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Original Article

Investigating the Impact of Hot and Dry Climate on the Type of Skylights in the Historical Houses of Kerman

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Abstract

Based on conducted studies, lighting in Iranian architecture is one of the fundamental and essen-tial features, with skylights playing a crucial role as a primary architectural element. Architecture in different regions is adjusted according to climatic conditions to maximize comfort while also considering the use of local materials. Given this, the design and placement of lighting elements can vary based on geographic location. The aim of this research is to examine the skylights in Qajar-era houses in Kerman and to explore the relationship between climate and regional archi-tecture, considering both lighting and temperature factors simultaneously. Thus, the research questions are as follows: What are the characteristics of the windows in the historical houses of Kerman? Was natural light considered a key element in Kerman's houses? Were the va-riety of windows in these historical homes adjusted based on climatic conditions? To achieve this goal, we studied four Qajar-era houses in Kerman: Azimi House, Kazemi House, Dinyar House, and Vaziri House. The research method is applied in nature and employs a descriptive and correla-tional approach for data collection, utilizing both field studies and library resources. By measur-ing the skylights and analyzing their de-sign and positioning, we concluded that in desert regions, skylights are designed with small dimensions and colored glass to not only prevent direct sunlight but also regu-late the lighting of the space. Additionally, these skylights are placed one meter above the floor and with a depth of less than 10 meters, providing both aesthetic appeal and envi-ronmental comfort.

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Introduction

in Islamic and Iranian beliefs, light can be examined from various aspects. Spiritual and metaphysical light represents God, while non-spiritual and material light manifests in different forms in art and architecture (Faleh, 2016). Throughout history, light has been one of the most important elements in Iranian architecture, a result of Iranian knowledge and artistry. In fact, the orientation of buildings was not possible without considering light, and the presence of light itself was considered one of the beauties of the building, influencing the atmosphere both spiritually and visually. Given the significance of light in architecture, the orientation of the building plays a crucial role in regulating the amount of received light. On the other hand, the climate of each region and the importance and function of the building determine the type of lighting elements, which are expressed in various ways. These lighting elements play an important role in the external form of the building and in expressing architectural concepts and features, emphasizing the im-portance of light in art and architecture. Unfortunately, in modern architecture, natural light has become less emphasized in the design of buildings (Kateb, 2018). Iran is a high-altitude country located between 25 and 40 degrees latitude in a dry region in the northern hemisphere, where the maximum benefit can be gained from sunlight. One of the promi-nent features of this region is its climatic diversity and its four seasons. According to en-vironmental experts, these four climates include: hot and dry, hot and humid, cold moun-tainous, and humid temperate climates. This climatic diversity allows architects to design architecture specific to each region, providing the necessary conditions, one of which is the comfort of the residents and proper lighting (Keshtkaran, 2011).For example, in hot and dry regions, which are exposed to intense sunlight, light control elements are used. Additionally, the size and type of skylights in these regions differ from others due to the climatic conditions (Kateb, 2018).

Characteristics of desert houses

Housing in desert areas has special conditions due to the climatic conditions, the orien-tation of the houses in these areas is west and east, which is known as Ron Kerman, the houses in these areas are mostly introverted and designed for four seasons (Shatrian, 2008). Buildings were typically constructed in dense and compact layouts to create shade on exterior surfaces and to prevent air infiltration during both winter and summer. An-other characteristic of architecture in these regions was the creation of central courtyards and inner courtyards, which helped to generate humidity and moderate the air tempera-ture (Kasmai, 2012) (Kasmai, 2012). The materials used for houses, primarily unbaked mud bricks and clay, were selected for their high thermal capacity, with less reliance on stone. By constructing houses within hillsides or underground, they extended the evaporation time to an infinite degree, which significantly reduced the heat exchange between the interior and exterior of the buildings (Kasmai, 2012). Wood was used for making doors and skylights, while the walls were built thick to prevent heat penetration. The courtyard walls facing the wind were constructed taller, and many houses featured windcatchers (badgirs). The roofs were dome-shaped to neutralize the effect of wind and regulate temperature. Entrance doors were typically made short to prevent dust from entering. In these houses, the only open-ing to the outside was the entrance door, which led to the courtyard through a corridor and vestibule. Skylights were usually placed in the upper part of the walls and were small in size to control the amount of light entering (Shatrian, 2008). Therefore, one of the factors that can influ influence the amount of sunlight entering and reflecting inside the building is the careful attention to the details of skylight construction (Owens, 2009). In skylight design, when selecting the frame, factors such as aesthetics, harmony with the facade, and security is-sues must be considered. Additionally, since two variables—glass and non-glass elements (frame)—are used in the construction of skylights, these two components should not neg-atively affect each other or have an adverse impact on the building's lighting (Heydari, 2012). Additionally, wide or circular frames of openings create a soft contrast, while deep sky-lights moderate daylight and soften the contrast (Owens, 2009). Another element related to the window

and influencing lighting is the canopy and the thickness of the wall in which the window is located. Depending on the location of the window frame—whether it is aligned with the external, internal, or middle view—it has a different effect on the delivery of internal light. Additionally, the color of the window frame can affect the amount of internal light. Light colors of the frame, such as white, yellow, blue, and light green, do not negatively affect light transmission, but darker colors, such as brown, dark green, and dark azure, have a negative effect and reduce light transmission by about 1.5% (Heydari, 2012).

Methoology

In Iranian architecture, skylights have long demonstrated their role and importance, and depending on the climatic diversity in each region of Iran, specific types of skylights can be observed. In fact, the size of the skylight was determined based on the facade and its function, especially in hot and dry regions. In such climates, skylights are vertical and smaller compared to other regions to minimize sunlight exposure. Based on the afore-mentioned points, the research method of this paper focuses on the interpretation and analysis of skylights in historical houses. This paper examines the traditional skylights of four historical houses from the Qajar era in Kerman. By studying library documents and conducting field research, historical and foundational information has been gathered, and the measured data is presented as follows:

•Analysis of the dimensions and materials of the skylights.

•Analysis of the wooden decorations used in the skylights and the percentage of glass surface compared to the total skylight surface.

•The position of the skylight on the wall and the amount of received light (Authors, 2022).

Traditional houses in Keaman

Dinyar House

The mentioned building is located on Naseri Street, between Moshtagh Square and the Char-Rah Kar intersection. It was built by Mr. Dinyar Zoroastrian during the Qajar era. The building was designed as a garden, with the structure placed in the middle and gar-dens located on its northern and southern sides. This building has an introverted design and includes both summer and winter living spaces, along with rooms known as se-dari and panj-dari (traditional elements of Iranian architecture where three or five windows are joined together).

The entrance to the house features a vestibule (hashti) with three doors: one leading to the courtyard, another to a connecting hallway, and the third to a small basement. The house has hallways on both the right and left sides. The right hallway connects the vesti-bule to the porch and serves as a passage between the rooms, while the left hallway, with a similar function, connects one side to the courtyard and the other to the porch. These hallways include two vestibules with domed ceilings that provide access to the side rooms.

The house consists of six rooms. The main hall (shahneshin) has a panj-dari (five-window room) and is taller than the se-dari (three-window) and do-dari (two-window) rooms on either side. It features a winter living space facing south and a summer living space facing north, both with ceilings in a kalil (pointed arch) style (Fig 4, 5).

The se-dari and do-dari rooms are located on the northern side, and two more rooms behind them are connected to the hallway, while a fifth room is situated on the eastern side, symmetrically aligned with the vestibule (Fig 6, 7). The porch of this house is lo-cated in the summer living area and features four brick columns and two half-columns attached to the wall, all supporting a ceiling in the kalil style (Fig 4). The building mate-rials used in this house are brick, plaster, and mud. The exterior facade of the northern side is brick, while the rest is covered in mud plaster. The interior walls are coated with plaster.

A notable feature of this house is its floor plan, which centers around a panj-dari in the middle, connected to the se-dari rooms via two hallways. This type of layout is typical of regions with desert climates (Heritage, 2013).

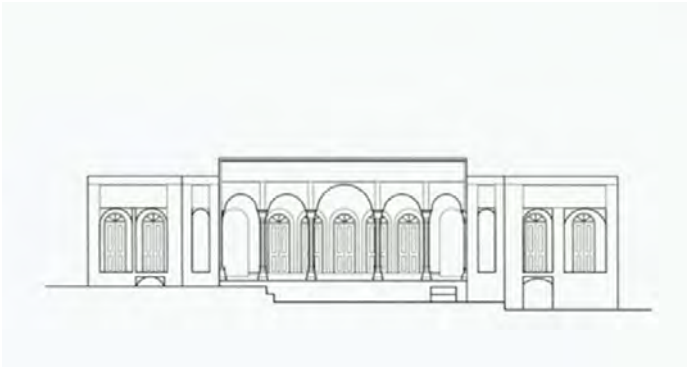

Figure1.
north view of Dinyar's house (Heritage, 2013).

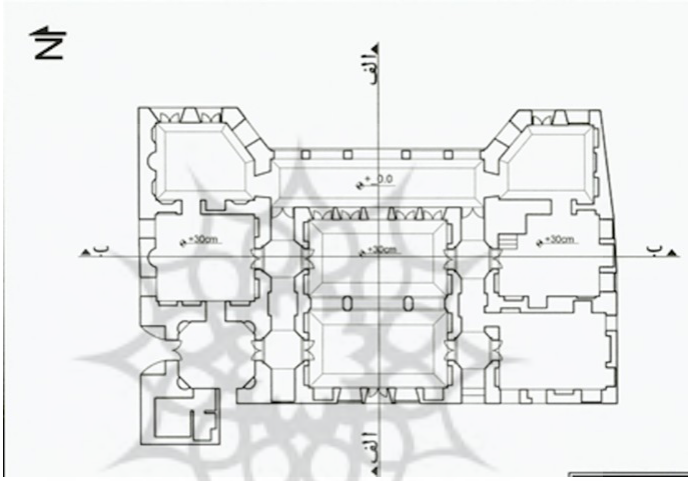

Figure2.
Plan of the Dinyar house (Heritage, 2013).

Figure3.
Plan of the South view of Diniyar (Heritage, 2013).

Figure4.
north view of Dinyar's house (Authors, 2022).

Figure5.
South view of Diniyar house (Authors, 2022).

Figure6.
Northeast room of Diniyar house (Authors, 2022).

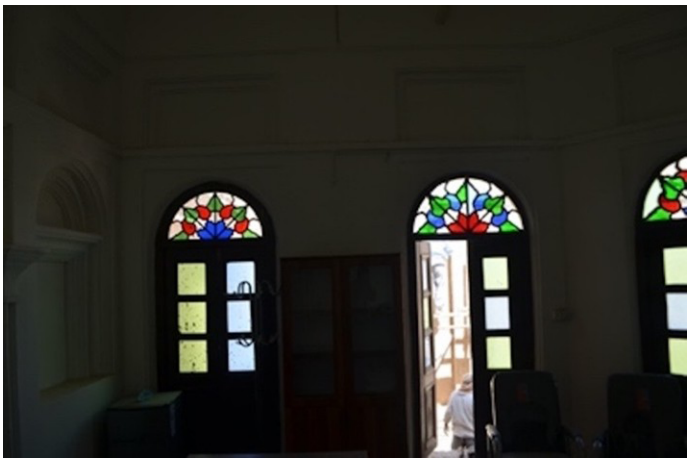

Figure7.
Northwest room of Diniyar house (Authors,2022).

Azami house

This building is located in the city of Kerman, at the end of Aziz Bazaar, in the Seh-Rah Shomal-Jonoubi neighborhood. Based on research and available documents, includ-ing samples of tilework from the Ibrahim Khan Bath used in the old service area of this house, the age of this house is estimated to be over 250 years. Among the elements of this house, the vestibule (hashti) stands out, covered with a domed ceiling and featuring a ko-lah farangi (a traditional ornamental structure). After passing through the hallway, one enters the courtyard, which contains a small garden with an octagonal fountain. On the northern and southern sides of the building, there are porches, and beneath the porches are basements (Fig 11, 14) and on the east and west sides of the house, there is a sedari room that is similar in shape (Fig 12, 13).

The four sides of the courtyard are surrounded by the building, with the architectural design being symmetrical, meaning that the hallways, rooms, and doors are symmetrical-ly arranged. The ceiling of the porches is flat, the ceilings of the hallways are barrel-vaulted, and the rooms have domed ceilings. The entire building is elevated 70 cm above the ground on a raised platform. The materials used in the construction include a combi-nation of brick, unbaked mud bricks, plaster mortar, tiles, cement, and mosaic, with the doors and skylights made of wood, though these have been modified in the present time.

Decorative elements of this house include tilework, ceiling paintings on the northern porch, decorative parapets along the rooftop, plasterwork on the upper parts of the hall-way entrances and the vestibule ceiling, niches in the rooms, the fountain in the middle of the courtyard, the octagonal pool, and two kolah farangi structures (Heritage C. , Azami House, 2013).

Figure8.
Plan of The West view of Azami house (Heritage, 2013).

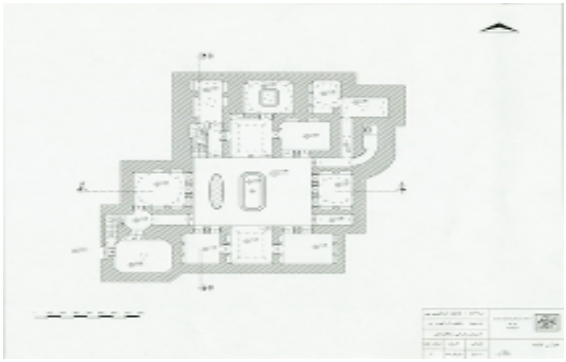

Figure9.
Plan of the Azami house (Heritage, 2013).

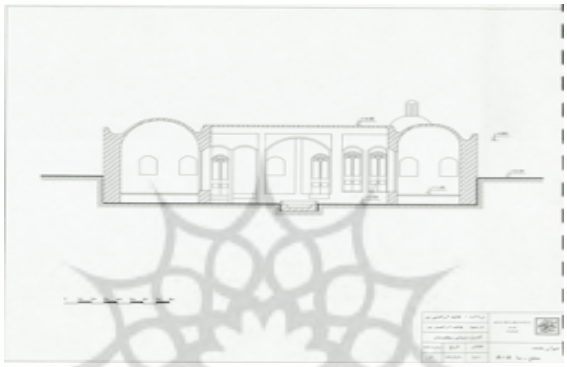

Figure10.
Plan of the East view of Azami house (Heritage, 2013).

Figure11.
South view of Azami house (Authors, 2022).

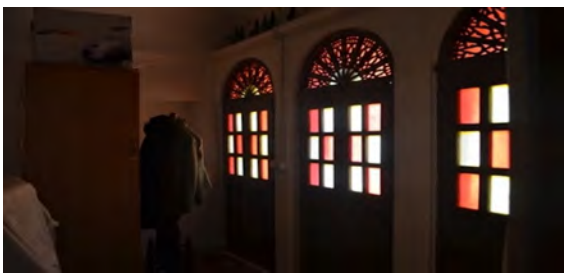

Figure12.
East view of Azami house (Authors, 2022).

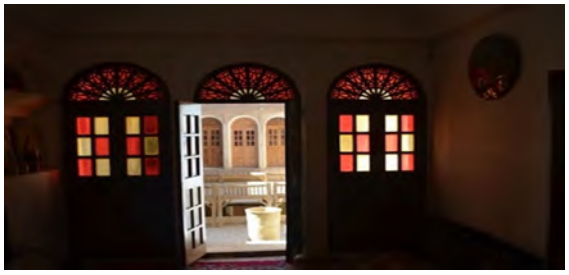

Figure13.
West view of Azami house (Authors, 2022).

Figure14.
North view of Azami house (Authors, 2022).

Kazemi house

Kazemi House, located on Borzou Amighi Street and Shirin Alley, dates back to the late Qajar and early Pahlavi periods. The owner of this house was a Zoroastrian, and one of its distinguishing features is the unique brick decorations in the form of muqarnas on the facade, as well as a qanat (underground water channel) that passes through one of the house's basements. The main elements of this house include the entrance, which leads to a small courtyard. On the right side of this courtyard, there is a space for keeping ani-mals, while on the left side, stairs lead to the roof. This courtyard was actually a green-house, and the door of one of the rooms opened into it. It was connected to the main courtyard by two steps. The main courtyard is rectangular, with a pond in the center (Fig 18), and along its length, there is a porch, also rectangular and elongated, from which the entrance doors to five rooms open (Fig 15, 19, 20).In total, the house has six rooms, all with kalil (pointed arch) ceilings. The floors are covered with mosaic, and all doors are wooden. One of the rooms is located on the eastern side of the house, between two small courtyards, and has three skylights facing the courtyard (Fig 17).

Another feature of the house is the kitchen, which is divided into two sections. The first section opens onto the porch, while the second, the pantry (matbakh), opens into the small courtyard.The basement is another element of the house, located in three directions, and due to its use as a food storage area, it has multiple niches. The western base-ment includes a cold room through which a qanat passes. The walls of the cold room are made of stone and brick, and the floor is also covered with bricks. The basement is lit by roof skylights and lattice windows, or the entrance door itself would serve as a source of light (Heritage C. , Kazemi House, 2013).

Figure15.
north view of Kazemi house (Authors, 2022).

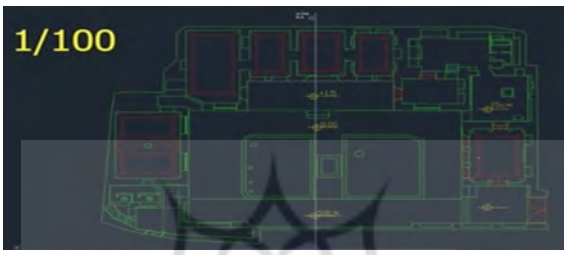

Figure16.
Plan of the Kazemi house (Heritage, 2013).

Figure17.
East view of Kazemi house (Authors, 2022).

Figure18.
West view of the Kazemi house (Authors, 2022).

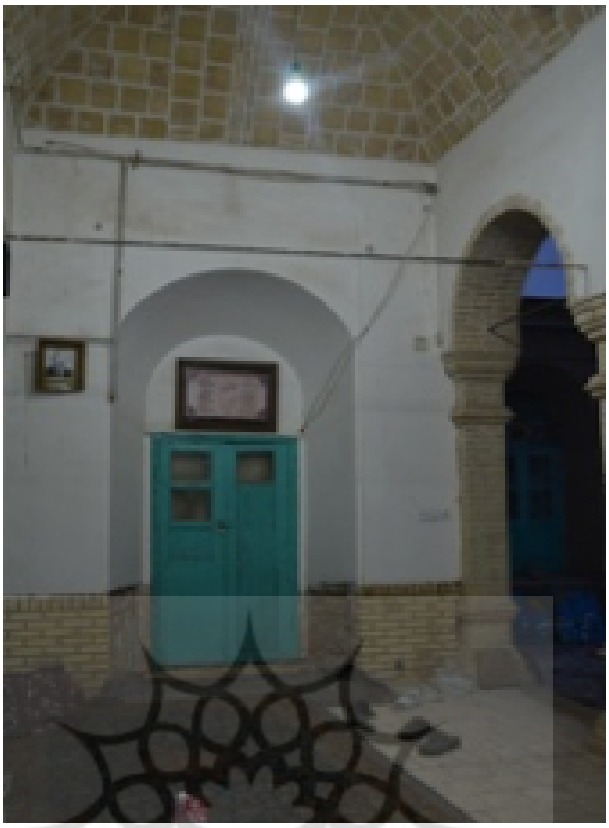

Figure19.
Northeast view of the Kazemi house (Authors, 2022).

Figure20.
Northwest view of the Kazemi house (Authors, 2022).

Waziri house

The Vaziri Garden House is located in the Zoroastrian neighborhood of Kerman on Firoozabad 4 Street, dating back to the Qajar period. Evidence of this era can be seen in elements such as two-door rooms (dodari), the type of arches, and Western-style door-ways. Additionally, Zoroastrian cultural signs are evident in the decorations and plaster-work, such as the depiction of cypress trees and the framing of the dado panels. The house is structured like a pavilion (kushk), located in the middle of the garden, with the eastern and western sides of the building surrounded by courtyards and gardens. Like many tradi-tional houses in Kerman, the structure is introverted and built in the Ron Kermani style.

The house has two courtyards: a public and a private one. After entering the house, the public courtyard features pistachio and pomegranate trees. On the east side of the court-yard, two main parts of the house—the shahneshin (main sitting room) and the public building—can be seen. Behind these, to the east, lies the private courtyard.

The shahneshin includes a panj-dari (five-door room) on the west side with a porch in front of it. Behind the shahneshin, there is a space known as the gavgardan (cow churner) (Fig 25, 26). After the shahneshin, there is the public building, which has a central panj-dari and a porch in front of it, known as the main hall. To the east of the hall, there is a four-leaf door that opens into the private courtyard.

On both sides of the panj-dari, there are two symmetrical dodari rooms, forming the side rooms, these rooms have additional rooms on the eastern side, each featuring two skylights facing the private courtyard (Fig 23).

The rooms on the eastern side and the private courtyard are the summer living spaces, as they receive the least amount of sunlight, while the rooms on the western side and the public courtyard are designed for winter living, receiving more sunlight (Fig 21, 23).

Between the shahneshin and the public building, there is a relatively large pond, which used to direct water from the gavgardan through underground pipes (tanpusheh) to the garden's courtyards.

Another section of the complex is the kitchen, located at the southern end of the court-yard. Although it has since been repurposed, to the west of the complex stands a newly constructed building on what was once part of the house's courtyard. This building now functions as a restaurant, with its exterior adorned with the "Wall of Love," which fea-tures six frames decorated with Kufic script, displaying the names of famous literary lov-ers from Iranian literature (Heritage C. , Waziri House, 2013).

Figure21.
North view of the general building of the Waziri house (Authors, 2022).

Figure22.
Plan of the Waziri house (Heritage, 2013).

Figure23.
South view of the general building of the Waziri house (Authors, 2022).

Figure24.
Western view of the general building of the Waziri house (Authors, 2022).

Figure25.
North view of the Waziri house (Authors, 2022).

Figure26.
eastern view of the Waziri house (Authors, 2022).

Table1.
Analysis of the doors and windows of the studied houses (Authors, 2022).

Name	View	Window type	Window and door surface	Percentage of Window surface to Facade surface	Percentage of Window surface to Wall surface	The height of the window sill to the floor of the room	The height of the door to the floor of the room
Waziri House	North View	Several window openings	[illegible]	[illegible]	[illegible]	[illegible]	
	East View	Two Windows and one door	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	West View	Ventilation window	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
	South View	Several window openings	[illegible]	[illegible]	[illegible]	[illegible]	
Sadeghi House	[illegible]	Several window openings	[illegible]	[illegible]	[illegible]	[illegible]	
	Northeast View	Several window openings	3.15 m² & 1.44 m²	[illegible]	[illegible]	[illegible] & [illegible]	[illegible]
	North View	Several window openings	[illegible]	[illegible]	[illegible]	[illegible]	

		one Do-dari on both sides	& 6.7 m² & 6.7 m²	49.26 % & 50.75 %		& 5.55 & 5.12		
	Northwest view	one window and one door	3.08 m² & 3.55 m²	26.73 %	90 %	8.65 & 4.56	86	
	West view	Two windows	2.16 m²	7.97 %	90 %	5.50	90	
Azimi House	North View	porch with one door at the end and one Dadari on the right side	2.355 m² & 4.706	18.19 % & 36.28 %	90%	3.48 & 3.07		
	South View	porch and Dadari on both sides	4.706 m² & 4.706 m²	37.37 % & 37.68 %	90%	3.24		
	East View	Sedari	7.059 m²	61.65 %	90%	2.68		
	West view	Sedari and one door	9.412 m²	37.17 %	90%	3.98		
Wazirya House	the throne	Panjdari and two windows	14.43 m²	25.69 %	82%	4.74 & 8.18	97 cm	
	South view	panjdari and Dadari on both sides	21.35 m² & 4.56 m² &	38.07 % & 33.15 % &	82 %	3.92 & 5.15 &		
	Public building	North view	Two Rooms With two windows	3 m² & 3 m²	22.20 % & 14.74 %	82 %	3.88 & 3.92	97 cm
		Northwest view	sedari and one door	9.12 m²	28.83 %	82 %	4.51 & 5.44	
		Southwest view	sedari and one door	9.12 m²	28.63 %	82 %	4.55 & 5.47	

light

In Islam, light and illumination can be defined from two perspectives: the spiritual and the non-spiritual. In Islam, spiritual light refers to God, who is the light of the heavens and the earth. In fact, the spiritual dimension and the creation of existence are closely in-terconnected. According to research, it can be said that light holds great significance in Islam and plays an important role in Islamic values. This is because light greatly influ-ences success in both this world and the hereafter. Light is often used in contrast to dark-ness and ignorance, and the Qur'an emphasizes the transition from darkness to light. Ad-ditionally, the Qur'an likens light to the straight path and guidance, as mentioned in a verse: "Allah guides those who seek His pleasure to the straight paths and by His permis-sion brings them out of darkness into light, and guides them to the straight path (Almaede, 1392). Considering the aforementioned points, it can be said that divine light in Islam leads to the advancement and success of civilization. On the other hand, in archi-tecture, spiritual light is used to create a sense of peace in the configuration of buildings, walls, and other details, reflecting human creativity (Faleh, 2016).

Material and non-spiritual light refers to sunlight and artificial light. Natural sunlight can enter a building in three ways:

•Diffused light through clouds, known as daylight.

•Direct sunlight beaming through gaps in the clouds.

•Reflected light from surfaces or man-made structures (egan, 2009).

Light and architecture

In architecture, lighting elements allow light to penetrate the building in various forms, with light spreading across surfaces like a living entity. In fact, light in architec-ture is one of the key factors that connects the interior space of a building to the outside world. Overall, lighting not only adds aesthetic and visual appeal to architecture, but it also symbolizes the infinite nature of God and the limitations of humans. All human creations become beauti-ful through light but are still bound by limitations, whereas God Himself is light, and His creation is timeless (Faleh, 2016).

Lighting Coefficient

Daylight factor is actually calculated by dividing the amount of internal lighting in a space by the external lighting, without considering direct sunlight (Baker & Steemers, 2002). Various factors influence the amount and quality of daylight, such as the sun's an-gle, geographic latitude, the location of the space, the height of structures in front of light-receiving surfaces, attention to shading elements, the material of interior walls, the size and type of glass, and its placement. Additionally, the amount of light through a sky-light can vary depending on the frame, glass, wall thickness, added components, and the color of the skylight. All of these elements affect the quality of natural lighting within the interior space (Feridonzadeh & Cyrus Sabri, 2014). Considering these factors, the distri-bution of daylight is influenced by the ratio between the room's depth and the height of the skylight (room ratio), the proportion of the illuminated surface area to the room's floor area, and the amount of visible sky in the surrounding environment. All of these as-pects are closely tied to the skylight and its structure. These elements play a crucial role in ensuring an effective and balanced distribution of natural light within the space (Mousavi, Mahmodi, & Tahbaz, 2019).

In Table 1, the area of the skylight, the room depth, and the height of the skylight in the four examined houses are analyzed. These measurements provide insights into the

relationship between the structural elements of the skylight and the effectiveness of natural light distribution within each house.

Table2.
Physical's Characteristic of Windows in the Traditional Houses of kerman (Authors, 2022).

Name	Windows Material	Glass Type	Window shelf position	The size of the window shelf	Additional Elements to Create Shade
Dinyar Houses	Wood & Clear Glass	Transparent & Colored	on the out-side	50 cm	No canopy
Kazemi House	Wood & Clear Glass	Transparent	on the out-side	64 cm	No canopy
Azami House	Wood & Clear Glass	Transparent & Colored			No canopy
Waziryi House	Wood & Clear Glass	Transparent & Colored	on the out-side	70 cm	No canopy

The concept of the window

One of the architectural elements that plays a key role in shaping a building and its lighting design is the skylight. In addition to providing illumination and regulating the amount of light received, skylights also contribute to air circulation, offer views of the outdoors, and enhance the aesthetic appeal of the building (Kateb, 2018). In Iranian archi-tecture, considering the climatic conditions, buildings were designed in such a way that the summer quarters were separated from the winter quarters to prevent excessive heat in the summer and cold in the winter. In this context, the skylight played a significant role as a climatic solution. The key factors that make skylights important include providing light, regulating heat, creating favorable conditions for viewing the outdoors, and ensuring the architectural compatibility of the skylight with the overall design (Feridonzadeh & Cyrus Sabri, 2014).

In Iranian architecture, there is a great diversity of skylights, influenced by different climatic conditions, the orientation of the building, the culture of each region in Iran, the function of the space, and the wall on which the skylight is installed. For example, in spaces like the "Shah-Neshin" (a main reception area of high importance), the skylight must be designed to create a sense of calm and pleasantness. On the other hand, spaces that do not require intense lighting due to their function should have skylights that regulate the amount of light using controllers or colored glass to adjust the incoming bright-ness accordingly (Feridonzadeh & Cyrus Sabri, 2014).

Window performance in lighting and energy consumption

Natural lighting is considered one of the key qualitative factors in buildings. Beyond just providing light, attention to natural lighting plays a crucial role in reducing energy consumption.

Additionally, it impacts the heating and cooling systems of a building, which are es-sential factors in the overall quality and efficiency of the structure ((Zeinalzadeh, Nikghadam, & Fayaz, 2021).

Alongside these factors, the skylight is considered a fundamental element in buildings, with multiple aspects. These include:

•Aesthetic aspect

•Functional aspect, which includes providing lighting, heating, and cooling

Given these considerations, it can be said that neglecting the influential role of sky-lights may lead to them being perceived as intrusive elements. For instance, excessive sunlight entering a room can cause overheating and eye discomfort due to glare (Feri-donzadeh & Cyrus Sabri, 2014).

The thermal and lighting performance of any space is influenced by the characteristics of the skylight, including its size, material, placement, and the features of its shading el-ements. These factors play a crucial role in determining how effectively the skylight can regulate temperature and light within the space (Montaser Koohsari, Fayaz, & Moham-mad Kari, 2016).

On the other hand, the larger the space, the more and larger skylights are required to provide sufficient lighting. This, however, can lead to increased heat loss and a higher cooling or heating load, which in turn raises energy consumption. To make the right choice, it is important to consider the combined effects of lighting and temperature based on the size of the skylight, ensuring an optimal balance between natural light and thermal efficiency (Almodóvar & Pablo la, 2014).

In the past, the shape and proportions of skylights, along with their orientation and other features, were carefully adjusted to control the amount of light, heat, and cooling received by each space throughout the year, depending on the function and importance of that space and the local climate conditions. However, today, due to the rapid increase in population, growing demand for housing, and limited space in construction, less attention is paid to the impactful role of natural lighting and the reduction of energy consumption (Zeinalzadeh, Nikghadam, & Fayaz, 2021).

Relationship between window height and room depth in light uniformity and glare pre-vention

In rooms with a skylight on one side, the amount of light received is significantly greater near the skylight compared to areas farther away from it. As the room depth in-creases, the light intensity decreases towards the far end of the room. This creates a gradi-ent in lighting, where the parts of the room closer to the skylight are much brighter than the areas further from it (Feridonzadeh & Cyrus Sabri, 2014).

Glass and its application in architecture

In architecture, to provide natural lighting and measure the amount of light received, glass and its various types play a crucial role when used in skylights, as well as the ratio of glass to the skylight surface. Glass acts as a medium for transferring light from the out-side to the inside. Therefore, the larger the ratio of glass to the skylight surface, the more light enters the space. Additionally, light frequency in clear weather is higher through vertical glass, and in Iranian architecture, the southern facade receives the most sunlight in clear weather (Feridonzadeh & Cyrus Sabri, 2014).

In addition to these points, the role of colored glass should be highlighted, with the most complete historical example being the Orosi windows. These are one of the ele-ments of Islamic architecture, with their history dating back to the Safavid and Qajar periods. However, colored glass was used during the Zoroastrian era and even earlier, though with limited colors and without specific patterns. In the Qajar era, it became more widespread and adopted structured designs. The reasons for using colored glass in skylights include:

- Providing light for the interior space
- Establishing a connection with the outside world
- Enhancing the aesthetic appeal of the building facade
- Creating colorful lighting inside the space
- Reducing sunlight and controlling heat intensity
- Repelling insects

(Montaser Koohsari, Fayaz, & Mohammad Kari, 2016).

Overall, these skylights, which contained colored glass, filtered the light and acted as a sundial to remind people of the five daily prayers. In later years, they were used for var-ious other purposes (Omidi, Golchin, & Masoud, 2021).

Table3.
The percentage of glass to window area based on the window frame grid value (Heydari, 2012).

Network value	Very High	High	Average	Low	Very Small
The percentage of glass to the surface of the window	60	68	75	82	90

Conclusion

In desert regions such as Kerman, due to the abundance of sunlight, skylights play a significant role as a key element in architecture. Based on studies conducted on the sky-lights of historical houses in Kerman and their alignment with the principles of architec-ture in hot and dry climates, it can be concluded that Kerman's architecture and its related elements represent a climate-adaptive design. This design not only optimizes energy con-sumption but also provides sufficient light for the comfort of the inhabitants.

The findings of this research are as follows:

- Constructing skylights with relatively small dimensions and placing niches inside or outside the room to diffuse light and prevent direct sunlight.
- Using colored glass to avoid uniform lighting, enhance beauty, and reduce light intensity for residential comfort.
- Designing skylights with dense grids and frames to reduce direct sunlight and regulate interior lighting.
- Positioning skylights at a height of one meter from the floor, and keeping room depths less than 10 meters in relation to the skylight, which is a distinctive feature of houses in desert regions.

Data Availability

The data underlying the results presented in this paper are not publicly available at this time but may be obtained from the corresponding author upon reasonable request.

Conflict of Interest

The results obtained in this research do not conflict with any individual or organization.

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Authors' Participation

This research is derived from the first author's doctoral dissertation. The primary data collection, encompassing all observational and analytical components, was conducted by the first author under the direct supervision and mentorship of the second and third authors.

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