

## CLIMATE ADAPTED HOUSES IN IRAN: HOT, COLD AND HUMID CLIMATE

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**Abstract.** *The issue of Climate Change has raised so much attention for decades, specifically in recent years. Modern trends in urban architecture which tried to create living machines similar to each other in any context, have now been proven to be insufficient and unless we decide to respect nature and make our buildings cooperate with their contexts as soon as possible we cannot address further threads regarding our future life. If we take a look at traditional architecture existing in old towns and rural area, we can see how people managed to bond a new construction with its surroundings. In this article we study different architectural patterns which exists in old architectures of towns and villages in Iran; the country which can be a good case study due to its rich diversity of nature, climate zones and architectural background. In Iran we have a range of climate of cities from hot and dry to humid and very cold ones. So, depending on the city climate, water supplies and energy sufficiency people tried to create best residential buildings. Here we try to check out some examples.*

**Key words:** *Iran, climate change, houses, architecture*

### 1. INTRODUCTION

The issue of Climate Change has raised so much attention for decades, specifically in recent years. We can now see and feel how everyday life is being affected by the consequences of this global concern and the urge of taking the knowledge into action needs to be addressed more than ever. While more than half of the world population live in cities, Urban Architecture seems to play a significant role in energy usage and sustainability. The way that our buildings respond and bond with their nature can have a crucial impact on energy sufficiency. Modern trends in urban architecture which tried to create living machines similar to each other in any context, have now been proven to be

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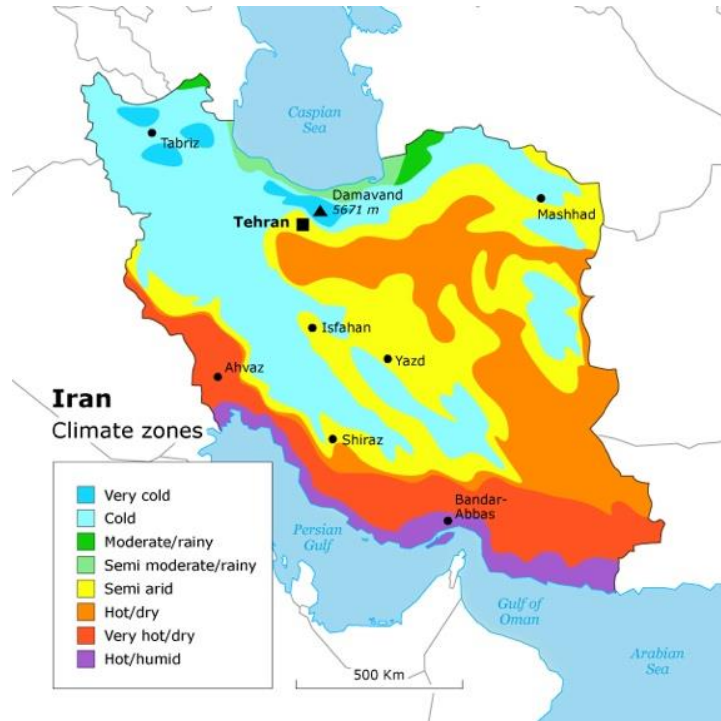
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**Fig. 1** Iran Climate Zones (Iran Geography, n.d. Archive of Fanack<sup>1</sup>)

In this article we study different architectural patterns which exist in old architectures of towns and villages in Iran; the country which can be a good case study due to its rich diversity of nature, climate zones and architectural background. In Iran we have a range of city climates from hot and dry to humid and very cold ones which are shown in the figure below (Fig.1). So, depending on the city climate, water supplies and energy sufficiency, people tried to create best residential buildings. Here we try to check out some examples. To better study the subject, four major climates zones now existing in Iran are classified into ‘Hot and Dry’ climate, ‘Hot and Humid’ climate, ‘Cold and Very Cold’ climate and ‘Moderate and Humid’ climate. We study the main characteristics of each climate zone and then we mention architectural ideas which helped the building collaborate best with its settings.

The method of research in work is adjusted to the nature of the research, which requires the application of several methods. The methods used here are: analysis, synthesis, comparative method.

<sup>1</sup> <https://fanack.com/iran/geography/>

## 2. HOT AND DRY CLIMATE

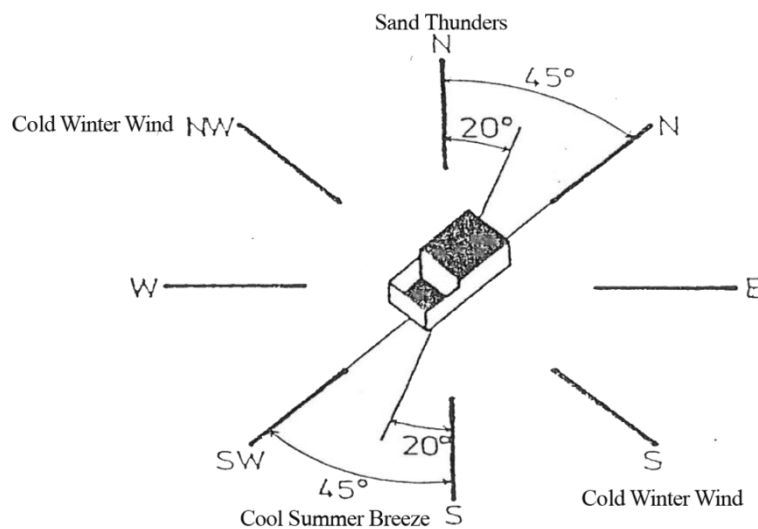
In this climate we have

- Burning sun
- Very high temperature in day in very low temperature at night
- Hot summers and Cold winters
- Dry weather, little raining and lack of water
- Sand and dust thunders

Cities like Yazd, Kerman, Shiraz and Kashan which are mainly located in the middle of Iran comprise this category (Hassan, 2015, 3).

The most important building characteristics are ordered into:

### 2.1. Orientation



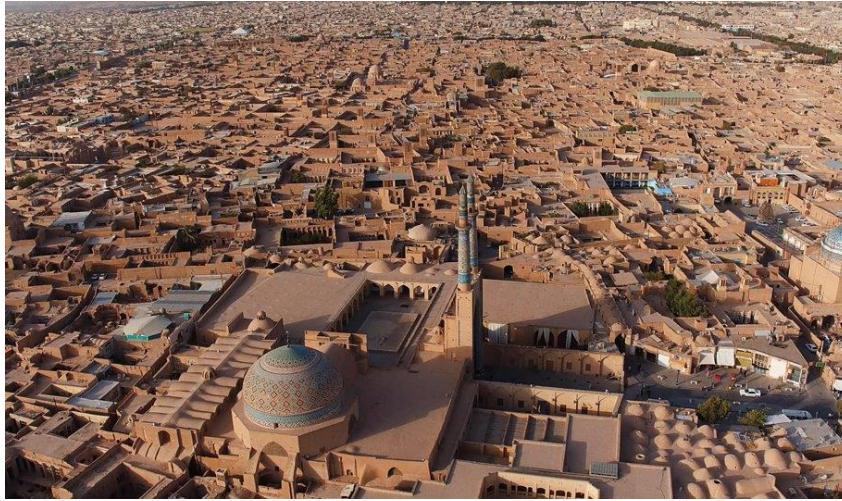
**Fig. 2** Winds Orientation in Center of Iran (Source: Hassan, 2015)

Building the house in Northeast-Southwest Orientation to receive cool summer breeze and reject cold wind. (Fig.2)

### 2.2. Compactness

Houses are dense and have joint walls. Alleys are narrow and curved so that unwanted winds cannot easily enter the house and this characteristic also helped defending the city in old times.

These curved paths also provide more shadow for pedestrians. (Fig.3)



**Fig. 3** Bird View of Yazd, Iran (Source: Archive of Kayhanlife<sup>2</sup>)

### 2.3. Materials

Using materials which is accessible around the city and has a high heat capacity is very important. The combination of soil and water creates a perfect match! So “clay” and “Mudbrick” are the main materials to build the houses. Not only have they got a high heat capacity but also their bright color helps the building to absorb less heat in summer and reveal less heat in winter. Also people try to use bright colored coverings on the wall; Things like Plaster. (Fig.4)



**Fig. 4** Brick and Mudbrick as the Main Materials (Source: Archive of Kayhanlife)

<sup>2</sup> <https://kayhanlife.com/unesco-inscribes-iranian-city-yazd-world-heritage-list/>

#### 2.4. Form of the Building

In order to reduce the outside openings and preserve the inside space from sand storms the shortest side of the building would be facing the wind. Overall the cubic form is the best matching form. Walls are thick, ceilings are high and openings are mainly inside the house, facing the main central yard. So, the houses built in this climate are mostly introspective. (Fig.5)



**Fig. 5** Introspective Housing, Yazd, Iran (Source: Archive of Kayhanlife)

#### 2.5. Down-level Central Courtyards

The courtyard is built in the middle of central yard and is usually deeper than the whole building so it can be at lower temperature. Courtyards are usually including a big fountain and some trees to reduce the temperature on a whole of 3-4 degrees. (Sadat, 2013) (Fig.6)

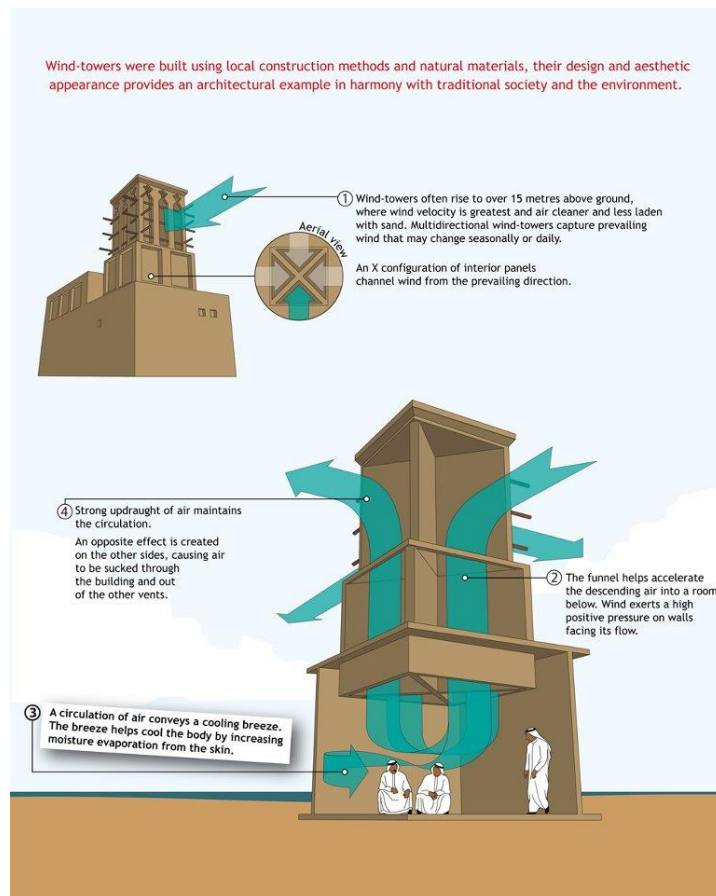


**Fig. 6** Down-level Garden in a House in Yazd, Iran Døskeland (Source: Archive of Kayhanlife)

## 2.6. Wind Catchers

Wind tower (wind catcher) is a traditional Persian architectural element to create natural ventilation in buildings. Windcatchers tend to have one, four, or eight openings. In the city of Yazd, all windcatchers are four- or eight-sided. The construction of a windcatcher depends on the direction of airflow at that specific location: if the wind tends to blow from only one side, it is built with only one downwind opening. This is the style most commonly seen in Meybod, 50 kilometers from Yazd: the windcatchers are short and have a single opening.

Depending on the direction and type of wind, windcatchers are designed in many different types and if there is a small fountain under them, they can create a very cool atmosphere underneath. To keep buildings free of dust and sand blown in from the desert, windcatchers were built facing away from the wind. (Hengameh, 2013) (Fig.7,8,9,10)



**Fig. 7** Wind Catcher Functionality (Source: Archive of Goumbook<sup>3</sup>)

<sup>3</sup> <http://goumbook.com/wind-tower-traditional-zero-energy-cooling-system/>



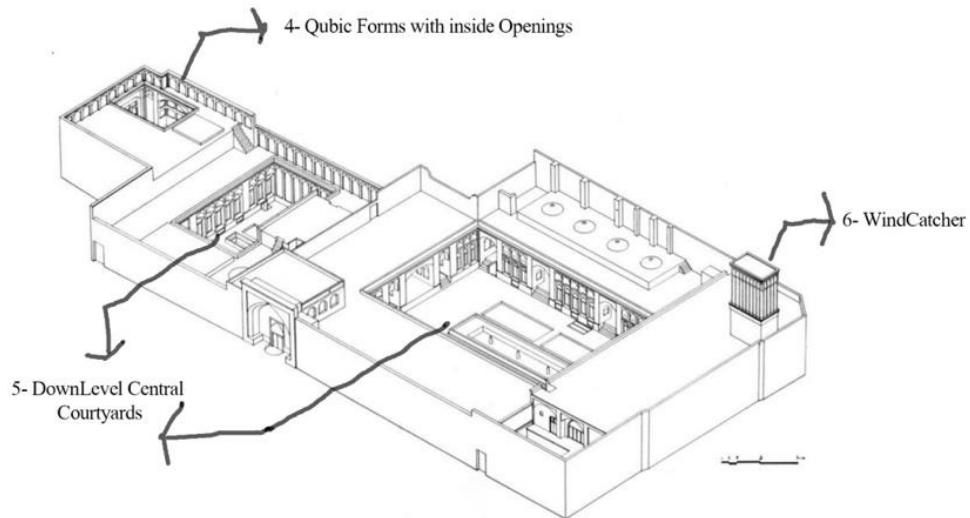
**Fig. 8** Dowlat Abad Garden and Wind Catcher, Yazd, Iran  
(Source: Archive of Chasingtheunexpected<sup>4</sup>)



**Fig. 9** Fountain under Dowlat Abad Wind Catcher, Yazd, Iran  
(Source: Archive of Chasingtheunexpected)

<sup>4</sup> <https://www.chasingtheunexpected.com/beneath-yazd-tallest-wind-catcher-beautiful-dolat-abad-garden/>

So here is a complete example of House featured above:



**Fig. 10** Lari's House in Yazd, Iran (Hassan et al, 2015)

### 3. HOT AND HUMID CLIMATE

A thin line of cities near the Persian Gulf in south of Iran like Bushehr and Bandar Abbas are in this climate. In this Climate we have:

- Low annual rain
- Very High humidity throughout the year
- Very Hot weather in summer and moderate in winter
- Little temperature fluctuation in day and night
- Poor vegetation (Shahryar, 2008)

The most important building characteristics are ordered into:

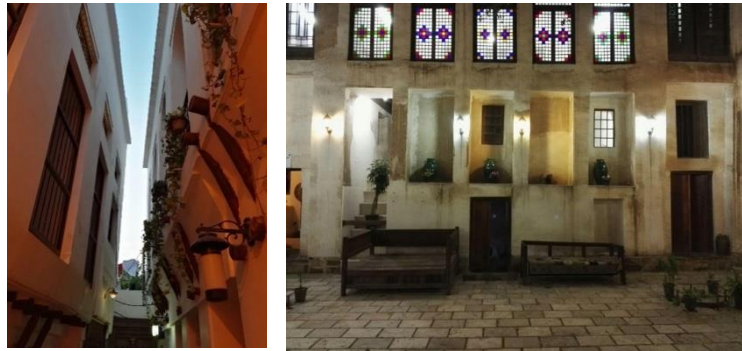
#### **3.1. Semi-Introspective buildings with central courtyards**

They also connect to the outside of the house in reverse to hot climate buildings:

#### **3.2. Very high ceiling and windows**

The height of windows sometimes reaches 4 meters. Hot air would climb up and get out of the room through the windows below the ceiling (Fig. 11).





**Fig. 11** High Windows in a House in Bushehr, Iran (Source: Author's collection)

### **3.3. Wide and high Balcony (Shenashil)**

Balconies are important part of the house, because when it is hot and humid there is better shadow and ventilation there and most of time of residents is spent in Shenashils.

### **3.4. No underground construction**

Because of the sea level they cannot have underground constructions, so the ground level is important for storage of food and the rooms are in first and second level to receive better ventilation.

### **3.5. Flattened ceilings**

No curved or round ceiling is common here. So people can sleep on the roof at nights.

### **3.6. Materials**

Here also people use materials with high capacity of heat and bright colors such as white plaster and brick. Wood is also used for windows (Mohammad, 2015, 10). (Fig.12)



**Fig. 12** Outside of a House in Bushehr, Iran (Source: Author's collection)

#### 4. COLD AND VERY COLD CLIMATE

Cities Located in west of Iran, Mostly around the Zagros Mountains Like Sanandaj, Kermanshah and Tabriz. (Fig.13,14) In this Climate we have:

- Long-lasting cold winters
- Short cool summers
- Downfalls mostly in Snow
- Significant temperature Fluctuation in day and night
- Low Humidity (Majid, 2010)

The most important building characteristics are ordered into:

- Orientation and Compactness in Plans (trying to receive the most winter sun and the least winter wind)
- Least surface/volume ratio (cubic form of Plans)
- Introspective buildings with central yards
- High heat capacity materials (they use stones and wood to build a house and where possible they use clay)
- Low height ceiling
- Flattened roofs (to use snow as an insulation)
- Small openings and gardens (because of the cold weather most of residents' time is spent indoor. They use windows to trap sun in the room and warm it) and
- Thick walls (Mohammad, 2015)



**Fig. 13** Houses in Cold Climate, Palangan, Kurdistan, Iran (Source: Author's collection)



**Fig. 14** Houses in Cold Climate, Palangan, Kurdistan, Iran (Source: Author's collection)

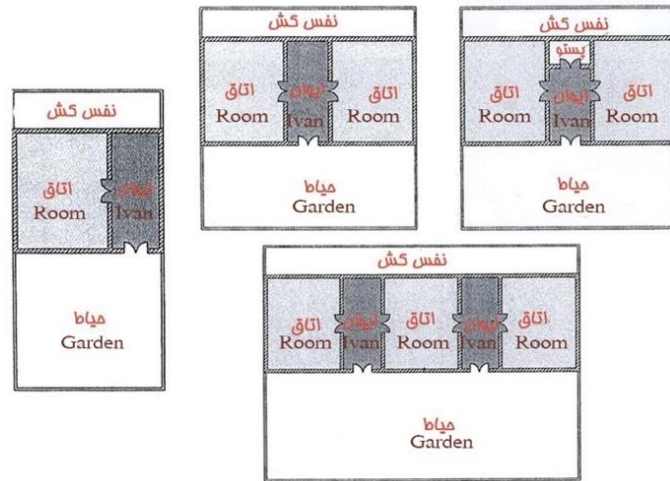
#### 5. MODERATE AND HUMID CLIMATE

A thin line of cities near the Caspian Sea in North of Iran - from east to west - are in this climate. In this area the short distance between Sea and Alborz Mountains caused the weather to be always humid. Cities such as Mazandaran, Golestan and Guilan are in this climate zone. In this Climate we have:

- Warm and Humid Summers and Moderate Winters
- High rain level and Humidity
- Low temperature fluctuation in day and night (Yusuf, 2000)

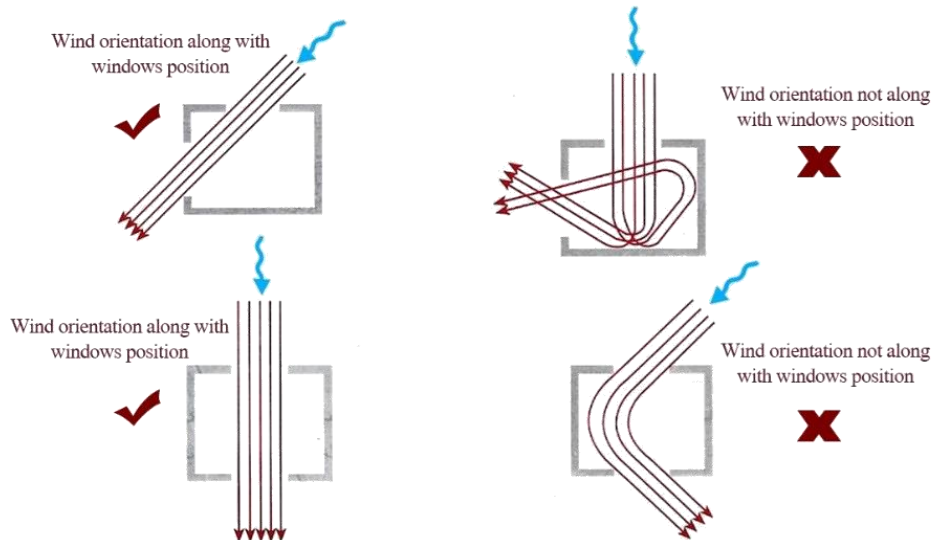
The most important building characteristics are ordered into:

- Orientation (generally east-west stretched House plans)
- Openings (in all sides of the house there are high openings)
- No underground constructions (because of the humid level ground houses are mostly built on a wooden foundation)
- Materials (low heat capacity materials such as wood, cement, stones and rice shoots are used)
- Gable roof (buildings closer to the sea have higher ceiling and sharper Gable roofs)
- Extrovert Houses and Ivans (Ivans are of the most importance. Humidity causes the residents to spend most of their time out of buildings and so Ivans can provide both wind and a shelter to the rain) (Fig.15)



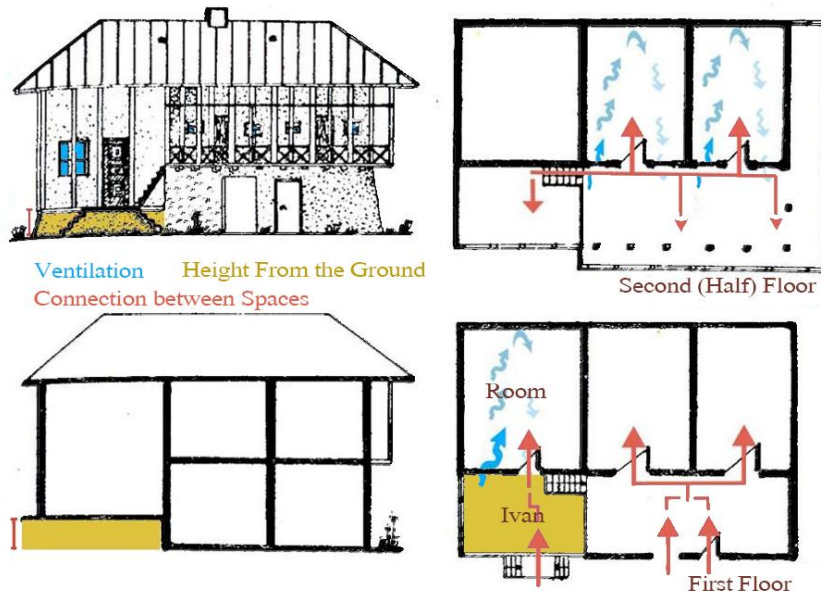
**Fig. 15** Ivan's Significant Role in Northern Houses, Iran (Source: Author's collection)

- Wind ventilation (the most important feature is to provide wind circulation in the house with proper positioning of the windows) (Mohammad, 2015). (Fig.16)



**Fig. 16** Wind Ventilation in Northern Houses, Iran (Source: Author's collection)

So, here is a complete example of House featured above (Fig. 17, 18):



**Fig. 17** A Northern House Functionality (Source: Author's collection)



**Fig. 18** Rafiee's House, Guilan, Iran (Source: Archive of Guilan Rural Heritage Museum<sup>5</sup>)

<sup>5</sup> <http://www.gecomuseum.com/LandingPage.aspx>

## 6. COMPARATIVE ANALYSIS

The following table presents (Tab.1) a comparative analysis of the examples presented in four climate systems in Iran.

**Table 1** Features of Residential Architecture in four main climates of Iran

Climate	Hot And Dry	Hot and Humid	Cold and Very Cold	Moderate and Humid
Annual Rain	Very Low Annual Rain	Low Annual Rain	Mostly Snow	High
Day/Night Temperature fluctuation	Significant Fluctuation	Little Fluctuation	Significant Fluctuation	Little Fluctuation
Humidity	Dry	High Humidity	Low Humidity	High Humidity
Summer/Winter Intensity	Burning Sun Hot Summer Cold Winter	Moderate Sun Hot Summer Moderate Winter	Cool Summer Very Cold Winter	Warm Summer Moderate Winter
Other Features	Sand and Dust Thunders	Poor Vegetation	-	-
Plan orientation	Northeast-Southwest	East-West	Northwest-Southeast	East-West
City Fabric	Cubic Dense Fabric	Intensive and Continuous	Cubic Dense Fabric	Linear stretched Fabric
Material	Clay Mudbrick	White plaster Wood Brick	Stone Wood Clay (if available)	Stone Wood Cement Rice Shoots
Introspective/extrovert Architecture	Introspective	Semi-introspective	Introspective	Extrovert
Other Features	Down-level Courtyards Windcatchers Flattened Roofs	Central Yards Shenashis (Balcony) High Ceiling Thick Walls Flattened Roofs	Low height ceiling Small opening Thick Walls Flattened Roofs	Numerous Openings No Underground Construction Gable roofs

(Source: Author)

## 7. CONCLUSION

In this paper four main different types of climate in Iran have been studied. As shown in the table below, we can see that in the middle of the country dry weather (Cold/Hot) has resulted into introspective houses in Northeast-Southwest Floor Plans with denser city fabric; while by approaching north and south we have more humidity in result of Caspian Sea and Persian Gulf and therefore houses tend to look outward with East-West Floor Plans to receive the best wind and city fabric becomes more spread.

Overall the use of local material is a key element in old Persian Architecture and it is depicted how buildings have been adapted to the nature and people built their houses with complete respect and collaboration with their surroundings, coming up with specific ideas for different climates, feature that we highly lack in today's architecture specially in regards to the recent climate change issues.

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### **KUĆE U IRANU PRILAGOĐENE KLIMI: TOPLA, HLADNA I VLAŽNA KLIMA**

*Pitanje klimatskih promena je izazvalo puno pažnje, posebno u poslednjih deset godina. Savremeni trendovi u arhitekturi i urbanizmu koji su pokušavali da stvore žive mašine slične jedna drugoj u bilo kom kontekstu, sada su se pokazale nedovoljnima. Ukoliko se ne odlučimo da poštujemo prirodu i učinimo da naše zgrade budu u skladu sa svojim kontekstima, ne možemo se baviti daljnjim životnim temama. Ako pogledamo tradicionalnu arhitekturu koja postoji u starim gradovima i ruralnim područjima, možemo videti kako su ljudi uspeli povezati novu građevinu s okolinom. U ovom članku proučavamo različite arhitektonske obrasce koji postoje u starim arhitekturama gradova i sela u Iranu, u zemlji koja može biti dobra studija slučaja zbog svoje bogate raznolikosti prirode, klimatskih zona i arhitektonske pozadine.*

*U Iranu postoje, u pogledu klime, različiti gradovi: topli, suvi, vlažni i veoma hladni. Zavisno od gradske klime, vodosnabdevanja i dovoljne energije, ljudi su pokušali da naprave najbolje kuće za stanovanje. U ovom radu su analizirani neki od karakterističnih primera.*

**Ključne reči:** *Iran, klima, kuća, arhitektura*