

# The Effect of Footbridges and Pedestrian Subways on the Movement System Within the Urban Planning

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## Abstract

The footbridges and pedestrian subway are among the material components of the urban fabric, itself considered as one of the three important elements, i.e the public transportation special traffic units and pedestrian movement systems, of the transportation system in any part of the world, which will be discussed later. Any defect at the transportation systems elements would lead to ineffective transportation system with traffic jam and difficulties because of a defect between the surrounding environment and the movement system. Therefore, the present study discusses the effect of the footbridges and pedestrian subways on the movement system within the urban planning, the through the theoretical and practical side, applied through data collection and interviews with specialists, by asking them some unified questions and distributing questionnaires to everybody who used or didn't use the bridges or subways, within the study area. In order to achieve the study's goals, some international studies and one local case were discussed, whereby the effective application of the pedestrian systems was explored, with applied examples to reach the aspired result. Then an analytical study of the case area, located from AL-Istiklal Street until Jordan University Street, was explored in order to reach conclusions, whereby the study area's footbridges and pedestrian subways situation can be assessed and how they are applied with regard to the location, shape and use. Then some recommendations were suggested by raising the necessity to activate the role of the footbridges and pedestrian subways through the correct application of the pedestrian systems locations and improving the bridges construction and architectural criteria in order to achieve smooth, comfortable and easy pedestrian systems.

**Keywords:** Bridges, subways, urban, planning, movement and traffic systems.

## 1. Introduction:

The modern technological revolution has spread in all over the world, including in Jordan, accompanied by finding a modern vision to build a civilized country with regard to planning and design. The increase of the population, however, was accompanied by unprecedented increase in vehicles and buses at the streets, which led to aggravation of the movement and traffic problem. Therefore we can say that the planning process was incomprehensive, as it didn't take into account one of the most important strategies of the urban planning, which is the transportation and traffic system which is considered fundamental to determine the civilized and organized urban environment which is linked through the movement paths. The transportation and traffic system effectiveness is seen through the correct application of the three elements. i.e., first the public transportation system, second the special traffic units which deal with traffic jam and allowed speed and third the pedestrian movement system, such as the pavements, bridges and subways. The consequence was that new roads were opened and already existing roads expanded. So, a new problem has been created, i.e, how the pedestrian can cross the road. Therefore, it is naturally not possible to directly cut the roads, because there are no time discrepancies between buses and cars so that man can pass, so it has become imperative for the authorities concerned to find roads to facilitate traffic in the jammed streets, such as creating footbridges or subways, but these could no longer do the function for which they were established, so my study aims to know how such installations (i.e., the footbridges and subways) were affected, as they are considered as important urban elements of the movement system (the transportation and traffic) within the urban planning in order to reach conclusions and recommendations to increase their effectiveness.

## 2. The study problem:

1. The footbridges are not widely used by the pedestrians, so they are functionally ineffective.
2. There is lack in educating people how to use the footbridge, and what are the laws in this concern.
3. There is difficulty in using the footbridge.
4. No consistency exists between the footbridges and the surrounding urban space.

The high cost of constructing subways and their accompanied technical problems.

## 3. The study importance:

1. To study the footbridges and pedestrian subways and analyze their construction, aesthetic aspects and their connection with the urban environment, because they are among the most important material elements in the urban design and considered as the motors for the (cognitive separation between the vehicles and pedestrians).
2. To indicate why the footbridges are not widely used.

- 3.To discuss the traffic death accidents.
- 4.The extent of relation between the urban planning and land uses scheme with regard to the movement and traffic system.
- 5.The role of culture and laws to improve the pedestrian's behavior.
- 6.The necessity to bring coherence between the footbridges, pedestrian subways, and the surrounding urban environment.
- 7.To confirm the ability of the places adjacent to the footbridge and pedestrian subways to aid in their use.
- 8.To identify the movement lanes, away from being a mere movement axle only.

#### **4.The study goals**

1. To describe and evaluate the footbridges and subways in Amman through the case study.
2. To find future criteria for the forms of the footbridges.
3. To design the footbridges and pedestrian subways in safe planning criteria.
4. To study why there are more footbridges than subways.
5. To decrease the traffic accidents for the pedestrians, through confirming the hypothesis that there is a relation between footbridges importance and their ability to lessen the traffic accidents rate.
6. To deal with the pedestrian random use of the street by confirming the hypothesis that there is a relation between the pedestrian behavior in randomly crossing the street and the effect upon the places adjacent to the footbridges and pedestrian subways.
7. To take care of the streets environment as a wide space designed for people, just as it is designed for vehicles.
8. To confirm the hypothesis that there is a relation between the easy use of the pedestrian subways and their ability to attract the pedestrian.

#### **5. The research methodology**

The research methodology of this study was based upon two aspects, theoretical and the practical.

##### *5.1 The theoretical aspect: we will discuss the following:*

The urban planning role and its relation with its most important elements, i.e, the transportation and the traffic and to discuss why there is traffic jam.

The footbridges and pedestrian subways history in Jordan generally, since the beginning until present time.

##### *5.2The practical aspect: the following will be discussed:*

1. To make a detailed study to the area according to more than one methodology, to include the documentation and field description methods, then collect and use the data through the analytical method to reach conclusions to develop this study.
2. To prepare a questionnaire for the pedestrians in the study area, after making spatial and descriptive documentation process.
3. To make some interviews with the specialists, such as the technical department engineers of Jordan Engineers Union, and other engineers from other departments, in addition to engineers from the supervision and design department of Amman Greater Municipality as well as some engineering bureaus to ask them some unified questions.
4. To analyze the results by using SPSS (Statistical Packing for the Social Sciences) to reach conclusions and recommendations to discuss the effect of the footbridges and pedestrian subways in the movement system within the urban planning.

#### **6. The previous studies:**

Some international studies were selected, from China and the USA in addition to one local case, as mentioned hereunder, to discuss where the footbridges and subways can be correctly placed, based upon some principles and criteria and by discussing successful examples as follows:

##### *6.1(Jiang), Zheng (2012), discussion on downtown area overpass pedestrian system, China, international Journal of information and computer science.*

This study also discussed the importance of pedestrian system elements, such as the footbridges and subways and the bases in this concern, in addition to giving successful application examples which adhered to suitability and safe use of such facilities.

##### *6.2AL-Khafaji, Saba (2011), the engineering magazine, Baghdad university, Iraq, allowed for publishing.*

This study identified the aesthetic concepts of bridges and the importance to have knowledge over this matter in order to pave the way for integration between the construction and aesthetic aspects, in addition to analyzing an applied example in this concern.

6.3 Shbeeb, Lina (2011), *footbridge assessment in Amman, Road safety center of Excellence, Amman, and German Jordanian University unpublished.*

This study has analyzed the general definitions of the footbridges, pedestrian subways and passages connected between the buildings at the middle of the block and also mentioned international studies and experiences in the field of separated passage. It also made comparisons between the pedestrian systems (bridges and subways) to get acquainted with distinctive features and defects of each, then to concentrate on the footbridges, as being axle for this study, through discussing the goals and causes related to them in order to reach their specifications and places for their construction, taking into consideration the shape, form, materials used, fences height and bridge width, after that the local case was studied, i.e., the footbridge near the Safeway, Amman.

6.4 Black, J (2005), *civics lessons: Chicago's new Millennium park, is ambitious, expensive and popular, USA, Journal of the American planning Association.*

This study discussed the design of the footbridge at the Millennium park, as well as the materials used, as the designer wanted to give a natural impression, away from stagnation, as he used sculpture through the stainless steel plates, as he thinks that the bridge looks like a river whereas the other think that it is like a giant serpent with silver shells, as Jerry's works are characterized by abstraction, especially with animal forms.

## **7. The study's theoretical background:**

### *7.1 The movement and traffic system:*

The movement and traffic system, formed through organizing the movement paths, is considered as the basic element for the urban environment in order to understand our urban behaviors and how to positively deal with the environment, as it connects the pedestrian and vehicles movement and organize their urban spaces with the existence of the material and oral elements.

#### 7.1.1 The urban planning and its relation with the movement and traffic system.

The urban planning is the application of specific vision to develop and adjust the urban environment through developing and expanding certain strategies, such as the transportation and communication strategy and the land uses to achieve the biggest benefit through appropriate distribution of activities and services.

First: the technological development effect on the urban planning.

The progress in science and medicine and the big increase of the population has led to many activities, functions, schools and universities, thus necessitating the need to re-study the cities situation and how to plan in a scientific way and get away from random methods. With the construction expansion and appearance of skylights, the distances inside the cities are no longer measured with meters but with tens of kilometers, because the work places are away from the residence places, so the need for daily transport has increased, in addition to using the public and private spaces with the population increase.

Second: the effect of cities degradation on the urban planning the city is consisted of social, cultural, economic and political Fabric.

It remains strong as long as this fabric is solid, because the social issues are related to the economic ones, so when the economic situation of the population deteriorates, i.e., lesser jobs or lesser income, this would negatively affect the social built-up. The economic life is connected to indispensable basic services, such as water, electricity and communications, when the city no longer offers such services, many would leave it and reside at the outskirts. Such phenomenon is common in the developing counters, where sheet houses spread as belts, with the accompanying problems such as the transpiration and traffic. Such crises and phenomena would mean that the city lacks the safe planning and architectural organization.

#### 7.1.2 Land use planning and its relation with the movement and traffic system.

The land use and the transportation are complementary to each other because it is important to create an integrated planning. The streets are considered as a land use, which, in itself, is directly affected by the transportation infrastructure. The transport imposes certain, use methods, such as the urban land use and extension. In addition, the land use may cause big traffic jam.

#### 7.1.3 The urban environment and its relation with the movement and traffic system.

The urban environment concept: It is a group of multiple systems which work alongside each other.

The city has an environment with its specificity and contains man environmental systems which also work alongside each other. The urban infrastructure is one of the most important axles for the urban environment, as it is sometimes called the urban structure whereby all the material and moral components are assembled together.

#### 7.1.4 The movement paths

The street is not designed to be a movement path only, but also an attraction, with motivation and recreational factor. Based upon the environmental behavior perspective, the street can be defined as follows: it is the relation between the people and the environment, i.e., the result of a group and cultural and environmental (material) interventions. There is a variety of continuous sounds for the buses and vehicles and a big mixture of people, as the street is divided into the pedestrian and vehicles movement, the pedestrians, whether standing or moving,

are affected by the culture, whereas the vehicles are affected by the roads state, parks and preventive installations.

#### 7.1.5 The movement and the urban views

The movement is related to the relation between the total of the buildings and the urban spaces, because it is a system in charge of organizing the contact and the connection between the environment's different locations.

A clear picture should be taken for the movement's current system in any city, where the data are collected through the different transportation system elements (the public transport, special traffic units and the pedestrians), by considering the following:

First: the public transportation system's elements, such as the network length, form and its affect field.

Second: the transportation system's elements and special traffic units, such as the roads network and knowledge about the traffic characteristics, such as speed and jamming places.

Third: the pedestrian's movement system's elements: through knowledge about the pedestrian roads network and the special locations, such as the pavements, barriers, bridges, tunnels, and pedestrian passages. Any deficiency in these elements would lead to ineffective transporting system, accompanied with traffic jams due to incoherence between the surrounding environment and the movement system.

#### 7.1.6 The space- behavior relationship

The built environment plays an important role in our behavior and experiences. Some sociologists have indicated that by manipulating the built environment, we can control the people's behaviors and experiences. The behavior is a function for two types of cultural and material factors, because the behavior is originally cultural, whereas the environment is materialistic which may support or ban the behavior. Some studies have indicated that the absence of the noise, heat, water pollution and congestion is a pre-condition for the ideal environment.

The tension has become common, for example, due to the above mentioned environmental factors, so it is used to explain wide and varied outcomes, mostly negative, whereas the congestion is a basic source for different diseases, such as the psychosis. Kevin Lynch indicated in a study entitled the congestion diseases, that the congestion's psychological study has confirmed a big connection between the street and a congested room. Therefore the squares and parks are important in ensuring two open lungs to enable people to escape from the congestion and the obstruction.

### 7.2 The bridges

The bridges were constructed since the old ages, first with the timber bridges, formed by tree timber by exploiting the falling of a tree at a valley or through a small river, so people used to go from one bank to another. Our ancestors had seen this idea, implemented and developed it over the years until present time.

#### 7.2.1 Types of bridges with regard to the materials and use method

1. The timber bridges
2. The metal bridges
3. The concrete bridges

7.2.2 The materials used in bridges were developed from timber to stone plates with a central support. Then the steel was used in the year (1890), after that, the iron was used since the (18th) century.

Big suspended bridges were used at the beginning of twentieth century, along with fortified concrete. The bridges at present time can withstand bigger loads continuously and from mid (20th) century until now, the per-tensed fortified concrete began to be used.

### 7.3 The tunnels

1. It avails reaching the underground
2. The tunnel is a connection between two points
3. It is a linear rectangle, digger underground, with certain length, width and height.

### 7.4 Bridges and tunnels in Jordan history

Jordan has been the center of attention since the old ages, for many prosperous cultures due to its climate and location variation and being a channel for commerce traffic for the Roman and Ottoman civilizations.

#### 7.4.1 Footbridges and pedestrian subways in Jordan at present time

There are currently (128) footbridges and (5) pedestrian subways in Jordan. The materials used are either concrete or metal. The first metal footbridge was constructed in front of (Saleem AL-Refae) school in the year (1994). The concrete footbridges were used since (2002), as (Sabri Farah) company is in charge of manufacturing them. The first pedestrian subway was established in the year (1994), Jordan university subway.

#### 7.4.2 Footbridges accidents

There were several footbridges accidents, so people began to use it lesser, because the traffic accidents increased, including the collapses, because trailers collide with them between time and time, so the pedestrians began to be afraid because it is unsafe and cannot bear the surprised abnormal conditions, also it was uncomfortable. Therefore this research deals with such problems and how they can be avoided.

Summary of traffic accidents in Jordan for the year (2011), according to Jordan traffic institute

1. The traffic accidents increased from (140014) in (2010) to (142588) accident in (2011) with 1,8% increase.
2. The death due to the traffic accidents increased from (670) in (2010) to (694) in (2011), i.e., 3,6% increase.
3. The traffic accidents cost in Jordan is JD 314, 5 for the year (2011)
4. The pedestrians accidents were 7% of the total accidents, resulting in 27,6% of total deaths and 17,9% of the total injured people, whereas the collision has constituted 96,7% of the total accidents, causing 57,2% of the total deaths and 73,1% of the total injured.
5. The height pedestrian death rate was among the group age 3-5- years, with 13% of the total deaths and 15, 74% of the total injured.

### **8. The study area:**

The study area is the venous road extension from AL-Istiklal street, connected with the Interior Ministry circle and the sport city circle until Jordan university road, i.e., eleven kilometer and (500) meter, with (15) footbridges and two pedestrian subways. If we classify the footbridges upon the construction materials, (8) are metal and (7) are concrete. The reason for choosing this road is because it is a main venous road in Amman and contains many cultural, educational, health and governmental facilities, causing thick traffic movement, so there were many traffic accidents, even though the speed is 60-70 KM. this study will analyze these footbridges and subways from many aspects, such as the location, how they are connected to the surrounding environment and pedestrians movement. A questionnaire was also prepared and distributed to the pedestrians along the study area, with a total of (750) samples with (50) samples for each footbridge. Also (30) engineers from the governmental and private sectors were interviewed and a number of questions were asked with some results which will be of benefit for the movement system within the urban planning.

### **9. The conclusion:**

*9.1 The study area's questionnaire analysis has revealed the following:*

1. The pedestrians feel uncomfortable when they use the footbridges. An age categories comparison has revealed that the age group (37) years and older are the most who feel uncomfortable.
2. The safety factor felt by the total sample was neutral, but by using the statistical analysis system upon (Anova) test, the age group (5-10) years old are the most who feel that the safety factor is absent.
3. The questionnaire results have revealed that the distance to reach the footbridge is the shortest possible.
4. The result regarding the question "where footbridges and subways should be located" is far away from the correct place.
5. The questionnaire has revealed that the pedestrians randomly cross the road and don't use the footbridges.
6. The samples said that the footbridges are least used in Amman.
7. The samples said that the places adjacent to the footbridges and subways have a big effect on them.

*9.2 The result of interviewing the specialists has revealed the following:*

1. They think that people don't feel comfortable to use the footbridges because they are not attractive.
2. The results showed that the urban environment has a big effect on non-using the footbridges and subways.

### **10. Recommendations:**

*10.1 To encourage the people to use the footbridges and subways and to motivate them through availing the comfort ability. The study result has shown that the age group (37 and over) is the most who use the footbridge, but they are also the most who suffer. The comfort ability means can be through:*

1. The variety of people using these systems, including the old aged and people with special needs as they use the footbridges which are uncomfortable for them, so they should be improved by using electric ladders and slopes.
2. Many public and private companies expose their promotional advertisements at the footbridges in such a manner as to limit the vision at its sides, in addition to the barriers, so people feel uncomfortable. So these promotional advertisements and barriers should be taken away because people can't walk freely. Also footbridge codes with new dimensions can allow the movement of a bigger number of people.
3. The previous studies have shown the importance, benefit and success of the shadowed footbridges because they attract more people who feel comfortable because they are protected from the rain in winter and sun in summer. The study area showed that only two out of (15) footbridges are shadowed because they cost more money by the private companies, as these belong to them, whereas the naked footbridges belong to Greater Amman Municipality. So, more shadowed footbridges should be used so as to be comfortable in summer and winter, taking into consideration the followed financial policy.
4. To completely disregard the normal functional role of the footbridges through making it attractive and an icon for the people and activate it as tourist attraction place and not a mere movement system. Its location should also be distinguished, in addition to its architectural design of each footbridge.



*10.2 With regard to the safety factor by using the statistical analysis system, the age group comparisons have shown that the age group (5-10) years most feel that safety is absent. So, we suggest the following:*

1. To classify the footbridges to metal and concrete, each with their special features, as mentioned through the study in addition to making the necessary periodical maintenance. The metal footbridges are constructed by using the fixation instruments and electric welding which resist for a long time if they are regularly maintained because of the oxidation and corrosion. The concrete footbridges are constructed with extension joints, so the concrete is directly affected by the rise or decrease of the temperature, so they should be regularly and periodically maintained to ensure their safety.
2. The lighting has a big role to attract more people to use footbridges because it has an aesthetic aspect on the eye and psychological effect as people feel safe. However, the footbridges of the study area are empty during the night, whereas lighting on the shadowed ones are only for promotional advertisements and not the whole footbridge. In addition, lighting should be made available to the subways all the night over not only for the period where the shops remain open.
3. There is lack of safety, with increased rate of crimes, theft and number and beggars, so people have stopped using the footbridges and subways alike. So it is imperative to avail control cameras, connected with the authorities concerned, to ensure safety.
4. Many people feel afraid of using the footbridge because the protection factor at its side is of simple height. The previous studies have also dealt with such matter. So full protection should be made available by using either full fences or above the person's height.

*10.3 The distance to be cut by the person to reach the footbridge through the statistical analysis system of the study area, was the least possible, with a rate of 40,3%. So the distance amount cut by the person to reach the footbridge can be handled through:*

1. The effective pedestrian systems are distinguished by their high ability to achieve the goal for which they are constructed. Increasing the distance to be cut to reach the footbridges or subways can be attained only through making them comfortable and eliminating any hurdles in their way. Also, all pedestrian systems, such as pavements and passages, should have the capacity to accommodate an increased number of people.
2. Many previous studies have shown the importance of the places adjacent to the footbridges which, if directly connected with them, should make it more easy to access to such systems, in addition to not sensing the distance to be cut to reach the adjacent side.
3. The Arab region's climate is severe, so people are discouraged to walk long distances to use such systems. Therefore this can be handled at the urban design process for the pedestrians to encourage them to walk longer distances to reach these systems.
4. If the urban design process is characterized by continuous and consecutive aspects, then people can be motivated to cut longer distances without feeling tired. This can also be done by creating architectural formations characterized by coherence and visual variation to find a meaning for an urban scene with sensual, visual and functional features.

*10.4 The results of the study area questionnaire have shown a random behavior with a rate of (37,95) so this has an effect upon not using the footbridges. This can be handled through analyzing the random behavior of people at the urban environment and through the following:*

1. To fully understand the fixed and moveable nature of pedestrians and to give them full access to all pavements, passages, footbridges and subways with the agreed upon specifications and to apply these at the correct location and this can be done by offering full movement freedom without affecting their behavior.
2. The importance of popular participation in the areas where the planning processes are made, through listening to their opinions and needs in order to satisfy them, in addition to convincing them and what is being planned and that they have a big role in the urban planning process, because this would have a positive effect upon their behavior.
3. The importance of the environment adjacent to the footbridges with regard to the architectural and construction aspect. It is important to discuss the nature of the buildings adjacent to the bridges because it is necessary to combine between their design and the design of buildings to be constrained on their intersections in order to concentrate on the contact with the adjacent environment which has a big effect in this regard.
4. The effect of the culture and knowledge about the laws on the pedestrians random behavior, as the study area's questionnaire has revealed that the age category (5-10) years old are the least who use the footbridges because they don't have the culture or knowledge. Therefore it is important to intensify the traffic safety campaigns for the school students.
5. The role of the legislations and laws to limit the false behavior of crossing the streets, even if a law is adopted to impose fines on people who randomly cross the streets or those who don't abide by the traffic rules in order to decrease the traffic accidents, in addition to making them responsible for the accidents, along with drivers.

6. The role of Ministry of Transport and Communications to regulate the traffic, through adapting laws and systems to alleviate the traffic jam, for example by making the Ministry issue a public notice to all transport means, such as the buses, vehicles ... etc., that the footbridges and subways are obligatory stations for people to step in or out in order to lessen the long distances for them.

#### *10.5 The urban planning*

The problems related to the administrative procedures in planning and the weak coordination between the administrations has created big gaps in the urban planning process. So we suggest to handle with them through preparing comprehensive planning studies and through a comprehensive view to all the strategies in such a manner as the short time plans should be connected with the long term ones based upon certain indications such as the historical background and the environmental limitations (the topography, population distribution and density) because the urban planning has a big effect on the movement system, as the upper structures serve the infrastructure (such as water drainage... etc.).

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