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Examining Sustainable Urban Design Pattern by Explaining the Compatibility Model based on Density in Residential Fabrics of District 4th in Tehran City

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ABSTRACT

Concerns about energy and climate change have taken center stage in urban studies in recent years. Buildings are the primary focus of the problem of maximizing energy efficiency in cities, and among the energy Additionally, the most crucial aspects of urban energy efficiency research are consumption, solar radiation energy on the one hand, and thermal energy demand on the other. These factors, together with other climatic factors, primarily influence the standard of life in urban areas. The main aim of research is to establish a model of sustainability in the physical form of the city, the primary objective of the current research is to extract the ideal framework and also the proposed model in the form of a structure for the concept of urban design in urban morphology, which is, on the one hand, the architectural scale of the buildings of the urban fabrics. In terms of structure, the current research is analytical-descriptive, and the method of data collection is in the form of documentation, survey, modeling and simulation using energy analysis software in the field of energy with a micro-analytical approach of urban climate such as Envi-met. For this reason, 4 morpho-types were evaluated in the context of the 4th district of Tehran, and the findings of the research show the difference between the optimal state and the current state of the evaluated parameters, and the amount of difference and the effect of added density in each morphological type of the effective range based on the index It explains that the high-rise building type has the most positive changes in the proposed conditions, and the compact types have lower values respectively. In the future researches, other morphological variables and adaptation modes with climatic parameters can also be investigated in order to achieve energy efficiency in other modes.

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RUNNING TITLE: Sustainable urban design pattern by explaining the compatibility model based on density

INTRODUCTION

According to the United Nations report, the city form has a direct impact on energy consumption (Ejiagha et al., 2020). In this way, the shape of the city and its design pattern through features such as building density, mix of uses, communication network pattern and public transport network are effective in energy consumption (Van Esch et al. 2012; Yao, 2012 Ma et al. 2021; Leng et al. 2020). The energy consumption of cities is categorized into 5 main sectors: industry, transportation, housing, services, and agriculture, and most of the energy consumption in third world countries occurs in the transportation and housing sectors, among which buildings They are responsible for consuming the largest amount of 40% of energy and greenhouse gas emissions (Huang et al. 2020; Khatana et al. 2022), and the greatest potential for reducing greenhouse gas emissions is about 29% until 2030, in the case of buildings. Can be realized. Important influencing factors in energy consumption by buildings; density, diversity, design and other statistical characteristics. Therefore, the concept of energy in the building is formed in the form of classification clusters in urban contexts in the context of the concept of morphology. For this reason, building types as the cells of this concept determine the level of energy efficiency. The program for changing energy sources is based on five axes, according to which the largest amount of urban energy consumption takes place in the buildings (Morris & Pehnt, 2015). For this reason, to optimize energy efficiency in the city, buildings will be the main focus of attention. Among the consumed energies, solar radiant energy on the one hand and thermal energy demand on the other hand are the most important things investigated in energy efficiency in the city. In fact, the energy consumption of buildings is a result of the density and shape of the buildings as well as the way they are placed in relation to each other, and by making changes in these cases, the amount of energy consumed by buildings in the urban context can be significantly reduced. gave In recent years, issues related to climate change and energy have gained the most importance and focus in urban studies (Sun et al., 2020). Today, cities are responsible for emitting more than 70% of greenhouse gases (Zhang et al., 2023), although cities cover 2% of the surface of the globe (Zawadzka et al., 2021), their residents consume 60-80% of the world's energy. (Mumtaz et al. 2020). By intensifying this issue, energy efficiency is considered a key factor in urban development (Zaki et al., 2022). This is the cause of all-out efforts by governments to reduce greenhouse gas emissions (Qiu et al., 2019).

In the relationship between buildings and the surrounding environment, each building causes a change in the weather around it. These changes take place under the title of micro-urban climate

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and the influence of factors such as city geometry and section, shape, height, size of buildings, direction of streets and buildings, and surface of open spaces (Jamei et al, 2015). Man-made urban elements based on the effects of climatic factors including; They put air temperature, relative humidity, wind speed and direction, as well as solar radiation around and above them, creating an artificial climate that always has a mutual effect on each other. The shape of the urban space in accordance with the shape of the shelter and the weather conditions creates a micro-urban climate and as a result creates different conditions for living in these spaces (Kruger et al. 2020). Urban geometry also plays an important role in determining urban microclimate (L.G.R. Santos et al. 2021). Of course, other parameters such as the type and albedo of materials, greenness, humidity, radiation control and the effect of heat masses are also influential on the microclimate of the city (Ma et al. 2021). Among the mentioned parameters, the aspect ratio and the orientation of roads have the greatest impact on the severity of environmental conditions in cities (Rodriguez Algeciras et al. 2016; Abreu-Harbich et al, 2014). In addition to influencing the climatic conditions outside the building, the morphological parameters are also able to change the climatic conditions inside the building, for this reason, the investigation of the building as an independent unit and without considering its location and conditions on an urban scale should not be done. A city, taking into account its effects on climatic factors, is directly and indirectly influential in changing the amount of energy consumption in cities, especially heating energy, and building types cannot be considered as an independent unit without taking into account the location and conditions. It was investigated at the urban scale (Yao, 2012). Also, the effect of horizontal and vertical configuration, the ratio of construction area, plot area and occupation level are very important in the formation of urban fabric (Santos et al, 2021). But it should also be noted that cities and urban elements are always affected by weather factors in addition to their performance. Climate conditions are not only one of the elements that determine the amount of energy demand, but also the amount of energy consumption itself can indirectly create effects on the climate through changes in the spatial organization. In some cases, this effect causes a decrease in the need for heating in cold seasons and, on the other hand, an increase in the need for cooling in hot seasons. With the morphological approach, the relationships between climatic parameters and morphological variables can be investigated and explained. Elements such as masses, passages, and blocks, as the main urban forms, have their own indicators, which can be used to analyze the most accurate effects of this meaningful relationship. Measuring the density of the built environment and indicators such as occupancy level, ratio of open space and floors can also be considered as the main indicators of research (Wang & Zhang, 2016). In the present research, an attempt is made to answer the questions that are more about the question of the mechanism and relationships that form the main concepts, which can be; 1- What mechanism do urban morphological variables have on climatic parameters? 2- The topic of sustainability in urban forms, with what variables do they affect the urban climate? 3- What

Power System Technology
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model can be used to check the stability of the urban fabric based on the most effective morphological variable? The main goal in explaining the structure of the research is to examine the sources of innovation and extract the optimal framework as well as the structure of fixed variables in the form of a device in the form of a structural approach to the concept of urban design in urban morphology, so that in this way it is possible to develop the meta-model of sustainability in the context of the form He explained the physicality of the city based on one of the morphological components as a fixed effective variable. Finally, by presenting the optimal proposed model, it is possible to make policies in the direction of modifying the intermediate scale based on the detailed plan.

MATERIALS AND METHODS

Methodology

In this research, in addition to presenting a standard conceptual model based on the model of sustainable urban design, the structural model of the research variables will be presented based on the relationship. In this case, the model extracted from this model will be proposed based on a specific component. The current research is analytical-descriptive in terms of structure, which is considered as applied research in terms of its main goal. The method of data collection is in the form of documents (library) and field collection, data generation, modeling and simulation using energy analysis software and software in the field of energy with a micro-analytical approach of urban climate such as Envi-met. In the first step, according to the expression of the subject and the goal in the form of a conceptual framework, the issue of energy in urban morphology is considered according to the principle of sustainability of the urban fabric, the dimensions and indicators extracted from it in the form of shape and context maps in the scale. Explained, from the collection of approximately 25 types of different building configurations, of which 5 common types in Tehran metropolis were selected for classification and subsequently 4 types were simulated and evaluated in the context of the 4th district of Tehran based on LSA studies. Is. (The type of climate as well as the perspective of energy considerations in the heart of the evaluation is also considered as a fixed principle). The reason for choosing the sample type was based on the fact that; They should be in the transportation center and close to the main access points of the 2nd district of Tehran, they should have an appropriate spatial organization based on principle, area, axis, and nodes, and they should be present in the neighboring areas with regard to the creation of a micro-climate. After knowing the pattern of the mentioned species in the 2nd area of Tehran metropolis, the existing situation of the texture of the species is modeled, simulated and micro-climate analyzed and then according to the structure explained in, based on one of the situations Selected from the parametric scenario of morphology, the proposed mode is reanalyzed as the optimal model. In this case, the difference between the optimal state and the existing state of the evaluated variables explains the amount of difference and the effect of each of them and

Power System Technology
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determines the effective range based on the basic indicators. It is necessary to explain that the optimal state is a specific model of the sustainability pattern based on the calculations of morphological variables, which has been proposed in line with the sustainable (compressed) urban form. According to the mentioned forms in the urban context of Tehran and the survey conducted in the urban context of the 4th district of Tehran municipality, this area has 4 dominant urban forms, which include sheet building forms, high-rise apartments, and modern apartments. And the block is compressed. It should be noted that the selected morphological types were chosen only as an example of the mentioned species and the reason for this selection is among the several available of each morphological type in the region, as explained in the research method, such as Being located in the vicinity of each other, which includes the same microclimate and access network connections in this part of the region.

Case Study

Region 4 has 20 neighborhoods and 9 districts, an area of approximately 61288367 square meters and a population of 803789 people. Elaborating the foundations of the physical formation of the city, its physical structure such as block building and the urban division of urban land in terms of mass and space can make the connection with the city possibly in its complexities. Based on this, according to the block structure of the 2nd district of Tehran, which generally includes checkered and semi-organic textures, the process of formation in different periods can be proposed. In the same way, the division of small grains within the block with the title of grain classification map shows the characteristics of urban grains, and the number, area and type of plaques produced in urban palmistry periods in the mentioned context cannot provide the type and shape classification. According to this principle, the degree of relationship and the way mass and space interact can be understood in a specific way by including the space of each mass in the totality map of the region. The evaluation is presented as follows. Explaining that the forms presented in area 4, as examples based on the subject of shape and context, are presented in the form of geometric forms. These types include; The form of modern apartments is sheets, compact and high-rise blocks, which are specified in the shape of the location of any building.

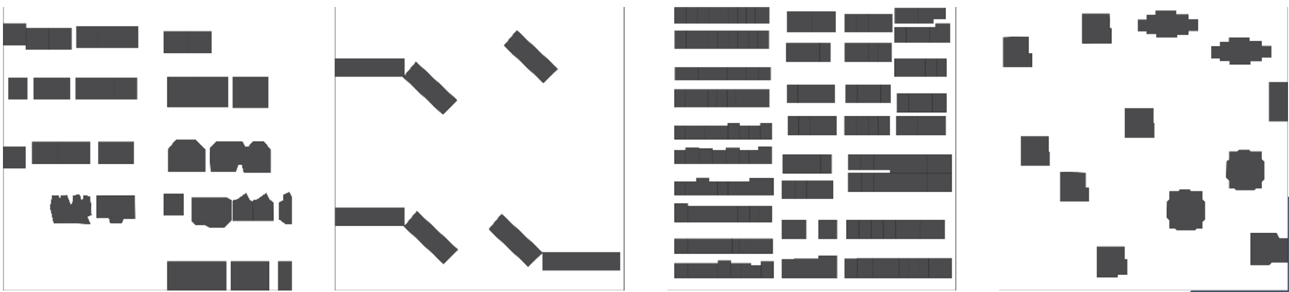

Figure 1: Figure and ground map of urban morphologies in Tehran district 4

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DISCUSSION AND FINDINGS

Envi-met Evaluation

In this part, four selected morphologies from the 4th district of Tehran municipality, three-dimensional modeling has been done in the Space environment of ENVI-Met4 software and with the climate data obtained from the Climate Consultant software for 2024 AD, in two-time frames. (Summer and winter revolution), climate simulation has been done for 48 hours in each case. In this simulation, vegetation, materials and heat from urban transportation and heat produced by buildings are ignored and only the effect of mass in creating and changing micro climate is considered. The results obtained from the simulation are presented in the format of two-dimensional and three-dimensional maps, data tables and graphs, and based on the information obtained from this stage, the behavior of morphological species in creating microclimates around them is evaluated. Which leads to increase or decrease of energy consumption in buildings, will be done.

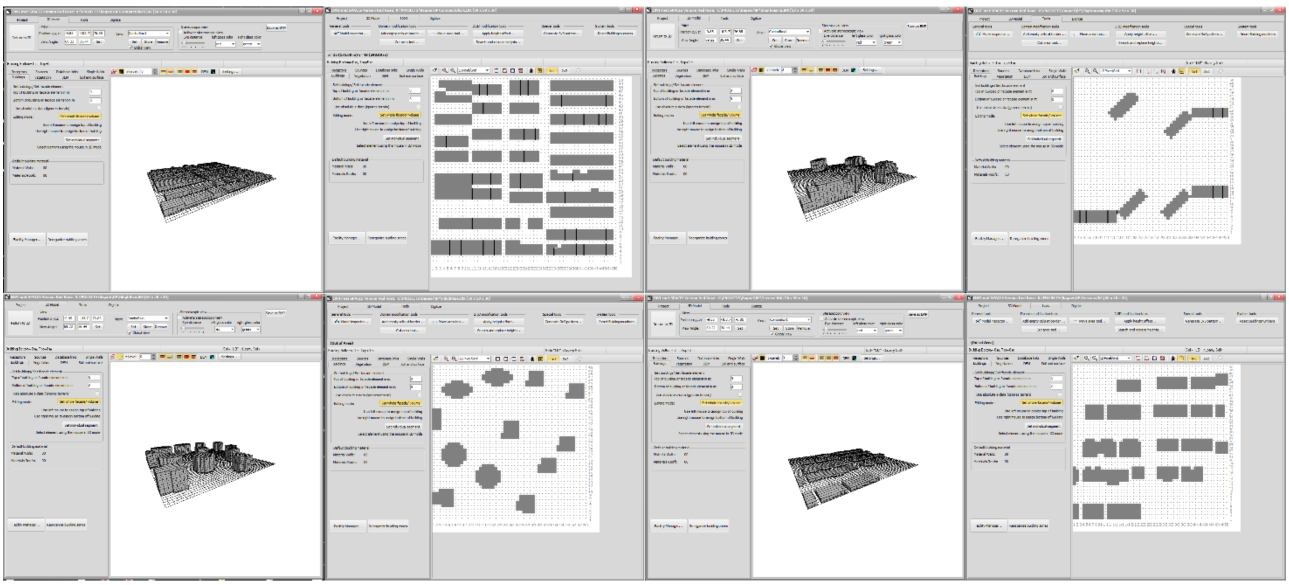

Figure 2: Modeling of the selected morphological species of Tehran district 4 in Envi-met software

Simulation has been done for each of the four forms and for 48 hours for the hottest and coldest day of the year. Thermal maps and 3D images of the simulation results for the hottest day of the year (June 22) at 15:00 (the hottest hour) and the coldest day of the year (December 22) at 5:00 (the coldest hour) are The changes of each of the four parameters during 24 hours for the selected species and the average of 24 hours of simulation of temperature, wind speed, humidity, direct radiation and the average temperature of radiation in the space around the

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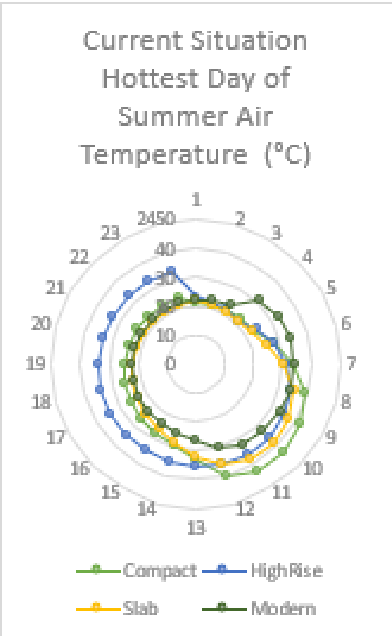
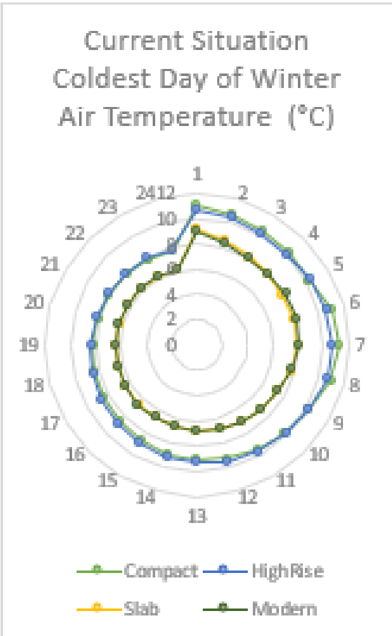
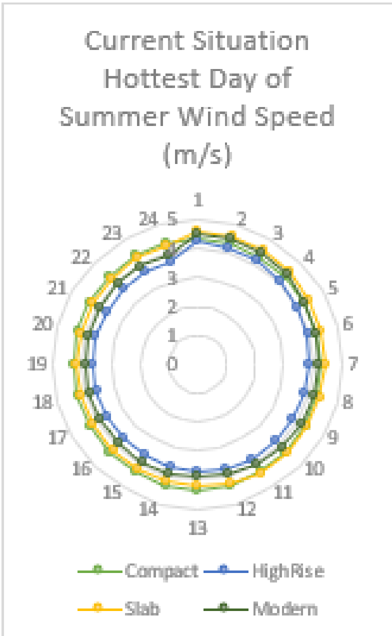
masses are evaluated and compared with the optimal state. Is. Using this information, it is possible to observe and compare the behavior of the microclimate due to the presence of each of these building types in this area of Tehran metropolis. The comparison of these quantities gives an indication of the best type of building from the point of view of sustainable urban design, and it can be suggested which type of building in this region is better or vice versa in terms of sustainability. Therefore, this is considered as the first step in achieving a sustainable urban design model.

As can be seen in the diagram, significant differences can be observed between the four selected species in the effect they have on the air temperature around them in completely identical conditions. For example, in the hot season, a high-rise structure causes the highest temperature in the space around it, which of course repeats the same behavior in the cold season and it also reduces energy consumption. Although the compact type of construction causes a lower temperature during the day, it increases the temperature of the surrounding air to the highest temperature and nearly 40 degrees during critical hours. This point is considered to be one of the most basic things in increasing energy consumption in this form. Because with this increase in temperature, the need for energy consumption to bring the temperature to the thermal comfort range is much higher, and this is possible from the comfort range only for a ventilation and electric cooling. Meanwhile, the modern apartment type shows the best behavior in the hot season and causes lower changes in the surrounding temperature. At the opposite point, this action is repeated in the cold season as well, which requires energy consumption to establish heat balance in the masses.







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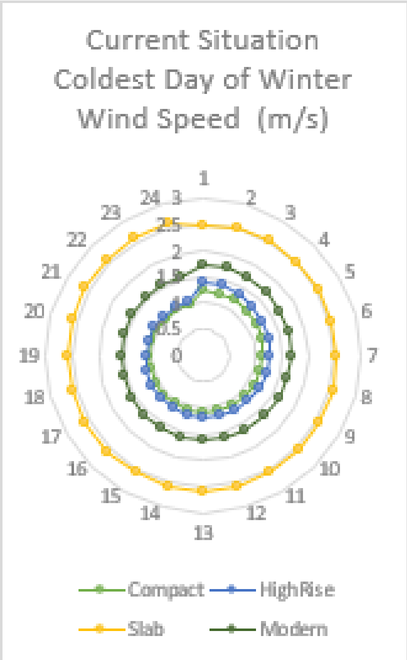
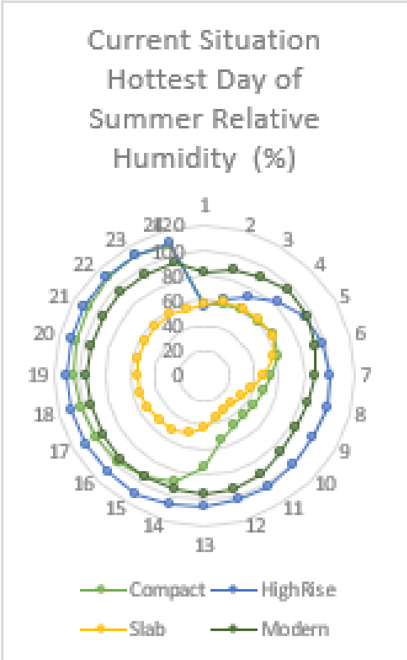




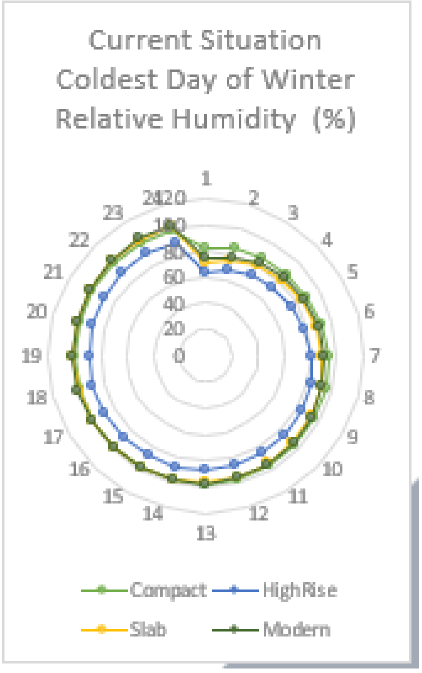
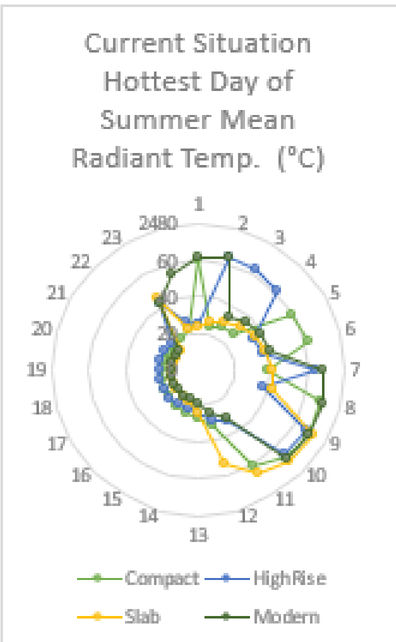
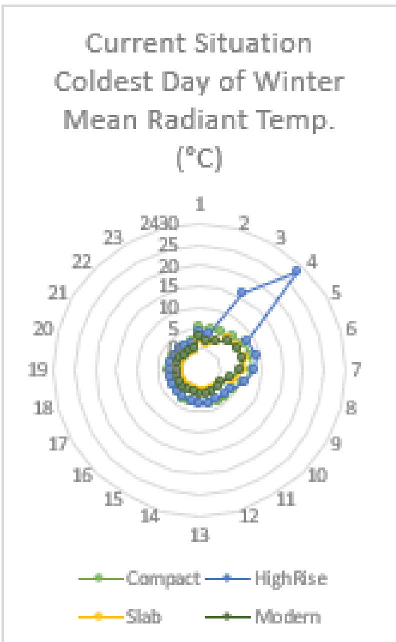
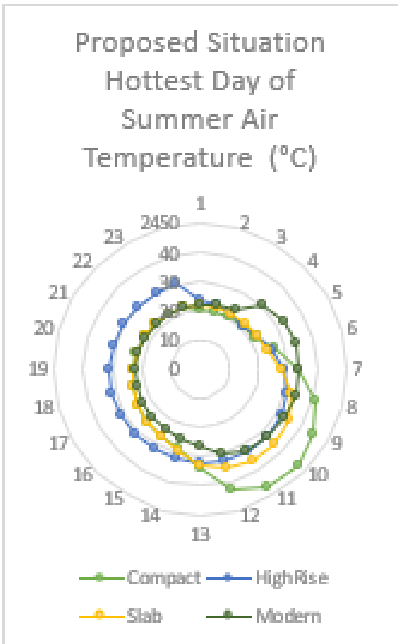


Chart 1-6: Variations in air temperature and relative humidity, average radiation temperature on the coldest and hottest days of 2024 for selected species







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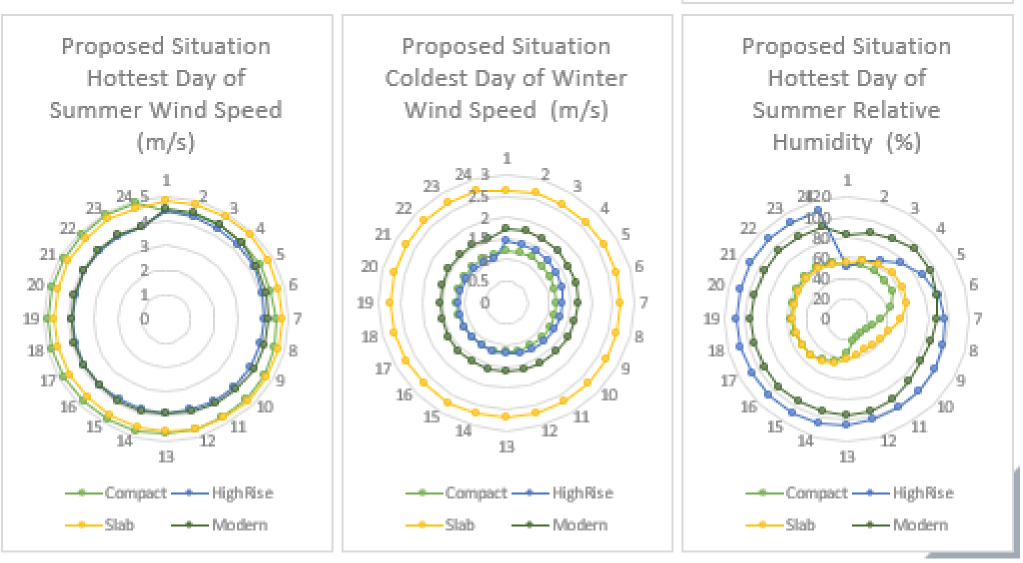

Chart 7-12: Variations in air temperature, mean radiation temperature, wind speed and relative humidity on the coldest and hottest days of 2024 for selected species

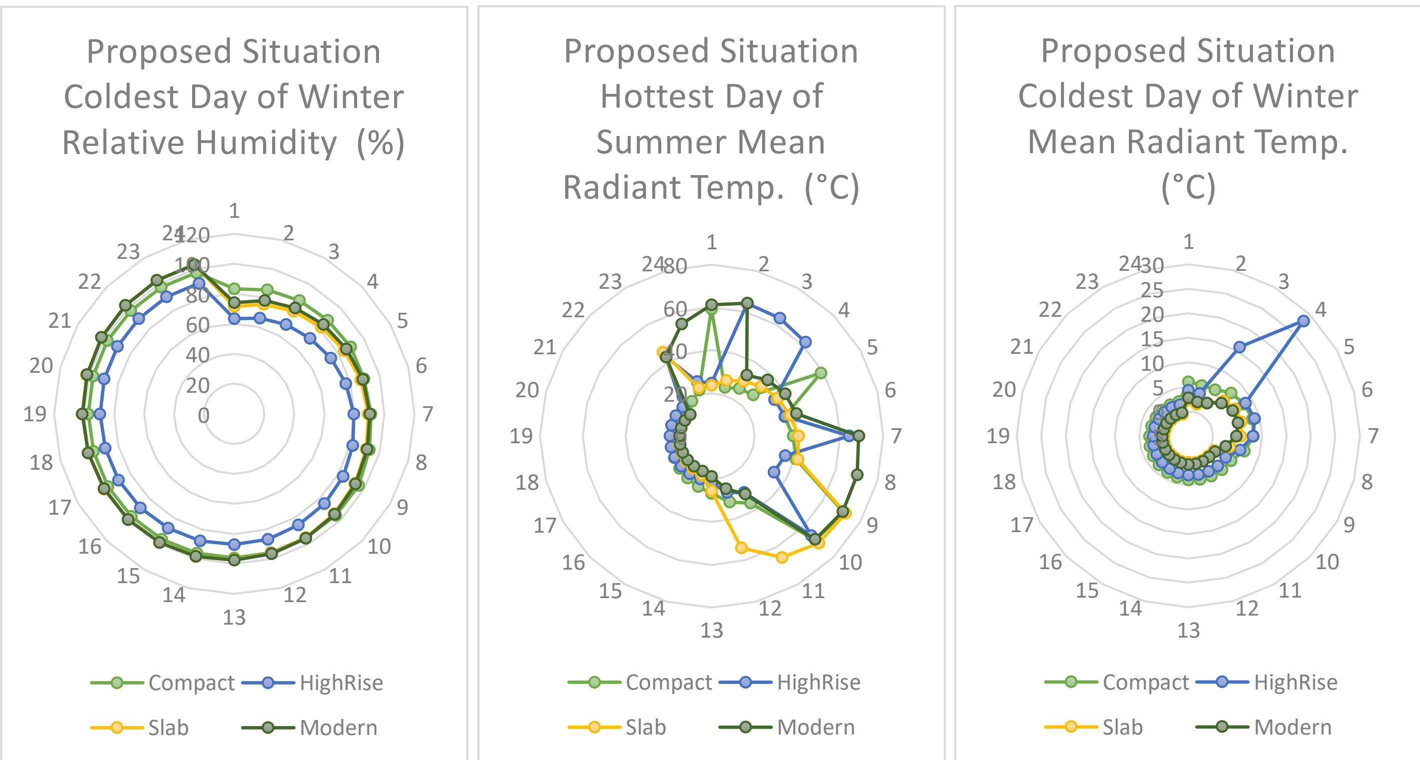

Chart 13-15: Variations in mean radiant temperature, on the coldest and hottest days of 2024 for selected species

Power System Technology
ISSN:1000-3673
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In terms of wind speed in the hot season, there is no significant difference between the studied species. But in the cold season, compact and high-rise buildings cause the lowest wind speed. Even though the modern apartment type is more than the two mentioned cases, it is still within the range of the optimal wind speed and does not cause the cold to intensify. Sheet construction type causes the highest wind speed in the cold season, and the reason for this can be investigated in the form of future research in line with the changes in wind behavior with the presence of different construction types. The study of relative humidity also indicates that modern and high-rise apartment types cause a higher relative humidity, especially in the middle of the day in the summer season compared to the other two types. But in the environmental conditions of the cold season, there is not much difference between the behavior of the microclimate around the selected species. In terms of the average radiation temperature, we can see irregular changes in the graph, which should be noted that the greatest impact of this parameter is on the thermal comfort of the open space between the buildings, and the ratio of its impact on the energy consumption inside the building ranks next. By examining the average graphs of microclimate parameters regarding four types of buildings, the difference between the temperature created in the space around the types shows that high-rise buildings cause the most heat and modern and laminated buildings cause the least amount of heat. So, the wind speed caused by sheet piles is significantly higher than the other three types, the lowest relative humidity in the cold season is in the space around the tall piles and in the hot season around the piles. Sheets occur and high-rise building type causes the highest and sheet type the lowest average radiation temperature. Of course, there are exceptions to each of the mentioned cases, both in reality and in the conducted investigations. But getting to know the amount and type of impact of each form in a specific area of the city makes it possible to identify the best and worst buildings in that part and to be able to use design tools to indirectly increase the energy efficiency in that part by neglecting the rules and standards. Let's move to a city. For each of the mentioned critical hours, the hottest day and the coldest day of the year, from each shape, the output of the thermal map and 3D display are also taken. 3D images and thermal maps help us in this discussion to give us a better understanding of the type and number of changes in the air temperature around the buildings and the role of shapes in these changes. Let's explain more concretely and understandably. Also, the mentioned data are displayed in the form of graphs for a better understanding of micro-climatic differences in different species. The three-dimensional images obtained from the simulation performed in Envi-met software and thermal maps from the critical hours of the coldest and hottest days of the year in this section graphically display the mentioned changes.

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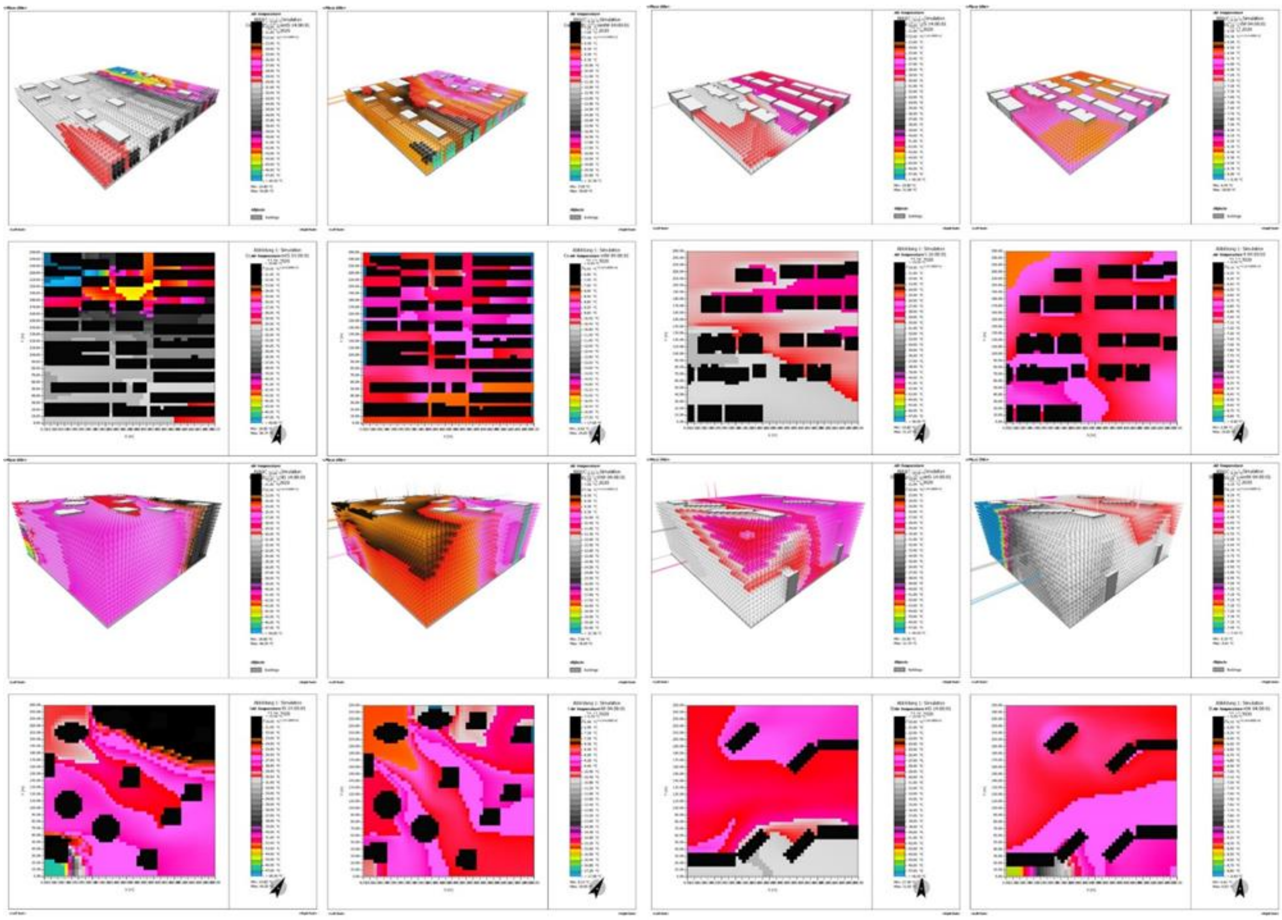

Figure 3: Two-dimensional and three-dimensional maps of air temperature for four selected forms

Therefore, based on the recognition and evaluation of the urban fabric of the 4th district of Tehran, with regard to the issue of energy in urban morphology and the principle of sustainability of the urban fabric, in order to provide an optimal model of urban design, the findings of the current research show the state of energy consumption according to the evaluation of the shape variables. It is the identification of species and climatic parameters, each of which has explained specific results and presented its type. In the following, by explaining the optimal model of the sustainability model of the urban fabric based on the concept of sustainable form, each form of the existing species will be evaluated in the optimal state. The structure of the research is presented, and its physical model can also be simulated. It is necessary to explain that the optimal model was assumed based on the principle of scenario creation according to a kind of homogeneous configuration in checkerboard form, and all the presented scenarios, taking into account the building density ratio and the occupancy level index, which are expressed as a percentage. After knowing the current state of the tissue, the

Power System Technology
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selected forms are simulated and climate analyzed, and according to the structure explained in the parametric scenario of morphology, the optimal compression state is selected as the optimal model and based on one of the states The selected item is analyzed again. In this case, the difference between the optimal state and the existing state of the evaluated parameters explains the amount of difference and the effect of added density in each form and determines the effective range based on the basic indicators. It is necessary to explain that the optimal state is a specific model of the sustainability model with the compression approach in the modern context, which is favored by the urban planning community as a macro approach to sustainability. Based on this, the optimal model can be considered according to the explained structure, based on the creation of optimal conditions with a low-density change limit and a positive change in microclimate. Of course, countless different modes can be proposed for this part, which itself requires fundamental research, but in this article, the proposed mode is selected based on one of the optimal modes. For this reason, upgrading the number of floors to the closest ideal state provides optimality, and to confirm this, we evaluate the mentioned state.

Evaluation of the optimal situation

In the following, the proposed states for the four selected forms are modeled as in the simulation done in the previous section, and all the states mentioned with increasing the density based on the optimal limit have been simulated. The simulation was carried out exactly under the same conditions as the existing situation and without any changes except the change in the morphology itself. The same climatic data as well as the same date and time period have been fully respected in the simulation in order to strengthen the quality of the comparison. The results obtained from this simulation stage in the first stage show the number of changes of each parameter during 24 hours of simulation for each of the proposed models. According to these graphs and the comparison between the simulation results of the existing situation and the proposed conditions, the impact of the proposed changes in the micro-climate parameters is determined, which results in an increase or decrease in energy consumption in the building. Will be relevant. In order to investigate and compare the microclimate conditions resulting from the existing situation of the four selected morphological types and the microclimate resulting from the proposed condition for each of the morphological types, first the maximum and minimum value of each of the investigated parameters for each morphological type and both the dates of the coldest and the hottest day of the year are determined and we extract the same values for the proposed modes. Then we determine the average, minimum and maximum air temperature, wind speed, relative humidity and average radiation temperature for each parameter in each form and proposed mode in the cold and warm seasons.

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Table 1: The maximum and minimum values of the evaluated parameters in the current state of selected morphologies for the coldest and hottest day of the year

		Air Temperature (°C)		Wind Speed (m/s)		Relative Humidity (%)		Mean Radiant Temp. (°C)	
		max	min	max	min	max	min	max	min
S	Compact	39.7030	19.2960	3.9943	3.8789	101.5800	41.0460	64.7700	16.3240
	High-rise	33.1020	19.1790	3.8830	3.3373	101.9700	49.8300	62.0190	19.2720
	Slab	35.2620	19.1630	4.1849	3.8166	57.5270	28.9400	66.6140	12.5130
	Modern	31.2590	19.7600	4.1525	3.5573	88.2810	76.5500	64.6980	13.0710
W	Compact	12.0260	8.1503	1.3170	1.0494	106.1700	87.1520	8.2768	1.8639
	High-rise	11.4100	8.2855	1.4795	1.1043	95.6930	68.1450	30.0730	1.7265
	Slab	9.7255	6.5730	2.7652	2.6585	109.1600	76.4540	6.4353	-0.5342
	Modern	9.5799	6.5712	1.8580	1.6532	109.5700	78.8530	5.8505	-0.0153

Table 2: The maximum and minimum values of the evaluated parameters for the proposed modes of selected morphologies for the coldest and hottest day of the year

		Air Temperature (°C)		Wind Speed (m/s)		Relative Humidity (%)		Mean Radiant Temp. (°C)	
		max	min	max	min	max	min	max	min
S	Compact	43.3870	18.4570	4.5334	4.0574	54.0650	18.1060	65.1520	15.3250
	High-rise	30.1740	19.5350	4.0390	3.5380	100.9400	47.2050	60.1070	17.5200
	Slab	33.6450	19.6460	4.4759	4.2095	58.4050	31.3050	66.1700	12.8680
	Modern	31.2590	19.7600	4.1525	3.5573	88.2810	76.5500	64.6980	13.0710

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W	Compact	13.2430	8.5868	1.2966	1.2301	103.7200	88.6850	9.0732	2.4524
	High-rise	11.2660	8.2523	1.5225	1.1290	95.9110	67.3220	30.0440	1.7483
	Slab	9.6834	6.5793	2.8862	2.8053	109.6500	76.3340	6.5805	-0.3806
	Modern	9.5799	6.5712	1.8580	1.6532	109.5700	78.8530	5.8505	-0.0153

Table 3: Average values of climatic parameters in the current state of the selected morphological species

		Average			
		Air Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)	Mean Radiant Temp. (°C)
S	Compact	28.70274	4.313076	77.67862	35.51075
	High-rise	31.50999	3.808251	99.5279	36.23896
	Slab	26.35411	4.314583	50.18592	31.79893
	Modern	26.55699	4.073839	92.03597	35.98799
W	Compact	9.347329	1.09436	95.3133	3.980289
	High-rise	9.365968	1.196268	83.44705	5.238338
	Slab	7.130621	2.569098	93.35704	1.372302
	Modern	7.149346	1.63457	94.29731	1.628079

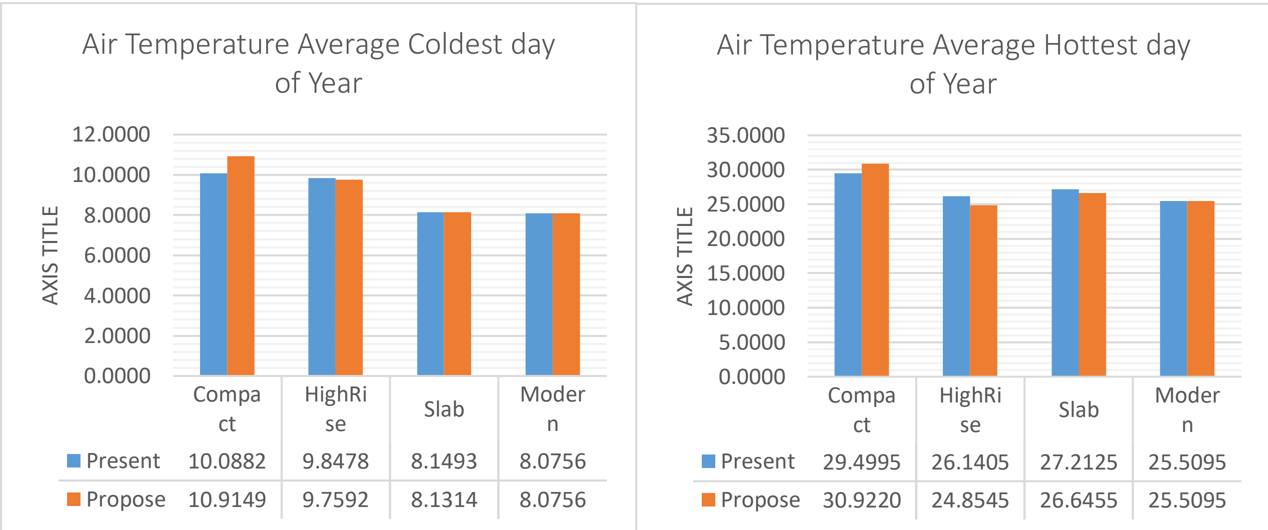
Table 4: Average values of climatic parameters in the proposed state of selected morphological species

		Average			
		Air Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)	Mean Radiant Temp. (°C)
S	Compact	28.40899	4.688771	44.93325	31.75774
	High-rise	29.26891	3.991398	97.15833	33.69603
	Slab	26.38822	4.712224	50.75422	31.94059
	Modern	26.55699	4.073839	92.03597	35.98799
W	Compact	9.921113	1.171855	93.92484	4.647842

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

High-rise	9.25403	1.230382	82.93256	5.211732
Slab	7.113113	2.694361	93.62897	1.510852
Modern	7.149346	1.63457	94.29731	1.628079

The specified average of the maximum and minimum values of each parameter in its respective position is compared with its counterpart in the proposed state in the form of bar graphs in order to change the amount of positive and negative effects of applying additional density on the selected forms. Created in the four micro-climatic parameters under investigation.

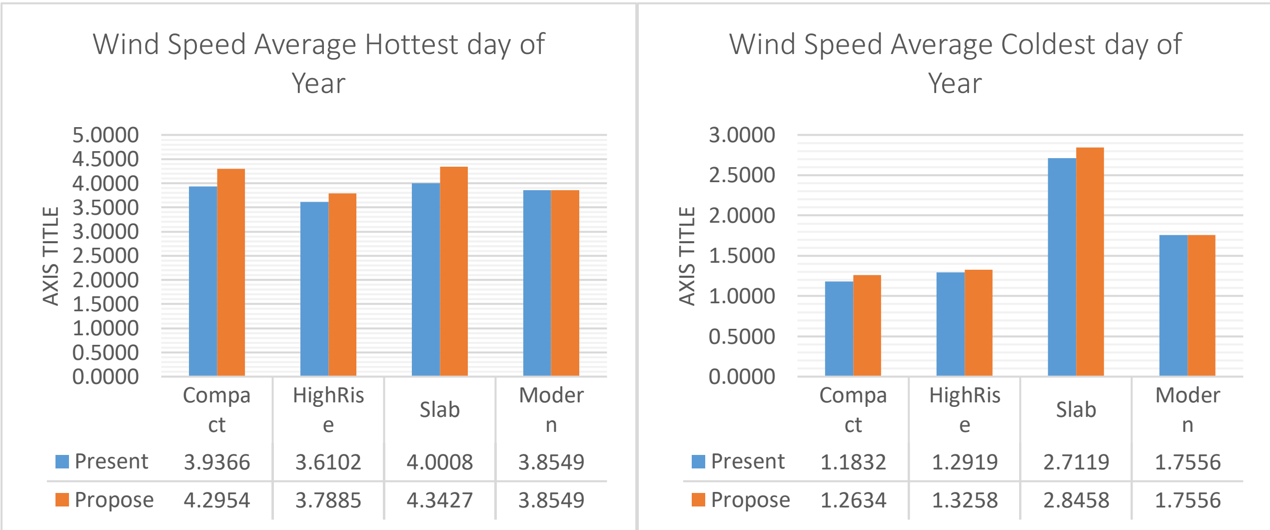


Charts 16 and 17: Comparison of the average air temperature of the existing situation with the proposed conditions on the hottest and coldest day of the year

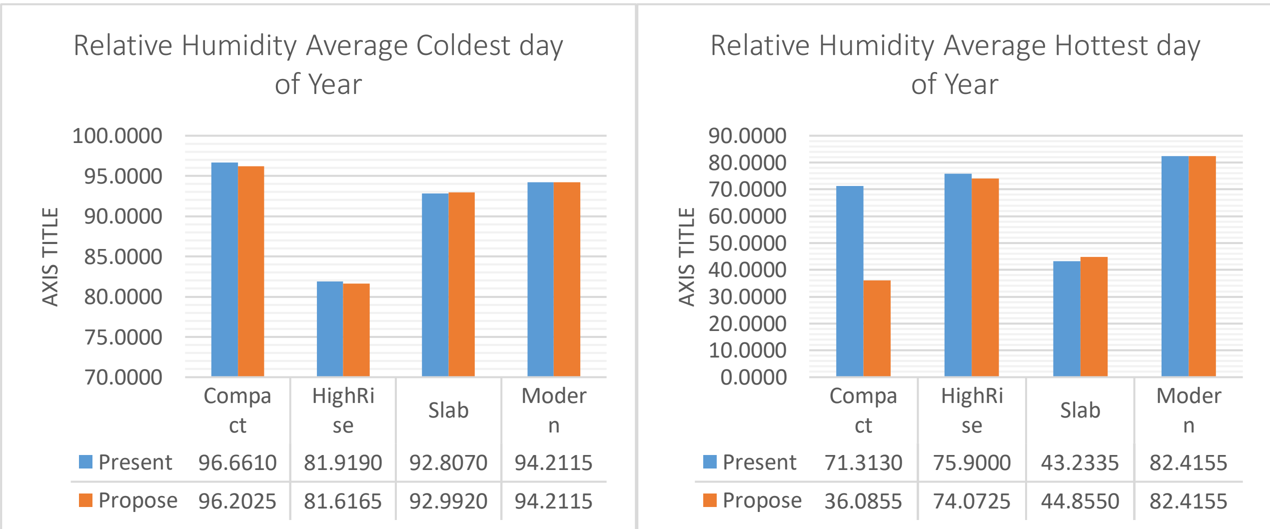
The comparison of the average changes in air temperature in the existing condition of the forms and the proposed state with more density, as it is clear in the above diagram, except in the case of the compact block form, in the rest of the cases or minor changes have been included. In the case of the compact apartment type, in both the coldest and hottest days, in the proposed model, we face an increase in temperature, which is less in colder and more than one degree in the heat. On a cold day, in the high-rise type, we have a temperature decrease of less than 0.2 degrees, and in the sheet type, it is less than that, but in the modern apartment type, we do not see a significant change in the air temperature. On the hottest day, both the leaves and high-ranking species have a decrease of 0.6 and 1.2 degrees, respectively, and the modern species remains unchanged. Considering the amount and type of energy required for buildings in the hot and cold seasons of the year as well as the approach considered in this research, the result of comparing the changes of this parameter shows the improvement of the heating energy

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

consumption in the compact type and on the other hand the improvement of the situation Thermal comfort in the hot season is at a high level. Of course, it can be acknowledged that the first case, in contrast to the optimal state in one season, brings negative changes in the other season as well. However, based on this comparison and considering only one parameter, it is not possible to comment on the rejection or approval of the overall positive or negative nature of the proposed changes.



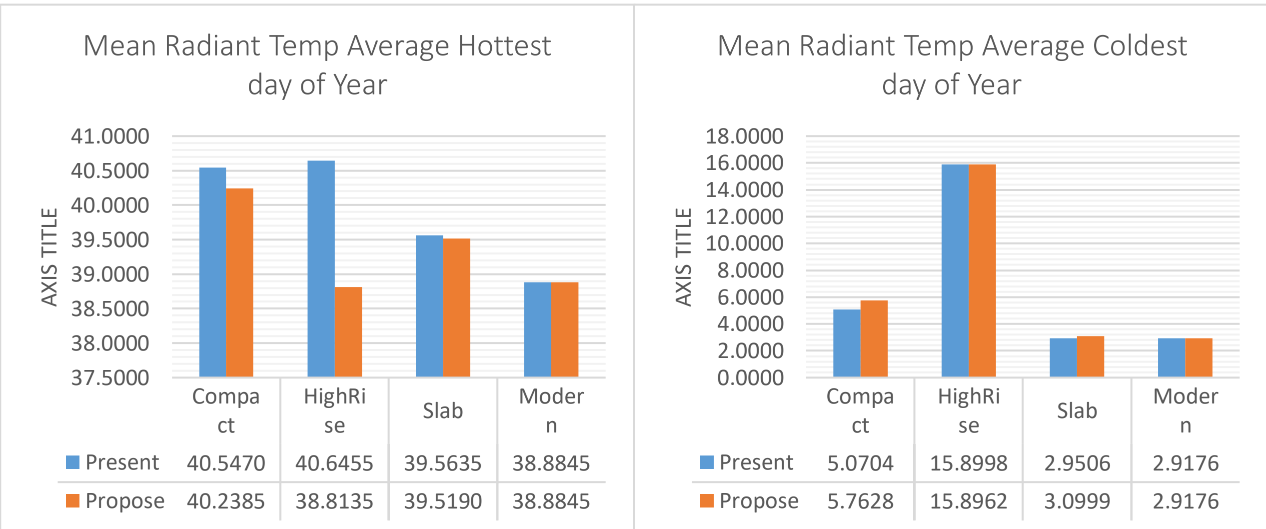
Charts 18 and 19: Comparison of the average wind speed of the existing situation with the proposed conditions on the hottest and coldest day of the year



Charts 20 and 21: Comparison of the average value of the relative humidity of the existing situation with the proposed conditions on the hottest and coldest day of the year

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

The changes in wind speed between the two existing and proposed states indicate that in the best case and only in one case, this rate has not changed and no improvement has been achieved. In other cases, it fluctuates with different amounts of increase. We see the highest increase in the hot season and in compact construction type. With this increase, the speed reaches more than 4, which is more than the desired limit. In other cases, the hottest day has also increased from 0.1 to 0.3. On a cold day, we can see an increase in wind speed with similar values in the proposed conditions for each of the shapes. The comparison of the changes in relative humidity between the current state and the proposed state shows that this parameter in the proposed state has a slight decrease in the compact construction type in the cold season and a significant decrease in the hot season, which is due to the adjustment of the average air temperature in this season. In this form, reducing the relative humidity is very desirable and will greatly help the energy efficiency. Other changes in the amount of relative humidity, except for the type of sheets in the summer season, which has an increase in the amount of humidity in the proposed state, are all associated with a decrease in the amount of relative humidity, which, as described, is on the way to achieving the goal. This is research



Charts 22 and 23: Comparison of the average value of the relative humidity of the existing situation with the proposed conditions on the hottest and coldest day of the year

The average radiation temperature obtained from the simulation in the current and proposed conditions shows us that the amount and type of changes applied to the high-ranking species had the best feedback regarding the changes in this micro-climatic parameter. Because in the hot season and in the proposed mode, we have the highest reduction in the average radiation temperature in the high order form. Another positive effect is in the cold season and the compact construction type, which increases the microclimate favorability in this type by increasing the average radiation temperature .In the table below, we can see the amount and

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

type of change of each parameter with the suggested mode. Of course, in parameters such as air temperature and average radiation, temperature, these changes have opposite differences compared to the cold and hot seasons.

Table 5: The number of changes in the average parameters between the existing state and the proposed state

		Difference			
		Air Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)	Mean Radiant Temp. (°C)
S	Compact	0.293755	-0.3757	32.74537	3.753006
	High-rise	2.241085	-0.18315	2.369569	2.542925
	Slab	-0.03411	-0.39764	-0.5683	-0.14165
	Modern	0	0	0	0
W	Compact	-0.57378	-0.0775	1.388458	-0.66755
	High-rise	0.111938	-0.03411	0.514493	0.026606
	Slab	0.017507	-0.12526	-0.27193	-0.13855
	Modern	0	0	0	0

Negative and positive numbers in this table indicate the type of change of each parameter. As indicated in the table, the number and amount of negative and positive changes for each form in hot and cold days in total indicate the type and total amount of changes resulting from the proposed situation in the microclimate adjacent to each form. Considering that the reviewed parameters do not have the same units, therefore, for ranking, the values in this table need to be scaled and then the ranking is done by calculating the overall result of the changes in each species.

Table 6: Scale-free state of changes in the average parameters between the existing state and the proposed state

		The rate of change in the scale-free state			
		Air Temperature (°C)	Wind Speed (m/s)	Relative Humidity (%)	Mean Radiant Temp. (°C)
S	Compact	1.142796	2.518582	7.241015	5.586099
	High-rise	8.718504	1.227779	0.523985	3.784973
	Slab	-0.13269	2.665699	-0.12567	-0.21084
	Modern	0	0	0	0

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

W	Compac t	-2.23219	0.519511	0.307031	-0.99361
	High-rise	0.435474	0.228694	0.11377	0.039601
	Slab	0.068109	0.839735	-0.06013	-0.20622
	Modern	0	0	0	0

By dividing each data by the total frequency of the corresponding column, we descale the values and, in the table, below, we use the collective result of the values related to each shape .for ranking

Table 7: Ranking the number of changes in the selected morphological species in the proposed state compared to the existing state

Rating of changes				
	Summer	winter	Total	
Compact	4.122123	-0.59981	1.761154	2
High-rise	3.56381	0.204385	1.884098	1
Slab	0.549124	0.160372	0.354748	3
Modern	0	0	0	4

As can be seen in the ranking, the high-rise building type has the most positive changes in the proposed conditions, and the compact types have lower values, respectively. Considering the low number of changes applied in the proposed model for the optimal state, the modern building type has a less added density than other types. Therefore, the changes due to this increase tends to zero. The absence of changes in this state is a positive sign and it indicates that with the increase of density in this species, although the density is low, the microclimate around it has not decreased in terms of desirability and has maintained its previous state. Practically, from another point of view, the results of the application of the optimal model in the case sample are generally due to the confirmation of the optimal function of the optimal model, which has resulted in 75% improvement and 25% microclimate stability. According to another interpretation, the application of the optimal model in the case sample, not only did not decrease the energy efficiency in any of the types, but in three quarters of the cases, it was associated with an indirect increase in the energy efficiency in the building blocks.

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

RESULTS AND CONCLUSION

Explanation of the model

In order to explain the model of sustainable urban design, in the first stage, sustainability as the starting point and the main model in the branch of urban studies and in the framework of the field of urban design has been investigated and by reviewing the literature on the subject, the sustainable urban form, which with the approval of the vast majority of thinkers, is the same compact urban form has been emphasized and the main focus of the research. Since the approach of the research is sustainability in the urban context, therefore, the scope of the focus is on the energy consumed by buildings, which is considered the most important factor of this matter. In energy consumption, the type of operational energy and finally the energy required for cooling and heating in the buildings that account for the highest amount of consumption have been taken into consideration. According to the final result and the explanations regarding the analysis and interpretation of the obtained results, it is clear and evident that the proposed model, which is the specific amount of density and the optimal occupancy level for the compression of the urban fabric, has positive effects in the direction of reducing energy consumption. Practically, by using this model, we will have the increase in density with the improvement of micro-climatic conditions. This means an urban design model that is based on a sustainable urban form (compact city) and results in reducing energy consumption. In fact, this model calls for some kind of method in the way of decision-making and decision-making, so that by placing urban design in the appropriate and desired part in the production of detailed plans and also setting the rules and standards of construction in urban areas, by applying the proposed model, the results of these major decisions should be guided towards sustainability and energy efficiency. Finally, based on the final evaluation of the proposed model, according to the variable number of floors, as well as the foundation of the scenario of building density and coverage level, it can be expressed as follows:

Table 8: The amount of building density and the number of floors suggested for the optimal base density model

Morpho-Type	The number of existing floors	The number of floors is optimal	The type of scenario used	Rate of change (height in meters)	The number of floors of the proposed model
Compact	8	12	Same BSC	12	12
High-rise	6	8	Same BSC	6	8

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

Slab	31	40	Same BSC	27	40
Modern	31	40	Same BSC	27	40

- The presented model, the type and method of using numerical data in the introduction of optimal states in the form of presented scenarios, this use is dependent on the knowledge of the studied platform, determining and correcting the form, as well as evaluating the existing and optimal state. It is suggested that if the results are confirmed in such a way that in this research all the mentioned paths were applied in the case study and the results were reflected, then the physical implementation of the model should be done. It should be noted that in each step of the practical steps of this design model, there are various states and conditions that need to be evaluated and investigated both in line with future research and in the way of completing this research. It is abundant.
- Based on this, the proposed model is presented as one of the modes of stability of the morphologies of the 2nd region of Tehran, and the structure of each of the morphologies is considered systematically based on the evaluation results. Explaining that in a systemic approach to urban textures, the explanation of the model based on the concept of density (compression pattern) can have countless states that each of the variables involved in urban morphology produces the number of its component units. It makes a state. Based on the following, the present result explains the foundation of a proposed model by considering the principles of urban density:

- Explanation of the optimal model is based on limited evaluation conditions. It means that the type of data under investigation is adapted based on mathematical concepts and geometrical principles.
- The impact of the proposed model in the field of urban design is taken as an intermediate scale from the scales of the sheriff's office of planning in an urban area. Therefore, the focus of the research results is based on a specific range in the middle scale.
- Based on the fact that evaluation limitations are considered as a common principle in morphological science, in the practical case of the proposed model, the structural requirement is that the application of the model and the policies resulting from it are done after the detailed plan segmentation process. takes for this purpose, the basis of the assumed model is not presented, but a new mechanism is proposed in determining the type of sustainability by using urban compression.

Finally, it can be stated that a sustainable urban design model based on the concept of sustainability can be formed when a compact urban form is applied in a developed manner in the context of morphology. With this in mind, in order to achieve a sustainable urban

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

design model, we first need to compress the urban form and create the principles of technology and policy, which is important in developing countries, especially in cities like Tehran, which have developed in a wide and horizontal manner. It is considered a new and innovative concept and in fact, after reaching the compression standard, it needs calculations and the involvement of other disciplines such as urban planning. Therefore, the conceptual mechanism of the article can be proposed based on the following steps:

- Compression pattern based on the principles of vertical urbanization.
- Compact urban form including regular forms
- Explaining policy making in the structure of the detailed plan
- Determining the segmentation of forms by urban planners
- Determining the initial density based on the basic calculations of urban planning science
- Determining the amount of building density based on the coverage level of each plot, including the number of floors

Based on this, as a suggestion for future researches, other possible states of the combination of evaluated and assumed fixed parameters and variables can be proposed. Researchers can continue this study and in order to complete and verify the obtained results, other morphological variables that have not been evaluated in this study and different adaptation modes with climatic parameters in order to achieve energy efficiency in the modes They should investigate that the change in the level of building cover, the effects of the direction of roads, the direction of mass, vegetation and materials can be the most important of these variables.

REFRENCES

1. Ejiagha, I.R.; Ahmed, M.R.; Hassan, Q.K.; Dewan, A.; Gupta, A.; Rangelova, E. (2020) Use of Remote Sensing in Comprehending the Influence of Urban Landscape's Composition and Configuration on Land Surface Temperature at Neighborhood Scale. Remote Sens., 12, 2508. DOI:10.3390/rs12152508
2. Huang, Z.; Wu, C.; Teng, M.; Lin, Y. (2020) Impacts of Tree Canopy Cover on Microclimate and Human Thermal Comfort in a Shallow Street Canyon in Wuhan, China. Atmosphere, 11, 588 DOI:10.3390/atmos11060588
3. Jamei, E. Rajagopalan, P. Seyedmahmoudian, M. and Jamei, Y. (2015). "Review on the impact of urban geometry and pedestrian level greening on outdoor thermal comfort," Renew. Sustain. Energy Rev., vol. 54, pp. 1002–1017, 2016, DOI: 10.1016/j.rser.2015.10.104.
4. Khatana, S.A.M.; Werner, R.M.; Groeneveld, P.W. (2022) Association of Extreme Heat with All-Cause Mortality in the Contiguous US, 2008–2017. JAMA Netw. Open 2022, 5,

Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

e2212957. DOI:10.1001/jamanetworkopen.2022.12957
5. Krüger, E. L. Minella, F. O. and Rasia, F. (2010). "Impact of urban geometry on outdoor thermal comfort and air quality from field measurements in Curitiba, Brazil," Build. Environ., vol. 46, no. 3, pp. 621–634, 2011, DOI: 10.1016/j.buildenv.2010.09.006.
6. L. G. R. Santos, I. Nevat, G. Pignatta, and L. K. Norford. (2021). "Climate-informed decision-making for urban design: Assessing the impact of urban morphology on urban heat island," Urban Clim., vol. 36, p. 100776, Mar. 2021, DOI: 10.1016/j.uclim.2021.100776.
7. Ma, R. Li, X. and Chen, J. (2021). "An elastic urban morpho-blocks (EUM) modeling method for urban building morphological analysis and feature clustering," Build. Environ., vol. 192, 2021, DOI: 10.1016/j.buildenv.2021.107646.
8. Morris, C. & Pehnt, M. (2015). Energy Transition the German Energiewende. Heinrich Böll Foundation, (Accessed 21 August (2015).
9. Mumtaz, F.; Tao, Y.; De Leeuw, G.; Zhao, L.; Fan, C.; Arshad, A. (2020) Modeling Spatio-Temporal Land Transformation and Its Associated Impacts on land Surface Temperature (LST). Remote Sens. 2020, 12, 2987. https:// DOI.org/10.3390/rs13010061
10. Qiu, C.; Mou, L.; Schmitt, M.; Xiang, X. (2019) Local climate zone-based urban land cover classification from multi-seasonal Sentinel-2 images with a recurrent residual network. ISPRS J. Photogramm. Remote Sens., 154, 151–162. DOI:10.1016/j.isprsjprs.2019.05.004
11. Rodríguez Algeciras J. A. and Matzarakis, A. (2016). "Quantification of thermal bioclimate for the management of urban design in Mediterranean climate of Barcelona, Spain," Int. J. Biometeorol., vol. 60, no. 8, pp. 1261–1270, 2016, DOI: 10.1007/s00484-015-1121-8.
12. Sun, X.; Tan, X.; Chen, K.; Song, S.; Zhu, X.; Hou, D. (2020) Quantifying Landscape-Metrics Impacts on Urban Green-Spaces and Water-Bodies Cooling Effect: The Study of Nanjing, China. Urban For. Urban Green., 55, 126838. DOI:10.1016/j.ufug.2020.126838
13. Wang, Y., & Zhang, L. (2016). Shape optimization of free-form buildings based on solar radiation gain and space efficiency using a multi-objective genetic algorithm in the severe cold zones of China. Solar Energy, 132, 38-50.
14. Yao, J. (2012). "Energy optimization of building design for different housing units in apartment buildings," Appl. Energy, vol. 94, pp. 330–337, 2012, DOI: 10.1016/j.apenergy.2012.02.006.
15. Zaki, S.; Azid, N.; Shahidan, M.; Hassan, M.; Daud, M.; Abu Bakar, N.; Salim, S.A.Z.S.; Yakub, F. (2022) Analysis of Urban Morphological Effect on the Microclimate of the Urban Residential Area of Kampung Baru in Kuala Lumpur Using a Geospatial Approach. Sustainability, 12, 7301. DOI:10.3390/su12187301

Power System Technology
ISSN:1000-3673
Accepted: 28-06-2024 Revised: 15-05-2024 Received: 06-04-2024

16. Zawadzka, J.E.; Harris, J.A.; Corstanje, R. A. (2021) Simple Method for Determination of Fine Resolution Urban Form Patterns with Distinct Thermal Properties Using Class-Level Landscape Metrics. Landsc. Ecol., 36, 1863–1876. DOI:10.1007/s10980-020-01156-9
17. Zhang, Y.; Wang, Y.; Ding, N.; Yang, X. (2023) Assessing the Contributions of Urban Green Space Indices and Spatial Structure in Mitigating Urban Thermal Environment. Remote Sens., 15, 2414. https://doi.org/10.3390/ rs15092414