



**FACES OF BIOPHILIA IN THE VERNACULAR
ARCHITECTURE OF THE GULF AREA (AND
LESSONS FROM IT FOR CONTEMPORARY
BUILDINGS)**

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Graduate School
Izmir University of Economics
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ABSTRACT

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Bharoocha, Ariba

Master's Program in Architecture

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The research aims to find traces of Biophilia in the vernacular architecture of the region around the Arab Gulf, also known as the Persian Gulf, in order to understand the relationship between the presence of Biophilia, the environmental, sociocultural factors, and the sustainable features of the local vernacular architecture, aiming to draw lessons that could be applied in contemporary buildings. Following the Biophilia hypothesis that most humans have an innate love of nature, biophilic design is an applied solution to appease this attraction to nature by integrating natural elements and processes into the built environment. From the various disciplines that can be related to Biophilia, this paper focuses on the architectural context, where Biophilia can be implemented at various levels: community, building, or small-scale. The vernacular architecture reflects various factors of two different categories, sociocultural and environmental, which have had an impact on generating the vernacular architecture around the Gulf as in the rest of the world. This research surveys various aspects of that architectural idiom through relevant samples in order to understand the diverse

faces of Biophilia as embedded in the vernacular buildings and settlements of the Gulf region. The work is based on 14 different patterns of biophilic design that are utilized as a method to analyze the presence of Biophilia in the region. The findings are used as lessons for contemporary architectural applications aiming at sustainable solutions in harmony with the environment.

Keywords: biophilia, biophilic design, vernacular architecture, sustainable design, Gulf region, Gulf vernacular.



ÖZET

KÖRFEZ BÖLGESİNİN YEREL MİMARİSİNDE BİYOPHİLİA'NIN YÜZLERİ (VE ÇAĞDAŞ BİNALAR İÇİN DERSLER)

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Bu çalışma, araştırmanın amacı, Basra Körfezi olarak da bilinen Arap Körfezi çevresindeki bölgenin yerel mimarisinde Biophilia'nın izlerini bulmak, Biophilia'nın varlığı, çevresel, sosyokültürel faktörler ve sürdürülebilirlik arasındaki ilişkiyi anlamaktır. Yerel mimarinin tasarım özellikleri incelenmekte ve çağdaş yapılarda uygulanabilecek derslerin çıkarılması amaçlanmaktadır. Biophilia hipotezi, çoğu insanın doğuştan gelen bir doğa sevgisine sahip olduğunu öne sürüyor - bunu geçiyoruz ve bununla bağlantı kurmadan sağlığımız zarar görebilir. Dolayısıyla biyofilik tasarım, doğal unsurları ve süreçleri yapılı çevreye entegre ederek bu doğa arzusunu yatıştırmak için uygulanan bir çözümdür. Biyofili, sosyoloji, fizyoloji gibi çeşitli disiplinlerde, tıbbi araştırmalarda olduğu kadar mimari ve iç tasarımda da geniş bir bilişsel alandır. Bu makale, Biophilia'nın topluluk, bina veya küçük proje düzeyinde uygulanabileceği mimari bağlama odaklanmaktadır. Yerel mimari, sosyokültürel ve çevresel olmak üzere iki farklı kategoriye ait olan ve dünyanın geri kalanında olduğu gibi Körfez'de de yerel mimarinin oluşmasında etkisi olan bir dizi

faktörü yansıtmaktadır. Bu araştırma, Körfez bölgesindeki yerel binalara gömülü olarak Biophilia'nın çeşitli yüzlerini anlamak ve çağdaş mimari uygulamalar için ondan dersler çıkarmak için ilgili örnekler aracılığıyla bu mimarinin çeşitli yönlerini araştırıyor. Bu, bölgedeki biyofili varlığını analiz etmek için 14 biyofilik tasarım modeli temel alınarak yapılacaktır.

Anahtar Kelimeler: biophilia, biophilic design, vernacular architecture, sustainable design, Gulf region, Gulf vernacular.



Dedicated to my mother for always being by myside and always supporting and praying for me.



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TABLE OF CONTENTS

ABSTRACT.....	iii
ÖZET	v
ACKNOWLEDGMENTS	viii
TABLE OF CONTENTS.....	ix
LIST OF TABLES	xiii
LIST OF FIGURES	xiv
GLOSSARY OF NON-ENGLISH WORDS.....	xxii
CHAPTER 1: INTRODUCTION	1
1.1 Summary:.....	1
1.2 Research questions:.....	1
1.3 Objective and focus:.....	1
1.4 Methodology:.....	2
1.5 Thesis structure	2
CHAPTER 2: BACKGROUND	4
2.1 Summary:.....	4
2.2 Chapter overview.....	4
2.3 Introduction.....	5
2.4 Literature on Biophilia.....	5
2.4.1 Brief introduction to Biophilia in architecture	5
2.4.2 Background of biophilic design	6
2.4.3 Biophilic design patterns	7
2.4.4 Biophilic Design in the context of vernacular architecture.....	8
2.4.5 Literature on vernacular architecture	9
2.5 Brief introduction to vernacular architecture	9
2.5.1 Vernacular architecture and sustainability	10

2.5.2	<i>Vernacular Architecture of the Gulf Region</i>	11
2.5.3	<i>Conclusion</i>	14
CHAPTER 3: THE GULF REGION		15
3.1	<i>Summary:</i>	15
3.2	<i>Chapter overview</i>	15
3.3	<i>Brief introduction to the Gulf region</i>	16
3.4	<i>Environmental conditions</i>	17
3.4.1	<i>Geography</i>	18
3.4.2	<i>Climatical conditions in the Gulf region</i>	20
3.4.3	<i>Vegetation</i>	24
3.4.4	<i>Types of Gardens</i>	31
3.5	<i>History</i>	32
3.5.1	<i>Ancient history</i>	33
3.5.2	<i>Colonial era (15th century onwards)</i>	35
3.5.3	<i>Modern period (1945–1990)</i>	36
3.5.4	<i>Contemporary period (since 1990)</i>	36
3.6	<i>Socio-cultural characteristics</i>	37
3.7	<i>Architectural characteristics</i>	40
3.7.1	<i>Style and influences in the Gulf region</i>	40
3.7.2	<i>Use of materials</i>	41
3.8	<i>Building typologies</i>	49
3.8.1	<i>Courtyard houses</i>	50
3.8.2	<i>Masonry Houses</i>	53
3.8.3	<i>Fortified structures</i>	55
3.8.4	<i>Religious and public</i>	57
3.9	<i>Conclusion</i>	58
CHAPTER 4: TRACES OF BIOPHILIA		59

4.1	<i>Summary:</i>	59
4.2	<i>Chapter overview</i>	59
4.3	<i>Introduction</i>	59
4.4	<i>Nature in space</i>	60
4.4.1	<i>Visual connection with Nature</i>	60
4.4.2	<i>Non-visual connection with Nature</i>	62
4.4.3	<i>Non-rhythmic sensory stimuli</i>	65
4.4.4	<i>Thermal and airflow variability</i>	67
4.4.5	<i>Presence of water</i>	77
4.4.6	<i>Direct and diffuse light</i>	83
4.4.7	<i>Connection with natural systems</i>	85
4.5	<i>Nature analogies</i>	90
4.5.1	<i>Biomorphic Forms and Patterns</i>	91
4.5.2	<i>Complexity and Order</i>	95
4.6	<i>Nature of space</i>	97
4.6.1	<i>Prospect</i>	97
4.6.2	<i>Refuge</i>	98
4.6.3	<i>Mystery</i>	101
4.6.4	<i>Risk/Peril</i>	102
4.7	<i>Conclusion</i>	104
CHAPTER 5: LESSONS FOR THE CONTEMPORARY ARCHITECTURE.....		106
5.1	<i>Summary:</i>	106
5.2	<i>Chapter overview</i>	106
5.3	<i>Introduction</i>	106
5.4	<i>Layout and orientation</i>	107
5.4.1	<i>Ventilation and Lighting</i>	109
5.4.2	<i>The window placements</i>	110

5.4.3	<i>The Mashrabiya (the screen with porous openings)</i>	112
5.4.4	<i>The badgheers (wind towers)</i>	113
5.5	<i>The use of material</i>	116
5.6	<i>Water and planting</i>	116
5.7	<i>Safety and privacy</i>	118
5.8	<i>Conclusion</i>	121
CHAPTER 6: CONCLUSION AND FURTHER RESEARCH.....		122
6.1	<i>Summary:</i>	122
6.2	<i>Research overview</i>	122
6.3	<i>The Research Findings</i>	122
6.4	<i>Further Research</i>	123
REFERENCES.....		124

LIST OF TABLES

Table 1. Thesis structure regarding chapters and topics.	3
Table 2. shows the 3 categories along with the 14 biophilic design patterns (which was proposed by Browning (2014)).	8
Table 3. the biophilic design pattern and the relation with Gulf vernacular architecture elements and the solution they can provide.	105



LIST OF FIGURES

Figure 1. On the left Hanging Gardens of Babylon as a historic example and on the right Bosco, Verticale, Boeri Studio in Milano, Italy as an example from recent architecture	5
Figure 2. Vernacular architecture from different regions (from left to right) Cliff of Bandiagara, Mali, Malay Houses, Malaysia and Singapore, Mugsum Mud Huts, Cameroon, Ab-anbar, Iran	9
Figure 3. Map of the Gulf region formally known as the Persian Gulf.	16
Figure 4. Geographical Diversity in the image the different geographical aspects of the region is shown from the coastline to the mountainous areas.....	18
Figure 5. The figure shows the Köppen climate classification map of the Gulf region and the regions surrounding, from which it can be observed that the Gulf region (indicated by the circle) has about the same climatic classification and it belong to the BWh climate which is defined as the desert climate or arid climate..	20
Figure 6. Psychrometric Chart of Kuwait very cold winter temperature and very hot summers. Humidity low ranging from 10% up to 90%.	21
Figure 7. Kuwait wind rose: the dominant shamal wind from the west north west direction.	22
Figure 8. Psychrometric Chart of Abu Dhabi shows extremely summers with very high levels of humidity.....	22
Figure 9. Abu Dhabi wind map show similar wind trend as above with the shamal coming from the north west.	23
Figure 10. Psychrometric Chart of Bandar Abbas show cold winter with extremely hot summer temperatures, humidity raging up to 90%.	23
Figure 11. Bandar Abbas wind rose showing the wind direction dominantly from south, majoring coming from the Indian ocean.	24
Figure 12. vegetation map of the Gulf region.	24
Figure 13. land use map of (from left to right) coastal region Iran marked in red, Kuwait and coastal southern Iraq marked in red.....	25
Figure 14. (top) Al Jahra oasis where date palm garden was cultivated, Kuwait and (bottom) shows old Basra settlements along with date palm gardens.	26
Figure 15. Dominant native plants in Kuwait including <i>Haloxylon salicornicum</i> (a),	

Nitraria retusa (b), Cyperus conglomerates (c),Panicum turgidum (d), Rhanterium epapposum (e), Centropodia forsskalii and Stipagrostis plumosa.	27
Figure 16.Dominants plants in the Gulf region a.citrus , b.date palm,c. Tertraena qatarensis, d.prosopis cineraria, e. alfalfa f. alfalfa grass.	27
Figure 17.land use of (left to right) coastal region of Saudi Arabia bordering Gulf Sea, Bahrain and Qatar.	28
Figure 18. typically the date palm garden in the Al Hassa oasis, Saudi Arabia and that can be seen in this image of an abandoned property.....	29
Figure 19. example of old Bahrain with shrubs	29
Figure 20. (left) A date palm stands beside the remaining framework of a well in this photograph, taken inside a deserted village in the north of the world, from which the family living in the compound must have drawn this essential aspect of their desert existence and (right) date palm farm in Qatar.....	29
Figure 21. land use map of the UAE (left) and Oman (right).....	30
Figure 22. Oasis settlement Liwa, UAE.....	30
Figure 23. (left to right) the Zygothylaceous, alfalfa and white mangrove.	31
Figure 24.Acacia tortilis in Sharm-Dabna, Fujairah Emirate (left), and Vegetation in Omani region (right).	31
Figure 25. Ganja Khan Mosque, Iran.....	32
Figure 26. Date palm garden, UAE.....	32
Figure 27. remnants of the ancient Delium civilization, Sar, Bahrain.....	34
Figure 28. example of the colonial architecture, Qatar.....	35
Figure 29. A view of the First National City Bank on Sharjah, UAE.	36
Figure 30.The Souk project Doha.	37
Figure 31. (above) tribal women weaving the tents and (bottom) tribal men having coffee together.....	38
Figure 32. Boats crewed by the poorer factions of Gulf society, or trading and pearling purposes.	39
Figure 33. Ottoman style houses in Basra, Iran.	40
Figure 34. On the left side it is a traditional house in a Fahidi District (Dubai) where it had used a wind tower (called <i>badgheer</i>) and in the right side it is Sheraton Hotel in Sharjah where the Barajils (<i>badgheers</i>) are just part of the décor.	40
Figure 35. show the cluster arrangement of the traditional tent structure with the use of dark fabric to provide protection from the sun.	42

Figure 36. (left) the fabric pattern and (right) waving done by the female member of the family, Sharjah, UAE.	43
Figure 37.the details of the tents showing the ropes and fabric arrangement.	43
Figure 38. (left) image from UAE shows a restored mud building with palm frond roofing and (right) shows the mud village near the coast of Saudi Arabia.	44
Figure 39.(left) the <i>Nuqsh</i> plaster panels and (right) the carving method where the mason carving pattern with a knife.	44
Figure 40.the plaster works example on the Siyaddi house, Bahrain.	45
Figure 41.Decorative wooden door to an entrance canopy to pedestrian.	46
Figure 42.the <i>arish</i> palm frond house, (left) showing the local building it and (right) a sample structure in the, Sharjah UAE.	47
Figure 43. shows woven ceiling panels of palm frond lashed with mangrove beams (left) and (right) show the spacing of the palm frond walls to provide for light and ventilation in the interior space.	47
Figure 44.an example from UAE stone house with palm frond roofing (left) and the typical stone layer (right).	48
Figure 45.shows the common stone houses near the mountain of the coast of UAE and Oman (left) and (right) shows the traditional placement of the layers.	48
Figure 46.Show how each material was used in, this section of the wall illustrates a key cooling element used which a result of the Persian influences in the region, show the wind flow through the <i>badgheer</i>	49
Figure 47.Example of courtyard house in Qatar.	51
Figure 48. A layouts of traditional Saudi houses showing courtyards in every house	51
Figure 49.Airflow in a traditional courtyard.....	52
Figure 50. Al Bader is an old Kuwaiti house that clearly embodies the typical architectural style of traditional Kuwaiti courtyard houses	53
Figure 51. simple houses which were most commonly constructed by the owners themselves.	54
Figure 52. the use of the roof and interior of the Arab masonry housing.	54
Figure 53. examples of Persian influence two examples of wind tower from, Yazad Iran.	55
Figure 54. shows a fortified structure with round watch towers, Sharjahh, UAE.	55
Figure 55.shows fortified structure with square watch towers, Umm Salal Muhammad,	

Qatar.....	56
Figure 56.show a domestic fortified structure (above) with the wind tower and the floor plan showing the separate quarters (bottom) Shekj Isa house, Muharaq, Bahrain. ...	56
Figure 57. Mosque made with palm frond in village in Qatar.	57
Figure 58.Masonry mosques with different minaret styles and a courtyard with plants for shade, village, Qatar.	57
Figure 59.(left) Showing the strucutre of the building and (right) the interior arrangement (shows a renovated version of shops) with palm frond ceilings, a souq from Sharjah, UAE.	58
Figure 60. the image of a restored Souq along the fortified building in Qatar	58
Figure 61. an image of Basra with cooling date gardens and river boats that made their way through the brick of Ottoman buildings.	61
Figure 62.Umm Salal Muhammad, Qatar large al lake used as a Source of water supply filled during the rainy season.	61
Figure 63. Date palm gardens in Al-Ahsa Oasis, Saudi Arabia.....	62
Figure 64. the date garden (falaj) in Oman (Source: UNESCO, 2018)	62
Figure 65. the interior view of the palm frond wind tower (left), the courtyard view (right) in the UAE.	63
Figure 66. Wind towers constructed from palm frond in Abu Dhabi and Dubai	64
Figure 67. The stone hose in Oman (above) and remnants of stone houses in Wadi Sham (bottom).....	65
Figure 68.The date gardens in the UAE1976.....	66
Figure 69. The water pool reflection in the domestic (left and religious structure (right). Isfahan, Iran.	66
Figure 70. A hawk (left) and the falcon's found in the Gulf region (right)sooty falcon.	67
Figure 71. The domestic animals with the tents (left) and domestic housing (right). 67	
Figure 72. The oryx (left) and the locust on the acacia tree (right).	67
Figure 73. Shows the <i>badgheer</i> an example from Dubai (left) and a section showing the movement of directing the wind that enterers through the top to allow a cooling effect below (right).....	68
Figure 74.Plan and section of the <i>badgheer</i> , top show the plan and the bottom showing the section through which the air flow ca illustrated.	69
Figure 75.Show the <i>badgheer</i> over a <i>qanat</i> an example from Yazad, Iran (top) Source:	

(Fathy, 1986), showing the air circulation (below).....	70
Figure 76. an illustration example of the air flow with the wind tower through the courtyard.	71
Figure 77. Illustration of the air circulation during night and day.	72
Figure 78. Traditional Kuwaiti courtyard houses.	72
Figure 79. An example of the traditional courtyard house with pool and a garden, Iran.	73
Figure 80. examples of variation of <i>Mashrabiya</i> (left) Iran Source: (akdn.org) and (right) Saudi Arabia.....	74
Figure 81. the different uses of the <i>mashrabiya</i> left to right humidity control, air flow and the diffusion of light.	74
Figure 82. shows the evaporation process on the <i>mashrabiya</i>	75
Figure 83. the working of the <i>Mashrabiya</i> to allow for air flow from the water jar causing evaporation cooling effect.....	76
Figure 84. shows a schematic diagram of the air pressure movement.....	76
Figure 85. shows the example of <i>Nuqoush Muftah</i> upper openings provide natural ventilation and lighting	77
Figure 86. cross section diagram of the Falaj.	78
Figure 87. the mother well an example from Oman.	78
Figure 88. the primary and secondary shafts.	79
Figure 89. (right) shows the cut and cover section and the sharia (left).	79
Figure 90. shows the surface channel, Abu Dhabi.....	80
Figure 91. Early nineteen seventies, Doha, Qatar, these are the common well that are found in the area, surrounding channel around the well to contain spillage and direct the raised water, and an extension leading to a contained area.....	80
Figure 92. (left), the schematic diagram of the houses near the dates garden and the water Source(right). Shows the falaj used as a water Source for the irrigation of the date palms	81
Figure 93. Masjid al luqta, Wadi, Adi Oman remnants, the section and plan shown below.	81
Figure 94. above shows the plan where the falaj is used and below shows the shows the cross section of Masjid al Luqata Oman where the ornamental pool is visible...	82
Figure 95. shows the diffusion of sunlight in the traditional <i>mashrabiya</i>	84
Figure 96. shows the experience of the diffusion of light from the inside of the	

<i>mashrabiya</i>	84
Figure 97. Dowlat Abad Garden, Yazid, Iran Lattice windows, (left) a vault version of a dome to provide skylight to enter, (right) leads the light inside pleasantly	85
Figure 98. shows the diffusion of light into the room through the <i>Nuqsh</i> panels	85
Figure 99. summer wind tent illustration by Abu Dhabi planning council.....	87
Figure: 100. the traditional Beduion tents.....	87
Figure 101. an example of the <i>beduin tents</i> during the winter months, Qatar.	88
Figure 102. illustration if the summer winter quarters and the use of roof spaces. ...	88
Figure 103. shows examples and cross section of a wealthy family house in Bahrain with separate quarters.....	89
Figure 104. Above an image of the <i>badgheer</i> and courtyard above the winter stay and the colonnade <i>Liwan</i> marked with red, Iran and (below) this an illustration of the winter and summer quarter in the region with use of wind tower. and courtyard in the middle.	90
Figure 105. right shows the detailing of the <i>enf</i> door post and left shows the simpler door decorations.	92
Figure 106. shows the more detailed <i>Nuqsh</i> panels which were usually done for the wealthier people in the community.	92
Figure 107. shows the <i>Nuqsh</i> detailing on the wall with the geometric patterns usually resembling flowers.	92
Figure 108. shows the example of the <i>Nuqsh</i> panels on top of the doors left and the door decorative elements right	93
Figure 109. the traditional Arab housing the ceiling decorative elements, the images show an example from Qatar.	94
Figure 110. shows the wood work balustrade and doors, AL-Aqaili House, Deira, Dubai.	95
Figure 111. (left) example from Dubai shows a tradition arish structure and (right) shows the spacing to allow for the air to follow and keep the house cooler.....	95
Figure 112. muqarnas used as a decorative element in the pedestrian entrance in Qatar.	96
Figure 113. Mud village, Oman ,AL hamara	98
Figure 114. (left to right) show the example of spaces in the traditional Qatar housing with the essence of refuge with at least three sides covered	99
Figure 115. (top) an illustration of indirect view through the screen and (bottom) an	

example of these <i>mashrabiya</i> screens on balconies, Old city Basra, Iraq.	100
Figure 116. (top) various patterns of the <i>mashrabiya</i> screen and (bottom) shows the inside and outside view of through the screens.....	101
Figure 117. traditional alleyways in the UAE (right), Iran (middle) and Iran (left)	102
Figure 118. Rmnants of a building in Wakra, Qatar, 1973. first floor opening in the upper level of the housing.	103
Figure 119. Mud village in Al hamara, Oman (left). the figure shows the openness of the village from a height. Old bazar, Shiraz Iran, (right) shows the old bazar the double height ceiling shows a sense of openness.	103
Figure 120. The arial view of Kuwait from the 1950's indicating the plot arrangements, with buildings placed adjacent to one another with narrow alleyways and each with the courtyards within the plot boundaries.	108
Figure 121. An arial view of the plot arrangements the UAE around the 1950's, showing the interior courtyards as well as the narrow alleyways.....	108
Figure 122. Aerial image of Band Abbas Iran showing similar to the closely arranged plots as the rest of the Gulf region.	109
Figure 123. A simplified diagram of the location of the building in the plot area. It indicates the privacy relationship within and outside the house.....	109
Figure 124. shows an example of the placement of the window opening on top so that the view from outside doesn't affect the interior which gives a sense of privacy along with providing indirect lighting solution.	110
Figure 125. Shows the alternative window opening option with the privacy, as light enters through the perforation and also the view to the interior is minimized and the bottom shows a contemporary use of the <i>nuqsh</i> panel in Kuwait.....	111
Figure 126. Shows the model of the majlis with the perforated window openings providing light, ventilation along with privacy.....	112
Figure 127. Contemporary use of <i>Mashrabiya</i> in masdar project Abu Dahbi.....	112
Figure 128. The <i>mashrabiya</i> over the sikkak narrow pathways left in the traditional Persian alleyways (left) and the use of contemporary <i>mashrabiya</i> in the alleyway in Masdar project Abu Dhabi (right).....	113
Figure 129.(left) Shows the classic example of a wind tower as well the interior courtyard. and also, the openings above the doors and (right) a contemporary version of <i>badgheer</i> used in Masdar project Abu Dhabi.	114
Figure 130.New type of windcatcher used in the university of Qatar.	114

Figure 131. Shows the <i>badgheer</i> (wind tower) over the sikkak (the narrow passage ways) to provide air flow affect in through the corridor.....	115
Figure 132.Shows the working of the wind tower in reference to how it can be used in the alley ways.....	115
Figure 133.An example of the horizontal <i>badgheers</i> (wind catchers) (right) and (left) the movement of the air into the horizontal wind catcher.....	116
Figure 134.this image shows the Al falaj irrigation system, with a narrows stream of water that comes from the underground irrigation passes through the date gardens.	117
Figure 135.shows a model for the use of shading through planting date palm trees over the sikkak narrow pathways	118
Figure 136. Example of horizontal windcatcher	119
Figure 137. example of <i>Mashrabiya</i> screens	120
Figure 138. example of planting near gate.....	120
Figure 139. <i>Mashrabiya</i> and planting	121

GLOSSARY OF NON-ENGLISH WORDS

Al Falaj: is a kind of underground water irrigation system used in the area to bring water from distances.

Arish : building material made of palm frond/stalks and is the construction pitched roofs from palm fronds.

Badgheer: a traditional wind catcher or wind tower used to create natural ventilation and passive cooling.

Bayt shar: tent structure made of sheep or camel wool.

Dain : palm frond knotted together to produce a standardized style of Matt.

Enf : vertical post on double door

Ghaf : a species of flowering tree in the pea family.

Hasir : a woven mat like thing, usually made from date leaves.

Juss bahar: beach plaster.

Juss : traditional way of plastering, usually lime mortar.

Libin : brick.

Liwan : front open rooms or halls, covered terraces.

Maidaan: open spaces or open market places or squares.

Majlis: a sitting room either inside or at the outside for gathering usually male informal gatherings or an informal gathering where issues are discussed.

Mashrabiya: a lattice system or in some cases a street open window which on the inside provides ventilation and indirect, as well as screening from the outside.

Midar : mudbrick.

Muqarnas: usually in honeycomb or stalactite form; a structural element often used between the foot of a dome and the supporting wall or otherwise around the head of a column.

Nuqoush Muftah: plaster panels with openings to provide ventilation

Nuqsh : plasterworks with carved plaster panels.

Qanat : underground water canal

Sablah : a shaded outside sitting room.

Salhat midar: surface plaster.

Sarooj : red clay mixed with manure.

Sikkak: narrow pathways or alleyways formed as a result of the close building layouts.

Souq : market places for trade goods.

Ustad : usually referring to person a master or teacher.

Waddi : Arabic term referring to valleys.



CHAPTER 1:INTRODUCTION

1.1 Summary:

This chapter presents the key research questions of the present work, its objectives and focus, the applied methodology, and the thesis structure.

1.2 Research questions:

The present research is structured based on answering the following questions.

- What are the traces of Biophilia in the vernacular architecture of the Gulf region?
- What lessons from it can be incorporated in contemporary buildings?

The term Biophilia refers to the "love of life" in ancient Greek, it has gained popularity throughout recent times. Vernacular architecture refers to architecture materialized by the use of local materials and expertise, typically without skilled architectural supervision, and focuses mostly on the local elements of culture and tradition within the geographic region (Heath, 2009). The relation of Biophilia with vernacular architecture has not been explored extensively especially in the context of the Gulf region (the Gulf region refers to the countries bordering the Persian Gulf as mentioned below). Therefore, the first Research question aims to study the Gulf region where the climatic conditions are considered to be hot-humid to delineate the biophilic design features in the local vernacular architecture by looking at different cases of vernacular architecture in the specific area. A second objective is to come up with lessons from the past that can be incorporated in the contemporary buildings in the same region.

1.3 Objective and focus:

The study intends to investigate the traces of Biophilia in the vernacular architecture of the Gulf Region along with looking at their sustainability.

The paper focuses on the vernacular architecture and their feature, their brief history along with discussing the biophilic design and sustainability aspect in them. This is done through viewing different literature and research done from previous years (mentioned in the bibliography section) while paying attention to the biophilic patterns, materiality, construction practice and sustainability as a framework. The relationships between environmental conditions and materiality are also going to be considered. The cases are selected on the basis of the use of local material, sustainability and the biophilic contributions towards it (as mentioned in the

methodology section). The study also aims to propose solutions found from the study to be used in contemporary architecture.

1.4 Methodology:

In order to develop important conclusions, a qualitative review of the existing literature on the subject was carried out, after which the different aspects of the vernacular architecture of the Gulf region were studied to delineate the biophilic feature that are present in them. This was done through looking at different cases of vernacular architecture that is present in the region.

Biophilia has a broad spectrum in terms of the research opportunities as it is present in sociology, physiology, in medical researches, as well as in architecture and interior design. Of all these, the research done for this paper focuses on the architecture aspects of Biophilia.

The methodology for this research includes theoretical bases using a qualitative method of research. The literature about Biophilia as well as about sustainability and its relation to vernacular architecture is presented. Second, section is an analytical approach for examining elements of the vernacular architecture of the Gulf region analyzing them in terms of Biophilia and sustainability. The biophilic features that is looked at was based on the 14 patterns of biophilic design proposed by Browning (2014). The final aim was to propose solutions that can be applied on contemporary architecture.

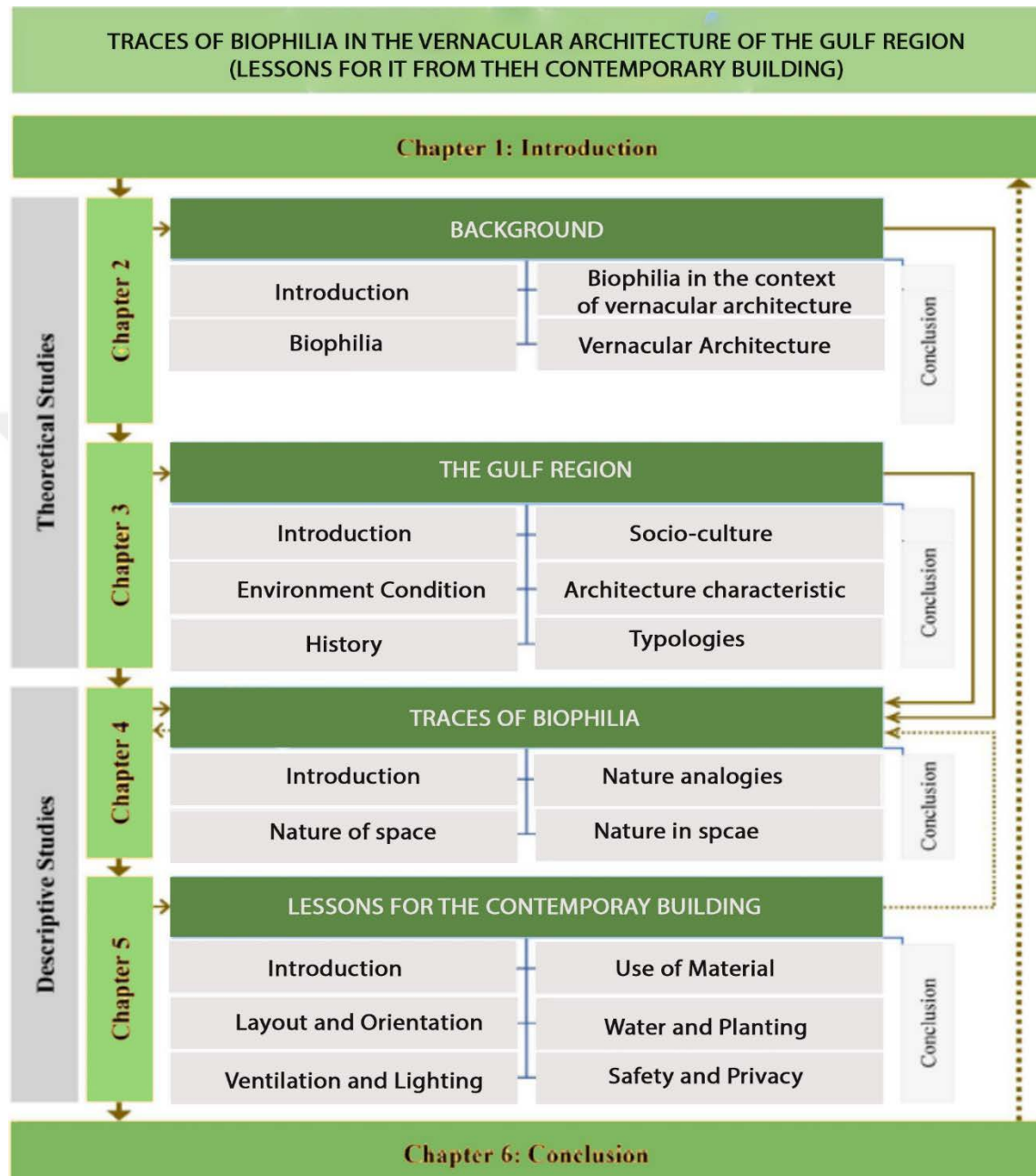
1.5 Thesis structure

After outlining the nature of the study, the research question, objective, focus, and methodology in chapter 1 of the thesis, this section describes its structure. The thesis is starting with an introduction to the topic proceeded by the discussion on the Gulf region, after which the two main questions of the thesis are addressed: first the traces of Biophilia in the Gulf region and then the lessons from it for the contemporary architecture.

The next chapter 2 discusses the background and literature review on Biophilia as well as the vernacular architecture of the Gulf region. In chapter 3 a study of the Gulf region is presented, where the geography, environmental context, history, socio-culture aspects and the vernacular architecture of the region is discussed. In chapter 4 the traces of Biophilia are addressed on the basis of the 14 patterns of biophilic design was as devised by Browning, et al., (2014). Chapter 5 presents the lessons from the biophilic examples of the vernacular architecture which can be considered for

application on the contemporary architecture. The last chapter 6 presents the conclusions and some recommendations for further research.

Table 1. Thesis structure regarding chapters and topics.



CHAPTER 2:BACKGROUND

2.1 *Summary:*

This chapter presents a literature background of Biophilia hypothesis and biophilic design, as well as explaining the concept of vernacular architecture and vernacular architecture of the Gulf, highlighting their relationship with sustainability.

2.2 *Chapter overview*

The chapter covers various topics related to the thesis. In brief:

- **Biophilia:** The term Biophilia is composed of two terms 'Bio: life' and 'Philia: affection' describing the link between nature and humans. With Biophilia being a broad spectrum, many approaches are present in it and discussed in this section
- **Biophilic design patterns:** A method devised by Browning et al.(2014) aims on enabling human connection to nature in the built environment. It consists of 14 patterns based on three elements: nature in space, nature analogies and nature of space.
- **Biophilic design in the context of vernacular architecture:** There are not many studies done on the connection of Biophilia to vernacular architecture. However, some studies that rely on biophilic architecture have indicated the potential for the incorporation of vernacular architecture studies.
- **Vernacular architecture:** The vernacular architecture is the people's response to the climate and geophysical context of their region with the uses of locally available materials for solutions appropriate for the given conditions.
- **Vernacular architecture and sustainability:** Vernacular architecture is considered to be sustainable since it survives the environmental challenges of a particular location providing solutions without using modern technology.
- **Vernacular architecture of the Gulf:** This section discusses the various literature background of the Gulf vernacular which are described in detail in the next chapter.

2.3 Introduction

This section of the paper is an introduction to the literature review and will discuss the existing literature and background of the research area and topic to get an overview of the existing literature. The list of bibliography that will be used to conduct the extensive literature review is presented in the bibliography section of the paper. The research sources that were used to conduct this literature review include primarily but not only on the Web of Science, ScienceDirect, Scopus, Google Scholar and Research Gate databases.

2.4 Literature on Biophilia

2.4.1 Brief introduction to Biophilia in architecture



Figure 1. On the left Hanging Gardens of Babylon as a historic example (Source: History, 2021) and on the right Bosco, Verticale, Boeri Studio in Milano, Italy as an example from recent architecture (Source: humansinnature , 2021)

The term Biophilia is composed of two terms 'Bio: life' and 'Philia: affection' describing the link between nature and humans (in other words the love of life). The idea of Biophilia was first proposed by psychologist Erich Fromm in 1964 and then popularized in the 1980s by biologist Edward O. Wilson, who researched the loss of interaction with nature created by urban living. In historic buildings and sites, the integration of natural qualities suggests that biophilic architecture is not a recent phenomenon; rather it is the codification of tradition, human intuition and neural sciences as an opportunity of applied science that demonstrates that relations with nature are important for maintaining a stable and active life as an urban species (Browning, et al.,2014). Some famous examples include the Alhambra Garden courtyards of Spain, the hanging Gardens of Babylon, and the Bosco Verticale, Boeri Studio in Milano nobles among many others (Browning, Ryan, & Clancy, 2014).

Biophilic Architecture is an impression of the incorporation of nature into the built environment. The Biophilic design idea centers around a perception that humans on physical, behavioral and social levels have a biological necessity for interfacing with nature and that their associations impact our prosperity, viability and cultural relations (Hopkins,2014).

2.4.2 Background of biophilic design

Biophilia is a word that Wilson (1984) developed, and he defines in his research that Biophilia as an

“Innate Human beings relational affiliated to all living beings Organisms are an inborn affinity” (Wilson, 1993, p.31)

Wilson mentions about how human beings inherit these positive feelings for nature. He believes that both positive and negative (including phobic) affiliations toward natural objects (species, phenomenon) as compared to artificial objects are evidence for Biophilia (Ulrich,1993).

As for biophilic architecture it relies on the theory of Biophilia, which means that humans have an inborn connection with nature. According to the Biophilic theory, it is an animate relationship between individuals and the natural environment, these effects of exposure to nature started in an organic bond between people and the natural world.

Afterwards, in the publication, the theory of Biophilia (Kellert & Wilson, 1993), contributes to studying the relevance of the biophilic theory of Wilson, which concludes that Biophilia is produced in a cultural community through natural selection. It was instead, approached by the ecological perspective that applies to increasing proof of the way people are aesthetically intrigued, physiologically and physiologically related, to nature, as well as how human beings reverence towards the world (Simaika,2010).

Not only does Biophilia have its base in science but also has its roots from physiology as psychologist, Erich Fromm (1964), first describes the concept in his book “The Heart of Man” in 1964. He describes Biophilia as a tendency to protect life and to fight against death and also describes the inverse of it as necrophilia; the word represented as the love of death (Fromm, 1964). He further explores the term Biophilia in his other publications and explains that Biophilia is not just a personal preference within one's subconscious; it expresses itself in the real environment and induces some to take action. Not just one's own nature, but also the character of those around the

biophilic personality and their world would be enhanced by the cultivation of Biophilia (Young, 2008).

Both views on Biophilia as described by Young (2008) have different approaches to the concept of Biophilia as Fromm's approach is directed towards enhancing human needs prior to enhancing other part of nature in the process and aims to emphasize more on humans' point of view, whereas the studies of Kellert and Wilson is directed towards enhancing nature along with enhancing human needs in the process as well as their love for seeing the planet preserve its biodiversity (Young, 2008).

2.4.3 Biophilic design patterns

In the realm of the built world, the book Kellert edited on the biophilic design (2008) coined the word "biophilic architecture" that founded the definition of Biophilia within it. The concept is defined as an approach to the design of the built environment in a manner that stresses the need to maintain, enhance and restore beneficial nature experience and defines two key dimensions of organic or place-based biophilic design. That can then be extended to six biophilic design elements, which act as a biophilic design guide:

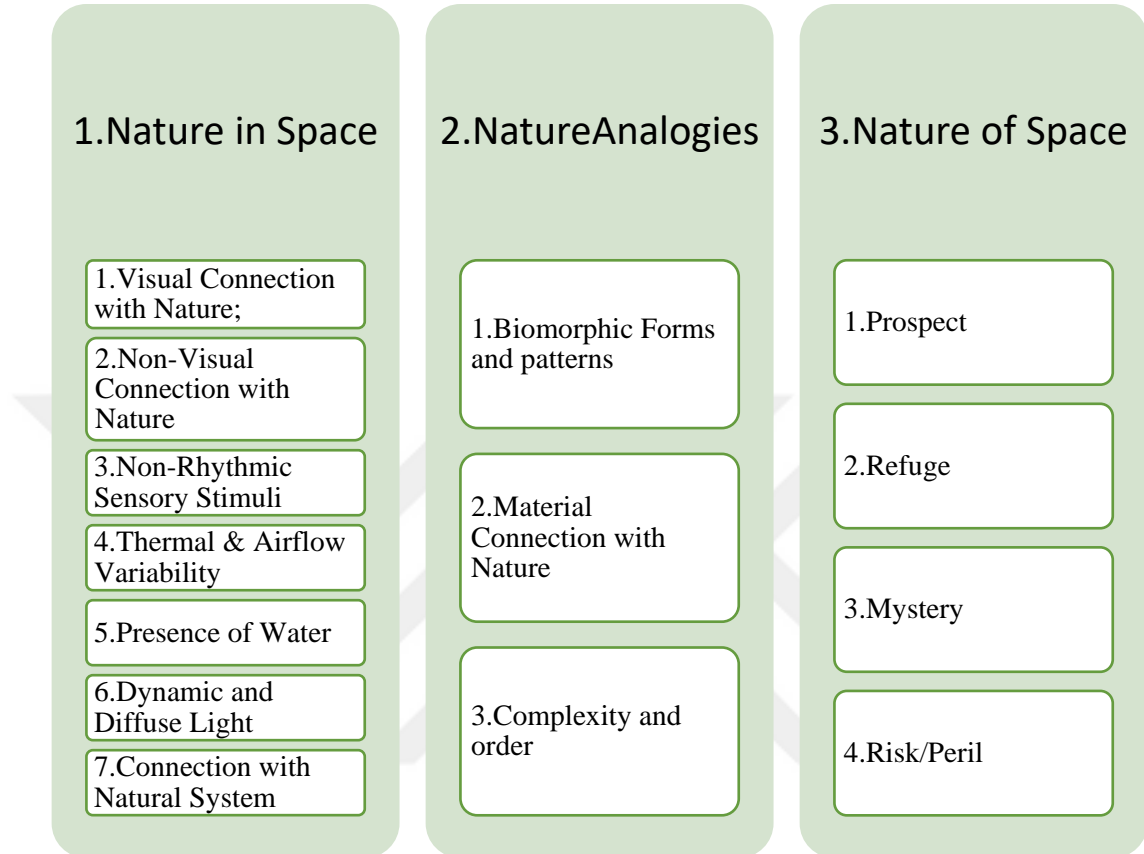
1. Visual connection with nature
2. Non-visual connection with nature
3. Access to thermal and airflow variability
4. Presence of water
5. Complexity and order
6. Prospect and Mystery

Each element and attribute, having a direct or indirect connection to nature that why each element is meaningful (Browning, 2016). Even though the list is formatted in a way where one can concentrate on the main categories or dig further into details, it can be a little daunting as an overall list due to being a set form element to take into consideration (Ojamaa, 2016).

The "14 Biophilic Design Patterns," is a similar system/list, devised by the Terrapin Bright Green company (Browning, 2014). Derived from a history of Biophilia and biophilic design, through describing the science and analysis behind each pattern, in order to present "14 Patterns" or a "series of tools" for applying biophilic design into the built environment Table 2. Where the research on the conceptual structure for biophilic design patterns first set out in Biophilic Design by

Cramer and Browning (2014), which divided the 14 patterns in three categories to better describe biophilic buildings:

Table 2. shows the 3 categories along with the 14 biophilic design patterns (which was proposed by Browning (2014)).



It presents a collection of design considerations to explore different aspects that should be addressed by designers to effectively incorporate biophilic design trends (Browning et al, 2014). The significance of the "14 Patterns" analysis is that it provides an open framework for transforming investigation into application design, blending research, benefits, and evidence, as well as how to apply them effectively via an acceptable design approach (Browning, et al., 2014). While the company's initial white paper focused on economic significance, "14 Patterns" placed a greater emphasis on health advantages, outlining how each of the 14 Patterns adds to stress reduction, cognitive efficiency, and emotion, mood, and performance proof. (Browning, 2014).

2.4.4 Biophilic Design in the context of vernacular architecture

There are not many studies done on this particular topic; however, some studies that rely on biophilic architecture have indicated the potential for the incorporation of vernacular architecture studies (Ramzy, 2015). For instance, the biophilic design trends that were studied by Terrapin researchers (Browning, et al., 2014), they

welcomed the positive response of the vernacular to topography, atmosphere, regional ecology and local materials. Therefore, indicating a potential for sustainable solution which bridges biophilic and vernacular architecture.

2.4.5 Literature on vernacular architecture

2.5 Brief introduction to vernacular architecture



Figure 2. Vernacular architecture from different regions (from left to right) Cliff of Bandiagara, Mali, Malay Houses, Malaysia and Singapore, Mugsum Mud Huts, Cameroon, Ab-anbar, Iran (Source: archdaily, 2020)

Vernacular architecture may be characterized as unpretentious, plain, organic, conventional constructions made of local materials and well-tried styles and varieties. The vernacular design in the building environment is produced on the basis of the needs of the community (cities, architecture, and interior spaces) (Curl, 2006). It is designed to meet the technical, economic, social, and cultural standards of citizens in compliance with the natural environment (geography, topography, location, nature, local construction materials, labor experience, and building techniques, as well as cultural influences). A symbol of a collective identification is vernacular architecture; it is the "mirror" of nations that represents place, time, and community. Vernacular architecture is designed for human needs; it has grown over time and changed itself to meet the needs of humanity in accordance with the environmental context by trial and error (John, 2005).

The notion of the vernacular as mentioned by Sharp (2002) as a progenitor of architectural ideas has been a debatable issue (Sharp, 2002). It is rather understood as a traditional branch of architecture. It is gradually becoming a response to quest for

urban or architectural ideas centered on the specific arrangement of spaces and buildings of a locality or area. The vernacular, in a way, blends both progressive and traditional, pragmatically focused on practice, and as a result could be a Source for modern urban and architectural solutions. In order to regain touch with the fundamental essence of space and building arrangements, urban developers, urban designers and architects are turning to the vernacular and to re-create a simple urban and architectural type. This is a return to the origins, or the bedrock. The vernacular is a fundamental reality, and is more connected to the environmental and local conditions (Eben Saleh, 2000).

2.5.1 Vernacular architecture and sustainability

The interest in the sustainability of vernacular architecture has increased noticeably over the years (Foruzanmehr, et al., 2011). While not nearly as frequent as compared to studies that continue to discuss more conventional topics such as the historical development or cultural expression of vernacular building practices, a large number of publications have directly discussed environmental performance issues of vernacular architecture in recent years, including its thermal abilities, energy usage and resource use (Rapoport, 1980). Although differing in terms of their thematic reach and conceptual methodology, the overarching concept that those interested in the contemporary production of sustainable architecture should benefit from the research of vernacular architecture, since it is one consistent theme to arise from these studies. In general, the theory goes those vernacular traditions have long been linked to their natural surroundings in an age marked by a multiplicity of environmental challenges. For those interested in contemporary architecture practice, this more sustainable method is considered to hold certain useful lessons (John, et al., 2005).

Vernacular customs are considered to be in a state of decline throughout the world and are mostly looked down on, discarded, ignored or deliberately destroyed (Oliver, 2007). They are consistently substituted by design styles that prefer more recent, advanced technologies, materials and shapes, since they are connected, by many at least, with the past and poverty. Interestingly, often these disappearing vernacular practices are precisely those that are recognized as being able to offer useful environmental design lessons. For instance, the wind-catchers of the Middle East are especially good examples of this paradox. These reflect a complex and refined design of vernacular passive cooling techniques for many researchers, however nowadays these methods are scarcely ever utilized by their owners for cooling purposes and have

usually been substituted by electro-mechanical cooling systems (Foruzanmehr, et al., 2011).

Any style of architecture should be interdependently linked to its local cultural and environmental background, including the vernacular. Starting from an approach that takes into account both the local cultural embodiment of the customs involved and their actual environmental output is significant. Only a careful analysis of a multitude of cultural and environmental considerations may expose the reasons underlying the decisions taken by individuals in regards to the preservation or abandonment of particular practices. The lessons a specific vernacular practice should actually offer in terms of environmental design and building, is the knowledge of local motives (Foruzanmehr, et al., 2011). The study of vernacular architecture and its environmental efficiency is frequently separated, resulting in analyses that provide insights on both aspects, but seldom on both.

2.5.2 Vernacular Architecture of the Gulf Region

The Persian/Arabian Gulf is surrounded by eight states, namely Bahrain, Kuwait, the coastal region of Iraq, the southern coast of Iran, Oman, Qatar, the north eastern coastal region of Saudi Arabia and the United Arab Emirates (UAE). All the Gulf States, with the exception of Iraq and Iran, are located on the Arab Peninsula. All of these states except Iran and Iraq prefer to use the term "Arabian Gulf" rather than the Persian Gulf's historical name (discussed further in chapter 03.3).

This section of the literature review focuses mainly on how elements of vernacular architecture have presented themselves over the years in the Gulf region and explains different techniques adapted to the region's environmental conditions. It gives an overview of the Gulf region which is further discussed in detail in chapter 3. In essence, this study explores the complex relationships between how elements of vernacular architecture are applied to buildings in the Gulf region; the implications of designing for different socio-cultural groups, particularly how these relationships affect the end-user, from different classes of privacy catering to the local culture (Motealleh, et al., 2018). Furthermore, the region has similar features between its parts due to the major influence from the historic empires that governed the region such as the Ottoman and Persian, who brought along the architectural feature such as the *mashrabiya* (latticed screen), *badgheer* (wind towers), domes and courtyard pools, etc. (R. Hawker, 2008).

The vernacular architecture of the Gulf region developed from ecological and urban morphological points of view in harmony with the environment. In the case of Kuwait, Qatar, Bahrain, Emirates and Oman, the fort is the primary building for defensive reasons, and there are groups of buildings around it (Eddisford & Carter, 2017). The fort generally included a castle, which provided a high-level space to watch and control the situation. It also included a space for weapons to be used on the spot in the event of a fight. The only difference between them was that the castle was with a circular plan and the other was with a square or rectangular plan.

The structure of the traditional city of Saudi Arabia for instance was based on a controlled hierarchy of roads, spaces and buildings. It could be said that both the castle and palaces were defending buildings with two or three level stories. The residential districts were divided by narrow alleyways called *sikkak*, with various widths ranging from 3-6 meters. These, in turn, led to the 2-4 m long cul de sacs, to which the main dwelling doorways opened. The traditional city organization in a compact aggregation of smaller and larger courtyards (Hobbs, 2017). Each courtyard was equipped with a group of collective and individual uses with open areas, access systems and shared facilities. This organization is an organic urban structure, arborescent and "animated," different from the rigid uniformity that is the product of urban planning's mechanical modes.

The urban design approach (compactness and global development rather than fragmented series of buildings seen as "objects") is the main feature of the Gulf vernacular. From an archeological point of view, the rural environment played an important role in defining the concept of urban dwelling and its connection with its surroundings through the organization and composition of the tribes and the physical environment (Borombaly & Prieto, 2015). Each traditional city is characterized by a residential architectural composition, which creates the style of the city. In the case of the Gulf region as a whole, houses are mainly determined by certain physical constraints, such as climate and material availability. In shaping the physical characteristics of the Vernacular Architecture, the harsh climate, the availability of construction materials and other geographical features have played an intrinsic role. The tent is the easiest and may be the oldest form of shelter used continuously throughout the deserts of the Arabian Peninsula. Because of their visual association with traditional *beduin* tents, tents are highly compatible with the nomadic way of life; they are also symbols of national identity (Babsail & Qawasmi, 2014). The other forms

include three types of houses are distinguished in urban areas: the construction of inner desert cities adapted to the hot dry climate; the coastal buildings adapted to the hot humid climate; and the building of mountains determined primarily by the availability of materials.

Buildings have tended to conform to the restricted space available for construction in architectural terms in most of the vernacular architecture in the Gulf. Buildings have given residents a high degree of privacy in functional terms, while facilitating inter-communal activities and a combination of these factors has contributed to the social values that residents derive (Sallal, 2017).

The structure of the urban spaces in most of the vernacular within the Gulf has standard features: narrow streets, closed views, open spaces given over to urban and social squares, but wide local variations have been created by the traditions of buildings. These variations give their dynamic character to the cities. A sequence of wide to narrow constructions takes the form of the urban structure. Open spaces narrow through interconnecting roads inside the city gates, and then open out into social squares again. All over the city, this pattern is repeated (Afshar, et al., 2011). Around the social square, the mosque and the public activities are located. The social square acts as a link between the mosque, the public activities, and the housing cluster's entrance. At the level of city planning, the minaret of a mosque seen as a landmark is a common phenomenon (Mazraeh & Pazhouhanfar, 2018).

The structure and the identity of the Gulf region reflect tribal origins or ethnic problems. Stratification is the way urban development is done. Dwellings and houses are a fundamental unit of the morphology of the city, and have their own features and social structure. One of the main characteristics of the traditional city is the composition and height of housing as a global and compact one (Sayigh, 2019). In addition to this, the minarets of the town form a distinct feature along the sky-line with the houses. The homogeneity of building materials, mostly baked bricks decorated with gypsum, is also noticeable, enhancing the visual value of the city (Maleki, 2011).

Some spatial, physical and cultural metamorphoses of their cities were caused by the rapid and unprecedented urban growth in the Gulf region (Alelwani, et al., 2020). Such metamorphoses also open doors and opportunities for new technologies and architectural languages rooted in vernacular architecture to be developed and/or reinterpreted. In this way, given its world-class architecture, the region has managed to manifest itself as a point of interest for tourists (Mileto, et al., 2014). Whether or not

the resulting manifestations in the constructed fabric were controversial, from architectural and other experts, eyes have zoomed in on the region, becoming points of reference. These vernacular designs provide domestic high-quality design examples, moving from a time when design paradigms would be looked outward by the region (Kahraman and Carter, 2019). The chosen vernacular prototypes of tents, mud-bricks, arish houses and wind towers highlight the architectural scale of the vernacular of the Gulf region and present the fundamental core of the comparative analysis, where such prototypes are the region's most recognized and recognized vernacular structures (Heidari, et al., 2017).

2.5.3 Conclusion

In conclusion after looking at the indicative literature review, it can be said that a focus on the biophilic attributes of vernacular architecture would effectively bridge the two domains vernacular architecture and biophilic design in order for them to benefit from each other. Therefore, a further survey is done to study these in depth in the proceeding chapter. In essence literature has revealed that the study of biophilic design in the vernacular architecture has not extensively been explored and especially in the Gulf region, therefore this thesis investigates these attributes in order understand their benefits.

CHAPTER 3:THE GULF REGION

3.1 *Summary:*

This chapter surveys the conditions that generated the vernacular architecture of the Gulf region, presenting its environmental, historical, and social framework, as well as the architectural context and typologies.

3.2 *Chapter overview*

The topics covered in this chapter include:

- **The region:** the region bordering the Persian Gulf, or Arabian Gulf, or Gulf Sea is considered in this study (around 200 km from the coast) as well as parts of the neighboring area since they provide to have influences on each other due to the movement of people.
- **Environmental conditions:** looked into the local geophysical features, the climatic variations, and the vegetation of the region. Which showed that the region is very much diverse in geography, has harsh climates with very cold winters to very hot summers with humidity ranging from 10% to 90%. And winds in the upper Gulf coming mainly from the west-north-west direction and in the lower parts of the Gulf from the south direction.
- **History:** discussed the different periods and influence in the region. From the ancient history of the Mesopotamian, to the colonial era, to the modern and contemporary periods.
- **Socio-cultural:** Socio-cultural aspects discussed refer to the major religion in the region and how it has influenced the local built environment from the privacy factor to the safety.
- **Architectural styles and influences:** The region have influences majorly from the Persian architecture and some of Indian influence.
- **Uses of material:** the locally available material was used such as palm frond, masonry, wood and plaster.
- **Building typologies:** Typologies such as; courtyard house, masonry house, palm frond house, and woolen tents.

3.3 Brief introduction to the Gulf region



Figure 3. Adopted from the Nations Online Project, Map of the Gulf region formally known as the Persian Gulf.

In Western Asia, the Persian Gulf is an enclosed sea and the states which border with the body of water are referred to as the Gulf region. The Gulf is an extension of the Indian Ocean through the Gulf of Oman and across the Strait of Hormuz, which lies between Iran and the Arabian Peninsula. The northwest shoreline is created by the Shatt al-Arab River Delta. The water body is traditionally and globally recognized as the "Persian Gulf". It is referred to as the "Arabian Gulf" or "The Gulf" by Arab governments. The International Hydrographic Association uses the term "Gulf of Iran (Persian Gulf)" (Grichting, et al., 2019).

These are (clockwise, from the north Figure 3) the countries with a coastline on the Persian Gulf: Iran; the Musandam exclave of Oman; the United Arab Emirates; Saudi Arabia; Qatar, on a peninsula off the Saudi coast; Bahrain, on an island; Kuwait; and Iraq in the northwest. In the Persian Gulf, several small islands are also found, several of which are the focus of territorial conflicts between the states of the area.

All of these nations, with the exception of Iraq and Iran, are members of the Gulf Cooperation Council (GCC) and tend to use the word 'Arab Gulf' rather than the Persian Gulf's historical name. All the Gulf States, with the exception of Iraq and Iran, are situated on the Arab Peninsula, with their predominant religion (Islam) as a common characteristic. A major difference is that the population of the Gulf area is predominantly Arabic on the west coast and Iranian on the east.

3.4 Environmental conditions

In this section the Gulf region is divided into four areas to better explain their common environmental attributes and make it easier to understand the region:

The upper Gulf

- Iraq
- Kuwait
- Iranian costal region

The central Gulf

- Saudi Arabia regions bordering the Gulf Sea
- Bahrain
- Qatar

The lower Gulf

- Iranian south coast
- UAE
- Oman (the gateway to the Gulf)

3.4.1 Geography



Figure 4. Geographical Diversity in the image the different geographical aspects of the region is shown from the coastline to the mountainous areas.

Geographically the region is divided into four areas:

- the mountain zone,
- gravel plains of the mountains,
- the coastal strip where most of the towns are located
- the great desert.
- The Eastern Gulf -which is the Iranian shore- is mountainous, and there often are cliffs; elsewhere a narrow coastal plain with beaches, intertidal flats, and small estuaries borders the Gulf.

The majority of the Upper Gulf area

- is covered by a flat, arid desolate desert with sandy plains punctuated by shallow depressions and low hills.
- In the southwest, toward the Saudi Arabian border, the ground (desert) begins to rise somewhat. An unidentified hill with a height of 306 m is the highest point. Inland basins are served by wadis, or temporary watercourses.

- In Al-Qurnah of south Iraq, the rivers Tigris and Euphrates meet forming one river, which flows about (193 kilometers) southeast, passing through Iraq's Basra and Iran's Abadan before emptying into the Gulf. For almost half of its length, the river serves as a border between Iraq and Iran, and it receives a tributary from the Iranian side, the Karun River. The width of the river varies from (37 meters) at Basra to 0.5 mile (0.8 kilometers) towards its mouth (Evans, 2020). Along the established banks, there are date-palm farms that are naturally irrigated by tidal action.

Central Gulf area

- The Rub' al Khali, Dahna, and Nafud deserts, which stretch from south to north and make up more than half of the land, make up around two-thirds of the province in eastern Saudi Arabia. Due to the breakthroughs achieved during the Green Revolution in farming and irrigation techniques, areas such as Hafr al-Batin and the Ahsa Oasis have become key places for desert farming (Philby, Bridger, William and Joshua, 2021).
- The Gulf of Bahrain surrounds much of Bahrain and is a relatively shallow entrance of the Persian Gulf. The seafloor near to Bahrain is rocky, with huge coral reefs mostly off the northern section of the island. The majority of the island is low-lying desert. Low undulating hills, stubby cliffs, and shallow ravines are formed by limestone outcroppings. The interior features an escarpment that climbs to 134 meters, the island's highest point, to form Jabal al Dukhan.
- Qatar's peninsula is low-lying. Its form is the surface representation of the Qatar Arch, one of the Plate's most prominent structural features. It is surrounded by loose sand and stones that have been chipped off the protruding limestone. The east has smooth plains with fine-grained dust covering the surface. The peninsula's southern and southern-western portions are mostly made up of sand dunes and salt flats. Hill ranges (known as 'jebels') may be found in western Qatar around the Dukhan region, as well as on the northeast coast at Jebel Fuwayrit. Jebel Nakhsh is a noteworthy mountain crest south of Dukhan that holds significant gypsum resources.

Lower Gulf area

- The Emirates have a diverse ecosystem that includes stony desert, coastal lowlands and marshes, and waterless highlands. The coastline attracts birdwatchers from all over the world since it is a sanctuary for migratory ducks.

- Oman is unusual in its vastly different scenery, ranging from desert to Rocky Mountains, and from bustling cities to serene coastlines. While the capital city, Muscat, is located on the 3,165km shoreline, the Al Hajar Mountains are the tallest mountain on the Arabian Peninsula with their height reaching 3,000m. The mountain separates Oman's low coastal region from its extensive deserts (Crystal, 2021).

3.4.2 Climatical conditions in the Gulf region

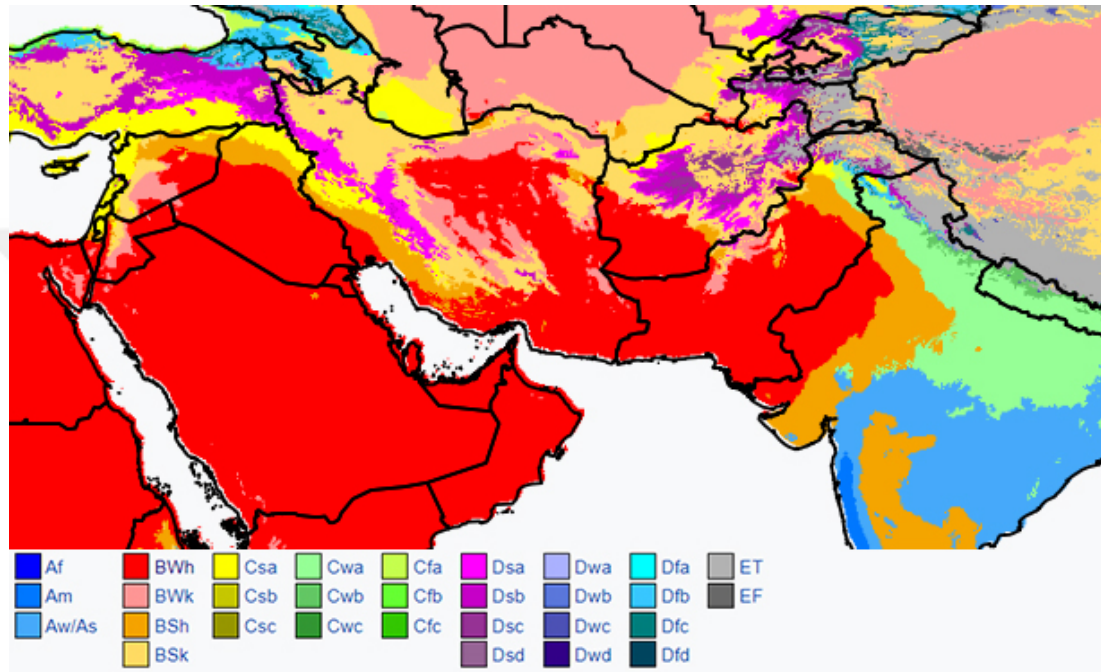


Figure 5. The figure shows the Köppen climate classification map of the Gulf region and the regions surrounding, from which it can be observed that the Gulf region (indicated by the circle) has about the same climatic classification and it belongs to the BWh climate which is defined as the desert climate or arid climate. (Source: Köppen_climate_classification, n.d).

The Gulf has a climate that is famously unpleasant. Temperatures are high, but in the northwestern extremities, winters can be very cool. Around November and April, the sparse rainfall occurs mostly as sharp downpours and is higher in the northeast (Evans, 2020). The humidity is elevated due to the high evaporation of the sea water under the intense sun. The slight covering of clouds is more common in winter than in summer. Thunderstorms and fog are uncommon, although in summer, dust storms and haze happen regularly. The shamal, a wind that during the summer blows mainly from a north-northwest direction in the upper part of the Gulf (Figure 7) and (Figure 9), is seldom powerful and rarely hits gale power, whereas winds in the

lower Gulf the prevailing wind direction is from the south with the wind coming from the Indian ocean Figure 11. In fall, squalls and waterspouts are widespread as winds often exceed rates of (150 km) per hour within five minutes. Gentle offshore winds in the mornings and powerful onshore winds in the afternoons and evenings result from intense heating of the ground adjacent to the coasts (Evans,2020).

The images bellow illustrates basic climatic parameters of 3 selected location, Kuwait (from the upper Gulf), Abu Dhabi (from the middle) and Bandar Abbas (Iran) (from the lower), showing the ranges of thermal comfort.

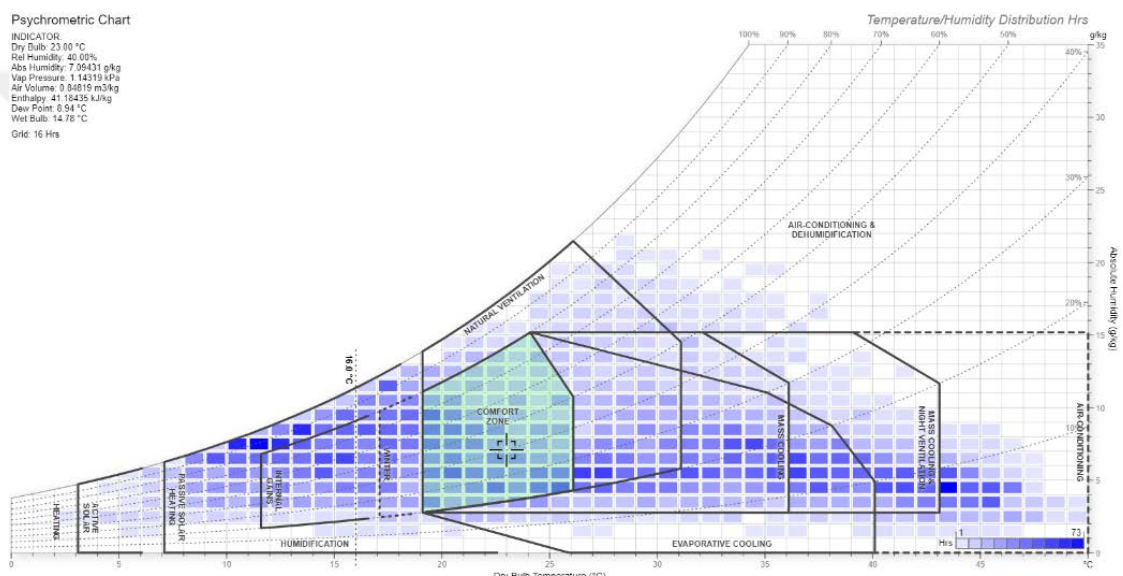


Figure 6. Adopted from andrewmarsh, Psychrometric Chart of Kuwait very cold winter temperature and very hot summers. Humidity low ranging from 10% up to 90%.



Figure 7. Adopted from andrewmarsh, Kuwait wind rose: the dominant shamal wind from the west north west direction.

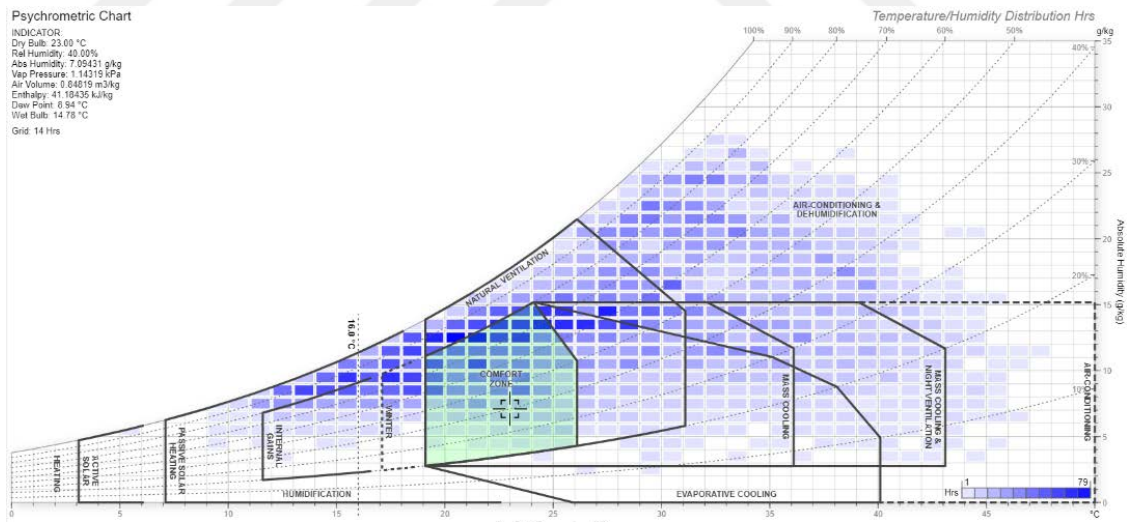


Figure 8. Adopted from andrewmarsh, Psychrometric Chart of Abu Dhabi shows extremely summers with very high levels of humidity.

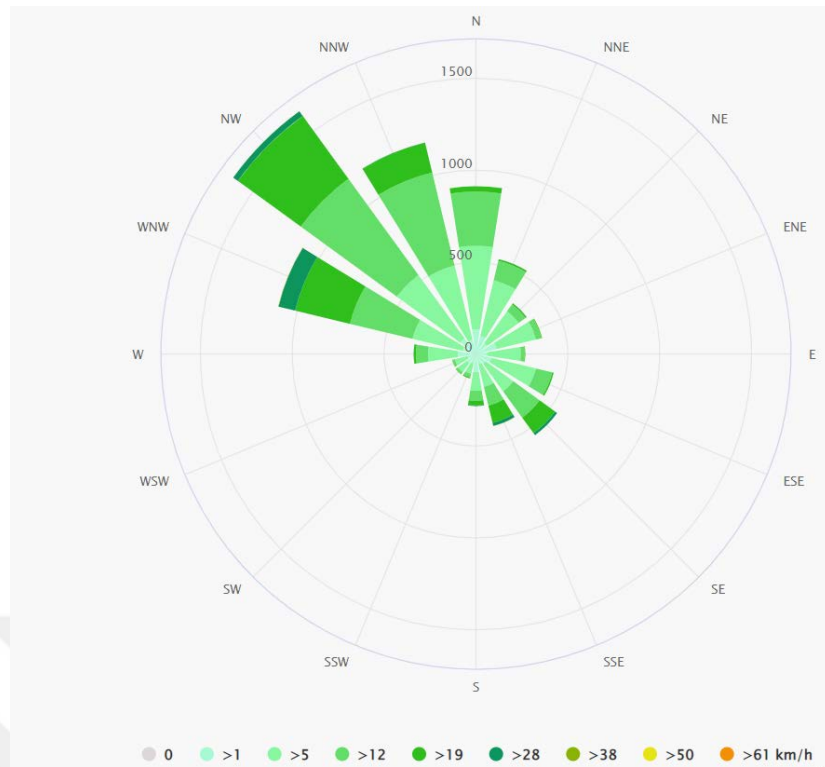


Figure 9. Adopted from meteoblue, Abu Dhabi wind map show similar wind trend as above with the shamal coming from the north west.

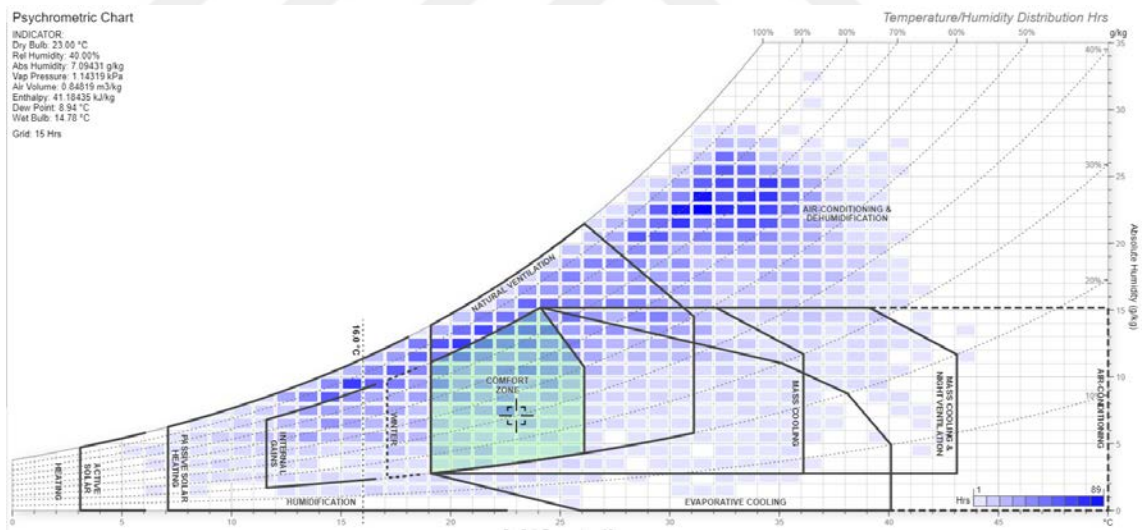


Figure 10. Adopted from meteoblue, Psychrometric Chart of Bandar Abbas show cold winter with extremely hot summer temperatures, humidity raging up to 90%.

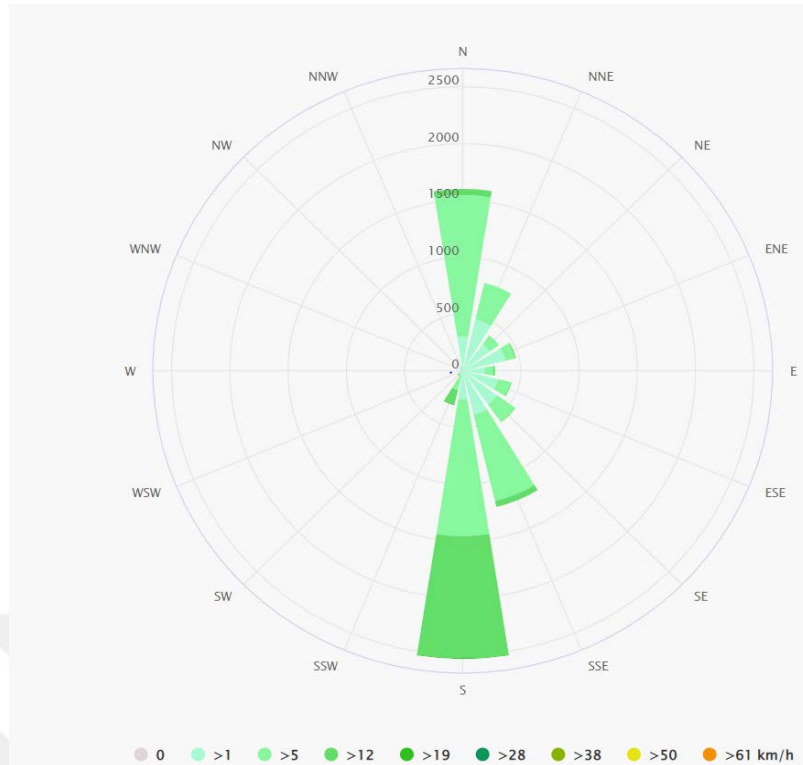


Figure 11. Adopted from meteoblue, Bandar Abbas wind rose showing the wind direction dominantly from south, majoring coming from the Indian ocean.

3.4.3 Vegetation

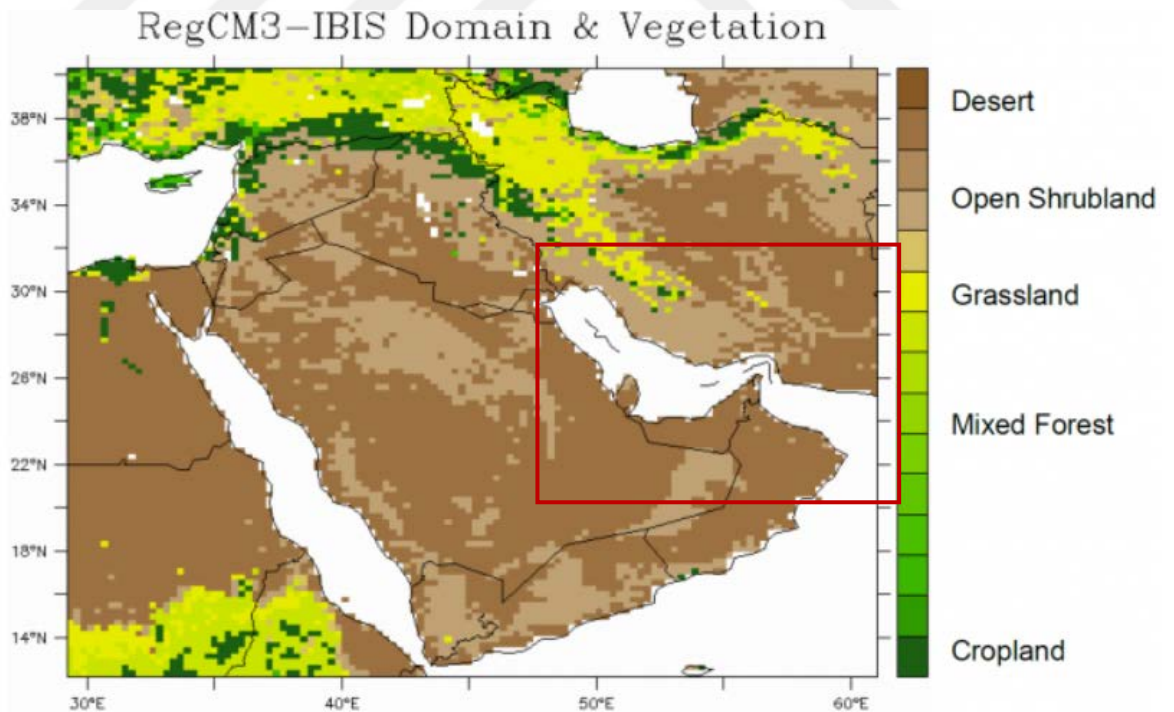


Figure 12. Adopted from cnr.mit.e, vegetation map of the Gulf region.

Even though the majority of the area is made up of sand dunes, some parts of the area support various types of vegetation, such as reeds and mace and tamarind where trees, shrubs, and reeds can flourish.

The greater part of these regions is situated around the landmass's coast. It has been revealed to be a major limiting factor for plants, even in "greenhouse crops" with plenty of water. Cactuses grow in most parts of the Great Plains, especially in semiarid arid environments, and they enhance the amount of useable water that reaches groundwater levels during times of severe drought. These groundwater Sources are the most accessible, yet contain less water, and are especially well-suited for identifying the spread of wild plants. Because water running down slopes and water pouring out of watersheds supplies them, the majority of the vegetation is located in areas where groundwater is plentiful, as well as wadis (unused river beds) valleys.

Upper Gulf

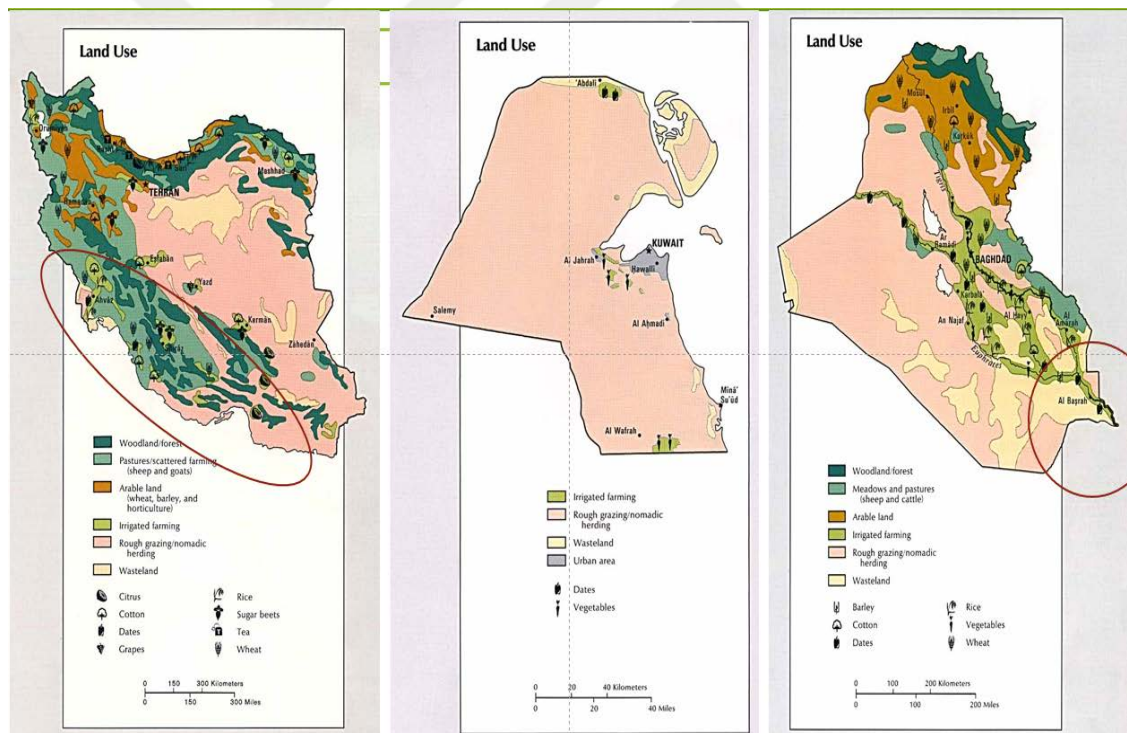


Figure 13. land use map of (from left to right) coastal region Iran marked in red, Kuwait and coastal southern Iraq marked in red.(Source: Anon., 2021)

Kuwait City, southern Iraq and the Iranian coast are mostly barren (Figure 13), except in oasis areas like Al-Jara'arah in Kuwait and the south western coast of Iran which consist of irrigation farming and woodland forests, where agriculture and water harvesting are practiced, such as those in which includes revitalization from the desert,

which are nearly everywhere in the country, and ephemeral grass (Figure 15): in the spring, these plants flourish in tidal areas that are next to or near the sea.

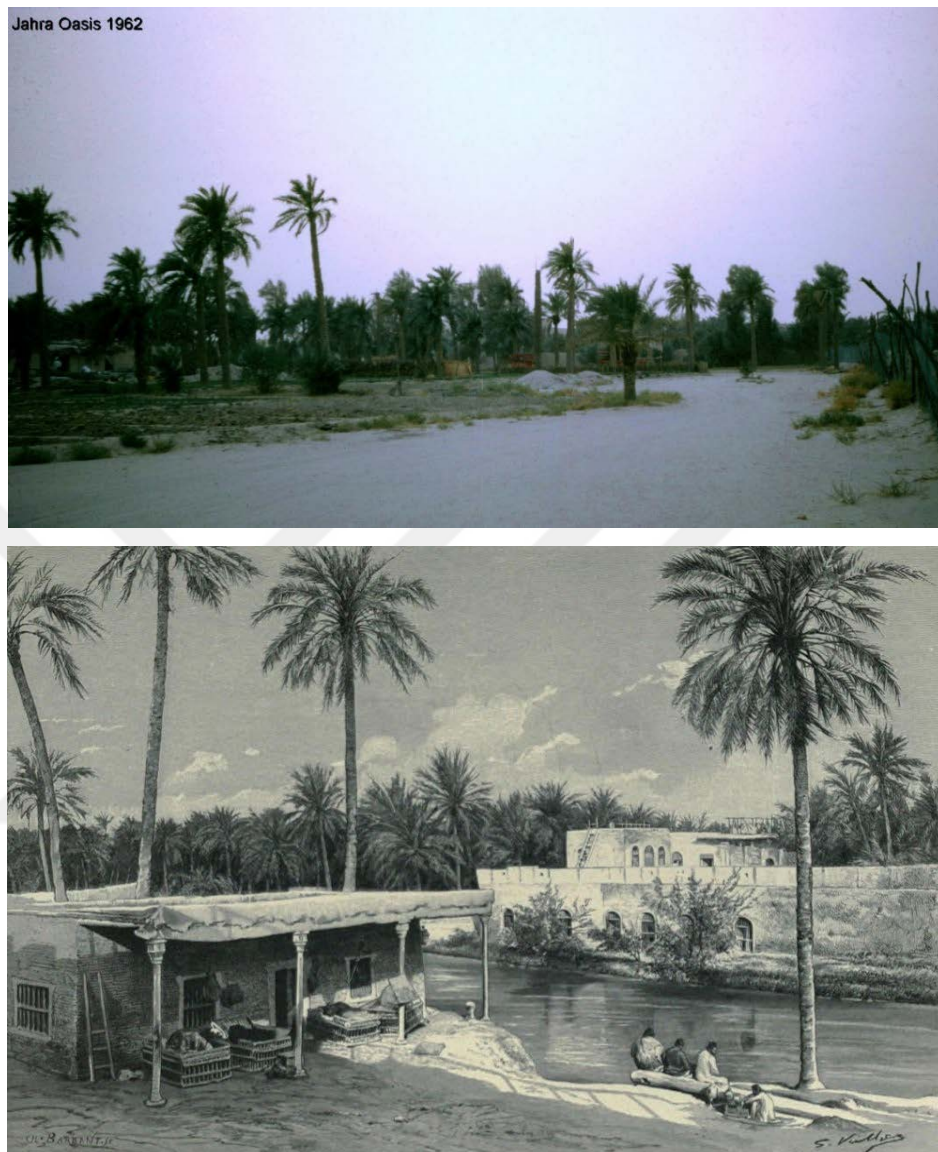


Figure 14. (top) Al Jahra oasis where date palm garden was cultivated, Kuwait and (bottom) shows old Basra settlements along with date palm gardens. (Source: Chesipiero, 2016)



Figure 15. Dominant native plants in Kuwait including *Haloxylon salicornicum* (a), *Nitraria retusa* (b), *Cyperus conglomerates* (c), *Panicum turgidum* (d), *Rhanterium epapposum* (e), *Centropodia forsskalii* and *Stipagrostis plumosa*. (Source: Al-Dousari, et al. ,2020)

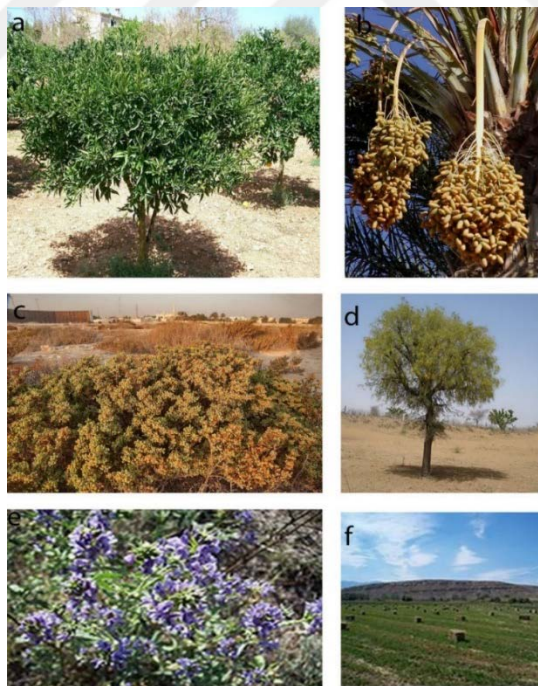


Figure 16. Dominants plants in the Gulf region a.citrus , b.date palm,c. *Tertraena qatarenensis*, d.*prospopis cineraria*, e. alfalfa f. alfalfa grass. (Source: Anon., 2013)

Central Gulf

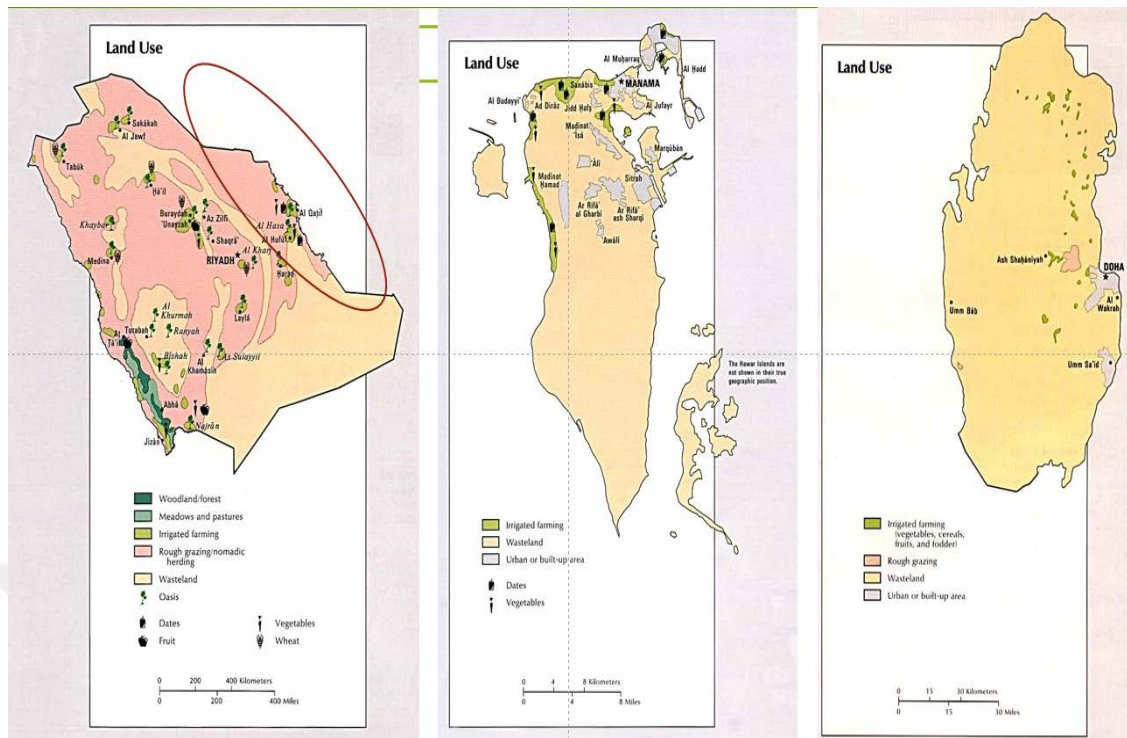


Figure 17. land use of (left to right) coastal region of Saudi Arabia bordering Gulf Sea, Bahrain and Qatar. (Source: Anon., 2012)

The eastern coast of Saudi Arabia consists of Oasis with date palm gardens (Figure 18) as well as the irrigation spots. Bahrain (Figure 19) and Qatar both have date palm trees (Figure 20) cultivations, from the northwest main land's having date palm, citrus and Alfalfa plants. The settlements usually have date palms near them (Figure 19). In Bahrain the tree of life which has been present for 400 years ago still survives in the irrigation area. The soil allows for salt tolerant plants to be present and survive, shrubs (Figure 17) which are similar those present in Kuwait are also present here.



Figure 18. Typically, the date palm garden in the Al Hassa oasis, Saudi Arabia and that can be seen in this image of an abandoned property. (Source: Lockerbie, 2021)



Figure 19. Example of old Bahrain with shrubs (Source: Anon., 2013)



Figure 20. (left) A date palm stands beside the remaining framework of a well in this photograph, taken inside a deserted village in the north of the world, from which the family living in the compound must have drawn this essential aspect of their desert existence and (right) date palm farm in Qatar. (Source: Lockerbie, 2021)

Lower Gulf

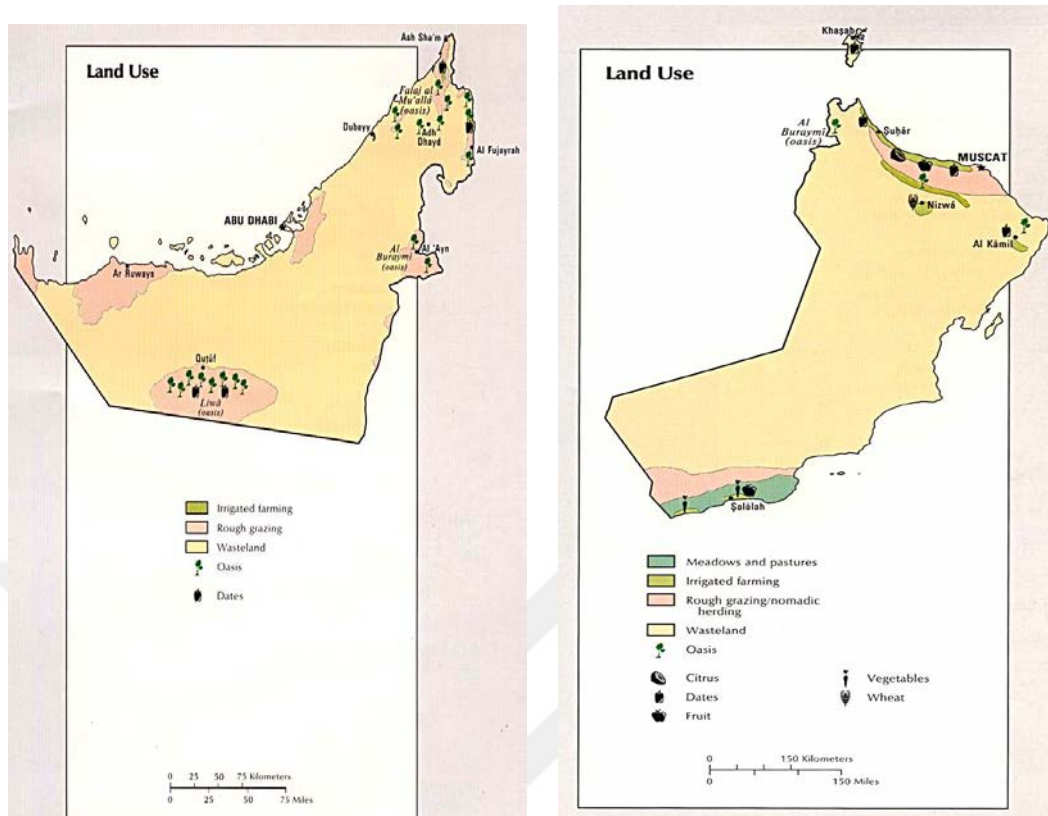


Figure 21. land use map of the UAE (left) and Oman (right). (Source: Anon., 2021)

In UAE formally known as the trucional states date palms, along with acacia trees (Figure 15 and Figure 16) in the oasis region (Figure 22) are often found and closer to the desert area, the flora is much more sparse and mainly consists of grasses and thorn bushes.



Figure 22. Oasis settlement Liwa, UAE. (Source: remotelands.com)

Oman on the other hand has a diverse range of flora in the region ranging from the more common as the rest of the Gulf such as the Zygophyllaceae, alfalfa and

white mangrove, to the *Boswellia sacra*, the frankincense tree, which only grows in the mountains of southern Oman (which is further away from the Gulf but worth mentioning).



Figure 23. (left to right) the Zygophyllaceous, alfalfa and white mangrove. (Source: Zona, 2008)



Figure 24. *Acacia tortilis* in Sharm-Dabna, Fujairah Emirate (left), and Vegetation in Omani region (right). (Source: Zona, 2008)

3.4.4 *Types of Gardens*

Since majority of the region accepts Islam as the main religion the presence of Islamic Garden can be observed along with date garden since the date tree was used as a common building material and food Source. As well as due to Ottoman and Persian influences in the region contribute to the architecture designs forms such as in (Figure 25).

In the Arab world, greenery and plantations are an integral component of traditional architecture (Smith, 1991), that is a major sign of Biophilia embedded in the traditional architecture. They are essential to the senses of sight and scent, may offer nourishment as well as function for watering plants, which can be a substantial Source of interior space cooling, especially in hot weather, through evaporation. Within the scorching desert temperatures that characterize the Arab region, the mix of sound, smell, and sight created by planting, together with water, in the courtyard creates a picture of heaven- this was essentially brought in the region through the Persian and Ottoman influence.



Figure 25. Ganja Khan Mosque, Iran. Source: Baghbani , et al., 2017)

The other type of gardens common in the area are the date palm gardens in the region. Which used the *falaj* (Arabic) or *qanat* (Farsi) system, the aqueduct water irrigation system (Lightfoot, 2000). These were common due to the various uses the date palm provided, such as building material and food Sources. The *falaj* system allowed for the sustenance development of the palm garden allowing it to occur for a larger area.



Figure 26. Date palm garden, UAE. (Source :abudhabi, 2014)

3.5 History

Over the course of time the region has been part of many layers of history and traditions from the ancient Mesopotamian civilization to the Contemporary period. Therefore, to better understand each historical period in and their influence in the region, the history of the region can be described in four periods (with the main focus

on the west coast of the Gulf and the Iranian side as the backdrop):

1. Ancient period
2. Colonial period
3. Modern period
4. Contemporary period

3.5.1 Ancient history

The Gulf's historical significance stemmed from its location at the southern end of the Fertile Crescent, the region of the Middle East that served as the birthplace of many civilizations. The sea connected two ancient worlds and great empires through various trading along the coasts and shallow coastal seas, the Mesopotamian societies far to the north building rituals and the great Harappan cities of ancient Pakistan founded along the Indus River that drained out into the Arabian Sea due east of Oman's northeastern coast. The Indus River ran from modern-day Syria north and east across Turkey, then south along the Tigris and Euphrates River valleys, culminating in Basra at the Gulf's head.

According to studies this region hosted civilization that dates back at least 5,000 years. The island of Bahrain was not only the site of the legendary civilization of Dilmun (Figure 27), and home to massive ashlar stone temples, but also, more speculatively, the site of the Garden of Eden (Freeman, 2016). Dilmun lived in the same era as the great civilizations of the area, which are now the contemporary states of Syria, Iraq, and Iran. The Code of Hammurabi (1792-1750 BC), a result of Mesopotamian legislation designed to ensure trade integrity, records these relationships, as well as those it formed with other trading partners. There is substantial proof from the stone tombs jewels, utensils, pottery, and other artifacts that boat trade in the Gulf dates back at least to the third millennium BC, and that there was likely shipping in the area even earlier.



Figure 27. remnants of the ancient Delium civilization, Sar, Bahrain. (Source: Anon., 2013)

Islamic era

The spread of Islam in the Gulf region appears to have been quick, according to documented sources. Although the chronology of the spread in the region is cannot be precisely determined, it appears reasonable to conclude that the spread of Islam in the Gulf between the 630s and 650s particularly the Iraqi and Iranian shores (López, 2017). The earliest Gulf people to embrace Islam were in Eastern Arabia, where they appear to have accepted the religion prior to Muhammad's (Peace Be Upon Him) death in 632. Despite some revolts in the two provinces of Bahrain (including the island itself and the coast of Eastern Arabia) and Oman during the Rebellion wars (632-634), triggered by the rejection of Islam by several factions in various parts of Arabia, most of these groups remained faithful to the Islamic community. Around the 630's the spread of the religion from the Eastern Gulf to the Iranian coast started to occur, where they allied with the Islamic soldiers who had crossed into Fars by land from Iraq (Lapidus, 1996). The largest and most impactful historical development occurred during this time period (Hawker, 2008). During this time, Islam's teachings served as the backbone of life in the region, enhancing earlier periods' settlement patterns, economic pursuits, and tribal social structure growth.

3.5.2 Colonial era (15th century onwards)

The first European country that invaded the Gulf region was the Portuguese, which lasted for 250 years which influenced in fort structure Figure 19. However, Portuguese control that had been at odds with local forces and the Ottoman Empire since the early 16th century came to a downfall. The Persian Empire collaboration challenged the Portuguese domination of the seas in the 17th century, after the entrance of the British and the Dutch (Metz, 1993). As a result of better trade relations with India, the British colonial office created a special division in the Gulf region called the "Persian Gulf Residency" in 1763. The basis of the various tribal alliances between the British East India Company and piracy was the halting of the emergence of the empire as well as on laying down a port and control of the pearl trade.

Consequently, because of the advancement of construction techniques such as the Persian wind towers, along with vast income inequalities between social groups and ethnic segmentation, grew the number of different typologies to include palatial compounds for ruling clans, and along with their natural determination to shelter their own people, also grew the population of pearl divers to hut-like residential form. To accomplish the social control, ports and the first major markets and, were set up locations where citizens of all socioeconomic backgrounds could meet in public, much of the various housing areas is developed in near proximity to the commercial centers. For much of the duration of this era, conflicts between the community members were mediated by an official in the more rural part of the territory who was selected by the town council or mayor.



Figure 28. example of the colonial architecture, Qatar. (Source: Metz, 1993)

3.5.3 *Modern period (1945–1990)*

The construction of first infrastructural networks, such as water, power, and sanitation, overshadowed the first period of global urbanization. The first roads were constructed to link ports and newly built airports with oil fields and the first settlements for guest workers engaged in oil production and infrastructure construction (Remali, et al., 2016).

The introduction of a new building industry occurred independently of the local community, and the first housing typologies were mostly inspired by the common housing architecture and requirements of more established Middle Eastern countries such as Egypt and the Levant (Figure 29). This was the result of a large influx of people from the area and South Asia, which resulted in these increasingly expanding cities. While the initial development units concentrated on establishing an infrastructure backbone and developing first construction codes, the territorial independence of most Gulf countries between 1961 and 1971 resulted in the creation of first public administration jurisdictions and capital cities (Remali, et al., 2016).



Figure 29. A view of the First National City Bank on Sharjah, UAE. (Source: EL-Tohamy, 2021)

3.5.4 *Contemporary period (since 1990)*

Despite the rapid growth of the private sector, rulers have remained the primary driving force behind any development due to their decision-making ability regarding direct investments of oil and gas revenues in infrastructure and key ventures, as well as the fact that the majority of development property, especially newly reclaimed land on waterfronts, has remained under their influence. Furthermore, the public sector has

continued to provide accommodation, as shown by the Sheikh Zayed Housing Program in Abu Dhabi in the 1990s.

Large megaprojects, which were mostly built as cities-within-cities, characterized housing construction during this time span. While the majority of changes have occurred along the coast, metropolitan sprawl has persisted in the form of developing suburban residential districts comprised of both vast gated compounds for expatriate workers and separated neighborhoods for the local community. In recent years, there has been a new trend of launching developments in downtown neighborhoods in order to entice the younger generation of residents to move from the suburbs to the capital. The souk project in Doha is an illustration of this Figure 21.



Figure 30. The Souk project Doha. (Source: EL-Tohamy, 2021)

3.6 Socio-cultural characteristics

Over the course of time three major aspects have contributed in shaping the society and hence the socio-cultural characteristics of the Gulf region.

- The first and most important was the tribe; a social group (Figure 31) which associated the common ancestry of the group. The Gulf was part of a large network of kin, who moved around the sands and waters across the desert plane settling and resettling around the region, fighting and trading amongst the tribes and their different divisions (Hawker, 2008). The culture throughout the region was depended on the tribal interaction with one another, the architecture however, was specific to tribal groups settled in various areas where those near the oases grew date. Each of the economic activities being subjected to the tribe and their location with poorer tribesmen sometimes crewed the boats and semi nomadic tribesmen grazed cattle



Figure 31. (above) tribal women weaving the tents and (bottom) tribal men having coffee together. (Source: Khan, 2019)

- The second aspect were the trade. As it was once an extension of the Tigris and Euphrates rivers, henceforth named as a "Cradle of Civilization" (or at least one of the "cradles" around the world). The first structures in the Gulf of around 3,200 BC are believed to have been built around the coastline. The following years, its prosperity began to spread farther into the main lands. The coastline was dotted with ships sailing (Figure 23) and from both the Indian Ocean and Africa to the Far East. With unprecedented amounts of trade and wealth having been created. Supporters and to set up camp there for different periods of trade items and dietary ingredients which as a result compete for supremacy, historically served as a table in which various

communities and tribes, cultures have shared cuisine and traded goods with the various tribes who have set up camp, traded native products for foreign items on the Gulf (Golzari, 2016).



Figure 32. Boats crewed by the poorer factions of Gulf society, or trading and pearling purposes. (Source: Anon., 2014)

- The third was the interference of empires, due to the increase in the value of trade towards the end of the 18th century the interests of the major empires such as the Ottoman Turks, the Persian and the British- pursued to secure their position in the Gulf. Which was experienced across the region in various ways, such as through the Ottomans (Figure 24) and Persian architecture influence. Therefore, opened the possibility of trade for building materials and new architectural concepts major through the expansion of Persians and Ottomans into the Gulf (Hawker, 2008).



Figure 33. Ottoman style houses in Basra, Iran. (Source: Housain, n.d.)

3.7 Architectural characteristics

3.7.1 Style and influences in the Gulf region



Figure 34. On the left side it is a traditional house in a Fahidi District (Dubai) where it had used a wind tower (called *badgheer*) and in the right side it is Sheraton Hotel in Sharjah where the Barajils (*badgheers*) are just part of the décor. (Source: (Boudiaf, 2019))

In the Gulf region, vernacular architecture is the result of the land, the local environment and community. There were three main aspects that contributed to influencing the architecture styles and techniques.

- First of which were the two important variables to be included in their designs were human needs and the environmental conditions. This region's vernacular design

incorporated many practical alternatives and devices for local environmental challenges, such as the Wind-catcher called *badgheers*, Domes and air vents, Courtyards and use of materials such as the *arish* and masonry, which became a popular architectural element in houses (Algburi, 2018).

- Second which incorporated the first environmental conditions along with the neighboring regions with the tribe's cultural exchange with each other. Examples such as the wind catcher is based on a typical Persian architectural system that has been used in buildings to produce natural ventilation. As well as, the *mashrabiya* a latticed screen which was used for ventilation, screening for privacy and light diffusion. The region also had a brief influence from the Indian decorative style in terms of carving rather than structure this was common during colonial era in the region (Hawker, 2008, p 12).

- The third was the Muslim religion in the region that has a significant influence from the Islamic architecture and most of the elements determine the design of the houses as privacy was one of key factors, such as the mosque, the garden as well as the separation of rooms in the housing (gender segregated) such that there is commonly a courtyard present along with some distinctive patterns on the walls (Hawker, 2008).

3.7.2 Use of materials

Since there were no architects, the design of the buildings was overseen by the master mason, or *ustad* in Arabic, which directly translates to "master." This was especially the role of some families who worked in the construction field. However, technological expertise was widely spread in the society, and many residents were able to quickly engage in the construction of their own homes. The houses were designed by mason, but the tenants were in charge of the maintenance. When the men were out at sea or finding family wealth in migrant labor elsewhere in the Gulf, the women would often help build and maintain their homes. The larger houses of the governing and mercantile classes were often constructed by the experienced builders, while the smaller houses of the lower classes were often built by the residents themselves.

The materials used were was often from the local and organic building resources such as mud-brick and palm fronds which required frequent maintenance therefore the tenants themselves had to look over the maintenance. Around the 20th century the merchant class along with the leading elite houses frequently consisted of imported features, such as the use of decorative cast plasters on the built-in cupboard's features imported from Europe, British Mesopotamian as well as Persian cooperation based in

Karachi not only that but also imported Italian columns, stained glass, fanlights manufactured in Persia or Turkey were imported through Ottoman controlled Basra.

The common local materials that were used in the buildings were the following:

- Wool

Wool made from sheep and camel were commonly used as tents Figure 41 called *bayt shar* house of hair to provide for temporary shelter as the tribes tended to move throughout the Gulf depending on trade and the seasonal changes. The constructing and weaving of the tents were usually done by the females of the tribe (Figure 36). The orientation and structure of the tents was regulated according to the wind directions and the privacy requirements. The structure of the tent consists of the wooden poles, ropes and the fabric which is erected low, flat and is aerodynamic profile which helps maintain the rigidity of the tents against strong winds (Figure 37). Due to the loose weaving of the material, *bayt sha'r* tent absorbs moisture and dissipates heat fast. The tent's color also offers a significantly deeper shadow than a light-colored material would (causing lower interior daylight glare). Due to this in summer, the temperature inside a tent is much cooler than the temperature outside (Lockerbie, 2021).



Figure 35. Show the cluster arrangement of the traditional tent structure with the use of dark fabric to provide protection from the sun. (Source: CIWT, 2015)



Figure 36. (left) the fabric pattern and (right) waving done by the female member of the family, Sharjah, UAE. (Source: Anon., 2011)

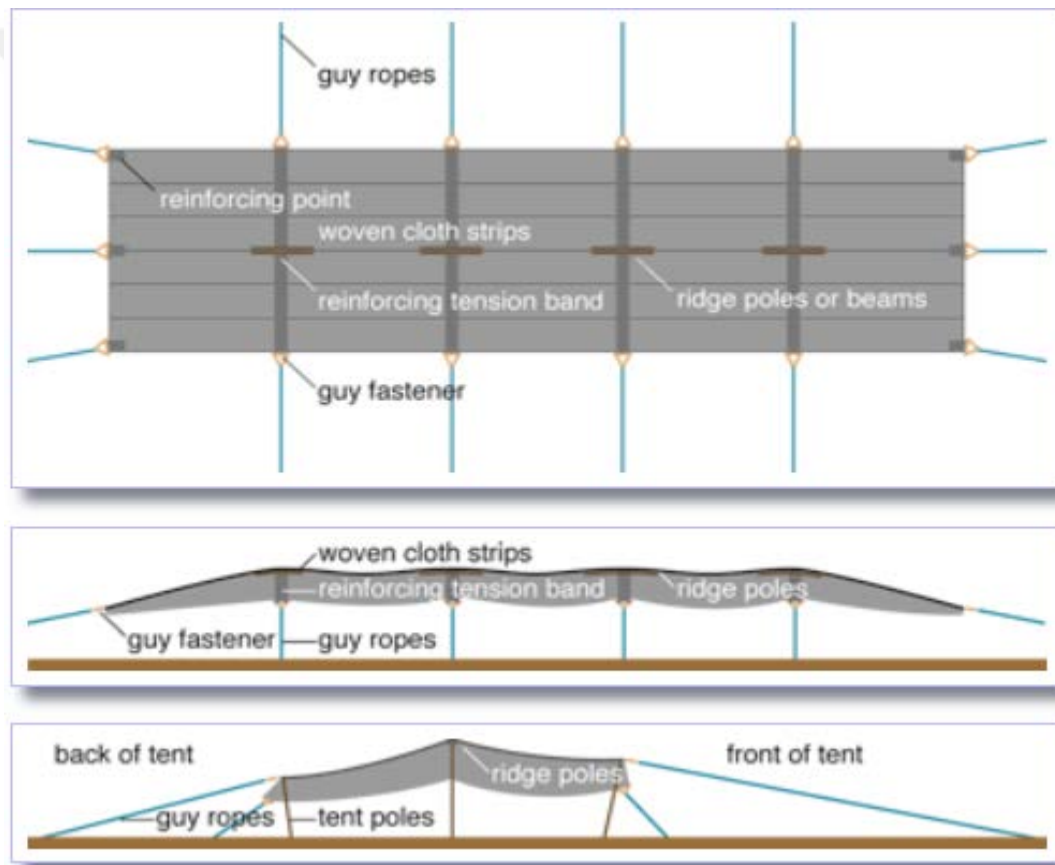


Figure 37. the details of the tents showing the ropes and fabric arrangement. (Source: Lockerbie, 2021)

- Mud

Mud-brick called *libin* locally known as *midar* cast from wooden molds occasionally used as mortar or surface plaster *salhat midar* for which the ingredient consisted of a clay, mixture with chaff acting as binding agent chopped wheat or barley straw and silty soil and sand to reduce shrinking and cracking. It has great practical

value due to its thermal inertia due to which it takes longer to heat up as well as to cool down due to which it was favored. The roofs of mud-brick houses were uses palm trunks as supporting beams and palm frond mats as roofing (Lockerbie, 2021).



Figure 38. (left) image from UAE shows a restored mud building with palm frond roofing and (right) shows the mud village near the coast of Saudi Arabia. (Source: Anon., 2020)

- Plaster

The plaster called juss was made in two main types. The first was juss bahar beach plaster which was made from the pounding and mixing of coral stones. The second was sarooj made of red clay mixed with manure and water, which was brought through the Persian influence. The plaster applied in three layers: first the layer consisted of mud which was laid to cover up any holes, the second layer also consisted of mud mixed with gypsum to create smooth surface and the final layer was a decorative coat of lime and gypsum (Figure 39). After the application of layers, the carving was done by the mason to create panels called *nuqsh* (Figure 40), through wooden molds or through knives (R. Hawker, 2008).



Figure 39. (left) the *Nuqsh* plaster panels and (right) the carving method where the mason carving pattern with a knife. (Source: Lockerbie, 2021)



Figure 40. the plaster works example on the Siyaddi house, Bahrain. (Source: Zakharia, 2016)

- Wood

The use of wood was common in making doors (Figure 41), since wood was not commonly available locally it was imported as timber from India or Zanzibar during the 17th century, which was then manufactured in Sur Oman, Kuwait, Bahrain or Bushehr Persia (Busch, 1995). In the bigger coastal towns wood in framing as well as support was largely used due to being the main centers for distribution to other Gulf areas. Away from the coastal area the use of palm trunks as well as wood from the acacia or *ghaf* trees were common (Thesiger, 1946). In the mountain the cedar tree was common as well as different qualities of clay gathered from the wadis and used to plaster the interiors.

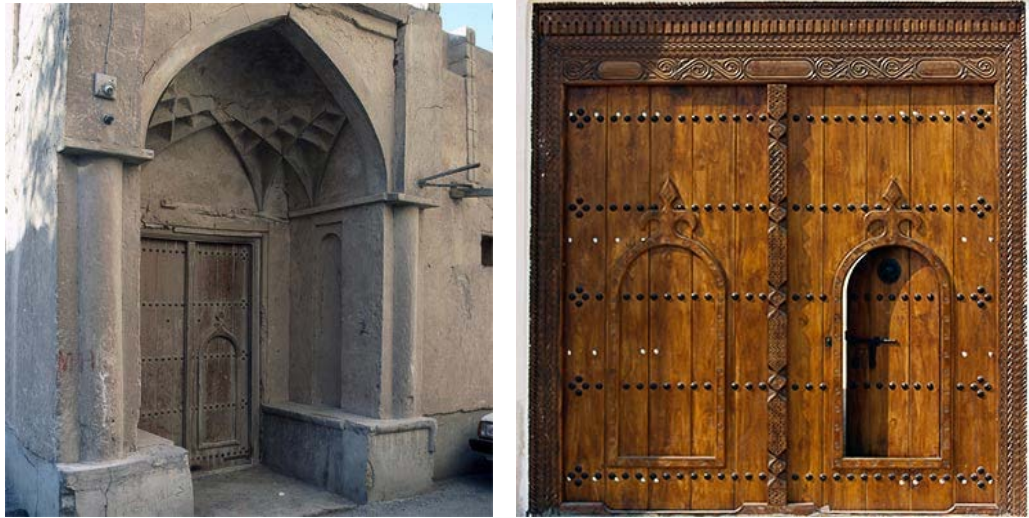


Figure 41. Decorative wooden door to an entrance canopy to pedestrian. (Source: Lockerbie, 2021)

- Palm frond

Parallel to the masonry houses the indigenous domestic style was present at around the same time which consist the use of Palm frond called *arish* a material from the palm trees (Figure 42). Palm trees are found all around the Gulf, providing a variety of resources. Date leaves were woven together to construct homes or woven mats *hasir*, which were often used to support the plaster roofing of monumental homes atop wooden poles. The thickness of the panels on palm tree trunk frameworks varied depending on the season in which the building was employed. Winter walkways or roof structures employed thicker variants, whereas summer home walls utilized thinner, less tightly knotted, or more widely spaced panels. The spaces between the woven panels allowed for ventilation inside the dwellings across the lower Gulf region (Figure 42), and it was traditional to have a shaded outside sitting room called a *sablah*, which was generally made from *arish*, along with the out structures and animal enclosures of the frames (Hawker, 2008).



Figure 42. the *arish* palm frond house, (left) showing the local building it and (right) a sample structure in the, Sharjah UAE. (Source: weebly.com)

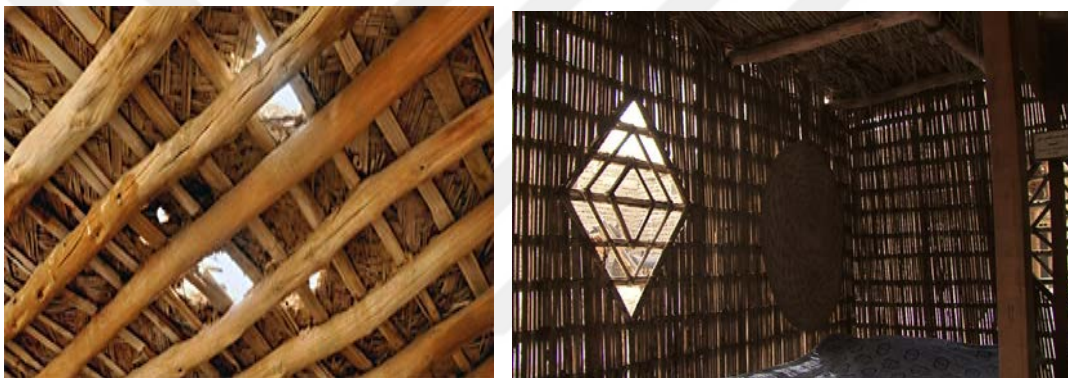


Figure 43: shows woven ceiling panels of palm frond lashed with mangrove beams (left) (Source: Lockerbie, 2021) and (right) show the spacing of the palm frond walls to provide for light and ventilation in the interior space. (Source: shutterstock,2021)

- Stone

Stone was most often used around the mountain buildings, which featured stone constructed winter dwellings with low roofs, a single room sometimes carved into the hillside, a single entrance at the narrow end of each home, and read gabbling sitting on the stone foundation. A matted *hasir* or braided Palm leaf roof would be used instead, where as in summer residences and mosques had gaps in the walls to allow for breeze such as in (Figure 44). (Hawker, 2008)

Stone was laid in courses at the foundation level (Figure 45), even in the oasis because the wet irrigated soil in many towns, since the stone was resistant to the salinity of the Arabian ground water and therefore, not subject to degradation. In the mountains or alluvial plain stone was the most plentiful building material (Orchard and Stanger, 1994). To face the exterior walls and chink up any gaps that would enable

ventilation, the winter dwellings constructed of stone were covered with mud plaster to prevent the cool air from entering. Summer houses were built on exposed peaks to maximize air flow and individual stones and walls were staggered to open up the interior spaces to for ventilation.



Figure 44. An example from UAE stone house with palm frond roofing (left) (Source: Anon., 2007) and the typical stone layer (right) (Source: Lockerbie, 2021).



Figure 45. Shows the common stone houses near the mountain of the coast of UAE and Oman (left) (Source: Patternson, n.d.) and (right) shows the traditional placement of the layers. (Source: Lockerbie, 2021)

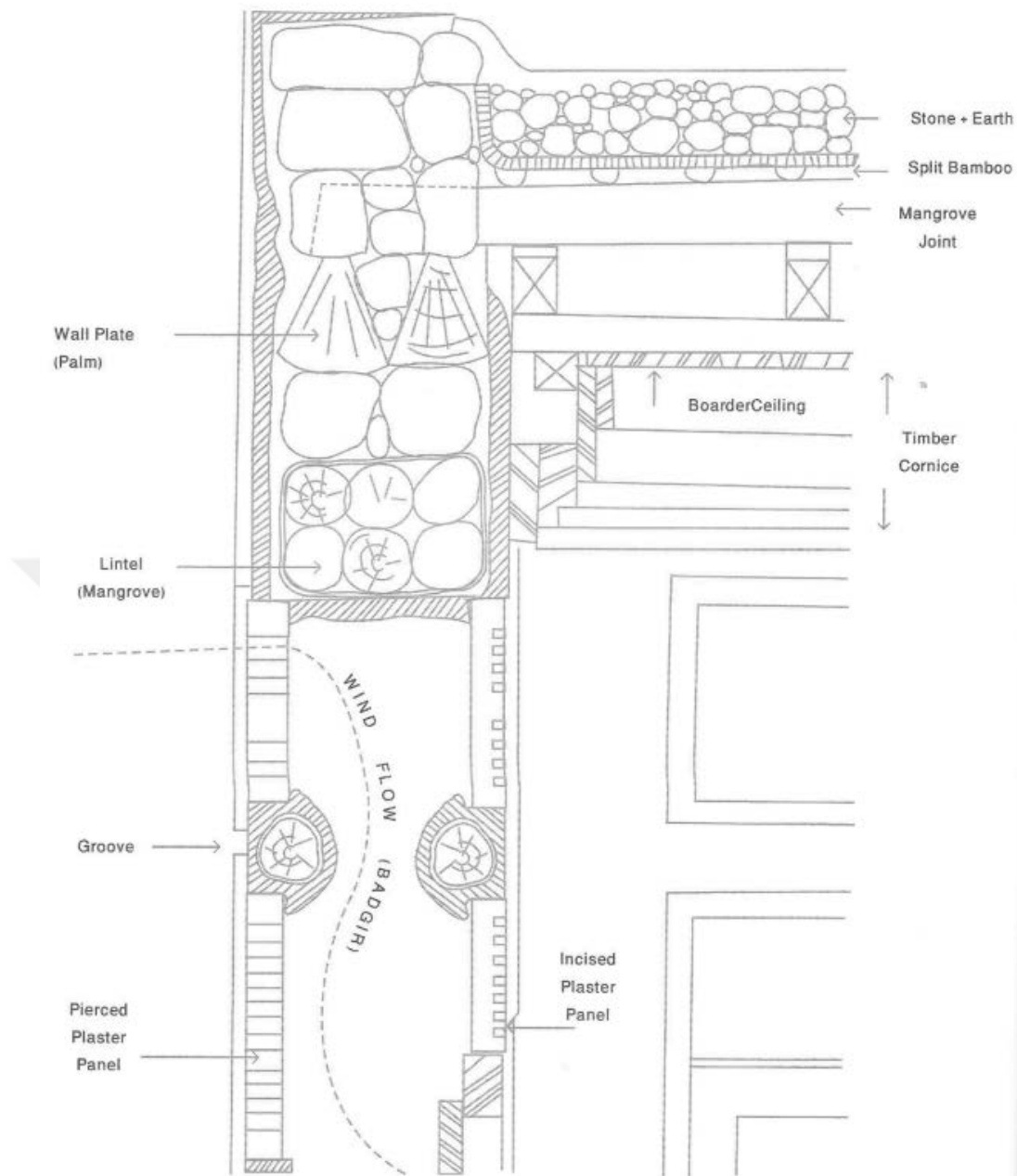


Figure 46. Show how each material was used in, this section of the wall illustrates a key cooling element used which a result of the Persian influences in the region, show the wind flow through the *badgheer*. (Source: Hawker, 2008)

3.8 Building typologies

There are many factors that determine the different typologies in the Gulf area the main being demographic and social changes, as well as technological advancements and sociopolitical interventions, both contributing to housing transformations across the globe. In vernacular settlements, housing have often been a clear result of the condition of building know-how, accessible local construction resources, and local climatic and cultural conditions (Oliver, 2007).

Over time, the Gulf's architectural and decorative styles changed in the region. The usage of materials and decorative shapes that these materials took were all factors in the design variance. As a result, it is believed that the neighboring regions and their specific environmental factors are the generators of the building typologies, which have typically resulted in a high level of architectural cohesion and representation despite a high level of individuality owing to a lack of building criteria. However, due to the extreme climatic conditions in the region it was difficult to date the exact period for each type of building as well as since the tribes of the area performed as conveying systems verbally to each other, few buildings were dated, and direct knowledge on dating was practically non-existent (Hawker, 2008).

Therefore, the building typologies can be explained as:

3.8.1 Courtyard houses

In most ancient civilizations, an inner courtyard was a frequent architectural feature, such as in Islamic traditions inner courtyards (Figure 47) are unique in that they were created centuries before Islam appeared in the region. Therefore, since they matched the Islamic values, it was natural for it to be embraced by Muslim regions, like many previous civilizations as an architectural reaction to the fulfillment of Islamic teachings that demand humility and introversion. Islamic structures were to represent this characteristic and contrast as much as possible with the surrounding environment. One of the main concepts underlying Islamic design is environmental contrast, which is where the notion of an inner courtyard in the typical Kuwaiti, Bahraini and lower Gulf region house came from.



Figure 47. Example of courtyard house in Qatar. (Source: Lockerbie, 2021)



Figure 48. A layout of traditional Saudi houses showing courtyards in every house (Source: Al Surf et al., 2012)

A courtyard is frequently referred to as the house's lungs as stated by Reynolds (2002). It is the primary outlet for those who live in the house, particularly ladies who seldom leave the house in the Islamic tradition. It's an architectural idea that supports

Islam's introversion while also attempting to reconcile Arab hospitality with the demand for seclusion inside the home. Traditional houses all featured one or more open courtyards on the interior, which were surrounded by walls to demarcate the house's borders from the outside world and neighboring houses, and to give the message that what was behind those walls was a private place that should not be intruded.

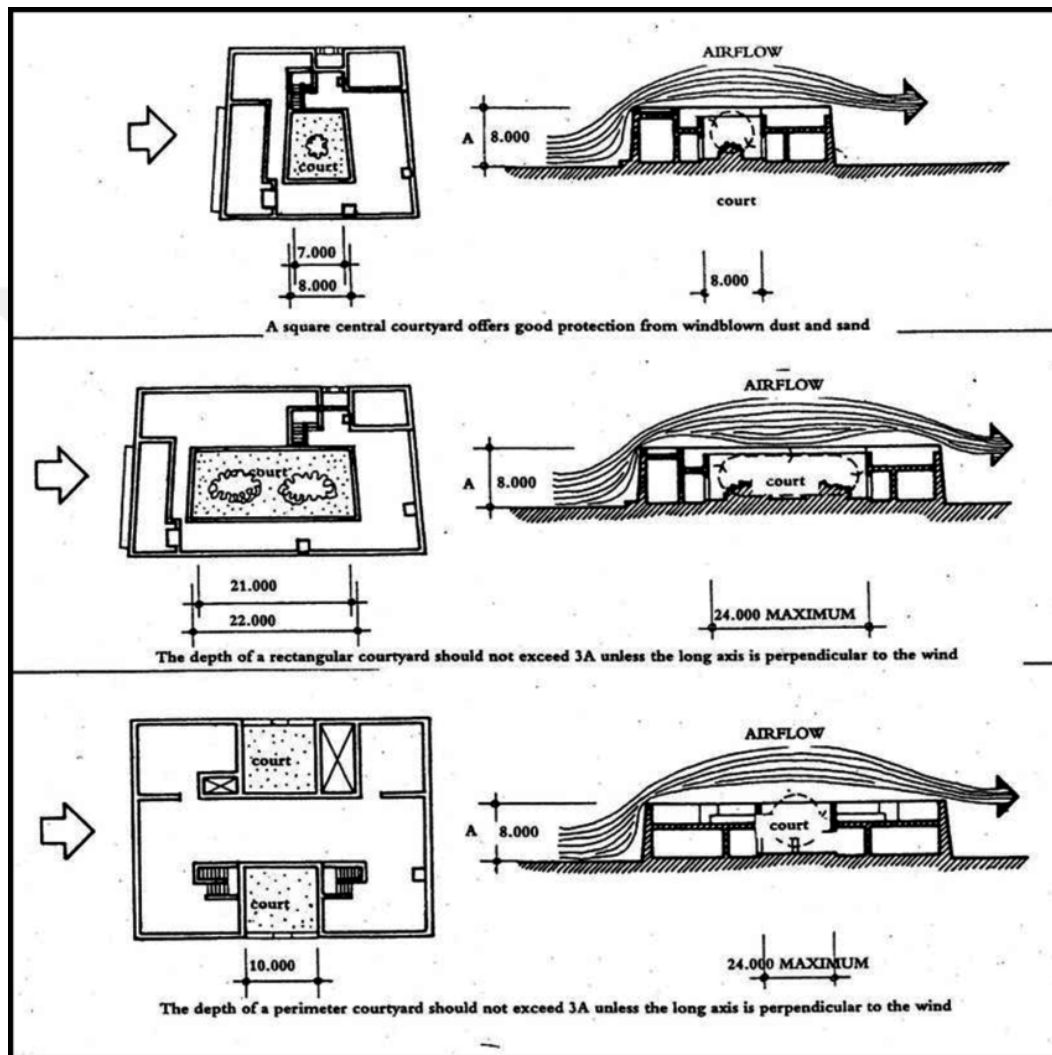


Figure 49. Airflow in a traditional courtyard (Source: Mabrouk, 2006)

The feature of the courtyard houses had the need to emphasize the need for seclusion and to enable mobility between different areas of the home; the inner courtyard was ringed by separate rooms that looked out solely via their doors and windows. The walls around the courtyard were generally fairly high (Figure 49) showing the houses external walls as high as the courtyards, thus they shielded the house from strong winds and dust, which is one of the reasons they can be considered compatibility with its natural surroundings.



Figure 50. Al Bader is an old Kuwaiti house that clearly embodies the typical architectural style of traditional Kuwaiti courtyard houses (Source: Carey et al., 2013)

3.8.2 *Masonry Houses*

The types of Masonry houses in the Gulf region are classified into two main types, which were determined in order to differentiate the types of structure as mentioned in (Hawker, 2008, p 48-60). The first type being the Arab masonry and the other being the Persian masonry.

- Arab masonry

This style was more common in the Gulf region. Houses of this type can most commonly be seen in the Qatar and Oman. The most common feature of this type was external buttresses and internal niches. Where the buttresses were the walls that were solid and supporting the weight of the roof beams and the external buttresses were devices to bolster the walls on the outside where support was needed to carry the weight of the thick walls. The internal niches were used to make an indent on the walls which served as both decorative and functional purpose to provide a relief to the flat plane surface of the wall and also to provide a storage area for the house goods (R. Hawker, 2008)





Figure 51. simple houses which were most commonly constructed by the owners themselves. (Source: Lockerbie, 2021)



Figure 52. the use of the roof and interior of the Arab masonry housing. (Source: Lockerbie, 2021)

- Persian masonry

This is another masonry style found in the region and it is originally considered to be from the Persian origins. It is based on the structural frame with solid piers and beams supporting non-load bearing infill panel. Acting as architectural skeleton the solid pier beams commonly compacted with coral and stone supporting roof poles. The wind towers, *mashrabiya* the lattice screens were the most common feature of the Persian masonry buildings (discussed in detail in chapter 4).



Figure 53. examples of Persian influence two examples of wind tower from, Yazad Iran. (Source: Baghbani et al., 2017)

3.8.3 Fortified structures

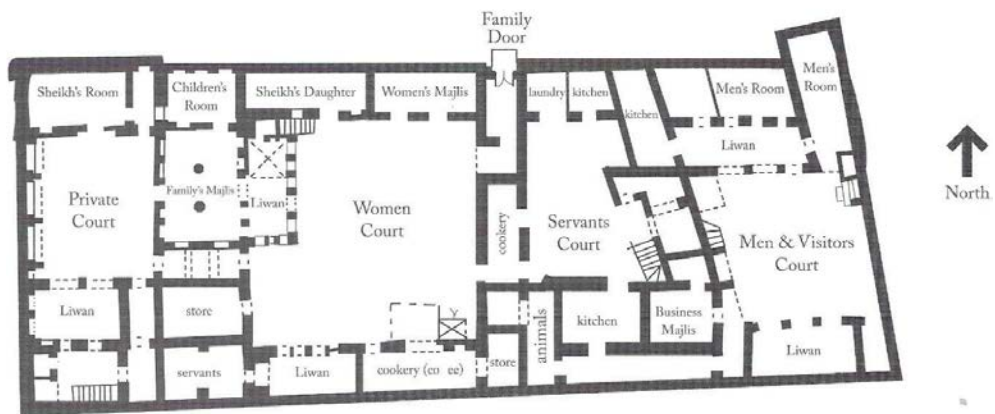
Along with domestic structures other building types were also necessary for the culture of the region such as the fortified structures. Due to the unstable political environment in the lower Gulf, there was a need for such structures mainly to keep a lookout for predatory movements, sea piracy and protection incursions amongst the traveling tribes. This resulted in two distinct features in the fortified structure; the watch towers and a form citadel. Watch towers were of two types round (Figure 54) and square type which was common in domestic forts (Figure 55) These structures were situated near oasis to provide a *falaj* system along with date palm gardens for food and water. As with all the housing structure in the region these also incorporated the privacy in the for separate male-female quarters (Figure 56). As well as separate summer sinter quarters for the family.



Figure 54. shows a fortified structure with round watch towers, Sharjahh, UAE. (Source:Anon., 2003)



Figure 55. shows fortified structure with square watch towers, Umm Salal Muhammad, Qatar. (Source: mapio.net, n.d)



Sheikh Isa House - Ground FLOOR PLAN

Figure 56. Show a domestic fortified structure (above) with the wind tower and the floor plan showing the separate quarters (bottom) Shekj Isa house, Muharaq, Bahrain. (Source: Hawker, 2008)

3.8.4 Religious and public

The religious structure has been important part of the culture since a long time in history. Therefore, many different variations of these structures can be seen from those made from palm frond *arish* (Figure 57) as well as masonry types (Figure 58), taking into account the hot climatic conditions as well to fulfil the religious needs of the locals. The other building that the region were the *souqs* market places which were a result of the trad that was common between the local tribes and regions (Figure 57) and (Figure 60).



Figure 57. Mosque made with palm frond in village in Qatar.(SourceLockerbie, 2021)



Figure 58. Masonry mosques with different minaret styles and a courtyard with plants for shade, village, Qatar. (Source: (Naeem, 2016) and (Lockerbie, 2021))



Figure 59. (left) Showing the structure of the building and (right) the interior arrangement (shows a renovated version of shops) with palm frond ceilings, a souq from Sharjah, UAE. (Source: heartofsharjah.ae)



Figure 60. the image of a restored Souq along the fortified building in Qatar (Source: Luthra, 2021)

3.9 Conclusion

This chapter has displayed the diverse architectural styles and aspects of the culture in the region. In essence, it has been recognized that nature and design are both essential components of the cultural identity. Where connection to Nature is through the local's adaption to the conditions of the natural environment and incorporating that into the built environment. The chapter looked into the different influences and styles that had impacted the architecture in the region. The focus of this chapter was to understand the Gulf region and the different influences that affected the architecture in the region. The long traditions of building and their incorporation of age-old solution to the problem of the climate and material.

CHAPTER 4: TRACES OF BIOPHILIA

4.1 Summary:

This chapter analyzes the vernacular architecture of the Gulf region through a set of 14 biophilic patterns proposed by Terrapin Bright Green sustainability consulting firm.

4.2 Chapter overview

The chapter examines three types of nature and space relations as observed in the Gulf vernacular architecture and its environment:

- **Nature in space** discusses the direct, physical and ephemeral presence of nature in a space or place through seven sub categories.
- **Nature analogies** addresses organic, non-living and indirect evocations of nature divided in three groups.
- **Nature of the space** addresses four types of spatial configurations in nature.

4.3 Introduction

This chapter intends to look into the traces of Biophilia in the vernacular architecture of the Gulf region. In terms of the framework the biophilic design, by taking references from the biophilic design patterns that was proposed by Terrapin Bright Green (Browning, et al., 2014), which is an environmental consulting firm. That proposal has divided the biophilic patterns into 3 main sections which are then divided into 14 sub sections.

- a) Nature in space
 1. Visual Connection with Nature;
 2. Non-Visual Connection with Nature;
 3. Non-Rhythmic Sensory Stimuli
 4. Thermal & Airflow Variability
 5. Presence of Water
 6. Dynamic and Diffuse Light; and
 7. Connection with Natural System
- b) Nature analogies
 1. Biomorphic Forms and patterns
 2. Material Connection with Nature
 3. Complexity and order
- c) Nature of the space

1. Prospect
2. Refuge
3. Mystery
4. Risk/Peril

These patterns based on the relationship between nature and human beings along with the psychological affect it has on humans with the aim to help designers have better understanding in creating spaces which connect nature with humans (Browning, et al.,2014). These patterns help in acting as tools for the design conditions in given environment, in this case in harsh desert climates.

4.4 Nature in space

The immediate, tangible, and ephemeral presence of nature in a location or place is addressed in Nature in the Space which is the first category of the biophilic design pattern. Plants, water, and animals, as well as breezes, sounds, odors, and other natural features, are all included. The most powerful Nature in Space experiences are accomplished through establishing meaningful, direct connections with these natural components which include seven major features:

1. Visual Connection with Nature;
2. Non-Visual Connection with Nature;
3. Non-Rhythmic Sensory Stimuli;
4. Thermal & Airflow Variability;
5. Presence of Water
6. Dynamic and Diffuse Light; and
7. Connection with Natural System (Browning, et al., 2014).

4.4.1 Visual connection with Nature

A visual connection with nature refers to the view of the elements of nature, the living systems and their natural processes (Browning, et al., 2014).

4.4.1.1 The experience of the pattern:

It is the visual experience of the natural environment, grabbing one's attention and can be stimulating or calming (Ryan, et al., 2014).

4.4.1.2 The roots of the pattern:

The concept behind this pattern originated from the studies on visual preference and responses to views of nature that revealed lower stress, enhanced emotional functioning, and improved attention and recuperation rates (Ulrich, 1993).

4.4.1.3 The appearance of this pattern:

1. Firstly, it can be observed in Basra which at one time used to be known as the Venice of the east (Samir, 2017), with its cooling date garden around the water canal that appears as a visual connection to nature (Figure 61).



Figure 61. an image of Basra with cooling date gardens and river boats that made their way through the brick of Ottoman buildings. (Source: Kadinsky,2017)

2. Secondly, it can be visitable in the water lake where water was collected during the rainy seasons of the year to use in summer. The (Figure 62) shows the water reservoir which usually had domestic structures surrounding it and date palm garden with them.



Figure 62. Umm Salal Muhammad, Qatar large al lake used as a Source of water supply filled during the rainy season. (Source: Lockerbie, 2021)

3. Lastly, in date gardens in Kuwait, UAE and Oman. The date garden (Figure 63) and (Figure 64) in the region are very common in the area they provide both a sense of connection to nature as well as are a vital part in the agriculture. The date palm garden date long back and it emerge in Mesopotamia and southern Iran as orchards, where a variety of fruit plants and, sometimes, wood trees were grown. Oasis agriculture first occurs in Oman about 3000 B.C. and continues to be a dominant feature of the agricultural economy of Arabia until the present day.



Figure 63. Date palm gardens in Al-Ahsa Oasis, Saudi Arabia. (Source: UNESCO, 2018)



Figure 64. The date garden (falaj) in Oman (Source: UNESCO, 2018)

4.4.2 Non-visual connection with Nature

The auditory, tactile, olfactory, or gustatory inputs that elicit an intentional and positive reference to nature, living systems, or natural processes are referred to as non-visual connection with nature (Ryan et al., 2014).

4.4.2.1 The experience of the pattern:

It provides with a fresh feel along with a balance of conditions that provide intricate and flexible conditions, at the same time stimulating a familiar and comfortable feeling of being outdoors. Through the reminiscing of either natural sounds, aromas or textures.

4.4.2.2 The roots of this pattern:

Emerged from the studies that were conducted on the effects of non-visual sensory interactions with non-threatening nature on systolic blood pressure and stress hormones, the impact of sound and vibration on cognitive performance, and perceived improvements in mental health and tranquility (Park, Tsunetsugu, Kasetani et al., 2009).

4.4.2.3 The appearance of the pattern:

1. The Non-visual connection to nature can be seen through various examples in the Gulf region firstly through the wind towers constructed from palm frond (Figure 65) and (Figure 37) provide a cooling system as the woven baskets contain water to further cool the wind which funnels down the wind tower shafts.



Figure 65. The interior view of the palm frond wind tower (left), the courtyard view (right) in the UAE (Source: Hawker, 2008, p 60).



Figure 66. Wind towers constructed from palm frond in Abu Dhabi and Dubai (Source: Rashdan, Wael and, Vrushali, 2019)

2. The stone houses (Figure 67) in the oases and mountain also exhibit this pattern as it is a textured and regional material it provides a sense of non-visual connection to nature. Since the people who lived in these types of houses lived in separate seasonal houses such as winter and summer therefore the wall thickness of these houses varied according to the need of the residents. These houses used to be strategically located on the rock spurs of the wadi side in Oman, with winter houses at the upper level of the rocks and the summer houses with side gaps in the stone walls on tops of spurs for optimum effect of cooling winds.



Figure 67. The stone hose in Oman (above) and remnants of stone houses in Wadi Sham (bottom) (Source: missionofroad, 2021)

4.4.3 Non-rhythmic sensory stimuli

Non-Rhythmic Sensory Stimuli are stochastic and ephemeral connections with nature that may be analyzed statistically but may not be predicted precisely”. (Ryan, et al., 2014).

4.4.3.1 The experience of the pattern:

It feels as if briefly aware of something that provides sensory stimulation of nature. As Browning describes it, “It is a brief but welcome distraction” (Browning, et al., 2014).

4.4.3.2 The roots of the pattern:

This pattern originated from the study which relate which involves human behavior which tends to be privy to something special, something fresh, interesting, stimulating and energizing (Browning, et al., 2014).

4.4.3.3 *The appearance of the pattern:*

The appearance of this pattern can be sensed both in naturally occurring through the wild life and simulating sense through the tent fabric billowing as well as the date gardens and reflective pools.

- Through the date palm gardens in the region (Figure 68).
- The reflective pool that are commonly used in courtyard houses and religious structures (Figure 69).
- The fauna from the famously known falcon in the region, to the domestic animals like chicken and camels that are present in the domestic housing and tent structure or even the locusts that are commonly found in the region (Figure 70), (Figure 71) and (Figure 72).



Figure 68. The date gardens in the UAE 1976. (Source: Lockerbie, 2021)



Figure 69. The water pool reflection in the domestic (left) and religious structure (right). Isfahan, Iran. (Source: Lockerbie, 2021)



Figure 70. A hawk (left) and the falcon's found in the Gulf region (right)sooty falcon.
(Source: Lockerbie, 2021)



Figure 71. The domestic animals with the tents (left) and domestic housing (right).
(Source: Lockerbie, 2021)



Figure 72. The oryx (left) and the locust on the acacia tree (right). (Source: Lockerbie, 2021)

4.4.4 Thermal and airflow variability

One of the key patterns in biophilic design is thermal and airflow as it connects humans to nature and natural airflow helps human life. It can be described as subtle changes in air temperature, relative humidity, and airflow across the skin, and surface temperatures that mimic natural environments (Browning, et al., 2014).

4.4.4.1 The experience of the pattern:

The space gives the impression of both flexibility and control (Browning, et al.,2014).

4.4.4.2 The roots of the pattern:

The Thermal & Airflow Variability pattern arose from study into the impact of natural ventilation, and the thermal variability that results, on well-being, and productivity; as well as physiology and temporal spatial pleasure perception (Browning, et al., 2014).

4.4.4.3 The appearance of the pattern:

This pattern can be visible in the two main traditional methods of using the natural air flow:

1. *Badgheers* (Wind towers or wind catchers)

The wind towers traditionally known as *badgheer*, are the most common element in the regional architecture due to its efficient thermal and air flow variability. They can be seen throughout the Gulf region. The orientation of a wind tower is governed by the construction type, the usage of wind power, and the prevailing wind direction. Wind towers are designed with a four-directional orientation to take advantage of all the favorable winds from north to south and east to west. A wind tower is made up of intake and outflow apertures. The way these wind catchers work is through directing the circulating cold wind from the higher levels downwards through the openings as shown in (Figure 73).

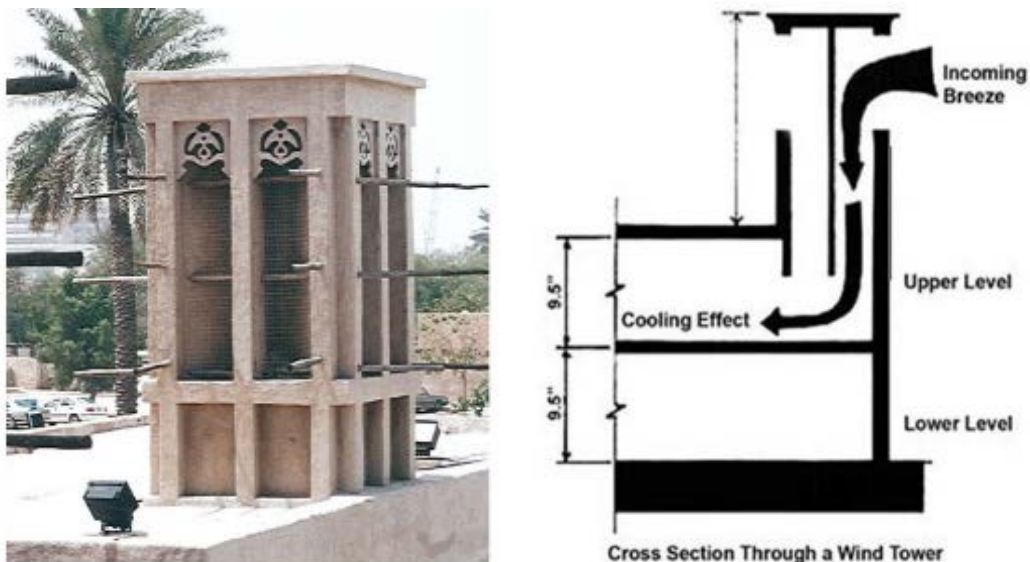


Figure 73. Shows the *badgheer* an example from Dubai (left) (Source: Stouhi, 2021) and a section showing the movement of directing the wind that enters through the top to allow a cooling effect below (right). (Source: Dalman & Salleh, 2011)

They have been utilized in hot, dry conditions for millennia (Movahed, 2016). Wind tower or catcher may be seen not just on top of conventional residences, but also on top of water cisterns and mosques. The earliest traces of wind towers may be found around the fourth millennium BC. The wind tower is made up of two parts, one of which is located in the summer living quarters of the house and the other of which rises from the roof. Internal walls or shafts split the wind tower into many vertical air passageways. The top shafts lead to openings on the sides of the tower head. The interior of the wind tower has two directions of flow: up and down. When the wind blows from one direction, the inlets will be on the windward side, while the exit will be on the leeward side, and vice versa (Maleki, 2011).

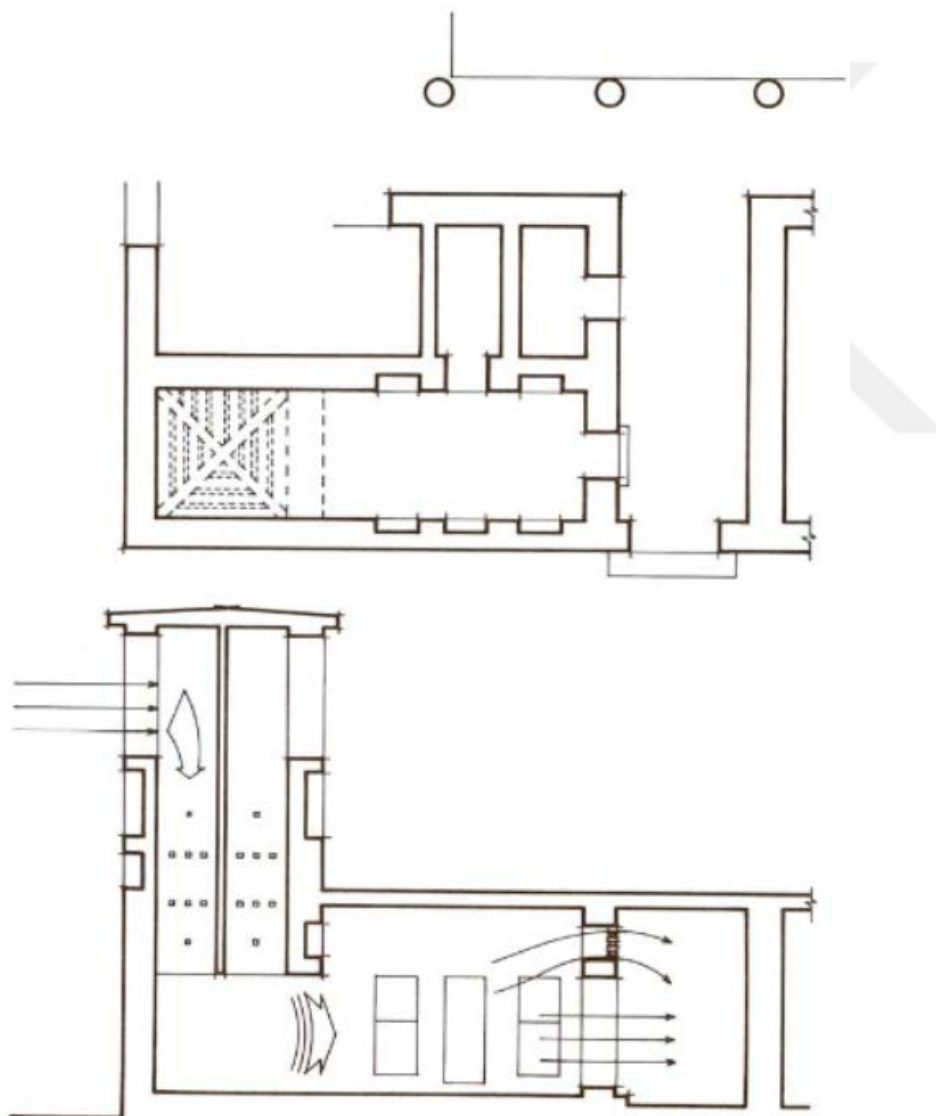


Figure 74. Plan and section of the *badgheer*, top show the plan and the bottom showing the section through which the air flow can be illustrated. (Source: Fathy, 1986)

Another way the *badgheer* are often used is above a *qanat* (Figure 75), a system used in desert locations to assure a continual supply of water to homes. Convection and evaporation generate a cold and thick air circulation in these channels because they act as water reservoirs and are situated in locations completely sheltered from the sun (typically below earth). The hot air sucked into the *qanat* mixes with the trapped air current below it, which is unable to ascend to the less dense surface air, and pushes cold air into the inner chamber.

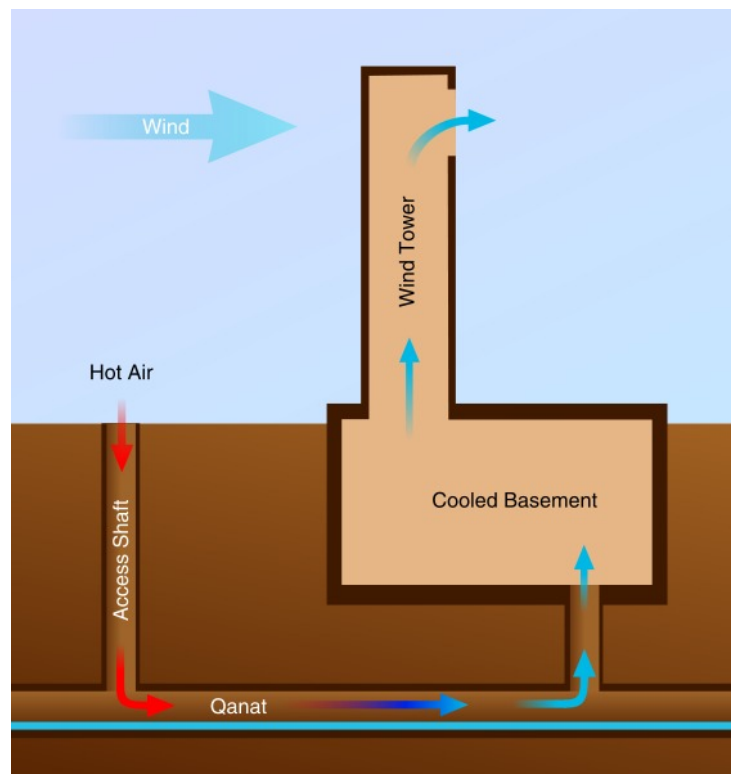
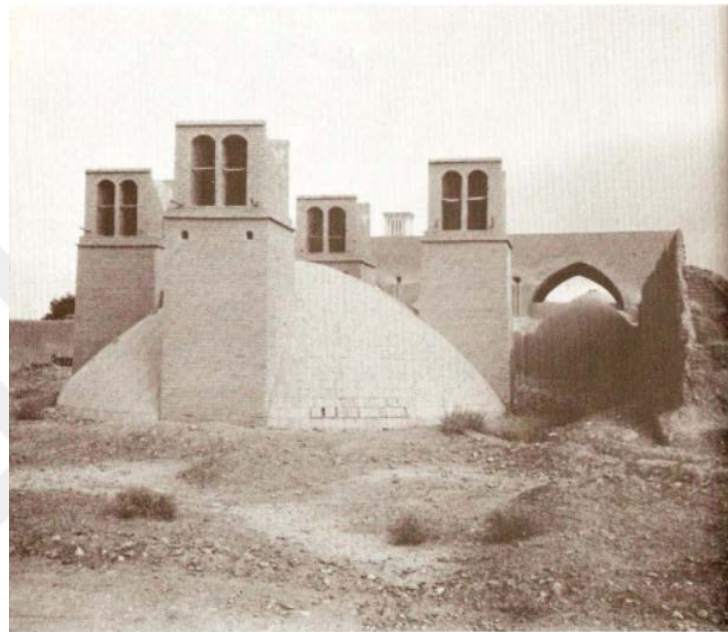


Figure 75. Show the *badgheer* over a *qanat* an example from Yazad, Iran (top) Source:

(Fathy, 1986), showing the air circulation (below) (Source: Stouhi, 2021).

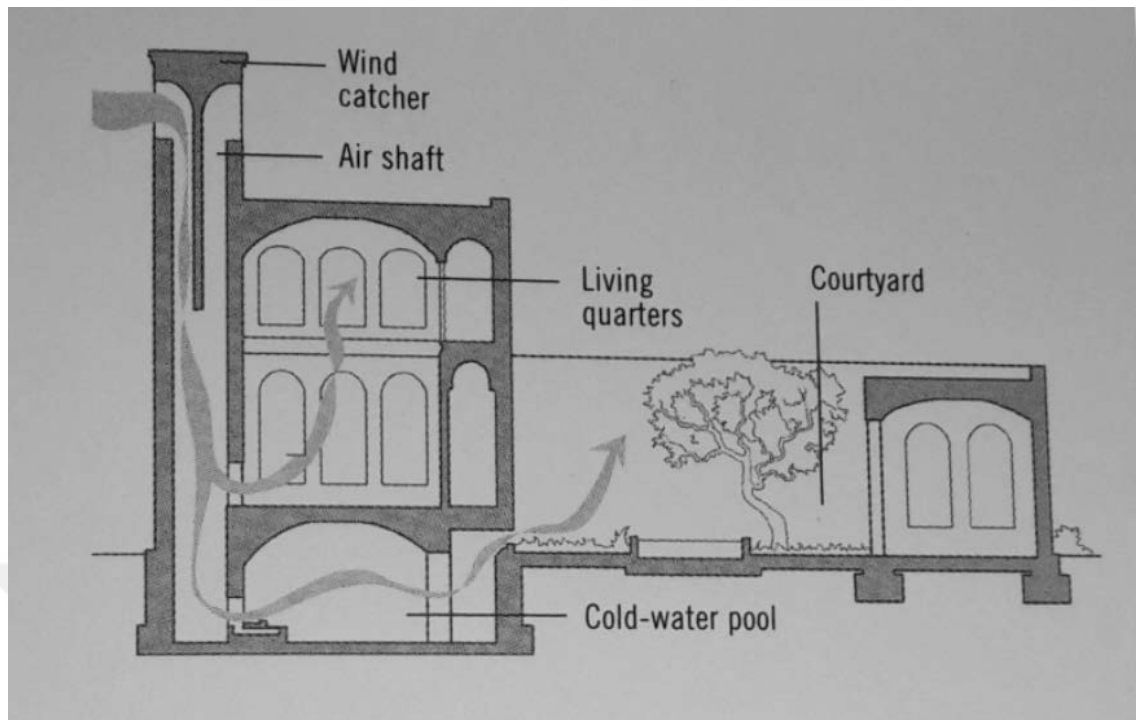


Figure 76. An illustration example of the air flow with the wind tower through the courtyard. (Source: zicr, 2017)

2. The courtyard houses

The courtyards at the center of the house, where another way air flow was achieved. Sometimes the *badgheers* were also used as shown above (Figure 76). The courtyard houses work in the way that they provide an inward opening that is open to the sky; which allows for the air temperature to drop. During the evening (Figure 77) the warm air in the courtyard which had been heated by the sun during the day and the surrounding buildings mass rises and is gradually replaced by the cold night air from above. The cooling of the rooms is achieved by the cool air seeping into them, that was accumulated in laminar layers in the courtyard. During morning (Figure 77) the shaded courtyard by the four surrounding walls and rooms slowly heats up but stays rather cool until the sun is directly above the courtyard, however the sun does not cause it heat but rather creates eddies inside (Fathy, 1986). The floor of the courtyard and the flat roofs radiate heat to the night sky and cool down substantially, thus becoming excellent sleeping places in summer. As well as the water elements and vegetation enhance cooling in a courtyard by evaporation and evapotranspiration.

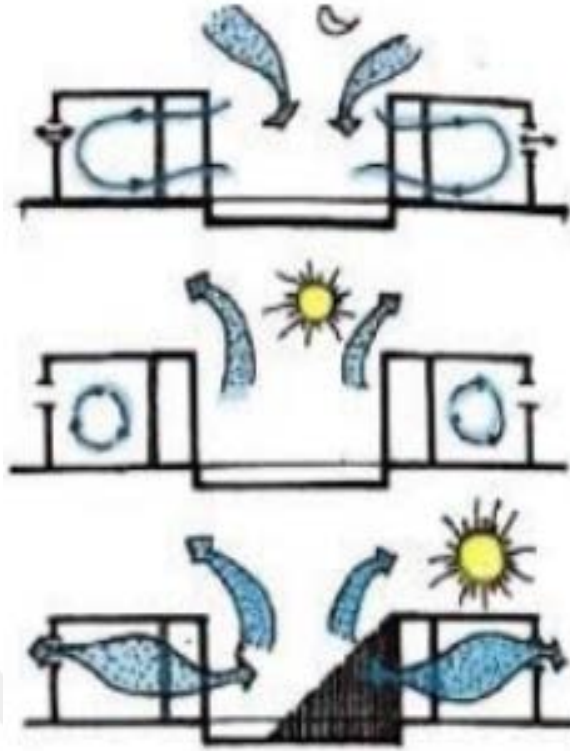


Figure 77. Illustration of the air circulation during night and day. (Source: Ibrahim, 2018)



Figure 78. Traditional Kuwaiti courtyard houses. (Source: Carey, et al., 2013)



Figure 79. An example of the traditional courtyard house with pool and a garden, Iran. (Source: Yazdanpanah, 2009)

3. The *Mashrabiya* (the latticed screening)

The *mashrabiya*, which comes from the Arabic language which means drink meant drinking place. Also, a common technique used to generate air flow regulation in the space (Fathy, 1986). *Mashrabiya* was a cantilevered space with latticed screens (Figure 80). It had mainly five functions from which three apply in this biophilic pattern (Figure 81).

- Controlling the air flow
- Reducing the air current
- Increasing humidity of the air current

and the rest of the functions discussed in the following biophilic patterns: 4.3.6 Dynamic and diffuse light and 4.5.2 Refuge.

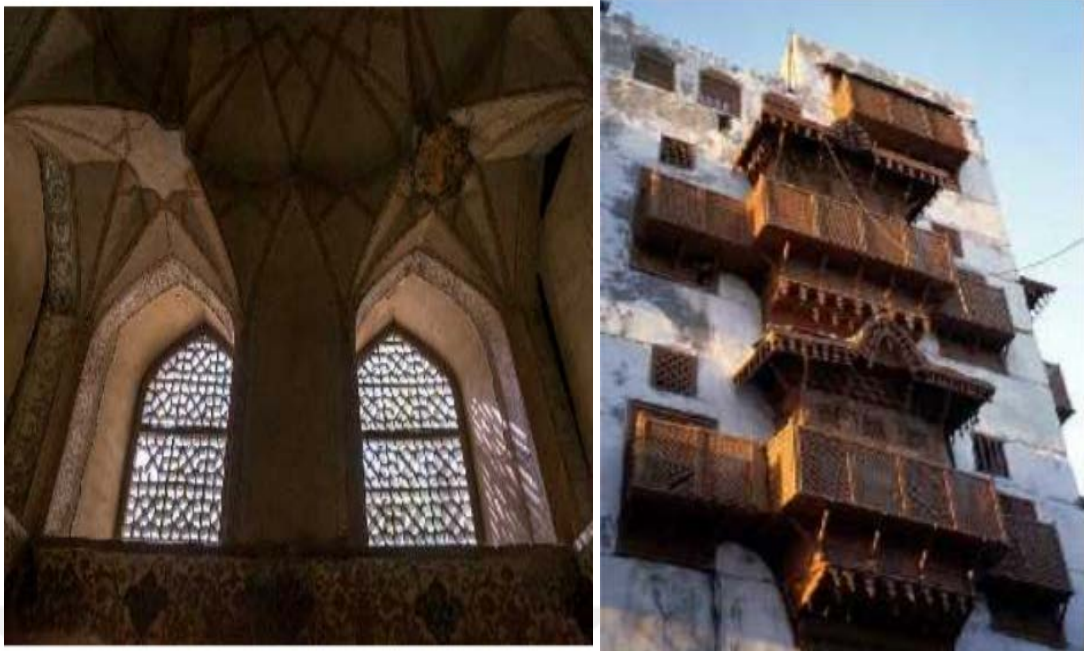


Figure 80. examples of variation of *mashrabiya* (left) Iran Source: (akdn.org) and (right) Saudi Arabia (Source: saudicaves, n.d)

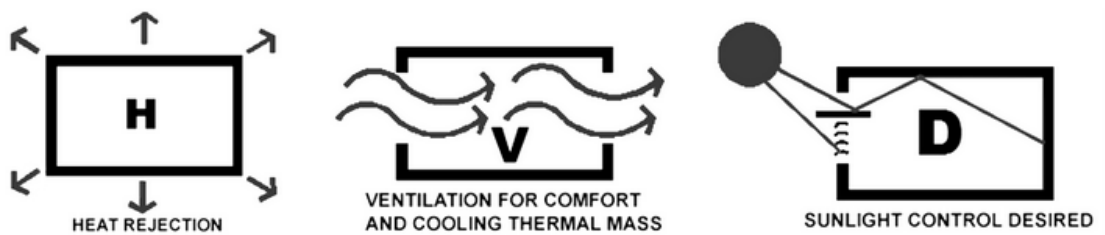
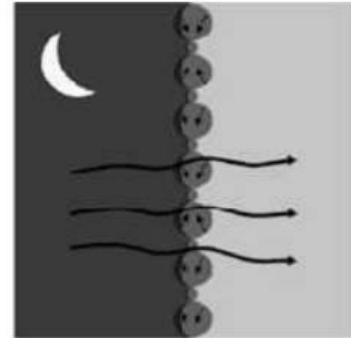


Figure 81. the different uses of the *mashrabiya* left to right humidity control, air flow and the diffusion of light.

Mashrabiya was used to ensure air circulation inside the building. It works by pulling the air into the room through the small interstices in the lower parts of the and hot air is ejected out through the large interstices in the upper part this technique not only enhances the air circulation but also speeds it up into other rooms and cooling the room quickly. It's function mainly focuses on the environmental, social and architectural factor it works as a protection device from the sunlight and it effectively reduces the heat gain specifically during the hot seasons. Its traditional construction does not require frequent maintenance. Depending on the material that is used primarily wood was used due to its durable factor, so can be used for longer periods of time as it is resistant to extreme weather conditions such as heat and humidity. As mentioned by Hassan Fathy (1986), the *mashrabiya* interstices works as both by intercepting the direct solar radiation and also by softening the uncomfortable glare.

As well as, since it is made out of wood usually in Saudi Arabia and Iran, it aids in regulating humidity inside the space as it is known that wood absorbs and releases moisture when as air passes through the interstices or lattices of the porous wooden and can carries it to the interior and therefore cooling the space (Figure 82) (Fathy, 1986).

At night, the mashrabiya absorbs moisture carried on the wind and passing through the interstices.



When heated by sunlight, it releases the moisture into the air that passes through, thereby increasing humidity within a home and reducing its temperature.

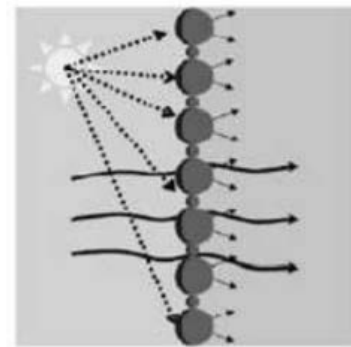


Figure 82. shows the evaporation process on the *mashrabiya*. (Source: Fathy, 1986)

By placing a jar with water at the *mashrabiya* cantilever evaporation can take place through the movement of air, where the air flow gets cooler as it passes over the jar which known as evaporation cooling (Figure 83).

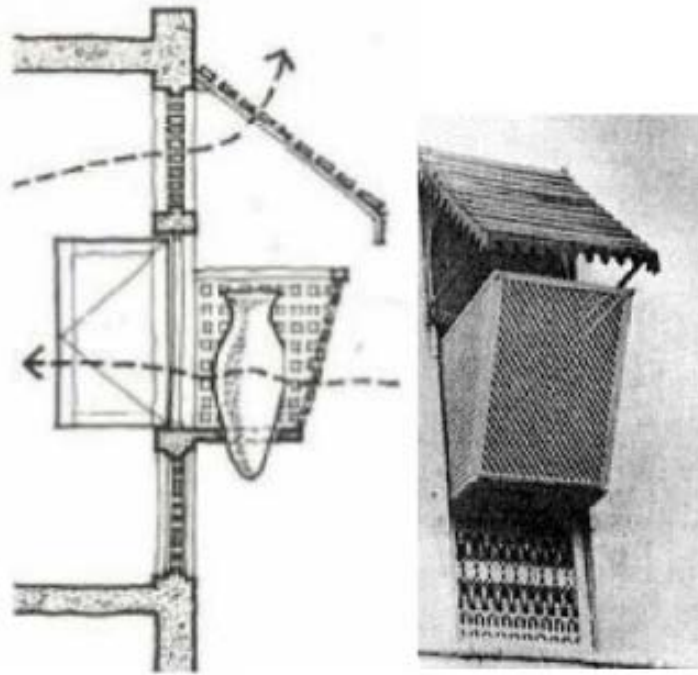


Figure 83. the working of the *Mashrabiya* to allow for air flow from the water jar causing evaporation cooling effect. (Source: (Fathy, 1986))

3. *Nuqush Muftah* (perforated plaster panels)

This system used the *Nuqsh* plaster carving which can be present commonly throughout the Gulf over door, in *majlis* areas (Figure 85). They provide soft daylight and can help to expel warm air from the upper part of the room when positioned at high level.

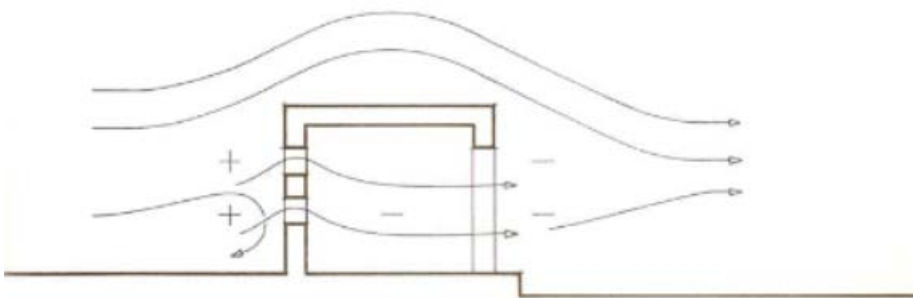


Figure 84. shows a schematic diagram of the air pressure movement. (Source: (Fathy, 1986))



Figure 85. shows the example of *Nuqoush Muftah* upper openings provide natural ventilation and lighting (Source: Lockerbie, 2021)

4.4.5 Presence of water

The presence of water is also one of the key features in biophilic design as it is the most crucial element for human life to survive. Presence of Water is a condition that enhances the experience of a place through the seeing, hearing or touching of water also feeling effects of its evaporation (Browning, et al., 2014).

4.4.5.1 The experience of the pattern

A space with a Presence of Water condition feels captivating and provides with a sense if calm (Browning, et al., 2014).

4.4.5.2 The roots of the pattern

The pattern evolved through the research on visual preference for and positive emotional responses to environments containing water elements; it proves to be affecting the perception and psychological and physiological responsiveness when multiple senses are stimulated simultaneously (Browning, et al., 2014).

4.4.5.3 The appearance of the pattern

The main Source of water in the Gulf region is the renewable ground water stored in the sedimentary deep aquifers (Figure 91). An aquifer is a subsurface layer of water-bearing permeable rock, rock fissures, or unconsolidated materials that is found under the surface of the earth (EC UKPONG, n.d.). These aquifers locally known as *Al falaj* or *Qanat* have been present on the region for thousands of years and can be found in Saudi Arabia, Kuwait, Bahrain, Qatar, the United Arab Emirates and Oman. Groundwater contained in the principal deep aquifers provides a reliable supply of water due to the vast volumes of water that may be found there. Theses aquifers can be date back to 2175 BCM and the majority of it located in Saudi Arabia

(Odhiambo, 2016).

The *falaj* (Figure 92) is one of the oldest and most remarkable water systems known to man. It dates back to the 714 BC. Falaj is a type of irrigation system construction of which involves digging a suitable aquifer to provide the quantity of water needed for irrigation. Al falaj consists of five parts: the mother well(s), the tunnel, the cut-and-cover section, the *sharia* and the surf channels (Figure 86) (Power & Sheehan, 20122).

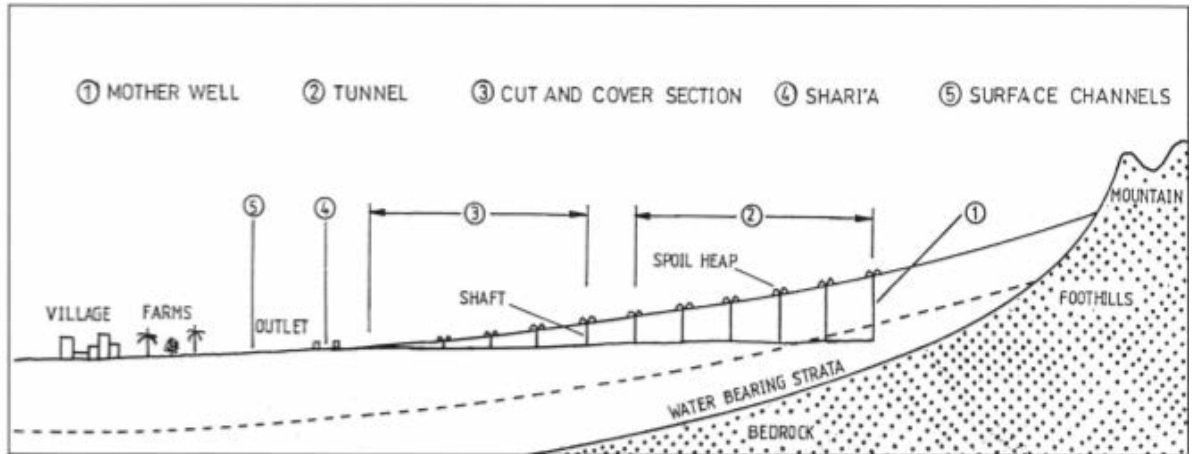


Figure 86. Cross section diagram of the Falaj. (Source: Rejeb, et al., 2017)



Figure 87. The mother well an example from Oman. (Source: Rejeb, et al., 2017)

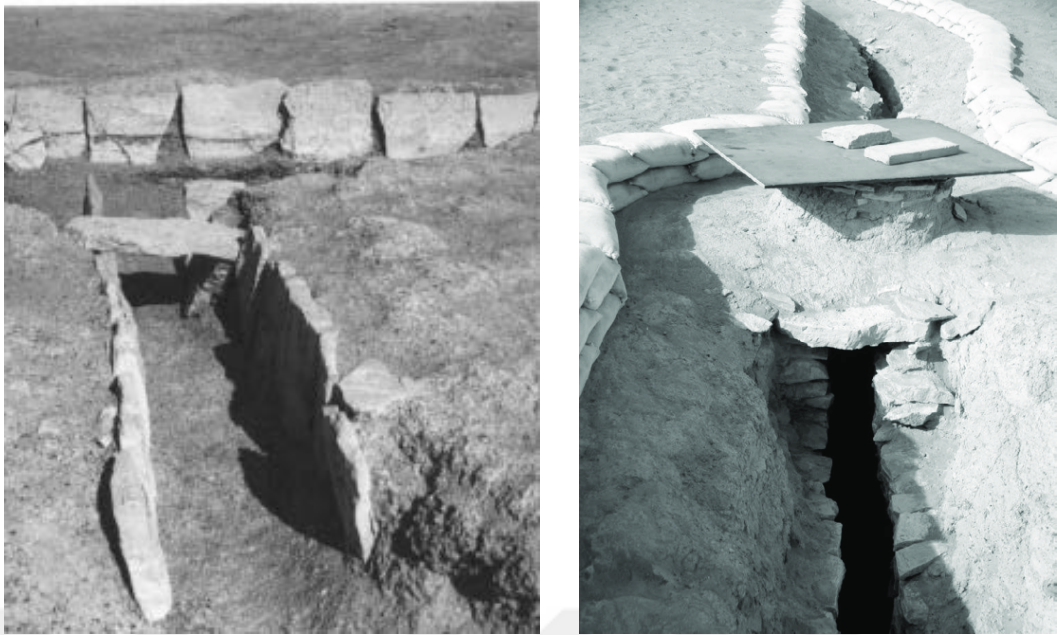


Figure 88. The primary and secondary shafts. (Source: Tikrit, 2002)

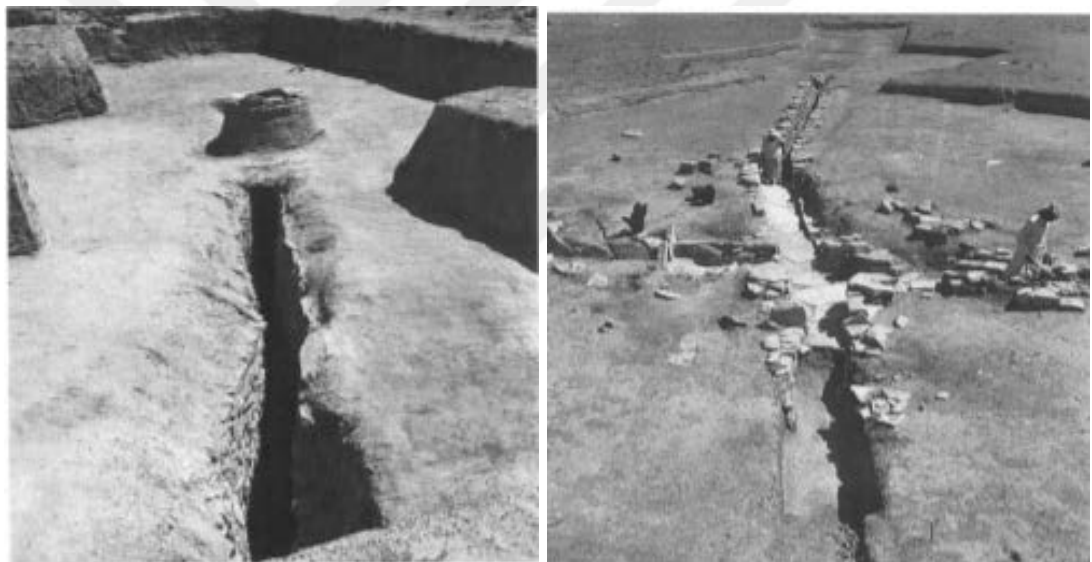


Figure 89. (right) shows the cut and cover section and the sharia (left). (Source: Tikrit, 2002)



Figure 90. shows the surface channel, Abu Dhabi. (Source: abudhabi, 2014)



Figure 91. Early nineteen seventies, Doha, Qatar, these are the common well that are found in the area, surrounding channel around the well to contain spillage and direct the raised water, and an extension leading to a contained area. (Source: Lockerbie, 2021)

The water for a falaj comes from subterranean Sources such as wells or wadis (valleys). It does not rely on machinery to extract water, instead relying on gravity to

drive water through its channels. This also regulates how water is distributed equitably and evenly across crops and the surrounding environment (Figure 92). Water flows continuously in the falaj throughout the year, but the falaj's fullness is determined by the rainy seasons, which dictates the fullness of the water Sources.

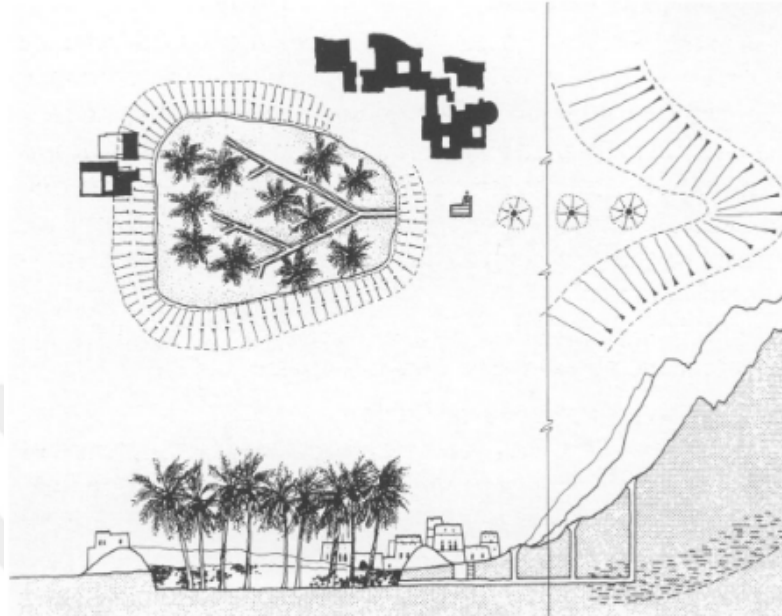


Figure 92. (left), the schematic diagram of the houses near the dates garden and the water Source(right). Shows the falaj used as a water Source for the irrigation of the date palms (Source: Smith, 1991)



Figure 93. Masjid al luqta, Wadi, Adi Oman remnants, the section and plan shown below. (Source: Smith, 1991)

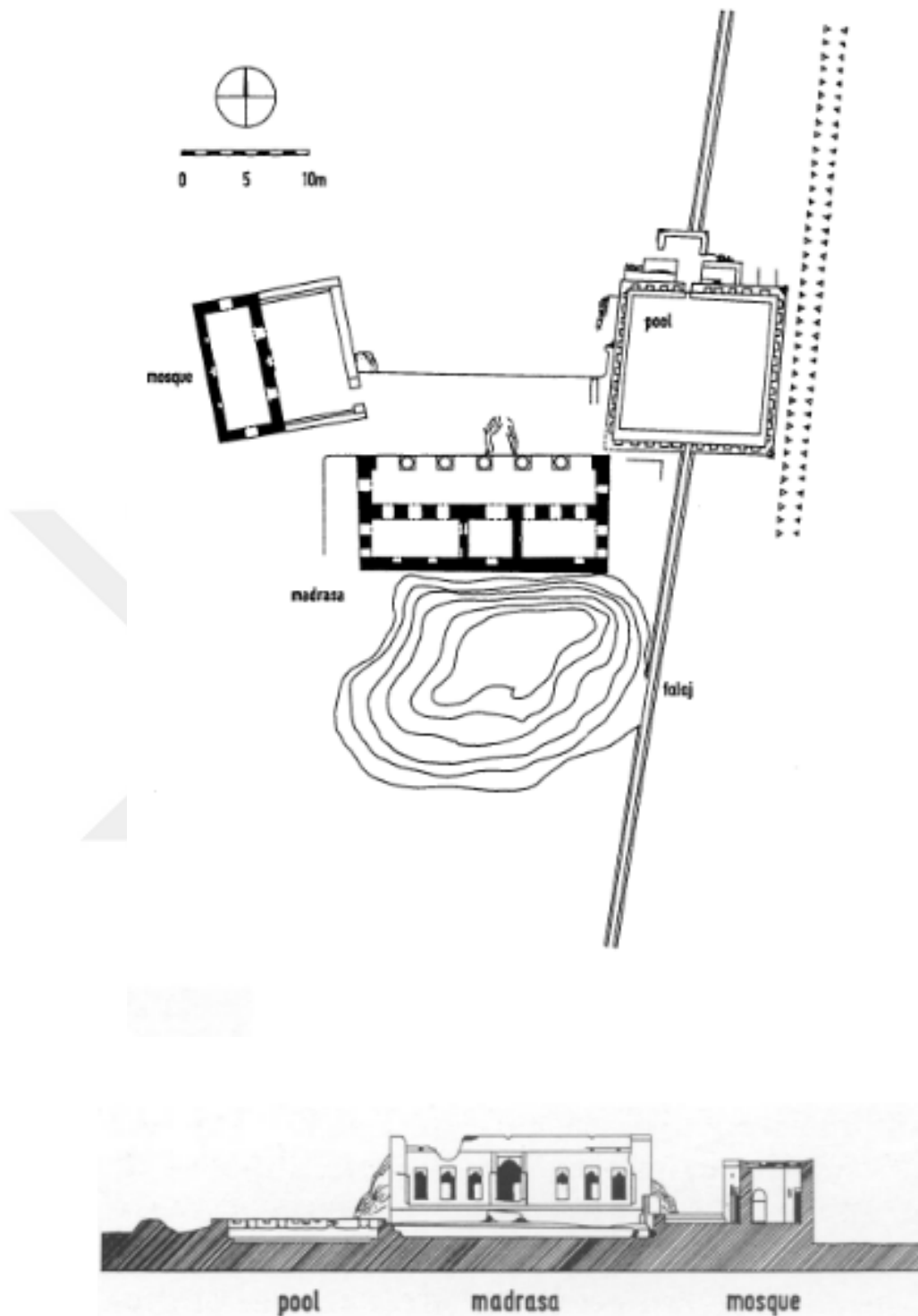


Figure 94. above shows the plan where the falaj is used and below shows the shows the cross section of Masjid al Luqata Oman where the ornamental pool is visible. (Source: Smith, 1991)

4.4.6 Direct and diffuse light

Diffuse & Dynamic Light creates natural-looking situations by utilizing changing intensities of light and shadow that fluctuate throughout time (Browning, et al., 2014).

4.4.6.1 The experience of the pattern

A space with a Dynamic & Diffuse Light transmits and demonstrates essence of time and movement to stimulate a dramatic sense of feel along with intrigue (Browning, et al., 2014).

4.4.6.2 The roots of the pattern

Lighting design has long been utilized to establish the ambiance for a room. The effects of daylight on performance, mood, and well-being have been investigated for many years in a variety of settings, and light has been widely explored and written about as a complicated topic of science and design. Illuminance variation and visual comfort, human variables and light perception, and the effects of illumination on the circadian system's functioning have been the subject of recent study (Browning, et al., 2014).

4.4.6.3 The appearance of the pattern

The appearance of this can be observed in the *mashrabiya*, the *mashrabiya* had many functions (Fathy, 1986), as mentioned above and diffusion of light is one of them. The function of the *mashrabiya* in this case works when daylight enters a place, it comes in the form of direct, high-intensity sunshine or lower-intensity reflected light when a traditional *mashrabiya* is used as a window screen in that space (Figure 95). The passage of direct sunlight into an architectural area has the potential to heat surfaces inside that space, which is a common use of the traditional *mashrabiya* throughout the winter months. As a result of this design, only diffused light is allowed to reach the area during the summer months, while direct sunlight is blocked during those months by the geometry of the *mashrabiya*.

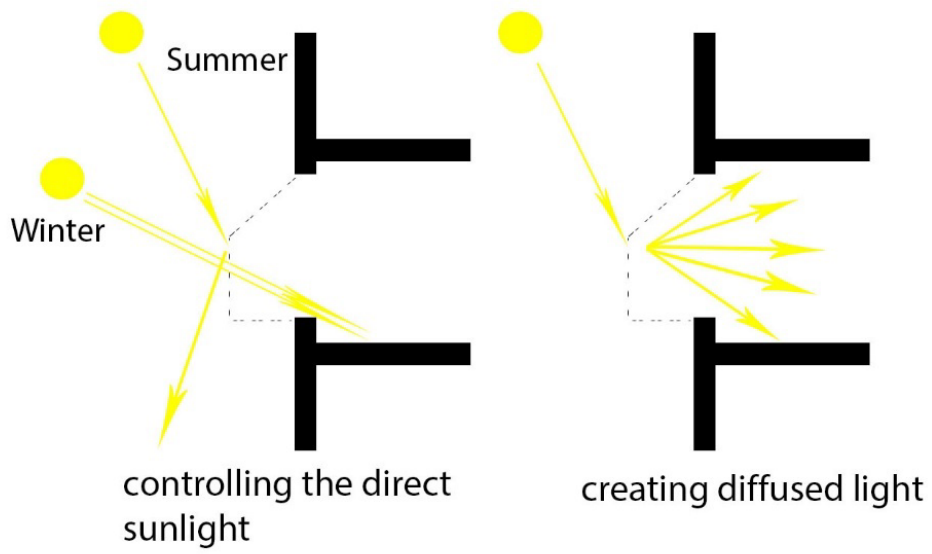


Figure 95. shows the diffusion of sunlight in the traditional *mashrabiya*.

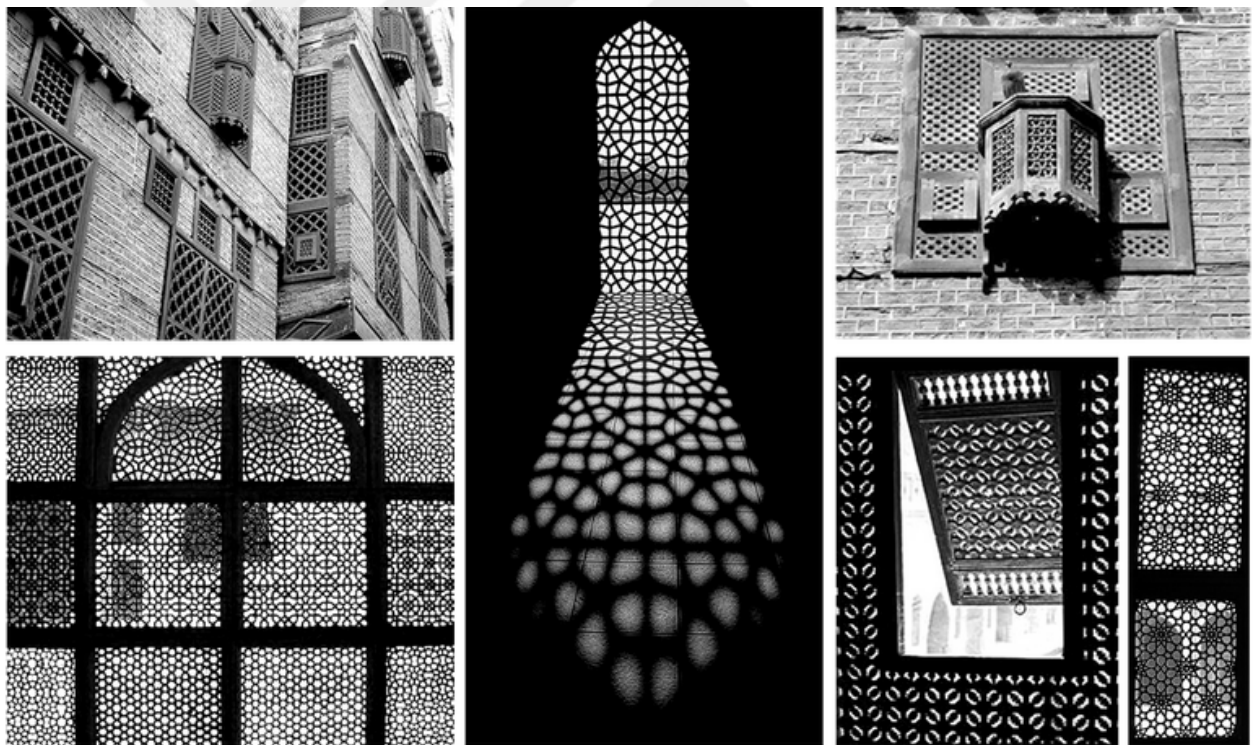


Figure 96. shows the experience of the diffusion of light from the inside of the *mashrabiya*. (Source: aidashafei, n.d)



Figure 97. Dowlat Abad Garden, Yazid, Iran Lattice windows, (left) a vault version of a dome to provide skylight to enter, (right) leads the light inside pleasantly. (Source: Baghbani , et al., 2017)



Figure 98. shows the diffusion of light into the room through the *Nuqsh* panels (Source: Lockerbie, 2021)

4.4.7 Connection with natural systems

The knowledge of environmental processes, particularly seasonal and temporal variations that are indicative of a healthy ecosystem, is known as connection with natural systems (Browning, et al., 2014).

4.4.7.1 The experience of the pattern

This pattern has a significant temporal component that may be reflected culturally. The experience of this pattern is connected to the location with a strong connection to natural systems that generates a sense of belonging to a broader whole, bringing seasonality and life cycles to mind. The sensation is typically expected and

might be pleasant, nostalgic, insightful, or instructive.

4.4.7.2 *The roots of the pattern*

The roots of this pattern are theorized that exposure to natural patterns and processes enhances good health responses. Kellert refers to this as "Natural Patterns and Processes" in *Biophilic Design* (Kellert, et al., 2008).

4.4.7.3 *The appearance of the pattern*

The appearance of this pattern can be seen in the seasonal migration during summer and winter months. In Saudi Arabia, Iraq, Kuwait, Qatar and the UAE the *Beduin migration* usually took place during these months. Whereas in Qatar, Oman and Iran there were separate quarters build for summer and winter seasons.

1. The *Beduin* tents

These were the traditional dessert dwellers known as the *beduin*. They use tents that are generally woven by hand Figure 100; made of goat hair, sheep wool or camels' mane. These structures during summers are usually located in the hinterlands where water oases could be found and also with the possibility of trade in mind. The location of the *beduin* tents commonly is chosen to take advantage of the weather conditions (Figure 99). In general, the front of the tent should face in the Mecca, Muslim prayer direction which sometimes but not always coincide with it. The tent front is oriented towards the prevailing wind direction throughout the summer, and the tribe commonly be shifted into the mountain shadow. For winter months they move deeper into the regions where vegetation (Figure 101) and wells could be available, for example in Qatar the northern part of the country provided for this need so the *beduin* would migrate to those parts during winter.

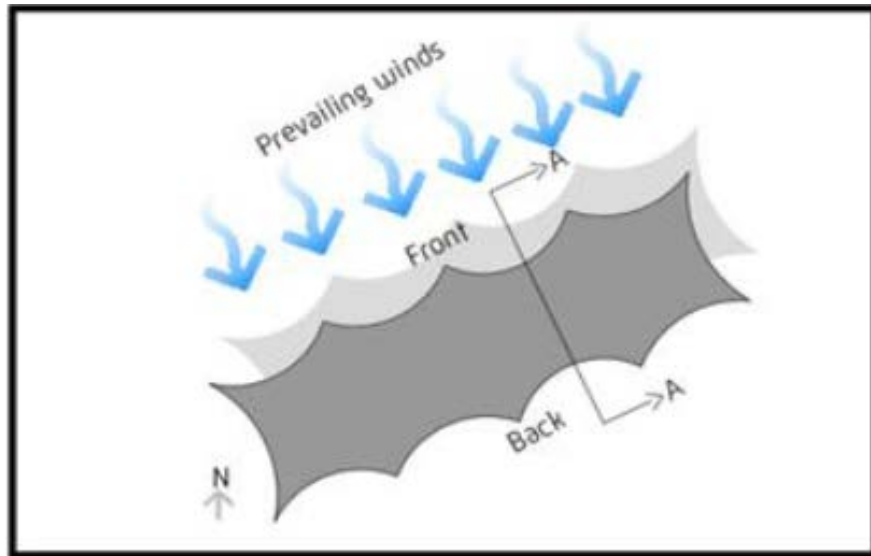


Figure 99. summer wind tent illustration by Abu Dhabi planning council. (Source: Abedi & Soltanzadeh, 2014)



Figure. 100 the traditional Bedouin tents. (Source: Lockerbie, 2021)



Figure 101. an example of the *beduin tents* during the winter months, Qatar. (Source: Lockerbie, 2021)

2. The summer and winter quarter in domestic housing

The winter and summer living quarters were an element of the courtyard houses (Figure 102), with a courtyard Figure 103 in the middle with *Liwan* colonnade (Figure 104) around it and the summer quarters in the upper levels to make use of the wind (Figure 104) movement and the winter quarters usually on lower levels. Some of the houses were built with towers to generate air flow during the summer months and usually closed during the winter.

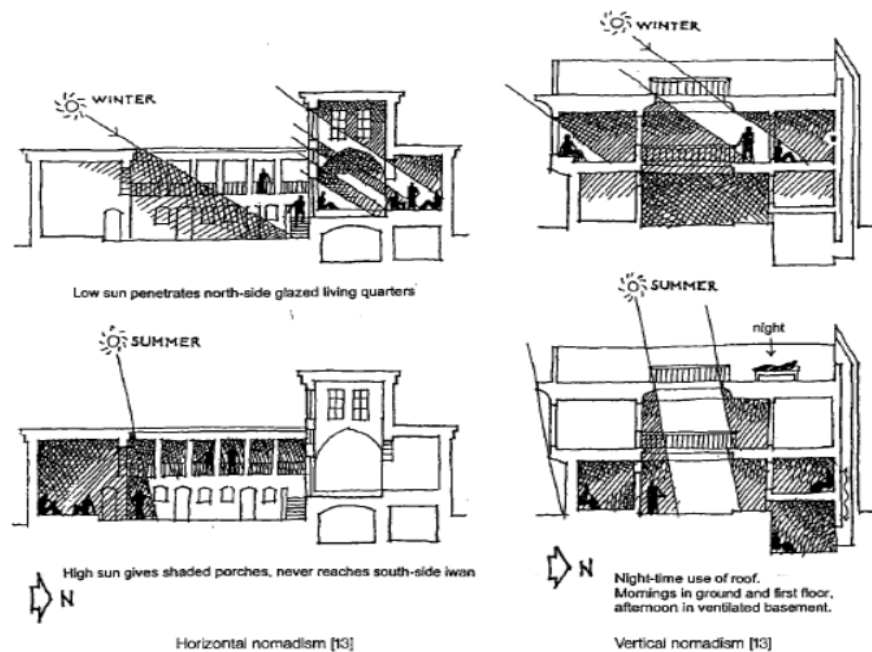


Figure 102. illustration of the summer winter quarters and the use of roof spaces. (Source: Ragette, 2012)

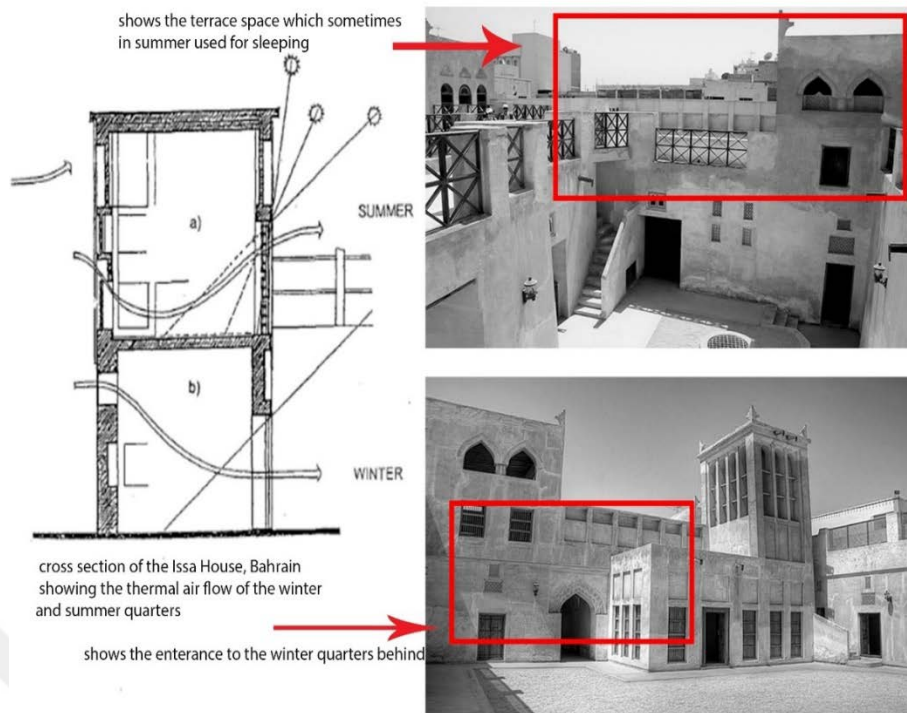


Figure 103. shows examples and cross section of a wealthy family house in Bahrain with separate quarters. (Left) (Source: Ragette, 2012) (right) (Source: Alraouf, 2014)

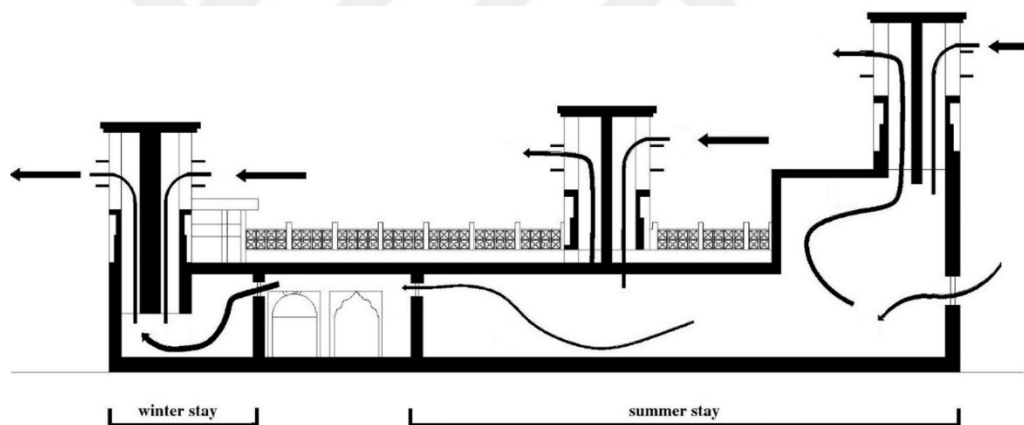
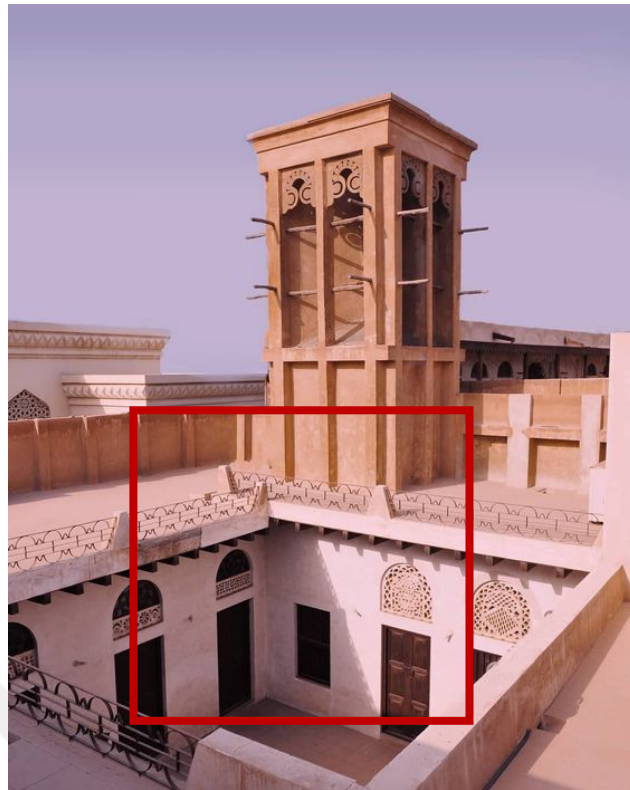


Figure 104. Above an image of the *badgheer* and courtyard above the winter stay and the colonnade *Liwan* marked with red, Iran and (below) this an illustration of the winter and summer quarter in the region with use of wind tower. and courtyard in the middle. (Source: Mazraeh & Pazhouhanfar, 2018)

4.5 *Nature analogies*

Organic, non-living, and indirect evocations of nature are all addressed in Natural Analogies. Objects, materials, colors, forms, sequences, and patterns found in nature are reflected in the built world as artwork, furniture and textiles. Natural materials that have been treated or severely changed, all give an indirect link to nature: although they are genuine, they are merely comparable to the goods in their natural condition.

Nature analogies consists of three patterns:

1. Biomorph forms and patterns
2. Material connection with nature
3. Complexity and order (Browning, et al., 2014).

4.5.1 Biomorph Forms and Patterns

Biomorph Forms & Patterns are the symbolic representations of natural contoured, patterned, textured, or numerical formations (Browning, et al., 2014).

4.5.1.1 The experience of the pattern

Stimulates an interesting feel and comfort (Browning, et al., 2014).

4.5.1.2 The roots of the pattern

The root of this pattern comes from the research on view preferences, which reduced stress due to induced shifts in attention, and increased concentration which led to the development of Biomorph Forms & Patterns. Right angles and straight lines are unwelcomed in nature, however organic and biomorph shapes appeal to people on a visual level. People may characterize biomorph shapes and patterns as symbolic representations of life, even if the human brain understands these patterns are not living entities (Vessel, 2012) (Browning, et al., 2014).

4.5.1.3 The appearance of the pattern

The appearance of the pattern can be seen at the decorative carvings on the door as well on the *nuqsh* panels (Figure 106) and (Figure 107). For the *nuqsh* the *majlis* was the primary beneficiary of this kind of carving since it was the most significant room built for receiving and entertaining visitors, making it the most apparent location to display adornment. A single band of panels was placed over each window, or two bands were placed above each window if the ceilings were high enough. The specific restriction in Qatar that applies to the placement of these panels is that every panel along a wall inside a room must be of a distinct design, albeit the pattern must be replicated in the panel that faces across the room from the one that faces inward. An exception to this rule is that there has been evidence of the artist modifying a single panel such that there is a degree of asymmetry inside the chamber in certain cases, which is a minor variance. When it comes to traditional Persian carpets, the same approach is often used, with the logic being that there can be no perfection in anything that has been made only by mankind.



Figure 105. right shows the detailing of the *enf* door post and left shows the simpler door decorations. (Source: Lockerbie, 2021)

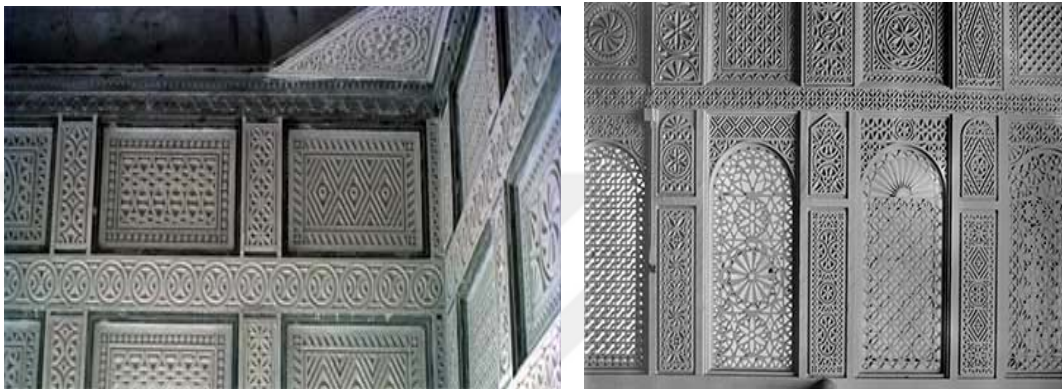


Figure 106. shows the more detailed *Nuqsh* panels which were usually done for the wealthier people in the community. (Source: Lockerbie, 2021)



Figure 107. shows the *Nuqsh* detailing on the wall with the geometric patterns usually resembling flowers. (Source: Lockerbie, 2021)



Figure 108. shows the example of the Nuqsh panels on top of the doors left and the door decorative elements right (Source: Lockerbie, 2021)

4.5.1.4 Material Connection with Nature

A Material Connection with Nature is made up of natural materials and components that, via little processing, mirror the ecosystem or geology of the area in order to generate a particular feeling of place (Browning, et al., 2014).

4.5.1.5 The experience of the pattern

A sense of warmth, natural feel along with stimulating a physical connection to nature (Browning, et al., 2014).

4.5.1.6 The roots of the pattern

While there is scientific evidence on the health effects of natural materials, current research is starting to offer light on design possibilities. As a result, the Material Connection with Nature design is based on a small body of scientific study on physiological reactions to varying amounts of natural materials, as well as the influence of natural color palette on cognitive function (Browning, et al., 2014).

4.5.1.7 The appearance of the pattern

The appearance of this pattern can be seen in the wood work of the coiling in the traditional Arab housing, where the threshold of the front entrance and the lower floor of the residence were always elevated at least 150mm above the standard exterior completed outer floor levels in place to avert flood or rain water from entering the house during heavy rains (Lockerbie, 2021). To avoid being swamped, dwellings would be built on minor elevations if feasible. The utilization of the ceiling structure as a decorative element of the area below was taken advantage of because of the high ceilings. Surmounted by a woven palm mat, the floors and ceilings were supported by

shandal beams, which were usually round and made of mangrove poles or timber beams, on top of which was placed, in the better houses, an ornamental woven reed or woven cane layer visible from below, and over which was placed the first of at least two layers of well tamped down earth (Lockerbie, 2021). The *shandal*, which was cut through the outer wall in order to gain the greatest structural bearing in (Figure 109). The use of wood for the doors and windows also shows the essence of this pattern (Figure 110).

The use of palm frond (Figure 111) also known as *arish* was also common for housing as date palm were readily available in the area. The regional palm cultivation has been around in the region for centuries to be used as a building material. This material allowed for the houses to be cooler during the summer as the panels were spread out in the walls due to which the interior of the house remained cooler. Palm frond was used as it was with much processing, they were weaved plaited in to strips of the palm leaves which were then sewn together to make bigger panels which could later be used for support of plaster, as floor mats, for roofing or even food covering (R. Hawker, 2008).



Figure 109. the traditional Arab housing the ceiling decorative elements, the images show an example from Qatar. (Source: Lockerbie, 2021)



Figure 110. shows the wood work balustrade and doors, AL-Aqaili House, Deira, Dubai. (Source: weetas.com, n.d)



Figure 111. (left) example from Dubai shows a tradition arish structure and (right) shows the spacing to allow for the air to follow and keep the house cooler. (Source: Bayt, n.d)

4.5.2 Complexity and Order

Complexity and Order has a variety of sensory information that is organized in a spatial hierarchy that is comparable to that seen in the natural environment. Complexity and order pattern has similar features to the Biomorphic Forms and patterns therefore, the examples in this pattern can also be related to the Biomorphic forms and patters and vice versa.

4.5.2.1 The experience of the pattern

As an exciting mix between monotonous and overpowering, a room with excellent complexity and order helps one feel engaged and information-rich.

4.5.2.2 *The roots of the pattern*

The Complexity & Order pattern arose from studies of fractal geometries and preferred viewpoints, as well as the perceptual and physiological reactions to the complexity of fractals in nature, art, and architecture, as well as the predictability of design flows and patterns in nature. Our bodies instinctively attenuate their response to stress caused by demanding labor and external factors in such fractal situations, therefore, that settings with a comfortable level of complexity and organization are therapeutic, or at the very least beneficial.

4.5.2.3 *The appearance of the pattern*

The appearance of this pattern can be observed in the *muqarnas*, which was not very common all over the Gulf region but can be seen as in Iranian architecture and a simplified version from the Iranian architecture in some places in the Gulf like Qatar, Kuwait and the UAE (Ragette, 2003). It is important in Islamic architecture because the intricate shape of the muqarnas represents God's creation of the universe in its symbolic portrayal (Esmail, 2012). The muqarnas is in essence a succession of corbels, and as such, it serves a structural purpose. The underlying structure may, however, take on a purely ornamental appearance, in which case it is a less genuine depiction of the underlying structure, given that it implies a structural function. A distinction may be made between this and patterns generated by the application of tiles or carved plaster panels or plasterwork *nuqsh* panels, in which it can be seen that there is no structural significance to the designs (Ragette, 2003).



Figure 112: muqarnas used as a decorative element in the pedestrian entrance in Qatar. (Source: Lockerbie, 2021)

4.6 Nature of space

Nature of the Space is based on natural spatial arrangements. This encompasses our natural and taught drive to look beyond our immediate surroundings, our attraction with the somewhat risky or unknown, obstructed vistas and revelatory moments, and even phobia-inducing traits when they contain a trusted aspect of safety. It is an indirect connection to nature through ways which mimic Biophilia.

It consists of four patterns:

1. Prospect
2. Refuge
3. Mystery
4. Risk/Peril (Browning, et al., 2014).

4.6.1 Prospect

It is an unobstructed view from a distance that may be used for monitoring and planning (Browning, et al., 2014).

4.6.1.1 The experience of the pattern

When alone or in unfamiliar situations, a room with a good Prospect condition provides a sense of openness and freedom while also imparting a sense of safety and control (Browning, et al., 2014).

4.6.1.2 The roots of the pattern

Visual preference and spatial habitat reactions, as well as cultural studies, psychology, and architectural study, all contributed to the development of the Prospect design (Browning, et al., 2014).

4.6.1.3 The appearance of the pattern

In the case of prospect, generally there was no direct relation with the vernacular architecture in the Gulf region other than the privacy needs; however, a few close aspects can be related to this pattern such as in (Figure 113) it is the mud village in Oman, since it is at an elevated position it resembles the sense of prospect with the open view to the rest of the village from the roof terraces. Also shows the fort structure that had elements such watch towers.

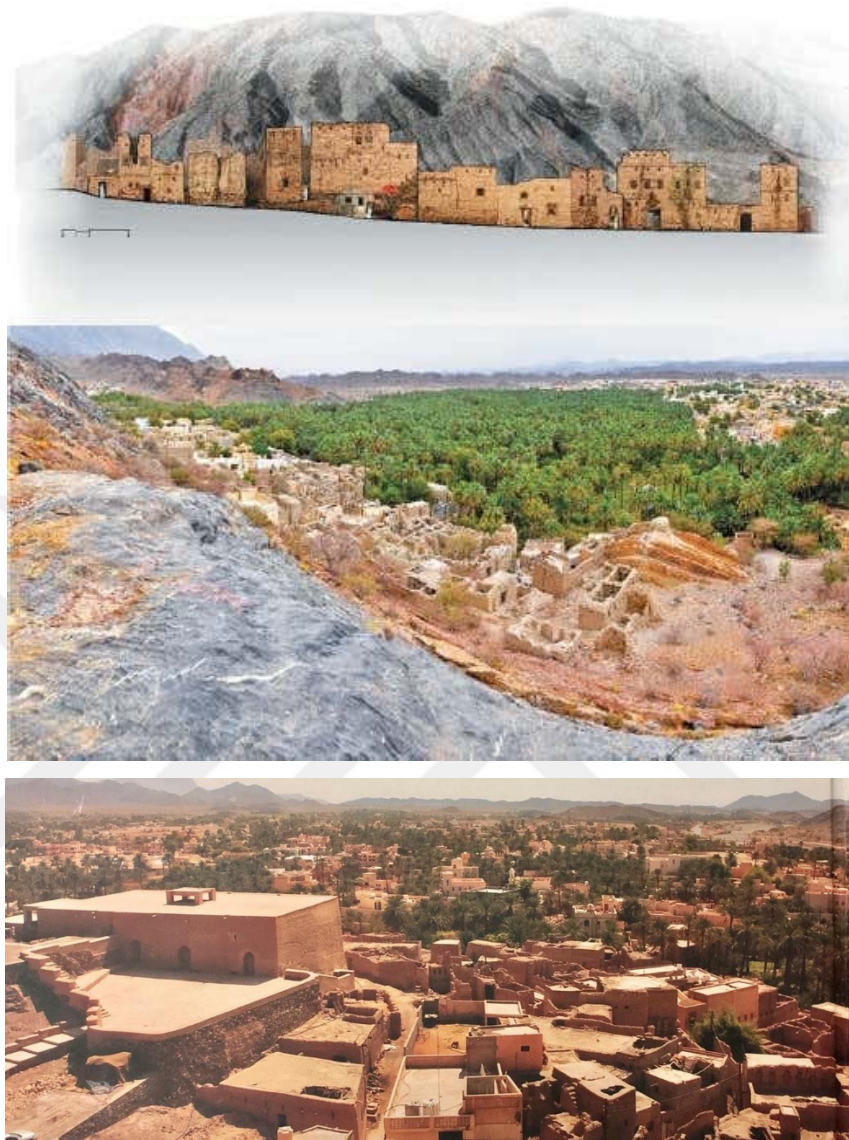


Figure 113. Mud village, Oman (AL hamara) (Source: Anon, 2021)

4.6.2 Refuge

In the context of retreat from environmental circumstances or the main flow of activity, a refuge is a safe haven where the person is shielded from behind and above (Browning, et al., 2014).

4.6.2.1 The experience of the pattern

Isolated or distinct from its surroundings; its spatial qualities express meditative, embracing, and protective feelings without needlessly disengaging the user (Browning, et al., 2014).

4.6.2.2 *The roots of the pattern*

Visual preference study and spatial habitat responses, as well as their link to Prospect circumstances, have all influenced the Refuge design. Refuge circumstances are vital for stress reduction and restorative experiences, which achieved by lowering blood pressure and pulse rate. As well as better focus, and safety perception, are said to be some of the other advantages of Refuge (Browning, et al., 2014).

4.6.2.3 *The appearance of the pattern*

This pattern appears in (Figure 114) which shows a close resemblance to the pattern as the pattern refers to a sense of protection from above and behind and at least three side of the space is covered to create a sense of refuge. The development of the housing units one of the essential features used to be the construction of the protective wall which was commonly added to the north and west of the walls of the single building which was considered to forming the basis for safe family life this was common for the courtyard houses.



Figure 114. (Left to right) show the example of spaces in the traditional Qatar housing with the essence of refuge with at least three sides covered (Source: Lockerbie, 2021)

This pattern can also be seen in other uses of the *Mashrabiya*, which was to screen the windows to avoid outsiders to see directly inside as well as for neighboring privacy. The screens were either used over cantilevered windows or regular windows to provide air flow, light as well privacy.

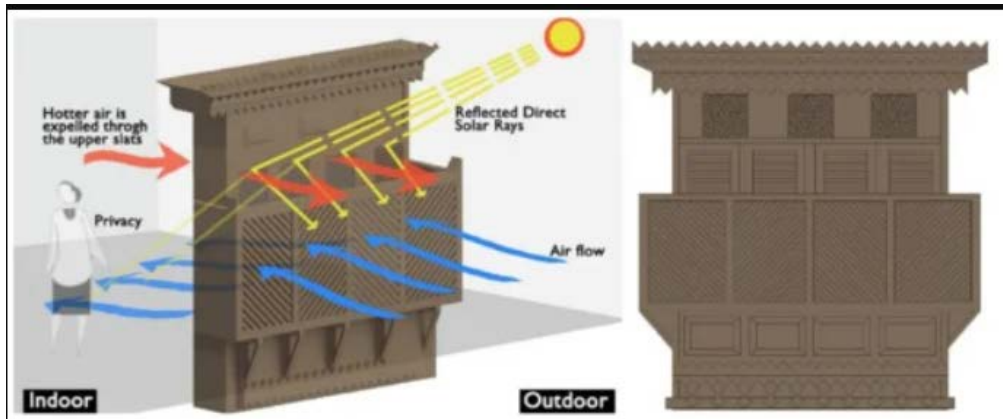


Figure 115. (top) an illustration of indirect view through the screen and (bottom) an example of these *mashrabiya* screens on balconies, Old city Basra, Iraq. (Source: Karban , et al., 2021)

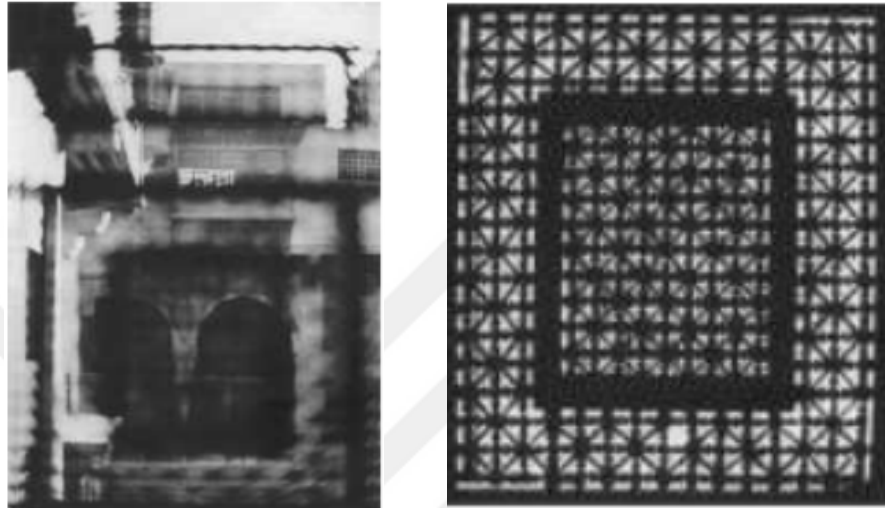
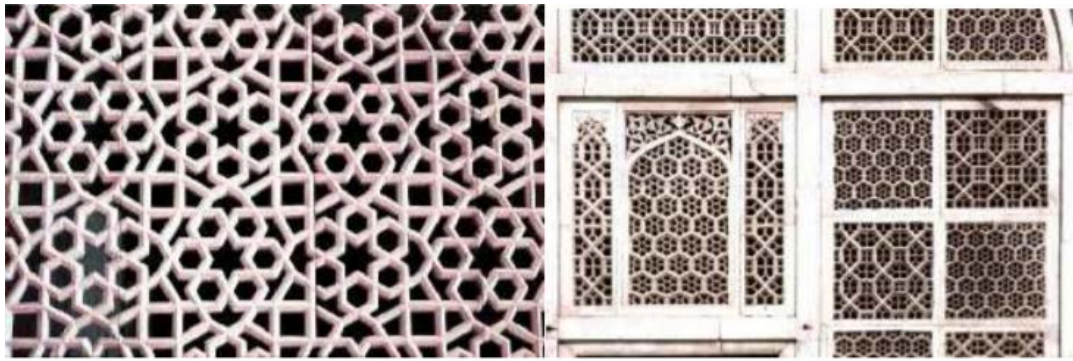


Figure 116. (top) various patterns of the *mashrabiya* screen and (bottom) shows the inside and outside view of through the screens. (Source: Fathy, 1986)

4.6.3 *Mystery*

When people walk further into an area, they are enticed by the promise of additional information, which may be obtained via partly concealed views or other sensory gadgets (Browning, et al., 2014).

4.6.3.1 *The experience of the pattern*

A condition that has a perceptible sensation of anticipation, or of being teased, which provides the senses with a sense of denial and reward, compelling one to study the environment more (Browning, et al., 2014).

4.6.3.2 *The roots of the pattern*

This pattern is founded on the premise that individuals have two fundamental wants in their environments:

- to comprehend and to explore,
- and that these basic needs should arise from one's existing location in order to create a feeling of mystery.

The Mystery pattern is based on studies of visual preference, perceived danger,

and pleasurable reactions to anticipated circumstances (Browning, et al., 2014).

4.6.3.3 *The appearance of the pattern*

The appearance of this pattern can be observed in the alley ways or sidewalks in the Gulf vernacular architecture (Figure 117) shows the sidewalks in the UAE and Iran, which were used to shielded from the summer heat and glaring sunshine by curving and narrow canals that run in an overall east–west direction, and by towering adobe walls on both sides that increase the amount of shade covering. These narrow deep canals, packed with air that has been cooled by the shadows, act as an air-block at the pedestrian level, preventing warm breezes from falling to the level of the dwellings near the ground. A section of the walkways is covered or vaulted which acted as a supporting strutting to the opposite walls and as a result caused maximize the amount of shadow covering, resulting in the formation of roofed alleyways. Narrow walkways also contribute to the creation of a thick network across the city (Fathy, 1986).



Figure 117. traditional alleyways in the UAE (right), Iran (middle) and Iran (left) (Source: Baghbani et al., 2017)

4.6.4 *Risk/Peril*

Risk/Peril is a recognizable hazard with a dependable countermeasure (Browning, et al., 2014).

4.6.4.1 *The experience of the pattern*

A thrilling location, and with an implied threat, maybe even a bit wicked. It has the potential to be deadly, but it is also interesting (Browning, et al., 2014).

4.6.4.2 The roots of the pattern

A biophobic reaction provoked by a close and present hazard might cause risk. Due to a trusted aspect of safety, this threat is inert and unable to inflict damage. Being aware of a manageable danger; helps have more pleasant experiences that produce powerful dopamine or pleasure reactions (Browning et al., 2014).

4.6.4.3 The appearance of the pattern

The appearance of this pattern is not directly visible as there were not many building that were present at an elevated area or even at a Predator-prey role reversal. However, the examples in figures below show a few examples that can be considered as being close to showing this pattern such as in (Figure 119) from Oman the mud village in al hamara and (Figure 118) show the openness and exposure over the encompassing heights of the stone walls instills a sensation of peril, which is tempered by the knowledge that one is protected by solid walls (Browning, et al.,2014).



Figure 118. Remnants of a building in Wakra, Qatar, 1973. first floor opening in the upper level of the housing. (Source: Lockerbie, 2021)

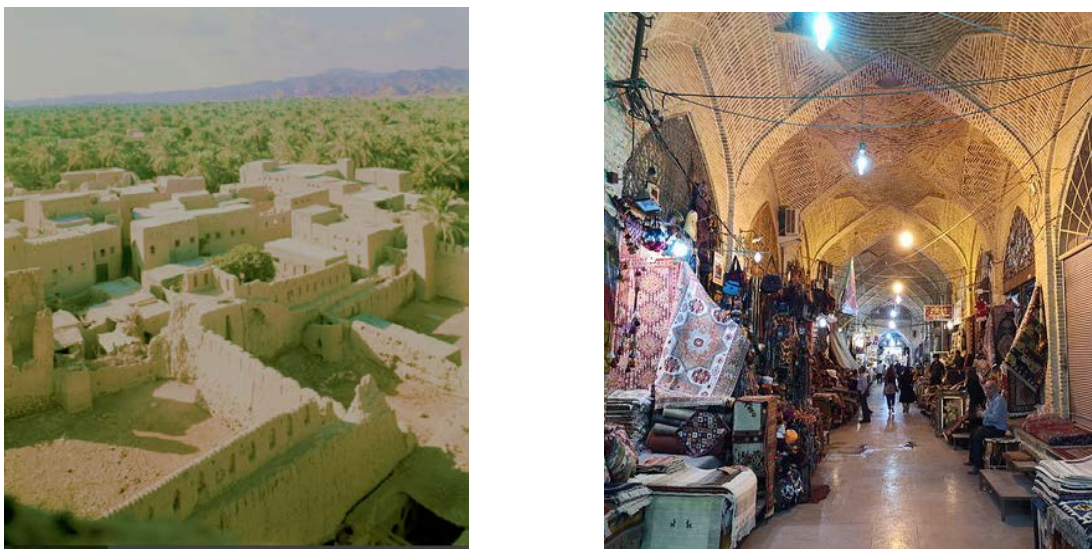


Figure 119. Mud village in Al hamara, Oman (left) Source: (Snoek, 1973). the figure

shows the openness of the village from a height. Old bazar, Shiraz Iran, (right) shows the old bazar the double height ceiling shows a sense of openness. (Source: Xismx, 2015)

4.7 Conclusion

This chapter looked into the 14 biophilic design patterns proposed by Terrapin Bright Green (Browning, et al., 2014), in the context of the vernacular architecture in the Gulf region and by exploring various architectural features in the region. It can be concluded that the region possesses much of the biophilic patterns, and that the lessons from it can be included in the contemporary architecture; this is discussed in the next chapter as a potential approach to a more sustainable design. Because when it comes to designing for people, the built environment, and the natural environment, biophilic design principles serve as an excellent guide for recognizing an essential component of taking people, the built environment, and the natural environment all into account at the same time.

Table 3. the biophilic design pattern and the relation with Gulf vernacular architecture elements and the solution they can provide.

relationship to nature		biophilic design pattern	elements of vernacular architecture	the soltion they can provide
direct, physical and ephemeral presence of nature	nature in space	visual	the palm gardens, the falaj (water irrigation system)	layout,water and planting
		non visual	the use of textured material in the stone house and the palm frond	use of material
		non rhythemic sensory	the wild life, the billowing badu tent fabric	
		thermal and airflow	the use of badgheers (wind tower),the use of mashrabiya, use of ceramic pots with mashrabiya ,the courtyards	orientation , ventilation
		presence of water	the water wells, the use of water in courtyards	water and planting
		dynamic and diffusion light	indirect light with mashrabiya and badgheers, through the patterned opening over doors	orientation, lighting
		connection to naturall system	the summer and winter quarters , the badu tend migrations	layout
indirect invocation to nature	nature analogies	bimorphic forms and pattern	floral patterns on doors and window openings	identity
		material connection	the use of palm fronds, limestone and mud sometimes also mixed with palm fronds, the wooden doors	use of material
		complexity and order	the muqarnas on enterences, the pattern of the opening over doors	identity
spatial configurations in nature	nature of the space	prospect	mud village on the moutain side	layout , privacy and security
		mystry	the sikkak (alleyways)	
		refuge	the design if majlis (semi private metting spaces ususaly for males)	
		risk/peril	not direct but could considered in old bazar iran and mud village on the moutain ares	

CHAPTER 5: LESSONS FOR THE CONTEMPORARY ARCHITECTURE

5.1 *Summary:*

This chapter explains various lessons that can be derived from the biophilic design elements in the vernacular architecture of the Gulf region, exemplifying their application in the contemporary architecture.

5.2 *Chapter overview*

The chapter discusses contemporary architectural solutions inspired from the locals' adaptation to the conditions of the natural environment and the incorporation of such conditions in their built space. Seen through a biophilic prism, the topics covered here include:

- **The layout and orientation** as important design aspects related to the local environmental context.
- **The ventilation, thermal mass and daylight** as elements of nature in space formations that can provide useful solutions through biophilic considerations.
- **Water and planting** as the most direct elements of Biophilia that could be essential components of contemporary architectural designs.
- **Safety and privacy** as 'Nature of the space' elements of Biophilia that match the traditional requirements of the Gulf region settlements.

5.3 *Introduction*

This chapter discusses the lessons from the vernacular architecture of the Gulf region that was discussed in the previous chapter 8 based on the 14 patterns of biophilic design (Browning, et al., 2014), which can be incorporated in the contemporary architecture of today. This is done through examples that can be proved useful against the harsh climate of the Gulf, that were used as solutions before. Therefore, they can be useful solutions for the contemporary architecture today. The chapter is spread out in terms of:

The orientation and layout

The ventilation, thermal mass and lighting

Use of material

Water and planting

Safety and privacy

5.4 *Layout and orientation*

The lessons from the vernacular architecture of the Gulf region that can be taken in terms of the layout of the buildings in accordance to the biophilic design can be the following:

1. The urban layout of the buildings
2. The narrow alleyways and pathways as a result of the urban layout
3. The location of the building with in the plot
4. The interior open spaces

The buildings in the Gulf region are usually adjacent to one another as shown in (Figure 120), (Figure 121) and (Figure 122) with narrow alleyways and passageways called *sikkak* connecting them together. This implies that the ratio of the surface exposed to the sun compared to the overall volume of the structure is kept to a minimum, which as a result minimizes the amount of heat that accumulates throughout the day on the walls. According to the Arabic-Islamic tradition in the Gulf region, this type of urban layout is shaped around the privacy in (Figure 123) of the interior of the home and which progresses to the more public spaces of the urban areas (Khalaf, 2012). The privacy of the inside of the household to the more public urban areas; due to the Islamic tradition of maintaining a private and neutral face to the outside world, traditional road hierarchies develop which extend down to pedestrian systems. The designs for the exterior semipublic spaces flow out from the interior of a house and its plot and are in essence a series of *majaalis*, which are structured in a hierarchical manner and along which people meet and discuss events. Due to this the inclusion of an inner courtyard is common, which is often planted with trees and has a water well. On all sides, the courtyard is often encircled by rooms or walls, increasing the amount of space that is shaded inside during the day and providing a gathering location for socializing in the evenings. When the sun lowers, the courtyard acts as a chimney, allowing hot air to rise and be replaced by cooler air from the surrounding rooms, which stimulates air circulation and generates a cooling effect throughout the building.

However, there have been a number of issues in the recent contemporary developments that have undermined this seclusion or privacy, as well as the Islamic practice of preserving a private and balanced front to the outer world. This issue in the contemporary design is due to the character of persons who move into new types of housing that are significantly impacted by the Western lifestyles is one of these factors; others are connected to the kind of plot granted by the government as well as the

planning regulations imposed on the plot, which are two other factors to consider (Benhamouche, 2004), therefore, including these elements back into the design could prove to be beneficial.



Figure 120. The arial view of Kuwait from the 1950's indicating the plot arrangements, with buildings placed adjacent to one another with narrow alleyways and each with the courtyards within the plot boundaries. (Source: Al-Beeshi et al.,2010)



Figure 121. An arial view of the plot arrangements the UAE around the 1950's, showing the interior courtyards as well as the narrow alleyways. (Source: abudhabi, 2014)



Figure 122. Aerial image of Band Abbas Iran showing similar to the closely arranged plots as the rest of the Gulf region. (Source: Dalman, 2011).

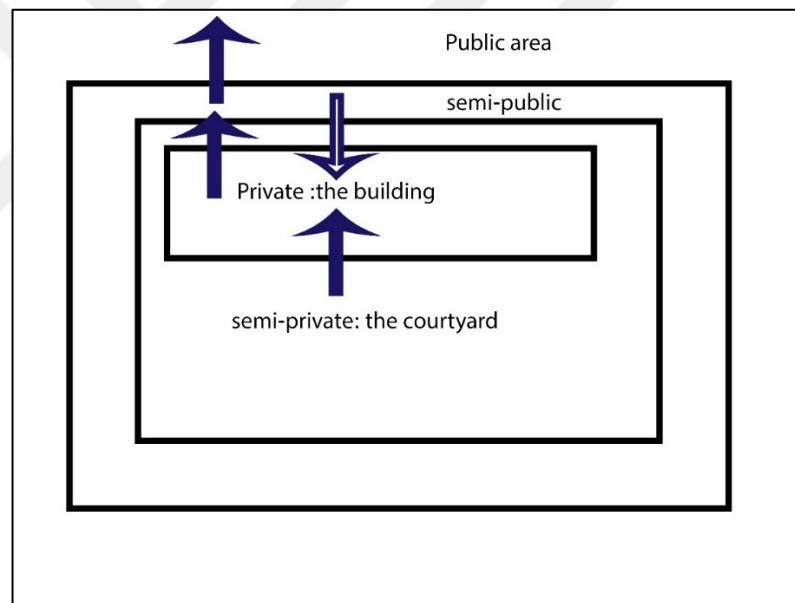


Figure 123. A simplified diagram of the location of the building in the plot area. It indicates the privacy relationship within and outside the house.

5.4.1 *Ventilation and Lighting*

In the vernacular architecture of the Gulf region the ventilation and natural lighting go hand in hand, since the openings that provide for ventilation as well as keeping the space warm or cold depending on the climate also provide the daylight. Architects often see daylight and sunlight as posing distinct challenges in terms of how they are guided and utilized inside structures. These factors naturally change depending on the season and time of day, but it is generally agreed up on that sunlight is beneficial in

the winter because it may assist warm interior spaces, on the other hand it can be regarded as a problem in the summer since it can cause overheating. Additionally, it adds character to a space as well as movement throughout the day since naturally daylight is beneficial throughout the day and throughout the seasons since it generates the most natural kind of lighting. The elements that were mostly commonly used for such conditions were the:

1. The window sill opening
2. The *Mashrabiya* (the screen with porous openings)
3. The *badgheers* (wind towers)

5.4.2 *The window placements*

Since the region is hot as well as the need associated to security and privacy is are major issues, it tends to be difficult to introduce light into the interiors through the external walls. However, this can be overcome with the placements of the window opening. One way this can be achieved is through the placement of the window vertical wall in a position at a level where it will not create a privacy problem. This is shown in the (Figure 124) where the diagram illustrates light that can be bounced off a horizontal sill and be reflected onto the ceiling of a room which in turn acts a Source of secondary lighting providing diffuse light.

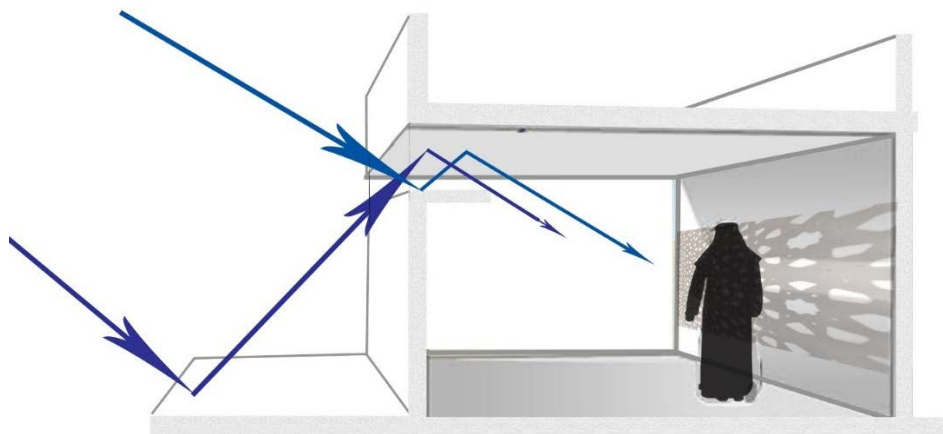


Figure 124. shows an example of the placement of the window opening on top so that the view from outside doesn't affect the interior which gives a sense of privacy along with providing indirect lighting solution. (Source: Lockerbie, 2021)

The other solution could be considering the placements of the openings on the upper part of the wall (Figure 125) and (Figure 126) with perforated screens *nuqsh*, which minimize the view to the interior but also control the direct solar rays providing indirect lighting. In addition, they facilitate air flow into or from the interior space, and

enhance security too. This type of window decoration has various designs which include floral patterns as the Islamic majority did not use animal patterns and opted for more geometric patterns. This method combines the aesthetic with the solution to the practical needs for lighting as well as air flow.



Figure 125. Shows the alternative window opening option with the privacy, as light enters through the perforation and also the view to the interior is minimized. Source: (Lockerbie, 2021) and the bottom shows a contemporary use of the *nuqsh* panel in Kuwait. (Source: Kassam, 2016)

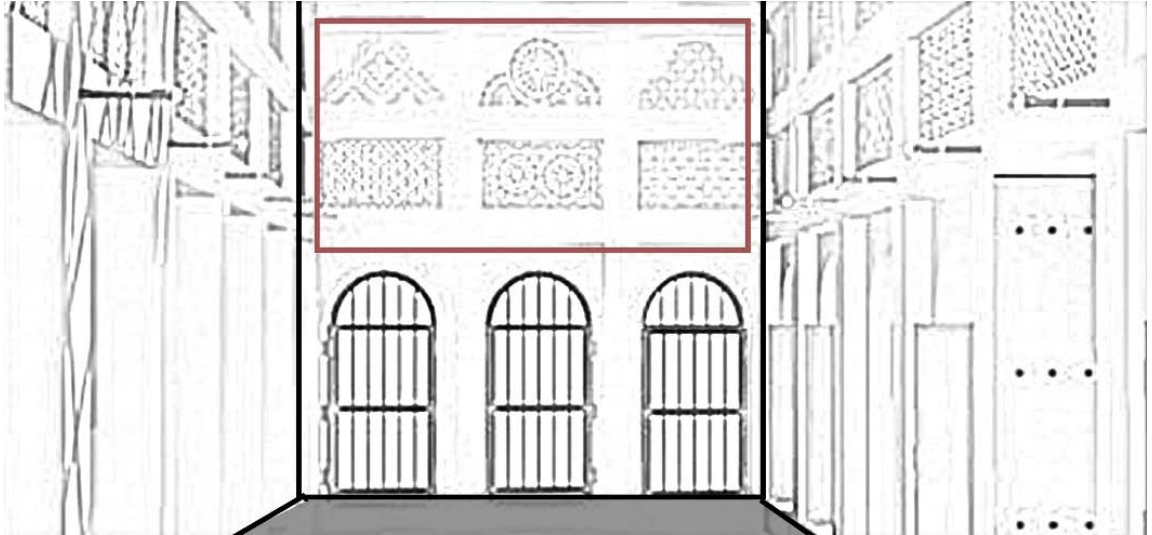


Figure 126. Shows the model of the majlis with the perforated window openings providing light, ventilation along with privacy. (Source: Lockerbie, 2021)

5.4.3 *The Mashrabiya (the screen with porous openings)*

The *mashrabiya* has more than one use that can be incorporated in the design of today from its ability to provide ventilation through the perforated design, as well as the diffusion of light to the providing screening for purposes of privacy which was discussed in detail in chapter 5. The *mashrabiya* can also use for the shading over the narrow pathways *sikkak* (Figure 128).

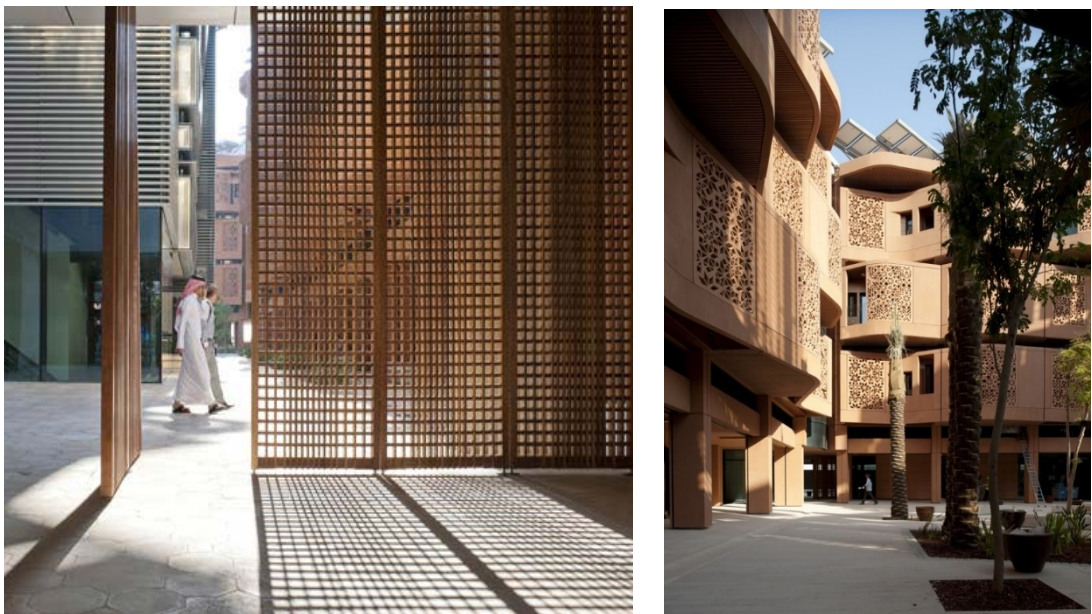


Figure 127. Contemporary use of *Mashrabiya* in masdar project Abu Dhabi. (Source: Baldwin, 2021)



Figure 128. The *mashrabiya* over the *sikkak* narrow pathways left in the traditional Persian alleyways (left) (Source: Lockerbie, 2021) and the use of contemporary *mashrabiya* in the alleyway in Masdar project Abu Dhabi (right). (Source: Baldwin, 2021)

5.4.4 *The badgheers (wind towers)*

Some buildings also include a wind tower, which circulates cool air with assists natural ventilation. To escape direct sunlight, the small pathways air inlets (Figure 132) were covered in most instances with light material from date palm trees. This allowed for improved air circulation between the apartments and the streets and courtyards of the buildings.

The stack effect is another phenomenon related with the *badgheer* (Figure 131) which influenced the development of the ventilation system. It works when a vertical pipe or chimney is heated by the sun, the interior hot air moves upwards, pulling cooler air from any volume at the bottom. A solar chimney is another name for this. This effect has the advantage of working effectively even when there is little or no wind movement outside. The *badgheer* was created as a technique to deliver reasonably clean air into traditional buildings no matter which direction the wind blew. The higher the intakes are placed, the better, since the quantity of dust in the air

decreases (Figure 132) as the distance from the ground increases. This effect is achieved by the traditional *badgheer*, since the tower, which is heated by the sun, pushes air to ascend when there is little or no wind.



Figure 129 .(left) Shows the classic example of a wind tower as well the interior courtyard. and also, the openings above the doors and (right) a contemporary version of *badgheer* used in Masdar project Abu Dhabi. (Source: Baldwin, 2021)



Figure 130. New type of windcatcher used in the university of Qatar. (Source: Baldwin, 2021)

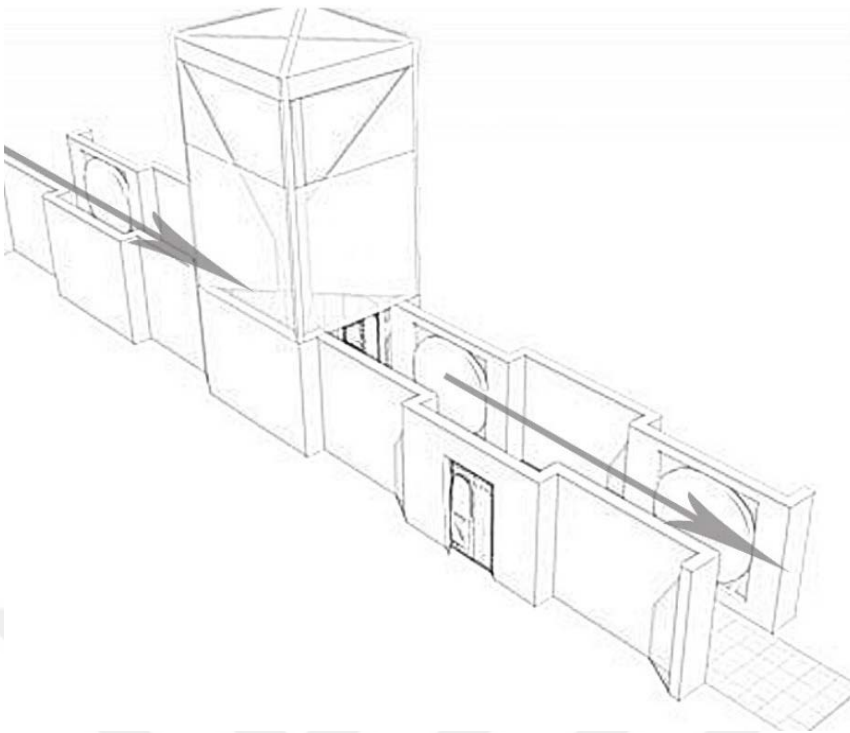


Figure 131. Shows the *badgheer* (wind tower) over the *sikkak* (the narrow passage ways) to provide air flow affect in through the corridor. (Source: Lockerbie, 2021)

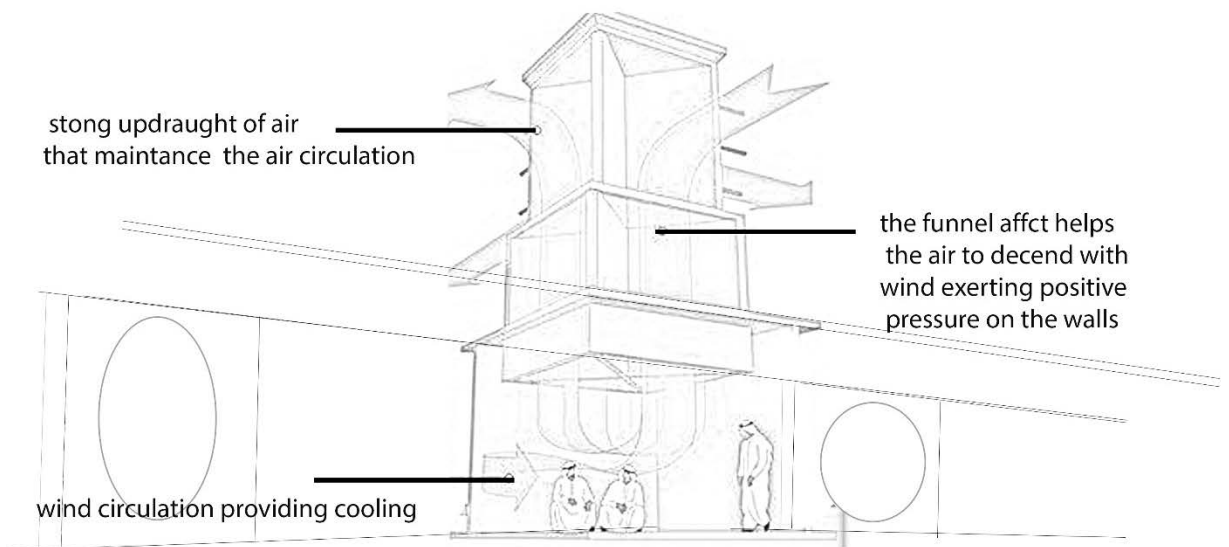


Figure 132. Shows the working of the wind tower in reference to how it can be used in the alley ways.

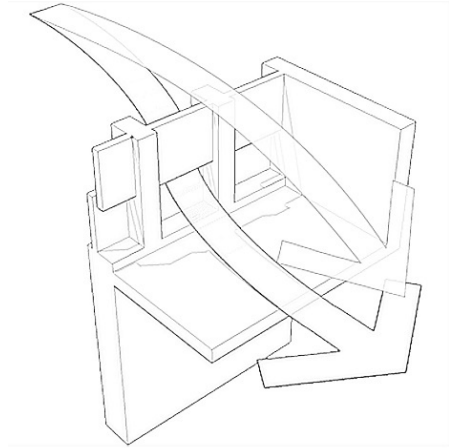


Figure 133. An example of the horizontal *badgheers* (wind catchers) (right) (Source: Lockerbie, 2021) and (left) the movement of the air into the horizontal wind catcher.

5.5 *The use of material*

Natural resources such as limestone and mud, which are sometimes combined with local desert plants such as palm frond are used to develop a building material that has the ability to adjust the temperature of the structure through its thermal mass. Its ability to absorb moisture in humid environments, which may then evaporate during hot and sunny days to offer a mild cooling effect, is a feature of the material. Furthermore, the sandy texture and color of the structures minimizes the absorption of radiating heat energy.

5.6 *Water and planting*

Temperature, humidity, and the rate of air movement are the three major factors that influence the body thermal comfort. Furthermore, psychological elements that influence how users respond to visual or auditory characteristics in and around exterior areas, whether accidental or intentional, should be considered. Planting should be utilized to soften reflections and provide sensations of well-being via movement, color, and our natural reactions to natural things. Planting significantly increase comfort levels. Groups of date palms (Figure 134), for example, provide shade and a more pleasant micro-climate underneath them. Their movement and color contribute to a sense of comfort. Inclusion of the *falaj* serves as a psychological and environmental moderator as well as an architectural feature, reflecting the building behind it.



Figure 134. This image shows the Al falaj irrigation system, with a narrow stream of water that comes from the underground irrigation passes through the date gardens. (Source: abudhabi, 2014)

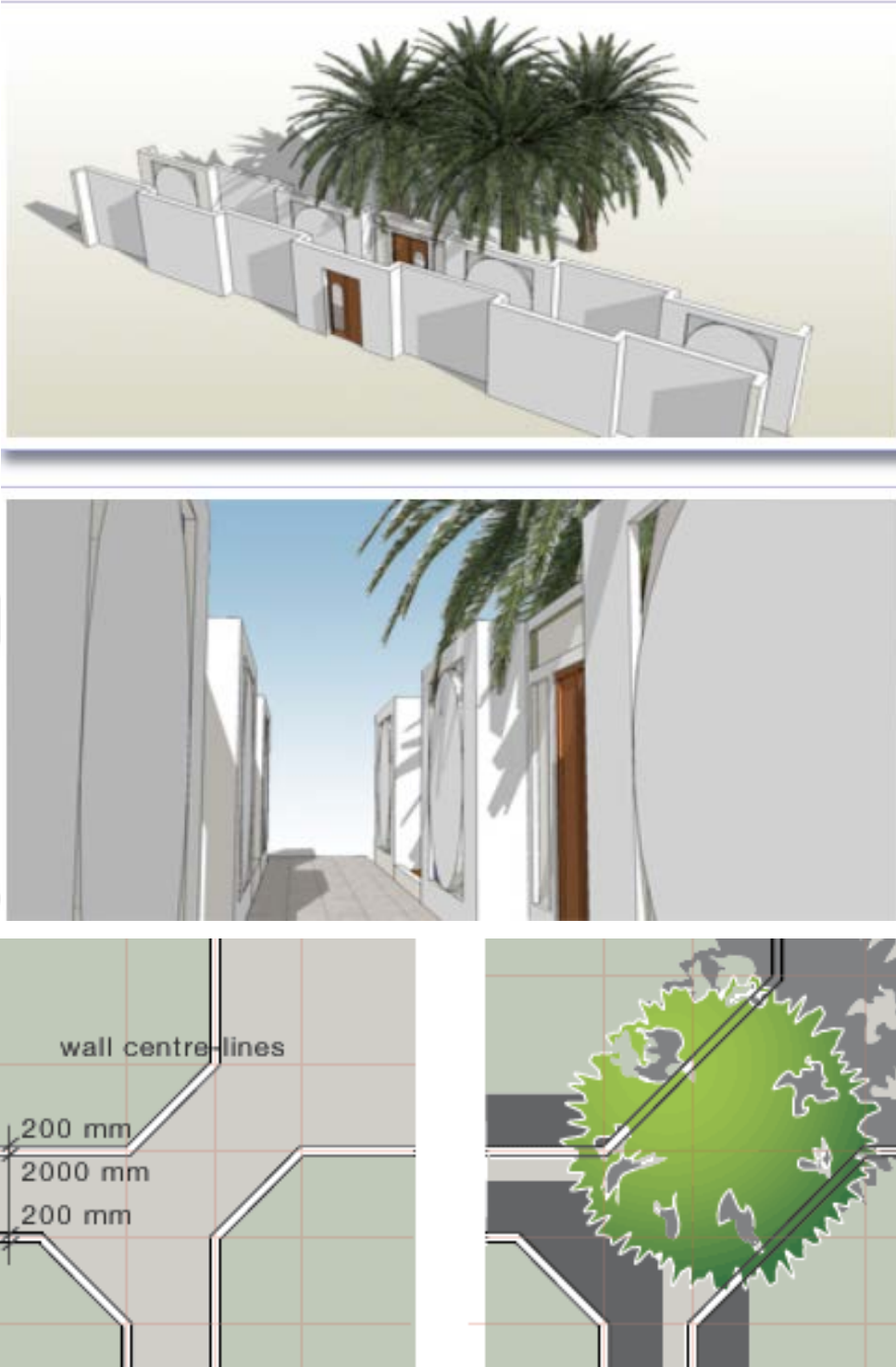


Figure 135. shows a model for the use of shading through planting date palm trees over the sikkak narrow pathways (Source: Lockerbie, 2021)

5.7 *Safety and privacy*

The privacy and safety are suggested here because the region is predominantly Islamic. Here are four possible layouts suggested by Lockerbie (2021), that would provide privacy by prohibiting residents of a centrally positioned house on a plot from

seeing into their neighbors' homes and vice versa.

1. Ensuring that the roof parapet is at least two meters high and, if possible, using a device such as a classic horizontal *badgheers* to provide airflow across the roof's surface, allowing the surface to cool and making the roof area more pleasant to use.

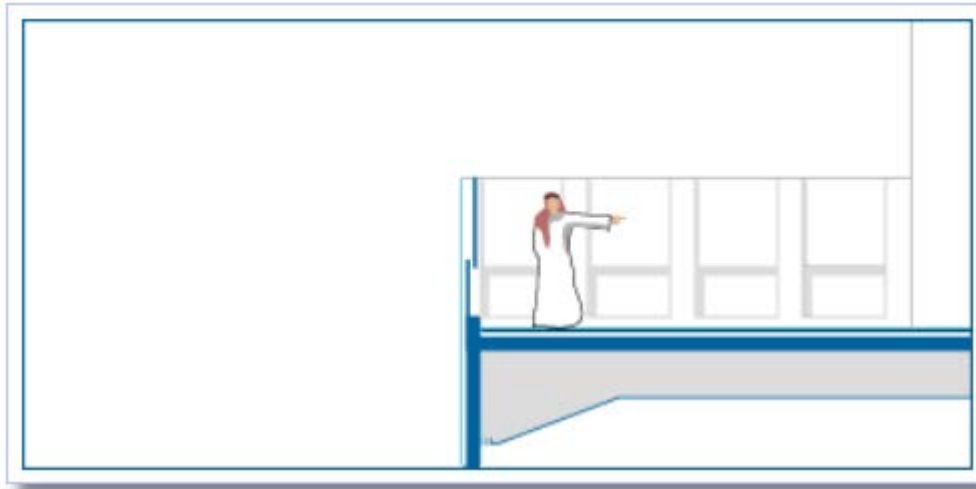


Figure 136. Example of horizontal windcatcher (Source: Lockerbie, 2021)

2. A solution that includes a *mashrabiya*, albeit they are often meant to offer seclusion to people within the home rather than to prevent occupants from being watched by their neighbors. However, *mashrabiya* main feature to allow light and air into buildings without invading neighbors' privacy. This is influenced by the *mashrabiya* being designed as louvres rather than typical *mashrabiya*, which are made of twisted wood or, more often, concrete blocks (Lockerbie, 2021). Using balconies above ground level to create an extension to indoor living areas while retaining privacy by building them high enough to prevent them from being seen or, including a louvred *mashrabiya* to enable light and air circulation.

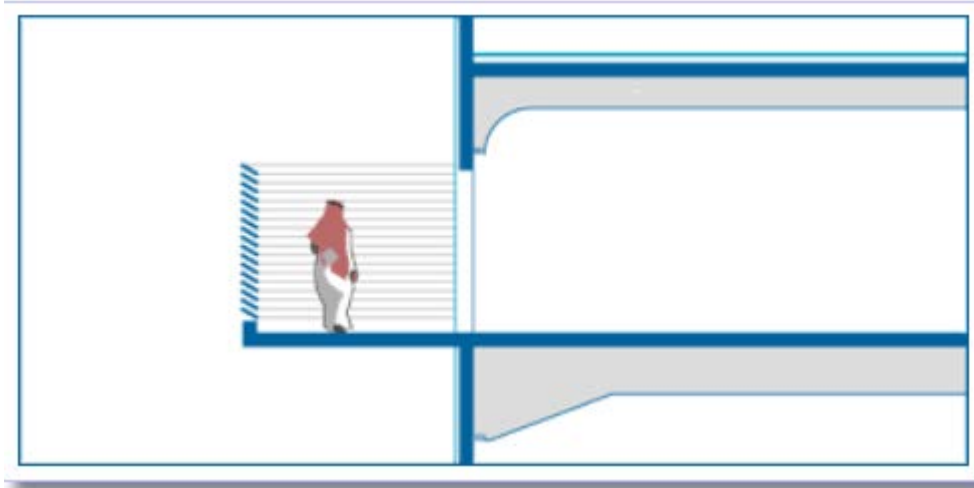


Figure 137. example of *Mashrabiya* screens (Source: Lockerbie, 2021)

3. Providing that the border wall is a minimum of two meters high in relation to the neighboring gardens' completed ground level and, ideally, the finished floor level of the property's internal ground floor.

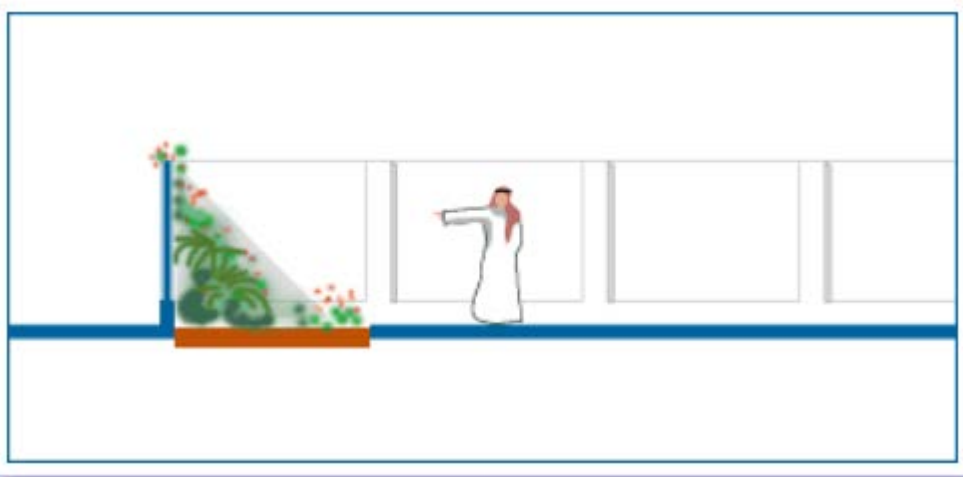


Figure 138. example of planting near gate (Source: Lockerbie, 2021)

4. Planters, for example, offer the extra benefit of giving color, movement, and fragrances to the interiors while also providing some particle filtration. A horizontal, louvred sun screen that would cover the windows while also providing minimal protection to small-scale vegetation.

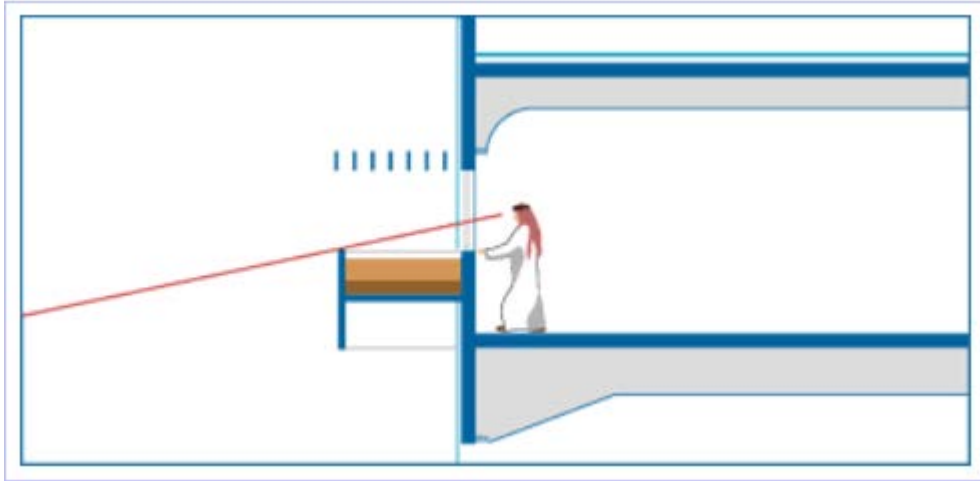


Figure 139. *Mashrabiya* and planting (Source: Lockerbie, 2021)

5.8 Conclusion

This chapter looked into the various examples and models that could be taken as a lesson for the contemporary architecture of the Gulf region based on the traces of Biophilia in the vernacular architecture of the Gulf. The discussion started from the layout and orientation which are considered as an essential part in designing a building where taking examples from the vernacular could prove to be a useful solution. The next topic was the ventilation and lighting which can be considered as the second most important aspect of design. And as it was discussed in chapter 4 there were various different examples which could be proved to work in the contemporary environment, not only for aesthetic reasons but also for the actual purpose which was used in the vernacular architecture of the Gulf region. The next topic was water and planting as these promote not only the physical comfort but also the overall wellbeing of the tenants. They are also a major element of the Islamic architecture that has influenced the region. And lastly the issues of safety and privacy were explored, as again the majority of the region is following the traditions of Islam and this factor needs consideration which sometimes is put aside by western design influences. Therefore, the safety and privacy were considered in terms of the Islamic perspective to provide solutions through developing the concepts that were discussed in chapter 5.

CHAPTER 6: CONCLUSION AND FURTHER RESEARCH

6.1 Summary:

The closing part of the thesis summarizes the work steps and findings, proposing also directions for potential further research.

6.2 Research overview

This research aimed to identify the traces of Biophilia in the vernacular architecture of the Gulf region, by taking references from the system on biophilic design patterns that was proposed by Terrapin Bright Green. It adds to the groundwork for thinking more critically about the human relationship with nature and how biophilic design may be employed in the built environment to improve human health and well-being in harmony with the local natural context. As a result, the thesis's goal is to show that a number of architectural arrangements of the vernacular architecture correspond to a good biophilic design.

The traces of Biophilia in the Gulf region highlight the relation between three elements; nature, place and people. Through this observation it can be perceived that biophilic design features have been applied in various places and local communities. The strongest relation from the 14 patterns of biophilic design that can be observed is the one related to the Nature in space.

6.3 The Research Findings

The main findings of the study show that the Gulf region exhibits numerous traces of Biophilia in terms of the local's adaption to the environments condition incorporating them in the built environment. The climatic conditions of the region, how the architecture is materialized according to the availability of construction materials and other geophysical features have played intrinsic roles in shaping the physical characteristic of the Vernacular Architecture (Boudiaf, 2019). Due to the harsh climatically conditions of the Gulf region the locals had to rely on different techniques to optimize people's comfort in buildings internal and external spaces. The strategies resulted from experience were naturally maintenance-free, did not pollute the environment, the noise and vibration were minimal and most of all were economical to build. The main architectural feature of these desert regions of the Gulf are the massive walls, the use of courtyards, wind towers *badgeers*, and air vents, *Mashrabiya* and courtyard.

Finally, the thesis exemplifies ways in which these biophilic attributes in the vernacular architecture can be applied to the architecture of today, to provide a better living experience. As well contemporary examples exhibiting the traditional architecture were expressed to show a lesson for future use. Based on the work done by Lockerbie (2021), some models for the contemporary use of vernacular architecture and the biophilic elements were also shown.

6.4 Further Research

The environmental and psychological advantages of biophilic design are continually being discovered, and more study is required to keep up with this rapidly evolving and vast subject. The impact of biophilic design patterns on people's perception and experience of the environment in connection to human well-being is still an open subject for further investigation.

As a result, conducting sociological surveys on people's reactions to nature might help us better comprehend the human-nature link in general. Apart from psychologists, architects and designers should be aware of the occurrence and use of biophilic design patterns, the durability of health effects, and the kind of the physical intervention required to trigger a reaction.

Furthermore, an exploration of the positive impacts of the biophilic patterns could be further explored in relation to the contemporary architecture, illuminating how it affects the human experience in the space, since many of the vernacular features are starting to be implemented in some Gulf countries but for aesthetic purposes. Further researches could also look into the contemporary interpretation of the traditional architecture, exploring ways for the cultural and technical applications of the tradition today.

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