IDENTIFYING AND MEASURING URBAN DESIGN QUALITIES RELATED TO WALKABILITY – SPECIAL REFERENCE TO JAFFNA DOWN TOWN

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October 2016

DECLARATION

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ABSTRACT

Walkability is an important concept in sustainable urban design and active living life. Walkability and walking behavior of the people are being decided by the significant physical features and urban design qualities.

This research mainly focuses on identified and measured urban design qualities related to Walkability -special reference to Jaffna downtown. Eight urban design qualities have been selected for the subsequent study.

The main objective of this research is "Evaluate how urban design qualities influence in the Walkability to identify and measuring selected urban design qualities such as Imageability, Legibility, Transparency, Enclosure, Human scale, Linkage, Complexity and Coherence.

Significant physical features and Urban design qualities related physical elements like courtyard, plazas, water bodies, parks, non - rectangular buildings, buildings with identifiers, street furniture, windows, wall, building colours etc. were collected and measured through Photographic survey, Walking through method, Mind map and Interview with people.

Urban design qualities related physical elements are poor in condition within the downtown and they are not contributing to the Walkability. Only hospital street is enhanced the Walkability through related urban design qualities. The major urban design qualities related physical elements such as square, plazas, parks, major landscape features, outdoor dining, street trees are unavailability within the town and present setup of the long sight lines, street wall, windows and building accent colours are also not upgrading the urban design qualities. Finally, Poor and unavailability of physical elements of the urban design qualities is the major reason to the low Walkability and Walking behaviour of the people.

Therefore, urban design qualities related physical elements have to enhance to increase the Walkability. Mainly related institutions like UDA, JMC, RDA and Archeology department will prepare and design to upgrade the urban design qualities.

DEDICATION

Dedicating to my loving Mother **Mrs. Komathy Jahanmohan** who has been always been positive role model in my life.

ACKNOWLEDGEMENTS

I'm deeply indebted to my principle supervisor Archt. Senaka Dharmathilake and Dr.Janka Wijesundara course director of Masters programme in Urban Design in the department of the Architecture, University of Moratuwa for their guidance, supervision and devoting their valuable time to make my dissertation in to reality.

My sincere thanks also goes to Dr. Gamini Weerasinghe, Head of Department of Architecture, University of Moratuwa for their valuable advice and encouragement.

Furthermore, I also wish to thank all the other academic and nonacademic staff of the department of architecture, for the assistance given to me in numerous ways.

My gratitude also goes to all the institutions and organizations, which provided me with their kind assistance to obtain necessary information and services.

Finally, my word of thanks goes to my dearest mother for her blessings; my colleagues and all the others who helped me in numerous ways to accomplish this project in a successful manner.

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LIST OF ABBREVIATIONS

Abbreviation	Description
UDA	Urban Development Authority
RDA	Road Development Authority
JMC	Jaffna Municipal Council

LIST OF APPENDICES

CHAPTER: ONE INTRODUCTION

1.1 Topic Explanation

Walkability is a measure of how friendly an area is to walking. Walkability has many health, environmental and economic benefits and is an important concept in sustainable urban design. (Wikipedia).

“Walkability is a construct as mental images or representations of intangible things that are thought to exist but not in a material or physical form and a construct cannot be observed directly precisely because it is intangible” (Aneshensel, 2001)

Walkability is a main theme in urban design concept and it is the best solution to solve high urbanization and urban issues specially traffic related problems in the urban design theme.

This research has identified and measured urban design qualities related to Walkability using related physical elements (Long sight lines, street furniture and manmade features etc.) of the urban design qualities.

The Urban design literature identifies numerous perceptual qualities of the urban environment that may influence walking behavior. The long list of perceptual qualities in the literature. This effort led to selection of eight urban design qualities for subsequent study: Imageability, legibility, visual enclosure, human scale, transparency, linkage, complexity and coherence**.**

This research focuses on urban design qualities that make one street more walkable than another and the Main objective of this research is "**Evaluate how urban design qualities influence in the walkability to identify and measuring selected urban design qualities such as Imageability, Legibility, Transparency, Enclosure, Human scale, Linkage, Complexity and coherence of special reference to Jaffna Downtown.**

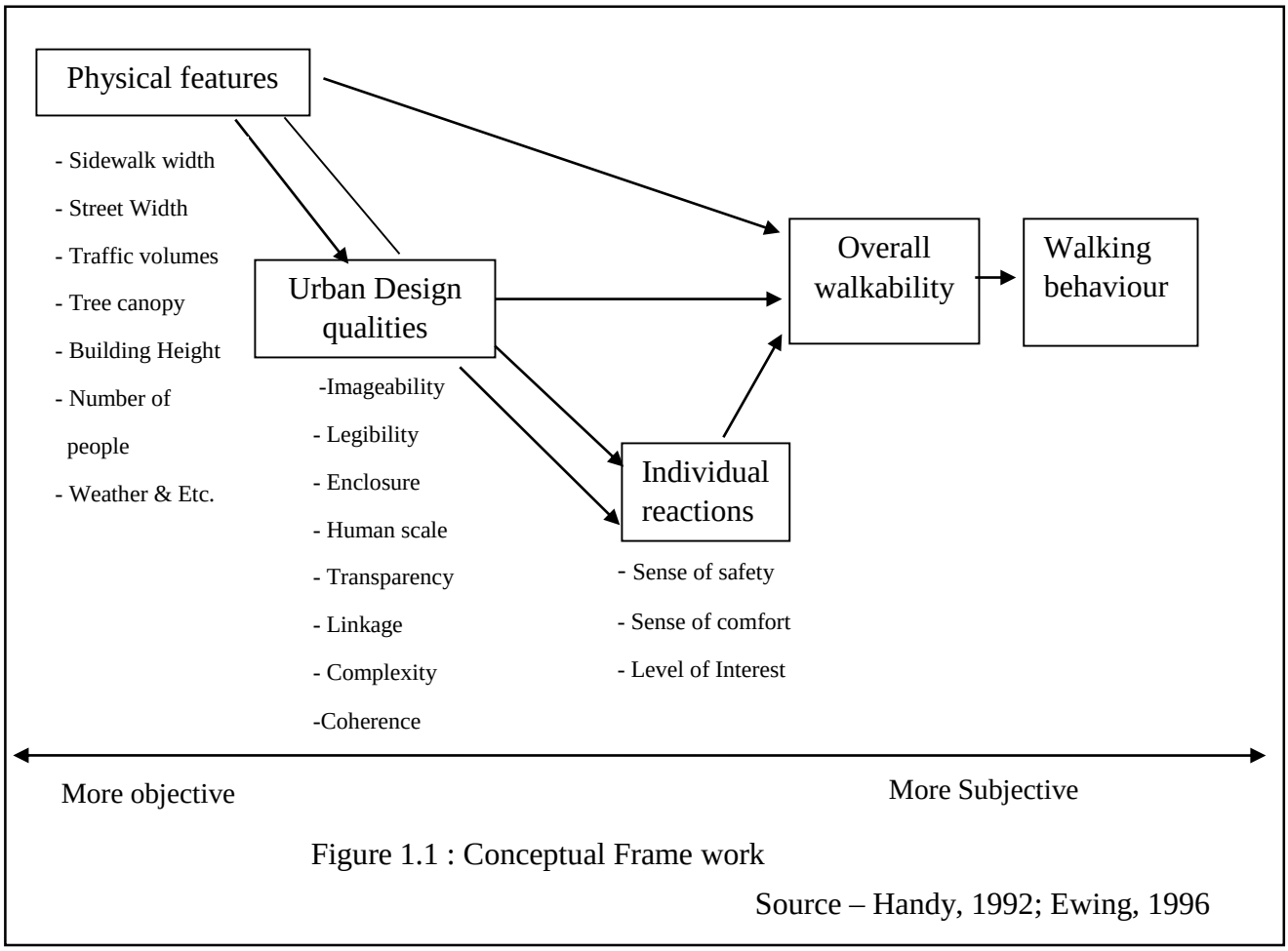


Figure 1.1 : Conceptual Frame work

Source – Handy, 1992; Ewing, 1996

1.2 Research Question

1. What are the urban design qualities related to walkability?
2. What are the connection between walkability & urban design qualities?
3. How to measure urban design qualities related to walkability?
4. How urban design qualities influence active living and walkability?

1.3 Scope of the Study

This research will identify & measure urban design qualities related to walkability. Mainly this research evaluate the relationship between walkability and urban design qualities through identifying & measuring selected urban design qualities such as imageability, legibility, enclosure, Human scale, transparency, linkage, complexity and coherence.

1.4 Methodology

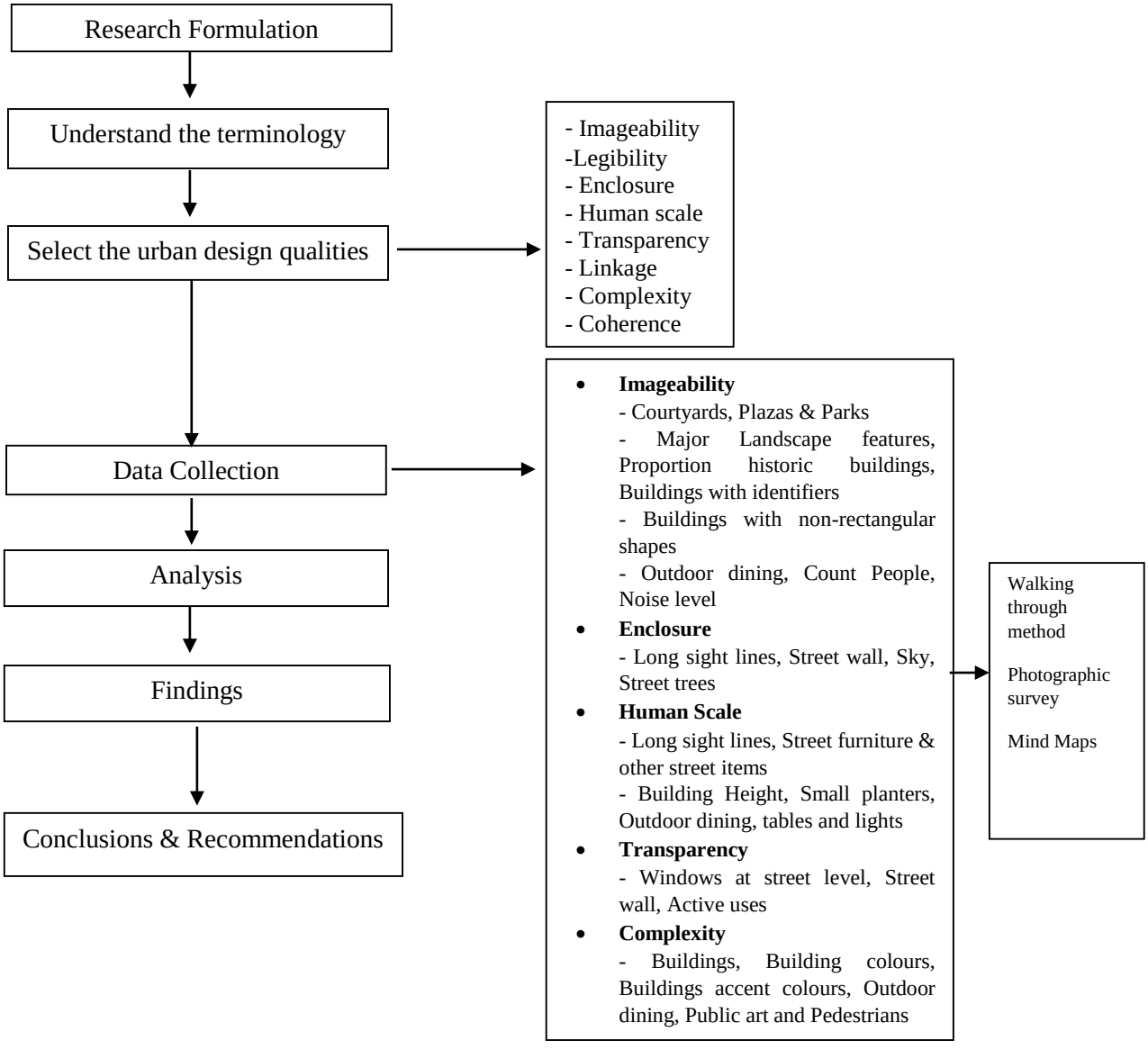


Figure 1.2: Method and Procedure

1.5 Outcome of the Study

- Identified urban design qualities related to Walkability
- Measured urban design qualities related to walkability
- Relationship between walkability, urban design qualities and physical features

CHAPTER TWO: THEORITICAL FRAME WORK

Walkability is a more important concept in sustainable urban life and providing many assets to the urban people, specially health, Environmental friendly, economical, diversity and co-efficient. Walkability is defined as “The extent to which the built environment is friendly to the presence of people living, shopping, visiting, enjoying or spending time in an area. (Wikipedia)

The urban design literature points to numerous perceptual qualities that may effect the walking environment. Physical features influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals. (Handy, 1992; Ewing, 1996) This chapter is mainly focuses on:-

- Definition for Walkability
- Historical background of the Walkability
- Importance of the Walkability
- Urban design qualities related to walkability
- Influence of the urban design qualities in walkability
- Related research of the walkability

2.1 Definition for Walkability

1. "Walkability is a construct as mental images or representations of intangible things that are thought to exist but not in a material or physical form and a construct cannot be observed directly precisely because it is intangible" (Aneshensel, 2001).

2. Walkability is about urban design that allows the citizen to use walking as an important, if not dominant, mode of transport for both work and leisure. It's not

just sidewalks but also over / under passes, public toilets, parks, shade, retail density, mixed use, security and accessibility.

3. The extent to which the built environment is walking friendly. This enables the opportunity for a subjective or qualitative assessment against specific criteria. These criteria may be characteristics, such as the "5'C's" i.e. connected, convivial, conspicuous, comfortable and convenient, or other criteria specific to a particular user. (Abbey 2005)

3 Walkability is a term applied to the built environment to describe a confluence of factors that facilitate human-centered activities such as strolling, shopping, commuting, and socializing. Walkability has an objective, measurable aspect; however, it manifests as a subjective experience with a strong aesthetic component. The essence of walkability speaks to basic human values such as scale, community, and safety and is found in both indigenous villages and the finest examples of intentional urban design.(Cohen 2010)

4. Walkability "is the extent to which the built environment supports and encourages walking by providing for pedestrian comfort and safety, connecting people with varied destinations within a reasonable amount of time and effort, and offering visual interest in journeys throughout the network." (South worth 2005)

2.2 Historical Background of the Walkability

Earlier period of the human era, Walking is the major transport form to connect one place to another. After the industrial revolution, economic growth led to increase automobile manufacture and automobiles offered rapid, reliable, convenient mobility, comfortable and affordable to the passengers.

However motorized transportation was created several social, economic and environmental issues in many countries. Specially high urbanized countries were affected by many of environmental issues through motorized transportation like carbon emission that contribute to global warming, air pollution, traffic jam, auto mobile oriented urban sprawl, noise pollution, accidents and unhealthy human life etc.

Therefore environmental friendly alternatives like public transportation and walking infrastructure have made more serious elements by urban planners and policy makers.

The word Walkability was created as a part of environmental approaches for maintaining and improving the health of citizens in the western countries where obesity is a serious problem. In this situation, people have started paying attention to an environmental approach for solving the obesity problem, with the purpose of making urban space healthier.

"Walkable urbanism" is a developed strategy in opposition to sub urban sprawl. It advocates housing for a diverse population, a full mix of uses, walkable streets, positive public space, integrated civic and commercial centres, transit orientation and accessible open space.

2.3 Importance of the Walkability

Walkability is a vital part of creating a sustainable future for all cities and well-connected walkable communities are getting more economic, social, environmental and health benefits. It can promote good health and a healthier planet by promoting exercise and reducing the risk of obesity, lowering car crash facility, reducing greenhouse gas emissions and vehicle related air pollution, cutting down gasoline bills and oil imports, improvements of the quality of cities, liveness, vibrant and Movement.

a. Health Benefits

Walkability is promote physical activity of the human that physical activity prevent from diseases such as cardiovascular disease, diabetics, hyper tension, obesity, depression and osteoporosis. Physical activity has been found related with

cardiovascular fitness, stronger bones, mental alertness, creativity, increased longevity and reduced risk of stress, cardiovascular diseases and even some types of cancer (Forsyth and Sourthworth 2008).

Walkable generally enhance resident's quality of life and getting out of the house for a walk contributes to emotional, mental, and spiritual well –being and provides opportunities for spontaneous social interaction

b. Social Benefits

Walkability improves local safety and security because having lots of people on the street discourages criminal and nuisance activity and reduce traffic congestion and noise pollution and it is socially connected neighborhood and create local communities as vibrant and dynamic.

c. Environmental Benefits

One of the most environmental benefits from walkability is the decrease of the automobile foot print in the community and walkability is reduced the carbon emissions. The benefits of less emissions include improved health conditions and quality of life, less smog and less of a contribution to global warming.

d. Economic Benefits

Walkability has also been found to have many economic benefits including accessibility, cost savings both to individuals and to the public, increased efficiency of land use, increased livability, economic benefits from improved public health and economic development among others.

Walkability is promoted tourism and increase the property value through high home sale prices, enhanced market ability.

2.4 Urban Design Qualities Related to Walkability

The urban design literature points to numerous perceptual qualities that may affect the walking environment (Handy, 1992; Ewing, 1996). Other fields also contribute, including architecture, park planning, environmental psychology and the growing visual preference and visual assessment literature.

A literature review produced a list of 51 perceptual qualities or urban design qualities

Adaptability	Distinctiveness	Intricacy	Richness
Ambiguity	diversity	legibility	sensuousness
Centrality	dominance	linkage	singularity
Clarity	enclosure	meaning	spaciousness
Coherence	expectancy	mystery	territoriality
Compatibility	focality	naturalness	texture
Comfort	formality	novelty	transparency
Complementarity	human scale	openness	unity
Complexity	identifiability	ornateness	upkeep
Continuity	imageability	prospect	variety
Contrast	intelligibility	refuge	visibility
Deflection	interest	regularity	vividness
Depth	intimacy	rhythm	

Source – Handy, 1992; Ewing, 1996

The following conceptual framework diagram describes, how physical features, Urban design qualities and individual reactions influences in Walkability.

Physical features influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals and urban design qualities are different from qualities such as sense of comfort, sense of safety and level of interest that reflect how an individual reacts to a place how they assess the conditions there, given their own attitudes and preferences. (Ewing & Handy 2006)

All of these factors (physical features, urban design qualities and individual reactions) may influence the way an individual feels about the environment as a place to walk.

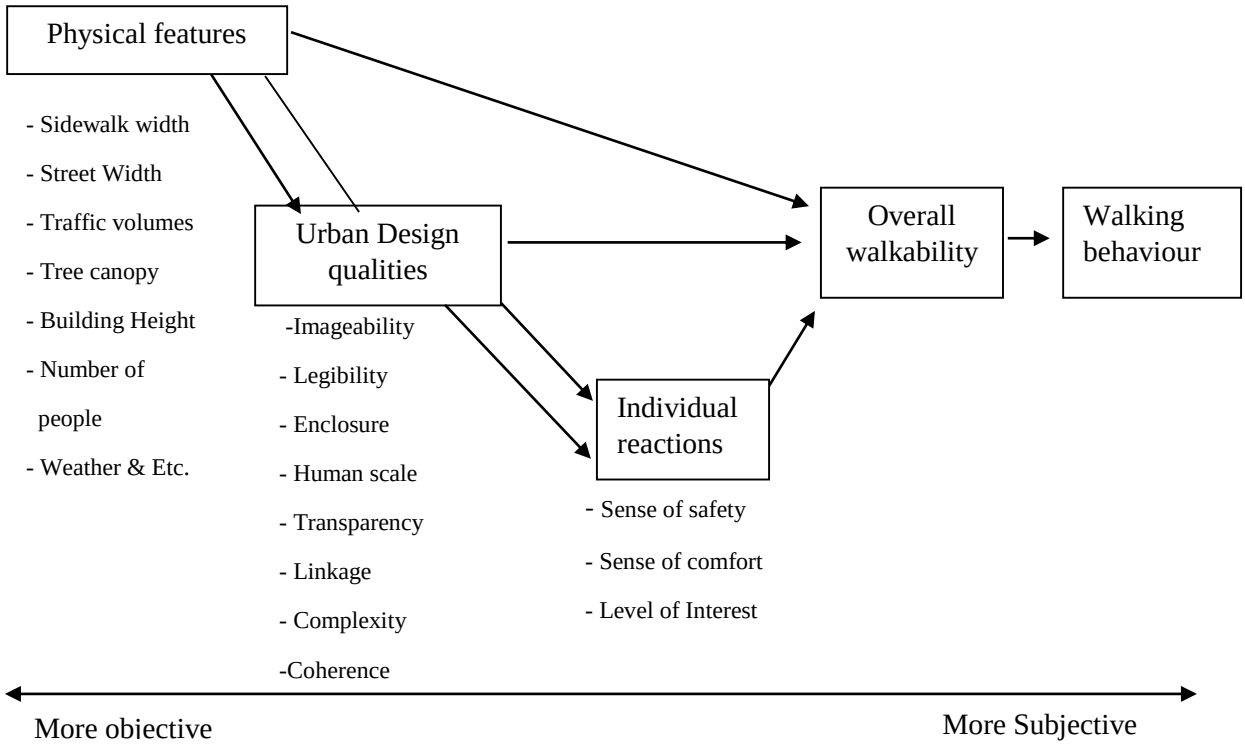


Figure 2.1: Conceptual Frame work

Source – Handy, 1992; Ewing, 1996

The Eight walkability related urban design qualities are selected for subsequent study: Imageability, Enclosure, Human scale, Transparency, Linkage, Complexity, Coherence and Tidiness.

I. Imageability

Imageability is the quality of a place that makes it distinct, recognizable, and memorable. A place has high imageability when specific physical elements and their arrangement capture attention, evoke feelings, and create a lasting impression.

Kevin Lynch defines "Imageability as a quality of a physical environment that evokes a strong image in an observer. It is that shape, colour, or arrangement which facilitates the making of vividly identified, powerfully structured, highly useful mental images of the environment".

Jan Gehl 1987 explains "Imageability is related to 'sense of place' this phenomena using the example of famous Italian city squares, where "life in the space, the climate and the architectural quality support and complement each other to create an unforgettable total impression".

Imageability is related to many other urban design qualities - legibility, Enclosure, Human scale, transparency, linkage, complexity and coherence and is in some way the net effect of these qualities.

II. Legibility

Legibility refers to the ease with which the spatial structure of a place can be understood and navigated as a whole. The legibility of a place is improved by a street or pedestrian network that provides travelers with a sense of orientation and relative location and physical elements that serve as reference points.

III. Human scale

Human scale refers to a size, texture and articulation of physical elements that match the size and proportions of humans and equally important, correspond to the speed at which humans walk. Building details, pavement texture, street trees and street furniture are all physical elements contributing to human scale.

Urban designers offer differing definitions of human scale. Alexander et.al (1977) state that any buildings over four storeys tall are out of human scale. Lennard (1987) set the limit at six storeys. Hans Blumenfeld (1953) sets it at three storeys.

In taller buildings, Roger Trancik (1986) says that lower floors should spread out and upper floors step back before they ascend, giving human scale definition to streets and plazas. Richard Hedman (1984) emphasizes the importance of articulated architecture and belt courses and cornices on large buildings to help moderate scale.

IV. Transparency

Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street or other public space and more specifically, the degree to which people can see perceive human activity beyond the edge. Physical elements that influence transparency include walls, windows, doors, fences, landscaping, and openings into midblock spaces.

Transparency is a material condition that is previous to light and air an inherence quality of substance as in a glass wall. A classic example of transparency is a shopping street with display windows that invite passersby to look in and then come in to shop. Blank walls and reflective glass buildings are classic examples of design elements that reduce transparency (Journals of urban design)

V. Enclosure

Enclosure refers to the degree which streets and other public spaces are visually defined by buildings, walls, trees, and other elements. Spaces where the height of vertical elements is proportionally related to the width of the space between them have a room - like quality. Numerous urban design theorists have articulated, a sense of enclosure results when lines of sight are so decisively blocked to make outdoor spaces seem - room like.

Gorden Cullen (1961) explains that "Enclosure or the outdoor room is perhaps the most powerful, the most obvious of all the devices to instill a sense of position, of identity with the surroundings. It embodies the idea of hereness." Christopher Alexander et.al (1977) say that "An outdoor space is positive when it has a distinct and definite as the shape of a room, and when its shape is as important as the shapes of the buildings which surround it"

Allan Jacobs (1993) says that people react favorably to fixed boundaries as something safe, defined and even memorable an invitation to enter a place special enough to warrant boundaries. Jacobs & Appleyard (1987) speak of the need for buildings to "define or even enclose space rather that sit in space". Richard Hedman (1984) refers to certain arrangements of buildings as creating intensely three dimensional spaces.

VI. Linkage

Linkage refers to physical and visual connections from building to street, building to building, space to space, or one side of the street to the other which tend to unify disparate elements. Tree lines, building projections, marked crossings all create linkage. Linkage can occur longitudinally along a street or laterally across a street.

Tree lines, building projections, marked crossings all create linkage. Linkage can occur longitudinally along a street or laterally across a street.

VII. Complexity

Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage and human activity.

Amos Rapoport (1990) explains the fundamental properties of complexity. Complexity is related to the number noticeable differences to which a viewer is exposed per unit time. Human beings are most comfortable receiving information at usable rates.

Rapoport & Hawkes (1970) contrast the complexity requirements of pedestrians and motorist. Pedestrians moving 3 mph require a high level of complexity to hold their interest. Motorists travelling 60 mph will find the same environment chaotic.

Street high in complexity provide many interesting things to look at: building details, signs, people, surfaces, changing light patterns and movement, signs of habitation. Jan Gehl (1987) notes in his classic life between buildings, an interesting walking network will have the "psychological effect of making the walking distance seem shorter," by virtue that the trip is "divided naturally, into manageable stages".

Complexity results from varying building shapes, sizes, materials, colours, architecture and ornamentation. According to the Jacobs & Appleyard (1987) narrow buildings in varying arrangements add to complexity, while wide buildings subtract.

VIII. Coherence

Coherence refers to a sense of visual order. The degree of coherence is influenced by consistency and complementarity in the scale, character, and arrangements of buildings, landscaping, street furniture, paving materials and other physical elements.

2.5 Urban Design Qualities & Physical Features

Urban design qualities and physical features are important features in walkability. Mainly overall walkability and urban design qualities are depend on physical features like side walk width, street width, traffic volumes, tree canopy, building Height, number of people and weather and each urban design qualities has significant physical features.

Urban Design Quality	Significant Physical Features
Imageability	People
	Proportion of historic buildings
	Courtyards/Plazas/Parks
	Outdoor dining
	Building with non- rectangular shapes
	Noise level (Rating)
	Major landscape features
	Building with identifiers
Enclosure	Proportion street wall
	Proportion first floor with windows
	Building Height
	Small planters
	Urban Designer
Human Scale	Long sight lines
	All street furniture and other street items
	Proportion first floor with windows
	Building Height
	Small Planters
	Urban Designer

Transparency	Proportion first floor with windows
	Proportion active uses
	Proportion street wall
Complexity	People
	Buildings
	Dominant building colours
	Accent colours
	Outdoor dining
	Public art

Table 2.1: Urban Design Qualities & Physical Elements

Source – Handy, 1992; Ewing, 1996

2.6 Influence of the urban design qualities in Walkability

Urban design qualities are most important factors of active urban street life and create streets are more walkable. Physical features and urban design qualities contribute a better Walkability.

The following conceptual framework diagram explains how urban design, physical features and individual reactions are influencing Walkability. Mainly physical features influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals.

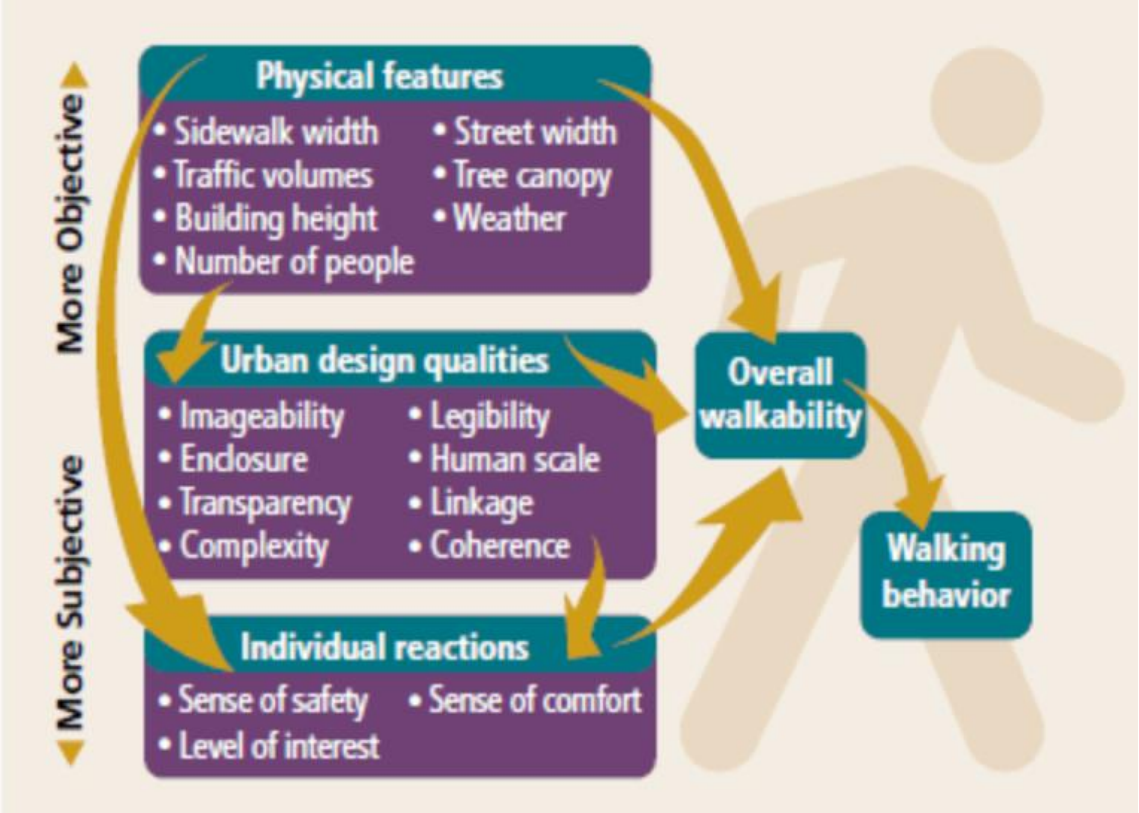


Figure 2.2: Connection between Physical features, urban design qualities & Individual reactions

Source – Handy, 1992; Ewing, 1996

Mainly overall Walkability, urban design qualities and Individual reactions (sense of safety, sense of comfort & level of interest) are depend on physical features like sidewalk width, street width, traffic volumes, tree canopy, building height, Number of people, and weather etc. That overall Walkability is decided by the walking behaviour of the people. By measuring these intervening variables, can better articulate the relationship between physical features of the street environment and walking behaviour.

For example, enclosure means to the degree to which streets and other public spaces are visually defined by buildings, walls, trees, and other elements and significant physical features for enclosure are street wall, sky across, long site lines and sky ahead. This all physical features influences on Enclosure and physical features of the enclosure and enclosure creates more walkable streets for the people.

Image A - HIGH ENCLOSURE

A continuous street wall on both sides of the street gives this scene high enclosure. The buildings and uniform street trees create a room like effect by limiting long sight lines and views of open sky. This high enclosure

Image B - LOW ENCLOSURE

This scene has low enclosure because the arrangement of buildings does not provide a well-defined street wall. The feels open, with the ability to see far into the distance with large amounts of open sky. This low enclosure is not influenced to walkability

Source: - Active living research program of the Robert wood Johnson foundation

Physical features, urban design qualities and individual reactions are influencing in the overall Walkability. Mainly physical features are increasing urban design qualities that qualities are deciding the overall Walkability.

2.7 Related Literature Survey of the Urban Design Qualities Related to Walkability

A. Identifying & Measuring urban design qualities related to walkability (Reid Ewing, Susan Handy (2006)

This research has attempted to measure subjective qualities of the urban street environment and has developed operational definitions and measurements protocols for subtler urban design qualities believed to be related to walkability.

This study investigated numerous perceptual qualities that may affect the walking environment to which the urban design literature points and this research tries to objectively measure seemingly subjective qualities of the walking environment.

The goal of this research is develop operational definitions and measurements protocols for key urban design qualities of streetscapes. The operational definitions take the form of statistically derived equations that link objectively measured physical features of the environment to ratings of urban design qualities.

The hypothesize of the study is perceptions lie on the casual path between objective measurements and subjective reactions and considers the role of perceptions as they intervene between the physical features of the environment and walking behaviour.

The main method of this research is Visual assessment survey: sample of streetscapes and identify detailed physical features associated with each quality.

The following methods were used this research:

- **a.** Recruitment of a panel of urban design and planning experts
- **b.** Creation of a library of video clips of streetscapes
- **c.** Selection of video clips
- **d.** Rating of urban design qualities of streetscapes by the expert panel
- **e.** Measurement of physical features of streetscapes through a content analysis of video clips
- **f.** Inter-rater reliability testing of physical measurements and urban design quality ratings
- **g.** Statistical analysis of relationships between physical features and urban design quality ratings
- **h.** Selection of qualities for operationalization
- **i.** Development of operational definitions and measurement protocols for urban design qualities based on statistical relationships

Five criteria were established for the one method of the selection of qualities for operationalization

1. The urban design quality was rated by the expert panel with at least a moderate degree of inter- rater reliability (ICC > 0.4)

2. The total variance in ratings of the urban design quality was explained to at least a moderate degree by measurable physical features of scenes

3. The portion of total variance in ratings attributable to scenes was explained to a substantial degree by measurable physical features of scenes

4. All physical features related to ratings of a particular urban design quality were measured by the research team with at least moderate degree of inter-rater reliability

5. The urban design quality as judged by the expert panel had a statistically significant relationship to overall walkability ratings by the expert panel.

B. Measuring the Unmeasurable : Urban Design Qualities Related to Walkability (Susan Handy 2009)

This research is comprehensively and objectively measure subjective qualities of the urban street environment. The immediate purpose of this study is to arm researchers with operational definitions, can use to measure the street environment and test for significant associations with walking behaviour.

This study sets out to objectively measure seemingly subjective qualities and instead simply asserts their importance. This approach is to link specific physical features to urban design perceptual quality ratings by a panel of experts for a sample of commercial streets.

51 perceptual qualities, eight were selected for further study based on the importance assigned to them in the literature: imageability, enclosure, human scale, transparency, complexity, legibility, linkage and coherence.

This research firstly discusses each urban design quality that was successfully operationalized as it is depicted in the literature and is characterized by the panel of

experts. The qualitative discussion leans heavily on classic works in urban design and it ends with a 'consensus qualitative definition'.

Secondly, previous attempts to operationalize these particular urban design qualities are described. These come from visual assessment studies, urban design guidelines and land development regulations.

The conceptual framework of this study considers the role of perceptions as they intervene between physical features of the environment and walking behavior and physical features influence the quality of the walking environment both directly and indirectly through the perceptions and sensitivities of individuals.

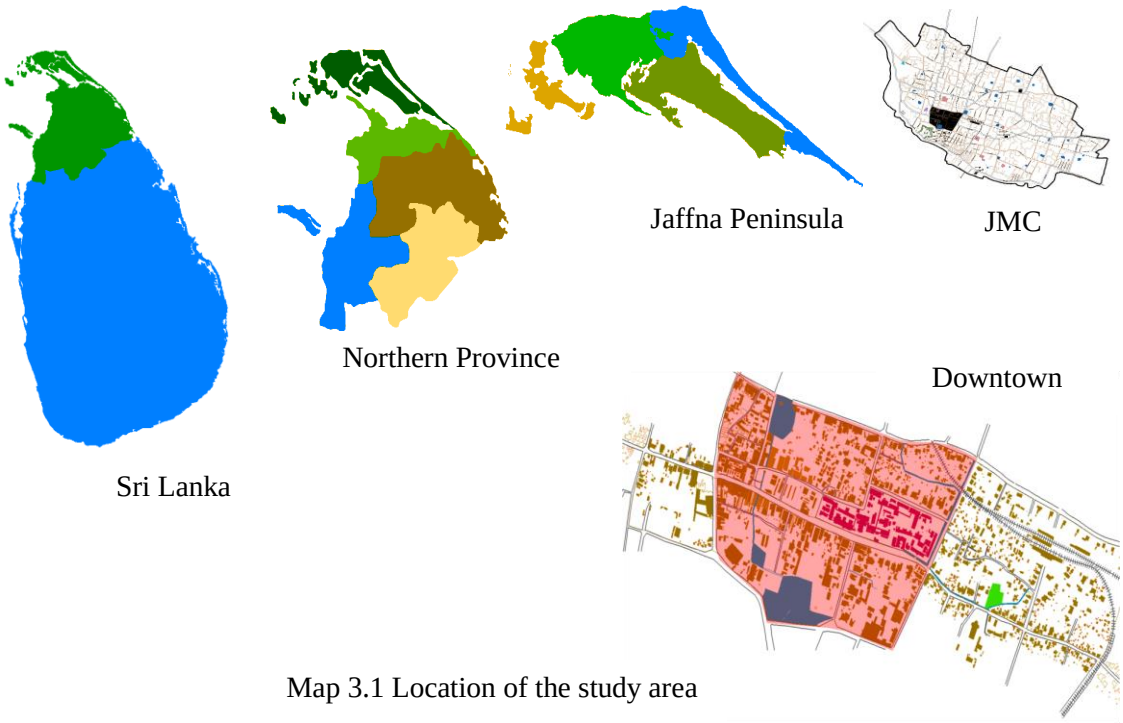
CHAPTER 3: RESEARCH AREA AND METHODOLOGY

3.1 Introduction of the Study Area

Jaffna town is the second order city in Sri Lanka and provincial capital of the Northern Province. Earlier it was the second largest city in Sri Lanka and upgraded as a Municipal council in 1946.

The Municipal area land extent is 20.1 sq.km. The topography is flat and located dry zone of Sri Lanka. The population is nearly 118000 and population growth rate is 1.3% (District secretariat hand book - 2014). Down town is located southern part of the JMC area and total land extent is 0.2 sq.km. The Major transport routes are K.K.S Road, Stanely road, Point Pedro road and Hospital road.

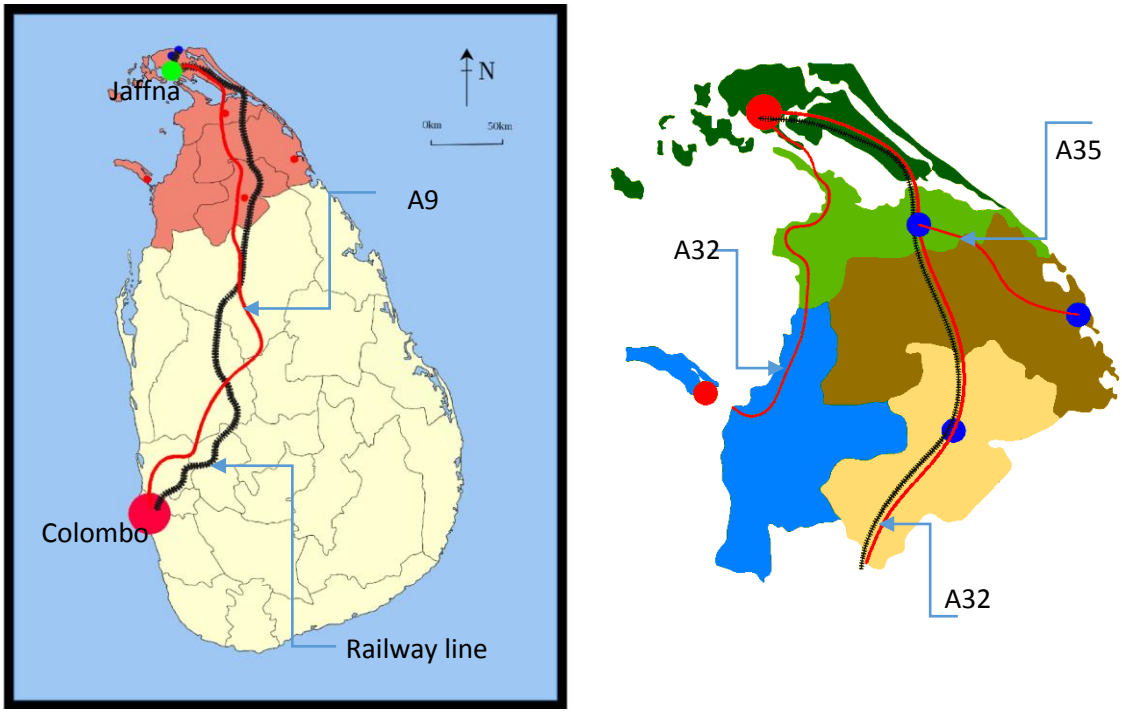
All the main town activities are concentrated within the study area such as teaching Hospital, public bus stand, public market, new markets, post office, railway station and commercial activities.



Map 3.1 Location of the study area

3.2 National and Regional Linkages

Jaffna is connected by railway line, A9 and A 32 with other part of the country and it was connected by Railway line in 1906 and consist domestic airport is located in Palali and sea port in K.K.S. South India and Jaffna was connected through the sea in ancient times.



Map 3.2 National & Regional Linkages

3.3 Historical Background of the Study Area

Jaffna town is an ancient town in Sri Lanka and consist long history. Jaffna kingdom is one of the most important kingdoms in Sri Lanka. It is called as an Aryachakaravathi Kingdom or Jaffna kingdom. The period of kingdom is from 1215 to 1624. Nallur is an ancient capital of the Jaffna kingdom.

Jaffna was captured by the Portuguese in 1624 and captured by the Dutch in 1658. Nallur is the first town in the Northern region. The well planned grid pattern town was built during the Dutch period. It was based on the Dutch fort. The Jaffna fort was built by Portuguese in 1625 and renovated by Dutch in 1680.

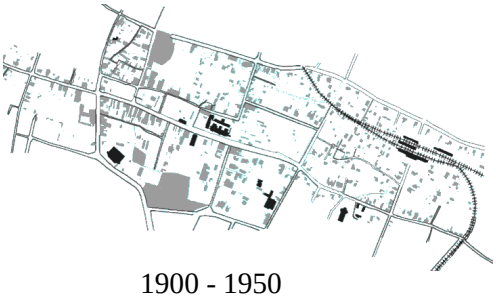
Historically, Jaffna has been a contested city. It was made into a colonial port town during the Portuguese occupation of the Jaffna peninsula in 1619.

Jaffna city was established as a colonial administrative centre by the Portuguese colonials in 1621. Post-independence the city was overtaken by the growth of settlements near Colombo. But even in 1981 Jaffna was the largest city outside the greater Colombo area. The city is home to number of educational institutions established during the colonial and post-colonial period. It also has number of commercial institutions, minor industrial units, banks, hotels and other government institutions such as the hospital. It is home to the popular Jaffna library that was burnt down and rebuilt. The city is anchored by the Jaffna fort rebuilt during the Dutch colonial period.

However during the war situation the town was moved to North east direction. The Present town is located based on the Hospital road.

Vempady Girls High School	-	Built in 1838 by British
John the Baptist	-	Built in 1888 by Jakoppu Shamuevel
Hospital	-	Built in 1903 and upgraded as a Teaching Hospital in 1983
Railway station	-	Jaffna was connected by Railway line in 1906 and reconstructed in 2014
Post office	-	Built in 1911 by British
Public Bus stand	-	Built in 1965
Public Market	-	Built in 1985
JMC commercial building	-	Built in 2013
Cargills square	-	Built in 2014
Hospital Building	-	Built in 2014

Before 1900



1900 - 1950

1980 - 2010

Before 1950 - 1980

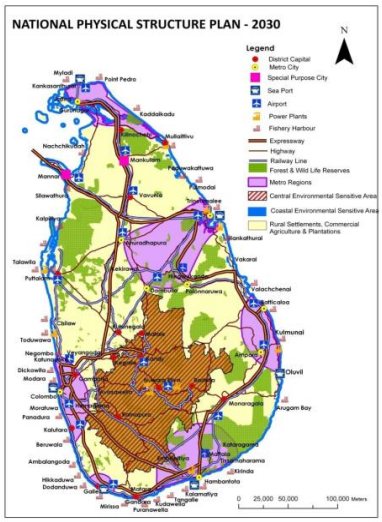
After 2010

Map 3.3 Historical Evolution of the Jaffna

Figure 3.1 Historical Evolution of the Jaffna

3.4 National Urban Policies

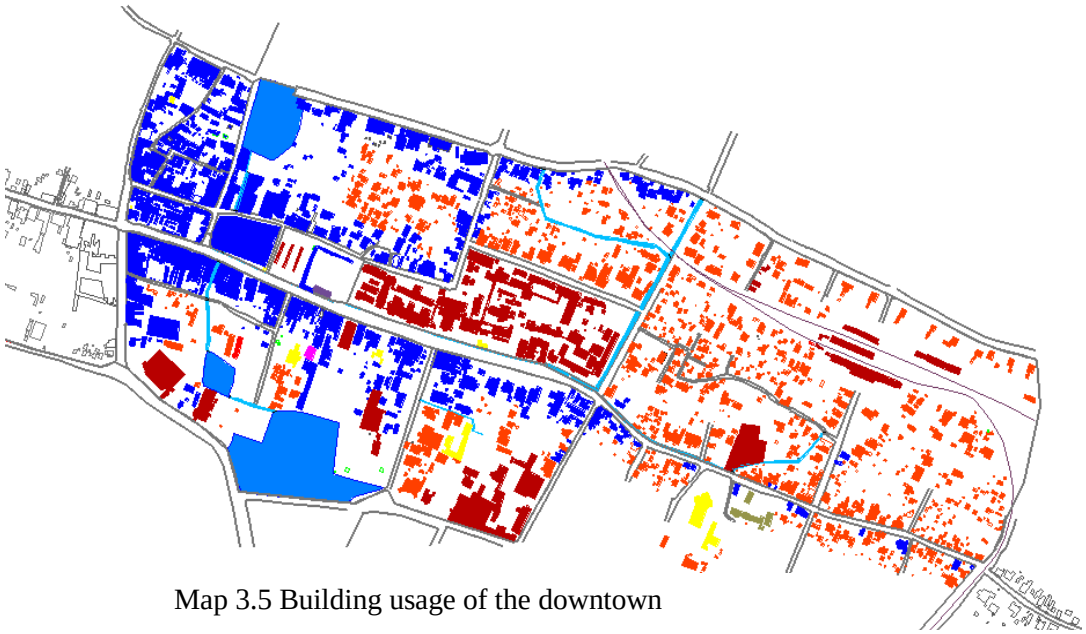
Jaffna and Jaffna city have selected as one of the Metro region and Metro city in Sri Lanka according to the National physical planning policy -2030 and World Bank has selected Jaffna city as a Strategic city in Sri Lanka.



Map 3.4 National Physical Planning Policy - 2030

3.5 Building Usage of the Study Area

Most of the buildings are occupied by the commercial activities and service centres are Residential areas are less than compare with commercial activities. 22 % of the Down town lands are occupied by the Teaching hospital.



Map 3.5 Building usage of the downtown

Source – Draft Development Plan of Jaffna MC - 2010

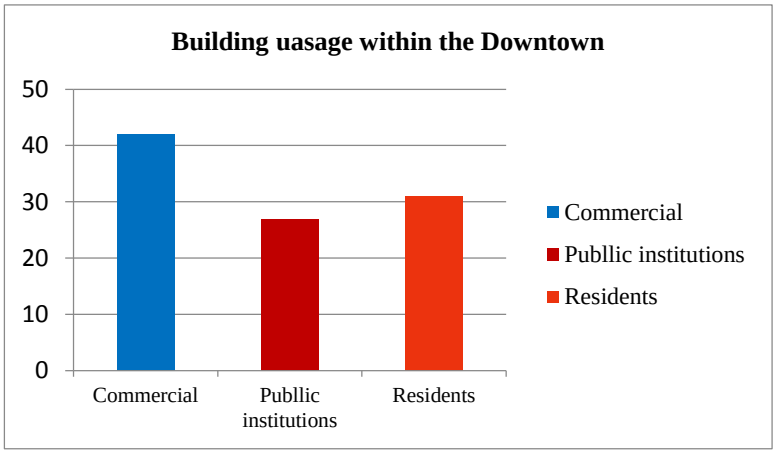


Figure 3.2 Building usage of the downtown

3.6 Building Ownership

78 % of the land are owned by the Private and 28 % of the land are owned by the JMC. Left side of the Hospital road (From Signal Junction to Vempady Junction) lands are belongs to JMC.

Map 3.6 Building ownership of the downtown

Source – Draft Development Plan of JMC -

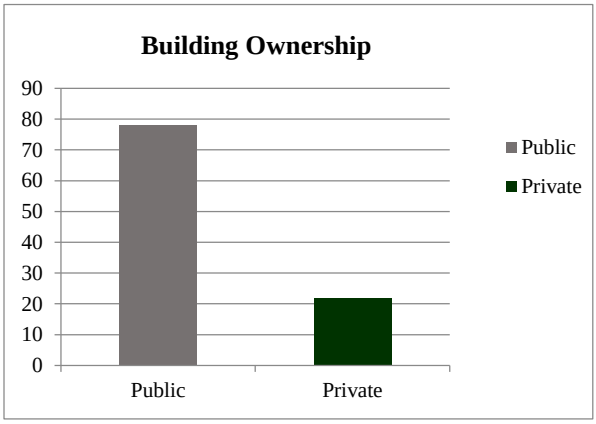
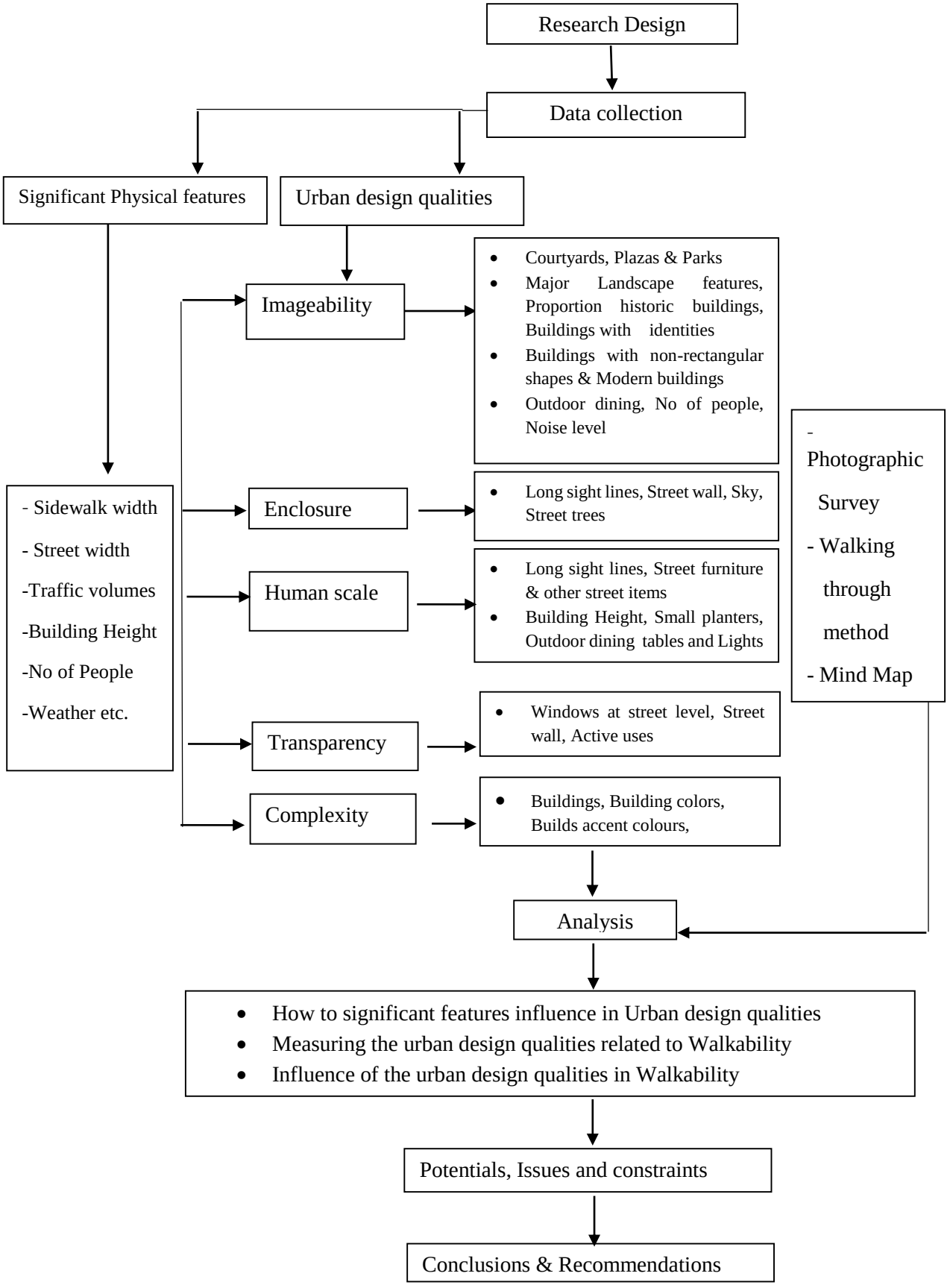


Figure3.3 Building ownership of the downtown

3.7 Research Methodology



For this research, especially methodology explains how physical features and urban design qualities are connected and mainly case study analysis was used to measure urban design qualities of the downtown.

Related physical elements of the urban design qualities like courtyard, historic buildings, rectangular buildings, outdoor dining, street trees, rectangular buildings, etc. are collected through photographic survey, walking through method and Mind map.

Through this case study analysis, what are the physical elements are available within the downtown, how physical features enhance urban design qualities of the down town and how urban design qualities influence in the walking behavior of the people and finally conclusions and recommendation are being providing to enhance the urban design quality of the downtown.

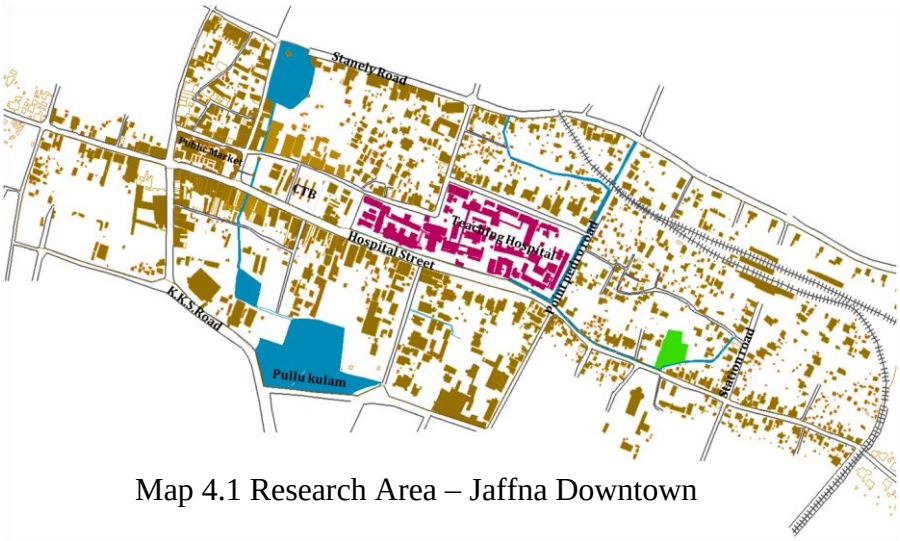
For Example, Imageability is one of the main urban design quality and some of the physical elements like courtyards, plazas, parks, landscape features, historic buildings, non-rectangular buildings, outdoor dining etc., In hospital road of down town, some imageability related physical elements are available specially historical buildings, non-rectangular buildings, number of people that type of elements enhance imageability and also walking behavior of the people.

CHAPTER FOUR: CASE STUDY ANALYSIS

This research mainly focuses on identifying and measuring urban design qualities related to Walkability and analysis part of the research is based on the research question such as: - what **are the urban design qualities related to Walkability, How to measure urban design qualities related to Walkability, What are the connection between Walkability and urban design qualities and How urban design qualities influence active living and Walkability.**

Based on this research question, this research is mainly concentrating on measuring urban design qualities related to Walkability within the down town of Jaffna. The research area is down town or central business district area (CBD) of Jaffna and the total land extent of the study area is 0.26 sq.km.

The busiest streets of the down town have been selected for the analysis such as Hospital Street, Stanely road, K.K.S.Road, Kasthuriyar road and Powerhouse road and eight urban design qualities have been selected to measure related to Walkability such as: Imageability, Enclosure, Human scale, Transparency, Linkage, Complexity and Legibility.



Map 4.1 Research Area – Jaffna Downtown

The following diagram describes, how physical features, urban design qualities and Individual reactions influence the overall walkability. However, Physical features directly influence the urban design qualities, Individual reactions and overall walkability. Physical features are enhancing the urban design qualities and urban design qualities are mainly contributing to the Individual reactions. Overall walkability are depend by these all factors and walking behavior are decided by the overall Walkability. This research is mainly analyzed based on the following conceptual frame work.

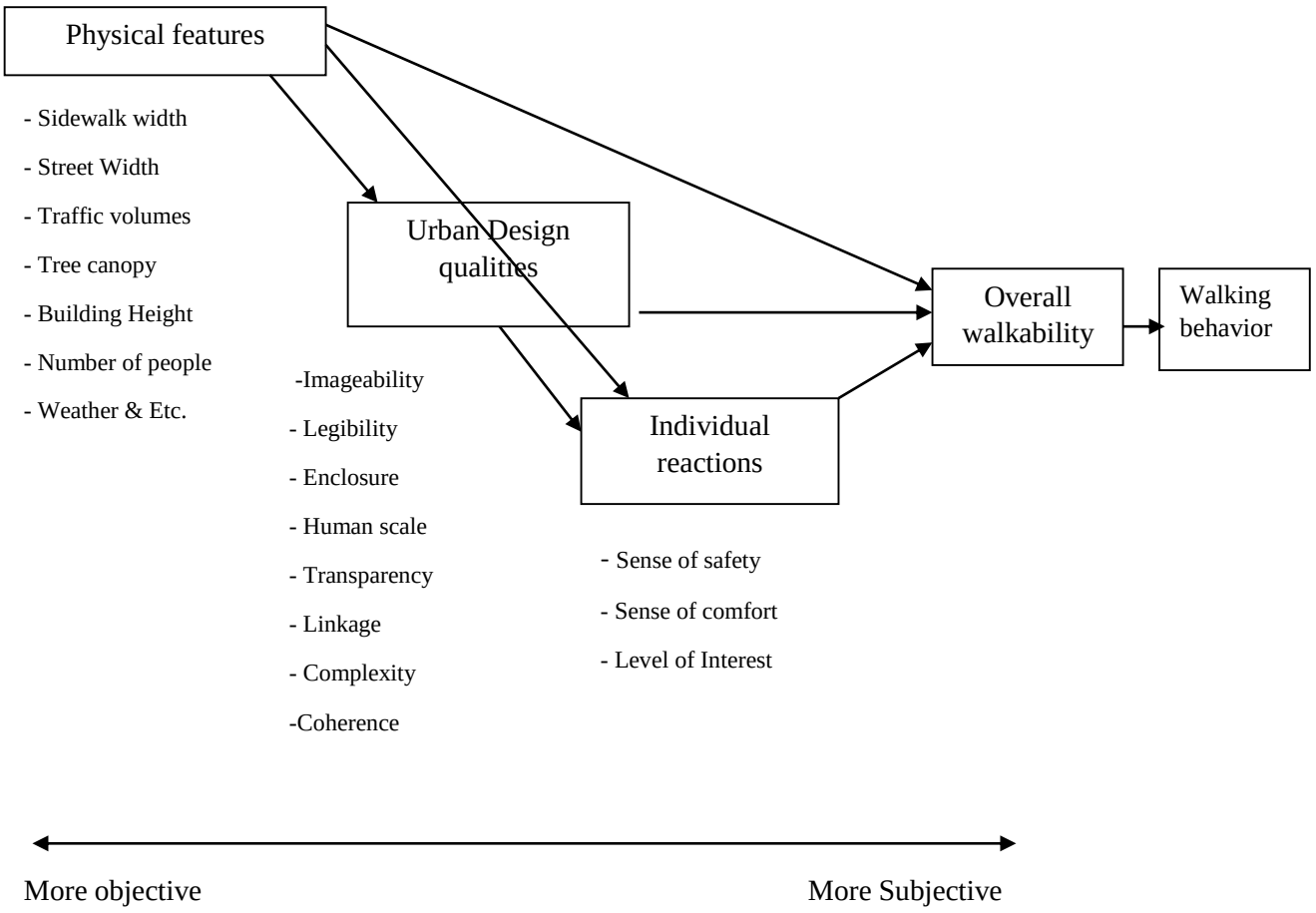


Figure 4.1: Conceptual framework of the Walkability

4.1 Identifying the Urban Design Qualities

Numerous urban design qualities influence in the Walkability and nearly 51 number of urban design qualities are contributing to the walkability. For this research only eight urban design qualities have been selected for measurement.

a. Imageability

Imageability is the quality of a place that makes it distinct, recognizable, and memorable. A place has high imageability when specific physical elements and their arrangement capture attention, evoke feelings, and create a lasting impression.

b. Enclosure

Enclosure refers to the degree which streets and other public spaces are visually defined by buildings, walls, trees, and other elements. Spaces where the height of vertical elements is proportionally related to the width of the space between them have a room - like quality.

c. Human scale

Human scale refers to a size, texture and articulation of physical elements that match the size and proportions of humans and equally important, correspond to the speed at which humans walk. Building details, pavement texture, street trees and street furniture are all physical elements contributing to human scale.

d. Transparency

Transparency refers to the degree to which people can see or perceive what lies beyond the edge of a street or other public space and more specifically, the degree

to which people can see perceive human activity beyond the edge. Physical elements that influence transparency include walls, windows, doors, fences, landscaping, and openings into midblock spaces.

e. Complexity

Complexity refers to the visual richness of a place. The complexity of a place depends on the variety of the physical environment, specifically the numbers and kinds of buildings, architectural diversity and ornamentation, landscape elements, street furniture, signage and human activity.

f. Legibility

Legibility refers to the ease with which the spatial structure of a place can be understood and navigated as a whole. The legibility of a place is improved by a street or pedestrian network that provides travelers with a sense of orientation and relative location and physical elements that serve as reference points.

g. Coherence

Coherence refers to a sense of visual order. The degree of coherence is influenced by consistency and complementarity in the scale, character, and arrangements of buildings, landscaping, street furniture, paving materials and other physical elements.

4.2 Measurement of Urban Design Qualities

Selected Urban design qualities have been measured using Photographic Survey, Walking through method, Field survey, Mind map and interview with pedestrians. Mainly urban design qualities related datas were collected using photographic survey and walking through method.

Related physical elements datas are collected to measure the urban design qualities related to Walkability. For Example:-

IMAGEABILITY - Physical Elements
No of Courtyard
No of Plazas
No of Parks
Bodies of Water
Manmade features
Modern Building
Historic building frontage - both side
Number of buildings with identifiers
Number of non-rectangular building
Presence of outdoor dining
Number of people
Noise level

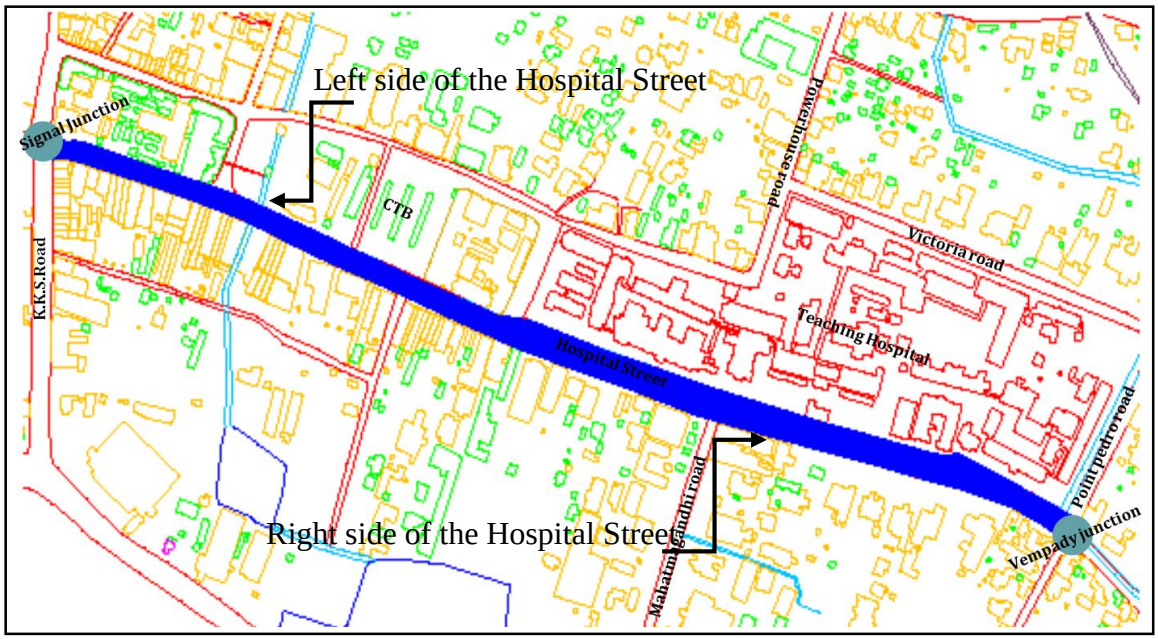
Table 4.1: Physical elements of the Imageability

4.2.1 Hospital Street

Hospital road is the busiest street of down town and down town main functional activities are based on the hospital road and the total length of the hospital road is 3.06 Km which is starting from Kandy road and ending point is Karainagar road. The part of the Hospital Street is included within the down town and it is started from Point Pedro road (Vempady Junction) and ending at K.K.S.Road (Signal junction) and total length of the hospital road within down town is 0.84 M.

The total width of the Hospital road within the down town is nearly78ft and this is the only street is located with four lanes in Northern Province of Sri Lanka and middle part of the hospital road is used as a vehicle parking area.

According to the traffic survey (January 4th 2016), nearly more than 12000 of pedestrians are using hospital road to fulfill their needs and 39547 no of vehicles are passing this street daily and all the service providing centres like Teaching hospital of the Northern Province, Public Market, New Markets, Central bus stand and commercial centres are located at Hospital Street.



Map 4.2: Hospital Street of Jaffna

Cargills square | New market | Teaching Hospital | Powerhouse

Figure 4.3: Important places at Hospital Street

Hospital Street	
Total Length	**1.00 Km**
Total Width	**78 ft.**
Vehicle Lane	40 ft.
Middle Island parking	10.5 ft.
Side walk	4 ft.
Water canal	20 ft.
Traffic Volumes	
Number of pedestrians	13478
Number of vehicle	39547
IN	21373
OUT	18174
Trees	**14**
Building Height	
Teaching Hospital	G+3
Public Market	G
New Market	G+1
Cargills square	G+3
Central bus stand	G+1
Commercial shops	G+1

Figure 4.2: Significant physical features of the Hospital Street

Urban Design Qualities	Elements	Left	Right
Imageability	No of Courtyard	02	00
	No of Plazas	00	01
	No of Parks	00	00
	Bodies of Water	00	00
	Manmade features	01	00
	Modern Building	01	18
	Historic building frontage both side	03	02
	Numbers of building with identifiers	02	89
	No of non - rectangular building	15	89
	Presence of outdoor dining	00	00
	Number of People (Diff.3. Times)	3568	3265
		4358	3978
		4878	4234
Enclosure	Noise Level	High	High
	No of Long site lines	Yes (1)	No
	Proportion of Street wall -Left	yes	No
	Proportion of active uses - Opposite sites	Yes	Yes
	Proportion sky both sides	No	Yes
Human Scale	No of Long site lines	Yes	No
	Proportion windows at street level	No	No
	Average building height	Yes	Yes
	No of small planters	No	No
	Street Furniture	No	No
Transparency	Proportion of windows at street level	No	No
	Proportion of street wall	No	No
	Proportion active uses	Yes	Yes
Complexity	Number of buildings	89	89
	Building basic colours	yellow	Blue
	Building accent colours	Light brown	Brown
	Outdoor dining	No	No
	Number of pieces of public art (Monuments, Sculptures and Murals)	Yes (Middle part of the street)	Yes(Middle part of the street)

Linkage	No of Pedestrians	9843	8347
	Connection between building to street	yes	yes
	Building to building	No	No
	Space to space	No	No
Legibility	Street Network	Yes	yes
	Pedestrian Network	No	No
Coherence	Arrangement of building	Yes	No
	Landscaping, Paving materials	No	No
	Street furniture	No	No

Figure 4.3: Physical elements of the urban design qualities

According to the walking through method, photographic survey, interview with pedestrians and mind map, this study is analyzing, how urban design qualities influence the walkability and active living.

4.2.1.1 Imageability

Generally Imageability makes city as high quality of a place and it is created the lasting impression who are coming to down town.

According to the photographic survey, walking through method and interview with pedestrians, Imageability related physical elements are low at the hospital street of Jaffna and some of the Imageability elements have not at the hospital street like parks, bodies of Water, manmade features and outdoor dining.

However other elements like courtyard, plaza, modern building, historic buildings, non - rectangular building, buildings with identifiers and high amount of people are contributing to enhance the Imageability of the downtown.

Streets filled with people and important land marks (cargills square, power house and new markets buildings) make hospital road in Jaffna town an imageable place but lack of street

activity like outdoor dining, major landscape features and parks make this street is low imageable place.

However character building of the new market, cargills square and hospital's new building areas are high imageability areas at Hospital Street compare with other part of the hospital street and that places are enhancing the pedestrian movement.

High Imageability – Cargills square

Low Imageability – Right side of the Hospital Street (wholesale and Retail shops)

Non- Rectangular Building

Powerhouse

Cargill's square frontage

New Market

Vairavar temple of Hospital

Cargills square

Imageability of the hospital street are enriched by the cargills square, Power house which is designed by British period, some of the commercial buildings and New Market buildings which is reflect the Dravidian Architectural style are giving memorable, recognizable and last impression to the people who are coming to the downtown of Jaffna

Courtyard, Landscapes & Building with identifiers

Hindu Temple

Only new market complexes are consisted courtyard and Vairavar kovil is the only manmade landscape at the hospital road. All the hospital road commercial and other institutions have with identifiers or name board and temple are identified through the tower

Buildings with non-rectangular shapes

Most of the Right and left side of the buildings shapes are non – rectangular shapes. It is enhanced the imageability of the hospital street.

The above mentioned elements like square, land scape features, non - rectangular shapes buildings, historical buildings, building frontage, court yards and buildings with identifiers are upgrading the imageability of the Downtown. According to the interview with pedestrian people, they said, more memorable, distinct and recognizable places are

cargills square, new market complex and vairavar temple. These places are creating capture attention, evoke feelings and create lasting impression for the people.

The number of people of the hospital street like walking, standing and sitting pedestrians are high amount at this street compare with other street of the down town.

However other elements like parks, plazas, lack of court yard, major landscape features, historic building frontage, water bodies and absence of the outdoor dining are inadequate within down town. These elements are more important to enhance the imageability of down town and Noise level of the hospital road is high level due to the high usage of motorized vehicles and poor signage facilities. These above mentioned inadequate Imageability related physical elements are affecting the Imageability of down town.

Low Imageability of the hospital street are contributing to the poor level of Walkability and affect the Walking behavior of the people.

However, Hospital Street is bone of the down town and large amount of pedestrian movement and some of the imageability elements are highly contributing to enhance the imageability and through that, it is contributing to the Walkability. If upgrade Imageability related physical elements, that enhance the Imageability and increase of the Walkable.

4.2.1.2 Enclosure

Enclosure is given room like quality which streets and public spaces are visually defined by buildings, walls, trees and other elements. Enclosure is measured by number of long site lines, proportion street wall and proportion of sky both sides.

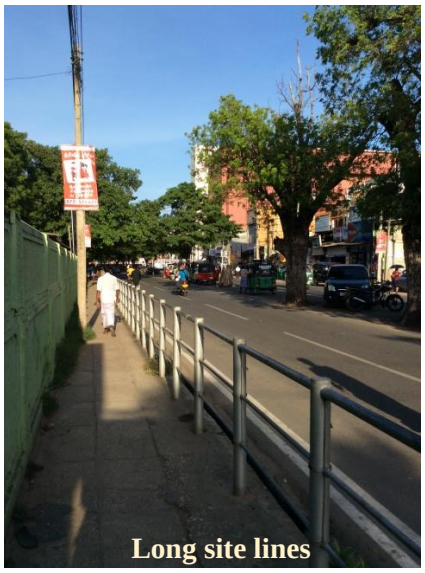

High Enclosure


Low Enclosure

According to the photographic survey and walking through method, left side of the hospital street has high enclosure and that area attracts high amount of pedestrians. Compare with left side of the hospital street, right side of the hospital street enclosure and pedestrian movement are very low.

Left side of the hospital road's teaching hospital street wall and new market's defined street columns are enhancing the enclosure to this area to give a room like effect by limiting long site lines and views open sky. Middle part of the hospital's regular trees pattern are given room like quality to the hospital street

Enclosure is affected by the long site line along the left side of the hospital road and right side of the hospital commercial's street wall are ill defined and that ill-defined street wall affects the right side of the hospital street enclosure



According to the survey, number of long site lines, proportion of street wall and proportion sky elements are poor in condition within the hospital street. Therefore enclosure level is very low. However left side of the hospital street contributes to enhance the small level of the enclosure. Specially New market buildings and hospital site's continuous street wall

and middle part of the hospital street's continuous trees along the hospital premises and left side and right side buildings are creating room like effect by limiting long site lines.

Even if right side of the hospital road are not contributing to the enclosure, but the limited area of the hospital street has consisted uniform street trees, continuous street wall. It gives the room like effect by limiting sight lines and sky.

Finally 25 % of the hospital street has consisted high level of enclosure but 75 % of the street has not included enclosure elements. It is the reason for the low enclosure and not only that it is the main reason to decrease the walking behavior of the people.

4.2.1.3 Human scale

Physical elements like Building details, pavement texture, street trees and street furniture are contributing to human scale.

Small buildings of right side of the street and active uses are only contributing to the human scale of the hospital street and there are no narrow streets and ample street furniture like small planters, tables, chairs, benches, parking meters, trash cars, newspaper boxes, mail boxes, bike racks, bollards, hydrants, flags, banners, merchandise stands, pedestrian scale street lights. This street is only included street light and street vendors.

The human scale of the hospital street is very low and there are no ample street furniture for the pedestrians and unavailability of this urban design qualities are major contributing to poor walkability and there are no standard quality significant physical features like pavement texture of the existing walking way and lack of greeneries and unavailability of the street furniture are limiting the human scale.

Street Vendors

Street Vendors

Ample street furniture is more important to enhance the walkability and urban design qualities. But Hospital Street has only street vendors, street trees and monuments.

4.2.1.4 Transparency

Walls, windows, doors, fences and landscaping are major elements of the Transparency.

According to the walking through method and Photographic survey, the major elements of the transparency like walls and all walls are being built using concrete materials and fences are not opened partially or fully. The modern building are constructing with using glass presently.

only the cargills square and some of the new buildings was built with using of glass and that buildings are contributing to enhance the transparency and other hospital street walls, windows, doors, fences are not contributing to enhance the transparency of the street and there are no landscaping features to enhance the Transparency.

Therefore transparency of the hospital street is very low and it is not contributing to encourage the walking behavior of the people.

Glass Materials Frontage

Full of concrete materials commercial shops wall and windows

Doors – Commercial shops

4.2.1.5 Complexity

Numbers and kinds of buildings, architectural diversity, ornamentation, landscape elements, street furniture, Signage and human activity are major elements to define the complexity.

There are no landscape elements, street furniture, pieces of public art but monuments and building's ornamentation, architectural diversity are enhanced the complexity of the street.

Monuments

Monuments

4.2.1.6 Linkage

Linkage refers to physical and visual connections from Building to street, Building to Building and Space to space.

Left side and right side of the hospital street buildings are clearly connect or linkage with street but there are no connections between buildings to buildings and space to space. It is affected the linkage of the building to building.

Map 4.3: Linkage of the Downtown

4.2.1.7 Legibility

Legibility of a place is improved by a street or pedestrian network that provides travelers with a sense of orientation and relative location and by buildings orientation and relative location and by physical elements that serve as reference points.

Pedestrian network are poor in condition within downtown and only part of the hospital road, K.K.S. road and sir.thuraishamy chettiyar street have consisted pedestrian way but there are no linkages among this walking ways.

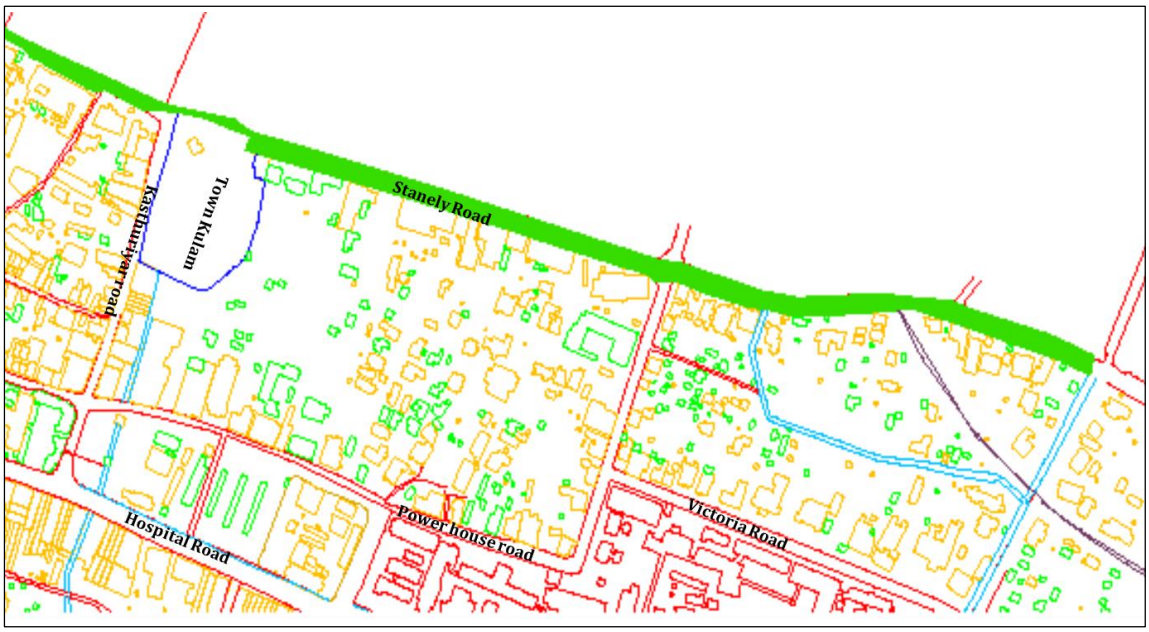
However pedestrian network is more contributed to the Walkability and legibility but there are no legibility within downtown.

Finally, through the measurement of urban design qualities, the walkability related urban design qualities are poor in condition. However compare with other streets of the downtown, Imageability, Enclosure are good condition at Hospital Street and they are upgrading the walkability of the people. But human scale, transparency, linkage and legibility are very poor in condition.

If develop the physical features and urban design qualities elements, Hospital street will get high level of urban design qualities and not only that it will be strongly contributed walkability and walking behavior of the people.

4.2.2 Stanely Road

Stanely road is one of the busiest road which is starting from K.K.S road and ending at rasavinthoddam road. The Total length of the Stanely road is 0.93 km within the down town. The whole of the road is occupied by the commercial activities including hardware stores, banking and financial institutions and the famouse Nagavihara Dagoba and Ariyakulam water body are located at Stanely Road.



Map 4.4: Stanely Road

Stanely Road	
Total Length	**1.00 Km**
Total Width	**62 ft.**
Carriage way	40 ft.
Shoulder	10.5 ft.
Traffic volumes	
Number of pedestrians	4532
Number of vehicle	7645
IN	4263
OUT	3382
Building height	
Commercial buildings	
Minimum	G
Maximum	G+3

Table 4.4: Significant physical features of the Stanely Road

4.2.2.1 Imageability

	Physical Elements	Left	Right
Imageability	No of Courtyard	00	00
	No of Plazas	00	00
	No of Parks	00	00
	Bodies of Water	01	00
	Man-made features	01	00
	Modern Building	05	06
	Historic building frontage both side	08	16
	Numbers of building with identifiers	52	95
	No of non - rectangular building	52	49
	Presence of outdoor dining	00	00
	Number of People (Diff.3. Times)	1147 (7-9 am)	965
		624(12-2 pm)	453
		747 (4-6 pm)	596
	Noise level		

Table 4.5: Physical elements of the Imageability

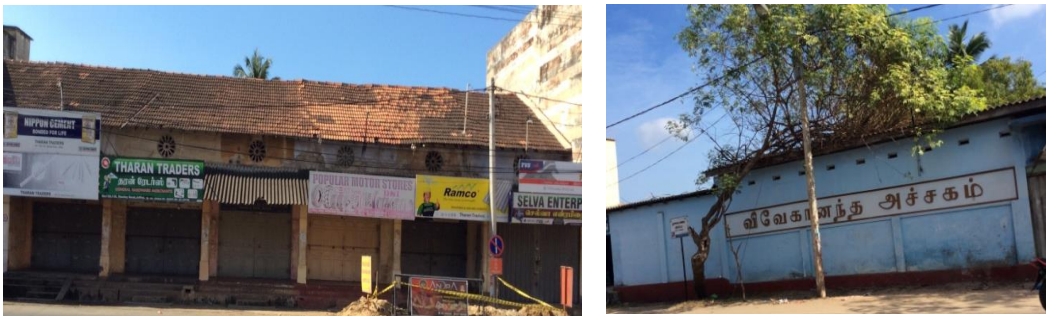
Nahavihara Buddhist dagoba, Ariyakulam inland water body, Modern buildings, buildings with identifiers, Non rectangular building and Historic building's frontage are contributing to enhance the imageability of the stanely road.


Low Imageability

Low Imageability

Major landscape feature of Nagavihara, Dutch period historic buildings, Non rectangular buildings, Modern buildings and Ariyakulam water body enhance the Imageability of the street.

Major landscape features, Water bodies and Modern buildings



Historical Buildings

Building with identifiers, Rectangular buildings

These above mentioned physical elements are upgrading the Imageability of the stanely road. However some of the places of the stanely road has consisted very low imageability. There are no court yard, plazas, parks and outdoor dining and also historical buildings and modern buildings are very low at stanely road.

According to the Photographic survey, walking through method and interview with pedestrians, Nahavihara and Ariyakulam surrounding areas have only high Imageability, high amount of people and noise level are also high.

Therefore only the Ariyakulam water body and Nahavihara area are attracting high amount of pedestrians at the stanely road. Because these two areas have high quality of walkability related physical elements. Therefore, they are very memorable and recognizable places to the people, who are visited to that street.

4.2.2.2 Enclosure

The enclosure level of the stanely road is very low. Only the Nahavihara and ariyakulam water bodies have consisted some of the enclosure elements compare with other part of the street.

There are no long site lines and trees to measure the enclosure. These are two main elements to measure enclosure.

Proportion street wall of the commercial street are ill defined and enclosure are affected by the ill-defined street wall.

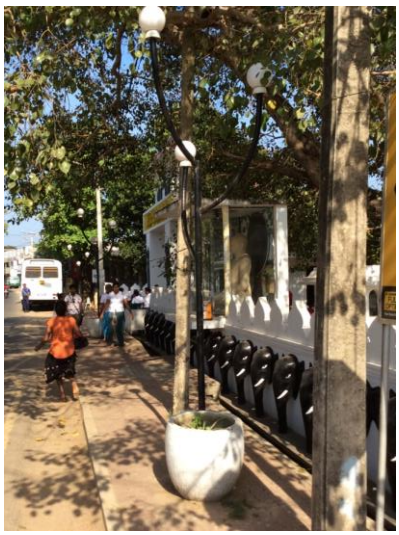
	Physical elements	Left	Right
Enclosure	Noise Level	High	High
	No of Long site lines	Yes (1)	No site lines
	Proportion of Street wall -Left	yes	No
	Proportion of active uses - Opposite sites	Yes	Yes
	Proportion sky both sides	yes	Yes
	No of Long site lines	Yes	No

Table 4.6: Physical elements of the enclosure

Uniform street trees create room like effect by limiting long site lines and views of open sky

Buildings does not provide a well-defined street wall – This scene feel and large amounts of open sky

Left side of the stanely road has consisted high amount of enclosure through the trees and defined street wall along the Nahavihara and Ariyakulam water body. But other part of the left side and right side have no side lines and trees to measure enclosure.



This place as a high enclosure place through the well – defined street wall and trees	Trees create this area as a room like effect by limiting the sky views

4.2.2.3 Human Scale

Physical elements like building details, pavement texture, street trees and street furniture are contributing to human scale.

	Physical Elements	Left	Right
Human Scale	Proportion windows at street level	No	No
	Average building height	yes	Yes

	No of small planters	Yes (along the Nahadeepa)	No
	Street Furniture	No	No
	Proportion of windows at street level	No	No

Table 4.7: Physical elements of the Human scale

Human scale of the stanely road is very low and there are no ample street furniture for the pedestrians and lack of urban design qualities related physical elements like small planters, tables, chairs, benches, parking meters, trash cars, newspaper boxes, mail boxes, bike racks, bollards, hydrants, flags, banners, merchandise stands, pedestrian scale street lights. Generally these factors are highly contributed to enhance the human scale.

However only the Nahavihara temple has consisted small level of urban design related physical elements such as small planters and pedestrians scale street lights and there are no other street furniture elements along the Nahavihara.

Small planters & Human scale street light at Nahavihara

Small scale buildings and active uses are contributing to the human scale in a similar level in other part of the stanely road. However the human scale related physical elements are very low at the stanely road and that also contribute to the low human scale and walkability.

4.2.2.4 Transparency

Walls, windows, doors, fences and landscaping are major elements of the Transparency.

Transparency	Proportion of street wall	No	No
	Proportion active uses	Yes	Yes
	Number of buildings	89	89

Table 4.8: Physical elements of the Transparency

New modern buildings are being constructed glass materials and aluminum composite panel. This type of buildings are upgrading the transparency of the street. Only 8 % of the buildings are modern buildings of the total buildings

The 92 % of the buildings are not contributed to enhance the transparency and the frontage of the building are being constructed using concrete materials that affect the transparency of the streets.

Glass materials walls and windows of the commercial shops are enhancing the Transparency of the Stanely road

Concrete materials wall and windows of the commercial shops are not contributing to enhance the transparency of the Stanely road

4.2.2.5 Complexity

Numbers and kinds of buildings, architectural diversity, ornamentation, landscape elements, street furniture, signage and human activity are major elements to define complexity.

	Number of buildings	**89**	**89**
Complexity	Building basic colours	White	Brown
	Building accent colours	Blue	Yellow
	Outdoor dining	No	No
	Number of pieces of public art (Monuments, Sculptures and Murals)	Yes	No
	No of Pedestrians	2518	2014

Table 4.9: Physical elements of the Complexity

Monuments, Building's ornamentation and architectural diversity are contributing to enhance the complexity of the stanely road.

But compare with all the buildings, Building's ornamentation and architectural diversity is very less at the street and no outdoor dining and other elements like number of pieces of public art and no of pedestrians are poor at the street. But Buddha statue are enhanced complexity near the Nahavihara.

Therefore high complexity areas are defined by these physical elements and they are contributing to the Walkability.

However, the complexity related physical elements are poor at the stanely road and poor elements are contributing to the poor walkability.

4.2.2.6 Linkage

Linkage refers to physical and visual connections from building to street, Building to building and space to space.

Stanely road are high linkage with other down town streets and spaces like Nahavihara and Ariyakulam are well connected but there are no linkage with buildings to buildings.

4.2.2.7 Legibility

Legibility of a place is improved by a street or pedestrian network that provides travelers with a sense of orientation and relative location and by buildings orientation and relative location and by physical elements that serve as reference points. There are no pedestrian network within the down town.

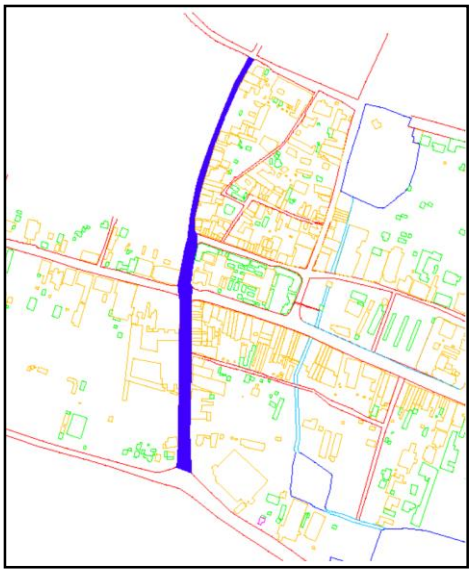
Finally the urban design qualities and related physical elements are poor in condition at the stanely road. According to the walking through method and Interview with people, The most memorable and attractable places are Nahavihara and Ariyakulam and the high amount of people like pedestrians, standing and sitting people are high at that places compare with other part of the street.

The amount of pedestrians are very low other parts of the street but historical buildings, modern buildings, buildings with identifiers and non- rectangular buildings are

contributing to enhance the urban design qualities, enhance the walking behavior and walkability pattern of the people.

4.2.3 Measuring urban design qualities related to walkability using related elements of the urban design qualities for K.K.S road and Kasthuriyar road

K.K.S and Kasthuriyar road are the most important roads within the downtown. The total length of the K.K.S road and Kasthuriyar road within the down town is 0.7 & 1.4Km. The width of the Kasthuriyar road is 4m and K.K.S.Road is 7m. The major commercial institutional activities of the downtown are occupied by the both roads.



Map 4.5: K.K.S.Road & Kasthuriyar Road

Physical Elements	K.K.S Road	Kasthuriyar
Total length	1.3 Km	0.7 Km
Total width	7 M	4 ft.
Number of pedestrians	12160	9324
Number of Vehicle	15876	13829
IN	8934	13285
OUT	6942	544
Building height	G+2	G+3

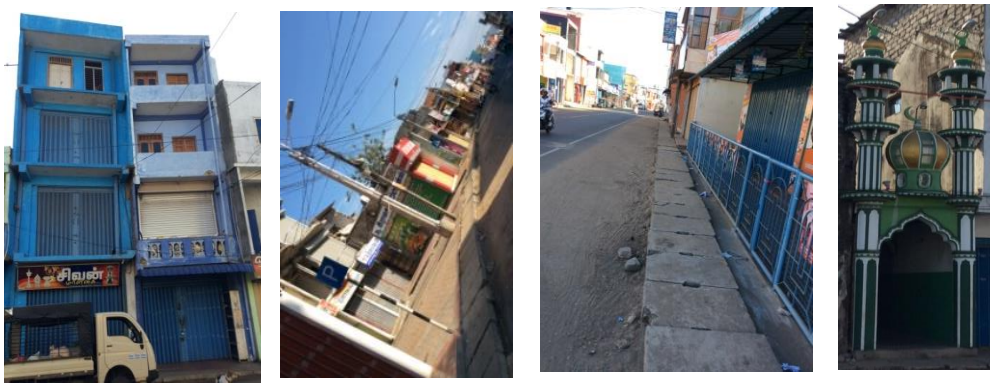
Table 4.10: Significant physical features of the K.K.S.Road and Kasthuriyar Road

Urban design qualities	Physical Elements K.K.S.Road			K.K.S.Road	Physical Elements Kasthuriyar Road		Kasthuriyar Road
	Elements	Left	Right		Left	Right	
Imageability	Number of Courtyard	00	00	Low Imageability. Less number of imageability related physical elements are at K.K.S.road such as non-rectangular buildings, buildings with identifiers and less amount of modern buildings and historic buildings. Other elements like square, plazas, parks, major landscape features and water bodies are not at the K.K.S.road	00	00	Imageability of the Kasthuriyar road is very low. No physical elements to enhance the imageability. 90% of the buildings are non-rectangular and 100 % of the buildings with identifiers. Kasthuriyar road is only consisted above mentioned imageability related physical elements
	Number of Plazas	00	00		00	00	
	Number of Parks	00	00		00	00	
	Bodies of Water	00	00		00	00	
	Manmade features	00	01		00	00	
	Modern buildings	13	16		04	02	
	Historic buildings frontage both side	04	07		00	02	
	Numbers of buildings with identifiers	47	53		17	21	
	Number of Non-Rectangular building	42	49		16	21	Historical buildings are 5% and 16% of the buildings are modern buildings of the total buildings. This percentage are only contributed for the small level of the imageability of the street And other physical elements like square, plaza, manmade landscape features, small parks and water bodies are not at the street.
	Presence of outdoor dining	00	00		00	00	

							Finally, Imageability of the Kasthuriyar road is very low compare with other street
Enclosure	Number of People	12160	9324	Ill-defined street wall are not enhanced the enclosure.	2475	2425	No sight lines at Kasthuriyar road to measure the enclosure. The commercial shops' street wall ill-defined and there are no defined street wall and uniform trees. This situation is created long site lines and views of open sky. Therefore enclosure of the street is zero level
	Number of long site lines	No	No		No	No	
	Proportion of street wall	No	No	No long site lines to measure enclosure. Unavailability of street trees are created views of open sky	No	No	
	Proportion of active uses	Yes	Yes		Yes	Yes	
	Proportion sky both sides	No	No		Yes	Yes	
Human scale	Proportion windows at street level	No	No	Unavailability of the street furniture. Average building height (G+2) are contributed to the human scale	No	No	Street furniture is the main physical elements to measure human scale. No street furniture is created this street as low human scale area.
	Average building height	Yes	Yes		Yes	Yes	
	Number of small planters	No	No		No	No	
	Street furniture	No	No		No	No	
Transparency	Proportion of windows at street level	No	No	Modern buildings are very low compare with contemporary buildings. There are no windows at street level	No	No	16% of the modern buildings are contributed enhance the transparency
	Proportion of street wall	No	No		No	No	
	Proportion active uses	Yes	Yes		Yes	Yes	

Complexity	Number of buildings	47	53	Lack of architectural ornamentation, diversity landscape elements	17	21	No landscape elements, street furniture, signage, public art, buildings' ornamentation and architectural diversity
	Buildings basic colours	Brown	Brown				
	Buildings accent colours	Blue	Blue				
	Outdoor dining	No	No		No	No	
	Number of pieces of public art	No	No	Street furniture and signage	No	No	
	Number of pedestrians	15932	14798		2412	1976	

Table 4.11: Measuring Urban design qualities of the K.K.S.Road & Kasthuriyar Road



Physical elements – K.K.S.Road

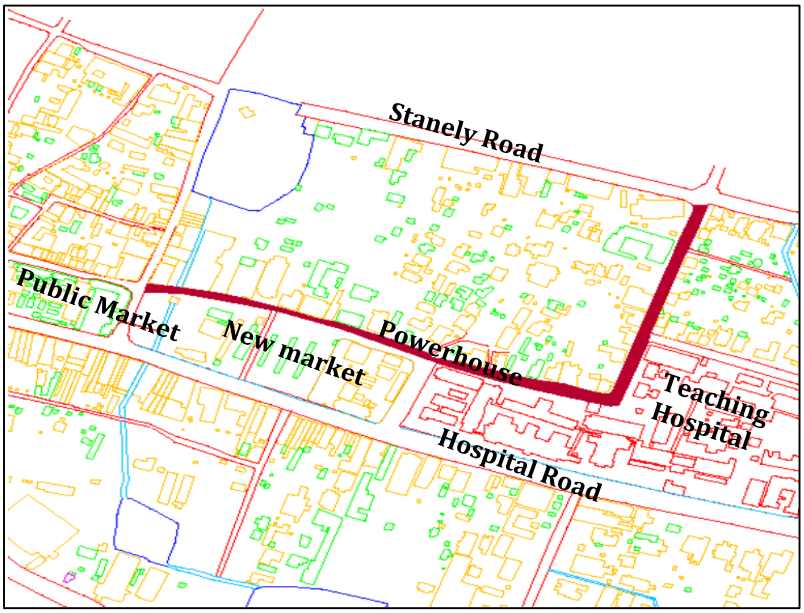

Physical Elements – Kasthuriyar Road

4.2.4 Power House Road

Power house is the most important street within the down town and 25 % of the down town commercial activities are concentrated at the power house road. Textiles, banks and financial, bus stand, new market, part of the teaching hospital and hotels.

The total length of the of the powerhouse road is 0.8 M and width is 64 ft. and middle part and both side of the powerhouse road specially from kasthuriyar road up to back side of the public bus stand are using as a private short distance bus stand.

Therefore the power house road is the most busiest and congested street within the downtown due to this reason. According to the traffic survey, nearly 5000 number of pedestrian are using this street and approximately 10000 vehicles are travelling this street daily.



Map 4.6: Powerhouse Road

Power House Road	
Total length	1.00 Km
Total width	78 ft.
Carriage way	40 ft.
Shoulder	10.5 ft.
Traffic volumes	
Number of pedestrians	6435
Number of vehicle	11435
IN	6784
OUT	4651
Building height	
Commercial	G+2
Institutions	G+1

Table 4.12: Significant physical features of the Powerhouse Road

Measurement of Urban design qualities related to Walkability using related elements of the urban design qualities.

Urban Design Qualities	Elements	Left	Right
Imageability	No of Courtyard	00	00
	No of Plazas	00	00
	No of Parks	00	00
	Bodies of Water	00	00
	Man-made features	00	00
	Modern Building	15	02
	Historic building frontage both side	04	00
	Numbers of building with identifiers	02	89
	No of non - rectangular building	44	19
	Presence of outdoor dining	00	00
	Number of People (Diff.3. Times)	3568	3265
		4358	3978
		4878	4234
Enclosure	Noise Level	High	High
	No of Long site lines	No	No
	Proportion of Street wall -Left	No	No
	Proportion of active uses - Opposite sites	Yes	Yes
	Proportion sky both sides	yes	Yes
Human Scale	No of Long site lines	Yes	No
	Proportion windows at street level	No	No
	Average building height	Yes	No
	No of small planters	No	No
	Street Furniture	No	No
Transparency	Proportion of windows at street level	No	No
	Proportion of street wall	No	No
	Proportion active uses	Yes	Yes
Complexity	Number of buildings	45	21
	Building basic colours	Blue	Brown
	Building accent colours	Red	Yellow
	Outdoor dining	No	No

	Number of pieces of public art (Monuments, Sculptures and Murals)	Yes	Yes
	No of Pedestrians	9843	8347
Legibility	Street Network		
Linkage			
Coherence			

Table 4.13: Urban design qualities of the Powerhouse Road

The above mentioned urban design qualities related physical elements was measured using walking through method, photographic survey and interview with people.

4.2.4.1 Imageability

Non Rectangular buildings, buildings with identifiers, number of courtyard and plazas, manmade features, modern buildings, historic buildings and outdoor dining are major imageability related physical elements to measure imageability.

According to the data collection and survey, the main physical elements like plazas, courtyard, manmade features and outdoor dining have not at the power house road but other elements like Historical buildings, modern buildings, buildings with identifiers and non - rectangular buildings are at that street. These available physical elements are contributed to upgrade the imageability of the street.

Modern buildings at Powerhouse road


Historical buildings of the Powerhouse Road

Number of people and pedestrian movement are high at this street compare with other downtown streets. The reason is private short distance bus stand is functioning at the power house road and this road is located very closure to the public bus stand.

The majority of the pedestrian's statement, only the Hatton national bank building and surrounding area and new market complex buildings have given to the evoke feelings and create lasting impression to the people and even if Some of the modern buildings, historic buildings and non-rectangular buildings are located, but they are not enhance the imageability of the street. The reason is, historical buildings are abundant presently.

According to the survey, Street has consisted only 10 % of the imageability related physical element and they are contributing to the poor walkability behavior of the people.

4.2.4.2 Enclosure

Enclosure is given room like quality which streets and public spaces are visually defined by buildings, walls, trees and other elements. Enclosure is measured by number of long site lines, proportion street wall and proportion of sky both sides.

A continuous street wall of the new market buildings and back side of the teaching hospital wall are given enclosure to the street and they are built in a defined structure. But other commercial shops' wall are being constructing in the ill -defined pattern which affect the enclosure of the street.

Defined wall of new market complex

Generally trees is the main elements to measure the enclosure and uniform street trees create a room - like effect to the street and they limit the long sight lines and views of open sky. But there are no trees at the power house road and the unavailability of trees are created long site lines and views of open sky. This situation is created low enclosure to the street. Low enclosure of the power house road is contributed to the less amount of Walkability.

4.2.4.3 Human Scale

Physical elements like building details, pavement texture, street trees, and street furniture are contributing to human scale.

Small buildings of left side of the street and active uses are enhancing the human scale of the street and ample street furniture like small planters, tables, chairs, benches, parking meters, trash cars, newspaper boxes, bike racks, bollards, hydrants, flags, banners,

merchandise standards, pedestrian scale street lights and street vendors are not available at the powerhouse road. Generally these elements are contributed to enrich the human scale of the street.

4.2.4.4 Transparency

Walls, windows, doors, fences and landscaping are major elements of the transparency.

The major elements of the transparency like walls, all walls are being built using concrete materials and fences are not opened partially or fully. The modern building are being constructing with using glass presently.

HNB building and some of the modern buildings are contributed to enhance the transparency and other commercial shops and hospital fences are not enhanced the transparency of the street.

Concrete Materials

Glass materials

4.2.4.5 Complexity

Numbers and kinds of buildings, architectural diversity, ornamentation, landscape elements, street furniture, signage and human activity are major element to define the complexity.

According to the measurement, urban design qualities are poor in condition at the power house road and that reduces the walking behavior of the people.

Finally if look at all downtown streets, only Hospital Street has minimum level of urban design qualities related physical elements and urban design qualities. At the same time other down town streets urban design qualities are very low according to the field survey and photographic survey and according to the interview with people, people do not like to walk at these down streets. Because only small part of the street has consisted walking way and other balance part of the streets have not walking way.

Pedestrian people have to use vehicle lane for their walkable purposes. Therefore people do not like to walk.

If improve the physical elements like pedestrian walking way, small parks, manmade features, courtyard, uniform trees, street furniture, defined street wall, architectural diversity and ornamental architecture. These all physical elements will be enhanced the urban design qualities such as imageability, enclosure, complexity, human scale, transparency and linkage and above mentioned physical features or elements and these all urban design qualities will be enhanced the walking behavior of the people, Walkability and also contributing to the active living urban life.

4.3 How urban design qualities influence the walkability within the Jaffna downtown

Significant physical elements, urban design qualities & Walkability are very close relationship and generally physical elements are more contributed to enrich the urban design qualities & walkability.

Significant physical features like side walk width, street width, traffic volumes, tree canopy, building height, number of people and weather are some of the physical features that contributes to upgrade the walkability and urban design qualities.

And also generally urban design qualities are measured by the physical elements such as street furniture, plazas, court yard, street wall, and street window. Therefore physical features are directly effect the walkability and indirectly effect the walkability to upgrade the urban design qualities of the downtown.

According to the walking through method, Photographic survey and interview with people, urban design qualities related to walkability measured and urban design qualities are poor in condition and they are not contributed to the Walkability due to the urban design qualities related physical elements and poor condition of the urban design qualities related physical elements.

According to the findings, Cargills square, new market complex, Nahavihara and Ariyakulam areas attracts high amount of pedestrians through good condition of the physical elements. Good condition of the physical elements are enhanced the urban design qualities in that particular area.

Therefore if develop the urban design qualities related physical elements within the Jaffna downtown, That qualities will be enhanced the urban design qualities and walkability and walking bahaviour of the people.

CHAPTER FIVE: CONCLUSIONS AND RECOMMENDATIONS

Jaffna town has low urban design qualities and significant physical features related to the Walkability according to the case study analysis. Poor level of physical features and urban design qualities contributes to the poor walking behavior of the people, walkability and active living life.

Urban design qualities related physical elements such as courtyard, plazas, parks, bodies of water, manmade features, modern building and historic building are inadequate and existing physical elements like non-rectangular building, street wall, long site lines, windows at street level and street wall do not enhanced the urban design qualities and lack of urban design qualities make low contribution to the Walkability.

Unavailability of the ample street furniture like small planters, tables, chairs, benches, parking meters etc. are not within the downtown to enhance the walkability. At the same time, the number of the pedestrian people are high at the downtown streets without the sufficient physical features like pedestrian walking way, street trees, street furniture etc.

Presently, Jaffna is the busiest town and attract more commuter population from the Northern and other part of the country. Traffic jam or traffic congestion is one of the main urban design problem and pedestrian people is also using vehicle lane for their walking needs. It creates more accidents, traffic problems and increase the travel time. Therefore, if developed the significant physical features that enhance the urban design qualities and Walkability.

Related urban planning and urban design institutions like urban development authority (UDA), Jaffna Municipal council (JMC) and road development related institutions like Road development authority (RDA) to design urban design qualities related physical elements within the downtown. UDA is the main physical planning organizations to

prepare and design the urban areas in Sri Lanka. UDA have to regulate building construction to enhance imageability of the downtown.

UDA is prepared development plans for the urban declaration areas in Sri Lanka and UDA is proposed better urban gathering spaces like outdoor dining, pedestrian walkway and natural water bodies for recreational purposes and UDA can regulate building pattern and conserve historical buildings of the downtown.

UDA can create both water bodies for recreational purposes of the urban dwellers and floating population and regulate building construction around the water bodies through zoning plans and planning and building regulations of the UDA.

And related authorities have to prepare rules and regulations about construction and modification of new buildings within the downtown and make awareness to the contractors, business people and other related people.

There are significant historical buildings mainly dutch period's buildings are located with lack of maintenance. Some buildings are abundant and some buildings are converted as a modernized buildings. Therefore archeological department have to prepare plans and regulations to conserve historical buildings of the city.

For example, Renovation and modification of Archeological buildings should be guided by archeological department and for above mentioned activities, Proper approvals should be taken from relevant authorities like UDA, JMA & Archeology department.

Generally natural water bodies are enhanced the scenic beauty of the city and increase the ground water capacity and Natural water bodies are one of the physical elements to measure imageability. But Water bodies are encroached by the public presently. Therefore relevant authorities will make necessary action to conserve natural water bodies and convert natural water bodies as a recreational areas of the down town that increase the imageability of the down town and also enhance the walking behavior of the people.

For Example, Pullukulam and Vannankulam are main water bodies within down town. However, presently both water bodies are encroached by unauthorized constructors and also waste dumping point.

Therefore, If enhance the significant physical features of the downtown, It will be contributed to the urban design qualities and good level of urban design qualities will be upgrade the walking behavior of the people, Walkability and active living life of the people.

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