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ARCHITECTURE COMPATIBLE WITH REGION AND FUNDAMENTALS OF GREEN ARCHITECTURE IN INDIGENOUS ARCHITECTURE OF PERSIAN GULF

* Zare S¹ and Zare M²

1-Department Of Art and Architecture, Architecture College, Dariun Branch, Islamic Azad University,
Shiraz, Iran

2- Sama technical and vocational training college, Islamic Azad University, Arsenjan Branch, Shiraz,
Iran

*Author for Correspondence

ABSTRACT

Increasing climatic dangers, lack of resources and environmental pollutions resulting from lifestyle, abnormal architectural activities and human activities, are considered as the most important challenges of today's world. Therefore, innovating ideas and taking effective actions for improving current situations are at the top of plans of architectural development and the set of thoughts and actions corresponding to architecture are introduced as "green architecture". Hence, understanding Iranian traditional architecture as the complete manifestation of green architecture is of great importance. In traditional architecture of Iran, buildings are formed by taking Iranian culture and identity into account and composition and architecture are no longer contrary to cultural, religious and tribal beliefs of people residing in a region. Even used decorations are not exceptional. In these buildings, besides keeping cultural identity in construction, five principles of people-centering, avoiding inefficacy, introversion, recognizing masonries and using indigenous masonries are met. The purpose of this paper is to recognize elements of Iranian traditional architecture which is completely compatible with the region and proving that these elements are formed along with principles of green architecture. The main question of research emphasizes on the issue that whether architecture which is traditional and compatible with Iran region can be a sample of green architecture. Theoretical framework illustrates that in various factors contributed to traditional and compatible architecture of Iran and these factors vary with region.

Keywords: *Green Architecture, Indigenous Elements, Iranian Traditional and Compatible Architecture, Hot and Wet Climate, Persian Gulf*

INTRODUCTION

Statement of Problem

Studying green architecture and tools contributing to formation of such strategy in architectural designs is the requirement of deeper understanding of goals and recommendations of sustainability. On the other hand, environmental, sociocultural and economic problems and strong interrelation of these issues lead us to indigenous architecture and sustainability strategy in comparison with each other to derive its lessons for today's architectural design.

What is included in past architectural culture as a tradition is today present as a lifeless body and obviously, for discovering and utilization of past values, today's communities are forced to search unfamiliar and forgotten values of the past (Raboubi, 2005).

Climate has always been an issue in architecture by which human fought thousands of years. Clearly, various problems such as burning sunshine, high temperature, temperature difference, its daily fluctuations and significant falls in night breezes has been considered for residence of people living in hot – whether humid or arid – regions. Hard summers and cold winters resulted from desert climate and in some cases, dusty storms, arid, hot and unsuitable storms prompted people to think. After thousands of years and gaining experience, human found solutions for various problems in the world especially in Iran whose purpose is to make a more comfortable living place for individuals and in some cases, public places. Today, by advances in technology, new technologies replaces these traditional solutions. However, they bring about problems such as environmental pollution, overuse of fossil fuels, and loss of

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heating energy, global warming and so on. Therefore, updating indigenous solutions and applying them can reduce energy usage considerably, solve environmental problems to a great extent and prevent entering of pollutants and toxic materials into the air. This will help improvement of environmental quality.



Figure 1: Hajich Village, Kermanshah Province (Source: salamkermanshah.ir)

Hence, by means of using materials available in environment and thoughtful usage of earth and environment, constructions will be with extreme accuracy and consideration and from economic point of view, according to religious belief about avoiding overuse, it is seriously attempted to avoid imposing excessive work and expenditure to client.

Importance and Necessity

By progressive warming of earth temperature and loss of environmental resources, we must seek for saving and protecting environment. This issue not only relates to our lives, but also can endanger future generations. Since buildings compose a part of environment and consequently a main part of its pollutants, with an exact thought, planning and design, we can construct buildings which have least effects on environment. Sustainable architecture is one of the ideas for planning and design of such buildings. What must be taken into account in this point is that most principles addressed in novel green architecture, was respected in traditional architecture of this country throughout its various regions which approves right effect of culture, religion and traditions of Iranians in past centuries.

Goals

This paper intends to review concepts of traditional architecture which is compatible with climate of various parts of Iran as well as sustainability issues as one of the solutions for using and returning traditional and indigenous architecture of Iran by considering components of this architecture to reduce energy usage and environmental pollutants as a new tradition in construction.

Literature Review

Talking about indigenous architecture doesn't have a long history. It is not longer than half of a century that literature corresponding to this topic appeared and by relying on others' findings and awareness made for public we can study complexities and characteristics of it.

For the sake of providing vision of those who investigated traditional architecture of Iran with regard to its compatibility with climatic conditions and construction, a summary of their opinions is selected and after presenting in this section, in the section of theoretical basics, addressed issues will be evaluated.

Ghazanfarpour: in investigation of "the relationship between climate and housing in Kerman province" he implies that "in recent decades, climate has not been taken into account and incompatible housing led to problems and issues." Then, by considering climate of central parts of Iran, he classifies it into hot and arid and hot and semi-arid regions and by means of the effects of solar irradiation, temperature and exposure to winds, provides criteria and principles for construction of buildings with respect to plan form,

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color of masonries and their type in aforesaid regions so that they can utilize maximum renewable energies.

Saghafi and Sameie: in their researches, “relationship between environment with compatibility of masonries and saving in buildings” is investigated and they note that due to “due to energy crisis in the world, lack of compatibility of masonries and increasing depreciation of buildings, specifically in some environmental situations”, this issue must be evaluated. Therefore, by implying to the significance of choosing a clothing appropriate for body, they investigated the manner in which old buildings were constructed by considering climatic conditions and incompatible position used in buildings.

Questions and Hypotheses

1. Is diversity of climatic characteristics an important factor in multiplicity of construction forms?
2. Does traditional architecture has the least effects on environment and ecosystem?
3. In which parts of modern architecture, instances of green architecture of traditional and indigenous architecture appear?
4. We can claim that traditional architecture was along with green construction.
5. In the past, indigenous masonries were used in right and complete way in buildings.

Research Methodology

Obviously, each scientific research need a method in accordance with its topic. Of strategic basics of a research is choosing an appropriate research method and its permanence and continuity throughout the work path and process. The method of facing a research problem is in close and bilateral relationship with structure and nature of research. In recent work, it is attempted to investigate methods of construction, tools and architectural structure of the intended region based on available documents and sources. In this way, the research methodology of current work is descriptive – analytical based on library studies and available documents and by considering researches performed in this context and taking climatic conditions of the studied region, its green indices can be recognized and introduced. To obtain suitable results, in this paper, library research including books, theses and papers is used and finally, obtained materials are analyzed and complemented and final conclusion is done for them.

Theoretical Basics

Green Architecture as a Contextual Specification

Despite of pervasive and fundamental slogans which are global and target the issue of protection of planet, for achieving realistic and practical solutions on one hand and supporting diversity which is natural to the environment, green architecture recommends local strategies as well and considers the slogan of “think globally but act regionally!” (Ahmadi, 2005).



Diagram 1: 3-stage process of green architecture

A combination of green architecture cannot be transferred from a place into another as a prefabricated product. Policy of green architecture provides many characteristics. However, socioeconomic stability and so on are basically content characteristics corresponding to local and regional resources or indigenous people rights, traditions and needs (Norton, 1999).

Therefore, technology of a certain building cannot be classified as a green architecture technology nor can be considered as an appropriate technology for this field. A valid system which works well in this place, will be inefficient in another place due to changes in cultural, social and physical factors of new context. Recently, many of environmental technologies fail before successfully completing as a result of inability of their designers to comprehend architecture’s sociocultural content or needs and expectation of those

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who intend to use it. Indeed, the issue here is oblivion an how to maintain local culture and values. This issue actually affects success or failure of the project (Cole *et al.*, 2006).

To coordinate and integration of green architecture in intended region and traditional and indigenous architecture, preparation of the context of green architecture is of great importance so that this style of architecture doesn't fail and its criteria move in accordance with climate and indigenous and traditional architecture.

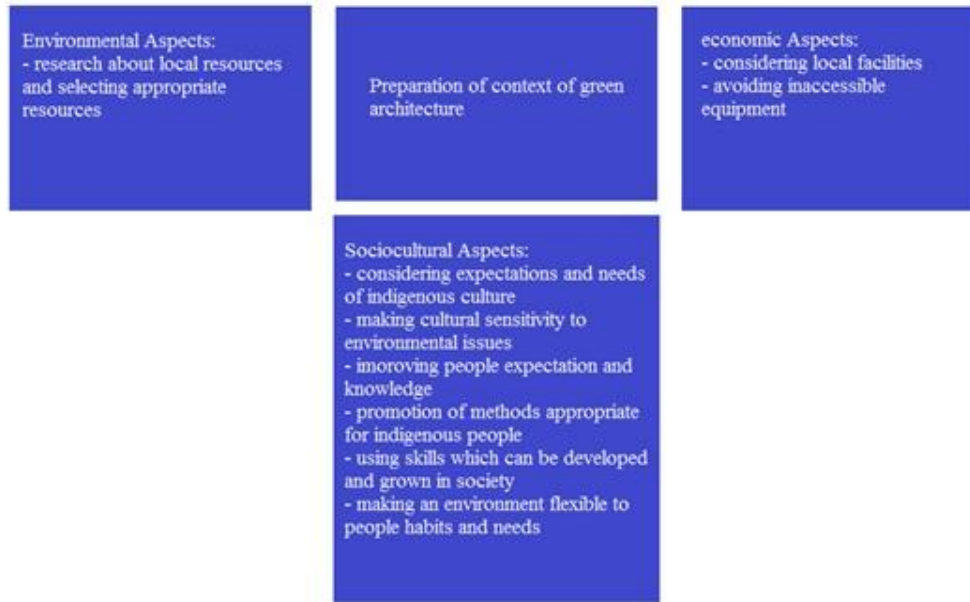


Diagram 2: Preparation of context of green architecture

Rejection or Acceptance of Stability by Traditional Ways [1] (for past)

According to above, green architecture strategy requires appropriate indigenous preparations. A mistake which may occur here is considering traditional or regional design instead of indigenous one.

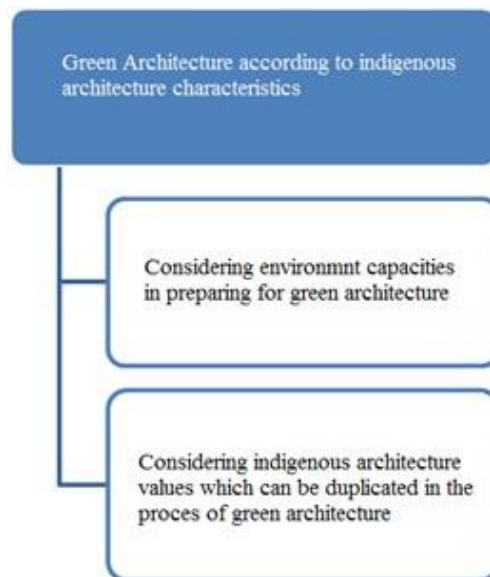


Diagram 3: Eliminating barriers of green architecture according to indigenous characteristics

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While indigenous design is not repetition of what was once common, we can somehow follow traditional design processes. Regional design is a part of indigenous design as well not itself. Traditional policies led to establishment of shelters which have been stable for centuries, however, they cannot meet today's needs and available resources. In this environment, finding new solutions and policies which are really green is so difficult. If we are to adapt ourselves with rapidly changing demands, we must therefore, grow them where solutions are available (Norton, 1999).

According to above, it is clear that imitating old architecture body is not intended, but recognition of green building in its place and time and its values which can today work well are intended.

Green Architecture Strategy in Principles of Iranian Indigenous Architecture

Principles of Iranian traditional building, through standard measuring unit, modular design and proportion in design. Which is presented by Iranian architecture is based on considering steps and levels of design and management of construction. Iranian traditional architecture is concentrated on the following issues:

6. Looking at nature

7. Steps of design and human design

8. Building stability

Looking at Nature

An architectural item first mixes with earth, receives water from it and after transformation of appearance and physiochemical content, returns it to the earth, faces to breeze and turns against disturbing winds. Mixing with nature is accompanied with following nature and utilizing it (Falamaki, 2005).

9. *Regional design*: presence of windward and water pools in yard, are good examples of Iranian architecture. Inspiration of nature using natural plants, light and ventilation and temperature characteristics of the earth and other natural forces are all included in this architecture. Building orientation is obtained from the most effective orientation for using natural resources and potentials (Pirnia, 2003). Traditional architecture is formed within its natural bed and in accordance with it. Its materials are derived from its environment and its plan is so that it has maximum compatibility with its region and least imposition and destruction whether for environment or the building itself (Tahbaz, 2004).

10. *Self-sufficiency; using indigenous masonries*: for example, using soil of foundation for fabricating bricks (Pirnia, 2004).

11. *Avoiding inefficacy*: in this case, it is necessary to imply to Iranians' old consumption culture. Avoiding inefficacy means the most suitable level of utilization of accessible resources and management of individual and social life based on available facilities (Taghizadeh, 2002). In this architecture, following nature, masonries and materials are used according to principle of contentment and their maximum efficiency and capacity has been exploited. For instance, in application of plaster or brick, by complete understanding these materials and their specifications, each of them are used according to its specification at maximum perfection. Meeting these principles provides an architect with lots of facilities.

Steps of Design and Human Design

Human design is the most important principle of green design which refers to livability of all components of universal system. This principle has deep roots in the need to maintain chain elements of living systems on which human survival and life depends.

12. *Introversion*: each society greatly respects its own culture, habits and traditions. Iranians' culture respects family and its privacy and activities corresponding to family and its privacy must be based in a space separate from public activities.

13. *Being people-based*: which refers to needs and outcomes of applicability of a building. That is, all needs of building utilizers must be met disregarding their social level (Pirnia, 2004).

Benefits of Using Principles of Iranian Indigenous Architecture in Line with Green Architecture Strategy

If we accept that the main figure of social and natural phenomena belongs to outside world and has specific characteristics and energy, moreover, if we accept that human in preparation of the made space using figures responded to his/her needs – whether physical or not – in the form of applications, we can claim that indigenous architecture is applied in each historical era (Raboubi, 2005).

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Diagram 4: Reproducible values of indigenous architecture in each of the fields considered by green architecture

Characteristics noted in previous section can be considered as values reproducible in the process of green architecture for today’s constructions.

Investigation of Iranian Traditional Architecture by Taking Green Construction in Four Climates of Iran into Account

In this study, we introduce four regions of Iran and then, investigate the hot and humid climate of Persian Gulf region in detail.

Architecture of Moderate and Humid Region

This region is the rainiest region of northern Iran having high level of humidity and hot summers. Therefore, “continuous rains and relatively high humidity is the main factor in architecture of this region” (Diba and Yaghini, 1993). Regional architecture is a sample of extrovert architecture. “Furthermore, to prevent penetration of humidity from bottom of the building, its level is higher than ground and in the gap of bottom and ground, air flow results in evaporation of humidity and air ventilation” (Same, 10). Rice stem is the main component of the coverage of sloped roofs. Building skeleton and in fact static of the building is composed of wood which is used in bodies as well. Final coverage is brick and it is coated by mud. In addition to this, other masonries such as stone, brick and clay will be used beside completely wooden buildings (Same, 10-11).

Architecture of Cold Region

Architecture of this region is like introvert architecture of hot and dry region. However, it has differences corresponding to cold weather. This region is known by its very cold winters and hot and dry summers. According to this climate, building must be constructed so that in winter keep maximum heat and in summer minimum heat absorption. To direct sunlight in northern faces, large windows are made so that more light can penetrate the building. In this region, due to cold weather, walls are thick and composed of brick and roofs are made up of thatch. It must be noted that traditional architecture of these regions is for stabilization of environment.

Architecture of Hot and Dry Region

Regional characteristics of this region include dryness, dehydration and hot summers (Memarian, 1994), together with sand storms in some periods of the year and wind in various directions as well as cold winters.

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In investigation of the architecture of this region, we can imply to housing architecture in some cities of central part of Iran having introvert architecture compatible with this region. In this region, buildings are constructed with masonries such as brick and mud whose heat capacity is high. Plan of buildings are compact as much as possible and it is attempted to reduce external area of buildings to their volume as well as maximizing shadow on external surfaces.

Hot and Humid Region

Regionally, this coasts are considered as hot and humid regions. Summers are relatively long and in winter, it is somehow cold only in January and February. Since this coast is in the neighborhood of seam, it is highly humid but due to limited rainfall, lack plant coverage except limited groves and farms of residents. This region is generally non-farmable and arid (Ghobadian, 2010).

General characteristic of this region can be described by its indigenous architecture which is a combination of introvert and extrovert architecture. To oppose heat and flow of air through internal spaces, in addition to covered porches, windows are installed in north and south face as well to utilize any breeze. Therefore, buildings face to the sea in wind blow direction.

Furthermore, unidirectional and four directional windward is used for transferring wind flow from the sea to internal spaces. Indigenous masonries used in walls are stone and brick and roofs are covered by palm straw, logs and thatch.

Persian Gulf Region

According to Geo-Botanic Classification of Javanshir; Gulf and Oman Region:

This region is separated from other regions of Iran by its savanna, relatively hot summers and warm winter. Average of hottest months of the year is about 38-46°C and average of coldest months of the year is about 4-15°C, rainfall is 90-300 mm and evaporation rate is high. This region is divided into gulf and Omani regions (Journal No. 203, 2010).

General characteristics of this region can be described by hot summers, high and permanent humid in all seasons. The important issue is small difference in day and night temperatures (Pour, 1988).

Architectural Characteristics of Indigenous Architecture of Persian Gulf

Due to proximity to sea and nearly vertical irradiation of sun in spring and summer seasons, evaporation of water as well as humidity is high. By moving far from coast, and in elevations, humidity of air reduces. High humidity in coasts, together with very high temperatures, makes sultry in most of the times especially in hot seasons which is intolerable. Using shadow, air current, appropriate masonries and direction living conditions can be made close to human comfort conditions. Elevated and meshed shelters on the roof, in addition to making shadow and keeping privacy of residents, doesn't prevent air current. It must be noted that the ratio of elevation to length of yards in hot and human region is more than similar yards in central part of Iran.

General Context of Northern Coast of Persian Gulf and Oman Sea: the best method for opposing hard climatic conditions of this region is to make shadow and using air flow both of which are important and determining factors in urban context and building form for human comfort.

Characteristics of Context in these Coasts are as Follows:

1. Semi-compact context
2. Relatively open rural context
3. Semi-confined spaces
4. Extension of cities and villages along with coastal line facing to sea

Building Form in Northern Coast of Persian Gulf and Oman Sea

1. Buildings having central yard and semi-introvert
2. Maximum usage of shadow and air current
3. Elevated rooms and extended windows
4. Elevated and vast porches
5. Lack of underground
6. Often flat arches
7. Unidirectional windward

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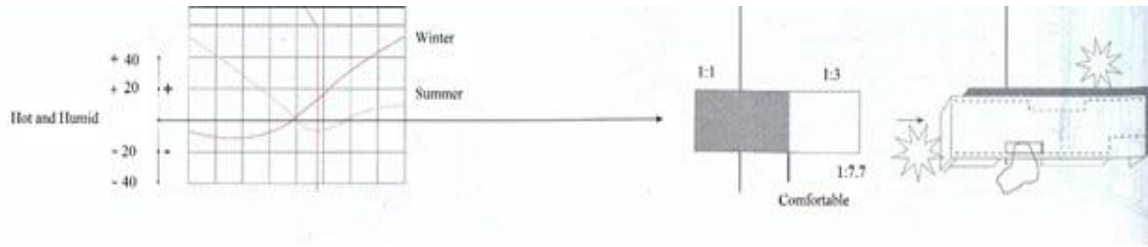


Figure 2: Relationship between building form and climate in hot and humid region (Kasmaei, 2008)

In this coast, most of the buildings are semi-introvert and rooms are around a central yard. Yard is in the part facing to the gulf. By establishment of porches facing to the sea and following traditional form and colors of the region, it is attempted to make the building compatible with the region as much as possible. The main difference of buildings having central yard with similar buildings in the central part of Iran is that although these buildings are introvert, their connection to outside is not completely lost and tall and elevated windows as well as vast porches facing to the alley or square are located in 2nd and 3rd floors of the building. The reason for this is using bidirectional air ventilation and reducing heat by opening windows facing to the yard on one side and windows facing to the alley on the other side. Narrow alleys make permanent shadow over these passages.



Figure 3: Traditional house in hot and humid region (Ghobadian, 2010)

Masonries Used in Northern Coasts of Persian Gulf and Oman Sea: In hot and humid region, using masonries having low heat capacity and don't store heat within themselves is better. Since based on climate, the main problem is excessive heat and storing daily heat for night is not appropriate. Hence, wood is the best masonry of these regions. However, in coasts, it is observed that wood is only used in roofs and doors and window and building body is composed of masonries having high heat capacity while walls are thick. This is because in this region, plant coverage is low and wood is limited for construction purposes.

In hot and Humid Regions, it is Suggested that:

8. Internal and external walls must be narrow and made up of masonries passing heat through themselves in a short time.

9. A place for sleeping in open space must be considered.

10. Building must be protected against heavy rains (Moshiri, 1999).

By taking 24 hour temperature changes into account, it is clear that temperature of closed spaces is higher than that of open spaces. Moreover, temperature equilibrium between human body and its surrounding space is one of the main requirements for comfort. For such equilibrium, it is necessary that body

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temperature to be constant or have small changes. Making such equilibrium depends upon various factors the most important of which are climatic one including air temperature, solar irradiation, relative humidity and air current.



Figure 4: Traditional house in hot and humid region (Ghobadian, 2010)

Lack of air current in space, increases temperature and humidity and makes an uncomfortable space for residents. Therefore, building direction has an important and determining role. In design performed for regions, it is observed that buildings are in north – south direction and use sea breeze.

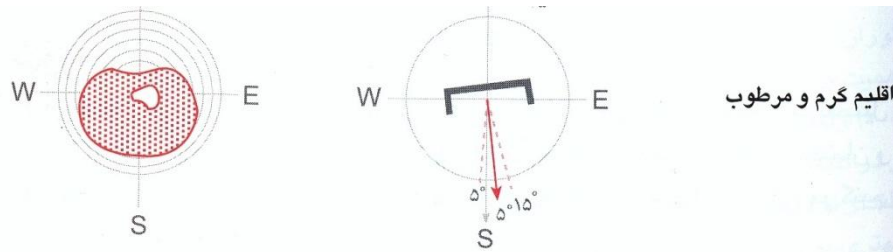


Figure 5: Building direction in hot and humid regions (Kasmaei, 1997)

Masonries used in lateral walls have high heat capacity and heat transfer characteristics. Roof must be flat and accessible and its slope must be so that it can drain water of heavy and irregular rainfalls. Roof must exceed lateral walls so that the joint of roof and walls is not exposed to irregular rainfalls accompanied with winds.

Openings must be designed or places so that they can utilize maximum air flow and wind can directly hit residents. It is better to make an awning to prevent direction entrance of light inside the house.

Effect of solar irradiation on internal temperature of a building depends on masonries used in its external walls and masonries have significant effect on comfort of residents. Higher outside temperature leads to warming up of external surface of walls and this effect is uniform all around the building and direction has no contribution to the value of heat absorbed in this case. Fluctuations of temperature of external to internal walls are dependent upon masonries' heat capacity and resistance and fluctuations decrease by increasing these characteristics and temperature equilibrium of inside and outside spaces will be delayed. Decreased fluctuation of internal walls temperature with respect to that of outside surfaces is proportional to heat resistance of wall masonries. However, delay in the time of maximum and minimum temperature in internal surfaces with respect to external surfaces depends on heat capacity of wall masonries.

In night, heat stored in building masonries are released with high heat capacity and leads to decrease in heat transfer from inside air to outside which is appropriate for regions where daily temperature changes in high such as arid and desert regions. However, for hot and humid regions which don't have significant

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temperature changes, doors and windows must be fully open to transfer inside heat and in this case, external walls must have appropriate heat capacity.

When the color of external walls is dark, by increasing thickness, maximum temperature of interior space reduces. But, when external walls are white, since nearly all of sun rays are reflected from the walls and only a small part of it is absorbed and wall thickness has no contribution to control of interior space temperature. However, in both cases, by increasing thickness, minimum temperature of the building increases and color of external walls has no effect on it. Moreover, heat conditions of the interior building in which external air flows depends on two factors; heat transfer from walls and natural ventilation conditions.

When color of external walls is bright, effect of natural ventilation affects the contribution of walls thickness and when they are dark, heat transfer from walls to inside of the building increases and consequently, thickness of wall will be important in control of heat conditions of the interior space.

Table 1: Principles met in indigenous architecture of hot and humid region (Kasamei, 2008)

Color	Context	Natural Ventilation	Windows no and area	Connection and to ground	Orientation*	Type of roof	Type of plan	of Masonry	Climate
Bright	Scarce	Low high	to Moderate	On ground	S – SW	Flat	Extended	Low HC	Hot and humid

Recommendations for Stability of Plan in Northern Coasts of Persian Gulf and Oman Sea

11. Buildings must be oriented in E –W axis with symbols exposing to north and south so that it can be less exposed to solar irradiation. In design along other axes, main space of the building must be protected from solar direct irradiation.
12. Around the building, shadow must be made by balcony and roofed porches.
13. To utilize air flow, buildings must be designed with large spaces.
14. For all rooms, permanent and continuous air flow must be considered.
15. Interior and exterior walls must be thick and their materials must be so that they can pass heat through themselves in more than 8 hours.
16. Openings must be in north and south walls in wind direction so that wind can hit residents and they can be protected against sunlight.
17. Appropriate size of openings is about 25-40% of the wall surface.
18. Roofs must be light and have heat insulators.

CONCLUSION

In this paper, it is attempted to briefly review four regions of Iran and investigate the characteristics of traditional architecture of Iran in hot and humid region of Iran so that through linking to old architecture, optimal utilization of energy and environmental stability can be implied. In study of indigenous buildings, optimal utilization of renewable energies such as wind, air flow and sun, has been considered in construction. Moreover, it was attempted that construction has least effects on environment. The important issue in modern architecture is overuse of non-renewable energies whose reason is applying inappropriate masonries and their transportation, wrong design of building or heating and cooling equipment which are incompatible with climatic conditions. Hence, by correct use of indigenous masonries and their combination, new construction situations and by means of experiences of experts of energy, we can benefit from maximum renewable energies which necessitates collaboration of architects and experts of energy so that by modern architectural technologies, we can have a modern architecture compatible with climatic conditions of the region. Finally, indigenous architecture meets all demands by its rules and principles and reflects some economic, social and environmental relationships and cultural symbols. This architecture has been table in its place and time and the aim is not sole body imitation but what must occur is appreciating its values which can best perform today.

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