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Original Research Article

A Comparative Study of the Morphology of Old Texture of the Sarshoor District and new Texture of the "Otobus Rani Complex" in Mashhad City with Emphasis on Cimatic Components*

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Abstract

Problem statement: The old and new textures differ in terms of the spatial arrangement of passages, squares, and open spaces, segmentation, and building typology. Factors such as the ratio of height between floors to the width of passages, building orientation and permeability, etc. are factors that influence the old and new textures. Climatic factors such as wind, radiation, temperature, and humidity affect the morphological pattern.

Research objective: Therefore, the current study was conducted analyze the effects of climatic components on the morphology of old and new textures. Now, how can we study the environmental comfort through the morphological study of the old and new tissues in terms of the influence of climatic components?

Research method: This research has used the content analysis method to conduct a comparative study of two old and new textures under the influence of environmental comfort characteristics of people determined morphological characteristics related to climatic components in selected urban textures; which finally presents a series of analysis resulting from the comparative method to compare two case studies of different data analysis tools ArcGIS 10.4.1, Auto Cad, UCL Depth-Map and Ray-Man and meteorological data and information in the form of qualitative and quantitative analysis.

Conclusion:The results show that there is a reciprocal relationship when examining the changes in the components of spatial arrangement and climatic stability in the old and new textures. Urban morphology has a significant impact on energy consumption and climate comfort. By using two methods to study climate components such as temperature, humidity, and wind speed in different textures of study samples and by using the spatial arrangement method, the environmental comfort level of people using these places was evaluated and compared which there are some differences and significant similarities in terms of climatic factors.

Keywords: *Environmental comfort, Morphology, Space syntax, Integration, Climatic components.*

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Introduction

Considering the climatic changes in recent years related to global climate change, studies show that urban morphology is closely related to thermal comfort and contributes to sustainable urban development (Chen et al., 2021). Urban morphology deals with urban areas, more specifically with their physical form (Loureiro de Matos, 2018). On the other hand, the increasing expansion of cities requires urgent measures and the city is forced to accept these changes (Sajadzadeh, Abbasi Kernachi & Sohrabi, 2020). The arrangement of the space presents the movement behavior of the users in the space and causes the formation of a two-way relationship between the behavior of the users and the body of the space (Kalantari, Ekhlasi, Andoji Garmaroodi & Khalil Beigi Khamene, 2017). This theory attempts to express that the characteristics of spatial configuration versus spatial characteristics have an effective role in shaping human activities and the degree of interconnection of spaces and the actual pattern of movement (Araújo de Oliveira, 2022). For the use of the physical method that cities are built on, determines the life patterns of people in that environment, such as quality of life, resilience of cities, vitality and things like these issues (Zhu et al., 2022). Harsh climatic conditions and temperature inversions due to inefficient construction in cities are among the limiting factors for human presence in the urban space and human behavior (Khalesi & Mansouri Daneshvar, 2020). Compared to areas with no building structure, the high-order compact and short-order structures have more thermal comfort (Ameri, Mashayekh Fereydouni & Pour Deihami, 2020). So the most important question is how to study and compare the morphology of two old and new tissues in order to study the environmental comfort according to the influence of climatic components. The old and new textures have significant differences and similarities in terms of climatic influencing elements. For example, in old textures due to the organic and dense pattern of the texture and the existence of old passages with low accessibility and permeability, which are based on pedestrian movement and with complex patterns that make it difficult for riders to access the passages, as well as high building density; Meanwhile, in the new textures, pattern of the textures and passages are regular checkered with high permeability and accessibility, the building density is relatively average with the pattern of apartment buildingTherefore, this paper attempts to evaluate the climatic comfort of people using these neighborhoods by examining the climatic components such as temperature, humidity and wind speed in the texture of two old and new textures using the space syntax method.

Theoretical Foundations of Study

Urban morphology means the study of the form of cities over time. Urban morphology studies are focused on the formation of human settlements and the process of urban formation and transformation, which seeks to categorize the spatial structure and characteristics of the urban form (Chen, Wang & Zhou, 2021). From Moudon's point of view, urban morphology includes buildings, open spaces, passages and streets, parks, and topographical elements. In his opinion, the urban form (morphology) is formed based on the typological classification of buildings and open spaces. In the study of urban morphology, Carmona focuses on the main task of analyzing the evolution and change in the traditional urban space. However, these elements are considered organisms that are constantly used and then change over time. Urban morphology can be considered as an independent variable from other factors such as climatic factors and environmental comfort of people in urban textures, which is related to the time factor (Fig. 1). Built spaces and empty spaces together create a sustainable urban form and define the built environment, while the use and functions have changed according to changing social conditions and cross-sectional needs in time (Khasto & Habib, 2017). Therefore, it is necessary to express the urban morphology in ways that improve the microclimate and thus the thermal comfort conditions. As socio-environmental systems, cities face increasing challenges that deal with a wide range of stressors such as climate change, population growth, urbanization, natural and man-made disasters,

and resource depletion (Roosta, Javadpoor & Ebadi, 2021). To do this, it is necessary to understand how the morphological characteristics of an urban space affect the microclimate. This issue is mainly influenced by geometry and built forms, vegetation, and water, as well as strategies to limit the production and impact of human interference (Al Sabbagh, 2019). Due to the rapid urban development and increasing density of cities, the morphology of cities changes and this affects the energy balance of thermal and comfort of humans (Chen et al., 2021). The general idea is that the spaces can be divided into components, as networks selected for analysis and then introduced in the form of maps and diagrams that express the relationship and relative integrity of those spaces. One of the techniques of urban morphology analysis is space syntax. Spatial syntax was first proposed by Bill Hillier of University College London in the 1970s. Buildings are physical things, but their purpose is to create spaces and connections that are used. The effect of any physical intervention is to create or modify these spatial patterns (Hillier & Vaughan, 2007). The general idea is that the spaces can be divided into components, as networks selected for analysis and then introduced in the form of maps and diagrams that express the relationship and relative integrity of those spaces (Kalantari et al., 2017). This theory includes six main indicators of selection, depth, connection, integration, synergy, and comprehensibility (Rui, Daping, Guangjie & Linjie, 2022). This theory includes six main indicators of choice, depth, connection, integration, synergy, and comprehensibility which is very popular in the analysis of a street network (Ashriye, Valipour & Amiri Raskati, 2017). Integration is one of the main concepts of space arrangement. Integration means the degree of integrity of a space with other spaces, which has an inverse relationship with the depth of the space (Peponis, Bafna & Zhang, 2008). The integration of a point indicates the connection or separation of a space from the overall system or other spaces. The greater the number of connections and coherence of a space the more nodes it connects with greater degree of connectivity (Tabatabaee, Malazi & Saber Nejad, 2016). The depth of a space means that to reach that space, you have to pass through several spaces, or in other words, the depth indicates the number of changes in direction that are required to reach from one space to another. Mostly, there is a strong relation between the depth of spaces and unused lands. So, these parts are mostly located at a great depth. Choice indicates that the pedestrian is more likely to choose this type of passage to move in urban spaces. This map shows the routes that are most likely to be used to reach urban destinations (roads with a high degree of interconnection). Connectivity has strongly influenced by spatial design. The theory of natural movement deals with the effect of spatial configuration on movement direction in the city and believes that spatial configuration is the most important factor for this direction. Factors such as spatial absorbers and land use are less important (Dorrani Arab, Ghalenoee, Zamani & Moazezi Mehr Tehran, 2017). Urban spaces are formed based on structural logic. Urban morphology as a unit of urban design and urban planning provides a basis for understanding the structures and complexities of built environments as well as creating changes and managing urban forms over time (Roosta et al., 2021). Changes in the configuration of urban spaces can cause significant changes in the microclimate. These changes affect the well-being and thermal comfort of pedestrians in these spaces and the quality and intensity of any activity (social or individual) in these spaces. Microclimate as a dependent variable depends on urban morphology and other factors such as general and local climate. Climatic parameters such as radiation, temperature, humidity, and wind speed in the open space are influenced the thermal comfort of people (Al Sabbagh, 2019). Patterns of urban

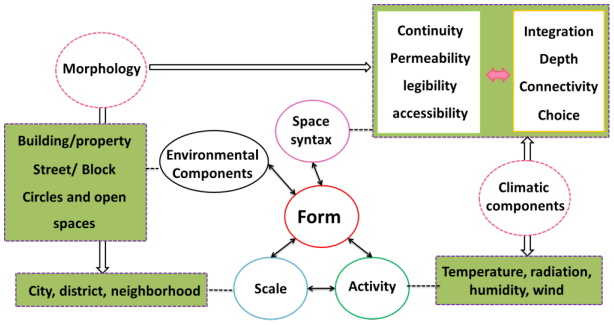


Fig. 1. Factors shaping urban typology. Source: Authors.

development and urban design without taking climate and climate change into account, such as inefficient locations, the design of traditional traffic patterns, the excessive destruction of urban land, high-rise buildings for profit and the use of materials and substances with high thermal capacity, and such problems have many consequences. This has an impact on the climate and climatic comfort in cities (Hassani & Mofidi Shemirani, 2021). As can be seen from Table 1, there is a close relationship between buildings and all other man-made urban elements and their surroundings. The thermal comfort of pedestrians is a variable that depends on the urban morphology, the characteristics of the microclimate and the adaptation possibilities in the urban space, so it plays a role as a variable that depends on the urban morphology (Al Sabbagh, 2019). Outdoor thermal comfort is related to solar radiation absorption machines (albedo) and the geometric arrangement of buildings and morphology (Amirtham, Horrison, Rajkumar & Surya, 2015). In this article, in addition to the discussed morphological factors, the factors of height-to-width ratio (W/H) and sky view factor (SVF) have been used (Zaki Shaikh Salim et al., 2020).

Research Background

MRJ Conzen is the founder of urban morphogenetics after Schluter. His focus on research was to describe, analyze, and explain the formation of the city form. To put it more simply, Conzen considers the method of city map analysis to examine three elements: the street, the plot of land, and the buildings which are paired together like pieces of a puzzle. In this regard, similar articles with the subject of this research have been reviewed in Table 2. After identifying the key concepts and examining the theorists' ideas, theoretical framework of this article, which is in response to the main problem of the article has examined. According to the two morphological and climatic components, the main variables and indicators and forecast the relations and results obtained from the theoretical framework and the used software are discussed in (Fig. 2). As a result, by adding analytical techniques to the findings of the article to analyze the two main components of the article, the main goal of the research, namely the climate comfort index for users of the two study spaces has been introduced.

Research Method

In this research, a multidisciplinary approach with a combination of morphological and climatic factors has been used. The configuration of buildings is one of the main factors affecting different microclimates in the city. A morphological comparative study of the Sarshoor district and the Otobus Rani complex has been done by two physical and environmental approaches. This article tries to show whether there is a significant correlation between morphological components and climatic parameters or not. To answer the main question, the space syntax criteria should be calculated separately for each district. For this purpose, the spatial syntax components for each district have been entered into UCL Depth-Map analytical software in the form of

Table 1. Morphological components of the texture influenced on climatic components by the researchers' point of view. Source: Authors.

Researchers Name	Morphological independent variables	Climatic dependent variables
Sayyed Hassan Abdallah & Mohamed Ahmed Mahmoud (2022)	W/H, SVF, Vegetation	OTC, PET, Thermal coefficient of facade materials
Yilmaz, Sezen, Irmak & Akpinar Külekçi (2021)	Passages Orientation , Buildings, Open Spaces	OTC , PET
Delmastro, Mutani & Pastorelli (2015)	Passages Orientation, Buildings, Open Spaces	Radiation amount
Boudjellal & Bourbia (2018)	Passages Orientation , W/H , SVF	Street Temperature
Xuan, Yang, Li & Mochida (2016)	W/H , SVF	Radiation amount, Wind Speed
Zabeti Targhia & Van Dessel (2015)	Passages Orientation , W/H , SVF	PET, Street Temperature

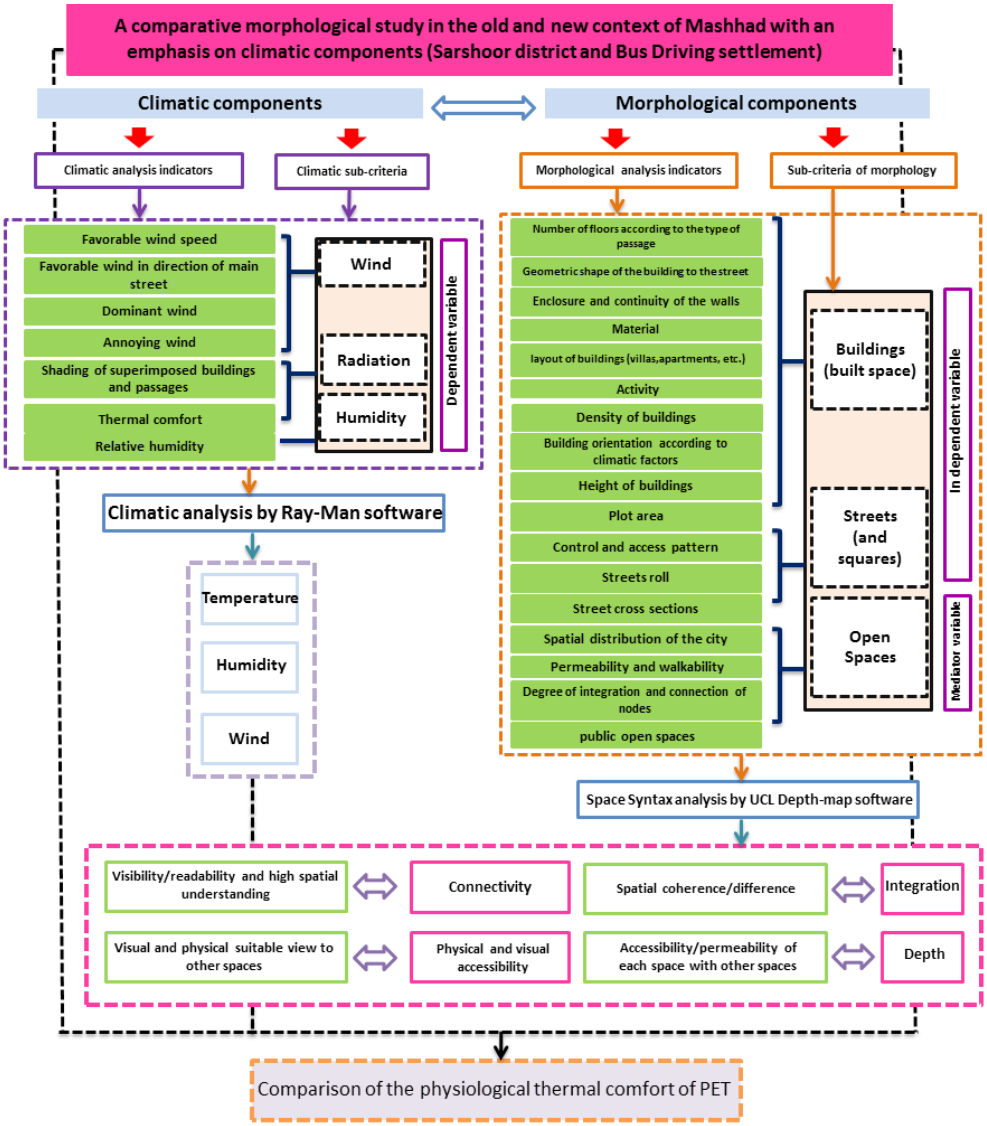


Fig. 2. The theoretical framework of the research. Source: Authors.

layers prepared in AutoCAD. The output of the spatial syntax software in SHP format has been entered into the Arc GIS 10.4. 1 software to analyze the spatial syntax of each district by spatial analysis and integration of climatic indicators in the two districts. Then, Physiological Effective Temperature (PET) of climatic indicators such as temperature, wind, radiation, and humidity was calculated in Ray-Man software and the relationship between these factors was investigated.

Introduction of the Studied Area

In defined Fig. 3 the studied areas are located in the 8th district of the central district and the 10th district of the northwestern part of Mashhad. Sarshoor pass with longitude: 36°30' and latitude: 60°2' and Azadeh and Miaad streets with longitude: 36°35' and latitude: 59°51' were investigated.

Findings

The physical approach is devoted to morphological studies of the city. The orientation and width of the streets, the height of the buildings, sky visibility factor (SVF); and the ratio of height to width of the streets are examined. Using the space syntax method and the UCL Depth Map software, the physical body of two case studies and the morphological components in the two neighborhoods studied were analyzed. The

main parameters of the spatial configuration analysis include passage length, depth, integration, selection and connectivity. First, the case studies were drawn in the Auto Cad software and then transferred to the UCL Depth-Map software. In this way, the morphological components and variables were analyzed with the mentioned software and the results were extracted in the form of graphical data and digital figures. The physical body of the two districts and the morphological components were analyzed with the spatial syntax method using the Depth-Map software through an axial map analysis and the results were expressed in diagrams and tables. According to the differences in texture typology in the two districts, different spatial arrangements can be expected for the two districts. Features for both districts are prepared in Table 3 which shows the type of morphology of the two districts.

According to Figs. 4 & 5 in the map of Sarshoor district and Otobus Rani complex, long lines provide the longest visual channel and access in an urban environment, creating a connection and understanding of the environment. The further the lines run from red to blue, the lower the degree of integration between the spaces. The difference between the structures of the two districts leads to a difference in the way they are integrated. The Sarshoor district with its old structure has a lower degree of integration than the new structure of the Otobus Rani complex district. According to the axial map, the separation between the axes of the Sarshoor district is clearer than that of the Otobus Rani complex district. The results show that the new Otobus Rani complex district has higher values of street network integrity, building density, and mixed land use than the old district. According to the Figs. 4 & 5 outputs of the software and the weighting of the morphological components in the scatter plot maps and their application in the form of warm colors with more weight and cooler colors with less weight, it is concluded that the degree of spatial integration and cohesion in the new texture With a correlation ratio of 0.22, it is more than the old texture with a correlation ratio of 0.017. The spaces have continuity and integration. Also, the discontinuity and multiple ruptures of the axes, on the other hand, the lack of connection and connection of the aforementioned axes with the spatial structures of the neighboring areas have caused a decrease in the amount of integration and coherence in the ossification of Sarshoor district. Regression analysis is also a proof of this claim. The closer the R^2 value is to 1, the higher the correlation is, and the closer it is to 0, the lower the correlation. The depth of accessibility and permeability of the spaces in the new texture of the Otobus Rani complex with other spaces with a correlation ratio of 0.227 is more favorable than the interwoven texture of Sarshoor district with a correlation ratio of 0.037 has been evaluated. This can be caused by the predetermined plans of city planners and designers. On the other hand, according to the preconceived designs of the spaces of the new texture of Otobus Rani complex with a correlation ratio of 0.246 the spatial understanding of the spaces is much higher than the texture of the Sarshoor district with a correlation ratio of 0. 01 due to the checkered ness of the passages

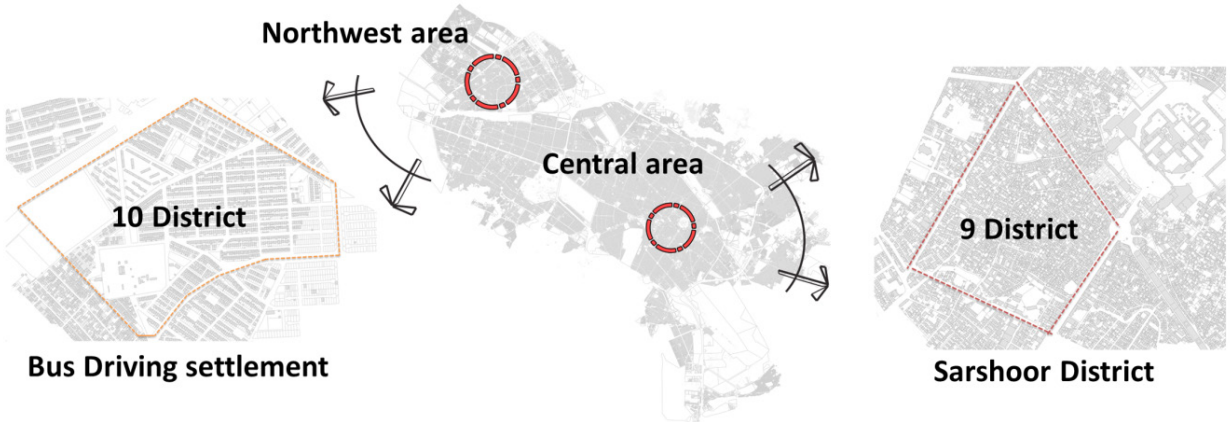


Fig. 3. Location of study areas. Source: Authors.

Table 2. Research background examination by using similar articles. Source: Authors.

Article Purpose	Study Components	Research Method	Article Results
Morphological investigation of new residential contexts optimize primary energy consumption (Case Study: Sepahan Shahr) (Mortezaee, Mohamadi, Nasrollahi & Ghalenoee, 2018).			
Investigating the relationships between morphological and typological indicators based on the pattern of primary energy consumption and identifying efficient and inefficient patterns.	Morphology (residential textures) Energy (urban microclimate)	Descriptive-analytical. Documentary and field methods: observation and questionnaire Modeling by using Design Builder software Comparison through correlation test and analysis of variance.	A strong correlation between the indicators of mass layout, the form and height of buildings, passages, and open spaces with energy, and a moderate correlation between energy and the proportion of blocks. Row building patterns have been introduced as the most efficient and square building patterns as the least efficient pattern of residential texture. H patterns were introduced as the best option for dense buildings.
Urban morphology: an introduction to the study of the physical form of cities (Oliveira, 2019).			
Definition of urban form or morphology and transformation processes of urban form elements	The physical elements of the urban form include Urban fabric, streets and squares, neighborhoods and buildings, and the relationship of these factors to time.	Authentic library documents Analytical framework using 4 approaches (including spatial analysis, spatial configuration, process typological approach, and historical-geographical approach, general aspects of urban form such as physical aspects, human interactions, and temporal contexts of Karl Kroph's theory.	The focus of the research is on the relationship between urban morphology in relation to social justice and health in the dimensions of economy, tourism, and environment in the form of two important categories of climate change and the need to reduce energy consumption in relation to the type of morphology.
Compilation of effective indicators for the typology of the urban fabric. Identity of the city (Zaker Haghighi, Majedi & Habib, 2010).			
Introducing typology of urban texture	9 indicators, including average lot area, occupancy rate, building density, open space index, average number of stories, permeability, percentage of non-modifiable uses, and the ratio of the area of the largest lot in the block to the area of the entire block	Documentary studies Systematic review Analytical-adaptive methods	Develop a theoretical framework using the classification and categorization of the urban context based on criteria, components, and indicators into two macro-categories and subtypes based on the needs derived from the planning goals and prioritization
Analysis of the schools of urban morphology. Geographical studies of arid areas (Poor Mohammadi, Sadr Mousavi & Jamali, 2011).			
Introduction of the word morphology into the concept of species morphology and comparative examination of existing theories To offer planning and urban design solutions for artificial landscapes.	Urban morphology, typo-morphology, urban texture, artificial environment 3 English, Italian and French schools.	Use of a variety of descriptive-analytical techniques	Identification of primary factors: Form, Scale, and Time from the intellectual framework of three schools of study to understand the approach of the artificial landscape.

has a much higher readability. Also, according to the formation of movement patterns due to topology of the road network in the complex texture of Sarshoor district, the natural movement pattern has been evaluated to be weaker than that of Miaad Street in the new texture of the Otobus Rani complex; While the power of choosing the route or in other words, the power of visual vision and physical access to other spaces in the new texture with a correlation coefficient of 0.001 is approximately as the same as the old texture with a correlation coefficient of 0. 01 which can be caused by only paying attention to the riding and not paying attention to the optimal routes to pedestrian strengthen circuit in the Otobus Rani complex district and for the Sarshoor district due to its confinement and physical and morphological complexity. The environmental approach pays attention to the thermal comfort conditions of the environment. At this stage, the indicators are divided into two categories such as quantitative and qualitative data. Quantitative data are divided into raw data that

Table 3. Textural features in the two studied districts. Source: Authors.

Feature		Old Texture of Sarshoor District	New Texture of Otobus Rani complex
Texture type	Checkered	Star and checkered combination	Asteroid
Land subdivision	Parallel to the plane	Regular and irregular combination	Irregular and small
Landform	Steady	Diverse and uniform combination	Diverse
Street network	Regular checkerboard	Regular and irregular combination	Regular and irregular
Design pattern	Based on a car movement	Based on the movement of pedestrians and sometimes cars	Based on the movement of pedestrians
Building height	Different floors and apartments	One or two floors	One or two floors
Building density	Different densities (high, medium, low)	High density	High density

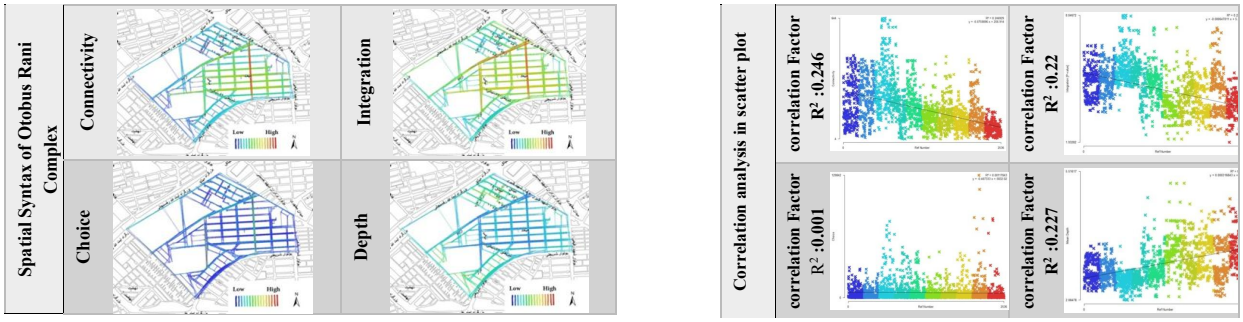


Fig. 4. The output of space syntax in the UCL Depth-Map software and the regression analysis of variables for the Otobus Rani complex. Source: Authors.

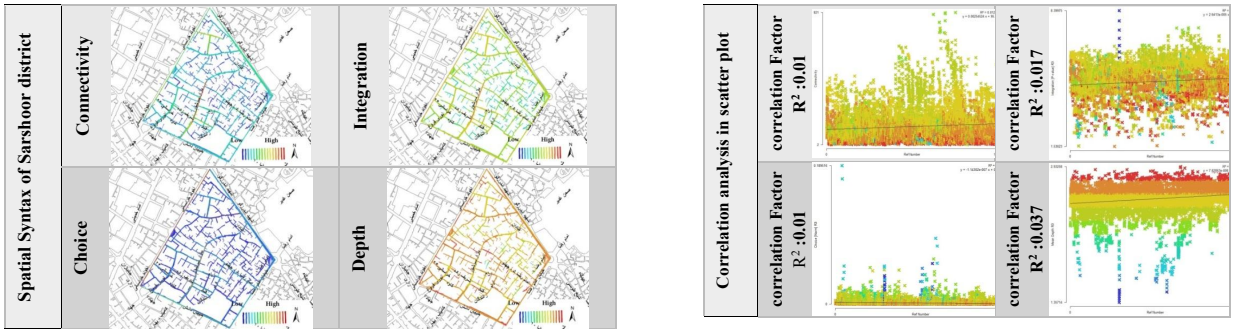


Fig. 5. Output of space syntax in UCL Depth-Map software and regression analysis of variables for Sarshoor district. Source: Authors.

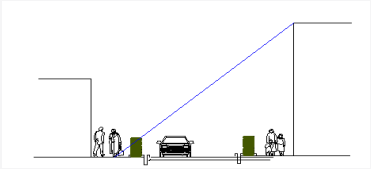
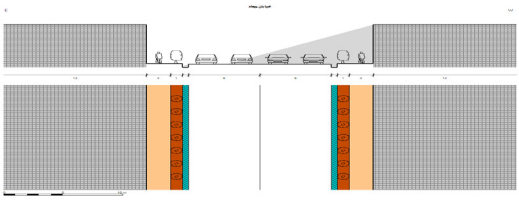
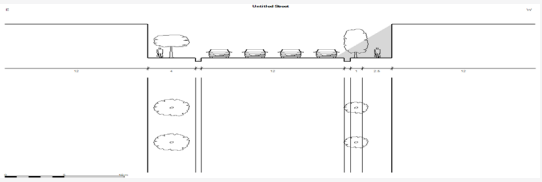
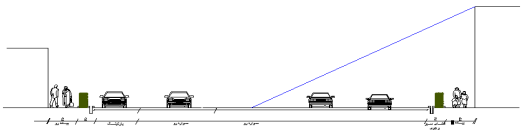
can be directly measured and secondary data which are the result of primary data calculations. The raw data including climatic dependent variables such as air temperature (Ta°C), relative humidity (Rh) and wind speed (V) prepared and measured from the Mashhad synoptic station due to table number 5. Also, the ratio of the height to the width of the street in physical studies section and secondary data, mean radiation temperature (Tmrt), physiological equivalent temperature (PET), and sky view factor (SVF). The sky view factor is an important parameter in urban microclimate analysis, which indicates the amount of sky observed from a point on the earth. It is a quantitative and dimensionless factor between 0 and 1 that determines the geometry of the surface. In Table 4 after processing district photos are imported into Ray-Man software to calculate the sky view factor. (Bernard, Bocher, Petit & Paloinos, 2018) First, urban morphology indicators such as sky view factor (SVF) and then the shadow factor of buildings (H/W) are prepared which, shows the degree

of enclosure and the shape of the street. These factors obtained through the three-dimensional map of the district in the GIS software.

When evaluating urban form using the sky view factor, the closer the SVF value is to 0, the higher the degree of enclosure, and the closer this value is to 1, the higher the spatial openness and the lower the enclosure ratio. On the other hand, the optimal occupancy (H/W) of the public spaces of a street is 1: 1 or 1:2. Therefore, the streets with a high canopy ratio and low SVF had better conditions for thermal comfort than the others, due to the shading provided by the buildings at street level during the day. In the desired locations, as you can see, Sarshoor 19 has better thermal comfort with SVF of 0. 29 and an enclosure ratio of 1:1, and even 2: 1 in some locations, which of course, due to the nearby hotels and guest houses, means that the wind in this passage is channeled and there is practically no environmental comfort. Moreover, the SVF at the 3 selected sites are 0.54, 0.68, and 0.63, respectively, and the enclosure is 1:2, 1:3, and 2:1, respectively, indicating the spatial openness of these passages, which can be increased by creating vegetation with suitable volume according to the local climate. It contributed to the creation of an optimal space by adjusting the physiologically equivalent temperature (PET). According to Fig. 6 to determine the amount of PET, 4 scenarios were created in 4 periods, i.e. on the first day of each season of 1401 (4 seasons) at 15: 00 each time with an environmental approach through measurements at two selected points including Sarshoor market and according to the National Center and Mashhad Meteorological Organization. The desired scenarios refer to the dates of 1/1/1401, 4/1/1401, 7/1/1401, and 10/1/1401, which are used for input into the software using the Gregorian dates of those days. Quantitative data and indicators are used for objective assessment of the environment, which involves knowing the state of the natural environment in the physical fabric. Qualitative data are used for the subjective evaluation of the environmental conditions. For the measurement, 4 types of public open spaces were selected in the two neighborhoods studied, forming 4 points. These 2 points were selected at the main intersection of Sarshoor pedestrian zone: Sarshoor 19 and the beginning of Sarshoor and in the area of the Otobus Rani complex district including Azadeh Street and Miaad Street in the central districts. The long-term meteorological data from the weather station will be imported into RayMan software for on-site comparison. This model is designed to predict long-term changes in the thermal environment and thermal indices. For this purpose, Ta, RH, and v are entered into the RayMan software as monthly data. If the meteorological data in the investigated districts are not obtained and cannot directly represent the thermal conditions at the measurement locations, it can be assumed that the thermal conditions in these districts are related to the meteorological data and the data should be corrected before they are entered into the software. To correct the data, the selected district with the greatest similarity to the area of the weather station is chosen as the reference. To increase the accuracy the geographic coordinates of the points were used. For Sarshoor intersection Geographic longitude of 36°30” and latitude of 59°51” selected. For Azadeh and Miaad streets Georgical longitude: 36°35” and latitude: 60°2” were selected. Then, the long-term Ta, V, and RH for each of the other locations are modified by the climate data of the meteorological station. The level of physiological comfort for each scenario in the selected locations is related to the sky view factor.

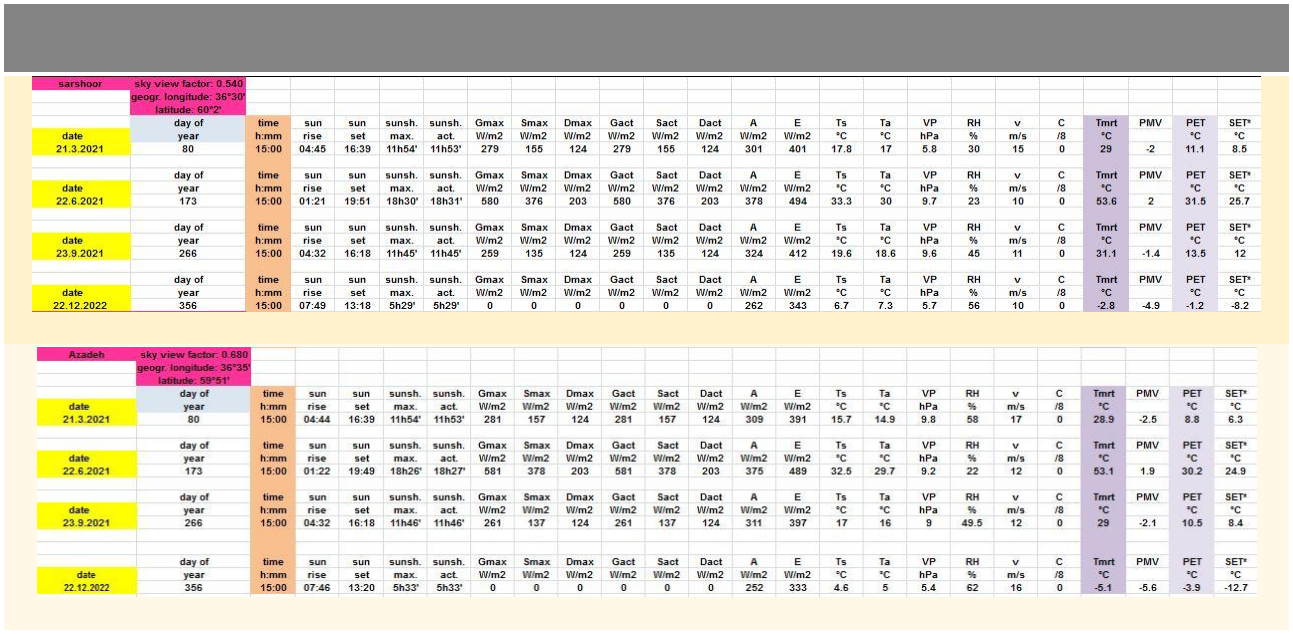
Physiological equivalent temperature (PET) of ambient comfort: it is one of the most commonly used indicators for evaluating the thermal comfort conditions in outdoor spaces. The concept of this index is “the ambient temperature of a closed artificial room without sunlight and wind, in which the amount of energy of the human body corresponds to the temperature of its skin in a real external environment”. As mentioned above, there are various indicators to measure the thermal comfort of pedestrians. The physiological equivalent temperature (PET) is a remarkable example of a steady-state model. PET allows one to compare the integrated effects of complex outdoor thermal conditions with one’s own experience inside the environment. PET can be measured with various calculation programs such

Table 4. The SVF factor in the two studied districts. Source: Authors.

Place	Cross Section	SVF	Images of Sarshooor district from Fish eye lens
Sarshoor 19		0.29	
The beginning of Sarshoor Pass		0.54	
Azadeh Street		0.68	
Miaad Streer		0.63	

as ENVI-met, SOLWEIG, COMFA+, OTC model, and Ray-Man. In this article, the Ray-Man method, short for "radiation on the human body", is used. It is an urban climate analysis tool that has been used in urban residential areas with complex shading patterns and accurate predictions of the thermal environment. In Table 5, the Ray-Man model requires morphological and geometrical data of urban forms, personal data (clothing and human activities), location, and day and season. In this article, the personal data (height, weight, gender, age, clothing, and activity) are considered fixed values by default.

According to the PET index in the 4 scenarios of the two selected points in Table 5, it can be stated that Sarshoor Pass has 11.1°C and 31.5°C less climate comfort than the texture in scenarios 1 and 2, respectively, due to its complex structure. The Otobus Rani complex has a comfortable climate of 8.8°C and 30.2°C. Also, in scenarios 3 and 4, Sarshoor Pass, with a climate comfort level of 13.5°C and -1.2°C, and the bus district, with a climate comfort level of 10.5°C and -3.9°C, do not have adequate climate comfort due to the high leveling in the low passes, which increases wind speed and prevents adequate solar radiation on the axis surfaces, leading to the trapping of air currents and the formation of thermal pollution in the surrounding district during the cold winter months. These factors disrupt the balance of the environment and disrupt the patterns of human movement, which are a function of morphology. Climatic and environmental comfort parameters play an important role in the design of buildings and spaces. High-rise buildings such as hotels and apartments in the Sarshoor district, due to their convoluted morphology, have led to an increase in wind speed during the cold season, a decrease in climatic comfort, and consequently a decrease in the presence of people due to the lack of environmental comfort in this district. As a result, it leads to a decrease in the level of comfort for citizens. Thus, we observe a reduction of environmental qualities in these spaces because urban morphology, open spaces, and street orientation



sarshoor	sky view factor: 0.540 geogr. longitude: 36°30' latitude: 60°2'																						
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
21.3.2021	80	15:00	04:45	16:39	11h54'	11h53'	279	155	124	279	155	124	301	401	17.8	17	5.8	30	15	0	29	-2	11.1	8.5
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
22.6.2021	173	15:00	01:21	19:51	18h30'	18h31'	580	376	203	580	376	203	378	494	33.3	30	9.7	23	10	0	53.6	2	31.5	25.7
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
23.9.2021	266	15:00	04:32	16:18	11h45'	11h45'	259	135	124	259	135	124	324	412	19.6	18.6	9.6	45	11	0	31.1	-1.4	13.5	12
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
22.12.2022	356	15:00	07:49	13:18	5h29'	5h29'	0	0	0	0	0	0	262	343	6.7	7.3	5.7	56	10	0	-2.8	-4.9	-1.2	-8.2

Azadeh	sky view factor: 0.680 geogr. longitude: 36°35' latitude: 59°51'																						
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
21.3.2021	80	15:00	04:44	16:39	11h54'	11h53'	281	157	124	281	157	124	309	391	15.7	14.9	9.8	58	17	0	28.9	-2.5	8.8	6.3
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
22.6.2021	173	15:00	01:22	19:49	18h26'	18h27'	581	378	203	581	378	203	375	489	32.5	29.7	9.2	22	12	0	53.1	1.9	30.2	24.9
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
23.9.2021	266	15:00	04:32	16:18	11h46'	11h46'	261	137	124	261	137	124	311	397	17	16	9	49.5	12	0	29	-2.1	10.5	8.4
	day of	time	sun	sun	sunsh.	sunsh.	Gmax	Smax	Dmax	Gact	Sact	Dact	A	E	Ts	Ta	VP	RH	v	C	Tmrt	PMV	PET	SET*
date	year	h:mm	rise	set	max.	act.	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	W/m2	°C	°C	hPa	%	m/s	/8	°C		°C	°C
22.12.2022	356	15:00	07:46	13:20	5h33'	5h33'	0	0	0	0	0	0	252	333	4.6	5	5.4	62	16	0	-5.1	-5.6	-3.9	-12.7

Fig. 6. Physiological environmental comfort (PET) factor in Ray-Man model for two selected points in 4 scenarios of old and new textures. Source: Based on the data of the National Meteorological Center organization, 2021.

have a direct and reciprocal relationship with climatic parameters and climatic comfort.

Discussion

The results of this research show that the attention to the indicators of urban morphology is one of the factors that influence the weather conditions outside the building: the level of energy demand in urban fabrics, air quality, the formation of thermal comfort, and climatic comfort. In this regard, the results of the article have provided a suitable answer to the main question of the article, showing that the mutual study of the influence of morphology on climatic factors and the influence of climatic factors on urban morphology can study the climatic comfort of people and create comfortable conditions for people. The results of this article with similar research evaluating climatic components to provide environmental comfort show that previous research has only examined one-dimensional morphology and thermal comfort or has only examined climatic components and thermal comfort without considering the researcher's opinion. For example, the results of the studies by Bourbia and Boudjellal on the influence factor of the height-to-width (W/H) index and the sky view factor of a group of buildings in four outdoor climates and the surface temperature in the city of El Oud in Algeria. They concluded that it is possible to prevent high temperatures in urban corridors through the control factor (SVF) and street alignment. Also the studies of Xuan, Yang, Li and Mochida, climatic factors such as wind speed and radiation level are among the most important factors affecting the factors of different urban forms (urban morphology) such as the relationship between building spacing and building height, which is also confirmed by the present study. Meanwhile, the results of the present study show that there is a low level of permeability and accessibility, as well as low and medium constriction, in the dense and organic textures in the Sarshoor district, which has a diverse and irregular segmentation form with a complex network of passages based on pedestrian movement. The effect of PET climatic comfort factors on morphological indicators by applying changes in the spatial, physical and environmental dimensions of the urban form and by manipulating the geometric shape of urban blocks such as dimensions and size, irregular orientation of parts based on the road network, complex arrangement of blocks and minutiae in the length of blocks, the materials (material, color) of the body and floor of urban blocks according to the climate of the city, the enclosure (ratio of height to width) 1: 1 or 1:2, the visibility of the sky or (SVF) with the values

Table 5. PET factor of human body sensitivity. Source: Abedi & Hanaee, 2018.

Degree of physiological stress	PET °C	Thermal sensitivity
Very extreme cold	Less than 4	Very Cold
Extreme cold	4-8	Cold
Moderate cold	8-13	Cool
little cold	13-18	Very Cool
No tension	18-23	Comfortable
little heat	23-29	Warm
Medium heat	29-35	Hot
Intense heat	35-41	Very Hot
Very intense heat	More than 41	So Hot

0.[29] and 0.54, which is directly related to the radiation temperature of open spaces. In hot seasons, when this value is between 0 and 0.5, the radiant temperature is reduced and the thermal comfort of users is increased, and conversely, in cold seasons, the thermal comfort of people is reduced. Since part of the Sarshoor intersection is covered, it is important in this district that users can enjoy the climate and be protected from direct sunlight, rain, and snow. The pattern (structure) of the street network and the vegetation (its type and density) in the form of a circular bench around the vegetation to harmonize and coordinate with the climatic variables in urban planning and design process can create a space that provides thermal comfort for all seasons. Even in semi-dense and dense regular checkerboard structures near Otobus Rani complex, which has a uniform and regular segmentation shape that has desirable spatial continuity and integration with a pattern of regular passage network based on the driving movement, it has a suitable level of access and permeability and high containment. environmental influences such as wind, temperature, radiation and humidity on the geometric shape of the building in the form of the same height of the building in the wind due to the density of the terrain and the use of light-colored material, dense bricks and clay and concrete due to the creation of a dense and compact enclosure to The cubic space is less than 2 for optimal effect. The wind flow with the direction of the passages is north-south and east-west of the district with an angle of about 30 degrees, which is desirable. The SVF in this district, with values of 0.[63] and 0.[68] in the warm season reduces the thermal comfort of people and in the cold season, thermal comfort for users is provided by increasing the radiant temperature. But in the northwestern parts of this district, these proportions have been upset by the presence of high-rise buildings and building complexes, so that this amount of thermal comfort in all seasons is not the standard amount and the climatic comfort of PET has practically disappeared. Spatial syntax factors in this district have been evaluated favorably due to its regular and uniform grid. This human well-being outdoors influences the activities of pedestrians and changes the quality of life in the city. To have vibrant and presentable urban spaces, predicting climatic impacts in urban space by adapting design solutions can change the inappropriate impacts of this phenomenon towards stability and resilience of cities to climate changes and responsive places. Therefore, the urban planner can carry out this study by making changes before starting the concrete work of urban planning. In addition, outdoor thermal comfort is one of the most important components evaluated for a better quality of life in the city.

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