recently, UK architects designed a 24-story modular high rise, believed to be the tallest modular building constructed in the world.⁵¹ Modular buildings are pre-fabricated buildings that started to gain popularity in the early

20th century. The Modular Building Institute (MBI) defines modular as a construction method or process where individual modules, stand-alone or assembled together, make up larger structures. Even though revenue growth in the modular building industry has recently dropped, it remains a market with increasing benefits.

Table 2 The advantages of modular design

Advantages of modular design ³	1. Reduced execution time, improving quality and reduction of costs
	2. Selection of modular dimension and its observing in all design stages
	3. Consistency of all materials, components and equipment with each other as we don't need reforms in construction location.
	4. Consistency of architectural design networks and conformity of these networks with utilities, furniture and equipment
	5. Organizing and segmentation of components and construction parts

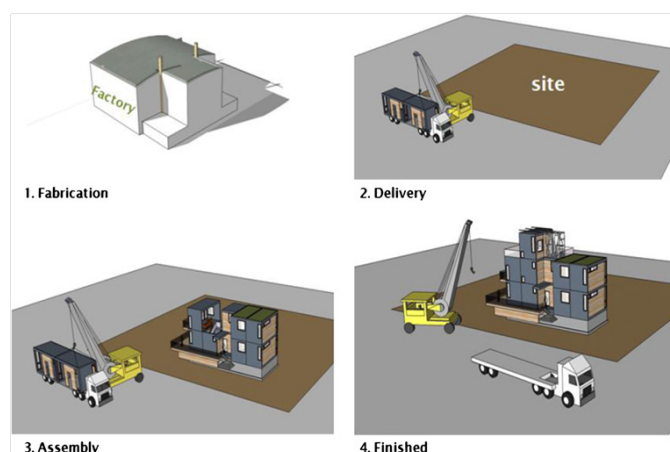


Figure 9 General construction process for modular construction method, source: Lee et al.⁴⁹

In modular design, production path in production lines is uniform as all products pass definite path and production process is similar for all equal products and only in final assembly, extra parts are placed according to the taste of customers.⁵² One of the main goals in using system principles is modular coordination and coordinating sizes and guiding building to a set of basic standard sizes.⁵³

Parallel to the use of simulation several researchers and planners in recent years have focused their work on using 3D visualization in the fields of construction management, productivity and cost analysis, resource management, and assessment of site layout. Based on their work, it has been found that 3D visualization provides more realistic and clear feedback of the simulation output and dynamic graphical depictions. These include features such as the state of each task at a specific time, the work space required for construction activities, and clear communication about the work with the project participants. This model is replicated as a model in all structures of building.⁵⁴

A modular plan should observe some principles as a product attempting to have interaction with the user. A modular plan should be organized based on desires, activities and abilities of user and they should be organized. The modular plan should be based on the mind of user to process information and in the entire application time, the condition is informed. The key basis of all these items is providing maximum awareness for user.⁵⁵ A modular plan is achieved based on thoughts, numbers and logic and its dimensions, structure and members are formed in lab conditions but we should consider that modular plan has a pure simplicity due to repetition and most of

theorists as Christopher Alexander criticized it but we should say that modular building is necessary in our time and it is also a necessity for low-income people.

The criticism of modular building from the view of Christopher Alexander

Christopher Alexander criticizes modular building and says that one of the most common types of these buildings is their modularity. These buildings are full of similar parts, similar rooms, similar houses and similar apartments in similar complexes. This thought that each building can-should be composed of modular units- is one of the most common assumptions of 20th century architecture.²⁶

In his criticism, he compares modular building with existing models in nature and says: Nature is not modular. Nature is full of similar units (waves, raindrops, leaves, grass). All of them are similar from structural aspects but none of them are equal in details.

1-A general and continuous structure is replicated. 2-The details of this general similar structure are not replicated even once. This is sensitive regarding atoms as most people consider modular structure as obvious. If you disagree with a person building a modular set and says such environment cannot be alive, the nature itself is composed of modular components as atoms and what is good for nature, is good for it. In this meaning, atoms forms have modular structure. But atoms are not modular and all of them are unique like raindrops and grasses.²⁶ Thus, we can say Modern architecture doesn't look to the nature honestly, it wants to colonize and reform the organic form of nature in order to make a settlement against the surrounding, and tries to dominate the nature, this point of view comes from the positivistic look of modern architecture to technology and ecologic problems.²⁸ These advantages cause that designers and mass producers are inclined to this position. Considering the existing identity and traditions in buildings should be considered by designers and manufacturers to use creative and alive spaces as comforting.

Conclusion

Housing is one of the main needs of human being to fulfill the needs as mental and physical and from structural bases; it should have good and positive feedback in city and urban identity. In modular building, house construction is done by facilities to facilitate work and reduce execution time that developed and developing countries are inclined to modular building. Modular building is a method enabling prefabrication⁵⁶ for execution in buildings and it creates a high quality building in terms of applied materials as achieved by factory

method. This method avoids re-working and high costs. This method presents flexibility in housing easily. In the design of these houses, it is necessary to consider Iranian identity and Iranian community culture as along with Islamic basics. The view of paper is immediate strategy to existing thoughts in cheap houses by which a high quality house is presented to residents to reduce house execution costs and also consider quality. The support of government in this regard is a must. The paper attempted to refer to quality and residency form the view of Schulz and Rapoport with the thoughts based on past and culture. The formation of place for living is investigated and culture is a requirement. In recent decades, modular building and cheap price of building and quality basis are raised as two contradictory issues. This concern that current houses are not consistent with our past identity and culture is used not only in Iran but also in most of countries considering the view to the past for vitalization of spaces. Although modular building and pre-fabrication have great advantages in cost and time, they couldn't present any answer for critics and there is no limitation for using it and it is used as a suitable system to fulfill the population problems needs in cities.

Acknowledgements

None.

Conflict of interest

The author declares no conflict of interest.

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