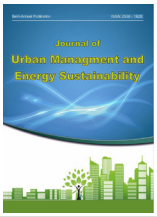
International Journal of Urban Management and Energy Sustainability (JUMES)

Homepage: http://www.ijumes.com



CASE STUDY RESEARCH PAPER

Study of spatial and visual comfort in the reception space of traditional houses in Mashhad city, IRAN

Pedram Hessari[1*], Maryam Seyf Shojaee[2], Parisa Noormohamadi[3]

1 Department of Architectural engineering, Ayatollah Boroujerdi University, Boroujerd, Iran Boroujerd, Iran*
2 Department of Architecture, Yazd University, Yazd, Iran.
3 Department of Architectural and Civil engineering, University of Torbat Heydarieh, Torbat Heydarieh, Iran

ARTICLE INFO

Article History:
Received 2024-11-14
Revised 2025-03-01
Accepted 2025-03-15

Keywords:
IRAN, Mashhad city, space, spatial comfort, traditional house, visual comfort.

DOI: 10.22034/ijumes.2025.2045753.1269

ABSTRACT

Occupant's comfort is one of the most important aims of architectural designers, which plays an essential role in various aspects, including spatial organization and visual comfort. In traditional Iranian architecture, living room or guesthouse is the main part of the house. This study aims to examine the visual comfort of the two sides of the landscape, communication and quality of light and glare in the living room space. The research is based on the existing studies and resources and software simulations. The method of collecting data is documents and library. The experimental method will be carried out in terms of spatial communication utilizing Depthmap software and visual comfort using Daysim software. Configuration factors and daylight factors were calculated in six Qajar houses of Mashhad, Iran. Factors such as window orientation, window to floor ratio, depth of space in guest's space are considered to evaluate their effects on the interior luminous environment, consequently on occupant's visual comfort. For this purpose, the reception space in six traditional houses of Mashhad city has been studied in terms of spatial communication utilizing Depth map software and visual comfort using Daysim software. The spatial configuration and proportions of houses have the potential to be efficient in visual layering, proper perspective, and glare control of the living rooms. Semi-open spaces such as porches, depth of space, window-to-floor surface ratio can be effective in providing uniform light in space.

Running Title: Spatial and visual comfort in the reception space of traditional houses

NUMBER OF REFERENCES	NUMBER OF FIGURES	NUMBER OF TABLES
32	03	02

*Corresponding Author:
Email: *P.Hessari@Abru.ac.ir*
Phone: +989387783830
ORCID: https://orcid.org/0000-0002-1666-4245

INTRODUCTION

Historically, our circadian rhythm was regulated by the natural cycle of sunrise and sunset. (Landvreugd, Nivard and Bartels, 2025). Research has established that solar radiation admitted through the windows have serious effects on visual comfort of the occupants in the indoor spaces. Use of solar shading devices can address glare problems. This signifies the need for design of optimal shading devices that increase daylight levels with desirable control on excessive sunlight with an aim to reduce glare and discomfort for the occupants (Joshi and Patki, 2022). When considering sustainable and energy-efficient design, daylight analysis should be considered. Daylight analysis determines how much light penetrates a room, and designers base their decisions on this parameter to install artificial light to meet operation demand. Therefore, natural light can be utilized effectively to reduce energy for artificial light. Cutting down on energy leads to lowering greenhouse gas emissions associated with electricity generation. In addition to cost saving and lowering greenhouse gasses, exposure to natural light can improve our mood and increase productivity. (Tue Duy Nguyen, et al., 2024). Sustainable design— being an all-encompassing concept that features daylighting—seeks to establish buildings that are not only low in energy consumption but high in resource retention, environmentally friendly and offer a healthy living space for people who live there. (Gourav Dey: Nang Mwe Noom, (2024)

Daylight is an important spatial design input that increases the spatial quality and enables people to integrate with nature. With the concept of sustainability, which has been talked about frequently in recent years, more improvement of spatial comfort conditions has started to be demanded more from designers. The fact that energy efficiency is also discussed more in design has led designers to consider these issues at an earlier stage of the design phase.(Mehmet Sait CENGİ Z1, 2021). Excellent daylighting in buildings is beneficial to protect the physical and mental health of users (Li, 2024) Daylighting design is an essential aspect for creating brighter, healthier buildings for everyone. Considering that daylight has a unique ability to shape the experience of a space, it is important for architects and designers to take it into account in order to build healthier, more sustainable buildings. Good daylighting design can improve the health, mood, cognitive abilities and productivity of the occupants of homes, schools or workplaces, while reducing the energy consumption of the building (ArchDaily, 2022). To improve the occupants' comfort, the indoor environment needs to be built considering their requirements. The luminous environment is an important factor that influences the occupants' space perception and evaluation, emotional state, and biorhythm. (Seo, Choi and Sung, 2021).

A building which can effectively use the daylight can certainly reduce the artificial lighting loads and create healthy spaces to result in higher productivity (Joshi and Patki, 2022). Among the necessary components of the full functioning of the dwelling should be the visual favorability of the architectural space, which is, among other things, in relation to the natural environment in all its diversity. Man is surrounded by nature, which is harmonious and unique in all respects. For this reason, there has always been and is a need to see some of this nature in the architecture of the house and other buildings. In architectural design, natural components are actively involved in enhancing aesthetic harmony (Ilvitskaya, Lobkov and Lobkova, 2020). Visual comfort can affect building occupants' behavior, productivity and health. (Blanco Cadena et al., 2022). Visual comfort encompasses a variety of aspects: Views of outside space and connected to nature, Light quality, Luminosity, Absence of glare (INSTITUTE, 2021). Therefore, it is evident that visual comfort is not solely dependent on the light quality or light level, thus reinforcing established knowledge. Visual connection with other spaces and outdoors is deemed essential for a person to feel comfortable within a space

(Thayanithy and Perera, 2023)). Visual comfort design in buildings is a process to optimize the lighting of spaces as well as to understand light in a way that provides residents with a comfortable, productive and healthy living environment (Medved, Medved and Microclimate, 2022). The configurational design of residential space plays a significant part in initiating user movement and influencing user social interaction patterns. (Khalil, Sadiq and Farhan, 2024). In locating the interior spaces of traditional houses, it is important that the guest space with private space be in the least integration and in other words, be completely separated and separated from each other in the plan. Also, the location of public spaces in traditional houses is that these spaces have the highest amount of access to the courtyard and on the other hand, private spaces are located in a place where the lowest access to the courtyard and the vestibule. One of Iranians' interests in building houses is the visual connection between the room and its outer space. Openness, vastness and free vision are among Iranian nature is a transparency of principles that have been constantly flowing in Iranian art and architecture (Hasani et al., 2024). What made traditional housing suitable for hospitality is the non-interference of private and public realms (the concept of privacy and personal space) and the overlap of the public and semi-public realms has been the concept of flexibility in times of necessity. On the other hand, the observance of the hierarchy of entry into the realms provided both the reverence of the guest and the entry of the guest stage into the privacy of the house. In general, hospitality in the field of concepts such as territory, flexibility, privacy, hierarchy can be examined. Paying attention to the concept of territory, the correct separation of realms (the concept of privacy) and the right combination of realms in times of necessity (the concept of flexibility), observing the hierarchy of entry into the private spaces of the family from the spaces of guest reception (Einifar and Abroon, 2021).

The traditional architecture of Iran, particularly its houses, is influenced by the identity and cultural values of the people of that time. Observation of privacy and its hierarchy in the structure of traditional houses is among the principles of traditional houses in Iran. Analysis and investigation of spatial relations in these buildings regarding privacy help us preserve and create privacy in modern housing. One can employ the space syntax theory to identify spatial ties and use them as an appropriate pattern. This theory allows us to know and analyze the social relationships in a building (Taheri Sarmad, Karami 2024). In traditional Iranian houses, rooms were not named according to their function, such as a living room, dining room, or bedroom. Rooms rarely served a single function. The house's main room, known as Panjdari (meaning a five-door room), served as a main reception area, also referred to as Salon, and was the most decorated room in the house. Orosi, another significant room with a high ceiling, was used for hosting special guests and ceremonial events. Seh-dari, a room with three doors, functioned similarly to a living room; its decoration was simpler than Panjdari. The family's daily activities (including eating, sleeping, and socializing) typically took place in Seh-dari, which had basic decoration. Close relatives and visiting neighbors were also entertained in this room. Seh-dari and Panj-dari were multifunctional spaces, serving as living rooms during the day and transforming into bedrooms at night. (Makino and Matsume, 2025).

In a study conducted by Maddahi in 2019, the role of semi-open residential spaces in the native houses of Mashhad city has been addressed. Quantitative data has been obtained through simulation by Depth map software and eventually the rational reasoning method has been used in order to analyze the data and draw conclusions. The results of the research illustrate that in the native-traditional houses of Mashhad, there were semi-open spaces such as Ivan, Safah and Tarimi, which played an important

role in the lifestyle and behavioral systems of residents. Semi-open spaces are an opportunity to connect more with the outside environment and a place for some lifestyle behaviors. (Maddahin and et al., 2019). Firouzi and Alipur in 2019, the place of Guest and hospitality in Mashhad houses has been studied through the Depth map software. Based on their results and studies; in the sample of houses studied by the Pahlavi era, the principle of confidentiality, hierarchy and territory has been led to the correct definition of relationships and behavioral patterns, especially relationships such as hospitality. Also, the existence of a biocompatible way with this in the past has provided the platform for performing activities tailored to the more exciting hospitality of today's world. On the other hand, another important factor that should not be ignored is the abundant flexibility of different spaces of the house in different time conditions in order to accept different activities. (Firouzi and Alipour, 2019)

Karbasi conducted his research in 2023 with the aim of evaluating the architectural history of Najafabad houses in the last hundred years and comparing these houses based on the technique of space syntax. History of home development in terms of spatial configuration several categories with several indicators using library studies, field observations and simulations have been evaluated with specialized syntax and space software. And behavioral patterns in spatial categories, entrance space, path of movement and privacy with navigable depth index, internal organization of main spaces with interconnected index and pause space, space movement and hierarchy were studied with the depth comparison index. To prove numerical results based on inductive statistics methods such as the Pearson correlation test, SPSS version 20 software was used. According to the results of this study, the spatial configuration of homes has changed over time and privacy has been decreased. There has been a direct statistical correlation between the integration, depth, and navigable depth available to common spaces in all periods. A gradual change in the relationship between the yard and the building and its role from active to passive, reducing privacy at the entrance, identifying multi-purpose vertical communication routes, reducing hierarchy on horizontal routesi the increase in the number of elements of organization and the change of organization from central to linear is evident (Karbasi, 2023). Hessari and Chegeni (2022) investigated the relationship between the concepts of flexibility and the theory of spatial configuration and also to measure the spatial configuration of houses in the Sufi neighborhood of Boroujerd. This research is of applied type and has been done through correlation strategy and space layout method. The tool for collecting information in this research is documentary and library research and a survey through a questionnaire. To evaluate the variables and components of spatial configuration and flexibility, the relationship between the components and variables is first measured using the correlation method and Spss software. The statistical population for measuring the relationship between flexibility components and spatial configuration variables is 25 experts and university professors. In the next step, five houses from the traditional houses of the Sufian Boroujerd neighborhood will be measured and evaluated using specialized space layout software to determine the variables of the concept of spatial configuration and their relationship with flexibility components. The results of this research show that the multi-functional space component in flexibility with depth and visual accessibility variables in the concept of spatial configuration, the seasonal and daily displacement component in flexibility with interconnected variables, space difference and Isovist in the concept of spatial configuration and the component of separation and aggregation in flexibility is related to the interlinking variables, depth, and difference of space in the concept of spatial configuration(Hessari and Chegeni, 2022).

Several articles on the configuration and spatial communication with the help of analysis with Depthmap software have been done. In a 2022 study conducted by Delosha Thayanithy and Narein Perera, daylight and window vision quality were evaluated for visual comfort in an office building. The results show that residents agree that natural light is the preferred mode of illumination for the workspace. Most residents found the space visually comfortable in terms of daylight integration. However, the lack of good prospects affects the visual experience of residents. The study focused on daylight integration and window view quality, as factors that affect the visual comfort of residents in an office building environment. The research method is based on the principles of post-occupation assessment in two stages. The first stage was the user survey and the second stage was study of the lighting of spaces with Design Builder software and then a perception survey using the accepted process of perceptual spatial analysis (PERCIFAL), to communicate the measured brightness level and the perceived quality of daylight in the spaces is done(Thayanithy and Perera, 2023) In 2020, Pourahmadi and colleagues analyzed the impact of physical parameters of the shells of Iranian hot and dry climate traditional houses on the visual comfort of residents. In this study, five-door rooms in three houses with different orientation were evaluated. Two dynamic indicators of the spatial adequacy of daylight and the annual penetration of sunlight were studied in different physical states and in the next step, glare analysis was carried out. In order to calculate the indicators of daylight adequacy and annual penetration of sunlight, modeling was implemented in the Rhino software and simulation was done using radiance through the Diva plugin version 3. In order to evaluate the glare, the software of Oleglir and Diva was used. The findings illustrate that only on the northwestern front is the achievement of the lead approval. Therefore, the current parameters of the shell on this front are an appropriate response to creating visual comfort in space(Khanmohamadi, Pourahmadi, and Mozaffar, 2020). In a study, ALJAWDER and EL-WAKEEL examined the effect of mashrabiya on the performance of daylight in a space and how it affects the quantity and quality of daylight accepted in space. The study was conducted in two phases in one of Bahrain's traditional homes to assess the performance of mashrabiya in providing daylight in space. The first step involved measuring daylight at Abdullah al-Zaid's house to measure and analyze brightness through traditional window devices mashrabiya (mashrabiyya) at specific dates and times to determine the impact of daylight on space. In the second stage, the simulation software Ecotect Analysis and Desktop Radiance was used and compared with the same room without mashrabiya. based on the results, daylight performance throughout the mashrabiya is better than without it. Mashrabiya can provide the recommended lighting level for residential activities and provide better uniformity compared to the space without mashrabiya. The device has the ability to reduce the impact of glare across the entire space. It is better to improve the design of the mashrabiya to increase the uniformity of daylight in space (Aljawder, EL-WAKEEL, and XVI, 2019). Taheri Sarmad, F. et al. (2024) carried out a study of traditional houses of the Qajar Period with different and various plan structures using the quantitative cognition method through space syntax techniques and DepthMap Software. This study employed Visibility Graph Analysis to assess the spatial relations in the building. This analysis has been used to examine the depth index and two visual integrity and connectivity for eight case studies. s. The results show that houses having one courtyard or the plan structure is designed in a way that most spaces of the house are arranged around one of the courtyards provide a more regular pattern of privacy hierarchy from public to private spaces rather than the samples having many courtyards that are similar in dimensions and shape. The mentioned case makes it easy

for us to comprehend space, so the legibility of the spaces is higher in these case studies. However, privacy in houses with several courtyards is more observed than in houses with one courtyard. In modern house designing, the residential architecture of Iranian houses has faced different kind of connection and integration between the interior spaces which has resulted in change of life style and cultural behavior of residents and it may have even had effect on visual comfort (specially in guest space) which will be examined in this paper. The spatial quality of the living room in the traditional houses of Mashhad city has been studied in terms of visual comfort and perspective and its relationship with other spaces (Connectivity). The aims of the current study is to examine visual comfort from two aspects of perspective and communication and quality of light and glare in traditional houses of Mashhad city. In this research, first the literature of the subject has been studied, then the living room space of traditional houses has been considered as an example and in terms of spatial communication, visual layering and visual comfort. For this purpose, Depthmap software has been utilized for spatial configuration and visual layering, and Daysim software has been used to check the brightness intensity in the living room. In addition, the geometry of space (depth, and the percentage of opening surface relative to the floor) has been considered. This study has been carried out in WHERE Iran, in which YEAR 2024.

MATERIALS AND METHODS

Space syntax translates its methodologies and measurements into user-friendly software programs enabling researchers to model plans at a building or urban scale and perform tests such as design alterations. One of the most useful is visibility graph analysis (VGA). It represents the matrix of visual fields from a gridded set of points in a closed system, i.e., closing exterior doors to the outside world. It can be beneficial for noting aspects of culture in house form, such as privacy in segregating spaces (Al-Mohannadi and et al., 2023). The visibility graph is a tool with which we can begin consciously to explore the visibility and permeability relations in spatial systems. The relation between visibility and permeability is a vital component of how houses work spatially and are experienced by their occupants. Visibility graphs analyze the range of any point in the spatial layout that is visible from other points. A graph also measures and calculates the points that are not directly visible by testing how many intervening points are needed for a point to see others (Mustafa and Ahmed, 2023).

Visibility graph analysis (VGA) is a method that allows researchers to evaluate the visibility and permeability of space from the position of the user (Shtepani and Yunitsyna, 2023). Integration expresses the mobility of a space around it and inside it to build its parts, clarity refers to the extent to which it is possible to see the spaces connected in a physical way, and given that the physical connection of the spaces refers to integration, the possibility of seeing the space from another space is called the Connectivity property, The clear system is the system in which the spaces connected visually tend to be integrated spaces, the more it is possible to represent the relationship between integration and communication with a straight line, this means that the more visually connected the space is, the more integrated it is (Hafez and Heritage, 2023). Connectivity is a local measure which is related with the amount of space which is visible from the specific point (Shtepani and Yunitsyna, 2023).

An Isovist is 'the set of all points visible from a given vantage point in space and with respect to an environment. Isovists are closely associated with 2.5D visibility analysis, which has applications in orientation and pathfinding both indoors and outdoors (Triantafyllou, Verbree and Rafiee, 2024). Visual Mean Depth (shown in the table 1 as Visibility Step Depth) can be summarized as the average number of visual steps or "turns" it takes to get from the originating point

to any other point in the system (Izaki and et al., 2024). Visual comfort is generally represented as a subjective reaction to the quantity and quality of light within any given space at a given time. A widely accepted definition of human comfort does not exist, but several metrics have been developed to quantify how much users appreciate environments, objects, or interfaces. Both too little and too much light can cause visual discomfort. Visual comfort encompasses a variety of aspects: Views of outside space and connected to nature, Light quality Luminosity, Absence of glare (INSTITUTE, 2021).

The Daylight Factor (DF) is a metric that is often used to evaluate the availability of daylight within a space. It is defined as the ratio of internal illuminance related to the external illuminance under a standard CIE overcast sky. Despite the simplicity of the DF, it also has two main limitations. First, it does not take into account climatic information as it is calculated under standard overcast sky conditions. Hence, the DF does not consider season, time of day, or variable sky conditions. Second, the DF does not consider the orientation or location of a building (De Kok, 2024). Useful daylight illuminance (UDI) is a modification of daylight autonomy conceived by Mardaljevic and Nabil. This metric, bins hourly time values based upon three illumination ranges: 0–100 lux, 100–2000 lux, and over 2000 lux. It provides full credit only to values between 100 lux and 2000 lux suggesting that horizontal illumination values outside of this range are not useful. These metrics can be used to analyze and evaluate different design alternatives to determine which design provides more usable daylight in the interior (INSTITUTE, 2021). UDI is the percentage of occupied time in a year when internal horizontal illumination from daylight is at a specific point within the designated comfort range. It measures both the frequency of occurrence of useful levels of daylight illumination and the frequency of excessive levels of daylight that are uncomfortable for residents (Hakimazari et al., 2024). Daylight Autonomy (DA) is defined as the percentage of the occupied time of the year when a minimum required illuminance at a point in a space is met by daylight alone. One possible limitation of the DA is that it does not report an upper limit. (De Kok, 2024). Daylight Saturation Percentage (DSP) defines the range of acceptable illumination between 430 and 4300 lux. It is common to use simulation software to obtain building performance data (Keshtkar Ghalati and Ahmadian, 2024).

In this paper the authors compare configuration factors estimated based on real data from an experiment. The required information was collected through descriptive and phenomenological methods with historical-documentary approach and making use of related references and texts. Since the case study presented and analyzed in this paper concerns six specific traditional houses namely, Akbarzadeh, Ardakani, Zarrinzadeh, Tavakoli, Kozeh kanani, Pishevaran with guest space, two analyses were conducted as well as spatial relevance and Annual lighting.

DISCUSSION AND FINDINGS

In order to obtain the spatial relevance in the living rooms, the plans were modeled via a 2D computer-aided design (CAD) software application named Autocad. The two-dimensional model of each house was imported in Depthmap software. And the outputs, table 1 and diagram 1 are set. And the factors related to the traditional houses are presented in Table 1. As shown in table 1 and diagram 1, the lguest space in Tavakoli house has the most connectivity to the other spaces (3884) (one room each sied) whereas, Pishevaran's guest space has the least connectivity to the other spaces (689.99) (connected with one room). Surprisingly, on the average, the most connectivity between spaces is dedicated to Zarrinzadeh house, while the least connectivity between spaces is for Akbarzadeh. The highest amount of Isovist Area of living room is for Ardakani house with 124.43, whilst the least amount of Isovist Area is dedicated to Zarrinzadeh with 38.24. (Fig. 1)

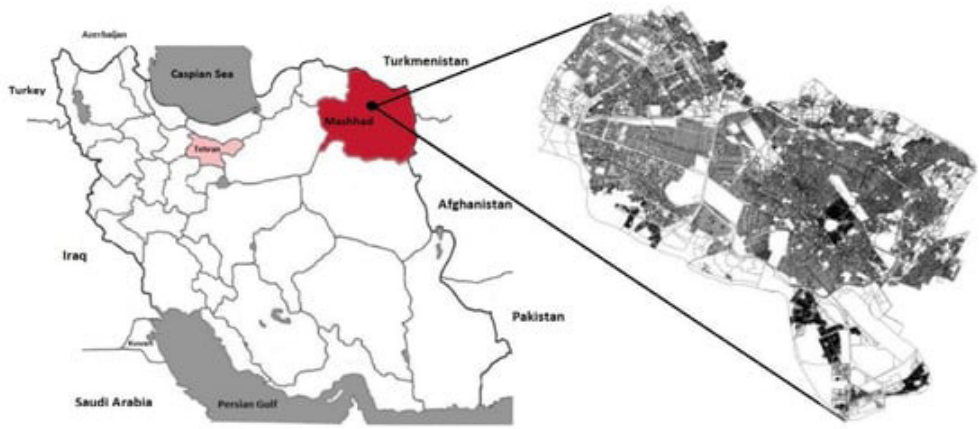


Figure. 1: Location of Mashhad city on the map of Iran

The Integration of the guest space in Pishevaran house is 24.32 which is the highest amount among 5 houses, although Integration of the guest space in Ardakani house is 5.81 which is the least amount amongst the others. The average amount is also in similar way (Pishevaran house: 23.8 and Ardakani house: 7.09). The living room in all houses other than the Zarinzadeh has high range of connectivity. It also has the least Isovist Area among the others. On the other hand, Ardakani and Zarinzadeh houses has the least integration. Also, it has least depth than the average total plan i.e., there are fewer steps than the average total plan to reach other points. As it is derived from the table1, the guest space is located in the traditional houses of Mashhad, in the field of public spaces. It also has less visual privacy than other spaces and usually has direct access to outdoor or semi-open space, thus they have a proper view of the environment. Therefore, traditional houses of Mashhad can be a proper pattern for the designers to rely on at the first design steps which appropriately controls the spatial ties in the interior. (Fig. 2)

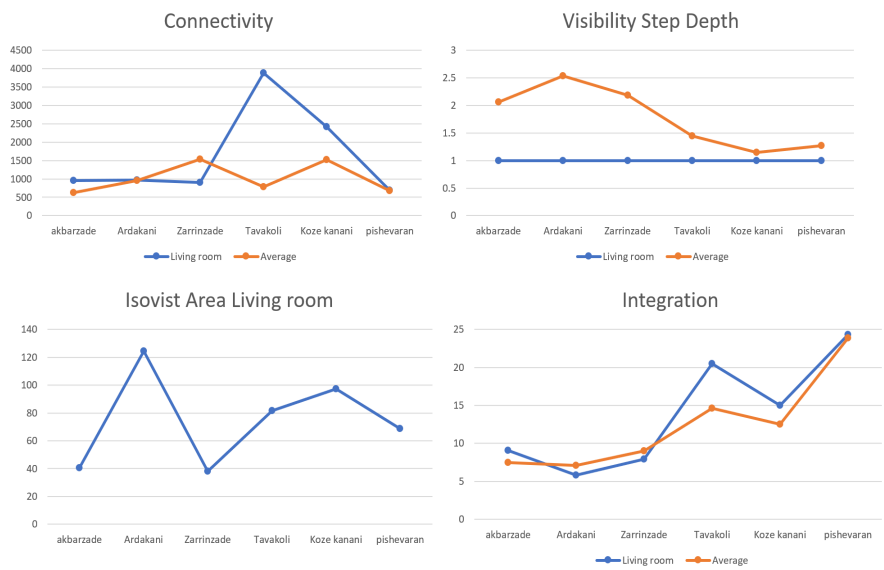
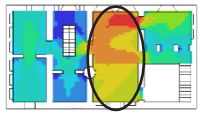
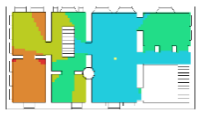
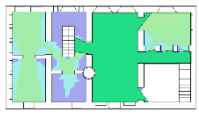
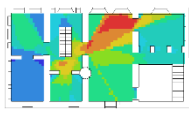
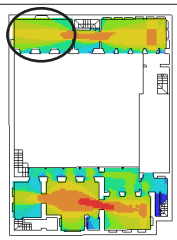
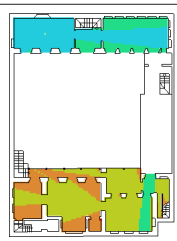
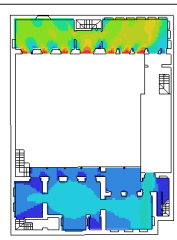
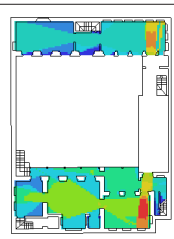
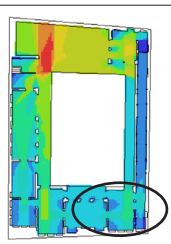
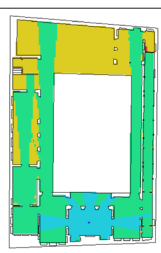
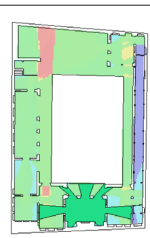
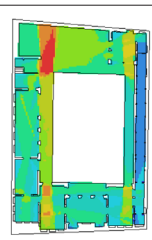
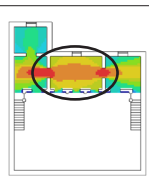
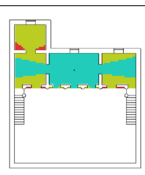
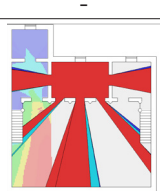
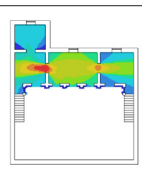
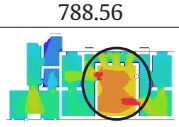
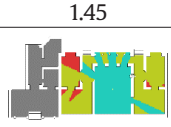
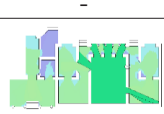
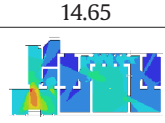
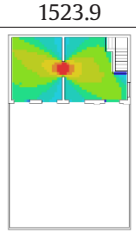
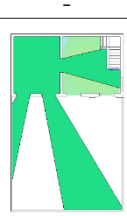
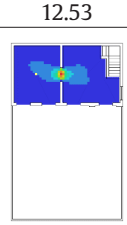


Figure. 2: Comparison of the configuration factors of the living room in traditional houses of Mashhad

Table 1: Measurement of configuration factors of living room in traditional houses of Mashhad

Visibility Graph Analysis					
		Connectivity	Visibility Step Depth	Isovist Area	Integration
Akbarzadeh					
	Living room	955.226	1	40.52	9.09
	Average	624.691	2.06	-	7.49
Ardakani					
	Living room	973.076	1	124.43	5.81
	Average	960.689	2.45	-	7.09
Zarrinzadeh					
	Living room	905	1	38.24	7.91
	Average	1532.06	2.18	-	9.02
Tavakoli					
	Living room	3884	1	81.73	20.49
	Average	788.56	1.45	-	14.65
Kozeh kanani					
	Living room	2419.2	1	97.1	15.01
	Average	1523.9	1.15	-	12.53
Pishevaran					
	Living room	689.99	1	68.82	24.32
	Average	684.2	1.27	-	23.87

In this analysis, the Daysim simulation engine enabled the performance of annual daylight simulations. The orientation of the window could differ between southwest, northwest, southeast, as the historical documents and related references showed (Tab. 2). The windows were modelled as a glass material and wooden frame. Window orientations for each house are -24° for Ardakani house, -22 for Akbarzade house, 60 for Kozeh Kanani, -50 for Tavakoli, 57 for Pishehvaran, -22 for Zarinzadeh respectively shown in table 2. After drawing two-dimensional plans, the three-dimensional model of each house was created and finally the three-dimensional model was entered into the annual daylight analysis software (DAYSIM). All the analysis took place throughout the year for 6 am to 5 pm. The intensity of lighting required for the living space, 200 lux and the working surface height is considered 0/85 m above the floor. The window-to-wall ratio of each house was adjusted 34% for Ardakani, 18.75% for Akbarzadeh, 13.44% for Kozeh Kanani, 30.13% for Tavakoli, 22.6% for Pishehvaran, 34.5 % for Zarinzadeh (Tab. 2).

Depth of space of Ardakani, Akbarzadeh, Kozeh Kanani, Tavakoli, Pishehvaran, and Zarinzadeh is 3.6 m, 8m, 10m, 3.95 m, 5 m, 3.4 m respectively. As shown in Table2, Zarinzadeh house has the highest Window orientation among the other houses (34.5 %) and the highest DSP (83.33%) which results in highest percentage of UDI (81.27%) between 100 lux and 2000 lux, so it has useful horizontal illumination values as mentioned before. Considering DF for Kozeh Kanani (100 %) and Ardakani (31%), and due to the fact that orientation is not considered, the number of windows (4 and 3 respectively) can be effective on this factor. Akbarzadeh with -22° Window orientation, 18.75% Window to floor ratio, 8m Depth of space has the least DA (63.97%) while Ardakani house with -24° Window orientation, 34% Window to floor ratio, 3.6 m Depth has the most amount (83.86%) of DA. Accordingly, Window to floor ratio effects on DA in guest's space. According to the analysis conducted in Ardakani house, the high ratio of window to floor causes light and user dissatisfaction. According to the analysis of UDI (100-2000 lux) and DSP window orientation factor provides more useful daylight illumination in the interior and comfort for residents in guest's space. This fact also exists for the DSP. None of the factors adjusted for analysis effect on DF, therefore more windows applied in the space, more DF is obtained. Window orientation, Window to floor ratio and Depth of space affects DA.

On the other hand, Zarrinzadeh house, is similar to Ardakani house (the window to the floor ratio), but due to the presence of porch and its shadow on the windows, the brightness has decreased and the light is more uniform to the house of Adarkani created. From the analysis done in rooms with high depth (Akbarzadeh and Kuze Kanani) it is determined that it is better to take light from two opposite fronts in rooms with high depth than in a more integrated space in terms of the intensity of light. In general, by considering the proper level of the window and measures such as Ivan, despite creating the right landscape, the lighting needed for the space can be created without disturbing the user.

RESULTS AND CONCLUSION

Sunlight is a multisensory phenomenon that can enhance occupant's comfort, health, and connection to the outside environment through its dynamic luminous and thermal attributes. Daylighting is a critical part of visual environment in workspaces. It creates a sense of well-being and contributes to the efficiency of the occupants. Daylighting represents a very important and an essential resource for architecture, in terms of spatial organization and internal comfort. Since ancient times, light had a dual role, on one hand, it provided internal comfort, while on the other it worked to define and design spaces. Daylight is the preferred lighting source: it is energy-efficient, flicker-free, dynamic and it has a spectrum that ensures excellent color rendering. However,

a good combination of daylight and artificial light has to be reached, since daylight cannot be the only source, because of its continuous variability, according to weather, the time of day and year and because its intensity decreases as the distance from windows increases. According to surveys, the living room had particular importance in traditional architecture and was located in the outer area of the house. It also is in public spaces and has less visual confidentiality than other spaces. This space is usually associated with open or semi-open space, so it has good quality in terms of communication between inside and outside the space and the visual landscape. On the other hand, the created windows provide enough or more daylight. In some cases, taking into account measures such as porch, the appropriate window level controls the brightness to prevent glare.

Also, in spaces with high depth, creating windows from two opposite fronts can be effective in providing uniform light in space. Therefore, it can be concluded that spatial configuration and proportion (space depth, window-to-floor surface ratio) can be effective in visual layering, proper landscape and glare control. If it is possible to use daylight in space in a way that does not cause visual distress and glare, despite the connection of residents with the outside environment, it increases the performance and sense of vitality of users and, on the other hand, contributes to the dynamism and sustainability of the space. Daylight can also play an important role in spatial segregation, which is well evident in traditional Iranian architecture. Additionally, spatial segration in the interior does not necessarily means that there is visual comfort for the residents. (Fig. 3)

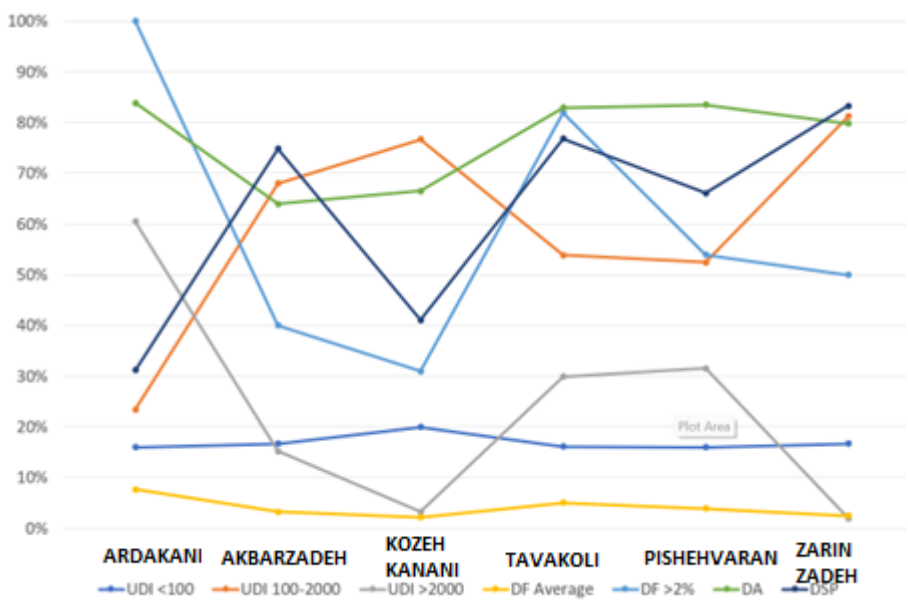
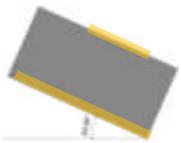
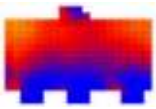
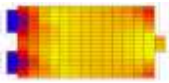
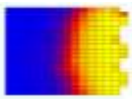
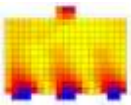
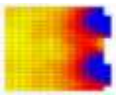
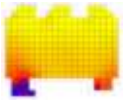
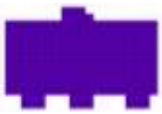
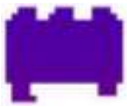
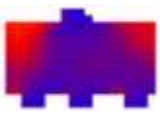
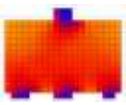
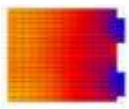
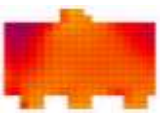
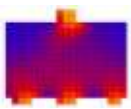
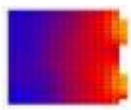
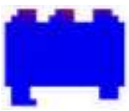
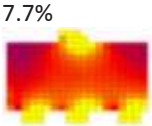
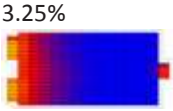
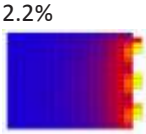
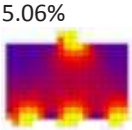
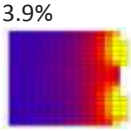
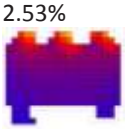
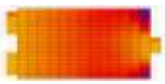
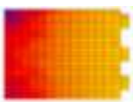
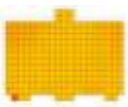


Figure. 3: Comparison of the daylight factors

Table 2: Analyzing the quality of daylight in traditional houses of Mashhad

		Ardakani	Akbarzadeh	Kozeh Kanani	Tavakoli	Pishehvaran	Zarinzadeh
Window orientation N							
Window to floor ratio		34%	18.75%	13.44%	30.13%	22.6%	34.5 %
Depth of space		3.6 m	8m	10m	3.95 m	5 m	3.4 m
DSP		31.22 %	74.88 %	41.11%	76.89%	66.15%	83.33%
							
UDI	<100	16 %	16.70%	20%	16.18%	16%	16.73%
							
	100-2000	23.5 %	68.07%	76.73%	53.87%	52.46%	81.27%
							
	>2000	60.5 %	15.23%	3.27%	29.95%	31.54%	1.98%
							
DF	Average	7.7%	3.25%	2.2%	5.06%	3.9%	2.53%
							
	>2%	100 %	40%	31%	82%	54%	50%
DA		83.86 %	63.97%	66.55%	82.95%	83.53%	79.84%
							

REFERENCES

Abboushi, B., Elzeyadi, I., Van Den Wymelenberg, K., Taylor, R., Sereno, M., & Jacobsen, G. J. L. (2021). Assessing the visual comfort, visual interest of sunlight patterns, and view quality under different window conditions in an open-plan office. 17(4), 321-337. https://www.tandfonline.com/doi/abs/10.1080/15502724.2020.1785309

Aljawder, H. M., EL-WAKEEL, H. A. J. S. S., Repairs, & XVI, M. o. H. A. (2019). Evaluating the performance of a daylighting traditional device, the Mashrabiya, in clear sky conditions: Case study of a traditional Bahraini house. 191, 395. https://www.semanticscholar.org/paper/EVALUATING-THE-PERFORMANCE-OF-A-DAYLIGHTING-DEVICE%2C-Aljawder-El-Wakeel/55e71aac1fa180c41440f6b5c452bacf69b33ce4

Einifar, A. and Abroon, N. (2021). Explaining the Continuity of Hospitality from Iranian House to Contemporary Apartment. Armanshahr Architecture & Urban Development, 13(33), 167-179. https://www.armanshahrjournal.com/article_127761.html?lang=en

Hafez, N. (2023). Analyzing the social efficiency of Contemporary and Islamic eras residential buildings in Cairo using Space Syntax. 6(1), 86-97. https://journals.ekb.eg/article_305467_eedc0c8ccac08b203226047d2705f51f.pdf

Hessari, P., Chegeni, F. J. J. o. A., & Urbanism. (2022). Measuring the relationship between spatial configuration concept variables and flexibility components. 46(2), 89–99-89–99. https://journals.vilniustech.lt/index.php/JAU/article/view/16437

Ilvitskaya, S., Lobkov, V., & Lobkova, T. (2020). The natural aspect in the visual comfort of the architectural space of an individual house. Paper presented at the IOP Conference Series: Materials Science and Engineering. https://iopscience.iop.org/article/10.1088/1757-899X/962/3/032085

INSTITUTE, T. E. A. R. (2021). Guidelines for optimum visual comfort derived from key performance parameters In. New Delhi , India: The Energy and Resources Institute. https://www.teriin.org/sites/default/files/2021-11/Guidelines-for-Visual-Comfort.pdf

Joshi, N., & Patki, P. (2022). Relationship of shading devices and its effects on daylight in Commercial buildings in Pune. Paper presented at the IOP Conference Series: Earth and Environmental Science. https://iopscience.iop.org/article/10.1088/1755-1315/1084/1/012079

Karbasi, A. (2023). The Developmental History of Space Configuration in the Last Hundred Year Houses of Najafabad. The Monthly Scientific Journal of Bagh-e Nazar, 20(118), 5-22. https://www.bagh-sj.com/article_167219.html?lang=en

Khanmohamadi, M. , Pourahmadi, M. and Mozaffar, F. (2020). An Analytical Study on the Effect of envelope's physical parameters on the Visual Comfort of Traditional housing in hot and Dry Climate of Iran (Case Study: five-door rooms in Yazd Traditional Houses). Journal of Architectural Thought, 4(8), 135-153. doi: 10.30479/at.2020.10857.1231. https://at.journals.ikiu.ac.ir/article_1973.html?lang=en

Medved, S., Medved, S. J. B. P. H., Ventilation, Moisture, Light, Sound, Fire,, & Microclimate, U. (2022). Visual comfort and architectural lighting. 251-330. https://link.springer.com/book/10.1007/978-3-030-74390-1

Mustafa, F. A., Ahmed, S. (2023). The role of waiting area typology in limiting the spread of COVID-19: outpatient clinics of Erbil hospitals as a case study. Environment, B 32(10), 1914-1928. https://pmc.ncbi.nlm.nih.gov/articles/PMC8960753/

Shtepani, E., & Yunitsyna, A. (2023). Evaluation of the Spatial Quality of Apartments from Different Price Categories Using the Visibility Graph Analysis: A Case of Tirana, Albania. International Journal of Real Estate Studies, 17(1), 83–92.. https://intrest.utm.my/index.php/intrest/article/view/268

Thayanithy, D., & Perera, N. (2023). Daylight and window view quality for visual comfort: the case of an office building in Jaffna. 13(2). https://besl.sljol.info/articles/10.4038/besl.v13i2.7680

Gourav Dey: Nang Mwe Noom, (2024), A Sustainable Design Approach for Daylighting Enhancement Strategies for an Existing Residential Building in Bangkok: A Case study. https://www.researchgate.net/publication/384256013

How to Factor in Daylighting Design for Healthier Buildings" 09 Jun 2022. ArchDaily. Accessed 26 Feb 2025. https://www.archdaily.com/983209/how-to-factor-in-daylighting-design-for-healthier-buildings

G.M. Ismailov, E.A. Sazanova, V.O. Notkina, A.I. Slobodenyuk, E.E. Logvinenko, E.E. Miroshnichenko, and M.A. Somova, (2024), Sunlight exposure on human health and vitality, BIO Web of Conferences 113, 06014 , INTERAGROMASH 2024, https://doi.org/10.1051/bioconf/202411306014

Mehmet Sait CENGİZ1, (2021), The Use Of Daylight In Architectural Designs And An Architect, MAS Journal of Applied Sciences 6(4): 950–967, https://doi.org/10.52520/masjaps.128

A.Landvreugd, M.G.Nivard, M. Bartels, (2025), The Effect of Light on Wellbeing: A Systematic Review and Meta-analysis, Journal of Happiness Studies () 26:1, https://doi.org/10.1007/s10902-024-00838-4

Jiyoung Seo, Anseop Choi, Minki Sung,(2021), Recommendation of indoor luminous environment for occupants using big data analysis based on machine learning, Building and Environment, Volume 198, July 2021, 107835, https://doi.org/10.1016/j.buildenv.2021.107835

Faezeh Taheri Sarmad, Ali Karami (2024), Analysis of Privacy Hierarchies in Traditional Houses of Iran Based on The Plan Structure Through Space Syntax Approach, Volume 17, Issue 47 Pages 17-31. https://www.armanshahrjournal.com/article_196534.html?lang=en

Tue Duy Nguyen, Hieu Trung Ho Le, Kuan Shiong Khoo, Ha Manh Bui, (2024) Algae Windows: A Novel Approach Towards Sustainable Building Design and Energy Conservation, Journal of Environmental Studies 33(10):1-13. https://www.pjoes.com/pdf-188699-113535?filename=Algae%20Windows_%20A%20Novel.pdf

Georgios Triantafyllou, Edward Verbree & Azarakhsh Rafiee (03 Mar 2024): Indoor localisation through Isovist fingerprinting from point clouds and floor plans, Journal of Location Based Services, https://www.tandfonline.com/doi/full/10.1080/17489725.2024.2320642

Khalil, K. F., Sadiq, C. J., & Farhan, R. F. (2024). Space performance assessment of traditional houses in Akre. Journal of Asian Architecture and Building Engineering, 1–19. https://doi.org/10.1080/13467581.2024.2358212

de Kok, V. C. A. J. (2024). DaylightGuide: A tool for personalized daylight recommendations for the home office. Technische Universiteit Eindhoven. https://research.tue.nl/files/334499925/2024_07_05_Kok_V._de_SBC.pdf

Mohammad Hakimazari, Parisa Kheiri, Mohammadreza Baghoolizadeh , Maryam Yaghoubi Moghaddam, S. Mohammad Sajadi, Mohammad Rostamzadeh-Renani, Reza Rostamzadeh-Renani, Mahmoud Behzadi Hamooleh, (2024), Multi-objective optimization of daylight illuminance indicators and energy usage intensity for office space in Tehran by genetic algorithm, Energy Reports 11, 3283–3306, Published by Elsevier Ltd., https://doi.org/10.1016/j.egyr.2024.03.011

A. Keshtkar Ghalati and M. Ahmadian, (2024). Effects of window and light shelve configurations on energy consumption and daylight illuminance in classrooms, Renewable Energy Research and Applications Vol. 5, No. 1, 107-119. https://pure.tue.nl/ws/portalfiles/portal/334499925/2024_07_05_Kok_V._de_SBC.pdf

Maryam Hasani, Mohammad Parva, Aliakbar Heidari, (2024), Evaluation of confidentiality in the architecture of historic houses according to the concept of transparency in spatial structure (Case study: Historical houses of Tabriz Qajar era) Int. J. Urban Manage Energy Sustainability, 5(2): 1-19, https://www.ijumes.com/article_713167_fa2cbff393d04ccc473576f9482a89ca.pdf

Kengo Makino and Yoshinori Matsume, (2025) Social Area versus Private Space in Current Tehran Housing: A Case Study of District 9 Apartments, Athens Journal of Architecture 2025, 11: 1-33, https://doi.org/10.30958/aja.X-Y-Z

Izaki, Åsmund, Brett Erica, Burger Shane (2024), Expanding Frontiers of Visible Space: Applying Isovist-waves as a principle for fast calculations of topological distances in Visibility

Graph Analysis, Conference: 14th International Space Syntax SymposiumAt: Cyprus, http://www.tabedizioni.com/space_syntax_symposium_14/10.36158_979125669032986.pdf

Li Li, (2024), Research on daylighting optimization of building space layout based on parametric design, Sust. Build., Volume 7, https://doi.org/10.1051/sbuild/2024003

Sarmada, F. T., & Karamib, A. (2024). Analysis of Privacy Hierarchies in Traditional Houses of Iran Based on The Plan Structure Through Space Syntax Approach, Analysis of Privacy Hierarchies in Traditional Houses, 17(47) 17-30, https://www.armanshahrjournal.com/article_196534.html?lang=en

HOW TO CITE THIS ARTICLE
Hessari, P. , Seyf Shojaee, M. and Noor Mohamadi, P. (2025). Study of spatial and visual comfort in the reception space of traditional houses in Mashhad city, Iran. International Journal of Urban Management and Energy Sustainability, ( ), -.
DOI: 10.22034/ijumes.2025.2045753.1269