

## THE INFLUENCE OF STREET'S ELEMENTS ON WALKABILITY: A CASE OF COLOMBO 07

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**Abstract:** The walking behaviour of pedestrians continuously depends on street design and its quality. In Asian countries, streets have evolved from traditional streets without interpreting the actual need and impact of street elements for walking behaviour. However, they act only as transportation links while limited to the name by itself. This research aimed to identify the street elements that influence walkability and to investigate the most influential factor for walkability in terms of “Link and Place” to promote walkability in the Sri Lankan context. This study was conducted using a mixed-method approach. The on-site observations were carried out through a photograph survey and rough sketches to observe the street elements. Later, findings were validated through the questionnaire survey regarding the seven principles of a walkable street. Then, data were analysed by using descriptive analysis and correlation analysis aided by SPSS software. The findings of the observation and questionnaire revealed that there are nine most common street elements of streets which influence walkability in the Sri Lankan context. Finally, the study agreed that both “Link and Place” functions are equally important for the walkability of pedestrians.

**Keywords:** *Pedestrians, street elements, walkability, Link and Place*

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### 1. Introduction

Walking is the primary transportation method for most people in their everyday routine. The street environment plays a major role in walkability because it encourages people to walk and inspires the street as a destination for economic and social activities. According to Khder et al (2016), the street can be identified as the backbone of the urban context which supports movements and accessibility of pedestrians. However, the impact of streets in walkability is a timely topic to be discussed in terms of urban planning. Most of the time, these two areas were studied separately at different times. Shaaban (2019) said that walking has been focused on by urban planners, urban designers, and architects as an indication of sustainable transportation in the built environment. As Southworth (2005) stated, the ability of the place to connect people with various destinations within a specific time and effort defines as walkability. This provides visual interest and attractiveness of the network during the journey. The view of modernism interprets the suitable street design can considerably enhance the quality and quantity of walking behavior. Marshall (2005) presented that a street can be seen as a road that happens to have an urban character; or as an urban place, that happens to serve as a right of way.

Cervero and Kockleman (1997) introduced three Ds which are design, density, and diversity. The ‘design’ factor is the most influential and relevant variable in walkability. It shows urban design incorporates the geometric elements like streets, street furniture, buildings, blocks, natural features, and vegetation in a city form directly or indirectly experience by the pedestrians. Barros et al (2017) showed the importance of exploring the concept of urban form in light of how the elements that make up the urban space are arranged and relate to each other, either from a bi or three-dimensional perspective. Previous researches on the street and walkability have mostly concentrated on street patterns or types of streets rather than the street elements and its impact. Khabiri et al (2020) showed that the effects of the physical dimensions of a place had been underestimated in walkability. Some researchers suggest that further research needs to address non-planner approaches. Some suggestions include examining the impact of walkability in different scales of an urban form like cities, suburbs, and neighborhoods. These studies highlight that street elements are principal components of a street that influence on walking status.

Therefore it calls the need of investigating it deeper. In the recent past, this relationship has been considered a key factor of street design by urban planners in American cities.

The streets in Asian countries have evolved from traditional streets without interpreting much on its actual need. As Dayaratne (2011) presented, the journey of Sri Lankan towns through streets is frequently disrupted by noises, conflict with vehicles, crowded sidewalks, disturbance from vendors, and various obstacles like billboards and lamp posts. Due to that, the street act only as a transportation link while limited to the name by itself. In past decades, the importance of streets had arisen with unorganized pedestrian movements and high traffic congestion. So, the implementation of appropriate street design is a challenge in the Sri Lankan context. Thus the main objective of the research is to identify the street's elements that influence walkability and to understand the interrelation of those aspects. This can be achieved by answering the research questions on what are the elements in streets that influence walkability and thereby finding the most influential factor of the street according to the "Link and Place" concept that promotes walkability which can be utilized in creating more walkable streets.

## 2. Literature Review

### 2.1. DEFINING THE WALKABILITY

Walkability is a concept that has been used to measure the pedestrian movement of a place. This term had been discussed since the early nineties by urban planners, urban designers, and architects as a sustainable transportation method. Table 1 highlights definitions and most discussed attributes of walkability per various studies.

Reference	Definition	Attributes
Litman (2011)	"The quality of walking conditions in an urban space which is inclusive of comfort, safety, connectedness and permeability".	comfort, safety, connectedness and permeability
Speck (2012)	"Gratify four main conditions; it needs to be safe, useful, comfortable and interesting. Each of these qualities needs to move towards together and none alone is satisfactory."	safe, useful, comfortable and interesting
Moayedi et.al (2013)	"Measure walkability through the quality of streetscape design, land use pattern, building accessibility and social safety."	streetscape design, land use pattern, building accessibility and social safety
Afsar, Yunos, & Yusof (2015)	"Walkability focuses on livability, accessibility, safety, street connectivity by streetscape elements and pedestrian activity".	livability, accessibility, safety, street connectivity, streetscape elements, and pedestrian activity
Mohd Syazwan et al. (2018)	"Walkability is the quality of waking state, comprises of safety, comfort and convenience attributes".	quality of waking state, comprises of safety, comfort and convenience attributes

Table 1: Definitions of Walkability (Source: Compiled by author, 2020)

#### 2.1.1 Principles of a Walkable Street

Rafiemanzelat illustrates that the "walkability and built environment have a strong relationship together by social and physical variables which make a vital and sustainable space" (Rafiemanzelat et al, 2016,p.103). A well-designed street with a presence of pedestrians is an active social place with a high level of communication. Past and recent studies discover that there is a significant relationship between the built environment and walking activities. So, Khder, Mousavi, and Khan (2016) group these

characteristics of a walkable street as the street design criteria. Accordingly, the principles regarding walkable streets are;

- *Connectivity*: Connectivity refers to straight paths and also shorter distances to reach the desired destinations that offer multiple routing options for a diverse range of activities, resources, services, and places, encouraging physical activity.
- *Safety*: Safety is considered important within the pedestrian network for people of different ages from the dangers of crime and traffic.
- *Accessibility*: An accessible place is capable of being used by people of all ages and mobility levels. Such an environment is considered as quality walkways to get their destinations or transit nodes easier and quicker.
- *Comfort*: A comfortable place is an environment where providing a sense of ease and enabling a feeling of personal safety. It should give the best walking experience and aesthetics of the environment.
- *Convenience*: A convenient place is a location with a clear image and legibility. The area is easy to understand, providing a sense of being near-at-hand with visual cues and physical directness to a pedestrian's most essential need.
- *Engaging*: An engaging place is a visually rich aesthetic setting with interrelated parts, providing a sense of contentment and enabling both formal and informal forms of social exchange.
- *Vibrant*: A vibrant place is an area pulsating with life, vigor, and activity. Many of these attractions are on how to support and enhance the holistic pedestrian experience along the routes to each destination.

## 2.2. DEFINING THE STREET

The street is one of the most important parts of a city which provides access through the city. As illustrated by Rafiemanzelat (2016) streets are generally used by vehicular movement as a pathway or transportation linkage. Kostof (1992) stated that the streets play an important role in city life while contributing to economic, social, environmental, and cultural manifestation. Jacobs (1961) stated street as a space to represent the outdoor space and he introduced the concept of "Great Street" which emphasizes the list of pedestrians' requirements. According to Moughtin (2003) the street can be defined as an enclosed, three-dimensional space between two lines of adjacent buildings, it is not only a means of access but also an arena for the social expression. He explained that the street or a section of a street consists of three main elements; an entrance, the place itself, and an end or exit to keep the quality of the street enclosure. Thus, the street is a combination of image, activity, and form as a built environment. Khder et al (2016) stated that this built environment includes tangible elements like road width, sidewalk, street furniture, and urban amenities.

Similarly, Frank and other's 2003 study (cited in Khder et al ,2016,p20) states that the "well-structured street designs based on the elements make it easy for pedestrians to opt for walking based on their build environment perception". Previous studies of Ewing et al (2006) developed walkability frameworks to highlight urban design qualities to assess the degree of objectivity by outside observers, though not with the objectivity of physical features.

## 2.3. "LINK AND PLACE" CONCEPT

The concept of "Link and Place" claims that the urban streets provide the setting for a wide range of urban activities which can be grouped under two broad types of street functions namely 'Link' and 'Place'. As a **link**, a street provides a conduit for movement and forms an integral part of the wider urban street network and other, more specialized, urban transport networks. As a **place**, a street is a destination in its own right: a location where activities occur on or adjacent to the street. Figure 1 show how the derived street elements are categorized into walkable principles and each principle is based on extensive research and literature to reflect its unique features that are considered under pedestrian environments and walkability which then were sorted out with the characteristic of "Link and Place" functions. The principles of safety and convenience affect both functions of link and place.

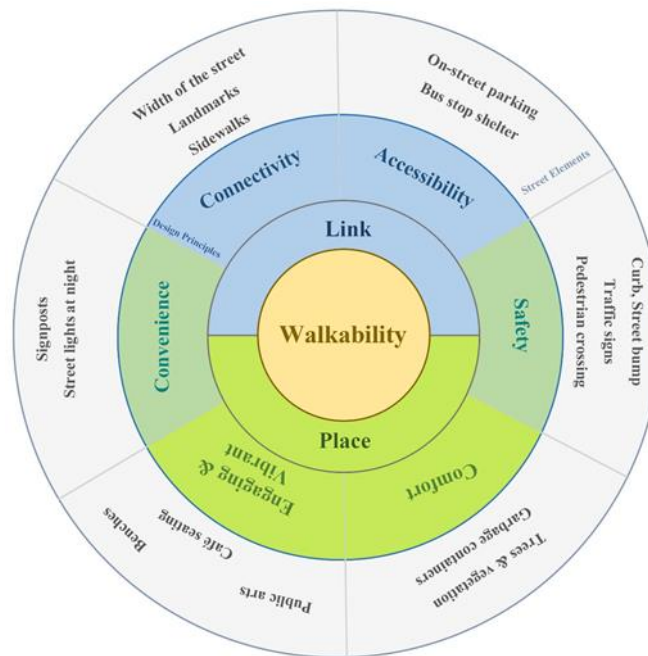


Figure 1: Conceptual Framework (Source: Compiled by author, 2020)

### 3. Methodology

The mixed-method approach is followed to collect primary data. On-site observations were used as a qualitative method to collect data about the street elements on walkability. Prior to the observations, a pilot study was conducted to identify the situation of the streets. Afterward, on-site observations were conducted for two weeks from 9 a.m. to 6 p.m. covering both weekdays and weekends. Accordingly, the selected streets were observed as an active participant, and data recorded as sketches, photographic surveys, and video records.

The information related to the level of influence on street elements, walking behaviour, and principles of the walkable street were collected using a questionnaire survey as the quantitative method. A random sampling was used where pedestrians were included as respondents. According to the pilot survey, the average pedestrian count was 552. So, it was expected to gather information from a sample of 150 participants in the case study areas. The confidence level is 90% and the marginal error is 6%. The survey was conducted for 154 participants to ensure the reliability of the study.

#### 3.1 CASE STUDY AREA

Dayaratne (2011) in his study introduced three distinct groups of streets that can be recognized and characterize today in Sri Lankan society and space. They are; traditional rural, traditional urban, and modern urban streets. The modern urban streets have been categorized under three groups (Figure 2) and the case studies were selected considering the category of multifunction streets.

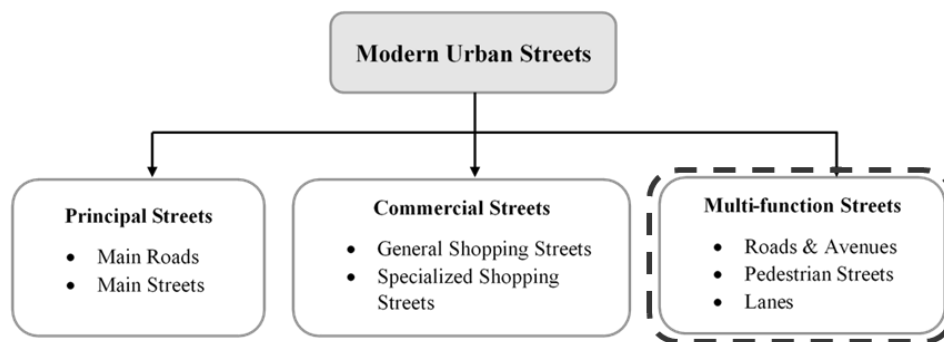


Figure 2: Classification of Modern Urban Streets (Dayaratne, 2011)

The selected three streets are Green Path, R.G. Senanayake Mawatha, and Premakeerthi De Alwis Mawatha, situated in Colombo 07, widely known as Cinnamon Gardens, one of Colombo's plushest suburban residential areas. The streets are open exclusively to pedestrians and cyclists who come for different purposes and the selection of these streets caters the objective of studying streets in present context which majority falls in to the category of modern multifunctional urban streets.

#### 4. Results and Discussion

##### 4.1 OBSERVATION AND IDENTIFICATION OF STREET ELEMENTS

According to the literature of walkable streets, sixteen street elements that influence walkability were derived and a conceptual framework was developed to understand the position and relation of each element with the principle regarding walkable streets. Hence, the findings of on-site observations were categorized as per the identified four zones. Table 2 shows the common nine street elements which can be identified in Sri Lankan streets. Yet, bus shelters, café seating, and public art which are categorized under building zone did not contain in these streets.

Category	Element
Travel Zone	Landmark
	Curbs
	Traffic signs
	Pedestrian crossing
Amenity Zone	Street light
	Signposts
	On-street parking
Sidewalks & Landscape Panel	Sidewalks
	Trees & Vegetation

Table 2: Common street elements in the case study area  
(Source: Compiled by author, 2020 from onsite observations)

In the questionnaire, a Likert scale was used to value most to fewer influenced elements for their walking behavior by pedestrians. In Green Path, the most influenced elements for walkability are the width of the street, sidewalk, trees, garbage containers, street lights at night, and art display. Pedestrian crossing and vegetation are the most influential factors for the other two streets. Other than that, pedestrians had been identified street bumps as an important element to increase their walkability. Generally, less influenced elements for walkability are café seating, and benches in these streets. Table 3 shows the most influenced street elements for walkability in Sri Lankan streets.

Category	Element
Travel Zone	Width of the street
	Street bumps
	Pedestrian crossing
Amenity Zone	Street light
	Garbage containers
Sidewalks & Landscape Panel	Sidewalks
	Trees & Vegetation
Building Zone	Public Art (Art Display)

Table 3: Most influenced street elements in the case study area  
(Source: Compiled by author, 2020 from questionnaire survey)

##### 4.2 THE MOST INFLUENTIAL FACTORS OF THE STREET ACCORDING TO THE "LINK AND PLACE" CONCEPT

When considering the relationship between principles of a walkable street (Figure 3), more than 85% of respondents agreed that street elements of the particular street ensure connectivity, accessibility, safety,

and comfort principles. Though, 66% of pedestrians say that street elements of those streets do not give a clear understanding and provide directions for walking. There is a lack of convenience in the case study and it creates a negative image of the street. More than half of the respondents (62%) say that the streets do not help to increase the activities and people's engagement while attracting pedestrians to a walk. Green Path, R.G.Senanayake Mawatha, and Premakeerthi De Alwis Mawatha fail to provide a sense of contentment and livability. Furthermore, the relationship between the interactions of pedestrians indicates the connection between each principle and how it impacts each other. So, the results indicate that there is a statistically significant positive relationship between the four principles. Street elements of connectivity and accessibility are common to increase or decrease walkability. At the same time, the principles of convenience, engaging and vibrant also may increase or decrease relatively because of the impact of street elements in both.

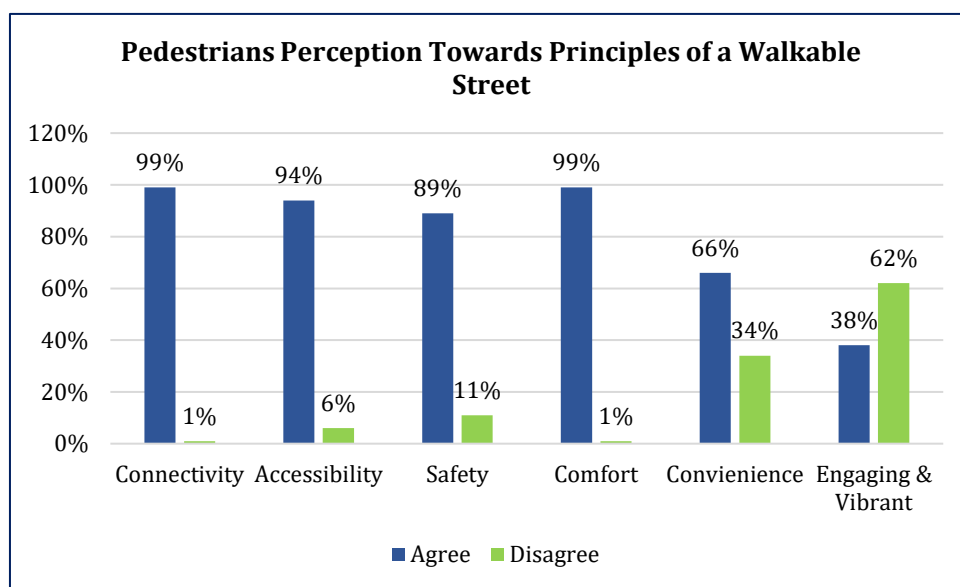


Figure 3: Pedestrians Perception towards Principles of a Walkable street  
(Source: Compiled by author, 2020 from questionnaire survey)

Respondents stated their satisfaction level on the principles regarding a walkable street in the existing situation. The results indicate (Table 4 and Table 5) that there is a statistically significant positive relationship between overall satisfaction level, convenience, engaging, and vibrant. It describes convenience, engaging, and vibrant mean to be the possible reasons for the increment or decrement of the overall satisfaction level of walkability. The pedestrians would be more satisfied with the street elements related to convenience, engaging, and vibrant which increase the “place” character of the street.

Correlations			
	Accessibility	Comfort	Engaging_and_Vibrant
Connectivity	.307**	-0.009	0.063
Convenience	.202*	.161*	.470**

Table 4: Relationship between principles of a walkable street  
(Source: Compiled by author, 2020 using SPSS from questionnaire survey)

Correlations						
	Connectivity	Accessibility	Safety	Comfort	Convenience	Engaging_and_Vibrant
Overall_satisfaction_level_of_walkability	.193*	.185*	.142	.059	.405**	.458**

Table 5: Relationship between satisfaction level and principles regarding walkable street  
(Source: Compiled by author, 2020 using SPSS from questionnaire survey)

The condition of the sidewalks and greenery in Green Path and Premakeerthi De Alwis Mawatha has made approximately 90% of pedestrians spend more than 15 minutes on these streets. Although, the majority of pedestrians (40%) in R.G.Senanayake Mawatha (Figure 4) spend more than one hour, the status of the street and the purpose of the pedestrian has governed it as those users are mostly school van drivers and parents. The frequency of pedestrians (Figure 5) indicates how many times they use that particular street on their daily basis. Accordingly, 39% of the pedestrians of Green Path, 58% from the pedestrians of R.G.Senanayake Mawatha, and 70% from the pedestrians of Premakeerthi De Alwis Mawatha use the street daily as these streets leads to their job destinations. However, 33% of the pedestrians using Green Path use it during the weekends.

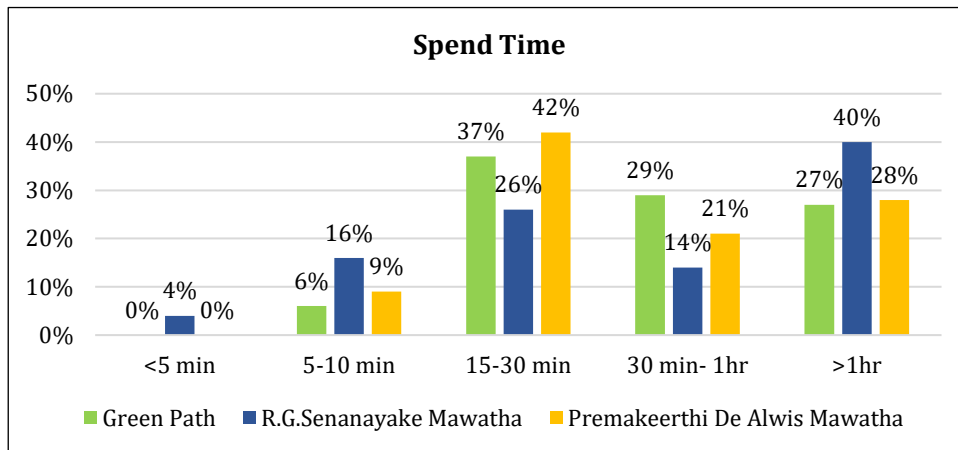


Figure 4: Spend Time  
(Source: Compiled by author, 2020 from questionnaire survey)

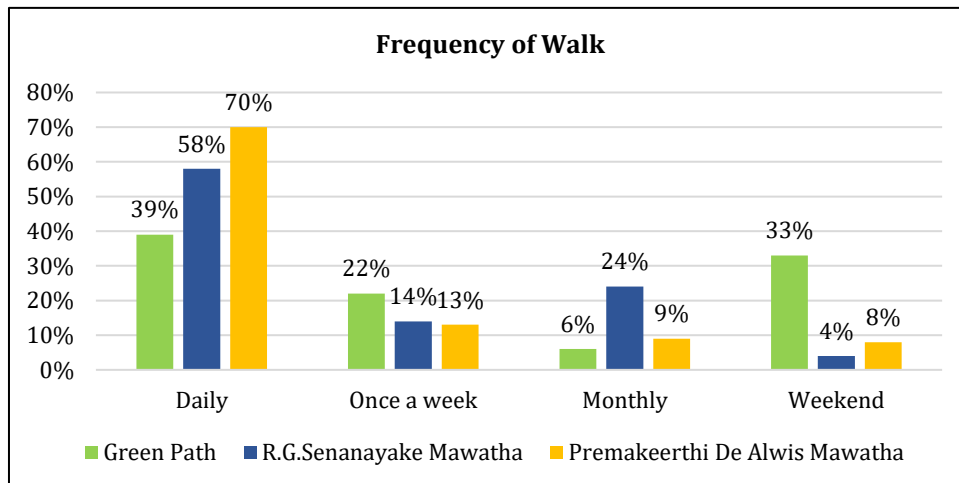


Figure 5: Frequency of Walk  
(Source: Compiled by author, 2020 from questionnaire survey)

There were several identified reasons for pedestrians to walk (Figure 6). They walk through the streets to fulfill their requirements within a period. Accordingly, 49% of pedestrians come for recreation and 20% of pedestrians come for social gatherings in Green Path. Further, the majority (48%) of the pedestrians in R. G. Senanayake Mawatha use the street for other purposes like school van parking, waiting, and religious affairs. 22% of pedestrians come for social gatherings and social interactions where they tend to be in small groups and use sidewalks to communicate with each other. The main reason for walking in Premakeerthi De Alwis Mawatha was highlighted as working or business.

According to the above findings, walking behavior of pedestrians is depending on the availability of street elements. The reason for the walk and frequency of walk (Table 6) depends on the availability of street elements its accessibility, engaging, and vibrant factors.

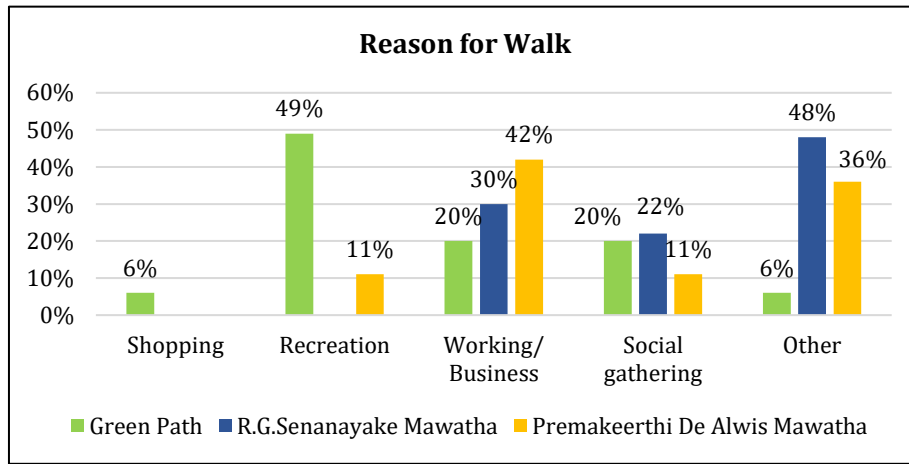


Figure 6: Reason for walk  
(Source: Compiled by author, 2020 from questionnaire survey)

Correlations						
	Connectivity	Accessibility	Safety	Comfort	Convenience	Engaging_ and Vibrant
Reason_for walk	-.085	-.256**	.137	-.035	-.067	-.435**
Frequency_of walk	-.081	-.054	.051	-.013	.113	.256**

Table 6: Relationship between walking behavior and principles regarding walkable street  
(Source: Compiled by author, 2020 using SPSS from questionnaire survey)

The final analysis is based on the perception of the “Link and Place” concept. As Jones (2008) cited, the street design should influence by both link and place that user needs to determine the appropriate balance of street space and capacity. The percentage of respondents was calculated as an amount from the sample size. Accordingly, 54% of respondents stated these street elements under relevant principle emphasize street as a “link” rather than a place in the existing situation. This highlights the streets in Colombo 07 that falls under “multi-function modern urban streets” act as a transportation link rather than a pedestrian destination.

Afterward, the pedestrians were asked to prioritise the principles of the walkable street according to their perception through the questionnaire survey. This was to emphasize how they sense and expect the streets in the future to be. The final result (Figure 7) shows both “Link and Place” functions are equally important for pedestrians and they consider both functions to be equally important for their walking behavior. It emphasizes that the street elements under each principle of the walkable street have great consideration for different purposes like recreation, living, walking, shopping, relaxing, and waiting.

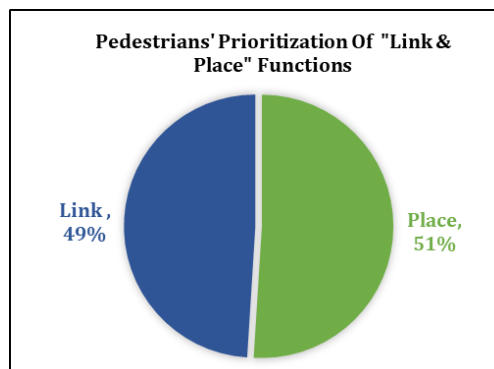


Figure 7: Pedestrians' Prioritization of “Link & Place” Functions  
(Source: Compiled by author, 2020 using questionnaire survey)



## 5. Conclusion and Recommendations

This study explores the street's elements that influence walkability and its interrelation to principles of walkable street and the concept of link and space. The findings from on-site observations highlight that the three streets contain not only general elements but also some specific elements on walkability. Thus, built environment factors at each scale may differ. The finding of the questionnaire survey confirms the results of observations. These results emphasise which street elements have a significant relationship on walkability and pedestrian. The results of descriptive and correlation analysis explore the relationship between those six principles and the overall walking behavior of people. It found that the principles of connectivity, accessibility, safety, and comfort are ensured in the case study area due to the availability of relevant elements.

Another finding is that, though the convenience, and engaging and vibrant principles shows a significant positive correlation where as per the developed conceptual framework it highlights the association of link and place, it indicates that there could be other elements which could influence the walkability. Although analysis has not extended to modeling stage, the moderate strengths of these correlations will lead into lower R<sup>2</sup> value. Further as per the findings, the street elements in both connectivity and accessibility are common to increase or decrease the walkability. Finally, the results of the expected level show the percentage of total values closely equal because pedestrians considered that both functions are equally important on walkability. Likewise, the "Link and Place" concept confirms that the street design should influence by both link and place aspects where it helps to determine the appropriate balance of street space and capacity.

The results also give an insight into further research areas. Further studies may examine the unobserved street elements under this conceptual framework like kiosks, bicycle lanes, and building-related elements such as archways to improve the effective framework in street design. Also, those can be focused on the walkability of other categories of modern urban streets; principle streets, and commercial streets as a comparative study. This study serves as a basis for street design in the Sri Lankan context by establishing street elements that support walkability which will lead to a healthy and active community.

## 6. Acknowledgments

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