# IMPACTS OF CLIMATE ON GENESIS OF VERNACULAR ARCHITECTURE OF DIFFERENT PARTS OF IRAN: CASE STUDY OF COLD AND DRY AZERBAIJAN – IRAN

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## ABSTRACT

*Understanding vernacular way of energy-saving and providing low-impact thermal comfort in the buildings of every region may have significant impacts on developing well-established green strategies for the new architecture for that region. The conducted preliminary desktop research revealed fundamental similarities among architectural approaches of different regions of Iran. The conducted literature review also revealed that much research has been done for exploring different angles of vernacular sustainable methods of architecture in central arid zone of Iran which is often recognised as the representative of the traditional architecture of Iran; as this part already contributes to almost three fourth of the total area of Iran. In other words, notwithstanding distinctive differences, the other creative methods of adopting sustainable architecture in other parts have been neglected by far. This research investigated the innovative methods through which the architects of cold and dry Azerbaijan managed energy use in the vernacular buildings. The study adapted field studies as well as archival research followed by qualitative methods of content analysis. The research discovered the similarities and differences between the vernacular methods of energy saving in this part of Iran and those for the arid central parts of the country. The results revealed that although there are a lot of similarities between these two architectural styles, the traditional architects of Azerbaijan have had various innovative and sustainable methods in construction and structure of the buildings which are exclusive for this region. This research contributes with highlighting particular and significant approaches of the neglected vernacular architecture of Azerbaijan which could be used as a reference for further development and adaptation in designing new buildings in this part of the world.*

***Keywords:*** *Azerbaijan, Iran, energy use in buildings, vernacular architecture, climatic design*

## 1 INTRODUCTION

Notwithstanding the harmonic cultural patters distributed all over the country, Iran could be divided into four geographical zones, the architectural characteristics of which significantly vary from the others, in accordance to the climatic conditions of that particular area (Figure 1). Due to the fact that the majority of Iranian states have hot and dry climate, many researches focused on investigating architectural characteristics of only this area, hence neglecting the unique architecture and urban design of the other zones. For instance, although Kasmaee (2012) and Razjuyan (2009) characterised Iranian architecture in accordance with four climatic zones and presented

some valuable information about the historical characteristics of each part, they suddenly altered the focus by discussing only the features of buildings of arid central parts with respect to sustainable design and vernacular ways of providing thermal comfort. This could be seen in many other similar publications (e.g., Memarian, 1997; Mahmoudi, 2009; Tahbaz and Jalilean, 2010; Soultandost, 2011; Raoofi Rod, 2006; Farrokh Yar, 2007; Farshad, 1997). As such, this study is concerned that the architecture of Iran has only been represented by the architectural characteristics of the desert areas; hence lack of sufficient reference for understanding vernacular patterns of other climates for guiding today's architecture in Iran.

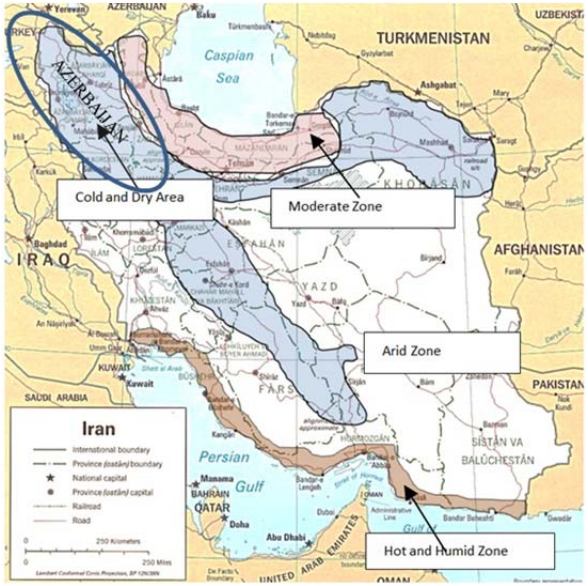



*Figure 1: The four climatic zones of Iran*

Among all neglected states, Azerbaijan is one of the most important states of Iran, being located at the Northwest of the county and sharing the same name with the northern neighboring country, Azerbaijan. Notwithstanding the distinctive architectural characteristics of the buildings of this cold and dry area, there is only little literature published for reflecting the specific ways of how the people of this area adapted their buildings to the harsh environment (e.g., Keynejad and Shirazi, 2010; Kheyri, 2006). This study therefore was motivated by this gap in the literature and aimed to identify the main differences between the architecture characteristics of buildings of Azerbaijan state with those for the central areas of Iran, with respect to climatic design issues.

## 2 RESEARCH APPROACH AND METHODOLOGY

Azerbaijan could be considered as one of the highest geographical places in Iran. The fact that the whole state is bounded by different highlands from all sides, has led to creation of numerous plateaus, e.g. Moghan, Tabriz, Sarab and Maragheh. The highest place of the state, Sahand peak (3722 meters), is only 50 kilometres from Tabriz, whilst Urmia Lake (1220 meters) is also not more than 100 kilometres far from Tabriz city (Shaterian, 2009). Such a geographical position and altitude lead to cold, dry, raining and snowing weather in certain seasons, with a massive difference between the conditions in the cold and hot seasons. In essence, this part of the country significantly differs from the central arid zones in terms of temperature and weather.

This study proposed hat climate could have significant relationship with the vernacular architectural features of every region. This proposition was further supported when observing the historic urban and rural areas in different geographical regions. The conducted preliminary observations suggested that whilst use of green open spaces and soft landscape, aqueducts for managing underground water and avoiding direct solar radiation have been predominant characteristics of the architecture for the arid zones of Iran, tendency for greater use of solar energy, vernacular solutions for thermal insulation of the enclosures, dynamic use of spaces and using smaller spaces in the winter time are the main characteristics of the cold and dry areas. Besides, due to the extreme cold weather in the almost half of the year, urban fabric is too dense and compact in cold and dry areas so that the exposure of the buildings to the outside environment is minimised (Figure 2).

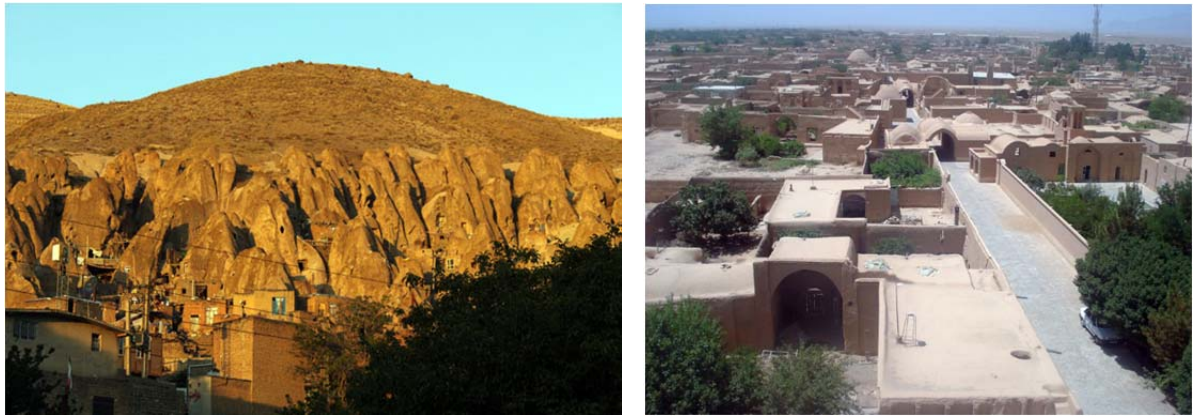


*Figure 2: Very dense and compact tissue of Kandovan as a historic village in cold and dry region (Left) as opposed to the very discrete tissue of Fahradj as a historic village in arid zone (Right)*

In terms of material and styles, the structure of buildings mainly comprise of flat roofs made of timber due to abundance of this material at this part. On the other hand, buildings in the arid zones are disjoined and materials are usually adobe with large arches and domes for providing spaces with larger volume to keep the internal spaces as cool as possible (Figure 3). While in the arid zones, the urban passages are often covered and narrow with high walls for controlling direct solar radiation during the hot days (Ghobadian, 1994), they are non-straight and short in the cold and dry climate for protecting the pedestrians from harsh cold winds.

*Figure 3: Qadaki house in Tabriz (Left) with small central courtyard and flat roofs as opposed to Aameriha house in Kashan with very large central courtyard and arches and domes*

In order to identify the differences between the architectural characteristics of both regions, this study adapted an explanatory historic research method which collected data through field observations, building surveying, and the review of literature. These covered studying five major types of historic buildings (i.e., mosques, caravansaries, houses, bazaars, and school), selected from cold and dry areas of Iran and compared with the similar buildings at to the central arid zones. The analysis was carried on based on matching the types of climatic architectural design patterns with respect to the energy management needs of each area. The analyses were carried on based on comparisons of the different architectural characteristics of the selected buildings in terms of seven main environmental design factors (as per elaborated in Figure 4): Orientation, Floor Heights and Design Proportions, Structure and Construction, Density of Urban and Rural Tissues, Water Use, Green Open Spaces and Soft Landscaping, and the Approach to Solar Energy Use and Shading Elements.

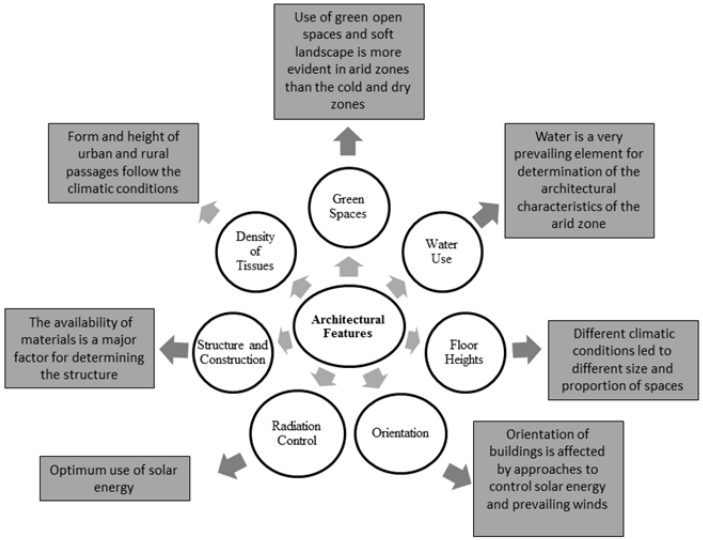



*Figure 4: The investigated seven main environmental design factors*

## 3 Results and discussion

This section reports on the results of the conducted comparison between the vernacular buildings of cold and dry region and arid zones of Iran, in terms of the determined seven criteria: Orientation, Floor Heights and Design Proportions, Structure and Construction, Density of Urban and Rural Tissues, Water Use, Green Open Spaces and Soft Landscaping, and the Approach to Solar Energy Use and Shading Elements for Buildings. Due to report of qualitative data, the discussions are directly associated with the results.

### *3.1 Orientation*

Orientation of buildings (particularly houses) is one of the most influencing factors in determining the characteristics of Iranian architecture and urban structures. The term 'Ron' was the dominant traditional term that Iranian architects used for the orientation of buildings. In terms of classification of building based on their orientation, Iranian vernacular architecture has three de facto Rons: Rasteh Ron, Isfahani Ron and Kermani or Shirazi Ron (Table 1). Pirnia (1995) asserted that vernacularly in Iran, climate (i.e. weather, direction of solar radiation, and prevailing seasonal winds) as well as the ground conditions, topography and slope has significant contribution to the formation of these Rons. Based on their tacit knowledge, traditional Iranian architects were aware of the direction of the prevailing winds and they knew that giving enough credit to this factor could significantly affect environmental comfort. For instance, although plateau of Tabriz which is located among high mountains naturally has various strong winds throughout the year, there are some prevailing winds which strongly affect the direction of houses in this region, e.g. the East wind throughout the year and the North-East wind which is very strong in winters (Department of Housing and Urban Development, 2010). As such, the vernacular houses of Tabriz mainly face South (varying from 15 degree towards East to 10 degree towards West) and all main spaces including Tanaby (reception), study rooms, and lounge are located at this side (Keynejad and Shirazi, 2010). Mosques also are not excluded from this rule and unlike those for the central parts of Iran, majority of mosques in Tabriz have multiple opening and

patios at the Southern side, e.g. Ostad Shagerd and Haj Safar Ali mosques. This Ron order is the only Iranian Ron which coincides with the kiblah direction as the direction for prayer of Muslims; hence the natural orientation of buildings is further supported by the religious beliefs in Azerbaijan area.

*Table 1: Main Rons of Iranian Architecture*

| row | Shaping the overall direction | Features | General direction | | City map | |
|---|---|---|---|---|---|---|
| 1 | Rasteh Ron (Tabriz Ron) | Buildings orientation follows the kiblah direction; this coincides with sunlight direction and is contradictory to the direction of the prevailing winds | Orientation east- south west | North | North ( east-south west) | |
| 2 | Isfahani Ron | Particular for the buildings of the center of Iran and for optimising energy use in the buildings | Orientation north west- south east | North | Isfahan (orientation Northwest – Southeast) | |
| 3 | Kermani or Shirazi Ron | Dominant in the buildings of Southern parts of Iran and meant for avoiding strong wind and solar radiation | Orientation west-east | North | Kerman (orientation West-East) | |

**Ron:** the orientation of buildings in the vernacular architecture of Iran which is measured based on the exposure of rectangle into a hexagonal

### *3.2 Floor heights and design proportions*

Unlike the buildings of the arid zone of Iran which traditionally had very high floor heights covered by domes and arches for helping air movement within the internal spaces, the vernacular buildings in Azerbaijan area had very short the height in order to keep the warm air as preserved as possible (Figure 5). This even applies to very high-end public and commercial buildings such as the historic bazaars (market), mosques and schools. In other words, in the Northwest of Iran (particularly in Azerbaijan state) cold weather and high precipitation in winter time are the most important factors which contributed to the form of the buildings in general. However, it could be said that the height of vault orders was also dependant on the social and economic status of every district. For instance, in Gheisarieh District, Kabud Mosque and Tajeddin Alishah Mosque in Tabriz, Jameh Mosque of Marand, Jameh Mosque of Orumieh the factor of the exposure of the building was more dominant of the environmental factors and these buildings had much higher vault order than the buildings surrounding them. Nevertheless, even in these exceptional cases in which vault heights are intentionally higher than usual practice, looking at how the buildings were used shows that they had some dedicated shorter spaces which were used during the cold times of the year and those high ceiling spaces only served during warmer seasons.

*Figure 5: Bazaar of Tabriz with relatively short vaults (left) as opposed to Vakil bazaar in Shiraz (right) with very high vaults*

### *3.3 Structure and construction*

Notwithstanding very rare cases in which high quality treated timber was used as a structural material (e.g. Hakhamaneshian empire imported cedar tree from Lebanon for covering Takhte Jamshid Place (Persepolis) with flat roofs), there was a common reluctance for using this material in the buildings of the central parts of Iran (Pirnia, 1994). This was basically due to

the hot and dry weather which makes untreated timber very vulnerable against fungus and insects attracts. At the same time, it seems that shortage of wood (and abundance of clay) in this region also did not encourage the business people to establish timber industry there. Therefore, use of adobe and brick for covering spaces by masonry arch and dome became very dominant in the central parts of Iran (Figure 6). This was quite opposite in the Northwest. In these areas, flat roof with timber has always been a suitable material for covering residential buildings. Even in the cases in which the rich owners requested for larger spans than what a normal flat timber roof could offer, use of pitched roofs with timber trusses overtook applications of domes and vaults which were very common in the houses of the central parts of Iran.

*Figure 6: Timber structure of roofs in the Northwest (Left) as opposed to the masonry domes and arches in the central parts of Iran (Right)*

However, the tendency to preserve the Islamic identity for mosques (which was traditionally tied with the shape of dome) as well as the problems associated with humidity in bathhouses and passages of bazaars made these buildings exceptional of this rule. However, in some cities such as Maragheh (Figure 7), Bonab and Ajabshir there are some mosques constructed with timber flat roofs with much elaborated decorations on the timber inside and outside. Later in the Safavid era (1501-1722), the construction patterns of such mosques were developed and adopted for building magnificent palaces like Aali Ghapoo, Kheshte Behesht, Chehel Sotoon (Figure 7), and Hasht Behesht palaces in Isfahan (Kheyri, 2006).

*Figure 7: The timber structure of Molla Rostam Mosque in Maragheh (Left) has been uses as the inspiration for designing Safavid palaces in Isfahan, such as Chehel Sotoon Palace (Right)*

### *3.4 Density of urban and rural tissues*

In Iran, religious beliefs and sharia always have direct impact on the genesis of architecture and urban structures (Nejad Ebrahimi et al. 2013). At the same time, these qualities vernacularly followed the climatic conditions, so that the characteristics of architecture and urban structures of every part of Iran could easily give enough insights into the environmental factors of that area (Soltanzadeh, 2011). Based on the geographic conditions, Tavasoli 2002 classified urban contexts of the whole country into two groups: dense and discrete tissues (Tavasoli, 2002). Dense tissues formed in the central parts of Iran as well as Northwest and discrete tissues formed in some parts of the Southwest and North of Iran. However, looking at the details of each tissue, there are distinctive differences between dense tissues of central parts of Iran and those for the Northwest. In the central parts of Iran, the ratio of the surfaces of the buildings to their volume is much greater than those for the Northwest, so that the resultant density of tissues in the cold climate is much higher than the arid zone (Soltanzadeh, 2011). This is more obvious when looking at the spatial planning of some functional buildings like caravansaries. Whilst caravansaries in all other three climatic zones of Iran are having a large central courtyard for obvious reasons of functional and security issues, they have very compact plan layout in Azerbaijan state in accordance to the harsh environmental factors (Figure 8).

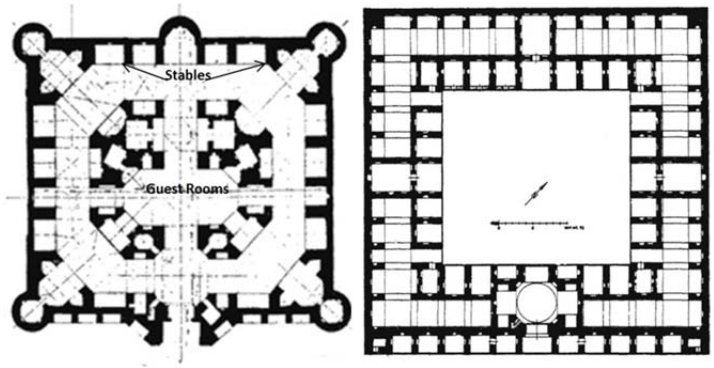



*Figure 8: Compact plan layout of Shebli Caravansary in Azerbaijan as opposed to the typical design of Iranian caravansaries with central courtyard*

At the same time, the urban spaces are much more compact and preserved in the cold and dry zones compared to the arid zone (Ghobadian, 1994). Besides, whilst in the central parts of Iran passages are straight and very narrow (and sometimes covered) with very tall walls for preventing direct solar radiation (Figure 9), in Azerbaijan area exposure to solar energy is seen as a vital factor, so that there is no shading on the passages and they are not as narrow as those for the central parts. The distinctive characteristics of these passages is being not too long and having a multiple axis for conserving the passages from the prevailing winds.

*Figure 9: Sabat or roofed passage in Kashan (Left) and a narrow passage with bracing arches in Yazd which provide sheltered pathway for the pedestrians*

### *3.5 Water use*

Basically, many parts of Iran suffer from shortage of water resources. Therefore, water use has become de facto issue for determining the qualities of architecture and urban structure in Iran. Although people living in mountain area and near the major sees have always caught adequate amount of surface water by building mills and masonry dams and managed it through canals, in the arid areas of the country they hardly managed their resources by building deep wells, Qanats (the traditional watercourses) and engineered reservoirs (Figure 10) for their survival. These methods of water management associated with the technical requirements of these elements formed a very strong identity for the central cities of Iran (Farrokh Yar, 2007).

*Figure 10: The simple structure of the crypt of Kordasht in cold and dry area (Top) as opposed to the complicated water reservoir with wind catchers in Naeen (Bottom) in the central arid zone of Iran*

Presence of water in open and semi-open spaces was also an element to stimulate air velocity and provide natural cooling in the central arid zones. As water resources in macro climate can lead to temperature moderation during days and night, it could also help to decrease temperature fluctuation inside the building, i.e. in micro climates (Ghobadian, 1994). As such, it is always evident in the architecture of the central parts of Iran, using water in the form of long shallow pools with in open spaces (main squares of the cities like Isfahan), semi-open spaces (central courtyards), basements and most of Persian gardens and pavilions (Figure 11). However, in the Northwest, deep small pools were located at the basements for providing daily water use of the households at the same time acting as a heat storage and humidifier (Figure 11); other than that, very small decorative pools made of granite and marble were also used in interior and exterior spaces.

*Figure 11: Pool-house (Hose Khane) in the basement of Qadaki house in cold and dry Tabriz (Left) and the long and the shallow pool in Fin Garden in hot and dry Kashan (Right)*

### *3.6 Green open spaces and soft landscaping*

Green spaces, particularly trees, have always been considered as important elements of Iranian places and planting and maintenance of trees have always recommended as ritual practices in Islam and the previous religions of Iranian people (Pirnia, 1994). This shows how much reliant was living in Iran on existence of vegetation. In the central arid zones of Iran, besides increasing relative humidity, presence of trees at the central courtyards as soft landscape elements has always helped controlling solar radiation and reducing the ambient temperature in hot seasons (Ghobadian, 1994). However, this is completely different in the Northwest where central

courtyard is not anymore a predominant architectural element. Courtyards are some decorative elements in the public buildings of this area and the role of soft landscape is totally for aesthetical issues. Even in some magnificent masterpieces of architecture, e.g. Kabud Mosque in Tabriz (Figure 12) and Jameh Mosque of Marand central courtyard has been totally replaced with a large dome and the sophisticated interior decorations compensated the lack of inspiration of landscape. Nevertheless, very large scale lands dedicated for breeding very tall Tabrizi trees have always been located just next to the cities and villages in Northwest for preserving the rural and urban areas from the harsh and cold winds and, not least, addressing the demands of local construction industry for timber.

*Figure 12: Kabud Mosque (1465) in Tabriz with a huge area (1256 $m^2$) under one dome as a covered central courtyard with very sophisticated decorative mosaic works*

### *3.7 Approach to solar energy use and shading elements*

Looking at the architectural features of the buildings of both arid and cold and dry zones of Iran, one could obviously appreciate how vernacular architects tried to optimise energy use in these buildings. In the buildings of the central parts of Iran, porches are very dominant elements of the buildings protecting the main spaces from direct solar radiation in the summer and acting as thermal buffers for keeping heat inside in the winter. Besides, the floor heights are so high and the spaces are mainly covered by domes and vaults which naturally are self-shading forms (Figure 13).

*Figure 13: Use of domes and self-shading forms in Agha Zadeh House in Abarkooh, Yazd*

*On the other hand, in Azerbaijan state, buildings are as exposed as possible to the solar radiation. Therefore, the roofs are often flat to prevent self-shading effect and the porches of buildings in this area are located at the Northern sides for protecting windows and enclosures of main parts of buildings from harsh climatic factors such as rain, snow, and cold winds (Keynejad and Shirazi, 2010). Therefore, in the schools of this area, unlike the traditional plan with central courtyard, the Southern side is open with no porch attached. Porches at these buildings also protect wooden doors and windows from tiredness due to direct exposure to rain and snow. Use of vestibules at the entrance of buildings, double glazed windows, suspended ceilings in the majority of vernacular buildings of Azerbaijan are the other instances of environmental design at this part of Iran. Table 2 summarises all architectural features discussed in the last seven sections with respect to all four climatic zones of Iran.*

*Table 2: Summary of constructional features of different parts of Iran*

| Climatic Zone | Architectural Features | | | | | | |
|---|---|---|---|---|---|---|---|
| | **Green Spaces** | **Main Water Source** | **Solar energy and radiation** | **Roof's Cover and Form** | **Orientation** | **Heights proportions** | **Tissue mass** |
| • Moderate climate in Southern coast of Caspian sea<br>• Plain areas with high precipitation-high humidity- little gap between the temperature of clod and warm seasons<br>• e.g., Ghorghan, Babol Sar, Ramsar, Rasht, Masooleh, and Lahijan | Plenty of green spaces | Rainwater and numerous rivers | Veranda around three sides of the buildings | Use of timber for constructing pitched roofs | Dominant factors are stack effect and cross ventilation | Low height interiors, but tall buildings due to use of very sloped pitched roofs | Very discrete tissues with detached buildings, narrow streets for reinforcing cross ventilation between buildings |
| • Hot and Humid climate in Northern coast of Persian Gulf<br>• High humidity and very hot and mild temperatures in summer and winter, respectively<br>• e.g., Shoosh, Shooshtar, Chabahar, Bandar Abbas, Gheshm, Booshehr, and Ahvaz | Little green spaces around the building only | Use of cistern for preserving water for household needs | Blocking direct solar radiation on the buildings by the use of porch at the detached sides | Flat timber roofs, with arch and vault in the façades | Facing see for getting the prevailing breeze | High roofed interiors covered by flat roofs with narrow and netted tall windows in the façades | Dense urban tissues and semi-dense rural tissues, semi-enclosed urban spaces with buildings and canyons facing sea |
| • Arid Zones in the central parts of Iran<br>• Very low humidity and precipitation throughout the year Covered by deserts with little vegetation cover and strong winds associated with dust<br>• e.g., Isfahan, Kerman, Yazd, Natanz, Bam, Naein, Ardestan, and Shiraz | Very little green spaces in the protected central courtyards | Development of qanat systems (traditional watercourse) and supply to the local reservoirs | Using porch at buildings and canopies for shading open spaces | Masonry arch and dome covers with use of brick and adobe | East to West orientation in accordance with Shirazi and Isfahani Rons | Very high roofed interiors covered by domes and vaults | Semi-sense urban tissues with enclosed urban spaces and narrow passages, with linked buildings in accordance to direction of sunlight and wind |
| • Cold and dry climate in the Northwest<br>• Extreme cold and warm in winter and summer, respectively- very heavy snow in fall and winter- low humidity in summer- relatively low rainfall<br>• Tabriz, Ardabil, Hamedan, Qazvin, Tehran, Sanandaj, Shahre Kord, Oroomoieh | Good amount of green spaces and soft landscape | Plenty of river, spring and well water guided through watercourse to local reservoirs | Facing the main direction of daylight and using solar energy for heating most important spaces | Flat timber roofs in residential and masonry domes and arches made of brick in public buildings | Northeast to Southwest orientation in accordance with the Rasteh Ron | Low height flat roofs with use of timber as the main structural element | Confined and small urban spaces, compact tissues with non-straight streets |

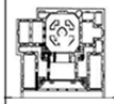
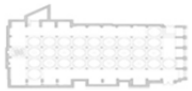
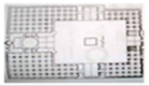
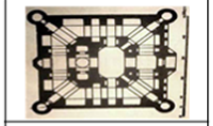
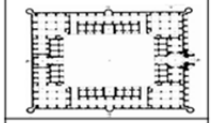
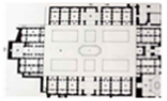
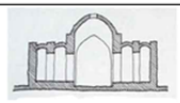
## 4 CONCLUSION

Comparing two different types of architecture evolved at the centre and Northwest of Iran with completely different climates, this paper highlighted the impacts of climate on the genesis of various vernacular architectures. The study relied on seven factors for determining the architectural characteristics of different buildings of each studies part and identified distinctive differences between these two architectures. The findings of research contributes with highlighting particular and significant approaches of the neglected vernacular architecture of Azerbaijan which could be used as a reference for further development and adaptation in designing new buildings in this part of the world. The summary of the aforementioned differences are as follows:

- Climatic issues are the predominant factors which determine the orientation of buildings in both studied zones of Iran. Although, in the central parts of Iran the orientation of buildings is aligned with the East to West axis for having minimum exposure to solar radiation, in the Northwest buildings are oriented from Northeast to Southwest for taking advantage of optimum use of solar energy as well as being protected of the prevailing winds.
- In the vernacular buildings of the central parts of Iran, the floors are very high with dome and vault covers for allowing as much as air circulation within the internal environments. On the other hand, the roofs are often flat and very short to decrease the ration of volume to the area of buildings and preserve the generated heat as much as possible.
- In terms of materials, due to the potential fungus and insects attracts to wood (due to hot and dry weather), there is only little use of timber in construction of buildings in the central parts of Iran, where masonry domes and arches are the dominant methods for covering the spaces. However, flat roofs using timbre are the main structural material are the common constructional elements for covering (particularly) houses in the Northwest.
- Large size central courtyards have become iconic elements for the buildings in the central parts of Iran. They act as a micro climatic element for creating a preserved semi-open space at the centre of buildings. However, these are very rare design element to be seen in the buildings of Northwest since their main function is basically to make shadow on all faces of buildings. Even in some more iconic buildings, such as mosques which have certain spatial planning to follow, this central courtyard has evolved into a large scale space at the centre of the building that is covered by a huge dome, e.g. in Kabud Mosque in Tabriz.
- There are distinctive differences in the ways that people vernacularly managed and preserved water for their survival in both zones. Whilst people in the central parts of Iran applied very complex methods for supplying water to the their buildings, it seems that this was not a big issue for the people living at Northwest managing comparatively adequate resources of water in their living area.
- Whilst green open spaces and soft landscape elements are very essential and functional factors for controlling the micro climates in the central parts of Iran, these are just decorative evolvements of the vernacular architecture in the Northwest and sometimes are totally eliminated from the buildings.
- Porches are shading elements of architecture in the central parts of Iran and are indispensible parts of particularly Southern and Western façades of buildings. However, in the Northwest, they act as thermal buffers and are seldom located at the Southern side of the buildings.

Table 3 presents a summary of all discussed differences.

*Table 3: Summary of the differences between vernacular architecture of central parts of Iran with the architecture of Azerbaijan area*

| Climatic Characteristics of each type of vernacular architecture | Cold and dry climate | | Hot and dry climate | | Type of Building |
|---|---|---|---|---|---|
| | Architectural Features | Plan and sections | Architectural Features | Plan and sections | |
| Ratio of the surface to volume in the buildings of arid zone is much greater than cold and dry areas, therefore tissue density is higher in the cold and dry areas | Because of the cold weather in most seasons, spaces are confine, height of roofs are short and pools in courtyards are small |  Behnam house in Tabriz | Houses have semi-open spaces for using hot seasons, courtyards in these areas are big with large pools |  Navab House in Yazd | Houses |
| In cold areas yards are not in use during most season of the year | The plan of mosques is closed, without yard and with Shabestani form; they has the least number of openings |  Hojatol Eslam mosque in Tabriz | Mosques have a central courtyard with four-iwans plan and have a large dome to the emphasis the direction of kiblah |  Goharshad Mosque in Mashhad | Mosque |
| Because of the cold weather in the cold areas, caravansaries do not have courtyard, then the central part in their plan is covered by dome or arch | Caravansary plans are closed without courtyard and the place for protecting animals is a part of the karvansara in the plan |  Shebli Caravansary in Tabriz | Karvansara's plan is in the form of a central courtyard with cells around it and the place for protecting animals is behind the cells; cells have porch for connection through yard |  Madar shah Carvansara in Isfahan | Caravansaries |
| Schools in the cold areas are designed in a form which has more closed spaces and cells have connection with outside by using filter | Cells had connection with courtyards through corridors and training was carried out within the interior spaces |  Seyed Hamzeh school in Tabriz | Schools had four-iwans or two-iwans plan and cells have connection with yards through the porch and the training was carried out in the semi-open places |  Ibrahim khan school in Kerman | Schools |
| Extreme cold does not allow to create large openings; the height of the domes and vaults are also low; therefore bazars in clod areas seem to be much darker | Height of vaults are low and they only have one openings at the center |  Bazar in cold areas | Height of vaults are high with opening in the center of dome and besides for skylight and air conditioning |  Bazar in arid area | Bazar |

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