

## Region Based Classification of Design and Construction Consistent with Climate

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**Abstract:** Diverse climate in our country, Iran, has led to different architectural styles and construction in different areas. In order to provide spaces for human comfort, using artistic ways in application of these native materials has left proper structures which are unique. To create spaces for comfort according to the current climate of environment needs to selecting the method of construction and using the natural materials. In other words, material is a foundation which according to climate leads us to proper construction method and all of these provided a comfortable space for human life in related climate. Geographical location and conditions, traditional construction methods, new construction techniques and considering the biological region has led to the different types of construct methods in different regions of Iran according to the different climate. Designing buildings in every climatic zone has been undoubtedly influenced by the natural environmental factors and the regional climate. Designing regions are compared based on the relationship of climatic conditions with used synthetic and domestic (regional) materials in buildings in different climates. Four types of regions with designs related to the construction of buildings are studied and reviewed based on the four climates considering the characteristics related to the climate. According to importance of sustainability of buildings in recent times, this paper can be useful for this aim.

**Key words:** Climatic conditions • Construction • Architectural power • Designing zones • Native (natural) materials • Traditional methods

### INTRODUCTION

Iranian architecture, have originated from Iranian thought and Iranian inherent art. Using the native materials in historical buildings with artistic style has doubled the beauty and elegance of building with geometric shapes. In the first step of shaping the geometrical structures, Architect gives life to the structure identity by the existing materials; these materials have two distinct technical and artistic aspects. The aesthetic sensibility to enliven the structure, that is often achievable with the geometric and form and by desired materials, sometimes may cause conflicts in environments by the severe technical frameworks and incorrect use of materials in building the structures related to each climate and under which the traditional structure will be affected badly [1, 2].

The power architectural which combines the art and technology will be determinant in right selection of materials.

Deep understanding of materials is a key for architects; it gives unique life to the structure as well as durability and performance; and the ability to the correct choice of materials may lead to resistance and static strength, endurance and permanence according to the performance as well as the possibility of implementing the climatic plans considering the economic framework.

Therefore, the better use of existing facilities and right choice of materials as well as the ability to use materials, have the important roles in creating the attractive and durable spaces.

Today's challenge is to create recyclable materials in order to achieve sustainable development, while it does not damage the environment and is consistent with regional climate [1-4].

This investigation is more comprehensive than previous researches and covers wider issues. Here, for accomplishing this research, descriptive research method and writing literature is used.

**Materials, Basic Feature in Construction:** Each climate has in turn adverse environmental and climatic conditions and in order to build a structure compatible with conditions, the traditional buildings which are compatible with the climate and load-bearing should be built by natural materials (stone, wood, straw, clay, limestone and sand) and synthetic materials (pipes, bricks and glass) together with the thoughtful manner. Using the traditional materials in constructing cities is based on the access to these materials, these materials include:

- Natural stone (granite, building facade stone) with high quality as decorative and load bearing materials.
- Marble in interior mines is used as mosaic to decorate the interior and exterior space, especially for religious structures.
- Wood is used for framing the walls, covering the arches of hallways and domes.
- Gypsum which is as a decorative material for columns, arches and domes.

Brick and adobe which are made from yellow clay have been used in old houses. The foundation of these houses is made from a mixture of clay, limestone, sand and water and wood is used in wooden structures for strengthening the building and bearing the tensile force in wooden window frames and brick and stone arches. In addition, the stone arch is used for decorating doors and entrances and as a decorative of entrances inside the house.

The application of colorful stained glass for windows and decorating door is common in traditional windows. Dome-shaped and arched shapes and smooth beams are common in covering the openings. Thick boards are used for the substructure of floor and stories and adobe, straw and clay are used in other layers for completing the floor. Roofs are covered in some parts by ceramic, black stone panels, or porous clay.

Even in the floors of house, sand covers the horizontal stones after the clay and adobe and then a thick layer of clay is used to protect the house from moisture penetration.

Materials selection is based on construction needs for and according to the operational conditions of materials such as strength, durability and resistance to fire and earthquake and it is important with regard to economic and technical recommendations.

Concrete structures are used more in the advanced construction industry and easy access in Iran. They are in the shape of large panels and concrete block in

buildings which are used for columns, frameworks, beams, plates, arches and wall panels and have benefited from concrete and metal on the foundation and skeleton of multi-storey building and concrete beams.

Steel structures can be used due to their mechanical tolerance and their usefulness in spans more than 30m wide and as columns; also light networking, facade structures and aluminum which is corrosion-resistant are used. This method has been used in earthquake-prone areas. In addition, timber has been used for prefabricated wooden structures in the north of Iran [1, 2, 5-7].

**Zoning of Design in the Construction:** According to the design in construction, four regions are as follows:

- The northern construction design zone (N) which has a temperate and humid climate in the southern coast of the Caspian Sea (Environmental- climatic zone I) and includes cities such as Gorgan, Rasht, etc.
- The northwest design zone (NW) which has cold and mountainous climate and has two Environmental-climatic zones: A) mountainous Plain (Environmental-climatic zone II), B) semi-desert mountainous region (bio-climatic zone III) and includes cities such as Urmia, Tabriz, Hamedan, etc.
- The southeast design zone (SE) which has a warm, dry climate with two climatic-environmental zones: a) tropical semi-arid mountain (Environmental-Climatic zone IV) B) subtropical deserts (Environmental-Climatic zone V), includes cities such as Kerman, Isfahan, Zahedan, etc.
- Southern construction design zone (S) with a warm and humid climate, has the fifth tropical and subtropical desert climatic- environmental zone of Persian Gulf (Environmental-climate zone VI) and includes cities such as Bandar Abbas, Bushehr, Abadan, etc [1, 2, 5].

**Northern Construction Design Zone:** The Southern region of Caspian Sea in Northern design zone (N), with relatively warm summers and cold winters and high humidity weather is considered as the temperate and humid zone which has suitable weather for human comfort. In order to achieve optimum conditions for human comfort in houses, the architectural solutions in construction, which benefit from adverse conditions of surrounding environment in favor of human comfort, are needed. Wood industry is used in forest areas in the north of Iran, in one or two storey buildings and holy places. Wood is very suitable due to its strong structure

and its resistance against wind and moisture. In the Caspian regions with natural stone (granite and limestone), these stones have been used in the construction of retaining walls as protections and moisture resistant.

High thermal capacity heavy materials are used in western parts of buildings in Caspian regions to prevent exchange of afternoon's heat into buildings and other parts are built by materials which have good thermal resistance. If heavy materials were used, their thickness will be considered at lowest as possible as. Heavy materials can reduce ventilation and air turbulent stream which are necessary for this region. Air turbulence and natural ventilation are useful things here. Generally, buildings have wide and extensive plans and much of them have geometrical shapes, long and narrow.

High soil moisture in Caspian regions may have caused that most structures to be built on the platform or pilot; if there is a direct contact with the ground, the pitch moisture barrier is used in porcelain stool and stories. In traditional architecture related to these areas, wide corridors, summer rooms below the ground level and porch are used for designing the houses located in the south of the Caspian Sea. Houses in these regions are built apart from each other with north-south orientation and east-west extension in order to create aeration and reduce the heat exchange.

In order to protect rooms from the rain, covered and wide balconies and multi-sided porches are proposed.

Due to the rainfall, the steep roofs and high ceilings of rooms are made. Selecting the color of structure in this climate is personal. It is better to insulate the roof because of high rainfall, but the walls and layers which are not exposed to the rain do not need to be insulated in order that air flows easily in the proper moisture.

The exterior facade of these houses are faced the sea and with the sea landscape. Similarly, the parallel links in the coast at a distance of 300-400m from coast for creating the spatial protective distance seem necessary. To reduce heat in day and night, sunshine canopies can be used to shade some parts of building. Different types of structures in the Caspian region, such as fan, chess, jagged, apart from each other and linear forms are proposed.

This construction method is suitable for the sea view.

In the northern urban buildings in coastal areas, the linear form of plans, big plans, multiple windows and painted exterior façade are clear. In these designs elements such as porch, patio, corridor, arch and types of royal dome are seen in separate buildings with free design, the margins, buildings and multi-purpose sequential building.

Aeration is important in the Caspian regions, thus openings are necessary for air entry and exit. In addition, it is necessarily to build openings and windows in front walls, different parts of building should have outside air and layering the lining of the walls should be prevented. Structures are in a rectangular shape in order to benefit from the air conditioning and maximum use of light and ventilation. If the ground is limited, we can benefit from buildings in height or with stories, because with this kind of structure we can take advantage of ventilation and rectangular windows are proper for the more use of light, wind and ventilation.

The best shape of yard for structures with yard is a rectangular form which its big side is faced with the south-north with a 30° deviation from the south. Urban constructions are primarily open on the north and south sides and are led to the front and rear courtyard and are limited to the Eastern and Western neighborhood; walls are made of brick block and brick, with a layer of cement and finished by gypsum which is too appropriate here and floor is made of concrete and in some places are pitchy insulated. For outer parts facing the prevailing wind and of the building and rain tilt, if there are not any neighborhood or limitation, protective insulator and coating are essential [1-4, 6, 7].

**Northwest Construction Design Zone:** The mountainous areas which are located in Northwest construction design zone (NW) has cold and dry weather, Weather in summer is pleasant and in winter cold and structure should be protected from undesirable cold air, therefore we should benefit from the minimum heat exchange through the walls and maximum sunshine in terms of indoor comfort. In order to keep the desirable conditions, heat resistance of materials should be increased the interior and west walls be built of heavy materials. In order to keep indoor Thermal equilibrium, it is necessary to use heat insulator on external side of walls to prevent heat exchange from inside of construction. Houses in the mountains are faced to the south and south-east and floors are built with stone as concrete layers (Khoshkeh chini) above ground (To prevent the cold ground).

Compact and compressed constructions in the foothills with less slopes have lowest level of windows, yard and structure; and on steep slopes, part of the construction is hidden inside the mountains and creates the stair shape in order to be safe from the contact of construction sides with open and cold mountainous. Underground space is warmer than upper space in hot and dry or colder seasons due to insulation. In large lands, constructions either are located like the spot in the garden, or are L and U-shaped houses around the courtyard and garden.

Elements that can be used in this mountainous area, includes corridors, porches, bedrooms and lobbies with ceiling. Because of intermediate spaces such as porches and corridors, the influx of cold air when opening and closing doors can be prevented. In addition, the room height is less in order to warm the space rapidly, but due to the use of heavy materials with high thermal capacity, the interior heat loss can be prevented. Internal and external walls are very thick. These materials are including stone, brick and adobe which can hold more heat and are considered as impermeable materials. We should take sufficient advantage of sunshine in mountainous areas, therefore, the southern wall of yard should be short and the distance of surrounding constructions in the south be more than the double height of the structure; and the eastern and western walls of yard are made longer due to the strong winds, the yard in these areas has a square or rectangle shape and the longitudinal axis is in line with the north-south axis. Also multi-layer external walls are used to protect the construction in non-traditional samples against heat, as a thermal insulation and constructions with interior corridors, domed entries, different types of porches, Halls, are appropriate middle spaces recommended in these areas. In addition, to minimize the external surface against the cold weather, compressed and compact plans are placed next to each other. The roof of structure is generally flat or steep. Flat roof acts as insulation due to snow accumulation on the roof. Some buildings which are steep, have one-side South-facing or two-side East-West slope and are insulated.

Dark colors are used in facades of structures and roof in order to absorb more sunlight in these areas. structures with an open side are built with about 15° 45° deviation from the south, as Southeast structures, in order absorb the sunlight and the ones with two open sides are built in front of each other, as north-south structures, with 30° deviation from north-south axis.

The constructions are built behind the prevailing wind; the wind-exposed surfaces should be reduced by arboriculture, the completely smooth facades be used and the total height of structure be reduced.

The shorter side and closed space facing the open spaces, reduces the energy loss on that side. The floor of yard and rooms are 1-1.5 m below the level of alley and houses and pathway have a 45° angle from each other in order to face with the cold winter wind. High-strength interior construction materials are used for a construction in cold rainy weather and for decorating the facade of construction, dark and cloudy color, sharp and curved shape of houses are used [1-4, 6, 7].

**Southeast Design Construction Zone:** The hot and dry zone which is the southeast (SE) design zone is unique

itself. Due to the high temperature difference between day and night and in order to avoid high heat in day and cold weather at night, thermal equilibrium and energy wasting should be controlled through the wall of construction. Compact and compressed plans of external surface are smaller compared to the size and density and compactness of house minimize the heat exchange through the walls. This area has developed less in terms of producing the construction materials and materials with high strength are used.

For structures in this climate, materials such as brick, adobe and mud which have high thermal capacity are used. In order to use the high thermal of soil in some areas, constructions are built inside the hills or under the ground.

In order to further reduce the heat of walls due to the sunshine, the external surfaces are covered with pipe clay or white color and walls are made of adobe and thatch and have high thickness.

The number and space of windows have been reduced and windows are installed in the upper of wall due to prevent the penetration of sunshine. Rooms are opened up to the internal and central yard in order to be safe against sand and storms.

Eastern and particularly Western walls in this climate are shorter; construction is placed in East and Southeast, and houses are compressed on the eastern-western sides, they are covered with arboriculture; due to this compact, the total mass of the structures materials are increased and time delay has been desirable. In order to reduce the temperature the whiten surfaces are used. In most areas of this climate, roof is in the shape of arc, arch, or dome, with no skeleton and made of adobe and mud. In semi-desert zones, due to the relatively temperate weather, woods are used in sufficient amount in flat roofs. The aeration of outer air into the house in this climate is avoided, but ventilators can be used in order to cool the air. The inner yards (central yard) which are planted with trees are the architectural signs of hot and dry zones; they have ponds and planting surfaces which supply moisture, also windows and openings open to the yard. The architecture of this area contains flat and domed covers and two-layer domes are used to prevent the warm and dry air entry into the house and to keep rooms cold and hot during day and night.

The color of exterior facade is bright and arches have semicircular forms. The spaces of houses in warm and dry zones include corridors, winter room, summer room, basement, porch, central yard, 5 and 3- door rooms, alcove, etc.

The recommendations which are provided in order to increase the climate level of limited space, depending on the climate zones, are as follows:

- Building the connecting places including the crosswalk and spaces for driving cars, yard, pond, fountains, ventilator and vertical and horizontal shade by canopies are necessary.
- Planting, water crossing, shading, street layout, crosswalk, covered patio with ceiling are appropriate.
- Protecting the construction against the southwest and southeast dust, creating the transport way in the direction of these winds, entrance of houses in the opposite direction of winds.
- Creating a good air conditioning in construction by shading the structures, shorter walls, reducing the outer covering in areas, shading by canopies in street and yards.
- Designing the main route of pedestrian crossing mainly from north to south is essential for creating the aeration.
- In urban structures, compact spaces, one or two yards, changed shape of open spaces with enclosure for using in the afternoon and at night, advanced ventilators and modern air conditioning, porches and terrace, multi-layer insulated walls, reflected surfaces, solar panels and wind generators can be used.

Spring house is built in order to cool the air of house in the summer by using the evaporative cooling of water; it has high ceiling, the pond and fountain are located in the middle, Ventilator is built in the roof in order to emit the hot air and accelerate the flow of air. Sash windows, netted-colored glasses and anti-Radiation spaces prevent the emission of sunshine into the house.

The best direction for structures in warm and dry southeast zone is in 15° deviation from the south and in structures with two open sides in front of each other is in north-south, northwest and southeast with 30° deviation from the south. This climate should have at least the thermal exchange of wall and smaller side size; and side levels should be connected to the adjacent structures in order to be less exposed to the surrounding environment. The best location for closed spaces is the south and southeast sides; also northern side is suitable for the summer and 4-season spaces. The structures with small windows are faced with the central yard, windows which open to the south and southeast, have horizontal canopies and windows on the north side have vertical canopies next to the window.

Materials used in this climate are based on the climate of area and their availability; they include adobe, mud, plaster and wood. Wood is a resistant element against the stretching forces of arch and the pressure of ceilings [1-4, 6, 7].

**The South Construction Design Zone:** The hot and humid climate of northern regions of Persian Gulf belongs to the South construction design zone (S) which has a very hot and humid climate; therefore it is necessary to establish aeration and shading. Structures in these zones have central yards, the Ground floor is as a service space and living spaces are located in the stories. This house has differences with houses in the central yard in warm and dry areas; these differences are about the elements as follows:

- Shanashil (wooden terrace-like element) is located in the outer surface of construction and on the side with central yard which are used as terrace.
- Direct entrance facing the yard of southern areas, in contrast with the indirect entrances with porch in warm and dry zones.

Structures in this area are mostly made of wood and thatch and ventilators facing the coast are used in order to enjoy the cool sea breeze. Orientation of houses is to the southeast or south side and structures are often located on the short columns and dome-shaped and flat roofs are seen. Structures are separate from each other in a line; less durable materials are mostly used (such as wood); some windows and doors are especially in the northern and southern parts in order to easily create aeration in spaces of house; the outer surfaces of houses light colored and the structure is in Southeast direction with 30° deviation from the South.

The following cases are used in order to design structures of South zones:

- Linear-building of structures along the sea, living room and public places, overlooking the sea.
- Full ventilation and protection of spaces and places from high heat in the summer by multi-layer stockade, horizontal and vertical shading by canopies, creation of vineyards, planting the heat resistant vines.
- Small windows in high roofs in order to allow hot air out of the windows.
- Large openings with wooden hulls and shading caused by wide canopies of porches.
- Flat roofs and netted and long parapet designed for shading in the yard and roof and creating the cool weather during the day.
- Interior spaces are in a line next to each other and are built as a narrow rectangular strip on a side or middle of yard; these spaces are developed for settlement and using the proper aeration in height.

- Openings are built for more ventilation in the North and South part.
- According to the proper use of aeration, the structure wall should be one-layer and the yard should be on both north and south side. Semi-open spaces are common in this area and canopy around the structure reduces the temperature of walls.

Closed spaces should be open on both sides by openings in order to take advantage of natural aeration. On one hand, the long side of closed space facing the north and south side will receive the steady light and on the other hand the possibility of having more openings and better aeration will be provided.

Open walls should be exposed to the shadow on one side and to the air flow on the other side. Therefore, these openings have wide and extensive canopies as well as the large frequency. In this climate, windows facing the south and southeast side have horizontal netted canopies, the northern windows have vertical netted canopies and if necessary the windows facing the East and West have horizontal and vertical canopies in front of the window, in addition, the movable vertical canopy is necessary [1-4, 6, 7].

## CONCLUSION

### Temperate and Humid Climate [The Northern Design Zone (N)]:

- The structure is in the south to southeast direction with 30° deviation from south (Table 1. 1-1).
- The structure has a rectangular shape which is extended in length and has a pilot shape (Table 1. 2-1).
- The location of structure and the direction of aeration are to a north to south side. Openings are placed in diameter or opposite each other (Table 1. 3-1).
- The structure is placed on a wooden, pilot base or on the platform (Table 1. 4-1).
- The northern and southern sides of structure are the empty spaces of yard for taking advantage of light and ventilation (Table 1. 5-1).
- The structure is as the unit element in the middle of the yard, either yard is placed around it, or the structure have yard on both north and south sides (Table 1. 6-1).
- The roof is steep and two-side, facing the Eastern and Western side or is south-facing one-side sloping roof (Table 1. 7-1).

- Porches are facing the south side or overall porches are built around the structure (Table 2. 8-1).
- Southern windows have horizontal canopy and Northern windows have vertical canopy (Table 2. 9-1).
- The materials of the walls are made of brick or brick block which is covered by a layer of cement and finally is coated by plaster; the floor of structure is made of concrete and floors in places such as kitchen and bathrooms has moisture insulator (Table 2. 10-1).
- There are a lot of windows and rectangular windows are essential for the proper use of light and wind (Table 2. 11-1).
- There are semi-open spaces among the rooms connected to the porch for routine chores (Table 2. 12-1).
- Selecting the color of walls and ceilings is optional and houses are decentralized and separate from each other (Table 2. 13-1).
- The ratio of space to the size is high and is as a rectangular in order to thermal exchange takes place easily (Table 2. 14-1).
- The form of structure is open, wide, rectangular and outward-oriented (Table 3. 15-1).
- Materials have high thermal capacity so that aeration can flow in room space (Table 3. 16-1).
- Spaces are linear, rectangular with eastern-western extension (Table 3. 18-1).
- The long side of closed spaces is facing the north and south sides (Table 3. 19-1).
- Rooms have proper height in order to easily create aeration in the room spaces (Table 3. 17-1).
- Wood is used in building the constructions in these areas due to its availability; also the modern materials of concrete and metal are used.
- To protect structures from rain, they have wide and covered balconies and overall porticos and porches.
- The facade is sea-facing and the plans have linear forms.
- Structures in Caspian regions are in the forms of fan, chess, apart from each other, or with jagged and linear forms.
- The structure is insulated in the direction of prevailing wind and rain.

### Cold and Dry Climate (Northwest Zone Design NW):

- Structures have Southeast direction with 15°- 45° deviation from the south (Table 1. 1-2).
- This area has compressed and compact houses in order to prevent the heat loss.

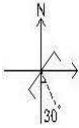




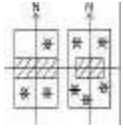

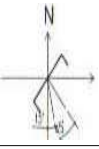
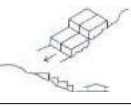


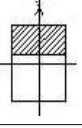
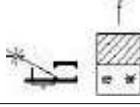
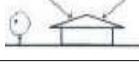
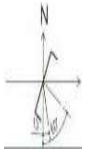

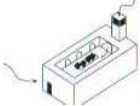

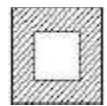
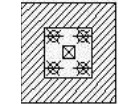


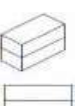

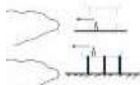
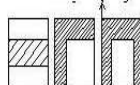
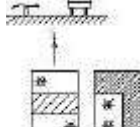

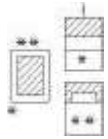
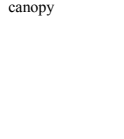




Table 1	1	2	3	4	5	6	7
Climate Type	Direction of structure	Shape of structure	Location of structure based on aeration	The method of placing	Fill and empty space	Shape, proportions and the location of yard and structure compared to each other	Shape and type of roof
1 Temperate and humid Northern construction design zone (N)	South-southeast with 30° deviation from south 	Extended as linear, rectangular, pilot 	Openings in the north-south, taking advantage of the North Wind 	Placing on the wooden columns, platform and pilot 	North and South sides Empty space of yard for maximum use of light and ventilation 	Unit structure in the middle of yard Yard on both sides of structure 	Two-side steep roof facing the East and West  Unilateral steep south-facing roof
2 Cold Northwest construction design zone (NW)	Southeast With about 15° to 45° deviation from the south 	Compressed and compact with square form with lower side level 	Minimizing the external surface of structure and the openings for preventing the cold mountainous winds 	building as staircase on the slope of mountain facing the south 	North side is full space. South side is empty space. Yard space takes advantage of light for heating in winter 	Yard is facing the south as rectangle In the direction of south-north axis Long wall in order to prevent cold winds 	two-side steep roof with for better drainage of rain 
3 Warm and dry Southeast construction design zone (SE)	Southeast 15°-60° deviation from the south 	Compressed and compact with square shape Less side level Less energy loss 	Using the Ventilator, pit of garden for aeration and cool air 	Is lower than the level of pathway 	Hachure space is filled space with room and the empty space is pit of garden 	Yard is Tree planted in the center. It has pond and fountain 	Flat roof is a place for rest at night 
4 Warm and humid Southern construction design zone (S)	Southeast 30° Deviation from South 	Pulled and linear, as a rectangle It has extended in height for better ventilation 	Expanded space in height for taking advantage of aeration and wind from the sea 	It is placed on the wooden columns above the ground and stories are extended in height 	Full spaces in the shape of U and L in Bushehr in the northern region of Persian Gulf and two yards in other areas 	Wall is shorter than the structure so that the proper sea wind enters the yard 	The roof and trench are netted due to the shading and creating the aeration in the roof 
Table 2	8	9	10	11	12	13	14
Climate Type	Shape and location of the porch and portico	Canopy and Shading	Type of Material Constructional Non-Constructional	Openings	Special spaces	Color and structure to the size	Ratio of Surface to
1 Temperate and humid Northern construction design zone (N)		South windows Horizontal canopy North windows Vertical canopy 	Wall is made of brick, brick block and a layer of cement which finished by gypsum.	Floor is concrete and moist places are isolated	There are a lot of windows. Windows are on two opposite walls Rectangular windows are suitable for taking advantage of light and wind	Intermediate space between the room and portico for doing routine chores	The color is optional. Structure is decentralized and dispersed
2 Cold Northwest construction design zone (NW)	Terrace in the area is just as for a perspective 	Canopy depth do not need to be much, so more energy shine into the depth of room 	Wooden timbers are used for roof covering and strong stones are used in foundation	Wood, mortar of straw-mud, stone and brick are used for body	Small openings with few number on north and south sides	Greenhouse space in the southern facade supplies moisture and reduce cold harsh weather 	Dark and cloudy color in the facade and ceiling absorb more light and heat the space of the room and the spaces are smooth, with compressed and compact structure 

Table 2: Continue

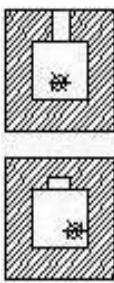
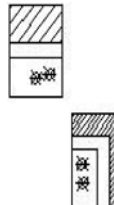
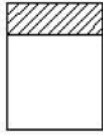

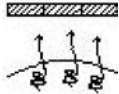
Table 2	8	9	10	11	12	13	14	
3 Warm and dry Southeast construction design zone(SE)		South and southeast windows. Horizontal canopy. Northern windows. Vertical canopy. Multiple horizontal windows	Wooden and straw-mud materials, metal beam and column are used	Usage of roof and double layer wall for ventilation and high thickness straw-mud and adobe	Small and few numbers of openings with horizontal canopy in upper sides in order to be protected from the sunshine penetration. Windows are facing the south and southeast	springhouse and entering the wind through the ventilator and passing the pond and fountain to cool the room	Reducing the heat by white exterior facade; it has bright color; the structure is compressed and compact	Less side levels surface means that the exterior surface is less than its size
4 Warm and humid Southern construction design zone(S)		South and Southeast. Northern Horizontal canopy. Vertical canopy next to the window	high thermal capacity materials in one layer	Wood and straw-mud are or low thickness materials are used for air penetration	Windows and openings are narrow There are a lot of openings in the north and south	There are ceiling fans and ventilators in rooms with high height in order to send out hot air	Light color in facade and roof Linear structure facing the sea	The ratio of surface to size is high and there is thermal equilibrium

Table 3	15	16	17	18	19	20	21
Form of Climate Type	Thermal capacity of materials structure	Height (elements)	Space of Spaces	Dimensions and proportions of Layout	Relation with base space	Dominant urban structure	exterior colors
1 Temperate and humid Northern construction design zone (N)	Wide and open Outward-oriented and rectangular insulator is required	Good heat resistance and low thermal capacity. Light materials in ceiling. Thermal	The height of room is appropriate in order to easily create aeration	As linear and extended rectangle. Rooms are on one side of yard or yard is on both sides of spaces	The long side of closed space facing the sea	It is discrete and separate from each other so the aeration will be created	Optional
2 Cold Northwest construction design zone (NW)	Compressed square cubic Outward-orientated possible	High thermal capacity Prevent heat exchange from the walls as much as sooner. Rooms are small	Low height of the rooms in this area in order to warm these spaces are as the staircase and are steep.	Some parts of spaces are into the ground. It acts as an insulator against the cold weather. Houses	Shorter side of the closed spaces facing the open paces common in this area.	Compressed structures which are next to each other. And a basement is	Cloudy and dark colors
3 Warm and dry Southeast construction design zone (SE)	Compressed as Square cube quite inward-orientated energy loss through walls. And domed ceilings have two hulls	Walls and roofs with high thermal capacity in order to reduce heat and top of the room and send out of the hatch in ceiling. Big rooms without mediated wall	The heights of rooms are too high in order to flow the warm air up to the such as winter and summer rooms	Structures are located in four sides of yard. They have different functions,	Summer spaces are large with high ceilings and winter rooms have short ceilings	It is compact and compressed	Bright colors



Table 3: Continue

Table 3	15	16	17	18	19	20	21
4 Warm and humid Southern construction design zone (S)	Wide, open and outward-oriented rectangle in the southern regions. In some parts as Inward-orientated and the only way to the out of space is via Shanashil (Bushehr)	Low thermal capacity. The heat exchange through the wall	Height of room is high. The additional heat is sent outside by the hatches up the room. The rooms are big.	Linear structures on one side of yard	The long side of closed space is facing the sea	Closed spaces are facing the north and south side and the Sea	Bright colors
							

- The structure has square shape with fewer sides than outdoor space (Table 1. 2-2).
- The external surfaces of structure and openings are minimized in order to prevent cold mountain winds penetration (Table 1. 3-2).
- Building the construction in the shape of staircase on the slope of mountain facing the south side (Table 1. 4-2).
- The structure is located on North side and yard on South side in order to benefit from more light (Table 1. 5-2).
- The yard is as a rectangular located in the south of structure, the wall of yard is long and in order to prevent the cold wind (Table 1. 6-2).
- The roof of these areas has two-side steep slopes in order to drain the rain fast (see Table 1. 7-2).
- The terrace in this area is not essential and it is only for perspective (Table 2. 8-2).
- Depth of the canopy should not be more, so more light shine to the depth of rooms and heat them (Table 2. 9-2).
- The rest of cold and dry climate (Northwest design zone NW)
- Internal and external walls are made of stone, brick and adobe in order to absorb more heat (Table 2. 10-2).
- Openings are small and in few numbers on northern and southern sides (Table 2. 11-2).
- There are greenhouses on the southern side in order to supply moisture (decreases the severe cold weather) (Table 2. 12-2).
- Walls and ceiling have dark and cloudy color in order to absorb more light and warm the space of rooms (Table 2. 13-2).
- External surface should be less than the size of structure (Table 2. 14-2).
- The structure has a compact form as a cube with an outward-oriented shape; it has porches facing the south for maximum use of solar heat (Table 3. 15-2).

- Materials are with high thermal capacity in order to prevent the heat exchange through the walls (Table 3. 16-2).
- The height of rooms in these areas is low in order to warm these spaces sooner, also the rooms are small (Table 3. 17-2).
- Part of the space of rooms is built into the ground, because it acts as a cold insulator (Table 3. 19-2).
- The shorter side and closed space facing the open spaces, which reduce the energy loss (Table 3. 219).
- Structures are closely packed together and next to the each other; they often have multiple stories under the ground (Table 3, 20-2).

#### Hot and Dry Climate [Northeast Design Zone (NE)]:

- The structure is in southeast direction with 15° - 60° deviation from the south (Table 1. 1-3).
- The structure has a hollow square shape; rooms are built around of it, the square shape prevents the energy loss because it has fewer side level (Table 1. 2-3).
- Using the ventilator, fountain and the pit of garden are critical in order to make room chiller and create aeration (Table 1. 3-3).
- Structure is built lower than the pathway (Table 1. 4-3).
- The rooms fill around the yard and makes empty and full spaces (Table 1. 5-3).
- The yard is planting in the center and has fountain and pond in order to cool the space of yard (Table 1. 6-3).
- The roof of these houses is a place for resting and sleeping at night and it is flat. The dome-shaped roofs are common for shading the roof of these areas (Table 1. 7-3).
- The southern porches are used to get light in winter. In addition, covered porches and semi-open spaces are used for routine chores (see Table 2. 8-3).

- South and southeast windows have horizontal canopy with and northern windows have vertical canopy (Table 2. 9-3).
- Materials such as adobe and thatch have high thermal capacity and high thickness (Table 2. 10-3).
- Small openings with low numbers have horizontal canopy; they are placed in upper parts in order to be away of the sunshine; the windows facing the south and southeast are suitable (Table 2. 11-3).
- The springhouse helps to chill rooms (Table 2. 12-3).
- The pipe clay or white color surfaces are used to reduce the heat; the exterior facade has bright color; the structure is compressed and compact (Table 2. 13-3).
- The structure size has less side level (Table 2. 14-3).
- The compact form of structure is as a cube and quite inward-oriented (Table 3. 15-3).
- Walls and roof have high thermal capacity in order to reduce heat and energy loss through walls. And domed ceilings are two-layer and act as heat insulator (Table 3. 16-3).
- The rooms have high height, so that the warm air flow to the upper height and leaves through the vent of roof. Rooms are big and there is no wall among them (Table 3.17-3).
- The structure is built on four sides of yard; each space has different functions, such as winter and summer rooms (Table 3.18-3).
- The summer room is big with high ceiling and winter room has short ceiling (Table 3. 19-3).
- Porch is built on the southern side; Shanashil (a kind of wooden terrace) in the city of Bushehr has a function as terrace in the Caspian regions (Table 2. 8-4).
- The south and southeast windows have horizontal canopy and northern ones have vertical canopy (Table 2. 9-4).
- Materials have low thermal capacity; they are one-layer in order to easily ventilate (Table 2. 10-4).
- Windows and openings are narrow and their numbers is high on the north and south sides (Table 2. 11-4).
- Ceiling ventilators are required in rooms with high height in order to spend out the hot air (Table 2, 12-4).
- Walls and roof have bright color; structures are linear in the sea coast and are facing the sea (Table 2, 13-4).
- The ratio of surface to the size of structure is high in order to keep the thermal equilibrium (Table 2, 14-4).
- The form of structure is wide, extensive and outward-orientated and in some regions of Bushehr is seen inward-orientated with an element such as Shanashil (terrace) (Table 3. 15-4).
- The materials have low capacity, so that the heat exchanges through the walls (Table 3. 16-4).
- Rooms have high height, so that heat can be sent out through the vents up the room; also the size of rooms is big (Table 3. 17-4).
- Structures are built in a line on the sea coast and in structures with yard, the house is located at the end of southern side of yard (Table 3. 18-4).
- The long side of the closed spaces (rooms) are faced the sea (Table 3. 19-4).

#### Warm and Humid Climate [Southern Design Zone (s)]:

- The structure is in the Southeast direction with 30° deviation from the south (Table 4. 1-1).
- The structure has a long extensive rectangular shape which is expanded in order to use the aeration more in height (Table 4. 2-1).
- The structure is placed on the wooden pedestals above the ground (Table 1. 2-4).
- The structure is surrounded between north and south yard in order to benefit from more ventilation; however in the city of Bushehr the houses have u, L and even o shape (Table 1. 5-4).
- Wall is shorter than structure in order to have sea-facing landscape (Table 1. 6-4).
- The roofs of structures in these areas are flat and the trench is netted (due to shading and creating the aeration in the roof) (Table 1. 7-4).

#### REFERENCES

1. Moradchelleh, A., 2010. Construction design zoning of iran territory And climatic modelling of civil buildings' space. Journal of king Saud University Science. July 29, 2010 (in press).
2. Moradchelleh, A. and H. Rashid, 2011. The study of the form of the building in climates of Iran. Middle East Journal of Scientific Research, 8(2): 306-313.
3. Ghobadian, V., 1998. Climatic Analiz of the Traditional Iranin Buildings, Tehran/Iran, 1998 (in Persian). ISBN:978-964-03-3875-5.
4. Ghobadian, V. and M. Mohammad feiz, 1973. Climatic Design Donald Watson, FAIA Kenneth Labs Climatic Design Energy \_ Efficient Building Principles and Practices. Tehran/Iran, (in Persian).

5. Kasmai M. and M. Ahmadinezhad, 2003. Climate and Architecture. Esfahan/Iran, 2003. ISBN: 964-5583-47-0
6. Tahbaz, M. and Jalilian, Sh. 2008. Architectural design principal compatible with climatic conditions of Iran, with focus on Mosque Design. Tehran /Iran, 2008. ISBN: 964-457-139-8.
7. Tavassoli, M., 2002. Urban Structure and Architecture in the Hot Arid Zone of Tehran/Iran, 2002. ISBN: 964-6225-05-9.