FUSION OF CONTEMPORARY ARCHITECTURE WITH HISTORIC PERSIAN ELEMENTS

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Abstract

Iranian architecture has a complex relationship with the internationalist objectives of Modernism. Modernist concepts of universal architectural design, dependent on technologies that control internal environment and formal principles that ignore regional tradition are now understood to be unsatisfactory in the context of architecture particularly where ancient but sophisticated design methodologies are present. Political and social change in Iran in recent years has contributed to a new environment for architecture in which more emphasis is placed on both historical precedent, and climate-responsive building.

This project investigates the relationship of traditional architectural forms to a contemporary building function. It proposes a design for a Climate Research Centre located in the Yazd University campus in a joint project with Canterbury University in New Zealand. The climatic conditions of Yazd are hot arid and have led to specific architectural devices that render the internal conditions of the buildings pleasant without mechanical methods. By utilizing environmental conditions such as wind and solar energies, these methods use particular building materials, shady courtyards, small windows and wind-catchers.

This project studied and used them as primary determinants of the design, which was developed with models and drawings in order to understand the traditional climate control techniques used in Persian architecture and incorporate these elements in designing a contemporary building.

These constraints in theory and building practice are combined to address the question of cultural locality and environmental performance in the proposal to develop an architectural form that functions in the climate of Yazd, serves a 21ST century. purpose, and respects the formal traditions of Persian architecture.
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1.0  INTRODUCTION

1.1  Research Question

How to Integrate the Contemporary Architecture with Historic Persian Elements to Design a Climate Research Centre in the Historic City of Yazd?

This research project firstly investigated the recent history of Persian architecture. Soundly, by studying the architecture of Yazd I develop the context for my research. The new design is of a contemporary Climate Research Centre, at Yazd University in Iran.

1.2  Research Question & Intent

Why design a Climate Research Centre in Yazd?

Sea levels have been rising, primarily as a result of human-induced climate change.\textsuperscript{1} During the 20th century, sea levels rose about 15-20 centimetres (roughly 1.5 to 2.0 mm/year), with the rate at the end of the century greater than that of the early part of the

century. Projections suggest that the rate of sea level rise is likely to increase during the 21st century. From 1993-2008 sea level change monitoring by NASA showed a high increase around the islands of New Zealand. In addition, global warming is resulting in the significant expansion of deserts on our planet. Moderate estimates by the Intergovernmental Panel on Climate Change (IPCC) predict that deserts will expand 10 percent worldwide by the year 2100.

Iran is climatically part of the Afro-Asian belt of deserts. The two major deserts of ‘Lute’ and ‘Dasht e Kavir’ make Iran vulnerable to the phenomenon of desert expansion. The city of Yazd in Iran is the capital of Yazd province and is practically surrounded by the ‘Dasht-e Kavir’ desert. As such it is a good location for monitoring desert climate changes.

Iran and New Zealand, as a result of being two countries in different climates and the consequences of global warming, have recently started collaborating on climate change research. Earlier this year the Centre for Atmospheric Research at the University of Canterbury in New Zealand initiated a joint climate change project with University of Yazd in Iran. A number of joint climate monitoring projects by these universities are currently underway. In line with this, it is proposed for this thesis that the two countries have agreed to build an atmospheric research centre in Yazd.
1.3 Research Objectives & Project Outcomes

There are three key objectives behind this research phase of the project towards the architectural design proposal for a Climate Research Centre in the university campus of the historic city of Yazd in Iran. The research objectives are:

- To analyse and understand the traditional techniques used in Persian architecture, in particular the architecture of Yazd, and to apply them in the context of designing a Climate Research Centre.
- To understand the architectural requirements for hot and arid climates and the environmental issues affecting the design process.
- To understand the local culture and history behind the city, and to incorporate those elements in designing the Climate Research Centre.

Projects Outcomes:

The architectural design phase of the project and the final document set presented relate directly to the following project outcomes.

- Careful analysis of the selected case studies influencing the layout of design process to fulfil the functionality of my proposed Climate Research Centre.
- The research findings and careful analysis of the history of architecture in Yazd and the climatic conditions will contribute to the design process.
- To produce an architectural proposal for a Climate Research Centre in university campus in Yazd, based on the research phase of this project expressed by:
  - A site plan of the proposal
  - Developed floor plans key internal spaces
  - Conceptual models
  - Detailed Section drawings of the proposal.
2.0 CURRENT STATE OF KNOWLEDGE

2.1 20th Century Architectural History of Iran

Iran has gone through many distinct periods due to the country’s geopolitical importance in the world. One of the periods highlighted in Iranian history was the Safavid Dynasty, founded by Shah Ismail (1501-1722). The Safavid dynasty established itself as a major political power and enjoyed its peak during the rule of Shah Abba the Great. The Safavids moved their capital from Tabriz to Qazvin and then to Isfahan. It was during this era that the art in Iran was developed into one of its most aesthetically productive periods\(^5\). It was also during this time that the state became highly centralized, the first attempt at modernizing the military was made and a distinct style of architecture was developed\(^6\).

After the end of the Safavid period, and with the emergence of the Afshar Dynasty and Zand Dynasty, Iran reduced its efforts at developing art and modernisation of the country as it became more involved in wars and the expansion of its territory. After three decades of Zand rule the Qajar dynasty began their reign in 1794. It was not until the Qajar period when Iran started a movement toward modernizing reforms. During this period the kings’ counsellor, Amir Kabir, established Iran’s first modern institution of higher learning known as Dar ul-Funun in 1851. This later became the University of Tehran.

However, the period that can be referred to as crucial in Iranian history is that of the first period of wars between Iran and Imperial Russia during 1804-1813, known as the Russo-Persian war up until the collapse of the system of constitutional monarchy and the start of industrialization in Iran by Reza Shah Kabir. This period is considered to be the foundation of the Iranian’s movement towards modernization. A significant aspect of this was the need for access to the means necessary for improving the defence capabilities of the country, which became evident with the increase in exchanges between Iran and West. As a result, various aspects of modernisation were explored, including sending students abroad, an increase in military and political relations with


foreign governments, and employing skilled workers such as scientists, engineers, political and military advisors.  

Although, it is believed that modernization in Iran began with the nation’s need for western technologies and science in defending the country, the idea of modernization has to be understood in the context of Iran, as modernity in Iran and that in the west are similar only in name, differing greatly in terms of content. In the last two decades the concept “modernity made Iranian” or better known as “Iranian modernity” has been widely used by the intellectuals and social critics around the world in understanding the objective reality of modernity in Iran. Nevertheless, it seems that the basic distinction between “western modernity” and “Iranian modernity” should be the very fact of it being influenced by culture of Iran. What needs to be understood is that modernity in Iran is formed within the social-cultural and political atmosphere of the country.  

Another distinctive characteristic of Iranian modernity is its state of suspension. Iranian modernity has settled within the social and cultural layers of Iranian society, while modernity in the west forms the basis of life and its structures. The state of suspension of this modernity has brought about the grounds for a lack of cohesion between various social categories. The reason for the state of suspension and its penetration into social layers is rooted in the two views represented by the traditionalists and the modernists. The traditionalists, whether voluntarily or forced by inevitability, have tried for years for years to close the gap between modernity and tradition, creating a new concept where modernity has been introduced next to tradition, but never transformed into a mature modernity since its origins and sources were foreign to Iranian society. On the other hand, social traditions have not been able to preserve the links either. These have weakened with the slightest tremors within the society.  

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The Iranian modernists also fail to establish a clear understanding of modernity. Instead of considering the elements that formed modernity, many Iranian intellectuals took only the principles and ingredients of modernist thinking from the west without much reflection, and constructed them into a form of belief by idolizing them. In Iran idolization is one of the main characteristics of modern thinking, as well as that of its opposite: traditionalism. The issue in hand is not who and what group has instigated Idolization in contemporary Iran. It is rather that having been primarily ideological, the advances of modernity in Iran could not find support without idolization. Therefore, these intellectuals took only the ingredients of modernist thinking from the west without much consideration of the socio-cultural environments of the country and looked upon it almost as certainty for the future.

These intellectuals, who were mainly supported by the government, initially opted for what was favoured via a propagandist and ideological approach and later idolized it and then proceeded with its spread. However, they also had relatively little success when evaluated against the actualities, acting more in imposing ideology in the guise of culture. As a result, by blindly following the ideology of modernity these intellectuals and their actions led to both the destruction of new thinking and modernization, as well as damage in the sphere of culture. For example, the efforts of the cultural advocates of the ideology of the monarchy of the Pahlavi period in the spheres of history, literature, art and poetry, which were directed at reinterpreting the history of Iran with emphasis on the factors of nationalism and monachism, the slogan of eliminating Arab influence on the Persian language, and the elimination of various cultural factors from the history of Iran. This approach was taken up once again after the Islamic Revolution, this time also by the defenders of traditional culture. Aspects that had been added were removed, and many other things were cast aside for instance the improvements made to women’s rights, while new elements that were rather unfamiliar were introduced into Iranian history.

In addition, another constructing element behind Iranian modernity is the principal of progress. The idea behind progress was introduced into the Iranian way of life mainly through the increase of collaborative work between Iran and the West and the exchange of knowledge and technology between travellers and
intellectuals in the early stages of the introduction of modernism in Iran. However, the desire for such progress has continuously alternated between the westernization of Iranian thought or thinking and the Iranianization of western thought or thinking.

In the early stages of modernisation during the early 20th century the Iranian intellectuals preferred to modernize and westernize Iranian thinking and way of life. Yet, in more recent times (especially with the start of the war between Iran and Iraq 1980-1988) due to the decline of political relations between Iran and the West the intellectuals in Iran have had a more limited understanding of western civilization therefore they were forced to Iranianize western thought or thinking.10

The adoption of modernity in Iran could be categorized into three historical phases;

1. Westernization of Iranian thought, from the beginning of the ruling of Reza Shah from December 15, 1925 until he was forced to abdicate by the Anglo-Soviet invasion of Iran in September 16, 1941. For many Iranian nationalists Reza Shah is considered the father of modern Iran.11

2. Iranian Phase of Western thinking from the fall of Reza Shah to the end of the Pahlavi ruling by Mohammad-Reza Shah Pahlavi who was overthrown by the Islamic revolution in February 11, 1979.

3. The phase between tradition and modernity, or tradition as viewed from the point of view of modernity. From the beginning of the Islamic revolution to date.

What is significant for this thesis in relation to these historical changes is the direct correlation between architecture and political and social developments of Iran. In other words, social developments in Iran during these periods have directly influenced the developments in architecture and the formation of the generation of trained architects, as well as the development of their thinking and works. These architects and their way of thought was influenced by their era can be classified into three major groups:


First Generation of Iranian Architects

The first generation of the Iranian architects appeared with the beginning of modernization in Iran during the reign of Reza Shah Pahlavi. Before this generation of architects most buildings were designed and built by traditional builders on the basis of Qajar architectural heritage and techniques. Therefore, the primary challenge for these architects was to transform the traditional discipline of construction into a modern method of architecture. This period of history in Iran can be referred to as the beginning of Iran’s contemporary architectural production. This generation of contemporary architects in Iran had a tendency towards the modernist architecture of Europe and the spread of such designs during the first and second period of Pahlavi rule. As a result, the roots of contemporary architecture in Iran can be related to the works and ideas of these architects. Among these prominent figures in Iran modern architecture are people such as Karim Taherzadeh (Behzad) who was educated in the university of Fine Arts in Istanbul and later in Berlin Academy of Architecture, Vartan Hovhanessian who completed his art degree in Paris and later became a professor teaching urbanization in Paris university before returning to Iran after 17 years in 1935 to participate in a design competition of woman’s collage, in which he won. Mohsen Forughi is a renowned architect who completed his studies in France and is best known for his design of Niavarān Palace Complex, the primary residence of the last Shah, Mohammad Reza Pahlavi, and the Imperial family until the Iranian Revolution.¹²

Second Generation of Iranian Architects

The group consisting of the leading figures of the second generation of Iranian architects can be explained within the framework of a cultural triangle: the influence of western culture and civilization; Iran’s cultural heritage (including the prominent role of pre-Islam architecture); and the emergence of architects from amongst those two. The significance of the first aspect lies in the fact that the philosophical, scientific, economic and military potentials of the West have had a decisive impact on the mode of living as well as thinking in Iran. The second aspect is important in

that it forms the main source of the cultural and intellectual identity of Iranians. The third aspect is that, architects as creators and narrators of culture have played an important role in relating western culture to the cultural heritage of Iran.

With the growing increase of the modernist influence in the culture and architecture of Iran during the reign of Pahlavi, during 1960 and the 1970 a group of architects, including Jalal Al-e Ahmad, Ahmad Fardid, Ehsan Naraghi, Fakhreddin Shadman, and Daryush Shategan expressed concerns about the loss of the Iranian cultural and architectural heritage and, consequently, developed a movement towards finding an architecture of Iran. However, what was formed during this period was a mutilated modern architecture with tendency towards vernacularism. This tendency towards vernacularism and historicism became of great importance in the works of these architects, influencing them to once again introduce traditions, beliefs and native cultural values in their work.

In the second phase of Pahlavi’s reign and with the development of a strong sense of nationalism, the second generation of Iranian architects used vernacularism and historicism to revive the ethnic identity of architecture in Iran as a form of resistance against the West. However, it should be noted that such resistance did not come about as a result of theoretical propositions of post-modern thinkers, such as Charles Jencks and Robert Venturi, but actually as a result of the project and built works of James Stirling, Louis Kahn, Alvar Aalto and the ideas presented by Hassan Fatahi in his book “The Architecture for the Poor”.

By examining the works and projects carried out during this period of history in Iran, one can form an understanding of the process towards formation of the architecture of the second phase. The architects of this period instigated a strong movement towards ‘architecture for Iran’, which created an identity in the international arena. Subsequently, from among these, only the works and ideas of a few are referred to, for example Hoseyn Amanat an Iranian-Canadian Architect graduated from the University of Tehran has designed monumental buildings such as:
- Azadi Tower (Tower of Freedom) previously known as Shahyad Tower
- Initial building for Sharif University of Technology in Tehran
- Three buildings in Bahá’í Arc in Haifa Israel known as The Universal House of Justice
- Centre for the Study of the Sacred Texts
- Seat of the International Teaching Centre
- Bahá’í house of worship in Samoa

Kamran Tabatabayi Diba studied architecture at Howard University, Washington, DC, graduating in 1964. Upon his return to Iran he designed The Jondi Shapour University (1968-76) at Ahvaz, and what is perhaps his best-known work, the Museum of Contemporary Art (1976), Tehran, which is lit by half-vaults in the roof reminiscent of the traditional wind catchers of the Middle East.

Nader Ardalan graduated from the Carnegie Institute of Technology, and Harvard University where he received a Masters in Architecture degree in 1962. Having spent many years in America, there was a deep-rooted need to know his origins. “Little did I know that this quest for origins would lead me ‘deeper’ than I
had ever expected” 13 Nader observes. In 1964, he accepted the position of “Architect of the Fields” from the National Iranian Oil Company and moved from San Francisco to Masjid-i-Sulaiman, in Southwest Iran. After two years he moved to Tehran, where as a design partner of Abdul Aziz Farmanfarmaian, he directed the design of Iran’s first high-rise residential apartments, the Asian Games Sports Centre and the Iran Centre.

After the fall of the Pahlavi dynasty and with the formation of the Islamic revolution, a new era in Iran’s history began. The architects of the post-revolution phase formed an artistic tendency pushing Iranian architecture towards an independent identity, and in most cases towards an indigenous cultural and architectural heritage. Yet, it is important to note that the main influence of architecture during the two decades following the revolution came only from the works of the architects of the later phase of the second generation belonging to before the revolution. No other tendency (at least in relation to government commissioned projects of national stature) has been of any significance. The works and ideas of these architects combined the influences of Classic Post-Modern, as well as Iranian historic architecture mainly of the Islamic periods, to bring about an identity which had official government backing.

The three most dominant forms amongst post revolution architecture design are firstly, the tendency towards modern architecture and its combination with Iranian architecture. This form of practice was commonly used by the architects of the later phase of second generation and the early post revolution architects. Secondly, the tendency towards Neo-Modernist architecture, mainly practiced by leading architects of the third generation. Lastly, the tendency towards computer-aided architecture, which is generally used at the level of architectural competitions and student projects at schools.

The primary concern of the leaders of the second generation of Iranian architects, and those of the later phase of this generation and their successors, was how to blend tradition with the ideas and developments of Modern Architecture. The work of the

architects of the later phase of the second generation is more concerned with this matter than the architects of the first phase, due to the strong backing of government officials of the Islamic Republic. However, the influence of technological developments and the computer-based approach cannot be neglected in the design process of these architects. Advancements in technology can be the reason which brings the works of the later phase of the second generation of architects closer to those of the generation after, the leaders of the third generation.

Amongst the most prominent figures of the later phase of the second generation of Iranian architects are names such as Farhad Ahmadi, who completed his education at Beheshti University in Tehran and is best known for his design of the Iran consulate in Seoul.

Bahram Shirdel an Iranian Architect famous for his FOLDING method in Architectural Design. Bahram studied at university of Toronto and then at Cranbrook Academy of Art directed by Daniel Libeskind from 1979 to 1982. Amongst his best known buildings in Iran is the Italian Embassy in Iran.
Iraj Kalantari Taleqani is a renowned contemporary Iranian architect, famous for his contribution to the modernization of Iranian architecture. He was born in 1938 in Tehran, Iran. In 1964 he graduated with an MA in Architecture from the Faculty of Fine Arts in University of Tehran. Among his famous works are the Iranian Embassy and the Ambassador's Residence in Tbilisi, Georgia, Meigun Tourist Complex north of Tehran, Iran, and Sepid Kenar Hotel near the port city of Anzali, Iran.  

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Third Generation of Iranian Architects

The third generation of Iranian architects consisting of young architects of today and the students of architecture at universities in Iran are associated with the formation of the Neo-Modern movement. The term Neo-Modern is used here to refer to those aspects of their work that deal with the development and currents after modernism. Due to the strong cultural and nationalistic values of Iranian people, although the third generation of the Iranian architects have a tendency towards western architecture, they too try to constantly escape the dominance of Modern Architecture by labelling their work as Neo-Modern.

The advancement of technology in the field of architecture and the increase of its influence amongst the third generation of Iranian architects plays a major role in the design and thought process of these architects to the extent that a major part of the works of young architects who graduate from the universities in Iran can be seen as copying the architecture of those western architects who have a reputation in this area. With the increase of student exchanges, expansion of internet usage within Iran and the advancement of technology in the country this generation of Iranians is familiar with western cultural values and technologies. Therefore, this generation have created a better understanding of modernity in all aspects of society.15

However, with the growing trend in nationalist values due to international sanctions and the sense of self-sufficiency produced this generation also attaches a great value to the historical and traditional values of Iran. Having such conflicting views, the idea of modernity within societies is still far from being understood and the ideas presented as modernist can be seen as unacceptable by many within society. In addition, the increase in cultural gaps between social layers of society has forced many intellectuals to create new concepts of modernism to attempt to become relevant to society. Therefore, the architects of this generation, too, have had difficulty in combining the modern ideas with tradition and their work has not yet stood the test of time. At least two decades will be needed to be able to form a relatively clear idea of the works and thinking of this generation.

2.2 Introduction to Iran

The relative location of Iran is in the northern hemisphere positioned in the Middle East, a geographical region of south-west Asia. The country is bordered by the Republic of Azerbaijan and Armenia in the northwest; Turkmenistan in the northeast; Turkey and Iraq on the west and Afghanistan and Pakistan on the east. Iran’s southern limits are the coasts of the Persian Gulf and the Sea of Oman. In the north Iran has a shorter coastline on the Caspian Sea.\(^{16}\) Iran is a very rugged country of plateau and mountains, dominated by the Elburz Mountains in the north, and the Zagros mountains along its western borders. The central and eastern portion consists of the plateau of Iran. the existence of the two deserts of Kavir-e-Lute and Kavir-e-Namak (Dasht-e-Kavir) of the Iranian plateau, as well as scanty rainfall has resulted in the central part of the country to becoming semi-dry and dry arid with hot summers and cold winters.\(^{17}\)

\(^{16}\) Tehran: Past& present , H.R.Norouzi Talab p.10.
\(^{17}\) Encyclopedia of deserts, Michael A.Mares p.302.
2.3 Yazd, an Outline of the Geography and History

The Climatic conditions of Yazd have made it necessary to adopt a particular architectural style and urban pattern. Being located beside the central mountains and far from the Caspian Sea and the Persian Gulf, the city has a climate which mostly resembles dry and semi-dry desert. The city of Yazd is an important example of Iranian urban history, the urban fabric, being well adapted to the region’s hot and dry climate. It is the fourth largest province in Iran; Yazd city is the capital of Yazd province, which borders Southern Khorasan, Isfahan, Fars and Kerman provinces.¹⁸

Historically, Yazd, with a large number of monuments and sites, possesses a rich heritage of ancient culture and civilisation during the various historical periods of Iran. The individuality of Yazd was largely enriched by the city’s sustainability, urban planning and architecture. Most historic areas of Yazd contain traditional structures, such as historic residential, commercial and public buildings, or religious monuments contrasting with narrow covered alleys. Among the important architectural and urban

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features of Yazd there are a large number of *badgirs* (wind catchers), *Ab anbar* (water storage) and *qanats* (underground water tunnels). The existence of these mud-brick ventilation structures, is a distinctive architectural feature of Yazd. As an ancient Iranian system of irrigation; the qanats are also among the outstanding infrastructural feature in which an efficient clean energy system has been used for centuries.

**Human Geography**

The province of Yazd, has become one of the most highly urbanized states in Iran. According to the 2008 census, Yazd has a population of 983,052, of which 785,213 are resident in the urban areas and 197,839 occupy the rural areas. Yazd province is divided into 10 districts, each including at least one town and a number of villages. These districts are: Abarkuh, Ardakan, Bafq, Khatam, Maybod, Mehriz, Tabas, Sadough, Taft and Yazd. The city of Yazd is the economic and administrative capital of the province and therefore the most heavily populated. The majority of people living in Yazd are of Iranian origin, and Aryan race. Due to Yazd’s geographical position and its historical background, the people of Yazd mingled less with non-Iranian races. As a result the culture of this province has been less influenced by other cultures. The city of Yazd was an important Zoroastrian religious centre during the Sassanian dynasty (226 - 642 C.E.) and has remained a stronghold of Zoroastrianism up to the present, although adherents of this faith comprise less than 10 percent of the city's population. In the early 2000s, about one-half of all Zoroastrians in Iran lived in Yazd.

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20 Yazd cultural heritage a paradise in kavir, a tourist guide to Yazd province, p.13.
Climatic Conditions

The climate condition of Yazd is hot and arid, with low humidity and very low rain fall. The average annual rainfall is 60mm and the high rate of evaporation is makes Yazd Province one of the driest provinces of Iran. The temperature variation is in between +45 to -20 °C, with the average being 11.9 ° up to 20.7 °C. The maximum temperature in the hottest months of the year, in the north and northeastern areas of the province is about 50 ° Celsius which is really intolerable. In the coldest month of the year, the temperature in the western areas, particularly at the foot of the Barfkhaneh and Shirkoooh peaks mountains falls down to about -20°Celsius.24

The diagram below shows the path of the sun in Yazd.25

Figure 14 Sun path Diagram in Yazd.

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Historical Background

With over 3,000 years of history, and possessing a heritage of ancient culture and civilization from during different ages, Yazd is one of the most ancient lands in Iran. According to historians, Yazd city was founded by Alexander, when he constructed a prison and named it such, and in other historians' opinion a city was founded with the name of “Yazdangerd” by command of Yazdgerd I (339-421AD) in the Sassanid era. The word "Yazd" means “clean and sacred” and "Yazdgerd" means “divine”. The city of Yazd signifies 'God's City and Holy Land', the name of Yazd which has been derived from it means sacred, auspicious and creditable”. Greek historians named the ancient city “Isatis,” which was probably over the ruins of the ancient city of “Katteh.” After the appearance of Islam in Persia Yazd was given the title “Darol’ebadeh.” In the Achaemenid era, this area always enjoyed valuable maintenance institutes, post offices and pony expresses.

In the old Yazd, maintenance had such importance that the Al-e Mozaffar dynasty attained. Over the centuries, many small and big villages have been founded and have disappeared. What has remained secure from destructive events, is expressive memories of this land's historical destiny and is an indicator of a fruitful culture and civilization.

Muslims constitute the majority of the population, while Zoroastrians and Jews are one of the minorities who have been residing in the province since ancient times. The language in the province is Persian with a distinctive accent.

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2.4 The Urban Structure of Yazd

The city of Yazd enjoys a long history dating back to the time of the Median Empire, an ancient settlement of Iran. In the course of history due to its distance from important capitals and its harsh natural surroundings, Yazd remained immune to major military movements and destruction from wars, keeping many of its traditions, city forms and architecture. The urban and architectural features in Yazd indicate a life style in which the adaptation to the specific climate situation has been an initial principle of architectural and urban planning.

In ancient times the architects were obliged to rely on natural energies to render the inside condition of the buildings pleasant. Furthermore, the urban morphology in hot-arid regions is the cause of a condensed and concentrated urban texture in which the main arteries are face the wind.

The urban form of the traditional city of Yazd is highly centralized and inward looking. The urban texture is condensed and compressed. Certainly, the orientation and relation to the environment has been of high importance in the planning of the city. The particular climatic problems caused the people of the hot, arid zone to find solutions through their architecture. The buildings are usually around a courtyard. The built spaces around this space have been designed to maximize its passive potential to warm the building in winter when sun angles have maximum penetration into the rooms. There is, sometimes, a distinction between rooms occupied in summer and those occupied in

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28 Tavassoli, Mahmood (2002) Urban Structure and Architecture in the Hot Arid zone of Iran, Payam Publications (Published in Farsi)
29 Ghobadian, Vahid (1998) Climatic Survey of Traditional buildings of Iran, Tehran University Press (Published in Farsi)
winter. The summer rooms face north away from the sun and the winter rooms face south and have glass doors that allow the low winter sun to penetrate. The high radiation and temperature in the summer, diurnal variation of temperature, seasonal variations from dry, hot summer to cold, dry winter, low humidity, limited water supplies and the dusty winds are the most important factors in forming the urban structure of Yazd.

Visually, the unity of the city fabric is reinforced by the use of locally found clay and mud brick as the main building material reducing the heat absorption and reflecting the sunlight. This city with its domes and vaults of mud and baked brick has been formed on different levels: street, court, balcony, and roof. The roof is a surface, as active as any on the ground.

The tenuous relationship of levels animates the fabric of the city, just as the roofscape animates the horizon with its domes, balustrades, wind towers, and steps. In this “compact city”, high-density urban structures of mixed land use promote walking and cycling as the main modes of movement for short journeys. While on an urban scale, the street appears as if it is carved out of a mass. In reality the wall defining it is a thin membrane.

The concentrated urban texture diminishes the penetration of the dusty wind and reduces the heat influence on building surfaces, Covered passageways and narrow alleys with long walls of clay make for shade and thermal comfort conditions in the hot summers. In addition, their direction is a way of avoiding hot summer sun and stormy winds. The organic network of ways has
been made according to ground slope and the underground water canals.

The skyline is dominated by fantastic mud brick towers, giving the city an incredible urban aesthetic. These wind catchers provide a historic example of the fundamental interconnectedness that exists between technical, social, economic and political decisions.30

Wind catchers serve three fundamental functions: to ventilate basements, to provide convective cooling and to cool the interior mass of the building.31 These wind catchers became a part of the identity of this city in coping with natural forces.

2.5 Sustainable Water Utilization in Arid Region of Iran by Qanats

To make use of the limited amount of water in this arid region, the Iranians developed man-made underground water channels called qanats. Qanat is a water management system used to provide a reliable supply of water to human settlements or for irrigation in hot arid and semi arid climates.32 The tunnels, many of which are kilometres in length, were designed to provide gravitational flow. The tunnels allowed water to drain out to surface by gravity to supplying water to the lower and flatter agricultural land.33 Qanats are an ancient, sustainable system facilitating the harvesting of water over centuries in Iran, and more than 35 additional countries of the world such as India, Arabia, Egypt, North Africa, Spain and even the new world.34 Qanats are one of the outstanding infrastructural features of Yazd city.

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There are about 22,000 qanats in Iran with 274,000 kilometres\textsuperscript{35} of underground conduits, all built by manual labour. The amount of water the usable qanats of Iran produce is 750 to 1000 cubic meters per second.\textsuperscript{36} The largest chain of qanats are situated in the Gonabad region in Khorasan province.\textsuperscript{37} The great advantages of qanats are: no evaporation during transit, little seepage, no rising of the water-table and no pollution in the area surrounding the conduits. The rate of flow in a qanat is controlled by the level of the underground water table. It exploits groundwater as a renewable resource\textsuperscript{38}. Thus, qanats are environmentally sustainable water harvesting and convincing techniques which do not cause damage to the tapped aquifer in the arid regions of Iran.

\begin{itemize}
\item \textsuperscript{35} Proceedings, American philosophical society (Vol.112, no.3,1968) pg 170.
\item \textsuperscript{36} Proceedings, American philosophical society (Vol.112, no.3,1968) pg 171.
\item \textsuperscript{38} Semsar, Y. A. and Tafti, M., An analysis of the actual situation of qanats of Yazd city. Proc. of Int. Conf. in qanats, Iran ,pp 78 96,2000.
\end{itemize}
Geographical Distribution of Qanats in Iran

Due to the shortage of water in the central provinces of Iran, there are thousands of water wells connected together by qanats. At present although the qanats have been replaced by modern deep wells, the agricultural lands of many Iranian cities in the central part of Iran such as Yazd, Semnan, Khorasan, Kerman, West Azarbajjan, Kashan, Shiraz and Isfahan still benefit from qanats. Yazd relies extensively on qanat water, due to its average annual rainfall of 60 mm and lack of permanent rivers. Consumption of underground water delivered by the qanats has been the only method for centuries. Yazd Province is proud that it still has numerous running qanats, particularly the mountainous ones. According to the census in 2001, there are 3,091 qanats with an annual discharge of 339 million m³ in Yazd. According to the total discharge of the underground water of the province, 1,403 million m³, some 24% comes from qanats, the rest being supplied by deep and semi deep wells and springs.

Diagram of a Typical Qanat

Figure 18 Diagram of a typical qanat, profile, cross sections and aerial view illustrating the varying dimensions of a tunnel- well. (Proceedings, American philosophical Society (Vol.112, no.3,1968) pg 171)

Boustani, F., Role of water in ancient civilization in Iran. Proc. of Int. Conf. on water culture and water environment protection, China, pp.69-72, 2005.


Qanats, used in conjunction with a wind catcher, can provide cooling as well as water supply. A wind catcher is a chimney-like structure positioned above the building to catch the prevailing wind. The tower drives a hot, dry breeze into the building; the flow of the incoming air is then directed across the vertical shaft above the qanat. The air flow across the vertical shaft opening draws cool air up from the qanat tunnel, mixing with it. The air from the qanat is drawn into the tunnel and is cooled, both by contact with the cool tunnel walls and the water. In dry, desert climates this can result in a greater than 15°C reduction in the air temperature coming from the qanat; the mixed air still feels dry, so the basement is cool and only comfortably moist (not damp). Wind tower and qanat cooling have been used in desert climates for over 1000 years.

Figure 19 A blue lines show the four main qanats of Yazd. The city wall of Yazd and the oldest quarters of the city are highlighted in brown.

(Author and Yazd Zonal Water Organisation)

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44 Boustani, F., Role of water in ancient civilization in Iran. Proc. of Int. Conf. on water culture and water environment protection, China, pp.69 72, 2005.
2.6 Water Reservoirs called (Ab Anbars)

The water reservoir is at a depth of 10 to 20 m under the ground and is covered by a dome-like roof and equipped with several ducts. The water is collected from qanats and is kept cool in the reservoir on the warm summer days. In the design of water reservoirs the architect benefits from the change of seasonal temperatures in desert regions and the isolated nature of the ground. During the winter water is accumulated in the reservoir and in summer the dome-like roof of the water reservoir and the upper layer of the water grow warm. Therefore, the upper layer of water evaporates and exits from the reservoir with the air flowing in the air trap. Naturally, in order to prevent dust and insects from penetrating the reservoirs the reservoirs are not equipped with ventilators. Since the water is stagnant in the reservoir, it is not suitable for drinking purposes.\(^{45}\)

the most difficult part of the operation, because to cover openings
of 15 to 16 m width requires experience. This was done by
resorting to elliptical arches; meanwhile, by digging a well, the
polluted water was extracted from the reservoir and led into a dry
qanat.46
The natural and climatic characteristics, in addition to the expanse
of Yazd’s deserts have given rise to the construction of various
reservoirs all over the province. At present there are about one
hundred of these reservoirs.47 Water reservoirs consist of four key
elements: Tank: a cylindrical water hole is dug into ground.
Dome: a semi-circular shape ceiling constructed over the reservoir
in order to prevent environmental pollution and keep the water
cool. Landing: a stair corridor or passageway constructed to allow
access to the water. Wind catcher: a multi sided cylindrical
structure, built to let the air circulate through the water reservoir
keeping the water drinkable.48

2.7 Traditional Badgir (Wind Catchers)

The wind catcher has been used in Iran since early times. It is one of the masterpieces of Iran’s architecture and it is also a sign of our predecessor’s intelligence in working with the climate. Wind catchers serve as a cooling system, used to provide acceptable ventilation by means of the renewable energy of the wind. We can consider it a most specific example of clean energy. The majority of wind catchers are in Iran; these wind catchers are made in two areas: the hot and humid area in the south, such as Lenghe Port, and the hot and dry area of the central plateau such as Yazd. The wind catchers play an effective role in modifying heat and adjusting the temperature of internal spaces as it uses the convection created by a wind flow. The ventilation structure called Badgirs are good examples of an efficient, clean energy system and make not only the traditional environments of the city cool especially during hot summers, but they also provide ventilation, to refreshing the air surrounding the buildings.

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49 Poor, J. and M. Reza, Design criteria for development of settlements in arid coastal region of Iran (case of study of Bandar Lenghe.
Definition of Wind Catchers

In Iranian architecture a wind catcher is a combination of inlet and outlet openings. The wind catcher is divided into several vertical air passages by internal partitions or shafts. The shafts on top terminate in an opening on the sides of the tower head. The flow inside the wind catcher is in two directions, up and down. When the wind blows from one direction the windward opening will be the inlets and the leeward opening will be the outlet. The city of Yazd has the greatest number of wind catchers and is known as wind catcher city.\(^{51}\)

Orientation and Function of the Wind Catcher

The orientation of the wind catcher generally means that the wind catcher flanks are based on the four main geographical directions. It is determined in view of function, use of wind power and the direction from which the wind blows. The desired winds in Yazd blow from the north-west. The long sides of wind towers are, therefore, oriented towards the north-west for maximum usage of the wind to provide cooling for buildings. Wind catchers are, nevertheless, built with a four directional orientation in order to use all desirable winds from north to south and from east to west.

How to Perform and Some Points in Wind Catchers Designing

A wind catcher is a device with significant form and constant structure in Iran architecture. It leads a suitable wind through the inner part of the building and it is a most effective

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device in making comfort. There are two kinds of functions for wind-catchers:

Traction of the opening facing the wind and suction of the openings away from the wind.

The way a wind-catcher works is based on taking the fresh air into the building and sending the hot and polluted air out. When the wind hits against the walls of internal blades of the wind-catcher it falls down, the other holes of the wind catcher opposing the wind direction, take the hot and polluted air away.\(^{52}\)

The function of the wind-catcher is that on the windward side the air is thick, so in this direction there is a positive pressure, but a negative pressure on the other side. In the wind catchers, according to this principal, the opening facing the wind takes the air into the room at the base and the air in the room, with its negative pressure on the opening opposing the wind is drawn out. The function according to temperature difference.

But it seems that there is a little attention given to the function of a wind-catcher regarding temperature difference. When there is no wind, the wind-catcher acts according to this action. During the day, since the sun hits on the southern face of the wind catcher, the air heats in the southern face of the wind catcher, and goes up. This air taken makes a kind of proportional vacuum inside the porch, and takes the cool air of the inner court into itself, so the existing air in the northern opening is pulled down too.

During the night it becomes cold outside, and the cold air moves down. This circle continues until the temperature of the walls and outside temperature become equal. Before it arrives at the point the night is usually over, once again the wind catcher functions as mentioned above.

**Categories Based on Forms of Plans**

Wind-catchers are seen in a diversity of forms and plans; there are square, rectangular and octagonal types. The square form is the type used in the four directional wind catchers. The rectangular forms consist of one, two, four directional. The octagonal form is the type used in eight directional wind catchers in Yazd.

The four directional towers are the most popular wind catchers in city of Yazd. They have four main vertical shafts divided by partitions.
Partitions can be classified in two groups:

Main Partition and Secondary Partitions. *Main partitions:* continue to the centre of the tower, forming a separate shaft behind the vents. The patterns of the partitions vary from tower to tower, but the most common are in forms of I, H and diagonal. *Secondary partitions:* remain as thick as the external wall, about 20-25 cm.

A shaft can be subdivided by a number of additional partition. Performing either a structural or thermal role, these can separate the tower in two or four shafts. Wind catchers could be categorized according to forms of the plan and patterns of the partitions. Figure 28

Partitions divide the tower into small shafts to increase air motion. Such an arrangement provides more surfaces in contact with the flowing air, so that the air can interact thermally with the heat stored in the mass of these partitions. They work like the fins of a cooler window or the fins of a radiator, because mud brick partitions give back stored heat during the night and they are able to absorb heat during the day.

Figure 28 Categories of wind catchers based on plan, X- Form blade, I- form blade, H form blade, + form blade.
Materials Colour, Texture and Height

The construction materials used for wind catchers depend on structure and function. The choice of materials ensures that the wind catcher operates effectively as a passive cooling system. Wind catchers in hot dry climates are built either of mud brick or more commonly, of baked brick covered with mud plaster. Mud brick (adobe) absorbs heat slowly, because soil has uncompressed volume.

Mud plaster (kah_gel) is a mixture of wet earth with fine or chopped coarse straw. These construction materials give the wind catcher a coarse texture. The mud plaster covering the facade of a wind catcher has a light colour and therefore reflects the sun.

To enable wind catchers to serve their function effectively through the appropriate utilization of wind currents, height is necessary. The wind catchers in hot, dry regions are higher than those in hot humid regions. When the air current is closer to the land surface, it is warm because of the effect of sunshine on the ground. Thus, in a hot and dry region, because of the low temperature and a higher wind velocity at greater heights, wind catchers are built higher to enable them to trap such currents. In central plateau of Iran buildings are all built below ground level, wind catchers are designed to service two interior spaces at different levels: the basement space and the reception hall on the ground floor used in summer.

Figure 29 A ground floor plan and a view section of a historic residential building in Yazd.
Structure and Ornament

The body of the wind catchers soar to a great height to receive winds. Since a wind catcher rises above a building, it needs a structure to support it. Wind catchers are built of mud brick or, more commonly, of baked brick and timber. The main structure of a typical wind catcher consists of a tower, several vents and partitions.

Timber beams are used to support partitions at various levels and to hold the structure together to increase the shear resistance of the tower.

The beams project out of the structure to providing a ladder and scaffolding for building the tower and for use during subsequent maintenance. Main and subordinate partitions are counted as structural supports.

Figure 31 Typical example of traditional wind catcher, Yazd.

Figure 30 Structures of wind Catchers.

Figure 32 Examples of vent head details.
**Dowlatabad Garden Highest Wind Catcher**

The skyline of city of Yazd is defined by badgirs rising from the city’s buildings. One of the most prominent wind catchers in Yazd city is the thirty-three metre high wind catcher of the former palace of the Karim Khan Zand (c. 1705-1779 CE). The palace, built circa 1750 CE, and its grounds, are now a public park called the Dowlatabad Gardens.

It is considered an architectural masterpiece and a symbol of the Yazdi architects’ genius, mental ability, talent and art. This wind tower has an octagon plan. It can receive wind from eight directions. The most significant characteristics of the design of this building are believed to be the attempt of the architect to select angles which provide the best views.
2.8 Persian Calligraphy

The art of calligraphy is one of the reputable and famous arts in Iran. The art of calligraphy, and its numerous decorations, has been much praised by Iranologs.

History of Persian Scripts

In ancient Persia and different historic eras, languages such as “Ilami”, “Avestaaee”, “Pahlavi”, and “Farsi-e-Mianeh” were spoken. It is believed that the ancient Persian script was invented circa 500-600 BC to provide monument inscriptions for the Achaemenid kings. These scripts consisted of horizontal, vertical, and diagonal nail-shape letters and that is the reason in Farsi it is called “Script of Nails” or “khat-e-mikhi”.

Centuries later, other scripts such as “Avestaaee” and “Pahlavits” were created. The Avestan alphabet or “Avestaaee” was created in the third century CE for writing the hymns of Zarathustra. Avestan is an extinct Indo-Iranian language related to Old Persian and Sanskrit. Avestaaee script was related to the religious scripts of Zoroastrians’ holy book called “Avestaa” and unlike the nail script - that was carved on flat stones, Avestaaee script was written with a feather pen, usually on animal-skin. It is surprising that this script has similarities with Arabic scripts such as “Sols” and “Naskh” that were invented centuries later. However, unlike these scripts, letters in Avestaaee were not connected to each other to form a word, but were written separately next to each other (similar to Latin scripts). However, it went from right to left.
After the initiation of Islam in the 7th century, Persians adapted the Arabic alphabet to the Farsi language and developed the contemporary Farsi alphabet. The Arabic alphabet has 28 characters and Iran added another four letters to arrive at existing 32 Persian Farsi letters.

“Nas’taliq” is the most popular contemporary style among classical Persian calligraphy scripts. It is known as “Bride of the Calligraphy Scripts”. This calligraphy style has been based on such a strong structure that it has changed little over time. It is as if “Mir Ali Tabrizi” had found the optimum composition of the letters and graphical rules so it has been a little fine-tuned during the passing seven centuries. Nas’taliq style is technically the most complicated style. It has strict rules for the graphical shape of the letters and for combinations of the letters, words, and composition of the calligraphy piece as a whole. Even the second most popular Persian calligraphy style “Cursive Nas’taliq” or “Shekasteh Nas’taliq”, noticeably follows the same rules as Nas’taliq, with more flexibility of course.

History of Nas'taliq

Around the 10\textsuperscript{th} century that Ebn-e-Moqlah Beyzavi Shirazi conducted a research and studied six major calligraphy styles and categorized them. These styles were "Mohaqqaq", "Reyhan", "Sols" or "Thuluth", "Naskh", "Reqaa", and "Towqee". All of these calligraphy styles followed 12 major principles. After “Ebn-e-Moqlah” another calligraphy master Hassan Farsi Kateb combined the “Naskh” and “Reqaa” styles and invented a new style, called “Taliq”. Eventually in the 14th century, Mir Ali Tabrizi combined two major scripts of his time Naskh and Taliq and created the most attractive Persian calligraphy style, “Nas’taliq”.

History of Cursive Nas'taliq

"Cursive Nas'taliq" or "Shekasteh Nas'taliq" was invented in the 17\textsuperscript{th} century. This calligraphy style is based on the same rules as Nas’taliq but it provides more flexible movements. It is a little more stretched and curved.

Figure 38 Natural Curves in Persian Calligraphy Nas’taliq Style.
3.0 METHODOLOGICAL APPROACH OF THE PROJECT

3.1 Overview of Methodology

This research and architectural design project follows a rational, linear process.

The first aim is to understand the architectural history of Iran combined with interpreting Yazd architecture. This includes having an understanding of the climatic conditions of the city.

The second aim is to understand the working requirements and functionality of the climate research centre by analysing the two independent case studies. Findings revealed both case studies were practical in terms of their desired functionality. However, the first case study is located on the university campus and is primarily used by students and staff members. The second case study is simply used as an office block. As a result, the developing design will accommodate both students and research personnel.

The project will conclude with the production of several architectural drawings combined with physical models for a research centre in Yazd.
3.2 Overall Summary of Traditional Architecture in a Hot, Arid Climate

Traditional buildings of Iran, both in architectural and constructional fields, are planned to receive maximum sun radiation during winter and maximum shade during summer, to use natural ventilation and to provide comfort for the occupants. Buildings with courtyards with indicators like thick walls, porches, underground, wind catcher, vault and dome, are clear examples of the architect’s understanding, environmental conditions.

Iran’s traditional architecture is determined by the climate and conditions. The wind catcher is the most, intelligent arrangement that uses the wind’s natural energy, making comfort possible in hot regions.

The urban morphology in hot-arid regions is a condensed and concentrated urban texture in which the main arteries are facing the desired wind and opposing the undesired one.

In the hot-arid region, of Iran materials with heat capacity and resistance like mud, mud-brick and brick, are used which are effective in cooling and heating internal spaces.
3.3 Traditional Versus Modern Buildings in Hot Arid Climates

Buildings, as they are designed and used today, contribute to serious environmental problems because of their excessive consumption of energy and other natural resources. Currently, energy constraints and global warming are considered to be the biggest challenges confronting the planet. Energy is a vital part of every aspect of life in the modern world. Demand for energy is rising rapidly. The analysis carried out by the US Energy Information Administration\(^54\) (EIA) estimates that, by 2030, global energy consumption will have grown by over 70% (EIA, 2007).\(^55\)

The world population, which has increased more rapidly than ever before over the last 50 years\(^56\) indicates a huge future demand for houses and the energy to run them.

The building sector is one of the major energy consumers. The proportion of total energy use attributable to building generally ranges from 10 - 15% in undeveloped countries to more than 40% in the developed countries.\(^57\)

In Iran statistics show that buildings account for about 39% of total energy consumption.\(^58\) According to a report in “The Second Conference of Fuel Conservation in Buildings” in Tehran,\(^59\) the amount of energy consumed in buildings in Iran is equal to 30% of its annual oil income (equivalent to US$15 Billion in 2005), with 50% of this being wasted.\(^60\) Air conditioned energy-dependent buildings result in more emissions of green-house gases, driving global warming.

The new part of Yazd has changed entirely from the traditional. Most of the modern buildings are dependent on air conditioning

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\(^56\) (Population Reference Bureau, 2005)

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\(^59\) Ghobadian, V. (2003), Climate Analysis of the Traditional Iranian Buildings, 2nd ed., Tehran University publication, Iran.
A large proportion of these modern buildings are poorly designed for the prevailing climate, leading to extreme use of electrical equipment and energy to maintain desired indoor conditions. These buildings are without enough insulation, unshaded, overglazed and tight skinned and with air conditioning, are using vast amounts of energy to provide thermal comfort, especially when the weather conditions are harsh and extreme.

My aim is to understand the traditional language in architectural methods of design in hot and dry climates and to apply these methods in a modern way, to provide for new and innovative approaches to the design of a flexible, adaptive passive building for hot climates.

I plan to use these traditional principles in designing my new climate research centre for the university of Yazd. I believe these traditional elements can provide inspirations for a new and innovative approach to the design of a resilient, adaptive, passive and sustainable contemporary building.

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3.4 Examples of International Research Centres

Figure 39 Research and Development Building in Istanbul, Turkey.

Figure 40 Research Centre for Renewable Energy Sources in Murcia, Spain by A-cero.

Figure 41 Tacoma’s Centre for waters adapts university of Washington.

Figure 42 National Centre for Atmospheric Research Colorado, US.
Figure 43  Rockwool Research Centre, Denmark.

Figure 44  Research Centre at Georgia Institute of Technology, USA.

Figure 45  Research Institute, climate Prediction, New York.

Figure 46  CUNY’S Advance Science Research centre, USA.
3.5  Case studies

Case Study One

Two buildings have been used as precedents for developing the programme for the climate research centre: one on the university campus and the other as offices.

Columbia University, International Research Institute, Climate Prediction Palisades, New York.  

Year: 1999  2,560 m²  Architect: Rafael Viñoly

Considering the design of Columbia University, International Research Institute for Climate Prediction Palisades, the simplicity of the floor plans complements the functionality of this building. Using a single storey structure averaging 4.6 meters in height, the building is set back from the property line and concealed from view by trees on three sides. With a curved slender form consisting of two partially overlapping wings Rafael Viñoly has aimed to concentrate on the function of the building as well as its harmony with its surroundings. In his design he has aimed to create a building that is functional, to best serve its purpose as a research centre, containing only the necessary spaces required such as classrooms, laboratories, computer facilities, and offices. By creating two separate wings and locating the entrance at the wing’s juncture, where the two structures meet, accessibility to both wings has been facilitated by equal walking distance, avoiding unnecessary foot traffic through the building.

Figure 47 Site plan: Plans of International Institute for climate prediction.

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62 http://www.rvapc.com/
In addition, Rafael Viñoly used natural materials, such as stone and exposed timber, which integrates the building into the landscape. For instance, the curved, design of the building aligned with the Hudson River and its roof, formed of simple wooden trusses placed upon a series of sinuous, curved, steel beams, echoes the hill’s contour, as well as taking advantage of the views and breezes from the Hudson River. By taking advantage of the environmental factors Rafael Viñoly’s design has managed to shorten the length of the cooling season by the use of the operable windows to allow for air intake. This aspect of overall air flow is facilitated by the building’s large eaves and overhangs. By means of a chimney-type effect, air is vented out through the skylight that runs the length of the building, thereby reducing the building’s cooling season by four months and resulting in substantial savings in operation costs for the Institute.\(^{63}\)
Case Study Two

National Centre for Atmospheric Research

Architect: Ieoh Ming Pei. Located at Boulder Colorado, US. Completed 1967. Site: 28-acre mesa within a 530-acre Rocky Mountain site. Gross Floor Area: 243,000 s/f (including 30,000 s/f terraces and outdoor spaces) and surface parking.

National Centre for Atmospheric Research “NCAR”, unlike the previous case study, has a more complex structure due to its mountainous surroundings. The architectural design of this building responds primarily to a complex technical programme and also to an extraordinary Rocky Mountain site. The function of this building has been affected by the architect’s plans to create a harmonious environment. Therefore, to respond to the environment the mass of the building is fragmented into two tower containing laboratories/offices with upper-level "crow's nests" that permit quiet contemplation of the spectacular mountain views. The clusters are linked by two basement levels and a core of communal facilities that affords research areas greater isolation. In designing this building Ieoh Ming Pei has ingeniously maximized the interaction among scientists by using alcove corridors that zigzag to provide multiple circulation routes through the complex.
The vastness of the Rocky Mountains presents the greatest design challenge, as it shadows the building and its effectiveness. Inspired by Indian cliff dwellings in nearby Mesa Verde, NCAR comes to terms with nature through elemental forms, the absence of identifiable human scale and the use of indigenous materials. To better merge with the mountain setting, Ieoh Ming Pei has used innovative architectural concrete walls which are bush-hammered and colored by local aggregates. Set into a corner of the site, the building is only glimpsed from a mile-long, curved approach carefully threaded up the mesa to preserve the natural terrain.

To conclude, the design of National Centre for Atmospheric Research is greatly influenced by its surrounding environment and its local culture. The use of local elements, concrete walls, high towers and complex design of this multi-storey structure prevents the building being be under mined by the vastness of the mountain surrounding it.

64 http://www.pcf-p.com/a/p/6146/s.html
4.0 PROJECT DEVELOPMENT

4.1 Site Analysis Location & Context

This is an overall site context of Yazd City, viewing the necessary adjacent areas. Yazd University is surrounded by two other universities Emam Ali University and Yazd Azad University. The train station and bus terminal is located in the centre of the city, easily accessible from both of these universities. Yazd CBD is an older section of the city with a historical urban layout. Shahid Sadooghi Airport is located in the vicinity of Yazd in the North West of the city.

The University of Yazd was founded in 1988 and has witnessed a period of rapid growth ever since. The university currently has five main faculties, Faculty of Art, Engineering, Humanities, Natural Recourses and faculty of Sciences. The University of Yazd is situated in a new development mostly suburban areas those are highlighted with yellow. Yazd University has two campuses which are close to each other, one is located next to Azad University and other campus is near Emam Ali University. I am planning to position the Climate Research Centre design in the centre campus as illustrated with red dotted circles.
Yazd University has three main routes from the site. One of the entrances is at the main road Porffesor Hesabi and the other two entrances are situated at Aram Street and Golest Street. I am planning to place a climate research center in the middle of Aram Street and Golest Street, so that the building can be viewed from both streets and it will also create an innovative facade for the university campus.
4.2 Diagram of Building Program

Concept: Bobble Building Diagram
4.3 Design process Concept: Using Calligraphy in Architecture

Taking notes from all types of Persian calligraphy, in particular contemporary classical scripts called "Cursive Nas'taliq" and “Shekasteh Nas'taliq”, looking at different examples I notice there are a few similarities in the styles of “Cursive Nas'taliq" and “Shekasteh Nas'taliq". These are:

- Emphasis on rhythm of letters
- Repetition of letters
- Interrelation of letters with one another
- Astonishing lines, heavy and light weight
- Beginning of letters and ending of letters are usually flowing
- Straight and curve, stretched lines
- Linear form
- Small writing in contrast with large letters

Below are a series of collages to explore these ideas from contemporary classical scripts Nas’taliq to create an architectural form of spaces for my Climate Research Center design.
In this example of the “Nas’taliq” writting I have used:

- Curves and geometry of the lines and dots
- The interaction between the letters and words and how they so perfectly interrelate to one another
- The flow of the writing
- The precision of the lines and curves and how overlapping lines do not take the importance away from each other.

The collage in this Figure 65 is drawn using the idea above. The geometry of the lines and dots and how different parts of my writing interact with one another shows how I would use this idea in the design of my building.

The primary idea behind my design for my building has been closely related to this and the way the forms have a perfect interaction between the words.
Figure 66  Another example of Persian traditional calligraphy “taliq”. This form of writing has more linear lines than curves forming it and the geometry of differs from “Nas’taliq”. The interaction between the words in this form also differs as the lines in different words run into one another rather than overlapping each other. The lines in this writing have forms making the interaction between them more symmetrical.

The collage in this Figure 67 is drawn using the idea from Figure 66. In this drawing I have used the symmetry of the horizontal and vertical lines that interact with one another to form this shape. Using similar symmetry I will then design my building to form a structure where different parts can closely interact with each other. The primary ideas taken from “taliq” is:

- Symmetry and geometry of the writing
- Interactions between lines and where they meet
- The parallel forms and the precision used in creating such straight lines.
- The flowing effect used in the beginning and end of each letter.
Design process: Concept Sketch Drawings
Concept: Sketch Drawings
Concept: Initial Sketch Drawings
4.4 Preliminary Concepts Models Design

Figure 68 and 69 represents my initial idea for the form of the building. Using lessons learned from calligraphy and traditional architecture in Yazd, my building was designed signifying the combination of curves from the “Nas’taliq” and the linear slender form of “taliq” combined with traditional methods of building in creating structures that surround a courtyard. The interaction between the separate parts of the structure and how the building flows derives from Persian calligraphy.

Figure 70 and 71 have been dominantly influenced by the “taliq” calligraphy. The shape in these designs has more symmetry and the interaction between the separate structures once again has been facilitated by the use of a courtyard which fuses the two structures. Although the building enjoys some of the features from the “Nas’taliq” calligraphy, such as the curved roof structure, the building has more geometrical symmetry in its design.
Figure 72 and 73 once again represent the design which has been prominently dominated by the “taliq” calligraphy. However, in these designs the structure has been formed to better suit its arid environment. In figure 72 the structure has a single linear form which has been wrapped like an eggshell in its facade to create a more shaded area protecting the building and the courtyard from the hot and dry weather of Yazd.

Figure 73 again uses the same idea from the design in figure 5 using more geometrical shapes rather than curves. However, in this design the building is formed by a number of structures which are connected to one another through a courtyard space. Using an idea, as in Figure 72, the courtyard area in this design is also shaded by structures that cover the courtyard space, creating shade and natural cooling from the environment.

Both of these designs have one idea in common: to avoid extreme heat penetrating the building.
4.5 Form Studies Concept Develop Design

The basic layout of these models is two stories high, based around a similar concept that consists of overlapping linear forms which interact through two common junctions and the central courtyard space. In model one I was exploring the idea of the symmetrically adjacent forms with the same height.

Model two has a more irregular shape with a cantilevered floor which allows movement beneath. This form allows for a greater shaded area on the ground floor.

In Model three I have created a hierarchy between the two forms. The lower level of this model includes a basement level that allows for a larger floor area, differentiating this model from the other two.
Wind Catchers Design

These models represent the incorporation of the wind catchers into my design. The difference between the two models is the height of the wind catchers and how far they rise above the roof. The Figure 77 has a rise of 12 meters above the roof as opposed to the 5 meters represented in Figure 79. The higher the tower is, the greater the flow of the wind would be.

The wind catcher has a trapezoid shape, oriented towards the north-west for maximum usage of the wind to provide cooling for buildings. Wind catchers are, therefore, designed with a four directional orientation in order to use all of the desirable winds from north to south and from east to west.

In the models, I have designed two wind catchers at the common junctions of the building to allow for an even distribution of airflow to provide natural cooling.
4.6 Design Strategies

The following are the strategies based on the physical aspects of the climatic architecture of Yazd. The following are the main architectural strategies, building configuration and design elements, and the reasons and the basis for more comfortable indoor and outdoor spaces for the inhabitants of the region. In the following, there are the architectural aspects of the hot arid climate, which includes the most important design strategies that drive from the analysis and are carried into the final design project.

- Introverted building morphology in the form of a courtyard to create an enhanced, inhabitable microclimate.
- Medium compact configuration with internal open space to reduce the structure’s exterior surfaces in proportion to the interior volume, and to reduce the insulation impact.
- Close arrangement around the courtyard for the effect of cold air drainage at night to increase daytime cooled spaces.
- Spatially efficient circulation between functional spaces to reduce internal circulation, to increase space-efficiency and to reduce volume and, therefore, minimise the need for cooling.
- In hot, dry regions, flat roofs are usually paved with square shape bricks called paved brick. These receive the most radiations of sun. Early morning it starts to increase and in late afternoon it decreases gradually.
- A rough building surface to decrease heat gain and to increase the contact with air movement, to reduce the exposure of the sun to the surfaces, and to create more effective cooling.
- Relatively small openings reduce radiation. Minimum window areas particularly on the west-facing facades to reduce the afternoon glare. Openings need to be on the south and north and, to a lesser degree, on the east, side. The openings need to be set high to protect them from ground radiation.
- Few small windows facing the direction of the cooler winds: to allow some ventilation and avoid glare.
- Wind-catchers in different sizes, directions and height in relation to specific breeze were used to produce effective convective cooling.
- Wooden screens (composite shading devices) used to control and filter daylight and to reduce indoor glare.
- Block and heavy construction materials used to increase the time-lag and to retain some heat for night time warming.
- Some degree of porosity in building material is essential to facilitate the dissipation of heat.
Developmental Sketches

Interior Perspective

Perspective central courtyard /ground floor
Developmental sketches

Interior Perspective

Perspective central courtyard exploring calligraphy
Exterior Development Sketch
Looking at main entrance and library at north-west perspective.
Exterior development sketch
Looking at Front of the building north, north-west perspective.
Site Plan

Climate Research Centre- located in Yazd, Iran University campus.
Concept Develop Floor Plans & Model
First level Floor Plan

- STAFFS OFFICES / Open floor plan: X4, 16 ppl
- STUDENTS OFFICES / Open floor plan: X4, 16 ppl
- LARGE MEETING AREA (LOBBY): X3
- MEETING ROOMS: X3
- LAB: X3
  - LAB 1: 24 ppl
  - LAB 2: 16 ppl
  - LAB 3: 24 ppl
- LABS KITCHEN: X2
- LABS CHANGING ROOM: X3
- TOILETS: X2
- LAB STAFF ROOM: X4
- COMPUTER LABS: X2
Basement Level Floor Plan

- EXTENDED LIBRARY / STUDY AREA (X1)
- EXHIBITION AREA (X1)
- LECTURE THEATRE LOBBY AREA (X1)
- LECTURE THEATRES (X2)
- TOILETS (X2)
- CONFERENCE ROOMS (X2)
- COMPUTER LAB (X1)
- MEETING ROOMS (X2)
- MEETING AREA / STUDY AREA (X1)
Section A – A

Section through ground level showing Persian calligraphy patterned glass doors.
Section through courtyard showing both sides of the building.
Section through second floor laboratories, ground floor lobby and entrance to, two level library areas.
Section cut through wind catcher and lobby area.
Elevation

South long Elevation
Exterior Perspective

West main entrance perspective of climate research centre.
Interior Perspective

Internal courtyard perspective of climate research centre.
Final Model Photographs

View of Yazd University campus site model and new propose building.
Final Model Photographs

View of library and staff entrance on north-east.

View of student entrance on north-west.
4.7 Project Development

The project development is broken down into three sections. These sections are investigated over the course of the project.

Understanding the traditional techniques that are used in Persian architecture, in particular the architecture of Yazd, to understand the architectural requirements for hot and arid climates and the environmental issues affecting the design process, to understand the local culture and history behind the city, and to incorporate those elements in designing the Climate Research Centre.

Car parking

The University of Yazd has two campuses, the carpark for both is located at the main Yazd University campus. All students and staff use the free shuttle bus to get across both campuses.

Description

The Climate Research Centre building is organized around the courtyard to create an enhanced inhabitable microclimate. The internal open space was essential to reduce the structures exterior surfaces in proportion to the interior volume, and to reduce the insulation impact.

A water fountain is positioned at the centre of the courtyard, with trees planted along the fountain structure in an L shape. The water can help to modify the microclimate. It takes up a large amount of heat in evaporation and causes significant cooling; trees will shade the courtyard also.

The sliding glass doors around the courtyard are designed with Persian calligraphy in an abstract pattern. These glass sliding doors will not only allow access to the courtyard space, but also control the amount of light that enters the internal spaces, as well as providing a sense of privacy and some degree of transparency.
Site plan Landscaping

The new pathways have been designed to give access from the existing driveway, to creating a new connection to the new research centre. Along the new pathways, trees were planted in both entrances of the building. The shade created by trees and the effect of the grass reduces air temperatures adjoining the building and provides evaporative cooling. The landscaping is designed from the north continuous to the south side. The landscaping is a mixture of grass and on the southern side of the building will be planting deciduous trees, helping to cut off direct sun during the summer. These trees shed leaves in winter allowing the sun to heat the building in winter.

Levels and connections

The building is two levels high with a basement. There are two entrances to the building. One positioned on the north – west side; it can be accessed by students. The other entrance, situated on the north–east side, is designed to be access for staff members and researchers. At parts of the building the first floor is cantilevered out to provide shade.

Structure

The building structure is reinforced concrete with concrete frame, beam and double tee flooring and roof. The roof is flat, paved with square shape bricks called paved bricks.

The site location is in the medium seismic zone.
Environmental control

Environmental control of the building is by using wind catchers. The two basement lecture theatres need to have an air conditioning system. The air conditioning units are located above the lecture theatre roof, exposed to the outside building landscape. The shapes of these openings are two segments of a glass structure, 6 meters apart from each other and rising 1 meter above ground level. Air conditioning systems are located at the centre of structure.

The wind catchers are positioned on the site to take advantage of prevailing winds, the bigger opening is facing north – west. A water fountain is placed at the bottom of both wind catchers at the basement floor to help to cool the passing air by evaporation. The shapes of the fountain are carried out to the ground floor and upper floor to create a void space around the wind catchers.

- Winter heating is provided by daytime heat stored in the mass of the structure.
- Temperature control is provided by regulating window openings and wind catcher air supply.

Voids

In addition to voids around wind catchers, there are two other voids in the building. Both are located at the ground floor. One is through the library, to the extended library below. The other void is situated close to the north – west entrance. This will provide a sense of connection and interaction from ground floor to the basement.

- Summer cooling is provided by night time air purging the daytime heat out of the building materials by cooling the structure.
Window openings

Openings are made on south and north and to a lesser degree on east sides, of the building. The openings are set high to protect from ground radiation. Relatively small openings are used for the building to reduce the intense radiation. Minimum window areas are located, on the west facing facades to reduce the afternoon direct radiation and indoor glare. The west and east side of the climate research centre has a double skin facade for insulation.

Wall

Exterior walls are patterned precast concrete panel with rough texture surface and some parts of the walls are brick panels. The rough texture is applied to decrease heat gain, to increase the contact with air movement, to reduce the exposure of the sun to the surfaces, and to create a more effective cooling. An air cavity is used within the walls to reduce heat transmission into the building. The interior walls will be concrete block or brick plastered in some areas.

Walls are designed to be high heat capacity; the daytime walls are heat storing materials and night time cool storing. East and West walls are shaded. High reflective qualities are desirable for both thermal and solar radiation.

The building surface colour is bright/ light colours it has a high reflection ratio on sun exposed surfaces. Dark absorptive colours were used where the reflection towards the interior was expected. The deep surfaces of my building are dark coloured for winter radiation absorption.

Wooden Screens

Screens are used to control ventilation, lighting and humidity in the cooling of water and ensure privacy in the traditional Persian architecture. At the research centre building the wooden lattice screens are internally positioned in outer wind catcher wall opening shafts. These screens have a geometric pattern, usually positioned at the finishing of the opening or finishing of a whole facade, these are used on both the exterior and interior.
CONCLUSIONS / CRITICAL APPRAISAL

This project set out to investigate Iranian architecture in the context of tradition, new technologies of climate control, and its connections to the Modern Movement. The traditional approach to moderating a harsh climate has been studied to consider the effectiveness of building forms that relied on wind catchers and air passages inside buildings to maintain a habitable environment without mechanical cooling systems that depend on energy sources: the passive systems of traditional design that made buildings work acceptably well. It has been noted that the architecture of Yazd is an expression of these sophisticated systems through the various towers that punctuate the city's skyline.

Assumptions were made at the start of the project that information would be available from the authorities in Yazd, but this proved to be over-ambitious. My own background experience of Teheran, where climate conditions are different and less problematic, has been less useful than expected. The project was therefore less able to fully analyse the architecture of Yazd’s extreme climate than I had hoped.

In spite of this, my underlying knowledge of the culture of Iran has informed the development of the design. The Climate Research Building is designed to incorporate both passive environmental strategies that have made Yazd’s buildings habitable for centuries and the building also re-interprets some of the formal characteristics of traditional architecture. This approach of referencing tradition and modifying climate through design reduces energy requirements and at the same time re-establishes the culture of architecture in a revised modernist proposal.
6.0  BIBLIOGRAPHY

2) Sabk Shenasi Mi'mari Irani (Study of styles in Iranian architecture), M. Karim Pirnia. 2005
6) Milani, Abbas. Lost Wisdom; Rethinking Modernity in Iran, Mage Publishers (March, 2004).
17) Tavassoli, Mahmood (2002) Urban Structure and Architecture in the Hot Arid zone of Iran, Payam Publications (Published in Farsi)

18) Ghobadian, Vahid (1998) Climatic Survey of Traditional buildings of Iran, Tehran University Press (Published in Farsi)


21) Boustani, F., Role of water in ancient civilization in Iran. Proc. Of Int. Conf. On water culture and water environmental protection, china, pp.69, 72, 2005

22) Proceedings, American philosophical Society (Vol.112, no.3,1968) pg 179


26) Culture and customs of Iran, by Elton L, Daniel. Ali Akhbar Mahdi P.119


28) Poor, J. and M. Reza, Design criteria for development of settlements in arid coastal region of Iran (case of study of Bandar Lenghe.


34) Ghobadian, V. (2003), Climate Analysis of the Traditional Iranian Buildings, 2nd ed., Tehran University publication, Iran.


36) http://www.rvapc.com/
39) ) Mahnaz Mahmoudi Zarandi “Analysis on Iranian wind catcher and its effect on natural ventilation as a solution towards sustainable architecture” (case study: Yazd (Qazvin Islamic Azad university) 2009.
41) Architectural review april 2010, building, the interesting spaces in the city became the backbone of the concept, Andre Spies, project architect.
42) Behroz Tavakoli and Mohsen Ghafor-Ashtiany.
45) http://www.rvapc.com/
47) http://www.yazduni.ac.ir/
48) Metric Handbook- planning and design data, edited by David Adler, second edition
49) http://www.stresscrete.co.nz/default.html
50) http://dictionary.sensagent.com/yazd/en-en/
52) http://www.world-geographics.com/maps/world/world-map/
53) Architectural Design Magazine Contemporary Techniques in Architecture, Wiley Academy, Issued 30 Jul 2002
54) Tehran: Past & present , H.R.Norouzi Talab p.10
55) Encyclopedia of deserts, Michael A. Mares p.302
57) Aeromagnetic Data Interpretation to Locate Buried Faults in Yazd Province – Iran, Mohammad Aryamanesh Department of Geology, Faculty of Sciences, Yazd University, Pajouhesh St., Yazd, Iran, 2009.
58) Historic cities of the Islamic world, By: Clifford Edmund Bosworth, Published, 2007
60) The Cambridge history of Iran, Volume 5 the saljuq and mongol periods By: University of Cambridge, 1st published 1968.