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Case Study

Investigating the Impact of Local Streets Edge Geometry on Reducing the Energy Consumption of Residential Buildings

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ABSTRACT: Geometric features and horizontal arrangement of buildings on the site are among the items that have been studied in evaluating the amount of energy consumed in interior spaces. Among these cases, we can mention the street edge line as the regulator of these parts and the border between urban and private space. This study examines the effect of these depressions and protrusions of building components at the edge of local passages on the amount of heating and cooling energy consumption of residential units by keeping the rest of the components constant and focusing on the geometric features of the road network. In this study, a residential area in one of the old neighborhoods of Isfahan, which is organically formed and has a suitable distribution in terms of changes in the edge, was selected due to its location in hot and dry climates. Then, the existing buildings in two retreat modes, one based on the existing edge line and the other straight line, in order to equalize the conditions, the heating and cooling energy consumption of each were modeled to determine the effects of light access and shading on each other. According to the results, the total energy consumption, including heating and cooling energy, is 11% less in buildings with irregular edges than in buildings with smooth edges and identical edges. These results show the effect of street edge geometry as one of the physical features of roads in optimizing energy consumption.

Keywords: Energy efficiency, street edge geometry, local passages, urban blocks, energy consumption

RUNNING TITLE: Impact of Local Passages Edge Geometry on Reducing the Energy Consumption

INTRODUCTION

In response to the emergence of the complexities of the city and the aggravation of the environmental problems of the city, sustainable development was raised and the attention of urban planners and designers was focused on sustainable cities. Meanwhile, optimizing energy consumption in cities that are the main consumers of energy, received a lot of attention. Urban warming, the creation of thermal islands, ecological changes, environmental pollution, floods, etc., are the consequences that the structure of today's cities have caused by the ecological changes that they have created in their environment. According to researches, the structure and form of cities have been influential factors in this field. In this regard, it is very important to study the form and structure of street edge formation, which are the common border between public and private spaces. The concept of street edge has been proposed as a set of lines that show the depressions and protrusions of building

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This article extracted from Foroogh madani esfahani Ph.D. thesis in the title of "The analytical model of the Climate resilient urban form Based on Concepts of Islamic City (Case Study: Tabriz City)" by supervisions of Dr Y. Shahbazi and Dr. M. Mirgholami in Department of Architecture and Urban Planning Faculty, Islamic Art University of Tabriz, Tabriz, Iran components and the distance between them (Cooper, 2005). What seems necessary is to pay attention to the organization and design of street edges both as a part of the body of urban space and as a regulating factor to the built spaces in terms of creating climate comfort and optimizing energy consumption. According to the research topic, the effects of street edge geometry on energy consumption can be studied in two areas: geometry and physical characteristics of roads and morphology of urban blocks. The network of passages as one of the main components of the city, which forms the skeleton of the city and the axes of development and systematizes urban forms, can be effective in optimizing energy consumption in various aspects. The network of passages can be effective in the amount of consumption in buildings by shaping urban blocks and their geometric characteristics. Focusing on urban heating, these studies examine the physical characteristics of streets, including enclosure, orientation, access to sunlight, and sky view factor (Shishegar, 2013; Bourbia and Boucheriba, 2010; Ali-toudert and Mayer, 2006, 2005; Johansson, 2006). On the other hand, many studies have been conducted on the effect of urban morphological features on energy consumption at various scales. These studies, which have examined the general form of the city to a single building, include variables such as density, urban fabric compaction, horizontal and vertical arrangement of parts, elevation system, orientation, building surface coverage and construction types as effective factors in terms of energy consumption, interior spaces have been extracted (Zhang et al, 2017; Okeil, 2010; Compagonon, 2004; YangJin and Dong-Wook, 2019,). However, most studies to investigate the effects of geometry of blocks and parts in optimizing internal energy consumption, have not paid attention to the guiding and regulating role of street edge geometry in the horizontal arrangement of parts and building blocks are considered separately from the surrounding passages. The aim of this study is to study the passages that are located in organic textures and have irregular edges and depressions and protrusions that are created by buildings. In most comprehensive plans for some cities in Iran, in order to improve the width of the road network, retreats have been made and the new edge of the road is marked as a straight line for both sides to the width defined for the road. Given that this research is conducted on an urban scale, in order to investigate the effect of volumetric changes in the urban wall by the plan lines of building parts on the amount of shading and energy consumption, the volumetric changes of a single building in the wall of the passage, which is considered in the architectural scale, have been ignored. Due to the general nature of the research and the methods of analysis and evaluation, this research is among the quantitative researches and in terms of purpose is practical. In the first stage, this research seeks to find the physical components affecting the optimization of energy consumption, and in the next stage, the effect of street edge geometry on the energy consumption of residential spaces is analyzed and evaluated. For this purpose, according to the studied variable, which is the amount of changes in the street edge, a local east-west passage was selected in one of the old neighborhoods of Isfahan, which has not yet retreated.

Sustainable urban development and energy

Attention to environmental issues became so prevalent in the late 1980s and 1990s that some theorists revised and supplemented their proposed principles. Ian Bentley, for example, wrote an article on environmental considerations entitled "Ecological Urban Design" and presented three criteria: energy efficiency, cleanliness, and support for ecosystems. According to him, there are two important factors related to energy efficiency. One is to reduce the energy required for construction and consumption, and the other is to increase the consumption of available energy, especially solar energy. Among the qualities that can be effective in energy efficiency are flexibility, mixed use, cleanliness, compact forms (Bentley, 1999, 69-91).

Major factors of energy consumption in urban environment

In order to achieve the goal of reducing energy consumption in the city, first, energy consumption factors in the city must be identified and introduced.

Steemers considers industry, construction, and transportation to be the three main pillars of energy consumption (Steemers, 2003).

In another definition, based on the forms of energy consumption, there are three types of energy consumption in the city, which are:

Embede energy: consists of all energy inputs required in the production of primary housing materials, as well as energy used in production facilities and transportation of natural resources and final goods (construction, materials, maintenance).

Operational energy: Operating energy for any building (residential and non-residential) includes energy used for cooling, heating, lighting and home appliances.

Transport energy (energy): energy used by public and private vehicles.

City form and energy consumption

With the implementation of policies, the scientific support needed to estimate the success of a variety of sustainable urban forms was provided to some extent. But despite the existence of appropriate implementation examples, discussions in this field, regardless of the necessary research, have been more in the form of support for this view and have led to many positive claims about the effects and benefits of various urban forms. The European Commission has been one of the first and most influential advocates of restricting urban development and creating more intensive urban forms. It was assumed that urban compact form species; Reduce urban sprawl, protect service and agricultural lands, Lead to the optimal use of existing and previously developed urban land. With the mixing of uses, their proximity to each other, different types of city trips such as walking and cycling have been encouraged and the use of public transportation has also increased. In addition, it has environmental, social and economic benefits.

Reti et al. (2005) in an article have examined the effects of urban fabric on the amount of energy consumption by the building. In which the model (DEMS) in combination with the analytical model (LT) compares the three cities of London, Berlin and Toulouse. This study considers 4 factors affecting the amount of energy consumption in buildings; the geometry of the city, building design, system performance and lifestyle of the inhabitants. Finally, by examining the parameters of urban fabric on energy consumption instead of the parameter of surface to volume ratio, the ratio of inactive to active ranges has been proposed (Ratti et al, 2005). In 2012, Liu & Sweeney conducted a study on household energy consumption for space heating and city and building form, which compact houses with smaller parts use less energy for heating than scattered structures and large parts (Liu & Sweeney, 2012). By dividing the city into two main components, mass (buildings) and space (road network), the studies on the effect of their geometry on energy consumption can be examined in two groups.

Physical form of building and energy consumption

Among the studies on the relationship between energy consumption and the geometry and physical form of the building, we can mention Steamers (2003) who divided the three main pillars of energy consumption in the city into industry, transportation and construction. Examined residential and office buildings in the UK and listed the factors influencing energy consumption: building type, building orientation, population density, building density and depth. Oakil also researched the optimal form of building and efficiency in terms of energy consumption in 2010. In this study, he presents the proposed form of solar building block (RSB) for maximum efficiency of solar energy in winter and summer (Okeil, 2010).

Regarding the studies done in the middle scale (neighborhood unit), the research done by Kempgenon can be done research in the scale of building blocks, which building density, placement, horizontal and vertical layout of buildings extracted as factors affecting access to sunlight (Compagonon, 2004). Cheng et al. (2006) by examining the three factors of horizontal and vertical layout of parts, construction area to piece ratio and site occupancy, concluded that daylight performance and the potential to benefit from solar energy in fabrics that have an irregular horizontal and vertical arrangement with less occupancy and more open space is more than the others (Cheng et al, 2006). Another variable that is an effective factor in absorbing solar energy and shading is the type of shape and orientation of urban blocks in the middle scale (Arboit et al, 2008). Also, the position of neighborhood units and the building mass pattern affect not only the access to sunlight but also the patterns of air flow and wind speed (Hachem et al, 2012; Sanaieian et al, 2014).

On a smaller scale, the location of buildings on a site that includes the orientation and distance of buildings from each other is very important in terms of adequate access to sunlight; In this regard, Ko (2013) by examining the research on the relationship between urban form and household energy consumption, the effective variables are the type of construction, density, arrangement of parts and surface coatings such as vegetation (Ko, 2013). In 2013, Martin et al. Introduced factors such as the average height of the building, the ratio of open and built space to the total area of the complex, as well as the amount of external surfaces associated with air as morphological variables affecting energy consumption in residential buildings. (Martins et al, 2013).

Other research in this field includes the project to study the impact of urban form on the scale of neighborhood units on residential buildings in Seattle. In this study, by examining the three variables of horizontal compaction, vertical density and amplitude of height changes, it was concluded that the annual energy consumption of multi-family buildings decreases with increasing horizontal density and decreasing building height changes (YangJin and Dong-Wook, 2019).

In micro and single scale, orientation, building elongation, number of floors, window area, type of canopies are known as architectural variables on building energy consumption. (Nasrollahi, 1393). Michel also in 2005 examined the relationship between urban development, form and energy consumption in buildings, 8 factors of urban geometry, building morphology, thermal performance of materials, efficiency of internal systems and equipment, type of activity, fuel price, infrastructure and internal and external temperature Introduced the building as effective factors on energy consumption at the scale of building units (Mitchell, 2005). Also in a 2017 study by Zhang et al. On China's cold climate the geometric parameters of the building in energy consumption were studied (Zhang et al, 2017). Other people who have studied the effect of building geometry on energy consumption in the city include (Okeil, 2012; Yangand li, 2011; Haukes and Foster, 2002; Van escha, 2012).

Passage network and energy consumption

The urban access network is one of the components of the city form that forms the urban structure and covers about a quarter of the city level. Different spaces and elements in cities are connected to each other by the network of roads and communications, and citizens mobilize the city through communication networks. Depending on the various factors, the road network also includes various types. In a 2009 study, Borbia examined the relationship between street design and micro-climate in the city, and geometric parameters such as height to width ratio, sky view factor and street orientation. The main factors in the amount of solar energy reception and its reflection and the geometry of open spaces on a micro scale have been introduced as the most important and influential factor in the microclimate. Also, from the research results, we can point to the direct relationship between the amount of sky view factor and the inverse relationship between the ratio of height to width with the amount of microclimate temperature. Shafaqat et al. (2017) have also studied the effect of geometric features of the road network on the urban microclimate and thermal islands. In this study, 27 criteria in the form of three categories of geometric criteria, climatic criteria and street landscape criteria have been studied that geometric criterion with a very small difference had the least impact on microclimates compared to the other two categories. In another study, Wang and Al-Namir (2012) sought to explain the relationship and the effect of different street geometries in order to reduce energy consumption in the building using energy simulation software. This study examines the three cities of Beijing, Shanghai and Hanzhou, and the different effects of geometric criteria in different climates. The main focus of this article is on the degree of confinement or the ratio of height to width of the street.

Since then, several studies have been conducted on the relationship between urban form and the category of thermal comfort, among which a number of projects have focused on urban canions and the effect of wall form and orientation on the micro-climate of roads. Ali Tudert and Meyer (2007-2006) used the ENVI-met model to simulation the thermal comfort of an urban outdoor space and considered the effect of different orientations. According to their findings, pedestrians in passages with east-west orientation suffer the highest thermal stress compared to other orientations and with increasing the ratio of height to width of passages, the air temperature gradually decreases; In addition, they examined the effect of different sections of the urban road on the quality of road comfort in different orientations and with different degrees of confinement (Ali-tourdert and Mayer, 2007,743).

Taleghani et al. (2014) modeled the east-west and north-south roads in the Netherlands on the hottest day of the year using ENVI-met software and calculated air temperature, average radiant temperature, wind speed and relative humidity with this software. The results showed that the average radiant temperature plays the most important role in the quality of thermal comfort (Taleghani et al, 2014, 10). Studies by Kruger et al. (2011) simulated using ENVI-met software and field survey in Brazil examined the effect of road orientation relative to prevailing winds and its effects on wind speed and spatial turbulence (Kruher et al, 2011, 621-634).

The results showed the effects of the passage geometry on the thermal comfort of the pedestrian. Studies on the geometry of urban thoroughfares generally confirm the significant effect of orientation, extent of enclosure, the amount of vegetation use and the cross-sectional shape of the road on the quality of thermal comfort of pedestrians in urban thoroughfares.

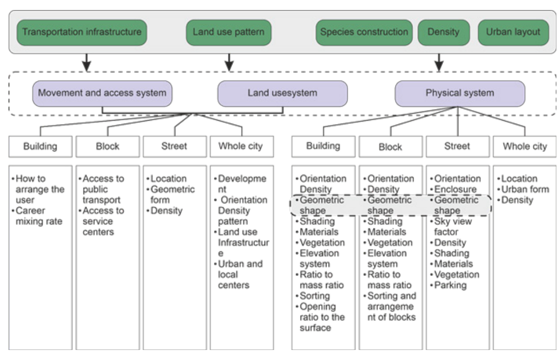
Tab 2: Research on the effect of geometric features of city form on energy consumption

	Auther	Year	Scale	Variables
Mass (Neighborhood unit, block, building)	Reti et al	2003	micro	Configuration and construction pattern, building surface ratio, amount of shadow, amount of daylight, sky view factor
	Compgnon	2004	meso	Building density, placement, vertical and horizontal layout of the building
	Heng et al	2006	meso	Horizontal and vertical layout of parts, construction area to piece ratio, site building surface ratio
	Arbit et al	2008	meso	Block shape, block orientation
	Salat	2013	macro	Composition and structure of the building mass, street network, active volume, opening to the street
	Taleghani et al	2013	micro	Building surface to volume ratio
	Ko	2013	meso	Orientation and distance of buildings from each other, type of construction, density, arrangement of parts, surface coverage
	Sanaiyan	2014	meso	Spatial position, building mass pattern
	Nasrolllahi	2015	micro	Orientation, building elongation, number of floors, window area, type of canopy
	Yang Jin & Dang Wook	2019	macro	Horizontal compaction, vertical compaction, elevation changes

Space (Passages, open spaces)	Janson	2006	macro	Enclosure, sky view factor, geometry
	Toudert & Mayer	2006	meso	Enclosure, orientation, street cross-section geometry
	Borbia and Butcher	2009	macro	Enclosure, orientation, sky view factor, geometry of open spaces
	Krueger et al	2011	macro	Orientation
	Wang and Alnimer	2012	macro	Enclosure, street cross-section geometry
	Van Sche et al	2012	macro	Orientation
	Taleghani et al	2014	macro	Orientation
	Shafegat et al	2017	meso	Enclosure, geometry, landscape
	Liang et al	2017	macro	Orientation

Along with the sustainable development approach and the role of energy in the survival of cities, various theorists in the field of urban planning have studied the relationship between energy and sustainable development, among which research has been done on how the urban form affects energy consumption and environmental reflections. Using the relationship between city form and sustainability, Jenks and Jones (2010) divided the effective elements of city form into five categories: density, type of construction, user pattern, urban layout, and transportation infrastructure. As mentioned in the research background, the studies can be divided into three main categories. Studies related to city form and energy efficiency, the impact of energy consumption and physical characteristics of buildings on a scale of single buildings and building blocks and studies related to passages and energy that are analyzed from both aspects of transportation and geometric features. Have been reviewed. According to this classification and the focus of this research, the geometry of the street edge as a common boundary between the street and urban blocks can be placed in both street and block categories. What is more, based on the collected information, this component has been studied in the literature and research background as a subset of morphology and typology of building blocks in micro scale and as an independent factor in urban scale and part of urban street space. Which forms and regulates building masses has not been proposed. On the other hand, the geometric component of the street edge includes four main variables, irregularity and fracture of lines due to depression and protrusion of parts, second width of construction parts, third type of construction and fourth distances between parts, which includes empty lands and access roads. (Cooper, 2003)

In this study, to investigate the effect of street edge fracture as an independent variable on energy consumption as a dependent variable, the other three variables that constitute a fixed street edge are considered. Figure 1 shows the general research process and the components studied in each section according to the literature, background and purpose of the research.



Tab 2: Components affecting energy consumption in the city

MATERIALS AND METHODS

Considering that the main purpose of the research is to measure the amount of energy consumption inside the building and its relationship with the geometric feature of the street edge, as well as considering new versions and having comprehensiveness and upgradeability as well as the possibility of optimization, in this research software Grace Hopper and related plugins are used. This software is more accurate while connecting to different software and at the same time provides more features to the user, however, due to the nature of programming, it also has complications.

Today, Rhino and Grace Hopper have been used by many designers in various fields as an extensive parametric software platform. Grace Hopper is a visual programming language that runs in the Rhino program. Grace Hopper is mainly used to create productive algorithms. Many Grace Hopper components create two-dimensional, three-dimensional geometries and a variety of numerical, textual, audio, and visual algorithms. In this program, data is transmitted in detail through a wire connection, which is always by taking the output of the command and connecting it to the input of the next command.

Ladybug and Honeybee plugin

Older energy analysis software has only discussed energy analysis and has had weaknesses in the field of optimization and design options, which Honeybee and Ladybug softwares have tried to eliminate this weakness and are of great help. Plans to improve. Ladybug is a plugin for analyzing the initial design process including weather information, shading, solar energy measurement, thermal comfort measurement, psychrometric diagrams and generalities that can help in the first design process. Ladybug easily imports standard weather information in EPW format into Grace Hopper, providing designers with a variety of legible and versatile 3D graphics in the decision-making process.

Other Grace Hopper energy plugins include Honeybee, which connects to Energy Plus, Radiance, D-SIM and Open Studio, providing a powerful space for the user and designer. Hani has no plug-ins for light and daylight analysis, modeling to optimize energy consumption, thermal simulation and building loads, cost estimation, creation of executive wall details, type of mechanical system, schedule and type of activity and all Includes details for simulating and optimizing building energy consumption.

The advantage of this program over other programs can be expressed in several ways; First, the parametric mode of Grace Hopper allows the user to optimize the design. Second, Hani Bey plugin, by connecting to different energy motors, offers all the capabilities of these softwares in the form of a single program, which minimizes the amount of errors. Third, the Ladybug plugin facilitates and accelerates the analysis and evaluation process by providing climatic information and specifications of the study area, and finally, the variety of outputs of this program makes it one of the most efficient programs in the field of energy analysis. Has done.

In this study, in order to investigate the effect of street edge geometry on the energy consumption of residential spaces, two categories of information are entered into the software. The first series includes the required data in software icons such as Activity and Opening and the second part includes the information used by design for the modeling part, a case sample is simulated, a part of which includes the building elongation and plan of parts and use is taken from the existing sample and the number of floors is considered in order to keep the variable constant. At the end, the results were presented in the form of graphs and tables.

Software data

Climate data:

Climatic data that includes the type of climate in different seasons, the angle of sunlight, the amount of humidity and precipitation, etc. are read in the form of .epw file according to the geographical location. In this study, the climatic site of Iran - Isfahan is selected.

Building performance:

In this section, the type of use of the building is determined so that at the time of data analysis, the type and amount of work and activity performed in accordance with the use of the building, which is considered as a residential use research (apartment).

Building materials and structure:

In Hani Bey program, there are two methods to determine the materials of a building, one is to define the materials and the thickness of the layers for different parts and the other is to use the existing standards based on geographical area. Suitable materials were determined for different levels.

Heating, cooling and air conditioning system:

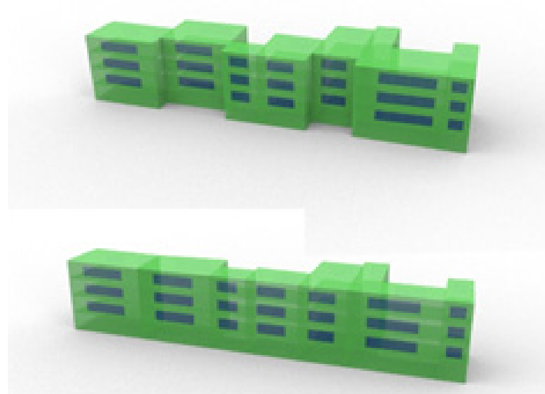
In this part, natural ventilation was used for air conditioning, which means natural ventilation, and heating and cooling systems were used for temperatures higher than 28 degrees and less than 20 degrees.

Data used in software design

In this study, using the existing maps of Isfahan, 7 residential license plates of a local passage in the area of Qasr Shams Abad, which had a significant protrusion and retreat, were selected. The selected buildings have a north-south extension and have two sides, north and south, and in order to neutralize the effect of the floors and its shading, the number of floors was considered in accordance with the approved detailed plan for the area, i.e., three floors on the pilot.

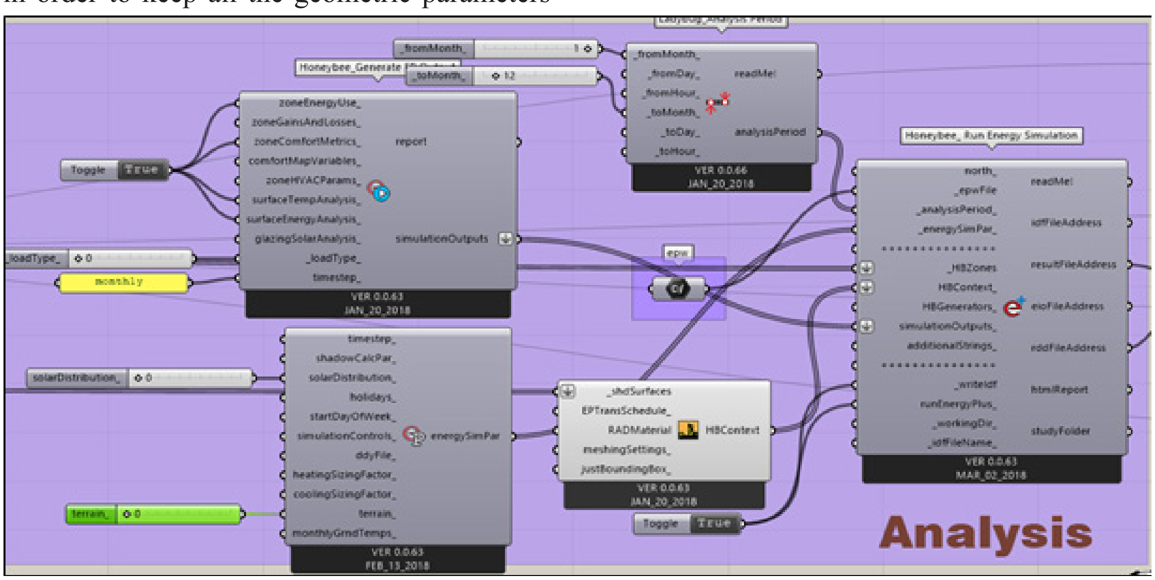
Modeling process and evaluation algorithms

In the first stage, the selected units, which included 7 building plates, were selected and in order to keep all the geometric parameters constant, all of them had a height of 12 meters by default, 4 floors, which were the ground floor of the parking lot and the other 3 residential floors. The selected buildings were modeled in the Rhino software environment and entered the Grace Hopper programming environment. In the second stage, the studied thermal zones, which were one zone for each floor, were defined and its physical plan, which was the use of a residential apartment, was also determined.



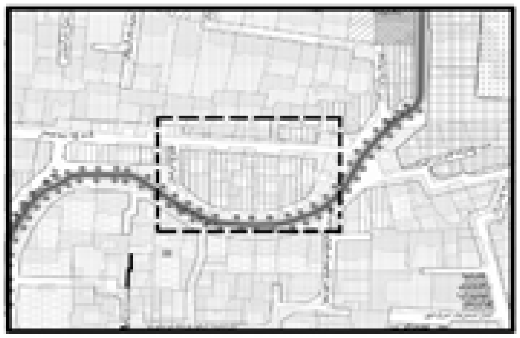
Tab 2: 3D modeling of case samples

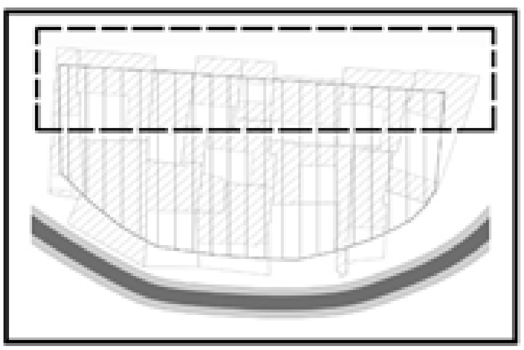
In the third stage, the material used according to ASHRAE 90.1 standard for the geographical area of Isfahan was determined in the desired condition, and in the fourth stage, the size of the openings in the north and south walls were designed equally for all units with a



Tab 2: Energy consumption evaluation algorithm

constant ratio of wall area. In the fifth stage, thermal loads and heating, cooling, lighting and ventilation systems for residential units were defined according to the thermal comfort range of 20 to 28 degrees Celsius and the use of "Ideal Air Load" system. In the last step, by entering the weather information and modeling in the Run Energy Simulation toolbox and also specifying the shading volumes on the thermal zone, the amount of energy consumption in the form of total energy consumption, cooling energy consumption, heating energy consumption is analyzed and evaluated. And its output is shown as a bar graph for 12 months.

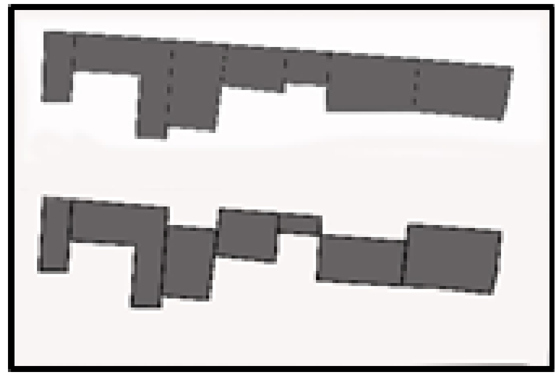




Tab 2: Position of the studied sample on the site

Case studied

In this study, in order to investigate the effect of street edge geometry on energy consumption, a local passage in the old neighborhood of Qasr Shams Abad in Isfahan, which had the desired characteristics in the study was selected. This range was selected based on the scatter of the studied variable, ie the amount of lag and protrusion of the plan of the parts at the edge of the passage and the same north-south orientation of all parts according to keeping the radiation angle constant. Due to the small width of the passage to achieve good sunlight, this sample was examined in two modes, one retreat on a straight line and the second retreat while maintaining the rhythm of changes at the edge. For this purpose, the southern parts of the passage with a facade were selected and by default, the maximum infrastructure and building surface ratio were considered for each. Figure 1 and 2 show the position on the site, the current status and the two statuses under review.



Tab 2: Examined samples after retraction on a straight and toothed line

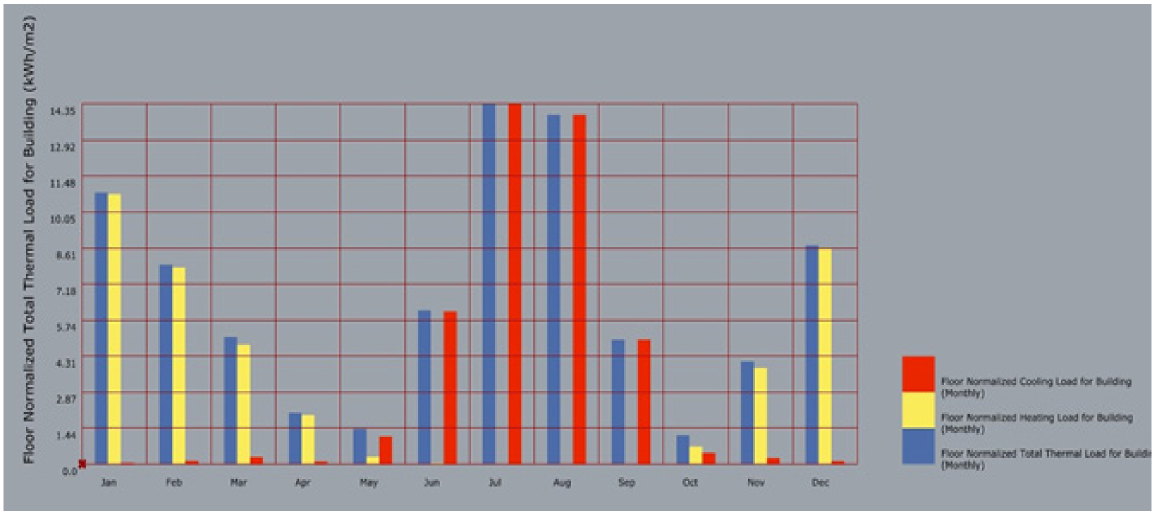
RESULT AND DISCOTION

What was obtained from the results of this evaluation on average per square meter is shown in Tables 2 and 3. According to the results, energy consumption per square meter in serrated edges was 80.64 and for smooth edges was 88.92 with a difference of about 8.3 kWh for a residential unit. With an area of 120 square meters, this figure is about 996 kWh per year, which is a significant figure.

Tab 2: Energy consumption values for serrated edge

energy	Jan	Feb	Mar	Avr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating energy consumption (kwh / m2)	10.76	7.83	4.76	1.95	0.29	0.03	0	0	0	0.71	3.84	8.61	38.82
Cooling energy consumption (kwh / m2)	0.5	0.11	0.29	0.09	1.11	6.09	14.35	13.92	4.96	0.44	0.25	0.11	41.82

Total energy consumption (kwh / m2)	10.81	7.95	5.06	2.05	1.4	6.13	14.35	13.92	4.96	1.15	4.09	8.72	80.64

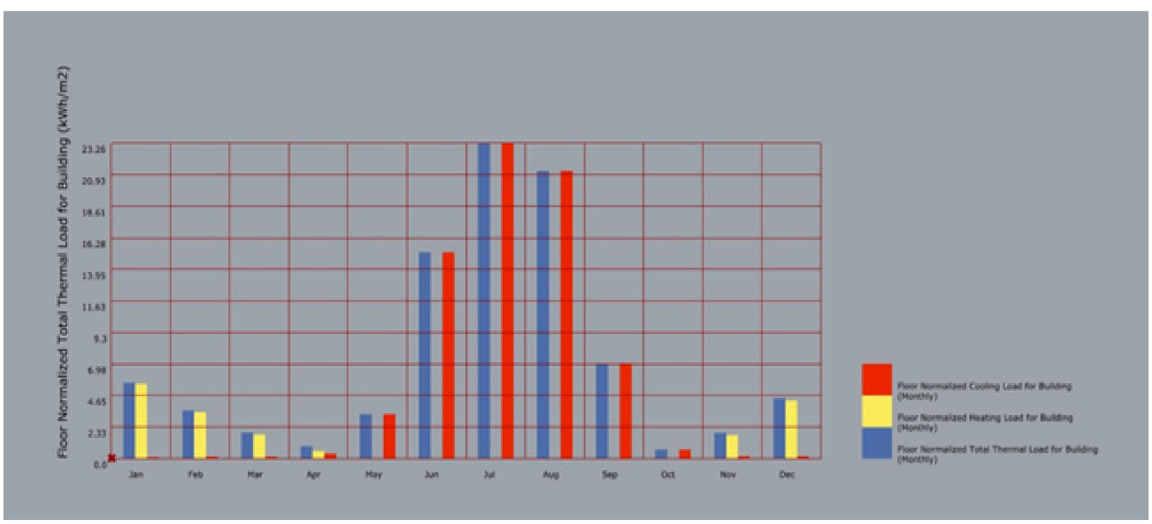


Tab 2: Cooling, heating and total energy consumption for the toothed edge

Tab 2: Energy consumption values for smooth edge

energy	Jan	Feb	Mar	Avr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Heating energy consumption (kwh / m2)	5.51	3.41	1.77	0.55	0.006	0	0	0	0	0.01	1.72	4.28	17.28
	0.08	0.14	0.13	0.36	3.25	15.21	23.25	21.20	7.00	0.64	0.16	0.15	71.63
Cooling energy consumption (kwh / m2)	5.60	3.55	1.90	0.92	3.26	15.21	23.25	21.20	7.00	0.65	1.89	4.44	88.92

What is significant is this amount of difference in energy required to cool the environment, and as shown in Table 3, flat-edged buildings require less energy for heating due to full sunlight in winter and less energy in summer due to lack of shade. Launching requires significant cooling energy.



Tab 2: Consumption of cooling, heating and total energy consumption for a smooth edge

According to the obtained results and their comparison, as shown in Table 4, the amount of energy consumption required for space heating at irregular edges has increased by about 22%, while the amount of cooling energy at irregular edges compared to Smooth edges have decreased by 17%, which is about 30 kWh per square meter per year, which is 21.5 times higher than the increase in heating energy. Finally, it can be concluded that the total energy consumption of smooth edges About 1.1 times the irregular edges. This means that buildings with smooth edges consume more energy at a rate of 8.28 kWh per square meter per year.

Tab 2: Comparison of energy consumption in the two cases studied

	Heating energy consumption in one year (kwh / m2)	Cooling energy consumption in one year (kwh / m2)	Total energy consumption in one year (kwh / m2)
Parts with smooth edges	17.28	71.63	88.92
Parts with irregular and serrated edges	38.82	41.82	80.64
The amount of difference	21.54	29.81-	8.28-
Percentage difference	%22.5	%17	%11

CONCLUSION

This study sought to answer two main questions, one is whether the geometric features of local roads affect the energy consumption of residential buildings and to what extent this effect is. In the background of research, various researches and researches that were about some geometric features of passages and building blocks were examined and its effective factors on energy consumption were identified. In the next stage, by focusing on the geometry of the street edge and the protrusion and indentation of buildings in the form of organic passages, the direction of research was inclined to study the effect and extent of this difference between levels in the urban landscape and the discussion of visual diversity. Is (Cooper, 2003). This time, it should be examined and studied in terms of energy consumption, and in contrast, it should be compared with the edges and smooth views that are designed for old and organic textures after the implementation of the approved detailed design. The variable considered in this study was the effect of shading the parts on each other and its effect on reducing or increasing the consumption of cooling and heating energy, which included electricity and gas costs, and the other variables, including the number of floors, materials, the ratio of opening size to surface, geographical location, fixed heating and cooling systems were considered. According to the results obtained in the two cases compared, the difference in total energy consumption was approximately equal to 8 kWh per square meter of surface per year, which was obtained for positive cooling energy and negative for heating energy. An 11% difference in total energy consumption at smooth edges compared to irregular edges while confirming the research hypothesis that it had an impact on energy consumption. It refers to the effect of the importance of shading on the walls and the consumption of energy necessary for cooling indoor spaces in hot and dry climates. Finally, according to the results and findings obtained in this study, it can be said that the geometry of the street edge is an influential element in energy consumption. They need to be researched and studied more carefully and comprehensively and even the possibility of optimizing the size of these surface changes to reduce energy consumption, and the maximum and appropriate use of solar energy is possible depending on the geographical location and is a significant issue for future research.

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