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Case Study

An Investigation of Wind-Powered Architecture in the 'House of Fekri' in Bandar Lengeh Port*

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Abstract

The climatic design of a region contributes to its environmental comfort conditions. In regions with a special climate, this issue is of greater importance. Wind plays a very crucial role in the form of the city, the orientation and width of roads, the location of houses, and the type of housing in the region. In coastal areas, heat and humidity are two dominant climatic factors that are controlled by winds. Local people have tried to use the wind to balance the temperature. The 'House of Fekri' is one of the most prominent houses that has adopted the approach of using wind as a climatic element to achieve temperature comfort. In this house, various strategies have been used to create interaction between the wind and the spaces of the house. This study attempts to examine the impact of wind on the formation of wind-supported architecture and scrutinizes its application in Bandar Lengeh. The 'House of Fekri' has been investigated and analyzed. Studies and field observations show that in the vernacular architecture of Bandar Lenge, different strategies have been used to use winds in settlements, and the revival and updating of those strategies contribute to renewable energy in Bandar Lenge. This study employed field observation, library study, data interpretation, and intuitive reasoning to study the strategies used for applying wind-powered architecture in the 'House of Fekri' . The results of this research show that several basic components, such as geometry, level difference, definition of space based on a scale, and different applications, can be evaluated in the wind-powered architecture of the 'House of Fekri' . Climatic design aligned with the wind flow can be reflected in features such as the extroversion of external walls, introversion of internal spaces, changes in the shape and dimensions of the wind catcher and its compliance with the climate, the spaces placed in the direction of the wind, a level difference created in the house, and natural ventilation use.

Keywords: *Wind-Supported Architecture, Wind Catcher, Wind, Bandar Lange, Hot and Humid Climate.*

Introduction

Natural elements are the most important elements and components contributing to the vernacular architecture of each region, which influence the architecture. Iran's vernacular architecture is not an exception, and attention to detail and compatibility with nature are two of its most important features. The weather and

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climate conditions of the region are among the most important factors affecting housing in different cities of Hormozgan province in terms of design, the formation of spaces, and the orientation of houses. Creating temperature comfort, and learning how to deal with heat in hot and dry or hot and humid regions of Iran are of great importance. Hormozgan province, with its hot and humid climate, has one of the most challenging climates, and the design method is very important to create temperature comfort. This climate has caused people living in this province to use strategies to control the humidity and heat of the air. The regional wind is one of the most important factors in creating airflow and cooling in houses, and it is one of the factors that can affect the design and creation of spaces in coastal areas. Areas with a hot and humid climate need the most suitable wind to achieve thermal comfort (Ranjabar et al., 2010). Wind, as an important climatic element in coastal cities, has a significant impact on human life and the surrounding environment. The use of wind in the spaces of the house, in addition to addressing the cooling needs of humans, can create new ideas for the building. Today, due to the lack of non-renewable energy sources, the approach of using renewable energy sources such as wind is of great importance. Wind, as a sustainable and renewable energy source, can have different applications, including cooling and creating air drafts inside the space. In areas where the wind is persistent, it can be used to move air. Hormozgan province and Bandar Lengeh are no exception to this rule and use wind to achieve thermal comfort. This research examines the wind-powered architecture of coastal cities and scrutinizes a case study of the 'House of Fekri' in Bandar Lengeh, one of the successful examples of adapting to nature in Hormozgan Province. According to the field observations, the strategies used in the vernacular architecture of Bandar Lengeh are not evident in the contemporary architecture of this city, and the use of wind-powered architecture is limited to the orientation towards the prevailing wind of the city. This research aims to identify the design components of wind-powered architecture, its application strategies, and the elements of wind-powered architecture. For this purpose, the House of Fekri, was selected as the case study. However, examining previous research shows that no research has been conducted on a case study. For this reason, and to achieve this purpose, the present study aims to find answers to the following questions using historical documents and field observations.

Research Questions

1. What strategies have been used in the Fekri to promote its interaction with the wind?
2. What components have contributed to the distinctive form of wind-powered elements in the architecture of the Fekri?

Background Research

In this section, previous studies on the effect of wind on shaping architecture have been discussed. The hot and humid region of Iran has one of the most critical climates in the world, and it is necessary to consider the climatic components while designing houses in this region. The vernacular houses of Iran have a significant relationship with the climatic components of their place (Tahbaz, 2008 cited in Nikghadam, 2013). In his book, Mohammad Reza Haeri Mazandarani, "Home, Culture, Nature," believes that to empower the space, the architectural methods of vernacular houses can be used to achieve architectural patterns for today's houses. In setting up the spatial organization, it is very important to pay attention to the climate and nature to save energy. For this reason, natural factors such as wind direction and solar radiation are very important in designing spaces and determining architectural elements to create a guiding spatial network (Haeri Mazandarani, 2016). Today, due to the designs, the buildings are very hot during the summer and even hotter than the surrounding environment, and in the winter, it is very cold and uncomfortable in terms of comfort. Even with the help of modern technology and money, comfort and peace are not provided, and if these devices fail for any

reason, life in such buildings becomes very difficult (Ghobadian, 2013 cited in Salimian & Hijazi Kanari, 2015). Moreover, we need to think about new energy sources to clean the earth and also reduce the use of oil resources. This requires us to return to the environment and natural energy and reestablish the relationship between humans and nature, something that Iranian architects did in the distant past (Eiraji & Namdar, 2011 cited in Salimian Hijazi Kanari, 2015). In his doctoral thesis, Nikghadam (2012), argues that climate is a fundamental point of view in the design of Iranian vernacular houses and that semi-open spaces play an effective role in shaping the climatic patterns of Iranian native houses. Therefore, using the patterns of semi-open spaces of vernacular houses in the hot and humid regions of Iran in the design of contemporary houses in this climate can lead to optimal energy consumption and increase the level of comfort (Nikghadam, 2012). This thesis investigated the climatic role of the central courtyard in hot and humid climates. In the studies that have been done on areas with a hot and humid climate, strategies such as creating shade and penetration of minimum radiation and heat from the sun into the building, using natural airflow, and using prevailing winds and local breezes to deal with heat and humidity have been suggested.

Yazdi et al. (2021) investigated the relationship between the physical components of Yazd houses during the Qajar era and examined their interaction with the hot and dry climate of that region. This research shows that there are exact proportions between the architectural components of the houses, the central courtyard and other spaces, and the climate of that region., Yazdi et al. (2021) investigated a different climatic area which is different from the current research in terms of climate.

A study on the traditional houses of Bushehr shows that the houses, which are in a hot and humid climate and built along the coastline, use the sea breeze to create natural ventilation. The creation of airflow by installing openings in the inner and outer walls plays a fundamental role in reducing the draft and extreme heat of the air. Also, the use of open, semi-open, and closed spaces in interaction with each other, in addition to increasing spatial diversity in Bushehr vernacular houses, has given logical answers to the cultural, climatic, and lifestyle needs of the residents (Hedayat & Tabayan,, 2016).

In another study conducted on Malay houses in Singapore, the researcher focused on the main features of the design which are based on a deep understanding and respect for nature. They reported that harmony with nature is no longer found in modern buildings and underscored the design of vernacular houses reflecting the nature and culture of the region, and meeting the thermal comfort of the residents. In this study, the thermal comfort elements of Malay houses were re-extracted, and things such as building orientation, use of natural air and proper ventilation, and arrangement of interior spaces were found to be effective in achieving thermal comfort in the building and stability (Hidayahtuljamilah Ramli, 2012). This research investigated a different geographical location, but in terms of climate, it has similarities with the current research.

By examining one-way and two-way wind catchers and checking their efficiency, Montazeri concluded that two-way wind catchers had better performance in terms of creating natural air ventilation in houses and cooling than one-way wind catchers. This study was done with an emphasis on one-way and two-way wind catchers, and it is different from the present study (Montazeri & Azizian 2008).

Studying the literature shows that the hot regions of Iran are encountering a challenging climate, and it is essential to consider the climatic components in the design of houses. By examining the sources, we can see that the vernacular houses of Iran have a significant relationship with the climatic components of their region. The literature shows that Iranian architects have been able to design houses that are in harmony with their climate by using the patterns of semi-open spaces and other climates. Studies show that paying attention to climate and nature is very important in arranging the spatial organization of houses and creating a spatial network

that guides natural factors, including wind direction and solar radiation. Such attention is effective in designing spaces and determining architectural elements. Also, some research shows that optimal energy consumption and improvement of housing comfort can be achieved by directing maximum wind flow into the building, creating a natural air draft, reducing air humidity, and creating shade during the day. The literature also shows that architectural design and the climate of the building sites can help to improve the temperature conditions and comfort of the residents. In general, many studies have been conducted on the interaction of housing in coastal cities with the wind and examined wind turbines as one of the architectural elements of Iranian architecture. In some research, wind catchers have been examined in terms of shape and form, and others in terms of function and climatic behavior. The studies that have been done on the architecture of wind-powered houses and wind catchers have been done mostly in the Bushehr, Yazd, Kerman, and Kashan regions. However, the review of previous research shows that our case sample has not been studied well, and researchers have scarce knowledge of it. It seems that so far, no research has been done on the issue of wind-powered architecture in Bandar Lengeh focusing on Fekri. Moreover, in previous research, the issue of wind in the House of Fekri, has been partially mentioned. In this research, wind-powered architecture and strategies for using wind-in-house architecture have been investigated independently in the House of Fekri, in Bandar Lengeh.

Research Method

The research method in this research is descriptive-analytical using a case study. This research used documents and field observations. First, primary data was collected through field observation; then, through historical study, using authentic documents, written sources, oral sources, and visual sources, more complete data was gathered about the sample under study. Finally, data analysis was done based on the qualitative method and through the data interpretation. The examples of wind-powered architecture, the form of the elements, and the behavior of the wind in a case study were examined through on-site observation, and to verify the findings, the issue was delved into by examining literature with an emphasis on historical sources.

Theoretical Foundation of the Study

The vernacular architecture of each region is affected by the climate, and humans always attempt to create a suitable living space compatible with the facilities and limitations of the climate. Wind, as a natural element affecting architecture, is effective in the formation of vernacular architecture. In hot and humid regions, various strategies have been invented for using wind for natural ventilation or cooling the interior space by vernacular architects, which have a suitable function for using wind energy. In these areas, factors such as location orientation, spatial organization pattern, and wind catchers play an essential role in creating climate-compatible architecture.

•The Compatibility of the Location of the Houses with the Climatic Factors

Various factors, including the angle of the sun, favorable wind direction, shading, and other environmental factors influence the orientation of the city, roads, and houses. These factors have different importance based on the climatic conditions of the region. In hot and humid areas, wind is of particular importance because it serves as a key factor in creating air drafts and moisture transfer. The orientation of the house and the location of the wind catchers are determined based on the direction of the wind with regards to the special relationship with the climatic conditions and to take better advantage of the wind power.

•The Pattern of Spatial Organization of Iranian Houses in their Integration with the Climate

The patterns of open and semi-open spaces in each city or port are aligned with the local climate components of the same region. These patterns are different from each other due to the difference in the central and local climate components. The climatic patterns of the semi-open

spaces in Bandar Lenge have responded to both climatic objectives according to the climatic components. The patterns are unique and the corridors and semi-open spaces pass through and around the closed spaces and continuously ventilate these spaces through multiple vents and create a pattern of multi-layered spaces, they protect the interior spaces from radiation and heat in depth (Nikghadam, 2013).

•The role of wind catcher

One of the architectural elements in Iran that uses the wind for temperature balance is the wind catcher. Windcatcher refers to a cooling system that is built using a climatic approach in houses in hot and dry and hot and humid regions of Iran and is in the path of the wind directing it into the building, it reduces the temperature inside the building (Ghobadian, 2013). Wind catchers are towers that have been used for centuries in hot climates to transfer outside air into residential spaces and suck air from inside to outside to help establish thermal comfort in summer (Bahadori & Yaghoubi, 2007 cited in Mahdavinejad & Javanrudi, 2012). As its name suggests, the windbreak is a part of the body of buildings in hot and dry or hot and humid areas of Iran, which by guiding the wind flow and using the clean energy of nature plays an effective role in adjusting the temperature and bringing it to a temperature that is comfortable for humans (Mahmoodi & Mofidi, 2009). These towers have different heights and cross-sections. The shortest wind catcher has a height difference of about 2 meters from the roof level or about 5 meters from the level of the adjacent yard, and the tallest one, which was built in Iran, is about 30 meters high from the level of the yard, while the most common height of the wind catcher is about 8 meters, and the cross-section of the wind catcher is completely different and their dimensions is variable. The most common cross-section is square or rectangular, while square and octagonal cross-sections are also used (Nāyibī, 2002). According to studies, the best examples of windbreaks in the south of the country can be seen in Bandar Lenge and Bandar Kong. The massive 4-way wind catchers are the main feature of these two old ports. The operation of wind catchers in this region is similar to the wind catchers of central Iran, only the cooling function of these wind catchers is done only through air movement (Ghobadian, 2013).

Case Study

• The House of Fekri

The House of Fekri, located in the Pakarti neighborhood of Bandar Lengeh, belongs to the Qajar period is 110 years old, and was built by Abdulvahid Fakhri, one of the famous merchants of Bandar Lengeh. The House of Fekri, includes interior spaces, a windy room, a kitchen, corridors and porches, a yard, and service. This house is a perfect example of climate-compatible architecture; The orientation of the house, the wind catchers, the color of the body, and the alignment of the house indicate the use of climatic conditions to achieve thermal comfort. The wind is one of the things that has been emphasized to be used in this house so the sea and regional wind has had a significant impact on the formation and construction of the house.

- Examination of wind-powered architecture in the House of Fekri

According to the location of the building and the special architectural conditions of this house in response to the climatic conditions, the investigation of the wind foundation architecture of the Fekri house has been carried out based on the three components of orientation, spatial organization, and the windbreak of the House of Fekri.

- The orientation of the House of Fekri

The Orientation of the House of Fekri, in front of the wind is one of the factors that effectively affects the extent of its influence on the interior spaces and interaction with the region's climate. This house has been designed and positioned based on its orientation towards the sea and the coast, as well as the direction of the prevailing wind in the area. By analyzing the wind pattern of Bandar Lenge, it has been determined that the annual winds in this area are oriented from east to west. Also, the winds that move from the seaside towards the

city have a great influence on the orientation of the house and wind catchers. Therefore, the orientation and height of the wind catchers are designed to be exposed to the sea and land winds in the best possible way. Also, the effect of the sea and land wind that flows from the sea to the land during the day and from the land to the sea during the night is an important factor in determining the orientation and height of the wind catchers and the house (Fig. 1).

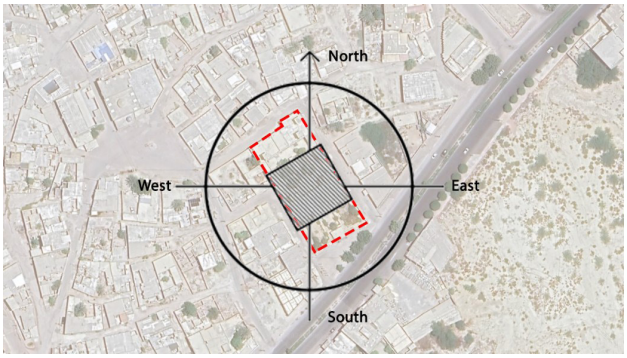

Fig. 1. The orientation of the House of Fekri, in Bandar Lange. Source: Author

- The location of Lenge Port

Bandar Lenge is one of the western cities of Hormozgan province, which is connected to Bandar Kong from the east, Bandar Sheshan from the west, and the Persian Gulf from the south. Lenge Bandar is situated 12 meters above sea level at latitude 26°33′28″ N and longitude: 54°52′50″ E. Bandar Lenge has hot and humid summers and no winter season. The average maximum temperature in summer is 35–45 degrees Celsius, and the average minimum temperature in summer is 10–15 degrees Celsius. Bandar Lenge has a gentle slope from north to south, that is, towards the sea. Its northernmost and highest part is 20 meters above sea level, 10 meters in the middle, and 5 meters above sea level 100 meters from the sea. The average height of Bandar Lenge is between 5 and 10 meters above sea level (Noorbakhsh, 1979).

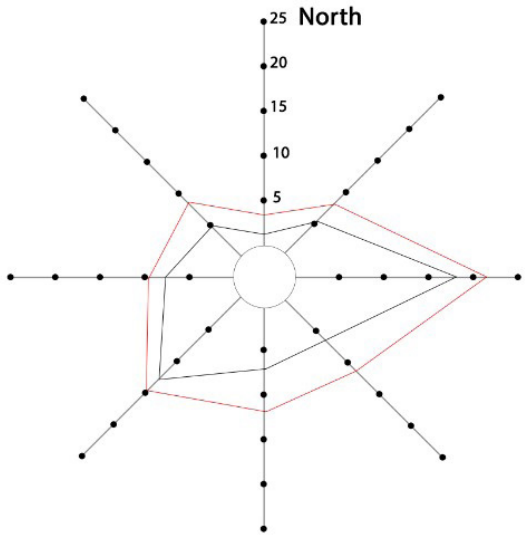

Fig. 2. The annual prevailing wind of the port. Source: Kasmaei, 2013.

- Types of winds in Bandar Lenge

The winds studied in Lengeh can be divided into two categories. The first category is "regional winds," and the second category is "sea and land winds." The most important weather factor that affects urban ventilation conditions is "regional wind." Regional winds are caused by differences in atmospheric air pressure, the uneven distribution of solar radiation energy and resulting temperature, and differences in air density (Givoni, 1998). According to Fig. 2, in Bandar Lenge, most of the wind is produced in dry weather, and this wind speed is up to 60 km/h and more in the hours before noon, and the wind is mostly zero at night. Throughout the year, the wind blows mostly from the northeast, east, southeast, and south, and it rarely becomes the north wind, and only in the afternoons does the wind sometimes blow from the southwest (Noorbakhsh, 1979).

The second category is the sea and land winds, which are associated with the presence of the sea, the transfer and movement of air, and the creation of permanent wind. Sea and land breezes in Lenge port during the day from the sea to the land (south to north) and during the night from the land to the sea (north to south), and the prevailing wind blows from east to west. The mechanism by which this happens is that during the day when the dry air is warmer, the warm air becomes lighter, moves up, gives way to cool air, and pulls the sea breeze towards the dry land. This happens at night in the opposite direction from the land to the sea (Fig. 3).

Finally, the location of the House of Fekri, is influenced

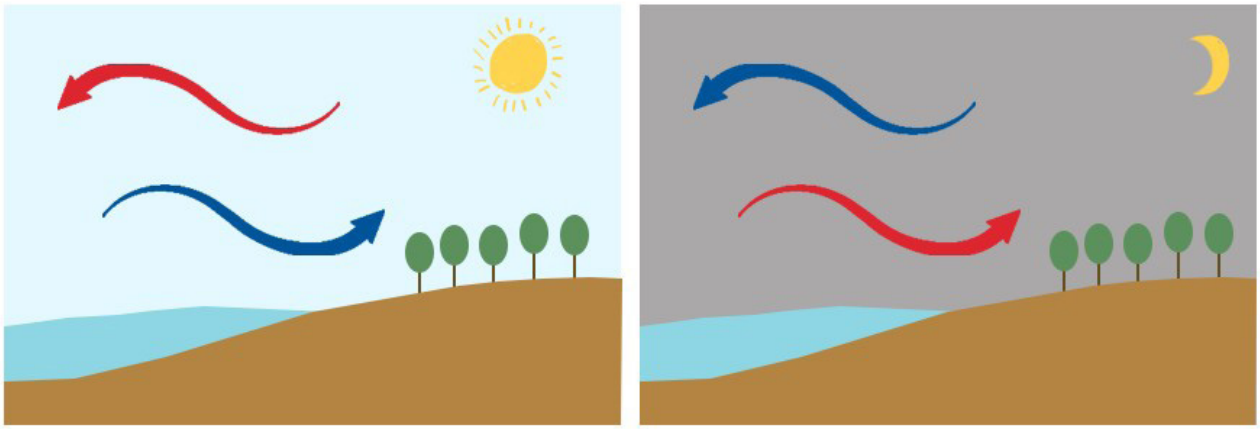

Fig. 3. Sea and land breeze movements during the day and night. Source: Author.

by regional winds and sea and land winds, and according to the direction of regional winds, which are often caused by air pressure differences and temperature differences, it has been done in such a way that these differences can be used optimally. It is very important to carefully check the direction and speed of the regional winds because the amount and speed of the winds can have a direct effect on the temperature of the house and its natural ventilation. This action not only helps to improve the natural ventilation of the house, but it can also be effective in reducing the need to use energy-consuming systems. As a result, with correct air management and considering the climatic context of the region, the location of the House of Fekri, becomes a critical point, which has a positive effect on the living conditions of the residents and optimizes energy consumption (Fig. 4).

Fig. 4. The location map of the House of Fekri, relative to the direction of regional winds and sea winds to the land. Source:Author.

- Spatial organization of the House of Fekri

The House of Fekri with a rectangular plan is parallel to the sea stretching from north-south. According to the field observations, this house is oriented towards the beach, and in addition to using the sea and land wind during the day, has also a wide view of the sea. The different parts of the house include the entrance, the courtyard, the intermediary space, the central courtyard, three rooms on the north side, and rooms around the central courtyard. The spaces and architectural elements of the house are in a continuous relationship with the wind flow. This house is built in a semi-introverted form, and the openness around the entrance courtyard has created a diverse texture of extroversion and introversion in the house to make maximum use of the wind flow in the courtyard next to the small introverted central courtyard. The connection of the house with the outside spaces is not completely closed, and the house has high windows and a wide yard towards the alley, which creates communication and interaction with the alley (Fig. 5). In addition to creating interaction, extroversion in the wall of the house is created by airflow between the alley and the central courtyard and the use of the view of the sea and the beach (Ghobadian, 2013).

The finished floor of the house is built 2.5 meters higher than the floor of the passage, and it seems that one of the main reasons for raising the bearing wall upper than the

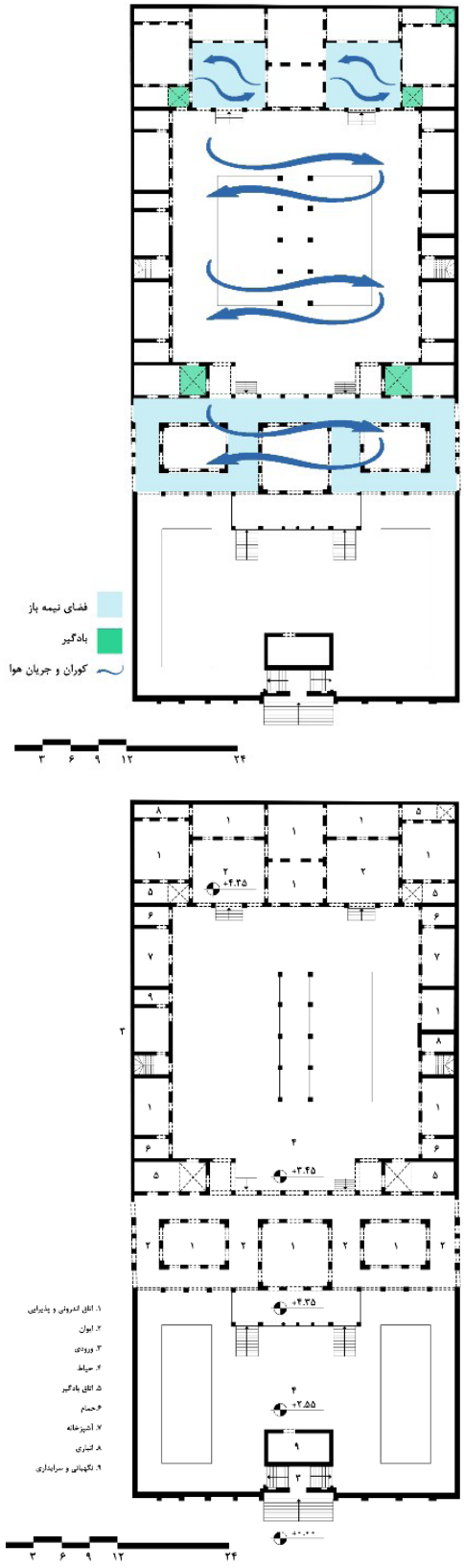

Fig. 5. Spatial organization plan of the House of Fekri and the existing wind flow. Source: Author.

level of the house and placing it directly against the land and sea winds is to expose corridors, and spaces to the wind likewise windbreaks. The house has four different height levels, and the spaces are located at different height levels. In hot and humid areas, it is very important to deal with extreme heat and humidity. The spaces of this house are designed in such a way that, in addition to being directly in front of the wind, it is possible to create air drafts, control wind movement, and control humidity and heat in them. For this reason, with the installation of Iwans and corridors, a channel has been created for air drafts and movement.

Iwans play a very important role in the house. In the hot seasons, most of the daily activities and people's lives are carried out there because, in addition to proper ventilation, there is also shade on the iwans. There are iwans on both sides of the courtyard in the House of Fakhri, and the wider iwans and corridors maximize the benefit of the shade. The iwans of the house have more depth than the houses in other cities. This is one of the factors prolonging the shadow time. According to the field observations and literature, most of the activities were done on the iwan, and the iwan was of great importance. The sleeping porches on both sides of the roof are also suitable for residents to benefit from the wind. Floor-to-ceiling openings and latticed gypsum windows increase the amount of ventilation and airflow (Konginejad & Attarian, 2016).

The central courtyard is the core of the house, which is an introverted, open, and independent space from other spaces. The spaces and openings around the central courtyard face each other, so it is possible to create air drafts between them. The courtyard plays a role in creating ventilation in the side rooms. According to Fig. 3, it can be seen that the wind flow that is created in the semi-open and open spaces of the house enters the closed spaces, and this flow moves between the closed spaces and creates air drafts in the indoor spaces, such as open and semi-open spaces. Also, by planting shade trees and plants in the yard, the amount of shade increases, and the amount of wind spread by the trees increases.

Also, the central courtyard with high walls and shading them on each other helps to reduce the temperature of the environment. The speed of the wind flow and the low temperature of the central courtyard compared to the outside temperature indicate the microclimate of the central courtyard in the hot and humid climate of Bushehr (Shaeri et al., 2018).

- Wind Catchers of the House of Fekri

The wind catchers are the most important and practical elements in the House of Fekri. There are five wind catchers with dimensions of 2 x 2 on the four sides of the house. The wind catchers of the house are 4-way wind catchers. Wind catchers are built on rooms that, in addition to the room below, also cool the adjacent rooms and create air drafts. These wind catchers cool the interior spaces only by moving air and creating drafts, and due to the high relative humidity in the air, there is no need to add humidity by using a pond under the wind catcher. The existence of sea and land breezes that blow from the south to the north and vice versa during the day and night and the prevailing wind from the east to the west is the main reason for creating the 4-way wind catchers. The catchers are located in the 4 main geographical directions so that they can receive the maximum favorable winds. Using a 4-way wind catcher increases the cooling capacity and creates a natural flow in the wind catcher. It also makes it possible to use it during four seasons (Fig. 6).

The average altitude of Langeh Port is 5 to 10 meters above sea level, and the sea breeze blows north-south direction. The height of the wind catchers in the house of thought is a maximum of 5 meters above the roof so that they can easily get exposed to sea and land wind. Moreover, the air breeze between the land and the sea and, in general, the local winds in the port of Bandar Langeh have less intensity and pressure than in the central regions of Iran, such as Yazd, Kerman, and Kashan. For this reason, the wind catchers should be built larger and wider than the contact surface and can push more air flow into their lower space. The number of wind turbines near the coast is higher and they are larger, but as we move away from the coast, the number of wind turbines and their dimensions decrease, so that there are few wind turbines on the northern side of the port (Ghobadian, 2013).

Conclusion

Being located near the Persian Gulf, Bandar Lengeh has special weather conditions including extreme heat in the summer and mild weather in the winter.

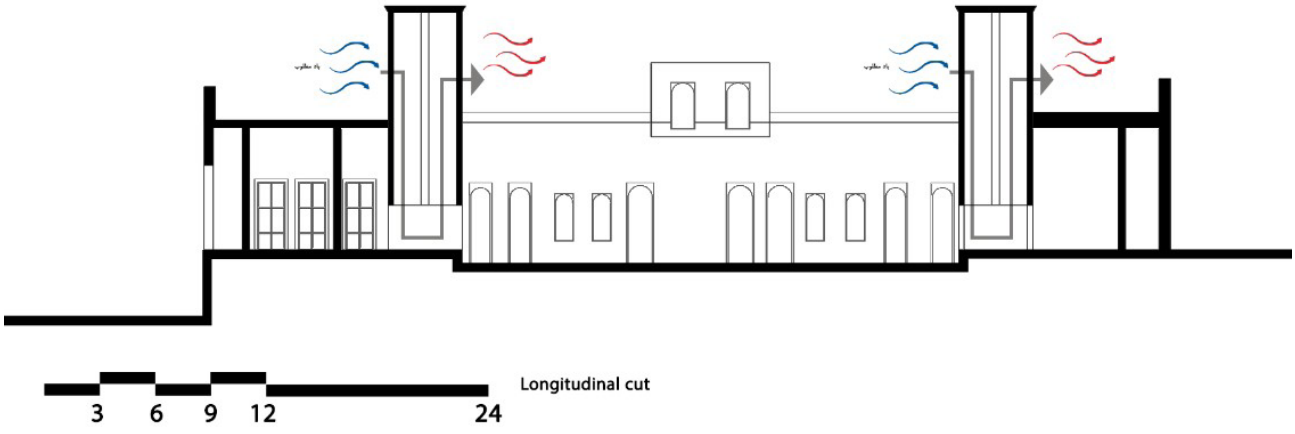

Fig. 6. The wind catcher mechanism in the House of Fekri. Source: Author.

Proximity to the sea reduces the temperature difference between night and day as well as seasons because air humidity prevents a sudden decrease or increase in temperature. However, high humidity can make living conditions difficult. It seems that using wind as an important factor can be a suitable strategy to reduce humidity and adjust temperature in this area. Continuous airflow can create favorable temperature conditions and the architecture which is in harmony with the local climate can improve the temperature conditions. Studies show that the House of Fekri, as a comprehensive design model for the climate, has unique characteristics promoting interactions with the wind. The architecture of this house has been designed to use climate to respond to unfavorable weather conditions. The important goals of this design also include determining the optimal direction of wind flow inside the building, creating natural air drafts, reducing air humidity, and providing shade during the day for the spaces. In general, the study of the House of Fekri, shows that the integrated interaction of architecture with the climate leads to the creation of a stable relationship between the house and the environment and provides a suitable environment for the lives of the residents.

Among the architectural strategies of the wind-powered to optimally direct the wind flow, it is possible to place closed, semi-open, and open spaces in the vicinity of each other, introversion in the plan of internal spaces, and extroversion in the outer wall, creating corridors and semi-open spaces between closed spaces, placing the house parallel to the line pointed out, the coast, and the construction of windbreaks. All these elements harmoniously lead to the direction of the wind flow to cool the windy room, create air drafts and natural flow in the spaces of the house, and increase efficiency from the wind flow. In particular, the design and use of the wind catcher have provided a greater ability to absorb wind, and based on physical principles, it transfers the wind permanently and with a large volume to the interior spaces of the house. This approach not only affects the use of renewable resources for cooling and natural ventilation but also helps to optimize the environmental conditions of spaces and increase the quality of life of residents.

Discussion

The current research shows that the House of Fekri has provided special elements in response to adverse weather conditions. The main purpose of these elements in the House of Fekri is to direct the maximum flow of wind into the spaces, to create air drafts, and to avoid humidity. The findings of the research identify wind-powered architectural elements of vernacular housing in Bandar Lengeh and present strategies for the beneficial use of wind energy in living spaces by studying the House of Fekri, the case study of this research.

In the climate analysis of the architecture of the House of Fekri, the three axes including spatial organization, distance from the sea, and a special architectural element (a windshield) determine the climate-oriented approach. The architectural elements of Badayeh and the strategies for using them in the House of Fekri can be briefly mentioned in the following cases:

1. Creating both air drafts and natural airflow is very important in the formation of the spatial organization of the house. According to the observations, one of the strategies for cooling indoor and closed spaces is to place semi-open and open spaces adjacent to those spaces. Introversion in the plan and creating a central courtyard and extroversion in the outer wall are two of the most important architectural strategies for this house. Extroversion in the outer wall is to absorb maximum wind, and introversion in the interior spaces is to maintain as much wind flow as possible in the interior spaces. Corridors and semi-open spaces pass between and around closed spaces and create air drafts and airflow in these spaces, and by creating a pattern of multi-layered spaces, they move the interior spaces deeper and protect them from radiation and heat. The narrowness of the corridors

and the high height of the walls also strengthen the wind flow.

2. Placing the house parallel to the coastline, building the house at a height higher than the road level, and placing it directly in front of the wind flow cause more wind flow from the sea to enter the central courtyard and then create a natural airflow in the interior spaces. Placing the windows of the spaces around the central courtyard in front of each other creates more wind flow and air circulation and then reduces the relative humidity.

3. Building a wind catcher and directing the wind to different spaces of the house, in addition to cooling the wind catcher room, creates air drafts and natural flow in the spaces of the house. To increase the efficiency of the wind flow, wind catchers with large dimensions and four sides are built against the regional wind and the wind of the coast and the sea to transfer the wind permanently and with a large volume to the spaces of the house.

Powered by the design of this house, updating and revitalizing these methods help use them in the design of sustainable spaces in hot and humid areas by using renewable energy. It seems that investigating and reviving the vernacular architectural methods of the region and re-creating them to reuse and build modern buildings with those methods requires more detailed studies and research.

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The author declares that there was no conflict of interest for her in conducting this research.

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