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Investigating the Effect of Sidewalk Flooring on the Behavioral Pattern (Walking) of Citizens in Urban Spaces (Case Study: Vali asr St., Tehran)

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ABSTRACT

The present study has evaluated the effect of architectural forms on the walking activity of citizens as a behavioral model in urban physical spaces. The research hypothesis claims that by designing purposeful and appropriate architectural forms, the behavior and actions of users in urban physical spaces can be to some extent, it designed or controlled, and that the pattern and domains of human behavior in urban streets are the result of the components of environmental quality that are included in the design of that street. The present theoretical proposition has been tested in two sequences from Valiasr Street in Tehran. At the theoretical level, the research method is descriptive-analytical and at the experimental level, it is a survey that has been done using the behavioral research method. The results show that the floor form and street form are the most influential architectural forms in urban physical spaces on the activity of users walking from space in the study sample. Also, some environmental factors have a direct effect on human reactions; The research findings show that people's speed is directly related to the dimensions of sidewalk carpets and a person tries to take a step according to the senses he receives from the sidewalk flooring form and as a result his speed changes according to those forms.

1. Introduction

1.1 Statement of Problem

New needs and forms of human life created by the modern and industrial world are not traditionally met in urban space design forms, and living conditions in large and industrial cities, a general revision of urban space design and human environments, which is the source and reference of behavior. Demands citizens in

that space. However, this is not possible only through the revision of human environments, but also the constituent and functional elements and algorithms of human environments and physical spaces must be analyzed. Looking at the history of cities, it is clear that urban structures and planning influence human behavior and the way cities function. The colonial cities of the Roman Empire are marked by streets, squares, vertical buildings, and barracks. A formula that strengthened the role of the military. The compact structure of medieval cities with short walk-

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ing distances, squares, and shopping malls supported its function as commercial and industrial centers^[1]. What has happened with twentieth-century planning in crowded cities has been to diminish the role of man in the main streets and alleys of cities. “We build cities and cities build us”, writes Jan Gehl. However, the role of man in building cities is limited to design offices and on paper, while Richard Rogers writes of the city: “Cities are places where people meet to talk, trade, or just Relax in peace and enjoy life. Public domain of the city - streets, squares and parks are the place where these activities take place and accelerate”^[2]. From Rogers’ point of view, all one’s efforts and attention are related to his perception of the world around him at a certain moment in time, and how this perceptual format is formed and changed. The premise of this view is that the individual’s perception of the world around him and himself is the main determinant of behavior, and past and mental factors are minimized. How to perceive the space around a person depends on his senses and psyche at the moment; The environment created by influencing the human psyche also designs his behavior and actions in a certain context. In general, behavior is the result of the individual’s perceptions and views of the social environment and the artifact^[3].

Therefore, in the present study, architectural forms that form a part of urban physical spaces, assuming that they play a role in human behavior and are the source of fluidity and movement in space as one of the dependent variables and influencing human behavior in urban design Is examined.

1.2 Research Objectives

What has been set as a goal for all world sciences is to serve humanity and human humanity, the principle in urban design is to pay attention to human needs and what is important is the role of architecture to achieve this lofty purpose and determine the mission of architecture among other sciences. Architecture, like other sciences, must rush to the aid of contemporary man and take steps to solve the problems of the modern world, so it is necessary to enter the realm of problems of the world around it that psychologists, sociologists, urban planners and humanistic behaviorists deal with. Psychological cognition of human behavior in relation to the physical environment is discussed in the field of environmental psychology. Gifford defines environmental psychology as the study of the interrelationship between an individual and his or her physical location^[4]. In this interaction, the individual transforms the environment, and at the same time his behavior and experiences are transformed by the environment. In his definition, physical headquarters refers to physical space

as the functional and organizational goals defined in it. Proshansky believes that environmental psychology is a discipline that deals with the interactions and relationships of people and their environment. According to him, the physical environment is also a social environment and sometimes it is not possible to separate these two aspects from the environment. Therefore, the aim of the present study can be to design human behavior by redesigning architectural forms in physical urban spaces to help promote social interactions and control some controllable behavioral patterns in communal urban spaces.

1.3 Research Background

Form: Fewer terms can be found that last as long as “form”, The term has been around since Roman times, And fewer terms are so international like to this. The Latin word forma has found its way into many modern languages; It is used in the same way in Italian, Spanish, Polish, and Russian, and with a slight variation in other languages, in French as “forme”, in English as “form”, in German as “Form”^[5]. “Form” is one of the key terms that is very commonly used in various general and specialized topics of art, so that it can be considered one of the most important basic concepts of art.

Human Behavior: How to perform an activity. Human behavior is the result of a person’s motivations and needs, the ability of the environment, the person’s mental image of the outside world resulting from his perception and the meaning that this image has for him. Therefore, each activity under the influence of the above conditions can take different forms and cause various behaviors. For example, sitting on a bench, squatting, and licking are activities related to sitting^[6]. Behavior results from social and artificial perceptions and views^[3].

Physical space: Physics is the science of studying the properties of nature. This science is generally known as the science of matter and its movement and behavior in space and time. If we speak more broadly, the main goal of physics is to study and analyze nature, and this science always seeks to understand and predict the behavior of nature in various situations^[7]. Urban spaces are built environments that interact in two ways with their users. Man and the built environment continuously affect each other in a reciprocal way^[8]. Physical space refers to urban spaces in which human physical activities take place.

Results of domestic and foreign research:

The Theory of Threshold and Privacy of Human Activities was first proposed by Edward T. Hall in the 1950s. This expert refers to the issue of human behavior and strongly emphasizes the attention to human behavior in the design of a space, especially in an urban space. Other

theorists have emphasized the importance of human privacy in urban spaces, but of all of them, Kurt Kafka’s view is particularly important.

According to Kurt Koffka, an urban environment can be studied and analyzed with four types of attitudes:

(1) Physical attitude: Attitude towards an environment from the perspective of geographical factors and its environmental elements.

(2) Social attitude: Attitude towards an environment from the perspective of institutions, individuals and groups that use that environment.

(3) Psychological attitude: Attitude towards an environment from the perspective of mental images resulting from that environment.

(4) Behavioral attitude: Attitude towards an environment from the perspective of a set of environmental factors to which a person reacts.

The study focuses on “behavioral attitude” and with emphasis on the effect of sidewalk floor form on human behavior patterns (walking) examines environmental elements and its relationship with citizen behavior design. What can be deduced from these four divisions is that Kurt Koffka distinguished between the real or objective world around man and the phenomenological world. An environment that consciously or unconsciously affects people’s behavioral patterns and mental reactions. According to these concepts, it is necessary to study an urban environment in which social and cultural system has been formed. Certainly there are specific definitions of distance, privacy, and human respect in different social systems. In fact, it can be said that it is in cultural and social norms that human relations reach their specific pattern.

The design of the cityscape and the introduction of its five constituent elements (node, edge, sign, path, and sphere) by Kevin Lynch in the 1960s are still one of the most influential theories in the field of urban issues after half a century. Lynch opened up new perspectives for researchers on other urban issues by addressing public perceptions of the environment, city inference, visualization, or mental landscape. According to Lynch, the moving factors of any city, especially humans, are effective in creating the image of any city. And because people feel the city in motion, these qualities are fundamental and their use can contribute to the identity of the fabric; These qualities help the observer to know his direction and distance and bring the form to his senses while moving^[9].

Amos Rapoport is one of the leading behavioral theorists who has paid attention to urban issues. By denying the subject of human-environment interaction, he denies the passive position of man in the urban space and considers movement in the environment as the most important factor in understanding the environment and mental design. Also, another point of attention is Rapoport orientation in urban environment. According to him, specific points, access and use are the three factors that affect orientation. Pedestrians use a set of specific decision-making points to be considered by designers, specific inputs and outputs and routes are discussed in the access discussion, and land uses, since they can provide a focus of activities, usually orient people. They are affective and can be studied^[10]. According to Pasini, orientation is not limited to recognizing the human path in the artificial environment through architectural design elements and urban furniture, but also all graphic signs and communication elements,

Table 1. Theorists with emphasis on environmental-behavioral effects^[12]

Row	Theorist	Year	Text title / theory	Key notions
1	Kevin A. Lynch	1960	Cityscape Node	Edge, Sign, Path, and Scope of the Five Elements of Cityscape
2	Amos Rapoport	1977	The human aspects of the urban form	The passive position of man in relation to the environment - Orientation of pedestrians in urban environments
3	Romadi Pasini	1984	Routing in architecture	Orienting people in urban space and paying attention to the special needs of users
4	Moore & Altman & Holoil	1985	Evaluation of cityscape	Investigation of psychological effects of urban spaces on people
5	John Lang	1987	Creation of Architectural Theory (The Role of Behavioral Sciences in Environmental Design)	Human’s perception of space People’s perceptions of the environment as a kind of mental schema
6	Hossein Bahreini	1966	Analysis of urban spaces in relation to the behavioral patterns of users	Providing appropriate design criteria with quantitative and qualitative analysis of street space and behavioral patterns of users, especially pedestrians

signs related to building spatial elements, logical spatial planning, communication signs and It also includes audio, tactile elements and all items that are provided for the special needs of users^[11].

The main focus of John Lang's research is the role of behavioral sciences in environmental design. In his book entitled *The Creation of Architectural Theories*, he deals with how man perceives space and environmental factors that affect this matter, and considers people's perceptions of the environment as a kind of mental schema that shapes his behaviors and activities it form in the urban public arena^[12]. In his book *Analysis of Urban Spaces*, Hossein Bahreini evaluates the quantitative and qualitative patterns of street users - which in his opinion is the most important element of city form and the most important tool of urban design, and seeks to analyze several main streets of Tehran, especially pedestrian behavior. The pedestrian should provide appropriate criteria for design in them. He believes that the use of space, especially by pedestrians, is mainly of cultural origin and the environment (form and space) has only an auxiliary or deterrent role and does not determine behaviors in any way.

2. Conceptual Model of Research

2.1 Purpose of the Research

- (1) Designing a walking pattern from human behavioral patterns through redesigning architectural forms.
- (2) Help control congestion or increase sensory load on sidewalks by taking advantage of the effects of architectural form on gait pattern.

2.2 Hypotheses

- (1) The pattern of human behavior on urban streets is the result of the quality components of the environmental forms that are taken into account in the design of that street.
- (2) By designing purposeful and appropriate architectural forms, the behavior and actions of users in physical urban spaces can be designed or controlled to some extent.

2.3 Methodology

- (1) Data collection tools and methods, validity and reliability of the tool:
- (2) This research is of quantitative-qualitative type, the qualitative type of which is carried out using descriptive-analytical method and library studies.

2.4 Methodology for Data collection

Data analysis instrument in the present study were urban

data collection and analysis instrument.

The data collection instrument and their analysis mechanism in the present study are as follows:

- (1) Environmental mapping; Using behavioral method. In general, two types of behaviorism can be distinguished. A) station behavior and b) motor behavior^[13-22].
- (2) Questionnaire.
- (3) Observe and record the behavioral patterns of the environment.
- (4) SPSS software is for explaining and describing objective observations, questionnaires and interviews.

2.5 Statistical Population, Sample Mass and Sampling Method

Statistical Population

The statistical population selected for the study is all pedestrians, businessmen, residents and all beneficiaries of Valiasr Street in Tehran, which has been selected due to its communication location, social traffic node, importance of location, age and cultural diversity. Sampling method using objective observation of the behavior of place users (citizens); Photo and video analysis is a purposeful questionnaire and interview. In order to conduct the present study and due to the length of Vali-e-Asr Street in Tehran, in order to achieve better results, this street is divided into sequences that according to the diversity: cultural, land use, pedestrian traffic and the amount of architectural elements in the two Sequences that comparatively address research strategies have been selected. Selected sequences are as follows:

- (1) First sequence: Vali Asr Square to Vali Asr intersection
- (2) Sequence 2: Rah Ahan Square to Gomork intersection(mowlavi)

The data collection tool in this study was a questionnaire and behavioral method, using the collected materials and information, the studied variables were identified and then to measure each of the variables, a number of questions were asked in the form of a questionnaire, which is the structure of the questionnaire. form. In compiling the questionnaire questions, an attempt was made to design the questions in line with the indicators obtained in the conceptual framework of the research as an evaluation of the effect of architectural forms (dependent variables) on the behavioral pattern of walking in urban physical spaces. Asked unambiguous questions to users of street space and then had been analyzed.

In the field of physical, skeletal and structural factors, questions were asked about the sub-index of activity, walking and architectural elements in the street, the re-

relationship of this activity of users (as a dependent variable) in the street space with each form of architectural elements in Has questioned and analyzed it separately; The relationship between users' "walking" activity and each of the elements of the form of walls, furniture, edges, corners, material texture, street form and sidewalk flooring was questioned. The number of questionnaires in this study (based on sample size and Cochran's formula) was 200 for a total of selected sequences on Saturdays to Mondays, 17 to 19 September 1397 for three days and at 10 to 13 and 17 to 21 between users Distributed from the street (residents, merchants and passers-by) in selected scenes of Valiasr Street in Tehran. The way of answering the questions was the way the questioners referred to the respondents and the way of the face-to-face interview. The results of the questionnaires after extraction using SPSS software are graphically analyzed and described in the next section.

3. Analyzing Collected Data

The description of statistical outputs resulting from the

analysis of questionnaires related to the effectiveness of the behavioral pattern of walking through architectural forms in urban physical spaces in the picture (Figure 1) is as follows:

3.1 Street Walls

Statistical data show that most people understand the form of street walls as influencing the behavioral pattern of walking, and about 48% of the total statistics in this chart are related to "complete communication".

3.2 Furniture

The graphs obtained from the statistical data related to the walking pattern in the furniture proposition show that the highest statistics are related to the subset of "more or less irrelevant" with 19.50% and if the subset of "sighted" with the statistic of 9 Percentage of the turning point of the chart. The results show that about 44.50% of all people tend to "non-communication", while 36.50% of people tend to "complete communication".

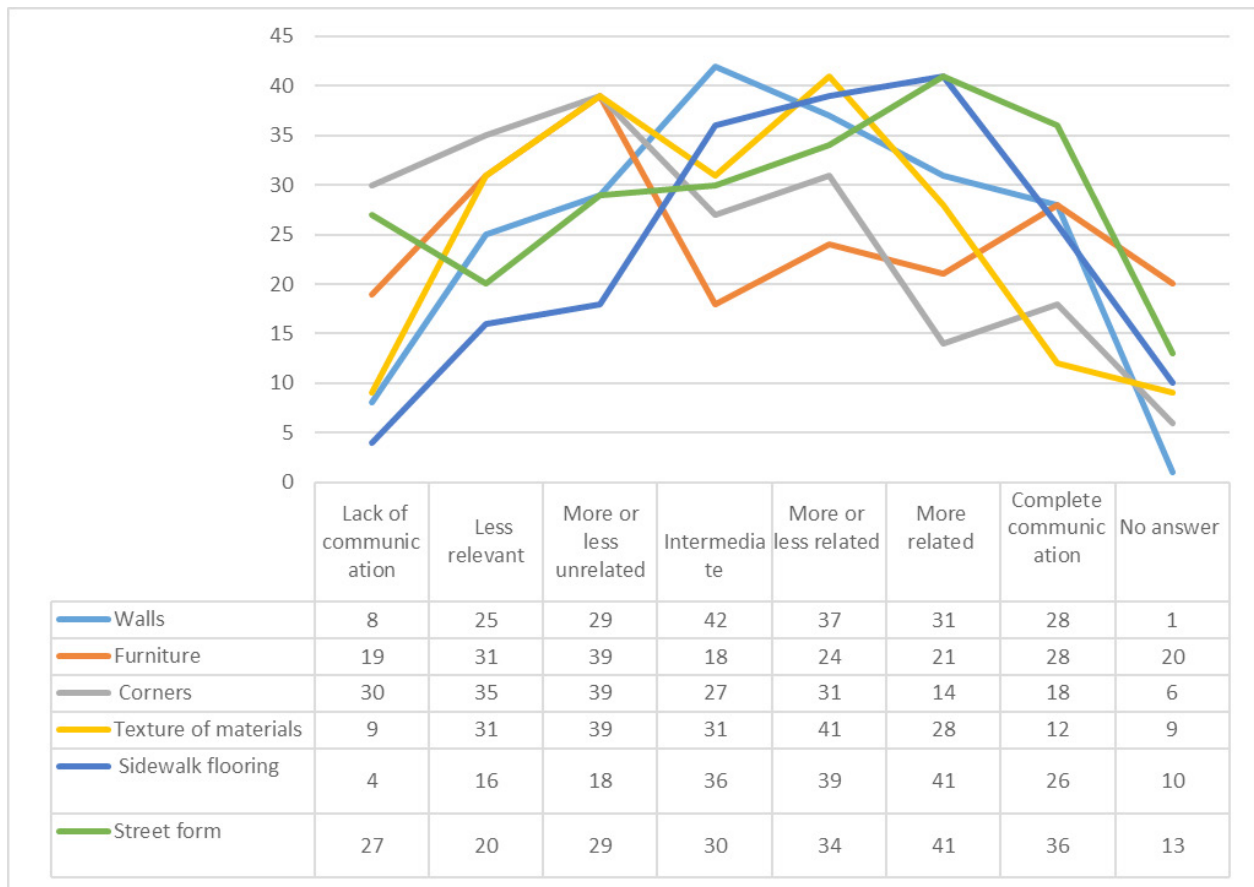


Figure 1. Index of the effectiveness of the behavioral pattern of walking through architectural forms in urban physical spaces in a total of sequences (Authors)

3.3 Corners

Statistical outputs related to the effective proposition of corners show that most users of space in the whole of these sequences do not consider walking to be related to the form of corners, the highest statistics are related to the subset of “more or less irrelevant” with 19.50%. While the opposite point on the other side of the graph, the “more or less related” subset, is 15.50%; In general, if we consider the “intermediate” passage with 13.50% as the turning point of the chart, most people, ie about 52%, do not see the form of the corners as affecting walking activity.

3.4 Material Texture

The most statistics in the relevant chart are related to the subset of “more or less related” with 20.50% of the total statistics, and then the opposite point on the other side of the chart, ie the subset of “more or less unrelated” with difference. Slightly, about 19.50% of the total statistics and subsets of “intermediate” and “less relevant” each with 15.50% of the total statistics have the most statistical data, respectively.

3.5 The Form of Flooring

Most people in these sequences feel the form of flooring of the passages on the walking activity effectively. Most of the statistical data are related to the subdivision of “more relevant” with 20.50% of the total statistics. In general, the number of people who receive this activity affected by the form of flooring is 53% higher than the total number of people who do not receive it affected by the overall figure of 24%.

3.6 Street Form

The slope of the present diagram has a significant leap towards “complete communication” which shows that most people understand the street form effectively on the behavioral pattern of walking. The highest statistics in this statement are related to the subdivision “more relevant” with about 20.50% of the total statistics.

In general, Sidewalk flooring form and street form are the most influential architectural forms in urban physical spaces on the activity of users walking from space in the study sample.

The results of research conducted by the method of conducting “Behavior measurement” research indicate that the form and dimensions of pavement have a significant effect on the speed of pedestrians in urban thoroughfares. This part of the study was done by considering people as “subjects” and without their knowledge

and without the intervention of the researcher, so that in 2 summer days on Sunday, September 1, 2018 and on Tuesday, September 4, 2018, 60 people in each from the selected scenes of Valiasr Street in Tehran, walking on different types of flooring (different in terms of dimensions and form) was selected. The selection of these people was such that, at different distances of 20, 25, 40, 50 and 120 Meters and dimensions (15 * 15, 30 * 30 and 50 * 50 cm) and different forms of pre-determined flooring, 10 subjects were selected for each type of flooring in each of the distances, and using the behavioral method. A movement was recorded to record the amount of time the pedestrian needed to travel the specified distances, and then the average speed of each pedestrian was recorded by analyzing the numbers obtained. And was analyzed in relation to the form and dimensions of flooring.



Figure 2. Pedestrian speed determination mechanism (Author)

For example, the velocity of a person moving from point “A” to point “B” is obtained by dividing the time traveled by the distance traveled (Figure 2).

The distance between points “A” and “B” is 20 meters and the average time to pass it is 13 seconds and 66 hundredths of a second, which means that the average speed of pedestrians in this distance was about one meter per 68 hundredths of a second.

The general results of pedestrian speeds are given separately by the dimensions of flooring in Tables 2 and 3.

Table 2. Analysis of the average pedestrian speed based on the dimensions of the flooring in the first sequence (Authors)

Dimensions of flooring	Distance traveled	Average duration	Pedestrian speed (meters per second)
15 * 15	20 meters	13 seconds and 66 hundredths of a second	1.46 meters per second
30 * 30	120 meters	1 minute 18 seconds and 97 hundredths of a second	1.519 meters per second
50 * 50	50 meters	25 seconds and 7 hundredths of a second	1.994 meters per second

Table 3. Analysis of the average pedestrian speed based on the dimensions of the flooring in the second sequence (Authors)

Dimensions of flooring	Distance traveled	Average duration	Pedestrian speed (meters per second)
15 * 15	25 meters	15 seconds and 54 hundredths of a second	1.60 meters per second
30 * 30	40 meters	23 seconds and 27 hundredths of a second	1.71 meters per second
50 * 50	120 meters	60 seconds and 36 hundredths of a second	1.988 meters per second

The results of statistical data analysis in the above tables show that the dimensions and size of the carpet floor have an effect on the speed of pedestrians, this effect is a direct relationship and the larger carpet floor, the higher the average speed of people. Data analysis shows that there is a large difference does not exist, between the speed of pedestrians on the carpet floor with dimensions of 15 * 15 cm and 30 * 30 cm with an average speed of 1.53 m/s (for dimensions of 15 * 15 cm) and 1.61 m/s (for Dimensions 30 * 30 cm). This means that people may understand forms of different but proportional sizes in the same way or close to each other. While the average speed of people walking on carpet floor with dimensions of 50 x 50 cm is about 1.991 meters per second, which is equivalent to 1.2 times the speed of people on smaller dimensions.

4. Findings and Discussion

The general results of studies conducted on the study area on Valiasr Street in Tehran show that people in urban physical spaces generally perform the “walking” activity in two models, which include a targeted model and a non-targeted model.

Targeted pattern refers to the way a person behaves to achieve a predetermined goal. Such as: fast walking to get from point “A” to point “B”.

A non-targeted pattern is a behavior that a person does not have a pre-determined plan for. Such as: standing up suddenly and talking or looking at shop windows.

The results of the study show that in general, carpet floor form and street form are the most effective architectural forms in urban physical spaces on the activity of users walking from space in the study sample. Also, some environmental factors have a direct effect on human reactions; Research findings indicate that people’s speed

is directly related to the dimensions of sidewalk carpet floor. So that people are faster on sidewalks with larger carpet floor forms than they are on sidewalks with smaller forms. This coordination between the speed and the shape of the pedestrian floor is done subconsciously and occurs in proportionate forms; In such a way that the speed of people on carpet floor with dimensions of 60 cm with their speed on carpet floor with dimensions of 30 cm, which have a proportional difference of twice, has a significant coordination. This coordination goes back to the way people receive sensory data. This means that people perceive proportionate sizes in a similar or perfectly proportioned malar. Meanwhile, the speed of people on carpet floor with dimensions of 40 cm has a significant difference with their speed on carpet floor with dimensions of 60 and 30 cm.

Design can affect both categories of behavioral patterns in a variable way through targeted design of the built environment in urban physical spaces in different malar. (Targeted and non-targeted). This effect on targeted behaviors is far less than non-targeted behaviors that are more influenced by personal factors.

The effect on behavioral patterns of “Targeted walking” of people in urban physical spaces is mostly through the effect on their actions during the behavior, these effects can be done through physical barriers in the sidewalk and different types of carpet floor, which this effect only to the extent of guiding the path or forcing the person to change direction in order to achieve the predetermined goal will be through deterrent or guiding elements. Barriers installed in the middle of the boulevard to prevent pedestrians from crossing the street or metal bars installed at intersections to prevent pedestrians from entering the sidewalks are among these elements. Despite such elements, if there is a behavioral pattern with a strong goal, even these elements will not be able to prevent the inappropriate behavioral pattern and eventually lead to a norm-breaking behavioral pattern such as jumping from the top of the bar to cross the middle of the street or entering the motorcycle through the metal bars leads to the sidewalk area.

Influence on non-targeted behavioral patterns can be done through the direct effect of space on the human psyche (meaningful environment). This type of influence, which targets the subconscious part of the person, is influenced by the meaning of the environment and also affects the person’s behavior through mental schemas and the creation of a special sense in place.

5. Recommendations

Studies show that when a person receives the sensations he receives from the sidewalk flooring form, he tries to walk in accordance with them, and as a result, his speed

changes according to those forms. With such a possibility, we can use the design of sidewalk carpet formats and its effect on pedestrian speed to design sections of sidewalks or urban streets, in such a way that by designing and selecting appropriate forms and dimensions where there is a need to empty the sensory load or prevent congestion. Is to achieve the goal. For example, the use of larger forms at intersections and places where pedestrians are required to evacuate or cross more quickly may increase pedestrian speeds and can be avoided by congestion and deceleration. He prevented these neighborhoods.

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