

Functional Efficiency and the Most and Least Liked Aspect of Pedestrian Bridges in Urban Landscape of Tehran

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ABSTRACT

Pedestrian bridges have become an important part of a city's public environment to provide linkages from one place to another in order to tackle pedestrian safety issues. After a while, these facilities ingrained into the socio-cultural functions and one of their outstanding roles is enhancement of the visual quality in urban landscape. However, nowadays the design procedures only focus on their functional aspects and consequently neglect their aesthetic values. According to the reports from Tehran, most of pedestrian bridges in Tehran have less than 50% functional efficiency and they are believed that one of the factors responsible for this shortage related to their appearance aspects. Therefore there are a mutual relationship between functionality and visual qualities of pedestrian bridges in urban landscape and in order to help urban designers, bridges' engineers and planners to improve the aesthetic qualities for pedestrian bridges and then increase their functionality, baseline data is needed on people's perception to make decision for planning or designing the urban areas for them. As such, this study attempts to provide new insights into how people view pedestrian bridges in an urban landscape and further reveal new details and information regarding the perception for pedestrian bridges. In summary, this study conducted a survey with 384 respondents in Tehran regarding their most and least liked aspects of the appearance for pedestrian bridges in urban landscape of Tehran. So, a verbal description of respondents was collected and the descriptive words given by the participants for both questions were categorized based on their themes and these categories were labeled according to those themes. The themes can help determine the underlying reasons why respondents like or dislike pedestrian bridges. The findings first revealed that people in Tehran pay less attention to the appearance of the bridges because the bridges have low aesthetic values. Then the results supported by theory of "Good City Form", and also "Affordance theory" who both believe the appearance of an area can influence its function.

KEYWORDS: Pedestrian Bridges, Functionality, Urban Landscape, Appearance, Liked aspects, Perception

INTRODUCTION

After the Second World War, the widespread use of cars has resulted in new urban planning approaches to give priorities to the motor vehicles rather than pedestrians. This planning attitude makes planners to be more concerned about the safety of the pedestrians by providing appropriate spaces for them. The primary example of the space in urban areas is the pedestrian bridge. As a matter of fact, the pedestrian bridges are over-pass elements which have been designed to facilitate the both motor vehicles and the pedestrians in urban areas. The bridges' design varies greatly in style but mostly reflect the engineering innovation showing higher attention to the functions rather than the aesthetic values that related to the characters of the place which can be considered to consequently enhance the visual qualities of any region. Therefore, they may be considered to be more than mere elements in a transportation system in urban areas but rather "Signature Bridge" which means a bridge with the highest efficiency, economy and elegance [1].

According to a survey carried out by the United States Federal Highway Administration, the public interest on the appearances of the bridges is likely to increase and they want their bridges to show a positive feature of their cities. [9] The results showed that citizens are concerned about the bridges that are sensitive to their local communities especially in their visual appeal. The sentiments probably due to the facts that most of the bridges

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could be seen in many different angle of views due to their specific spatial position rather than the other urban elements and they have a great potentiality in promoting the aesthetic values for areas; and therefore, they should be designed as a structural art and finally as a “signature bridge.

One of the main problems concerning the visual quality of bridges all over the world is the breaking up approaches in design between engineering and architecture in which the engineering approach is intended to consider the structural format only due to this fact that it is independent from its surrounding context. However, the architectural approach considers its appearance and as an integrated element into its surrounding context. It argues that a successful bridge design must consider both the structural form and the aesthetic values especially on its integration with the surrounding context in order to have a bridge with highest level of aesthetic qualities which is important for a livable urban area. (Fig 1)

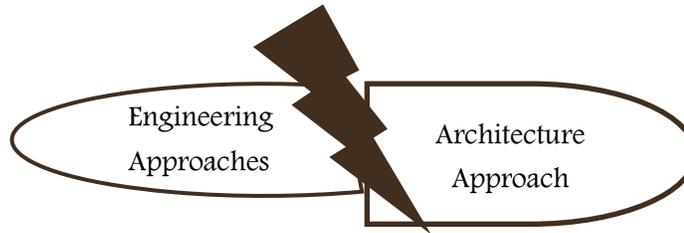


Figure1. Current Situation of Bridge’s Design in Urban Areas (Source: Authors)

Iran is featured to have a long history tradition in designing and constructing bridges. Throughout the country, there are many old and traditional bridges constructed during different civilization eras in different parts of Iran. During the ancient time in Iran, some cities were located beside a river; since, the bridges were built to link some important areas in the city with each other in order to safe pass the pedestrians into different part of the city. In general, the bridges of Iran at those times were too simple and comprising piers, container arches and a level crossing. However, over the time, as a result of development process in engineering and architecture, some changes in bridge’s structural form, dimension and functions were appeared [2]. As a matter of fact, pedestrian bridges can occur in any type of environment like residential, commercial, industrial and also undeveloped environments and they offer a unique opportunity to develop light and graceful structures and similar consideration to the other bridges can be applied for their aesthetic qualities. So the designers are strongly responsible for the appearance and aesthetics of bridges and must consider it as a major design imperative along with other considerations. [3]

For case of Tehran, Modernization comes along with the construction of highways in order to improve public and private transportation system. Consequently, the policymakers of Tehran decided to increase the numbers of passing routes as well as the pedestrian bridges in order to provide safety for pedestrians and also to reduce traffic congestion in urban areas. Today, according to the report of Beautification Organization of Tehran, there are more than 650 pedestrian bridges all over the city. [11] Therefore, the initial ideas of the pedestrian bridges in Tehran are just to ease the traffic congestion and increase the safety for city dwellers without any specific consideration to their visual appearance.

After a while, it was believed that these pedestrian bridges are more than elements for transportation system and play important roles for socio-cultural values [4]. Therefore, one of the most outstanding roles that the pedestrian bridges could play is their attributes for visual quality in urban areas [3].

However, according to the references most of the pedestrian bridges in Tehran have less than 50% functional efficiency. [2, 5, 6] The functional efficiency of the pedestrian bridges can be calculated through dividing the rate of people using a pedestrian bridge in one hour by the rates of the passengers around 50 meters of the same place who don’t use pedestrian bridge during the same time.

On the other hand, this problem is related to some of the factors such as inappropriate location of bridges, lack of legal instruments (or enforcement law to use the pedestrian bridges), lack of a strong culture for using the pedestrian bridges in urban areas, insufficient sense of safety regarding the bridges, lack of thermal comfort when passing the bridges, not paying attention to the future development causing bridges to lose their functionality through the time and finally neglecting the aesthetic or visual qualities of the bridges. [2, 6]

For interaction of function and appearance, theory of “Affordance” argued that the ability of the environments to provide the human activity as well can influence the people preference judgments against that certain environment. [7] In fact, he argues that human prefer an environment based on its suitability for action. For example, when human see a surface, his preference judgments regarding that surface influence largely by its ability to support his activities, such as walking. Also there is another theory as “Good City Form” by Lynch that can

support these claims. [8] Lynch, through this theory tries to establish a meaningful relationship between the urban form and human perception against it and he found seven criteria which an urban area can be evaluated in order to satisfy the human values. These criteria introduced to measure safety, perception, function, transportation and finally creating privacy and called as vitality, sense, fit, access and control, respectively and he further added two more criteria as efficiency and justice in order to create a good city form and called them performance dimensions. In such, this theory can explained how the appearance of an area can influence its function. This aspect pointed out through explaining the criteria of fit. In fact this theory defines it as how well a place can create balance between its spatial pattern or appearance and its functional behavior because it affects their efficiency. [8] Therefore this theory can support the assertion discussed during this study which claim the low functional efficiency of pedestrian bridges in Tehran is due to their inappropriate appearance that causes people perceive them unpleasantly and don't use them intensive and extensively. So we can conclude the function and forms in an urban area should support each other as well in order to satisfy the public users.

On the other hand regarding the aesthetic of pedestrian bridges there are many guidelines for applying in design processes of a bridge with appropriate appearance and aesthetic values. While reviewing this literature, one of the points is that they all concern about the necessity of creating a proper visual integration and harmony between bridges and their contexts in order to provide high level of aesthetic qualities for the area. In other words, all of these guidelines believe that the visual characteristics of the bridges should be harmonized in relation to the visual qualities of their location. Finally the Washington State Department of Transportation (WSDOT) introduced the term Context-Sensitive Design (CSD) for this phenomenon which is a determinant factor in aesthetics of transportation systems especially for bridges. [9]

As a conclusion for the literature regarding pedestrian bridges in Tehran, we understand that there are long times passed from utilizing the pedestrian bridges in urban areas in order to provide safety but the evidences have shown that the functional efficiency of these bridges in Tehran is not in a satisfying situation. It means people are not motivated to utilize pedestrian bridges for passing the routs, even if it endangering their lives. According to Golabchi and another one by Nikoomaram et al. and also the theory of Gibson and Lynch in this relation, one of the important factors in functional efficiency of pedestrian bridges are their visual appearances which can persuade people to use it. [2, 6, 7, 8] In such, pedestrian bridges, as a key urban element in Tehran should be designed wisely to create appropriate functional efficiency and people feel better in urban areas.

MATERIAL AND METHOD

As it mentioned, the focused problem here is that the pedestrian bridges in Tehran (more than 650 bridges) have low functional efficiency and according to the literature there are a mutual relationship between functionality and appearance of the bridges. However, previous studies attempted to find the most important factors for aesthetics of bridges and they introduce several influential items in this regards. This study tried to reveal the pattern of perception of people for pedestrian bridges in urban areas for their most and least liked aspect to identify the unanticipated factors that may influence people's preferences for pedestrian bridges in Tehran. This study conducted a verbal description survey for 384 students who live in Tehran, as representative of Tehran residents. The respondents to the survey for this research were selected from four famous universities in Tehran in a general field of study. According to the scholars in this relation for sampling activities based on a sampling table, we needed at least 384 cases for research respondents with the group proportionally distributed by gender. [10] In fact, the number of 384 participants was selected because it meets the minimum requirements for statistical analysis methods utilized in this study.

The survey was done by using open ended questions. An open-ended question is practical to allow participants to state if there is any special factor that can affect their opinion for pedestrian bridges by asking what participants like the most and the least about pedestrian bridges in urban areas in their own words. The participants were asked about the factors they liked the most regarding the appearance of pedestrian bridges in Tehran urban areas in their own words and conversely, what are the factors or issues that make them like the least in the appearance of pedestrian bridges in Tehran urban areas. The descriptive words given by the participants for both questions were categorized based on their themes and meanings and then these categories were labeled according to those themes and meanings. The themes can help to determine the underlying reasons why respondents like or dislike pedestrian bridges.

Therefore by asking the respondents about the most and least liked aspects of appearance for pedestrian bridges in urban areas of Tehran some data was collected and then analyzed. On the other words, the descriptive words that the respondents made regarding the pedestrian bridges were groups to some items that are similar in meaning and then analyzed based on their frequencies in order to identify the most and least liked aspect of pedestrian bridges in

urban areas in Tehran on their opinion. The results revealed interesting findings where some of them support the main issue of the research.

RESULTS

The survey was conducted by using open ended questions to enrich the understanding of the factors that may affect the appearance of pedestrian bridges in public perception and the following results have revealed:

The most liked aspect of pedestrian bridges

Of the 384 respondents, 365 real response were achieved of which 7.1% (n=26) stated that they don't like pedestrian bridges at all. That means there was no reason for the respondents to like the pedestrian bridges. Nevertheless, for the most liked aspects of pedestrian bridges, seven categories appeared as: "function of bridge", "structure of bridge", "color of bridge", "advertisements on bridge", "cleanliness of the bridge", "safety of bridge" and "presence of people". The table indicates the frequencies of each of these categories and examined the magnitude of the responses and ranks them based on their frequencies.

Table1. The Most Liked Aspect of Pedestrian Bridges(Source: Authors)

Theme	Frequency	Percentage (%)
1.function of bridge (presence of escalator, echelon, canopy)	133	36.4
2.structure of bridge(different form, greatness)	69	18.9
3. proper color of bridge	67	18.4
4.advertisements on bridge	39	10.7
5.cleanliness of the bridge and surrounding environment	18	4.9
6.safety of bridge	8	2.2
7.presence of people (memories)	5	1.4
8. Don't like at all	26	7.1
Total response	365	100.0

The results indicate the most frequent response related to the functional aspects of pedestrian bridges in urban areas (36%; n=133). The respondents described generally that they like the pedestrian bridges more when they have an escalator, the stairs are easy to climb, and the path is in shadows. The most frequent response in this category related to the escalator indicating that the presence of an escalator and easy climbing stairs is very important for the respondents. The second and third most frequent response related to the characteristics of bridge structure, such as a different form of a bridge and its greatness (19%; n=69) and the color of the bridges (18%, n=67). For structure of bridges, the respondents generally described that they mostly like a bridge when it has a different form, has super-elevation, and a high height. For color of the bridges they generally wrote that they mostly like a bridge when it has a different, but sharp color that can attract their attention. Of the responses, 11% (n=39) said that they like the pedestrian bridges because of the beautiful and effective advertisements installed on the bridges, which created harmony with the surrounding environment. In addition, 5% (n=18) of the responses cited cleanliness of the bridges and their surrounding environment as a reason to like the pedestrian bridges. However, only 2% (n=8) of the responses indicated that the respondents liked the pedestrian bridges for their safety. Finally just 1% (n=5) of the responses related to the surrounding population near the pedestrian bridges. Thus presence of people was the weakest reason for respondents to like pedestrian bridges and comprise those particular persons who have a memory, such as the people who sell flowers or people who they meet on the bridges every day. According to these results, the respondents mostly like pedestrian bridges because of their functional aspects, followed by the structure and color, advertising, cleanliness, safety, and presence of certain people around the bridges. The high percentage of responses for the functional aspects of pedestrian bridges (36.4%) illustrates that in urban areas, people mostly pay attention to the function of pedestrian bridges rather than other factors, such as their appearance. In fact, people pay less attention to the appearance of the bridges because they have low aesthetic values.

The Least Liked Aspect of Pedestrian Bridges

A total of 345 responses were collected from the respondents regarding what they least like about pedestrian bridges. From this amount, 6.4% (n=22) stated they don't like pedestrian bridges and didn't have any reason for their attitudes.

Table2. The Least Liked Aspect of Pedestrian Bridges (Source: Authors)

Theme	Frequency	Percentage (%)
1.function of bridge (lack of escalator, echelon, canopy)	122	35.4
2.structure of bridge(uniformity, improper shape, height, long)	75	21.7
3. dirtiness of the bridge and surrounding environment	40	11.6
4.advertisements on bridge	35	10.1
5.presence of people (beggars, druids, badgers and drug addicts)	20	5.8
6.improper color of bridge	17	4.9
7.un-safety of bridge	14	4.1
8. Don't like at all	22	6.4
Total response	345	100.0

Surprisingly, by using a similar content analysis, the results show almost similar categories as the most liked aspect responses. The categories then were ranked according to their frequencies.

Similar to the previous part, the most frequent responses for the least liked aspects of pedestrian bridges relates to the function of pedestrian bridges (35%; n=122); the respondents believed that they mostly don't like these bridges because of functional reasons like the lack of escalators, too many stairs, and lack of an appropriate canopy.

In addition to functional aspects, 22% (n=75) of respondents said that they didn't like pedestrian bridges because the structure of the bridges, i.e., the uniformity of bridges, improper form of railings, material of the bridges, their high height, and long length.

Furthermore, 12% (n=40) referred to the dirtiness of the bridges and their surrounding environments. However, 10% (n=35) said that they didn't like pedestrian bridges because they contained ugly advertising signs or advertising for non-proper concepts and thus created a disordered environment. On the other hand 6% (n=20) of the respondents said that they mostly didn't like the presence of particular groups of people around the pedestrian bridges. These responses related to the particular people who are seen around the bridges, such as beggars, druids, badgers, and drug addicts, and people didn't appreciated their presence. Further, 5 % (n=17) of the responses related to the improper colors of the bridges. The respondents wrote that they don't like the pedestrian bridges due to their improper colors, which generally include dun-sharp and opaque colors. Finally 4% (n=14) of the respondents wrote that they don't like the pedestrian bridges because they didn't feel safe on them. The respondents described safety as having a sense of calm when passing over the bridge and have no fears.

In summary for the least liked aspect of pedestrian bridges, the most frequent reasons given by the respondents related to functional aspects, followed by the structure of bridges (uniformity and improper design of bridges), dirtiness, advertisements, presence of abnormal people, improper color of bridges, and finally the un-safe situation of these bridges and their surrounding environments.

DISCUSSION

The findings from the descriptive analysis indicate that the respondents mostly like pedestrian bridges because of their functional aspects, followed by their structural form, color, advertising, cleanliness, safety, and presence of people around the bridges. Further they stated they least like pedestrian bridges for their functional aspects, followed by their structural aspects (uniformity and improper design), dirtiness, advertisements, presence of abnormal people, improper color, and finally the un-safe situation of the bridges and their surrounding environments. At first glance, these results reveal that people in Tehran largely are concerned about the functional aspects of pedestrian bridges rather than their appearance. In fact, people pay less attention to the appearance of a bridge, and therefore, when they were asked about the appearance of bridges, they frequently responded to their function, perhaps because the pedestrian bridges have low aesthetic values. The findings support the main issue for this study as well and also are in line with other researches. [6, 7, 8, 12, 13]

Mainly, the findings from this research are supported by Lynch's theory of "Good City Form", who believed the appearance of an area can influence its function. On the other side, this result relates to the theory of affordance suggested by Gibson, which refers to the probability of a high preference of environments by people who perceive that particular environment is proper for utilizing bridges. [7] Listavich in the field of bridge aesthetics also is concerned about the clarity of function for bridges and argued that the good appearance of bridges not only add to its aesthetic values, but also increases its functional efficiencies. [13] However the rest of the findings from this analysis, such as the respondents' comments for structure and the color of bridges, cleanliness of the bridge and its surrounding area and the perceived safety, were introduced by other literature regarding the aesthetic of bridges.

In terms of structure of bridges, it may be related to the idea of context sensitive design for pedestrian bridges, which in Tehran have not been considered as an affective factor for aesthetic qualities, because most of the

pedestrian bridges in Tehran have a similar form and similar structural characteristics. It is completely in line with many references who argue about the visual effects of contexts on the aesthetic qualities of bridges; specifically the appreciation of bridges is influenced by their environment. [3, 15] Also Zuk, who argued that, a pleasing site improves the overall appearance of any bridge. [23]

In terms of color of the bridges, according to other researches in this field, color is one of the variables that can define the visual and aesthetic aspects of any object. [14, 16] Also Bishop and Cañas *et al.* argue that there is a strong positive association between perception and certain landscape attributes especially colors in the landscape. [17, 18] In addition they believe that the visual quality of an object in the landscape is influenced by factors related to that object, and one of the main factors related to that object is color. It is presumed that color provides contrast within the visual scene, thus making the environment attractive. Garc'ia *et al.* also argue that sharp colors and shiny surfaces tend to attract the attention of people more often. [14]

Other researchers such as Leonhardt, Reese and Zuk suggest that the color of a bridge is a potential variable that influences other aesthetic qualities. [3, 19, 22, 23] Nevertheless, the Minnesota Department of Transportation in their report titled "Aesthetic Guidelines for Bridge Design" argued that creating harmony or contrast between the color of bridges and its environment should depend on the purpose of the project and also must consider seasonal changes and the day lighting situation. [24] Arriaza *et al.* suggest that landscape planners can alter the visual quality of the landscape by improving the colors and Garc'ia *et al.* argue that the color of the main landscape elements, such as vegetation, buildings, etc. should also be considered in the design. [14, 25] This study concludes that color is an important potential factor that significantly influences the perception for pedestrian bridges. The study's findings confirmed that the sharper colors of bridges' ceilings do provide a contrast with its context for a positive effect, while conversely opaque colors negatively affect the general people perception for pedestrian bridges.

In terms of cleanliness, from a theoretical point of view, people prefer landscapes that are clean and well maintained. [26] Meanwhile, Nasar distinguished the good maintenance and cleanliness of the urban landscape as a likable aspect that affect public appreciation positively. [27] In addition, Antrop believes that people prefer a landscape that is perceived as clean; a well-maintained appearance of landscape is generally appreciated. [28] All of the above-mentioned researches support the findings from this study, which concludes that the most frequent comments that people make for their most preferred scenes is about their cleanliness and neatness.

In terms of safety, the results for this study indicate that another frequent comment that people make about the most preferred scenes regards their sense of safety within the scenes. On the one hand, according to some scholars, the unmaintained area of a landscape can have a negative effect on its safety. [29, 30, 31, 32] Therefore, the terms 'cleanliness' and 'safety' are congruent with each other in terms of preference for a landscape. These arguments are similar to the findings in this study because people made comments about both cleanliness and safety for their most preferred aspects of pedestrian bridges. Those findings can support the potential of perceived safety on preference in the urban landscape. On the other hand this finding is supported by the theory of prospect and refuge suggested by Appleton, which argues that people prefer environments that provide them an opportunity to see without being seen, which finally may result in the safest environment. [33] Listavich also regards safety as one of the factors that must be considered in bridges aesthetics and named that value as the variable that can define the clarity of function of bridges. [13] The findings also are congruent with Nikoomaram *et al.* who believed that people do not utilize pedestrian bridges in Tehran due to their unsafe situation. [6]

In terms of advertisements, the results are in accordance with that of Nasar and Hongwho argued that urban signs capes and advertisements act as visual pollution and are one of the most frequently disliked aspects of urban appearance and, therefore, harm the image of a city. [27] Furthermore, in terms of the presence of people, the findings are in line with Real *et al.* who stated that the presence or absence of people in a scene affects the visual quality of the landscape. [34] Further, Whyte argues that the presence of people in a scene increases the preferences for that particular scene. [35] Therefore, they can be introduced as the potential factors that affect people's perception for pedestrian bridges in urban areas. But how these variables relate to the people's perception for pedestrian bridges and then how they can predict their preferences is another question. These questions should be addressed in future research.

Generally the finding supports the issue of this study, which is the deficiency of appearance for pedestrian bridges and from these all findings which extracted through this research, it can be concluded that the pedestrian bridges in urban landscape of Tehran are not considered as elements having aesthetic qualities and one of the factors which potentially influences on functional efficiency of the pedestrian bridges in Tehran is contributed to the visual appearance of these kinds of bridges or their aesthetic qualities and then people regarding their appearance concerned about the form of bridges, the color, cleanliness, safety, advertisement and the population around the bridges.

Conclusion

The results from this analysis first indicate that people in Tehran mostly do not appreciate the appearance of pedestrian bridges in urban areas and pay more attention to their functional aspects than to their appearance. This occurs perhaps because the pedestrian bridges in Tehran have not been considered as an urban element with aesthetic values and are considered as a functional element only. Furthermore, this finding is exactly in accordance with the Affordance theory by Gibson and the theory of good city form by Lynch, which argues that form follows function and believes that these two are strongly connected. [7, 8] Also the result parallels Nikoomaram et al. who argue that one of the reasons for low functional efficiency in pedestrian bridges in urban areas is related to the low quality of appearance. [6] However, after functional aspects of the bridges, respondents frequently refer to the form of the bridge. They stated that they most liked the different form of the bridges and least liked the uniformity of pedestrian bridges that was everywhere. This finding completely supports the theory of “context sensitive design” and other scholars that states that one of the main considerations for the aesthetic qualities of pedestrian bridges relates to its harmonious context [3, 9, 19, 20, 21, 22]. Also in line with the theory by Lynch (good city form) who believes that the harmonious relationship between urban elements and its context can produce aesthetic qualities and support of them. Therefore the context sensitive design of bridges would produce strongly higher aesthetic perception. [36]

Second, the color of bridges and that finding here also supports the previous findings from other scholars and the other part of the analysis from the current study that argues that color plays an important role in preferences for bridge aesthetics. On the other hand, the results show that advertisements and their harmonious interaction with surrounding, cleanliness, safety, and presence of memorable people are other themes that respondents named, respectively, as influential factors for their appreciation of pedestrian bridges. However, respondents named dirtiness, advertisements and their harm to the environment, the presence of abnormal people, improper color of bridges and lack of safety, respectively as factors that cause them not to like pedestrian bridges. These can be introduced as potential factors that may affect people’s perception for pedestrian bridges in urban areas. How does each of these variables relate to the people’s preferences and how can they predict actual preferences? These questions should be addressed in feature research.

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