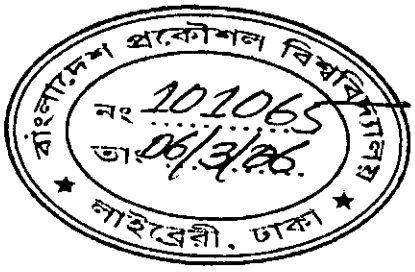
Accommodating the Pedestrians and Bicyclists in the Neighborhoods of Dhaka: An Investigation of Existing Situations



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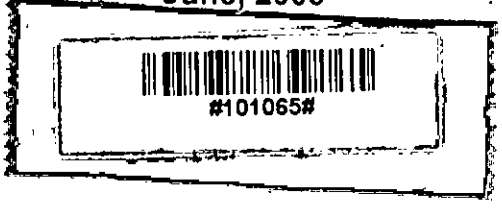
June, 2005



Accommodating the Pedestrians and Bicyclists in the Neighborhoods of Dhaka: An Investigation of Existing Situations

A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE
OF
MASTER OF URBAN AND REGIONAL PLANNING

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THESIS ACCEPTANCE FORM

Accommodating the Pedestrians and Bicyclists in the Neighborhoods of Dhaka: An Investigation of Existing Situations

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It is hereby declared that this thesis or any part of it has not been submitted elsewhere for the award of any degree or diploma.

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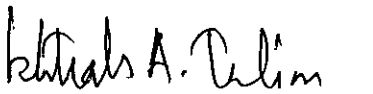

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Ishtiak Ahmed Taslim

The author wishes to dedicate this research to the memory of his beloved father, Dr. Taslim Uddin Ahmed, physicist, philosopher and teacher, who introduced the author to the realm of knowledge and learning.

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Ishtiak Ahmed Taslim

June, 2005

ABSTRACT

Walking and bicycling are environmentally friendly mode of transportation that enhances both personal and social well-being. Other than transportation, these two modes of travel provide many, health, economic and social benefits. Successful pedestrian and bicycle systems reflect the mobility and access needs of communities and are placed in a wider context more than simple movement of peoples and goods. Lack of appropriate facilities for walking and bicycling is one of the important reasons of physical inactivity and as a consequence lead to related chronic health disorders. In this system, issues such as land use, energy, health, environment and neighborhood livability are important factors.

Almost 60% of the 8.5 million weekday trips in Dhaka are solely composed of pedestrians; about 19.2% use the cycle rickshaw and the rest use different types of transports, such as private cars, buses, etc. It is predicted that by 2015 about 20 million people would be using the pedestrian mode of transport to reach different destination. From the above statement it is evident that millions of people use the pedestrian mode and a significant portion use bicycle rickshaw to reach different destinations. However the use of bicycle has been on the decline due to hazards posed to the users by motor vehicles and other factors.

In order to investigate the prevailing conditions of access facilities of pedestrians and bicyclists on the street network in Dhaka, and also find ways and means to accommodate the pedestrians and the bicyclists in the neighborhood streets, a planned residential area (Dhanmondi) and an unplanned residential area (Kalabagan) have been selected for this study.

Form the inventory of the study areas it was found that the streets in Dhanmondi are arranged basically in grid iron pattern with ill designed and ill maintained walkways. On the other hand in contrast to grid street network of Dhanmondi area, streets of Kalabagan area was developed in an organic way. Dead end streets characterize street network of this area with an absence of any walkway provisions.

From the study it is found that the walking trip made by the residents of Kalabagan is about 22 % compared with 9.5 % of that of Dhanmondi area. About 45% and 81% respondents of Dhanmondi and Kalabagan respectively desires to use bicycle for trip if bike lanes are provided.

For the research collected data were analyzed in order to find out why people prefer to walk or use bicycle and also the reasons why they are debarred / restrained from walking or bicycling. Data were analyzed also to find people's views regarding their neighborhoods and their ideas to make the neighborhoods active, livable, sociable, safe and so on. Recommendations are made based on the findings for the accommodating the pedestrians and bicyclists in the present transportation network.

Title of the Thesis:

Accommodating the Pedestrians and Bicyclists in the Neighborhoods of Dhaka: An Investigation of Existing Situations

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LIST OF ABBREVIATIONS

NMT	Non-motorized Transport
kms	Kilometers
DITS	The Greater Dhaka Metropolitan Area Integrated Transportation Study
TND	Traditional neighborhood design
NTD	Neo-traditional development
POD	Pedestrian oriented design
TOD	Transit oriented development
RAJUK	Jajdhani Unnayan Katripakha
DCC	Dhaka City Corporation
BUET	Bangladesh University of Engineering and Technology, Dhaka
PWD	Public Works Department
UDD	Urban Development Directorate
RHD	Roads and Highways Department
GIS	Global Information System
CAD	Computer Aided Design
NMT	Non Motorized Transport
MT	Motorized Transport
ADT	Average Daily Trip

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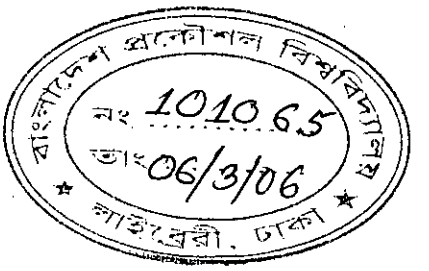
CHAPTER 1

INTRODUCTION

CHAPTER 1
INTRODUCTION



1.1 Statement of the Problem

To promote socioeconomic condition of a country as well as its urban areas transportation and mobility are important aspects to deal with. Though walking and bicycling are indispensable part of the overall transportation in the city they were not given due consideration in planning and design of the street network of Dhaka city and as well as its neighborhoods.

Despite the number of planned residential neighborhood in Dhaka there are limited facilities for the pedestrian and the bicyclist. They are not incorporated according to the basic required standards. Existing street system and available vehicular mode of travel are deficient in many ways. No undisrupted walkway network exists in any part of the city and walking has never been regarded as an interdependent part of the circulation system.

Planning for pedestrians must have the aim of providing a more safe, pleasant and attractive environment. It must provide continuous pedestrian circulation integrated with the interfaces of other components of the transportation networks (Kiwan, 1988). But the street network has been designed in favour of motorized travel following the standards used by the traffic engineers who generally come to view walking and bicycling as obstructions that impede the smooth flow of traffic. Though there exist very limited facilities for pedestrians in some neighborhoods, the existing environmental conditions both physical and visual aspects of the street discourage walking and bicycling.

This study envisages the need for planning and design that contributes to the enrichment of an environment that is pedestrian and bicycling friendly (both physical and visual), encouraging people to walk or bike. In this regard, this study intends to investigate how far such a vision has been carried out or implemented in the neighborhoods of Dhaka.

1.2 Background of the Problem

Walking and bicycling are environmentally friendly mode of transportation which enhance both personal and social well-being. In addition to transportation, these two modes of travel connect destinations as well as providing health and economic benefits. Successful pedestrian and bicycle systems reflect the mobility and access needs of communities and are placed in a wider context than simple movement of peoples and goods. In this system, issues such as land use, energy, health, environment and neighborhood livability are important factors.

The Centers for Disease Control and Prevention (CDC) in the United States of America has identified the lack of appropriate facilities for walking and bicycling as one important reason why Americans are not active as they could be, which, in turn, is contributing to a national health crisis. The CDC has pinpointed physical inactivity (and related chronic health conditions of obesity, diabetes, coronary health disease, high blood pressure, stroke, some types of cancer and gall bladder disease) as a major underlying cause of premature mortality in the USA .Much of this is because large segments of the population do not have the option of walking out their front door and being active participants in their own communities.

The CDC, thus, calls to promote physical activity "active community environments" having the following characteristics:

• Support and promote physical activity;

• Have sidewalks, on-street bicycle facilities, shared-use paths and trails, parks, open space and recreational facilities; and

• Promote mixed-use development and a connected grid of street and roads, allowing homes, employment centers, schools and shops to be easily accessed by walking and bicycling without the use of a motor car (Vermont, 2002).

Ideally, active community environments and livable communities are also defined by the following qualities:

- *Coherence* — A clear, understandable and organized footpaths or sidewalk, street and land use system consistent with the scale and function of the city or village. The

sidewalk and street system should link points of interest and activity, provide clean lines of sight and travel, and include simple instructive signing.

- *Continuity* — A unified pattern of pedestrian and bicycle facilities.
- *Equilibrium* — A balance among transportation modes that encourages walking, bicycling and use of transit.
- *Safety* — Protection from motor vehicles and related hazards, and promote vigilance and crime prevention.
- *Comfort* — Secure and negotiable walking surfaces, unobstructed passage on the sidewalk and at corners, and signals timed to enable safe and quick crossings. Road network that provide comfortable operating conditions and widths for both bicycles and motor vehicles.
- *Sociability/ Social interactions* — A sense of belonging, hospitality and suitability for individual and community interactions. Sidewalks should provide for many uses and activities.
- *Accessibility* — The opportunity for all individuals to walk or bicycle to all destinations.
- *Efficiency* — Simplicity and cost-effectiveness in design and function. Minimal delay along walking and bicycling routes.
- *Attractiveness/ Aesthetics* — Clean, efficient and well-maintained surroundings, with activities that provide sidewalk interest (Vermont, 2002).

Whyte and Appleyard states that "streets must be more than channels for car transportation; they must also accommodate people on foot, on bicycle; they must be a social place for people to meet face to face; and they must bring additional green space to communities"(Lohr, M., 1999), while Ashraf and Haque (2003) states that "The sidewalk (or the footpath) is the supreme mark of a civility of a city; it belongs to the culture of walking, strolling and promenading. The quality of sidewalks gives evidence to what the city managers think about a fundamental human condition: the pedestrian and his humanity...". Former U.S. President John F. Kennedy thought: "It's not wealth that built our roads but the roads that built the wealth"(Khan, 2001). If we judge Dhaka by the above stated concepts, how would it fare? Do the streets of Dhaka provide direct, continuous and convenient access to most destinations? Do the streets of Dhaka serve the mobility and access needs of the community?

A World Bank study (1998) shows that almost 60% of the 8.5 million weekday trips in Dhaka are composed of pedestrians. If 60% of 10 million population use the pedestrian mode then about 6 million walk and a significant portion use bicycle rickshaw to reach different destinations daily. With the ban of rickshaws off many streets of Dhaka, how will this effect million of people who use the NMT to reach destinations? Is there any possibility of bicycles replacing the rickshaw? Are the streets in the neighborhoods or communities of Dhaka been designed to accommodate and facilitate efficient movement of pedestrians and bicyclists? What constitutes a good neighborhood or community? What are the planning and design criteria of existing neighborhoods and communities in Dhaka? How to rectify flaws, if any, in the present street network and to upgrade/ improve the environmental condition, livability and accessibility within and between the neighborhoods or communities?

In order to answer the above questions, there is a need for an in-depth study and find out ways of accommodating the pedestrian traffic within the existing street network in Dhaka. This study intends to take up two neighborhoods or communities (the planned neighborhood of Dhanmondi and the unplanned residential area of Kalabagan) in order to inquire into the questions posed above and investigate the prevailing conditions of the street network in the above stated residential neighborhoods of Dhaka.

1.3 Objective of the Research

I. Investigate the design and planning criteria of existing neighborhoods;
II. Investigate how the pedestrians and bicyclists are accommodated within the existing street network of neighborhoods;
II. Investigate whether the existing street network within the community have been able to ensure accessibility, health, livability and economy;
IV. Investigate the quality of the existing neighborhoods.

1.4 Organization of the Thesis

Chapter 1 states the problem and provides the background for the research. The objectives of the study are established.

Chapter 2 presents literature study, which includes the present walking and biking situation in Dhaka city. It also intends to state elaborately the urban design situation historically and in present time in different countries.

Chapter 3 enumerated the method involved in the research.

Chapter 4 intends to introduce pedestrian and bicyclists environments. For that intention the characteristics of the pedestrian or bicyclists and their need are discussed. Importance of transportation planning, street network layout in the urban planning or neighborhood street network designs are also discussed. Benefits of walking and bicycling, which includes of personal and social aspects are discussed critically. Pedestrians and bicyclists system planning explained elaborately with figures and diagrams.

Chapter 5 mainly intends to discuss how the neighborhood can be planned and designed to create a pedestrian and bike friendly environment. For that intention this chapter describes, the concept of neighborhood design and theories developed and practiced throughout the world. It also describes the design elements of the neighborhood. Street network, street design, separate biking and walking systems as a part of the build environment of the neighborhood, which are also part of the transportation system, are discussed critically. Perception of street by the pedestrians, bicyclists and children also discussed. Urban area street classification, residential area street classifications are discussed. Finally the discussion focuses on the pedestrian oriented site design, on which central focus is on pedestrians.

Chapter 6 describes the problems and prospects for the accommodation of pedestrians and bicyclists, based on the aspects described in Chapter 4 and Chapter 5, in the study areas. For the study purpose and for careful examine and analysis; demographic, social, economic conditions of the residents as well as their views and opinions regarding

walking and biking are elaborated. This chapter also describes the present walking and biking network system and conditions within the area with the aim of probable recommendations for the solutions of the problems.

Chapter 7 recommends the measures that have to be taken for the accommodation of pedestrians and bicyclists in the areas based on the study findings. Recommendations are specified especially for the two study areas as well as for the overall improvement of the pedestrian and bicyclists environment in Dhaka city. Concluding comments are also given in this chapter.

CHAPTER 2

LITERATURE STUDY

CHAPTER 2

LITERATURE STUDY

2.1 Pedestrians and Cyclists in Dhaka City

Dhaka metropolitan area is the largest city in Bangladesh with a population of nearly 12 million distributed over an approximately 1528 sq.km area, whereas the city's area was only 73 square kilometers in 1951 with a population of about 350,000. The rate of increase of population at about 7% per year. The city is growing at a rate of 4.5 square

Table 2.1 DMDP Central Population Forecast

Strategic Planning Zones	Forecasted Population In Thousands					
	1991	1996	2001	2006	2011	2016
1-7	3844	4684	5747	6308	7008	7498
8-14	2044	2744	3464	4114	4764	5400
15-18	1005	1206	1408	1609	1789	1966
19	453	498	543	588	647	705
Total	7334	9132	11162	12619	14208	15569

kilometer a year (Karim, 1998). Fig 2.1 shows the growth of Dhaka city from the year 1600 to 1980. The growth of population in different Strategic Planning Zone (SPZ) is shown in Table 2.1 and SPZ are shown in Map 2.1.According to one reliable projection, by the year 2025, the population of Dhaka will jump to 25 million from its present 12 million (Ali, 2003).

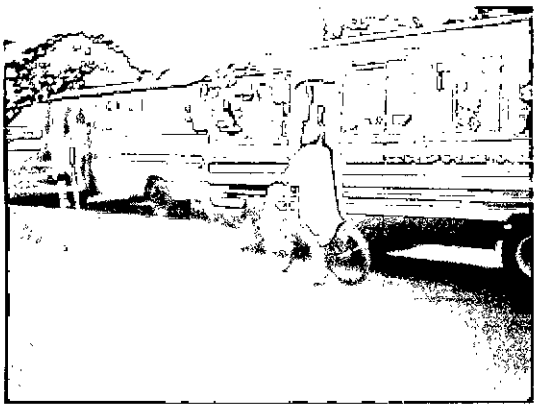


Photo 2.1. Bicyclists have to struggle for space with large vehicles, Mirpur Road

Photo 2.2 No Space for Pedestrians, in the streets of Kalabagan

Traffic system in Dhaka is known as heterogeneous traffic system characterized by motorized, non-motorized, slow-moving, fast- moving vehicles. Due to the high density, land use character, and geographic extents of the metropolitan area non-motorized transport (NMT) is the predominant mode of transportation in the city. Estimated in 1996 it shows that around 80% of the total trip in Dhaka city is comprised of non-motorized transport (NMT) (Karim, 1998). In many respects, the distribution of modal

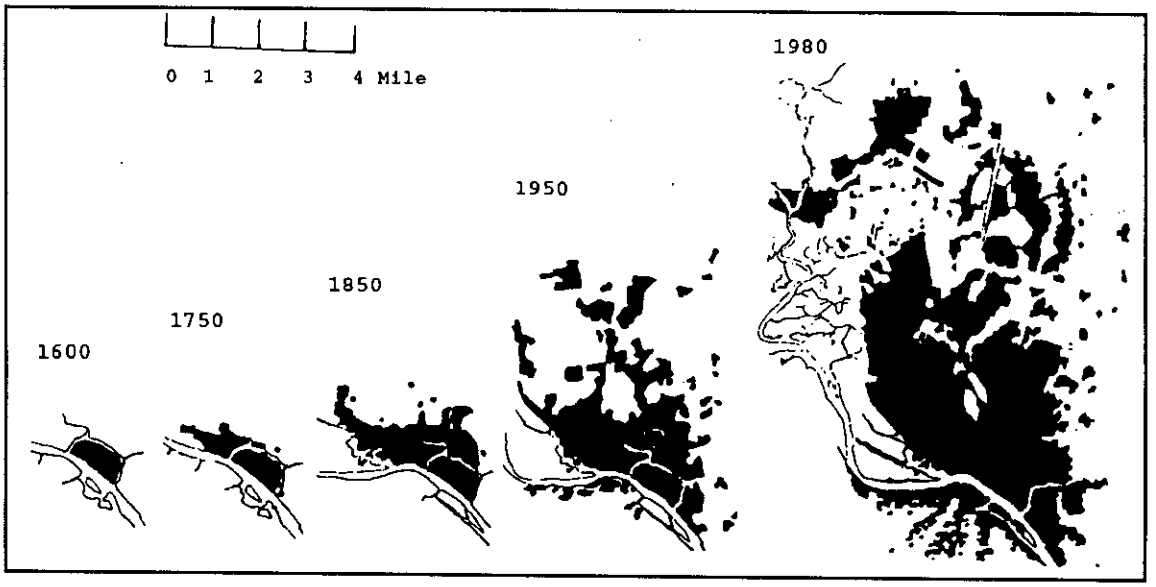
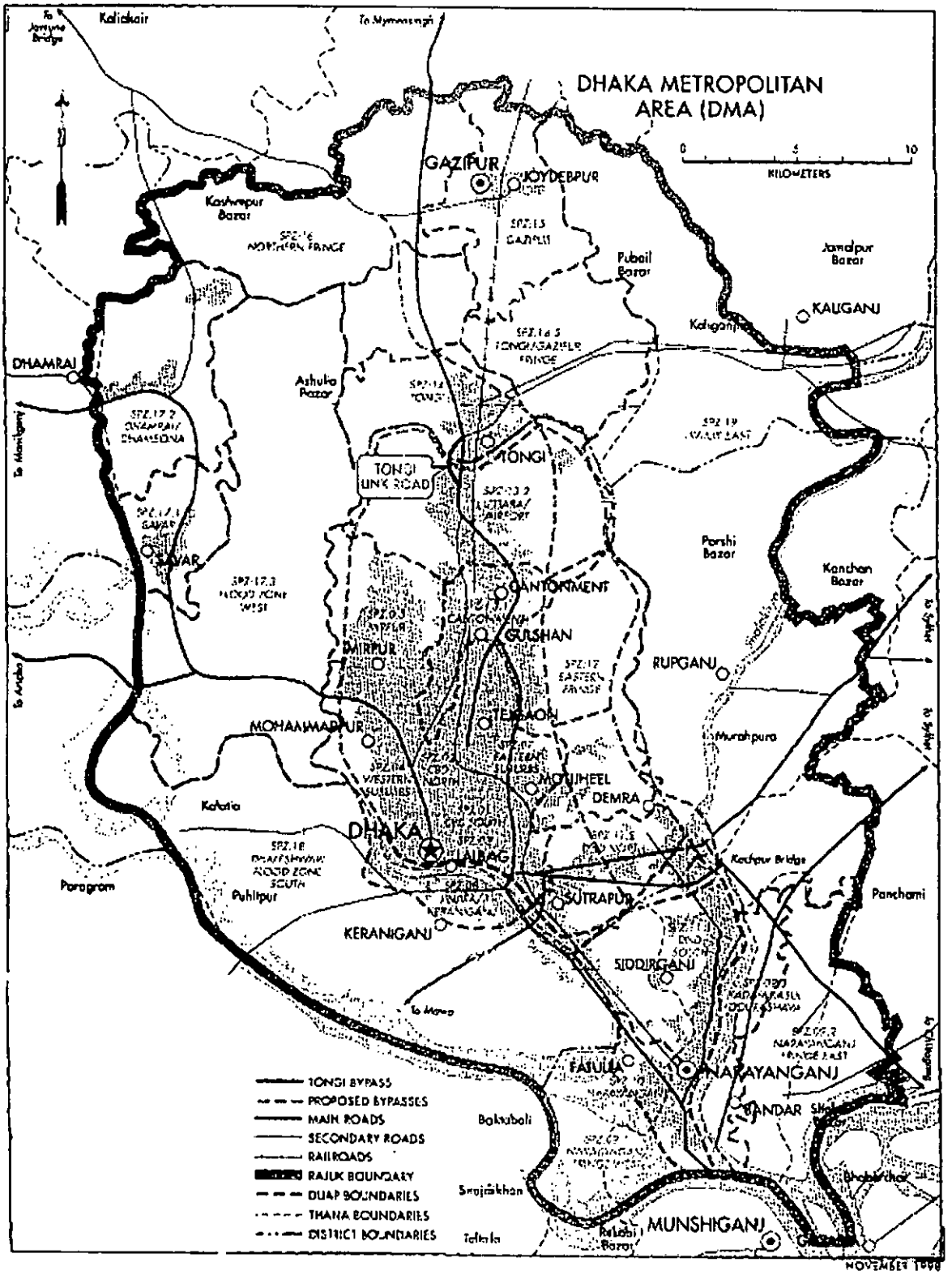


Fig. 2.1 Growth of Dhaka City from the year 1600 to 1980
Source: Reproduced from Dhaka- Smriti Bismritir Nagari, 2004

choices in Dhaka is unique among cities of comparable size in the Asia region. Walking to work and non-motorized transport (NMT) trips are major components of the travel pattern in Dhaka. In terms of number of trips, almost 60% of the 8.5 million weekday person trips are walk trips; 19.2% use the manually-pedaled cycle rickshaw; 1.4% use auto-rickshaw (motorized three-wheelers); 9.2% travel by bus; 3.1% by private car; and the remaining, about 7.7%, by various other modes. In terms of passenger kms. traveled, the share of buses is 30.6%, and those of cycle-rickshaw and walking are 21.7% and 17.7%, respectively (World Bank Report, 1998).

Map2.1 Strategic Planning Zone of Dhaka Metropolitan Area (DMA)



Source: World Bank, 1998, Report No: 18339-BD

Photo 2.3 A planned crosswalk- A response towards pedestrian need, Russel Square, Kalabagan.

Though statistical data on bicycle ownership in Dhaka metropolitan area are not known, it is observed that the bicycles are not extensively used in Dhaka. It is assumed that the streets of Dhaka are not pedestrian and bicycle friendly anymore (and this point will be proved with case studies); thus the reluctance to use bicycle for traveling. Bicycle ownership level in Dhaka is dismally low compared to that of India. There are only 34 bicycles per 1,000 households in Dhaka. Only 4% of the total daily travel trips are made by bicycles (Mannan, Karim, 2001). These vehicles are non-polluting and quiet, requiring no imported fuel; and are substantially cheaper on a per kilometer basis of travel than any other form of wheeled transport. Though by using the bicycle it is accessible door to door, speedy and relatively using less road space (Passenger Car Equivalent only 0.5) the use of bicycle is limited in number. However, the proportion of travel by bicycle is pitifully small compared to any other Asian cities; there are less than 50,000 bicycles in Dhaka city compared with 2 million in Delhi (Planning Commission, 1998). Dhaka's roads are so crowded and mismanaged that it discourages many potential bicycle rider.

The Greater Dhaka Metropolitan Area Integrated Transportation Study (DITS) team strongly supports the introduction of measures to increase the use of bicycles as an alternative to motorized travel and to an extent to replace trips by rickshaw. In order to achieve this object, DITS recommended that:

a) Expansion of credit schemes for bicycle purchase by Government employees including deducting repayments from monthly salaries. This scheme could be extended to private sector firms and NGO's possibly using tax rebates as intensives.

b) Promotion of bicycle are among students either through a bank credit scheme or

Photo 2.4 No defined or marked Bike lane on the streets, - High Vulnerability for Bicyclists, Panthapath, Kalabagan.

increased grants or by supplying bicycles as an alternative to university buses (e.g. for the cost of one large bus at Taka 13 lac, some 650 bicycles at Taka 2000 each could be supplied).

c) Encouragement of NGO's working in the urban sector to include bicycle credit among their other credit programs (Planning Commission, 1998).

Table 2-2 Modal Split Based on Trip Purpose and Income in Dhaka Metropolitan Area.

Purpose of trips	Income Group (BDT/Month)	Modal Split (%)			
		Walk	Rickshaw	Public Transport	Private Mechanized
Home based work trips	< 2000	80.6	10	9.4	0
	2000~9999	63.7	16	17.1	3.2
	10000~29999	43.2	32.5	12.8	20.5
Home based other trips	< 2000	88	5.7	5.6	0.7
	2000~9999	72.7	16.7	8.2	2.4
	10000~29999	37	38.4	6.6	18
Non home based trips		21.9	40.5	11.4	26.2
Total		63	20	10.7	6.3

Source: DITS (1994)

A World Bank study (1998) shows that almost 60% of the 8.5 million weekday trips in Dhaka are composed of pedestrians, about 19.2% use the cycle rickshaw and the rest use different types of transports, such as private cars, buses, etc. (Table2.3). Thus, only a small percentage of people use cars, buses, etc. But the total street system is designed

Table 2-3 Trip Task by Mode.

Mode	Estimated number of trips	%	Estimated average trip time
Autorickshaw	1,21,542	1.42	45
Bicycle	76,737	0.90	22
Bus	7,87,028	9.19	54
Car	2,66,243	3.11	25
Motor cycle	1,29,761	1.51	22
Rickshaw	16,46,064	19.21	26
Tempo	93,582	1.09	51
Train	2,752	0.03	118
Walk	51,59,007	60.22	15
Water	2,84,634	3.32	50

Source: Dhaka Urban Transport Project,1999

for this small group and which uses more than 75% of street network (see Appendix A). The Dhaka Urban Transport Study (1998) predicts that by 2015 about 20 million people will be using the pedestrian mode of transport to reach their destination.The purposes for which people travel are analyzed in Table 2.2. Home based trips account for more

Table 2-4 Road Use by Vehicle Type

Type	16 hours for 6 intersections	Proportion
Truck	4.520	1.9%
Oil Tanker	434	0.2%
Bus	4.994	2.1%
Minibus/Micro bus	14.360	6.2%
Tempo	9.904	4.2%
Car/Jeep/Wagon	19.550	8.4%
Auto-Rickshaw	42.622	18.3%
Motorcycle	4.382	1.9%
Rickshaw	422.052	52.3%
Bicycle	3.045	1.3%
Rickshaw Van	6.668	2.9%
Pushcart	834	0.4%

Source: Dhaka Urban Transport Project, 1999

than 90% of all person trips made within Dhaka Metropolitan Area (DITS, 1994). By far the largest group of trips is other Home Based trips in income groups (BDT 2000 ~ 9999), which account for 30% of all trips. Use of bicycle has been on the decline due to hazards posed to the users by motor vehicles and other factors. Table 2-4 indicates the underused proportion of bicycle in Dhaka city. The road use by different type of vehicles, it shows the proportion of bicycle is 1.3%, counted at six intersections for 16 hours. But use of the pedestrian mode is much more higher than developed countries as shown in Table2-5.

Table 2-5: Modal Split as Percentage of Total Trips in Urban Areas in Developed Countries, 1990

Country	Car	Public Transport	Bicycling	Walking	Walking plus Bicycling
Austria	39	13	9	31	40
Canada	74	14	1	10	11
Denmark	42	14	20	21	41
France	54	12	4	30	34
Germany	52	11	10	27	37
Italy*	25	21			54
Netherlands	44	8	27	19	46
Norway*	68	7			25
Sweden	36	11	10	39	49
Switzerland	38	20	10	29	39
UK**	62	14	8	12	20
USA	84	3	1	9	10
*Mean****	52	12	10	23	34

* Statistics for bicycling and walking as separate modes are not available. Combined figure includes all other modes. ** England and Wales. *** Rounded figures. Means for Bicycling category and Walking category do not include Italy and Norway.

Sources: Pucher & Dijkstra, 2000

2.2 Trends Towards Walking and Biking

This section intends to state the urban design situation historically and in present time in different countries. Intention of this study is to understand the different planning and design solution to enrich the environment for pedestrians and bikers. The literature study helps to understand how the streets were used historically; it is found that streets are not used only for communication but also for meeting and interaction. Pedestrian paradise or bicycle-oriented urban planning was incorporated in Erlangen, Germany. Gotheborg, Sweden zone system introduced for the coexistence buses and pedestrians ' Park and ride' system was introduced in Yokkalchi, Japan, and Frankfurt am Main, Germany to reduce the concentration of private vehicles in the central city and thus reduces the traffic jam. Other two examples- Hong Kong and Shiozu, Japan- explains the use of escalator and inclined elevator to assist walking between areas of different altitudes.

2.2.1 Urban Street Activities Observed in History

2.2.1.1 Street Scene in the Edo Period

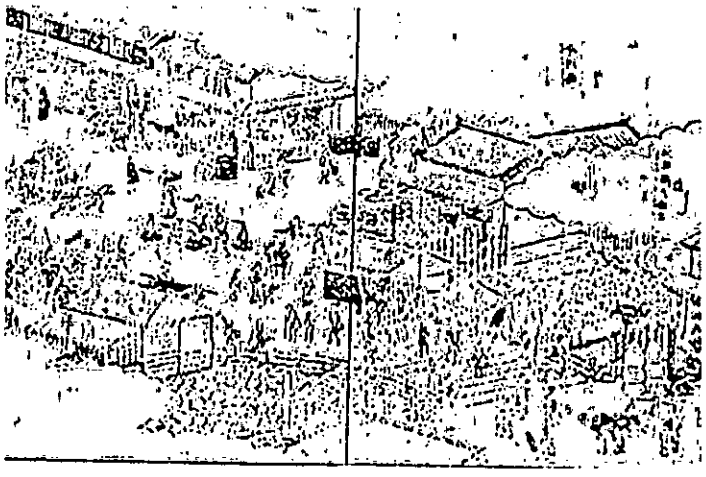


Fig.2.2 Street scene in the Edo period

Tokyo, the present capital of Japan, was formerly known as *Edo*. Until the modern era, there were no four-wheeled wagons in our society. People walked and carried goods on foot. In addition to traffic, the picture shows various activities on the streets such as meeting dealing (Fig.2.2). The street space was used not only for transportation, but also as a place of communication and interaction.

2.2.1.2 Architect Nolli's Roman Map

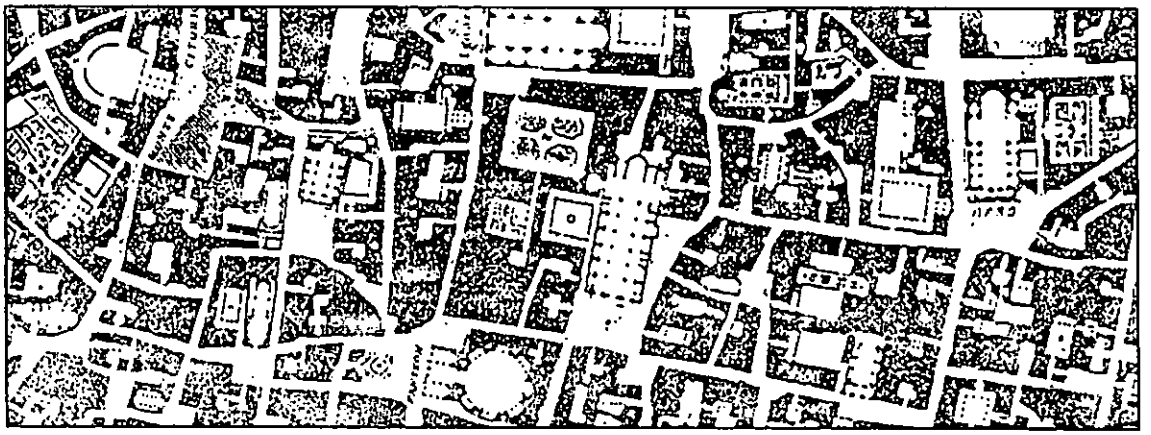


Fig.2.3 Architect Nolli's Roman map

This map of Rome (Fig.3.3), drawn by the architect Nolli in the 16th Century, is also interesting because it shows the essential nature of urban space. The white, public use spaces include not only streets and plazas, but also public buildings like churches, which are open to the public. This map clearly illustrates the nature of the street as a place for communication (Sawada, 1997).

2.2.2 Patterns of Urban Planning for Pedestrians

The most popular method to reserve inner cities for pedestrian use is the 'park and ride' system, which is already widespread in European cities. People driving into the city, leave their cars in parking areas just outside inner city. They walk and use the subways and /or tram cars as means of transportation within the city.

2.2.2.1 Regaining Road Space for Pedestrians and Bicyclists: Erlangen, Germany

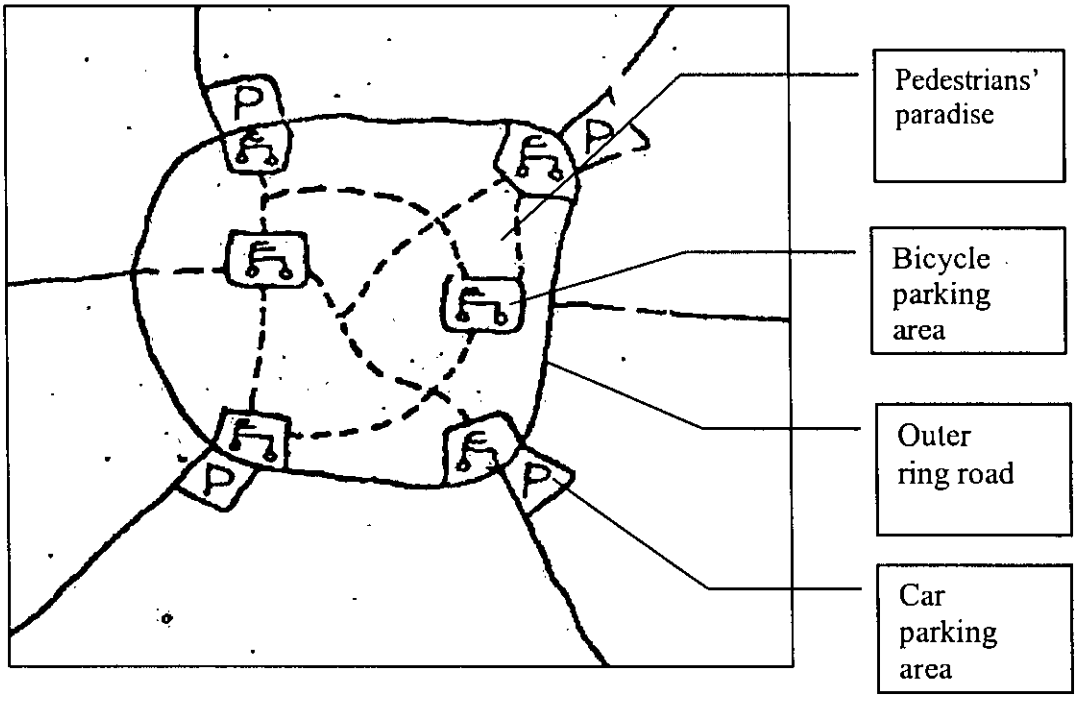


Fig.2.4 Regaining road space for pedestrians and bicyclists, Erlangen, Germany:

Erlangen in Germany, the population of which is 100,000 has tried to realize a bicycle-oriented city for 20 years. It started "Pedestrians' Paradise" (temporary car-free streets or plazas) or 'Woonerf' and also set up several huge parking lots alongside the loop highway (Fig.2.4). In order to encourage bicycles, the city established several facilities such as bike lanes, bike parking, bike rentals or bike service shops. It also provided special bus service for the handicapped in wheelchairs and shuttle service for the night time need.

2.2.2.2 Coexistence of Buses and Pedestrians: Gotheborg, Sweden

In Gotheborg, Sweden, the schedule of tram or bus service began to be unreliable in the early 60s due to traffic jams and complaints kept increasing. In 1970, in order to settle this problem, the city introduced Traffic Zone System to the central area. In this system an area of approximately 1sq. Km. in the central city is divided into 5 Zones (Fig.2.5).

When a car wants to drive from one zone to another, it first gets out of it to an outer ring road, and enters another zone through a specified entrance. Through this method, the

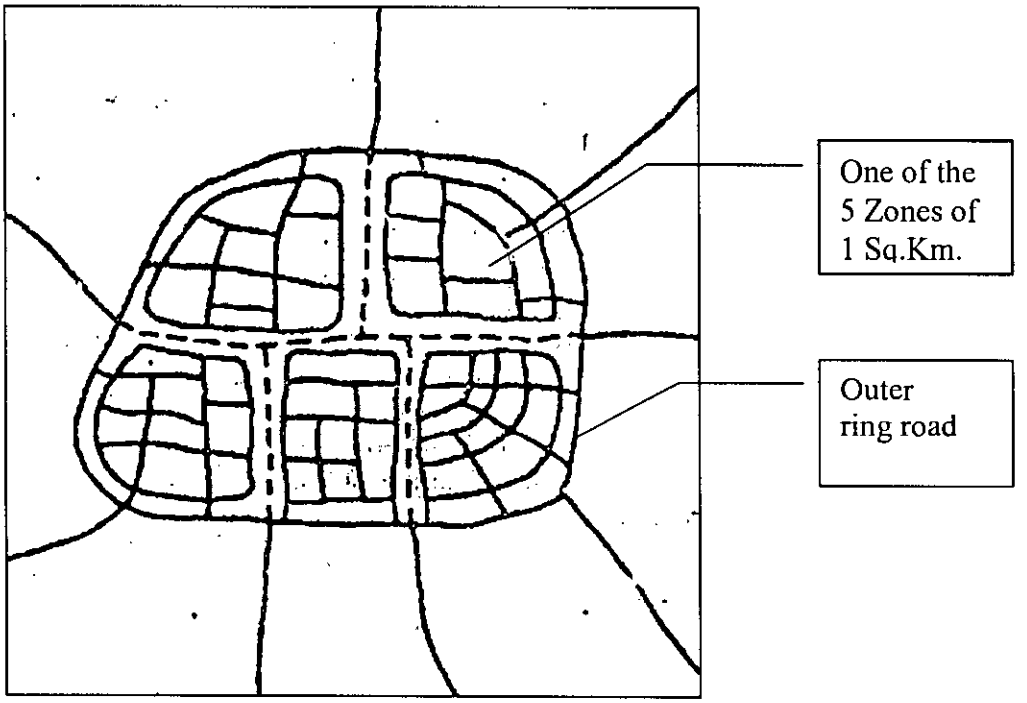


Fig.2.5.Coexistance of bus and Pedestrians: Gotheborg, Sweden

number of passing cars in the center was reduced to half. Trams and buses started to arrive every 6 minutes, and air pollution of noise also dropped to half.

2.2.3 Park And Ride

2.2.3.1 Simple 'Park and Ride': Yokkalchi, Japan

Yokkalchi, Japan is a regional center with a population of 270000. Gross proceeds from

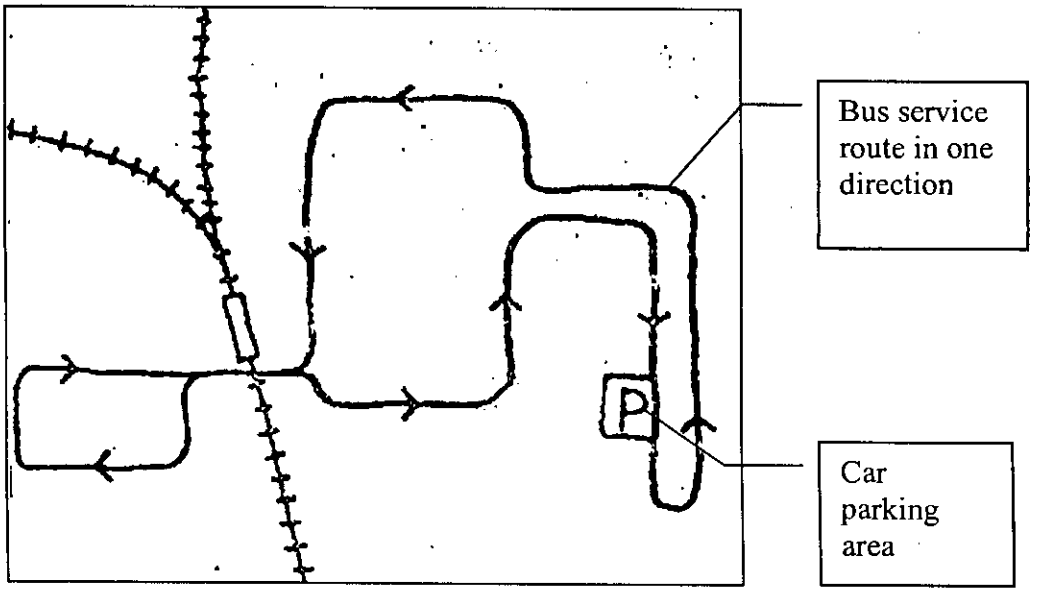


Fig. 2.6 Simple park and ride, Yokkalchi, Japan

the city and its outskirts reach Yen 73000 million a year (1990). Departmental stores and other large- scale shops gathered in the central area of the city, surrounded by the streets of small shops. A traffic jam was serious especially on week needs when people drove in for shopping. In order to solve this problems, both large and small shops teamed up to offer free bus service in the areas in 1991. The buses run on certain route in one direction only between 10.00 am and 6:00pm every 15 minutes, 29 times a day (Fig.2.6).

2.2.3.2 'Park and Ride' in a Large City: Frankfurt am Main, Germany

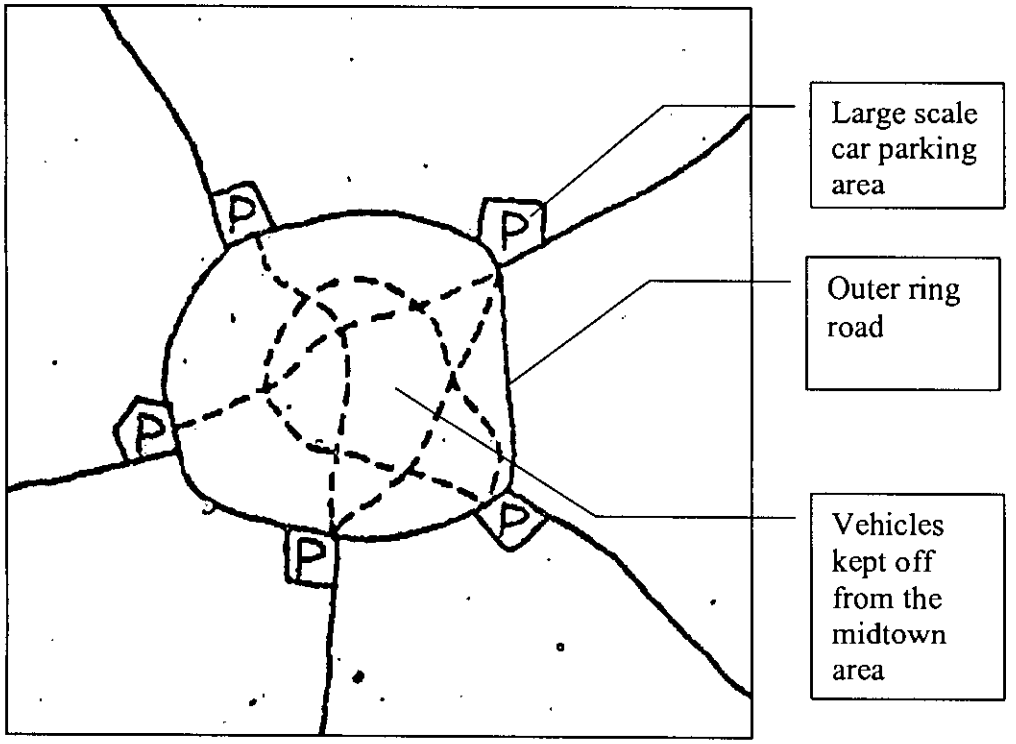


Fig.2.7 Park and ride in a large city. Frankfurt am Main, Germany

Population of Franfurt, Germany was 700000, and big part of it started to live in the suburbs of the city, which has led to increase of commuters into the city. Two third of 300000 commuters from the suburban towns drive themselves, causing the worst environment in the inner city. The city has planned to build large –scale parking lots adjacent to some of the stations located close to the exits of Autobahn (Fig 2.7). When realized, approximately 30000 vehicles will have been kept off from the midtown area. As for public transportation "Zone Ticket System" has been applied towards tram cars, subways and buses, which has enabled passengers travel at low cost between the central city and suburbs.

2.2.4 Walking With Escalator

2.2.4.1 Walking With Escalator Assistance: Hong Kong, Hong Kong Island

Hong Kong island is a hilly city. In coastal area facing the Kowloon Peninsula, there is a business district called Central with many skyscrapers and an exclusive high-rise

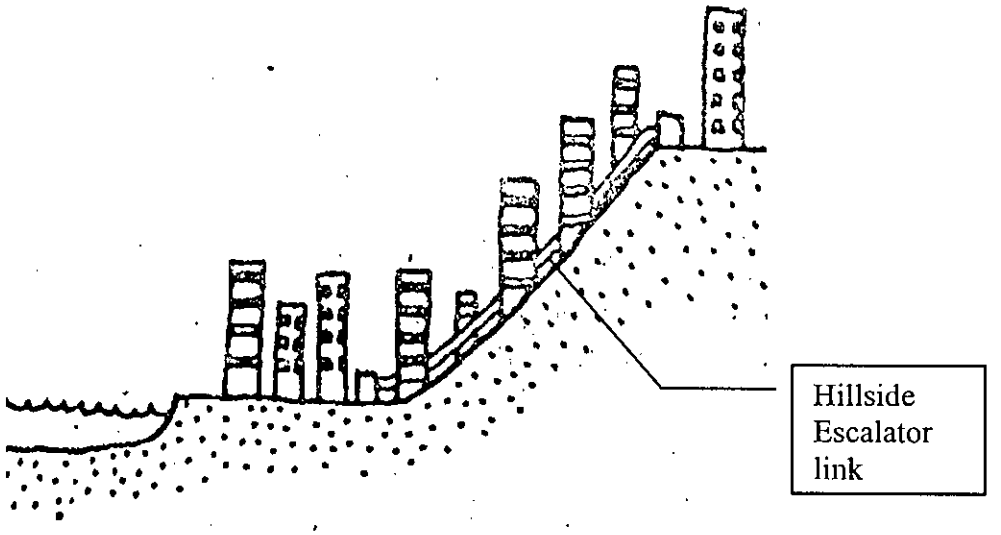


Fig. 2.8 Walking with escalator assistance, Hong Kong

condominium district called Mid- level section is located just above it. The altitude difference between the two is 130 meters and horizontal distance is 800 meters. Traffic jam caused by commuter cars during morning and evening rush hours is a serious problem between these two districts. Stairways and sidewalks are so long, steep, that long time and strength are required for daily walking (Fig.2.8). Hong Kong government built a 'Hillside Escalator Link' between Central and Mid- level, which has been operating for a few years. About 20 escalators and 3 moving sidewalks are linked together on a narrow, steep slope and are operated in coordination. This is being used free of charge and has reduced transportation time by 25 minutes out of its original 40 minutes. Getting on and off is allowed at any point. Residents of Mid- level readily take advantage (Sawada, 1997).

2.2.4.2 Walking With Inclined Elevator Assistance: Shiozu, Japan

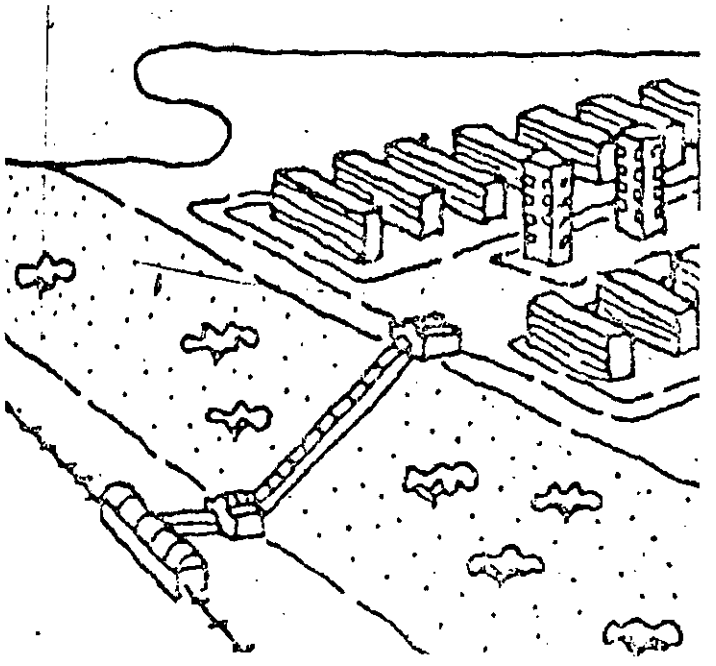


Fig.2.9 Walking with inclined elevator assistance, Shiotsu, Japan

As land prices have skyrocketed around Tokyo, housing of commuters has been developed farther out from central Tokyo. Shiotsu New Town is exactly the case,100 kilometers west of Tokyo, takes 90 minutes by train. This town is developed on a hill (Fig.2.9), and there is a steep slope between the closest railway station Shiotsu and the town. The developer built two slant elevators and two escalators before the sale of the housing lots (Sawada, 1997).

2.3 Pedestrian Environment Near School

Studies in USA and Great Britain indicate that pedestrian accidents account for a disproportionately large share of fatal traffic accidents, and children are disproportionately vulnerable to pedestrian accidents. Available evidence suggests that much walking, and many pedestrian accidents, occur near schools. A study in Great Britain found that 39% of pedestrian casualties among children ages 10 to 16 occurred on the trip to or from school (Preston,1994). In response to a perceived pedestrian safety problem near schools, it requires to create the safe routes to school.

In California, injuries to pedestrians and bicyclists account from more than 60% of transportation-related injury hospitalization/death for each one-year age group from 5 to 12 years (Agran, 2001). Pedestrian and bicycle injuries in traffic are the third leading cause of death among children 5-14 years of age (National Center for Health Statistics,1999).

According to a research conducted in California, shows that traffic environment is an important determinant of walking activity near schools, there is a striking difference in pedestrian volumes observed at the five school sites (Anderson, 2003). The two schools with vehicle traffic associated with unsafe walking environments had few pedestrians – approximately 75 pedestrians per hour at Sheldon and approximately 30 pedestrians per hour at Jasper. The observations at the three schools with vehicle traffic characteristics consistent with safer walking environments had pedestrian counts ranging from 150 to 600 per hour. This suggests the possibility that the traffic environment is an important determinant of walking activity near schools, although statistical verification of that hypothesis will have to wait until data at more school sites is collected.

A number of studies have examined the influence of environmental variables on the risk of pedestrian injury (LaScala, 2000; Kraus, 1996; Agran, 1996; Mueller, 1990). Speed is an important risk factor for injury and an important determinant of injury severity (Leaf, 1999). Poor visibility is also a risk factor, as demonstrated by the association of pedestrian injuries among children with the presence of parked cars (Agran, 1996). On the other hand, education of child pedestrians does not appear to be effective (Rivara, 1991).

2.4 Residential Street Improvement in Holland

In Holland, the citizens of Delft petitioned the local government to close and prohibit several streets to auto traffic because of hazards to pedestrians. This request however, was in direct opposition to those of the local public works and police departments. As a compromise, the municipality's planning department developed the concept of a residential street improvement to accommodate the pedestrian with reduced automobile access. A plan emerged with streetdesign in such a way as to give no illusion of separated systems. These Woonerf streets were residential street to be occupied by car

as well as people, and as such were to undergo major changes. In many cases the streets were reduced to one lane, some as narrow as 3 meters. In almost every case, alignments were never designed as straight path. Maximum speed limits were reduced to 15 kph (9.5 mph), which are much more compatible with pedestrians and bicyclists (Wynne, 1980). Not only are alignments circuitous and irregular, but design elements such as light stands, bollards, and plants are located so as to interrupt the visual plane of the street and reinforce the disconnected quality of the space.

CHAPTER 3

RESEARCH METHODOLOGY

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3.1 Research Methodology

Methodology describes the procedures to be followed to operationalize the research. Formulation of the objectives is the first stage of any type of research. The objectives selected for this study has been described in the previous section. To fulfill the objectives of the study following methodology would be followed (Fig.3.1).

An investigation in the causes that led the decay of pedestrian and bicyclist environment and facilities in the study area was necessary. An assessment of the causes of the declination of the environment and facilities may give a lead to the measure for improvement.

3.2.1 Literature Survey

An elaborate literature survey related to this topic helped to acquire a better understanding of the problem and to formulate strategies for this research. Literature survey related to study of undergraduate and post-graduate thesis and articles published in various journals. Website searches produced a rich volume of information on the topic in the developed countries. Similar information in the developing countries was scares. This is farther elaborated in Chapter 2.

3.2.2 Primary Data Collection

This thesis intents to investigate the present condition of access facilities of pedestrians and bicyclists in the neighborhood streets of Dhaka and find out how they were accommodated in the present transportation network. This will require a review of the criteria guiding planning and design of neighborhoods in Dhaka and

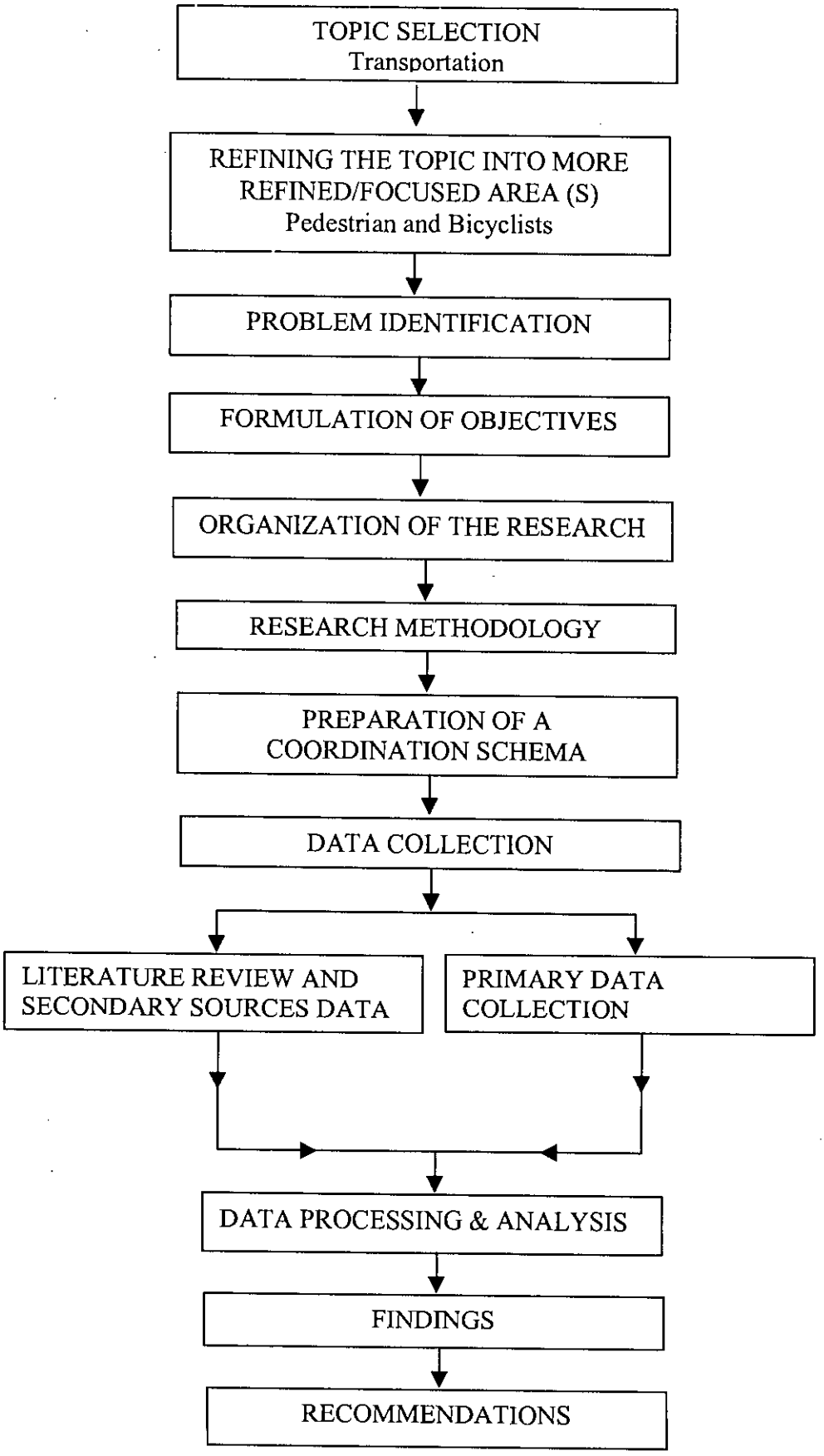


Fig.3.1 Research Methodology

Map 3.1 Location of Study Area

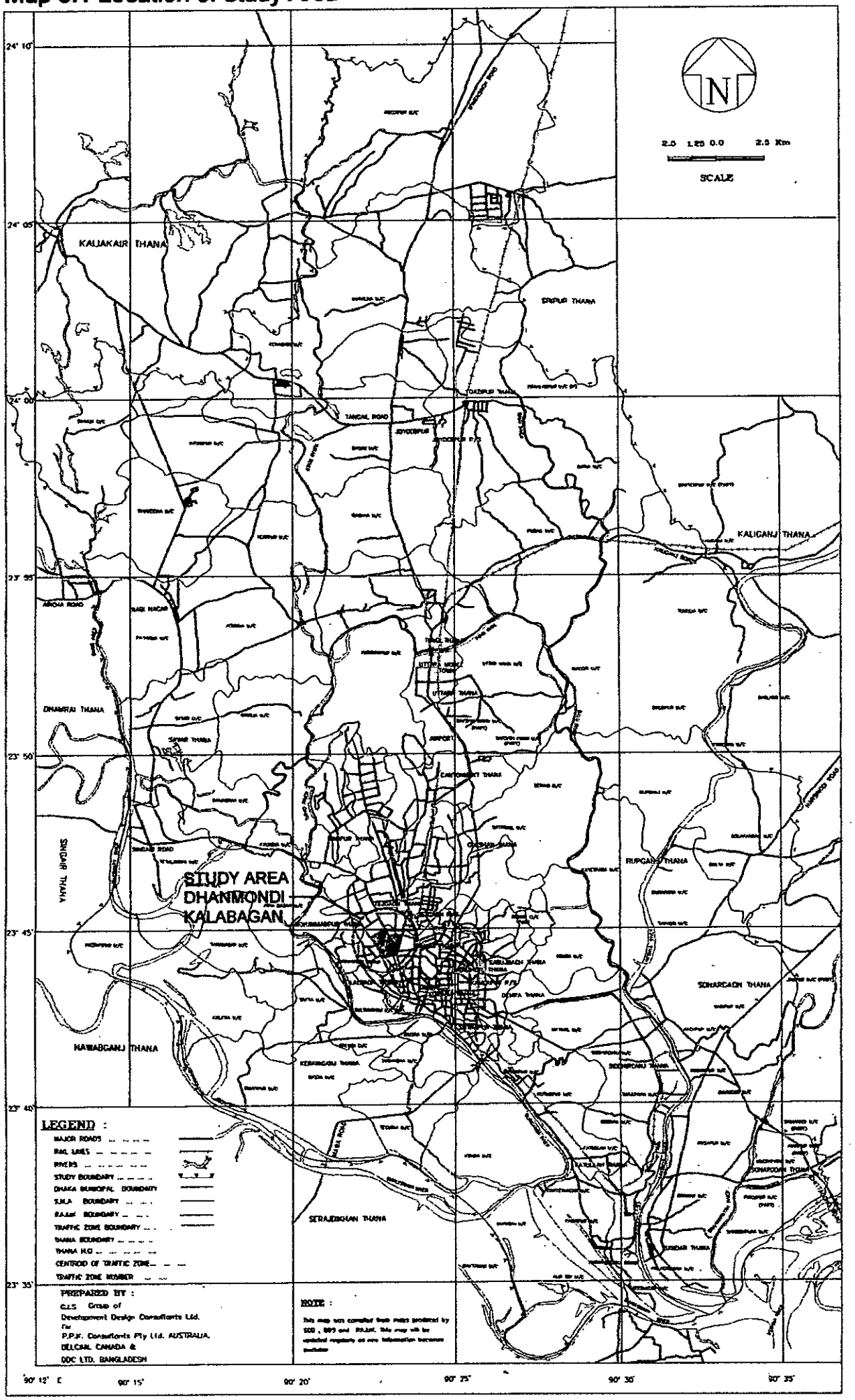
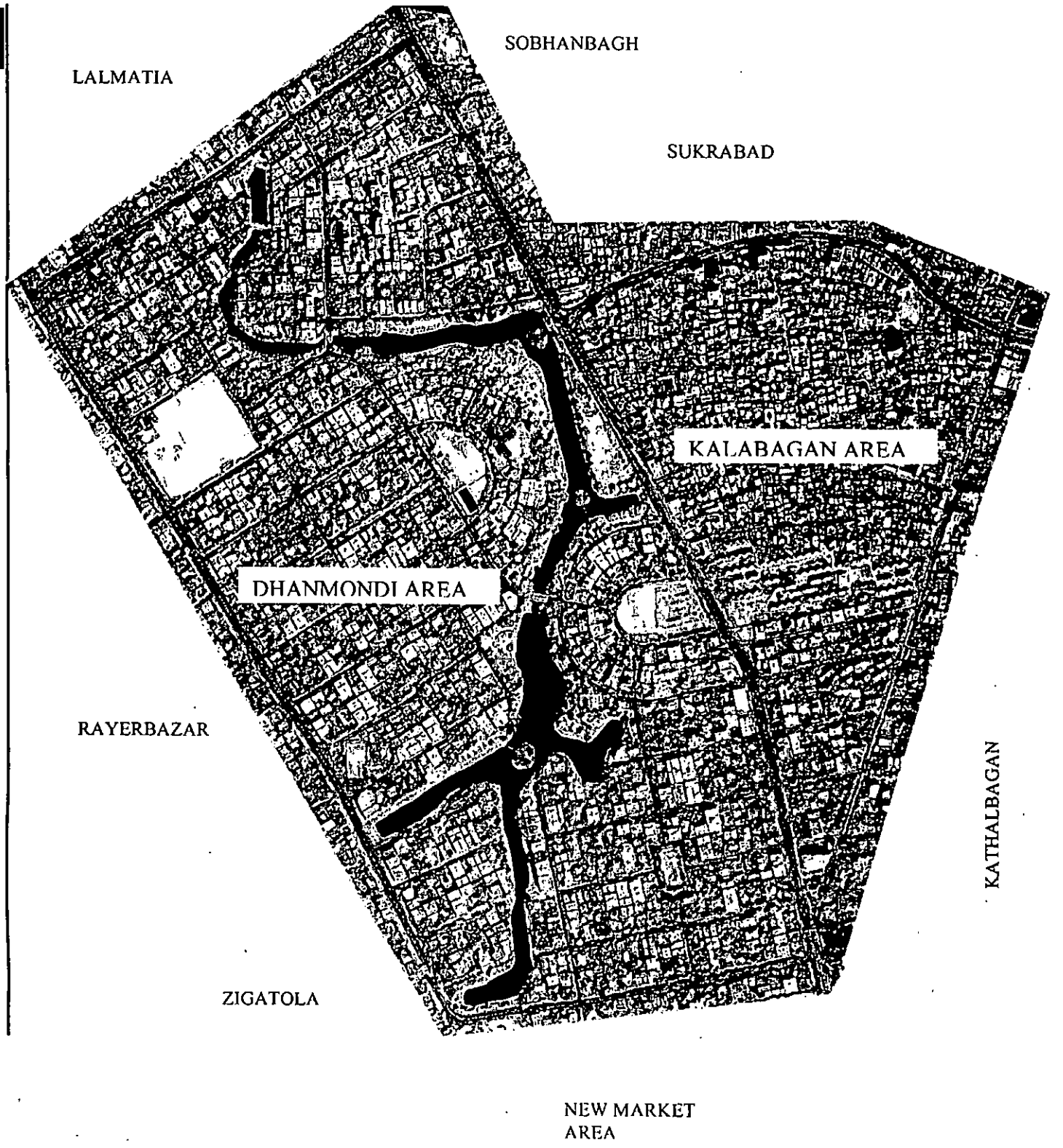


Image 3.1 : A Space image of Dhanmondi and Kalabagan Residential Neighborhood.



consequently a comparison of these neighborhoods with ideology/ theory. Since such a study was not done before data collection mainly relied on primary sources of information. A questionnaire survey was carried out in order to find out the opinion of the people preferring to walk or use bicycle to reach destinations and whether the existing neighborhood streets facilitate or deter their movement.

3.2.2.1 Reconnaissance Survey

The purpose of which was to acquaint with the area, evaluating the possibility of a field survey, and select a study area representative of the physical and social condition of planned and unplanned areas of Dhaka City.

3.2.2.2 Field Survey

Inventory of Existing Conditions:
Inventory of existing conditions for pedestrians and bicyclists begins with observing and gathering data on the existing conditions affecting walking and biking. Problems, deficiencies, safety concerns, needs of pedestrians and bicyclists must be identified. The existing walking and bicycling environment should be observed. For that purpose a base map was collected from Dhaka City Corporation (DCC) and during the reconnaissance survey the map was updated. Photographs of different aspects of the pedestrian and biking environment such as walkways, streets, open spaces, different build forms etc were taken.

3.2.2.2.1 Survey Site Selection

The areas under study are the planned neighborhood of Dhanmondi (high-class residential area) and the unplanned residential area of Kalabagan (middle-class residential area) in order to investigate the prevailing conditions of the street network which accommodates pedestrians and bicyclists in the above stated residential neighborhoods of Dhaka. The study area Kalabagan and Dhanmondi are located besides the arterial Mirpur Road. Dhanmondi area represents as a planned residential area in Dhaka city and Kalabagan as an unplanned area developed in an organic way. An in-depth study of the two neighborhoods brings to light the variety and depth of the

problems. The result of this research might help government agencies to formulate guidelines for neighborhood planning and development.

3.2.2.2.2 Preliminary Questionnaire and Pilot Survey

After preparing a preliminary questionnaire, a pilot survey was undertaken to test the accuracy and relevance of the question framed. Then the questionnaire was finalized (presented in Appendix-C) to conduct the questionnaire survey.

3.2.2.2.3 Question-Interview

In total 409 households were surveyed of which 141 households were from Dhanmondi area and 268 households from Kalabagan area, which are about 5% of the total number of households in those areas. For the uniform distribution of the household for interview in Dhanmondi area, from each block average a single household was selected for interview. As the municipal numbering of the structure is not systematic in Kalabagan area, the households to be interviewed could not be ascertained from the numbering. As the base map had all the streets, lanes and bye lanes marked, the interviewers followed the streets and selected every tenth structure on their right-hand side.

3.2.3 Pedestrian Level of Service (LOS)

Traffic field survey was required to obtain pedestrian flow data in the study area. For that purpose pedestrian traffic count in the selected study area was conducted. Pedestrian traffic count was conducted in working days and in good weather conditions. Ultimately this data was used to measure the pedestrian level of service (LOS). For this study to measure the LOS it requires knowing peak pedestrian flow (ped/ 15 min) and effective walkway width (ft). To count the pedestrian flow "Stationary Observer" technique was followed. In this technique the observer counts the pedestrians passing a "point". The "point" refers to a perpendicular line of sight across the width of a walkway (Khisty, Lall, 2003). Here peak 15-minute period of flow was used as the basis of analysis. From the field survey existing walkway width was collected and to get the effective sidewalk width, width adjustment factor for walkways (see in Appendix-D, Table- D-1 and Fig. D-1) were used.

The average pedestrian flow (v) is then computed as

$$v = V / 15W_E$$

where V= peak pedestrian flow (ped/ 15 min)

W_E = effective walkway width (ft)

3.2.4 Secondary Data Collection

Maps and planning reports was collected from the Department of Architecture, Ministry of Public Works and Housing, RAJUK, Dhaka City Corporation, EGIS, etc. Reports, Journals and theses related to the topic were collected from the Libraries of BUET, PWD, UDD, RDH, World Bank office in Dhaka, etc.

3.2.5 Data Analysis and Processing

The collected data was analyzed in order to find out why people prefer to walk or use the bicycle and if they do not find out the reasons why they are debarred / restrained from walking or bicycling. Data was analyzed also to find people's views regarding their neighborhoods and their ideas to make the neighborhoods active, livable, sociable, safe, etc. Excel was used to analyze and quantify data and GIS and AutoCAD used to produce maps for the two neighborhoods under study.

3.2.6 Recommendation Based on Analysis of the Data and Experiences of Other Countries

The major purpose of this research was to investigate the prevailing conditions of pedestrians and bicyclists environment in the neighborhoods of Dhaka. By comparing the existing condition with standards required for planning and designing walkable and biking friendly environment recommendations were made.

CHAPTER 4

STATE OF THE ART OF PEDESTRIANS AND BICYCLISTS ENVIRONMENT IN DEVELOPED COUNTRIES

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STATE OF THE ART OF PEDESTRIANS AND BICYCLISTS ENVIRONMENT IN DEVELOPED COUNTRIES

4.1 Introduction

This chapter intends to introduce pedestrian and bicyclists environments. For that intention the characteristics of the pedestrian or bicyclists and their need are discussed. Importance of transportation planning, street network layout in the urban planning or neighborhood street network designs are also discussed. Benefits of walking and bicycling, which includes of personal and social aspects are discussed critically. Pedestrians and bicyclists system planning explained elaborately with figures and diagrams.

Human-powered travel, whether by foot, bicycle, wheelchair or stroller, remains essential to our daily lives. These modes of travel are efficient, affordable, healthful and environmentally sound. In addition, fostering their use will reduce competition among automobile users for limited roadways and parking spaces.

Increasing the number of trips made on foot or by bicycle, and accommodating those users through improved or separated facilities, can also reduce congestion and decrease the number of conflicts between users.

Alternatives to motorized transportation have become increasingly desirable to many segments of our society. Reward communities that have the foresight and political will to foster the use of the full range of transportation alternatives know economic, environmental, aesthetic and health benefits.

4.2 Who is a Pedestrian?

A pedestrian is any person walking, standing or in a wheel chair. Wisconsin State Statutes, USA defines pedestrian as "any person on foot or any person in a wheel chair, either manually or mechanically propelled, or other low-powered, mechanically propelled vehicle designed specially for use by a physically disabled person"(Wisconsin

Pedestrian Policy Plan 2020). Everyone is a pedestrian at some point in his or her trip, whether it is from the doorstep to public transportation, or from the parking lot to an office building, or for an entire trip.

Most pedestrians are able to use different forms of transportation such as automobile or bicycles. However, other pedestrians may have no other transportation options except to walk or to use public transit. Examples include people who use wheel chairs and other people with disabilities, the elderly and children. For these pedestrians providing and maintaining facilities for access to destinations is crucial for daily life.

4.3 Walking Speed:

People walk at different speeds. The very young and the very old tend to walk more slowly than other pedestrians. Impairment may also slow the walking rate. Even the purpose of the trip plays a role in walking speed. According to the *Manual on Uniform Traffic Control Devices* (MUTCD) normal walking rates vary from 0.8 to 1.8 m/s or 2.7 to 6.6 km/h (2.5 to 6.0 fps or 1.7 to 4.1 mph) with an average of 1.2 m/s or 4.4 km/h (4.0 fps or 2.7 mph) (Vermont, 2002).

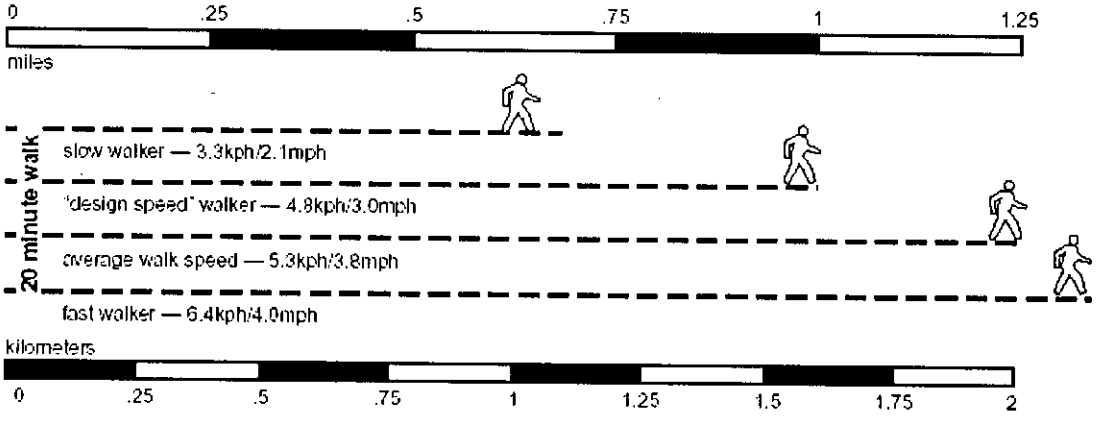


Fig 4.1 Walking Distances, Times, and Speeds

Source: Cambridge Pedestrian Plan, 2000

Walking speed is especially critical in places where the pedestrian interacts vehicular traffic such as intersections and at-grade crossings. The more lanes a person has to cross to reach the other side of the street, the longer the time the pedestrian is exposed to the risk of being hit. Similarly, the slower a person walks, the longer it takes to cross the street.

4.4 Who is a Bicyclist?

A bicyclist is any person using a bicycle i.e. a vehicle having two tandem wheels, propelled solely by human power, upon which any person or persons may ride.

Bicycle travel, a mode of personal transportation, which fills a niche between the automotive and pedestrian modes, should be given priority in planning neighborhood and transportation network.

Bicycling promotes important land use and conservation policies, which call for compact and integrated land use patterns. These patterns provide reduced parking needs, urban infill, keeping destinations within bicycling distances, mixed use development and more balanced and efficient land use for transport systems.

Table 4-1 Comparison Between Pedestrians and Bicyclists

Similarities	Dissimilarities
▪ Tend to be slower than motor vehicle traffic. ▪ Travel near road edge in conflict with other demands such as parking, driveways, utility poles, and signs. ▪ Vulnerable to weather, traffic volumes and traffic speeds. ▪ Unlicensed. ▪ Include wide range of ages and abilities (may include people with special needs).	▪ Bicyclists can travel much faster and farther than pedestrians. ▪ Pedestrians are the slowest mode, can change directions quickly, and frequently stop. ▪ Bicyclists can ride on roadway and follow vehicle traffic rules. ▪ Pedestrians require separated facilities, special consideration at intersections and traffic signals, and a comfortable walking environment. ▪ State law does not indicate how bicyclists are to be treated in a marked crosswalk.

Source: Vermont, 2002

4.5 General Bicycle Users

When planning for bicyclists and pedestrians, design considerations should meet the needs of a variety of age and skill levels. The Federal Highway Administration, USA identifies three levels of cycling ability (Iowa, 2000):

4.5.1 Group A -Advanced Bicyclist — These are experienced riders who can operate under most traffic conditions. They prefer to operate on the existing street and highway system.

4.5.2 Group B - Basic Bicyclist — These are casual or new adult and teenage riders who are less confident of their ability to operate in traffic without special provisions for bicycles. These riders prefer low-speed, low traffic volume streets or designated bicycle facilities.

4.5.3 Group C – Children — These are pre-teen riders whose roadway use is monitored by parents. Eventually they are accorded independent access to the system. They and their parents prefer residential streets with low motor vehicle speed limits and volumes, sidewalks, and trails (see Photo 4.1).

Local bicycle planning and design should, as much as possible, consider the needs of all three skill groups. However, Group B bicyclists will be the primary user of most bikeway networks.

Table 4-2 Classification of Rider Types

Type	Description	What they prefer
A-Advanced Bicyclist	Can operate under most traffic conditions	Efficiency, maximum speed, few delays, ease of passing, sufficient shoulder area
B-Basic Bicyclist	New adult riders, teen-age riders	Direct routes, low speed, low traffic volume, well-defined or separate routes
C-Children	Children, usually monitored	Adjacency to schools, parks, low speed, well-defined routes

Source: A Virginia Guide for Bicycle Facility Planning, 1994

4.6 Utilitarian and Recreational Bicycling

The wide range of bicyclists' abilities and multitude of purposes for riding must be understood before planning for bicycle transportation improvements. In general, bicycle trip purposes can be divided into two broad types, utilitarian and recreational. For a bicyclist on a utility trip, the primary objective is reaching a specific destination quickly, with few interruptions. On the other hand, a bicyclist on a recreational trip is riding for pleasure. The timing to a destination is often of less importance. Of course, for many trips and bicyclists, these purposes are not absolute or mutually exclusive. New bicycle facilities, therefore, should be designed to accommodate different types of bicycle trips.

Bicyclists differ widely in their abilities and in their preferences of riding environments. Some bicyclists place high importance on directness and have the ability to ride safely and confidently in heavy traffic. They will often choose to travel on arterial roads in lieu of quieter, more aesthetically pleasing alternate routes, because arterial roads are more direct and result in perceived or actual time savings. Arterial and major collector roads also offer bicyclists increased signal and operations support, better lighting and other benefits over local and minor collector routes. If an arterial road is not improved for bicycling, then many novice bicyclists are likely to make use of sidewalks. By doing so, they endanger pedestrians and subject themselves and motorists to numerous conflicts that neither is prepared to handle. Thus the full consideration of on-road bicycling facilities on all principal roadways is important. Since major attractors are often located on these roadways and rear access to properties is often limited or denied, a significant amount of bicycling should be anticipated by most age groups on

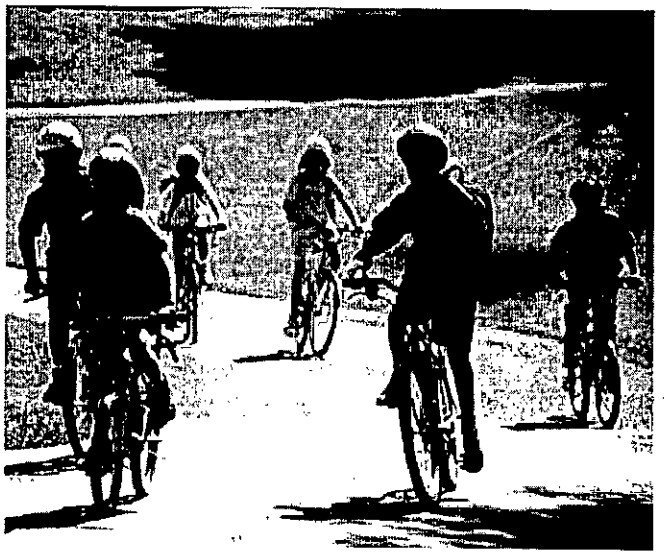


Photo 4.1: Bicyclist Group-C, Children

Source: Florida, 2000

all principal roadways. In some cases, additional design support can be given on parallel roads to attract bicyclists. This shift from the arterial road will only occur, however, when bicyclists find the alternate route provides direct access and personal security, as well as traffic safety. Bicycle facilities should be planned and designed to accommodate a broad range of bicyclists.

4.7 What has Transportation Planning Done?

Over the last several decades, street design has been heavily influenced by road design standards that are used by traffic engineers to regulate and standardize street construction. These standards have favored the construction of streets that are wide, smooth, and straight, conditions that encourage high-speed, motorized travel and discourage walking and bicycling Traffic engineers have generally come to view pedestrians and bicyclists as obstructions that impede the smooth flow of traffic.

Fairly recently, however, Transportation Departments in various cities and states around the U.S. have begun to develop level of service (LOS) standards for pedestrians and bicyclists, similar to long-established standards for motorized traffic. Level of service standards is a measurement tool used to describe how well roadways are operating for pedestrians, bicyclists, or motorists. Creating LOS standards for pedestrians and bicyclists are increasingly considered to be important in understanding the design conditions that will encourage pedestrian and bicycle travel (Epperson, 1994).

4.8 What Constitute a Good Pedestrian Friendly Environment?

A good pedestrian friendly environment should be free from hazards, accessible for all ages and abilities, with continuity, easy and present to use. Visual character of the streetscape, limited uses of the pedestrian way are also important.

4.8.1 Safety

Design facilities to be free of hazards and to minimize conflicts with external factors such as vehicular traffic and protruding architectural elements.

4.8.2 Accessibility

Accommodate the needs of people regardless of age or ability. A continuous unobstructed path connecting all accessible elements and spaces in an accessible building or facility that can be negotiated by a person using a wheelchair and that is usable by people with other disabilities. Pedestrian facilities used by the general public to be planned, designed, constructed, and maintained for use by a wide range of people, including people with disabilities.

4.8.3 Continuity

Provide continuous, direct routes and convenient connections between destinations, including homes, schools, shopping areas, public services, recreational opportunities and transit.

4.8.4 Easy and Pleasant to Use

Pedestrian facilities should be designed so that people can easily find a direct route to a destination and so that delays are minimized. Consider the effects of spray or splash from vehicles from the adjacent roadway onto the pedestrian facility.

4.8.5 Provide Good Places

Enhance the look and feel of the pedestrian environment. The urban pedestrian environment includes open spaces such as plazas, courtyards, and squares, as well as the building facades that give shape to the space of the street. Amenities such as street furniture, banners, art, plantings and special paving, along with historical elements and cultural references promote a sense of place.

4.8.6 Encourage Different Uses

The pedestrian environment is a place for public activities and social exchange. Commercial activities such as dining, vending and advertising may be permitted when they do not interfere with safety and accessibility.

4.8.7 Protection from Elements

Scope of protection from inclement weather is one of the important contributors for good pedestrian environment.

4.9 What are the Pedestrian Facilities?

As a part of the pedestrian environment pedestrian facilities are defined as the physical infrastructure that allows for or promotes walking and other forms of pedestrian movement (such as wheelchairs) as a form of travel. Examples of pedestrian facilities can include:

- Sidewalks,
- Walkways,
- Streetscape,
- Crosswalks,
- Traffic controls (such as walk /don't walk signals),
- Overpass and underpass,
- Multiuse paths,
- As well as curb cuts and rams to provide easy access for all pedestrians.

The term streetscape refers to the physical setting shaped by the relationship and design of the buildings, parking lots, streets, sidewalks, trees, lighting, street furniture (such as benches, plants, kiosks and bus shelters) and public art. The relationship between all of these elements and the quality of their design are what shape the image and scale of communities.

Pedestrian facilities also include transit stops, such as the connection to the stop and the waiting pad, other loading areas and grade separations. Although paved shoulders are not by definition considered pedestrian facilities, these treatments can still act to provide pedestrians with an important safety zone away from traffic along busy highways.

4.10 Benefits of Bicycling and Walking

Since human beings are basically pedestrians, we are all affected by the quality and continuity of our neighborhood pedestrian system. Planning should aim to make all daily activities as easy to accomplish on food and bicycle (as in the car).

Walking is for people of all ages. Along with walking, bicycling is more affordable than auto transport, and most people are physically capable of bicycling. Bicycling is more efficient than walking. It is the most efficient means of assuring independent travel. Bicycling helps keep them fit and improves health. However, bicycling does not replace the car or transit options for longer trips.

To incorporate use of bicycle in the transportation system it requires an understanding of bicycles, bicyclists, and bicycle facilities. With adequate planning and facilities development, the bicycle can play an important role in the overall transportation system.

Increased bicycling and walking offers individuals and the state a host of health, social, aesthetic, environmental and transportation benefits. Supporting the needs of bicyclists and pedestrians is an important movement toward a multi-modal transportation system.

Bicycling can help us create a better, transportation system as follows:

- Achieving intermodal links with transit.
- Creating safe and effective links between neighborhoods i.e. link neighborhoods to destinations where people go for their daily needs.
- Reducing complex and costly parking problems.
- Incorporating greenways development, urban redevelopment and resource preservation.

Neighborhood supporting and encouraging walking and bicycling can enjoy -

- More transportation options for local travel
- Safer and more enjoyable walking and bicycling.
- Reduced traffic congestion and associated air and noise pollution.
- Improved health for those who choose to walk or bicycle.
- Increased property values and tax base.

On this last point, economic benefits of plan implementation would go to homeowners as well as businesses. A community with outstanding bicycle and pedestrian facilities offers a superior quality of life to its inhabitants. This superior quality of life not only enhances property values by making the community a more desirable place to live and own a home, it also makes that community more desirable to businesses hoping to attract and keep highly skilled employees (Brunswick, 1998).

4.10.1 Economic Benefits

There are economic benefits to increased bicycling and walking. A variety of environmental benefits are derived from increasing bicycling and walking and reducing automobile use. Unlike most other transportation modes, bicycling and walking are non-polluting and consume no petroleum products. It is the most efficient means of assuring independent travel for most people and those with reduced incomes. Bicycling gives all people mobility at an affordable cost. As walking and biking are excellent form of exercise that contribute to prevention reduces health expenses.

4.10.2 Physical and Mental Health

Evidence is growing that regular exercise is important for positive physical and mental health. Exercise contributes to prevention and management of heart disease, hypertension, obesity, diabetes, osteoporosis and depression. Bicycling and walking are excellent forms of exercise, which can contribute to these physiological benefits.

A study showed that about 50 percent of all Americans are overweight, and regular exercise is a key component of effective weight-loss programs. Walking is the most readily available form of exercise; it does not require special preparation, equipment, or locations and can be easily incorporated into most people's daily lives. People are more likely to stick to walking than to other forms of exercise (Vermont, 1998). Public opinion suggest that there is a latent demand for bicycling and walking and that more people would walk or bicycle if conditions were better as a form of recreation and exercise.

4.10.3 Social and Community Benefits

There are also social benefits derived from walking or bicycling, as these forms of recreation and transportation offer opportunities for personal interaction which are less available when traveling by motor vehicle. Social interaction allows for people to communicate with one another, and helps to build a sense of community. Attractive, safe, and accessible places to walk or bicycle can help to improve the character of a community for recreation, culture, quality of life, and community pride (Cambridge, 2000).

Walking is an important for strengthened and stabilized neighborhoods. Studies have shown that the more automobile traffic on a street, the less interaction among neighbors. Walking is itself a positive force for creating a sense of neighborhood. The more people meet each other on the street, the stronger and safer the neighborhood is (Appleyard, 1981). Which is lacking in our neighborhood.

Bicycling and walking have aesthetic attributes as well. When traveling by bicycle or on foot, one is more acutely aware of one's surroundings than when inside a motor vehicle.

4.11 Community Layout and Walking and Biking

Land use pattern has strong influence on bicycling and walking. The proximity of development and potential for access between destinations is a primary factor in walking and bicycling patterns. Research shows that areas with higher densities and mixed use development are more conducive to walking. Bicycling is often discouraged by obstacles such as busy streets without bicycle accommodations and inadequate crossing opportunities.

4.12 Site Access

Both the basic development pattern and the design of individual sites can encourage or discourage bicycling and walking. For example, large parking lots in the front of buildings that discourage easy access and blank walls are intimidating. However, interesting facades and buildings that face the street and are closer to sidewalks create a

more pedestrian "friendly" environment. Parking for cars should either be provided on the street or behind the development. Parking for bikes should also be provided in a protected location and close to the building to encourage non-motorized access.

4.13 Walking and Bicycling as Integral Component of Transportation System

Good walking conditions for pedestrians are important inducements to using public transportation, since most public transit trips include a walk at one or both ends.
Conversely, good public transportation, with buses and subways that run frequently and are reliable, is essential to achieving a walkable city.
Good public transportation is a requirement if we are to move away from dependence on the automobile.

4.13.1 Transit Connections

Walkways should connect to loading areas from nearby destinations. Bus stops are frequently located in muddy locations without sidewalk connections that discourage transit usage. Bicycle parking should be available at all fixed rail service stations, bus service hubs, and express stops. In many cities, bicycles are accommodated on transit vehicles (see Photo 4.2). Loading the bicycle onto a rack on the bus or into a transit car combines the flexibility of the bicycle with the efficiency of transit for longer distances.

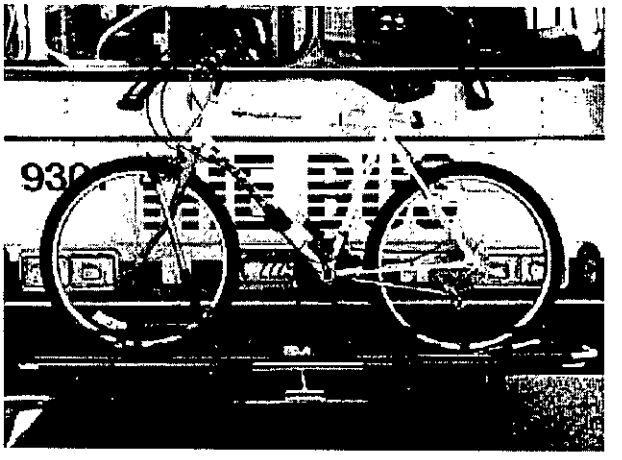


Photo 4.2 Bicycles are accommodated on transit vehicles
Source: Idaho Bicycle and Pedestrian, 1995

4.13.2 Corridor Connections

Corridor connections are the obvious connections through the community between residential areas and *priority destinations*. By connecting priority destinations along available roadway and trail corridors, it is possible to generate bicycle "desire lines." Corridors that connect destinations can be identified, and along with trail potentials, will

form the basis of the initial network. There might be just one or several roads within each corridor. By applying the network criteria, and evaluating roads for their bicycle compatibility, planners can identify bicycle network candidate roads. Trail opportunities must also be evaluated. While many trail opportunities can accommodate multi-use paths, some are suitable for walking only or will be designated for incompatible motorized uses.

4.13.3 Bicycling and Transportation Project

It is recommended that the following basic principles be considered when beginning any transportation project:

- Just as with motor vehicle support, assume every street is a bicycling street and all locations accessible to a motor vehicle should be accessible by bike.
- Involve all appropriate agencies and general public in planning corridors and communities.
- Use public funds for land use development that fully considers bicycling or mitigates the harmful effects caused by that development to bicycling.
- Plans should overcome existing barriers to bicycle travel and create no new barriers.
- Roadway improvements should provide access to all destinations through the most direct or feasible route.
- Involve the public in the conceptual stage, data gathering, goal development, and all other reviews and phases of work.
- Planning should be flexible throughout the development process. Accept new design concepts and anticipate future changes to the system.

4.14 Bicycle Facility and Urban Infrastructure

Planning and design for bicycles must be incorporated into the fabric of any development project. The bicycle facility is not to be viewed as a separate entity any more than a new arterial road or industrial area is viewed in isolation. The integration of bicycles into the overall transportation network must be dealt with at the base level within the context of the larger urban area, if it is to be cost-effective, efficient and ultimately successful. The overall concept of an urban design is often lost in the details

of many individual projects. Planning for changes to the urban infrastructure is both feasible and practical.

The aspect of budget considerations is of equal importance in the pre-planning stage. The costs of bicycle facilities when they are incorporated into the budget of the project is minor compared to the cost of undertaking such a project separately.

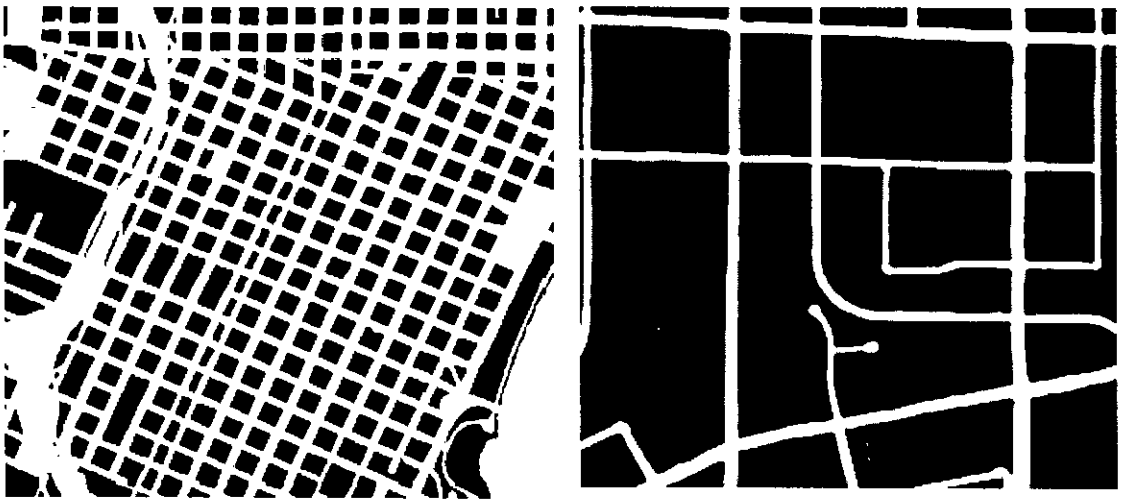


Fig 4.2 Same Scale, different cities.
(1) The City of Portland, top grid, has the markings of a successful city. Bicycling works best when there are many choices for routing. With many links, traffic is less likely on any one road, and speeds remain sensible. New Urbanism and pre-1950's development have fine grained roadway patterns.
(2) Less is not better. As society moved toward auto trips, fewer intersections allowed for higher speeds. Bicyclists have a tough way to go in Irvine, California, and most suburban sectors of any town. There are few choices. Any road that goes any place seems to be a main road.

4.15 Roadway Design and Traffic Operations

Roadway design and transportation planning oriented towards the mechanized transportation, less impertinence had been given for pedestrians and bicyclists. Transportation planning has, "... responded to traffic congestion ... by recommending that we build additional roads. Two-lane streets are widened with turning lanes, intersections are expanded, two lanes become four, and four lanes become six. Wider

roads attract more traffic and more traffic going at faster speeds makes walking more dangerous."-Mean Streets 1998, Surface Transportation Policy Project Florida.
For the accommodation of pedestrians and bicyclists it is important to consider the roadway design issues which effects pedestrians and bicyclists.

4.15.1 Roadway Design Issues

Pedestrians and bicyclists encounter many problems on the roads, such as high speeds, high volumes, and extremely wide intersections that are difficult to cross, and lack appropriate facilities.

4.15.2 Speed and Its Impact

Relationship between the vehicle travel speed and safe stopping distance is shown in Fig 4.3. According to research conducted in Germany, the impact of speed on the severity of pedestrian and bicycle crashes is dramatic. In crashes where the vehicle is

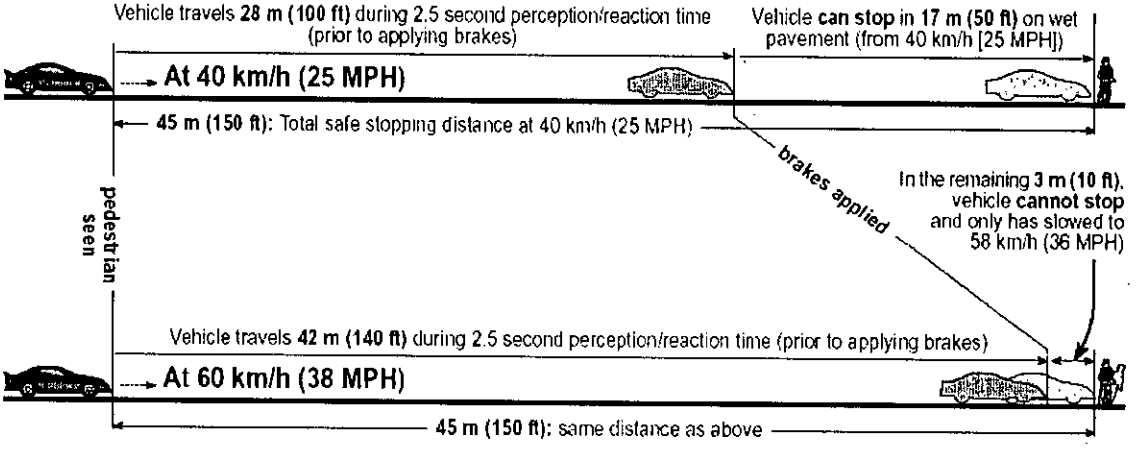


Fig 4.3 The relationship between safe stopping distance and travel speed.

Source: Cambridge Pedestrian Plan – 2000

traveling at 20 mph, fewer than 5 percent of pedestrians are killed; at vehicle impact speeds of 30 mph, close to 40 percent of pedestrians struck have died; and, at 45 mph, more than 80 percent are killed. Based largely on this and other studies of the impact of speed in the traffic mix, many European countries are implementing policies to maintain

very low speeds in congested pedestrian areas and residential neighborhoods. The results of a program in Graz, Austria, after one year, show:

• Serious traffic related injuries were reduced by 24 percent.

• Median speeds were not significantly reduced citywide and traffic flow was more homogenous.

• Traffic behavior improved, especially that of motorists toward pedestrians.

• Noise levels have been reduced.

4.15.3 Traffic Calming

Traffic calming is the term used to describe a variety of techniques that slow or constrain traffic so that pedestrians, bicyclists, and motor vehicles share the road on more equal terms. Traffic calming measures are most often used on residential or central business district streets where increasing pedestrian access and safety is desirable. Some communities are finding that they want to reclaim street space for multiple uses, including play space for children and a safer, more interesting environment for pedestrians and bicyclists. A trend toward "skinny streets" in residential areas is intended to create a more intimate, attractive, people friendly environment.

Properly designed and implemented traffic calming measures:

• Slow and/or divert traffic

• Reduce traffic accidents

• Reduce pollution

• Increase the safety and pleasure of walking and bicycling

• Provide opportunities for street "greeting"

• Improve the visual appeal of neighborhoods

• Provide opportunities for the shared use of streets as public space

4.16 Pedestrian System Planning

Pedestrian planning differs from bicycle planning partly because almost everyone walks. Individuals from every age group and ability level use the pedestrian environment and most destinations need to be accessible by walking. People may be walking less these days, especially in environments that lack pedestrian

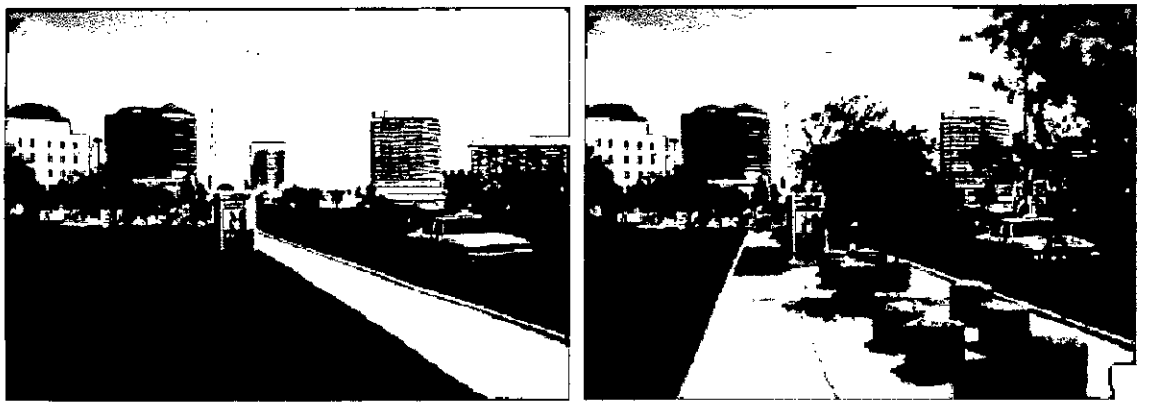
accommodations. However, many communities are attempting to reverse this trend since walking is healthful, brings people in contact with their neighbors, and offers mobility to those who cannot or choose not to drive.

A pedestrian friendly community must provide facilities that allow people to walk safely. In some circumstances, roadways and developments must be retrofitted to make walking easier and more inviting. Facilities alone will not encourage walking. Revitalizing downtowns and planning for density and mixed-use development are equally important.

4.17 Pedestrian Network Criteria

4.17.1 The Pedestrian Transportation System

Pedestrian facilities, like those for any transportation mode, are most effective when they are part of a system that assures connections, continuity, access, and safety. A community-wide system of facilities that is well designed and maintained is essential. It is important to consider the needs of pedestrians during transportation and development projects. In an interconnected pedestrian system, sidewalks are continuous; crossing streets safely is made possible; and, where appropriate, measures are taken to slow automobile traffic.



Sidewalk before landscaping Sidewalk after landscaping

Photo 4.3 Trees and landscaping within the sidewalk corridor should be used to contribute to physical, psychological and visual comfort (computer generated photos).

Source: Pucher and Dijkstra, 2003

4.17.2 The Sidewalk Corridor

In most communities, sidewalks are the primary transportation facility for walking. As such, the sidewalk system must be continuous and provide access to all pedestrian destinations. The sidewalk corridor is usually parallel to the road from corner to corner. It encompasses the area from the edge of the road to the property line and provides an area for walking, separated from vehicle traffic, and additional space for signs, streetscaping, and amenities. It must be adequately maintained to remain useful. Table 4.3 shows the sidewalk installation guidelines for different roads and areas.

Criteria for a Good Sidewalk Corridor

Accessibility - Sidewalks should be easily accessible to individuals of all ability levels.

Continuity and Connectedness - As the primary transportation facility for walking, the sidewalk route should be clear to users and should not be interrupted by gaps and intervening obstacles and conflicting uses.

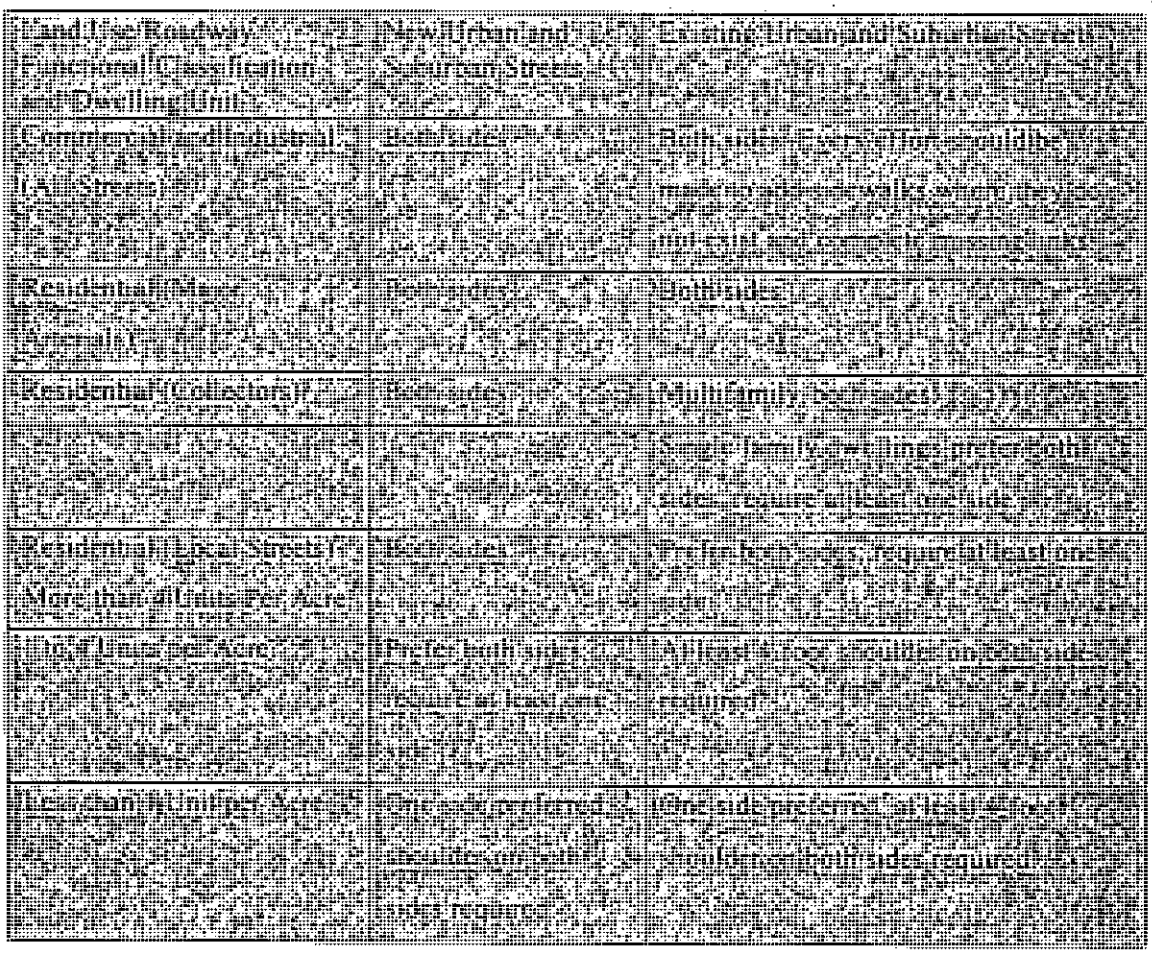
Safety - Sidewalks should be adequately separated from traffic, well lighted and free of dangerous surface irregularities.

Landscaping - Trees and landscaping within the sidewalk corridor should be used to contribute to physical, psychological and visual comfort (Photo2.2a).

Social Space - The social aspect of sidewalk corridors should not be ignored so that standing, sitting, visiting and children's play can occur.

Community Form - Sidewalk corridors should be recognized as a community asset and used to contribute to the character of neighborhoods and business districts, and to strengthen community identity.

Table 4.3: Sidewalk Installation Guidance



Notes:

1) Any local street within two blocks of a school site that would be on a walking route to school sidewalk and curb and gutter required.

2) Sidewalks may be omitted on one side of a new street where that side clearly cannot be developed and where there are no existing or anticipated uses that would generate pedestrian trips on that side.

3) Where there are service roads, the sidewalk adjacent to the main road may be eliminated and replaced by a sidewalk adjacent to the service road on the side away from the main road.

4) For rural roads not likely to serve development, a shoulder at least 4 feet in width, preferably 8 feet on primary highways, should be provided. Surface material should provide a stable, mud-free walking surface.

Criteria for a Good Street Corner

The following elements should be provided to ensure safe and well functioning street corners.

Adequate Space – Corners should be large enough to accommodate the typical number of pedestrians waiting to cross, congregating for social reasons or waiting for transit. They also must be able to accommodate curb ramps, poles and signs, as well as street furniture, transit shelters and other amenities.

Separation From Traffic – Corner design should effectively discourage the encroachment of motor vehicles into the pedestrian area.

Visibility – Pedestrians must be able to see and be seen by motorists at all times. Traffic controls and signals must also be visible from the pedestrian perspective.

Legibility – Signals, signs and pavement markings should communicate clear messages to the pedestrian.

Accessibility – All corner features including ramps, landings, call buttons, pavement markings and textures must meet standards.

4.17.3 Street Corners

Street corners are busy places. Pedestrian activities are concentrated at street corners.

Street corners are important in the larger scheme of street systems. They are the logical location for hardware such as street name signs and traffic control signs or traffic signal bases. Street corners house much of the hardware (traffic signals, etc.) that controls the complicated movements at intersections. The design of the corner affects the speed with which turning traffic can maneuver through an intersection.

They are of vital importance to the safe integration of automobile and pedestrian traffic. Here, people socialize, buy their newspapers, mail letters, and window shop while waiting for changing light traffic or buses.

The most dangerous and complicated part of an individual's walk – crossing intersections – occurs at street corners.

4.17.4 Crosswalks

Crosswalks accommodate the most hazardous stage of any pedestrian trip, crossing the street. The purpose of crosswalks is to concentrate pedestrian crossing movements so that the potential number of conflict points between pedestrians and motor vehicles are reduced. There are two types of crosswalks: marked and unmarked.

Crosswalks are the natural extension of the sidewalk at corners (or if there is no sidewalk, the area that would extend if there were a sidewalk). The majority of crosswalks are unmarked. Crosswalks are sometimes marked at mid-block locations. Pedestrians have the right-of- way at crosswalks but are required by law to obey traffic control devices and laws.

Criteria for Good Crosswalks

Clarity – It is clear where to cross and easy to understand possible conflict points with traffic.

Visibility – Pedestrians can see and be seen by approaching traffic – lighting is adequate and obstacles and the location of the crosswalk do not obscure the view.

Appropriate Intervals – The potential demand for crossing is reasonably well served by available crossing opportunities.

Adequate Crossing Time – The pedestrian is allotted or can take an adequate amount of time to cross and does not need to wait an unreasonably long time to begin crossing.

Limited Exposure – The distance required to cross is short or it is divided into shorter segments with median refuges.

Continuous Path – The crosswalk is a direct extension of the pedestrian travel path and is free of obstacles and hazards.

4.18 Bicycle Planning

Bicycle transportation planning is commonly construed as the effort undertaken to develop complete/comprehensive bicycle facilities for transportation and recreational activities. The resulting system is composed of shared use paths, improved roadways, bicycle lanes, bicycle parking, bicycle mapping and transit links. All facilities are interconnected and spaced closely enough to satisfy the travel needs of bicyclists.

Bicyclists want access to most of the same places as motorists, and they can legally use any roads from which they are not officially banned. Many roads are useable for local bicycling but others are undesirable because of such factors as excessive traffic and high speeds. Bicyclists have varying levels of comfort in traffic, depending on skill levels and aversion to risk. The average adult bicyclist is uncomfortable in heavy, fast traffic and prefers an improved designated bicycle facility system.

A bicycle facility network is a continuous, connected system of trails and on-road bikeways that accommodates the needs of the average cyclist safely and conveniently. This network offers information through signs and pavement markings, and special facilities as needed. The following six criteria should be considered in the development of a bicycle network plan.

4.18.1 Bicycle Network Criteria

Directness - A bicycle network plan should provide the most direct routes to major destinations.

Continuity - A continuous, connected system of bicycle facilities should serve major destinations. If there is a significant break in a proposed route, that route should be left off the designated system until the gap can be connected or bridged.

Safety - Where a choice exists, bikeways should be designated on streets with less traffic and lower speeds. When travel speeds are high and traffic is heavy, on-street

bicycle lanes or side-path facilities may be considered. When a bikeway crosses a major arterial road, a stop sign or traffic signal should control the crossing traffic.

Comfort - Comfort for a cyclist includes the safety of smooth pavements and light traffic, as well as intangible pleasures like tree-shaded streets, pleasant neighborhoods, and interesting views. On streets with significant traffic, bike lanes increase the comfort of average riders.

Access to Destinations - It is essential to provide routes that lead to major destinations, and to make specific destinations bicycle accessible. Access routes that do not require traveling through parking lots, and conveniently located, well-designed bike racks contribute to improved access.

Timely Implementation - A bicycle network plan is only as good as the possibility of its being implemented. Many significant improvements are low cost and others can be accomplished as part of already planned street and bridge projects. Prioritizing projects, developing alternatives for controversial proposals, and using funding efficiently will assure timely implementation. Planning for bicycle transportation has much in common with planning for other modes. A network of facilities that meets demands for circulation and access is required. The process of planning this network requires the identification of *priority destinations* and connecting corridors, the evaluation of alternatives, and the programming of projects.

Priority Destinations

When developing a facility network, it is important to identify priority destinations, which can include:

- Existing trails, parks, and recreational facilities
- Central business districts
- Shopping areas
- Schools and universities
- Community centers
- Public services, including libraries and post offices
- Employment centers

4.18.2 Factors and Principles of Success of Bicycle Planning

Factors as vital to the success of bicycle planning are - First, the importance of education for the motorist and the cyclist became an issue. Second, law enforcement and safety are crucial components to the successful implementation of bicycle facilities. Third, the actual design of the bicycle path must be suited to all types of cyclists. Finally, cycle routes must work in conjunction with other modes of transportation including bus, rail, and automobile (Lohr, 1999).

Clearly an integrated approach to bicycle planning is necessary. Based on the concerns outlined above, Hudson (1982) developed *six principles of planning for cyclists.*

Cycling plans must be integrated into all transport plans.

An administrative framework that communicates with both the public and other government agencies must be in place.

Planners must use the existing transport system and construct new facilities.

Cyclists and motorists must recognize a common set of rules.

Bicycle facilities must be maintained and their performance must be monitored.

Planners must recognize that cycling has its own set of opportunities and constraints.

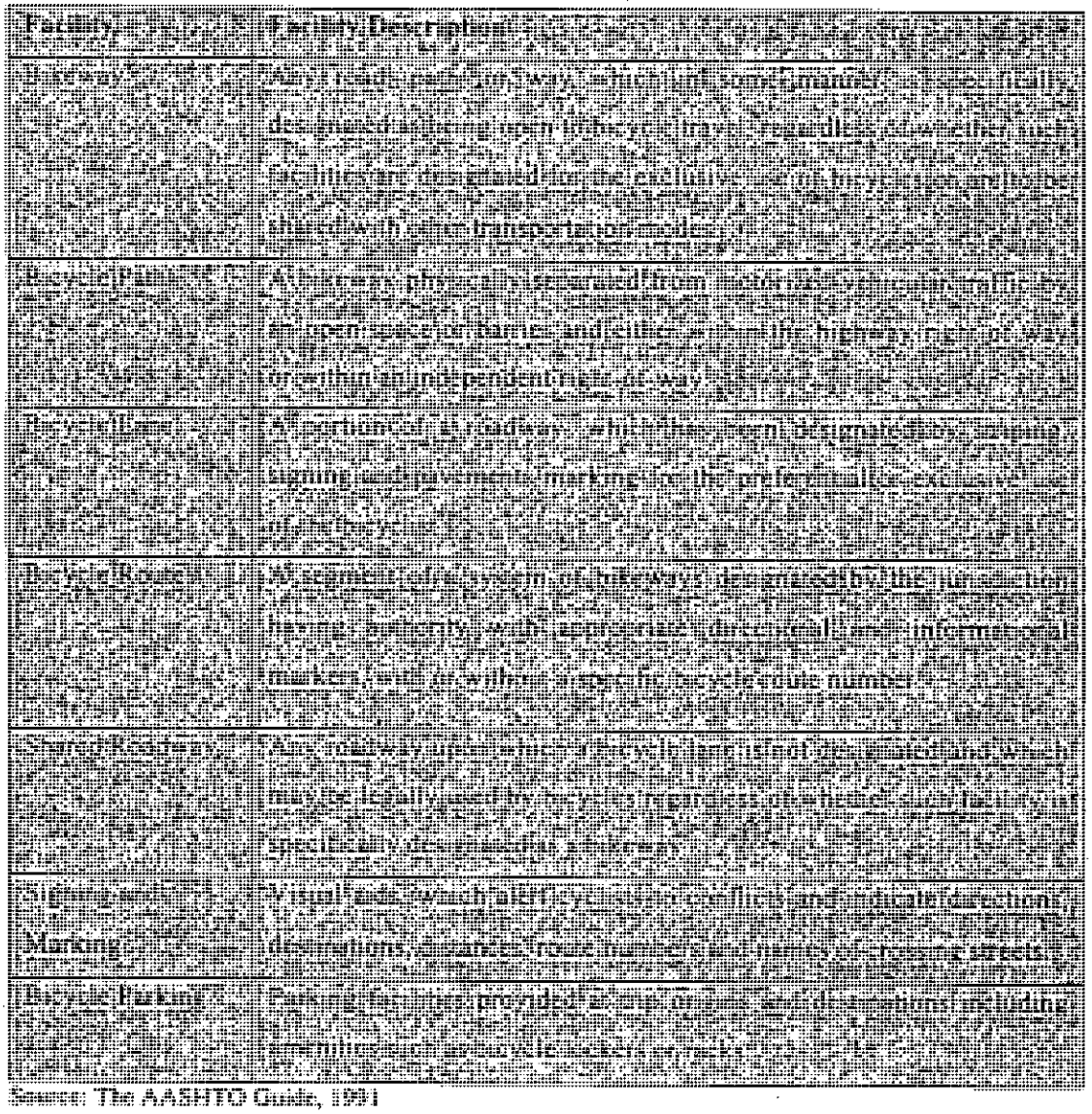
Hudson's principles still hold true today. However, more recent bicycle planning guides stress the second principle: an administrative framework that communicates with both the public and other government agencies is necessary.

4.18.3 Bicycling Uses the Existing Systems

Photo 4.4 Bike lane
Source: Florida Bicycle Facilities Planning and Design Handbook April 2000

Bicyclists have the same mobility needs as every other user of the Transportation System. They use the highway system as their primary access to goods, services, and recreational activities. Existing streets, often with relatively inexpensive improvements, must serve as the base system to provide for the travel needs of bicyclists. Shared use paths and path connectors can augment this existing system in scenic corridors, greenways or places where access is limited. Bicycle transportation planning is more than planning for bikeways, it is an effort that should consider many alternatives to provide for safe and efficient bicycle travel.

Table 4-5. : Examples of Bicycle Facilities



Source: The AASHTO Guide, 1991

4.19 Factors of Commuting or Deterring Bicycling

4.19.1 Factors of Bicycle Commuting

The National Bicycling and Walking Study, USA states that there are three primary factors that correlate with high levels of bicycle commuting:

Relatively short work trip distances

Relatively high ratio of bike lanes to arterial

Presence of a university

4.19.2 The Most Common Factors That Deter Bicycling Include

Concern about traffic safety

Adverse weather

Poor roadway conditions

Trip distances

4.19.3 Factors That Encourage Bicycling Include

Safe bicycle lanes

Financial incentives

Shower and storage facilities

Rise in fuel/gas prices

Walking trips are correlated with similar factors. Additionally, studies have shown that those who do not have regular access to a car walk more.

4.20 On-road Bicycle Facilities

The most effective way to improve conditions for bicyclists and integrate them into the transportation network is to accommodate bicycle travel on all new and existing streets. Even if it were desirable to create a system of bikeways separated from the highway it would not be practical or affordable. Shared lanes, Shoulder Bikeway, Bicycle lane, Separated, Multiple-Use Path are the ways to accommodate bicyclists into the existing street network.

4.20.1 Shared Lanes

On a shared facility, bicyclists and motorists share the same travel lanes. Shared

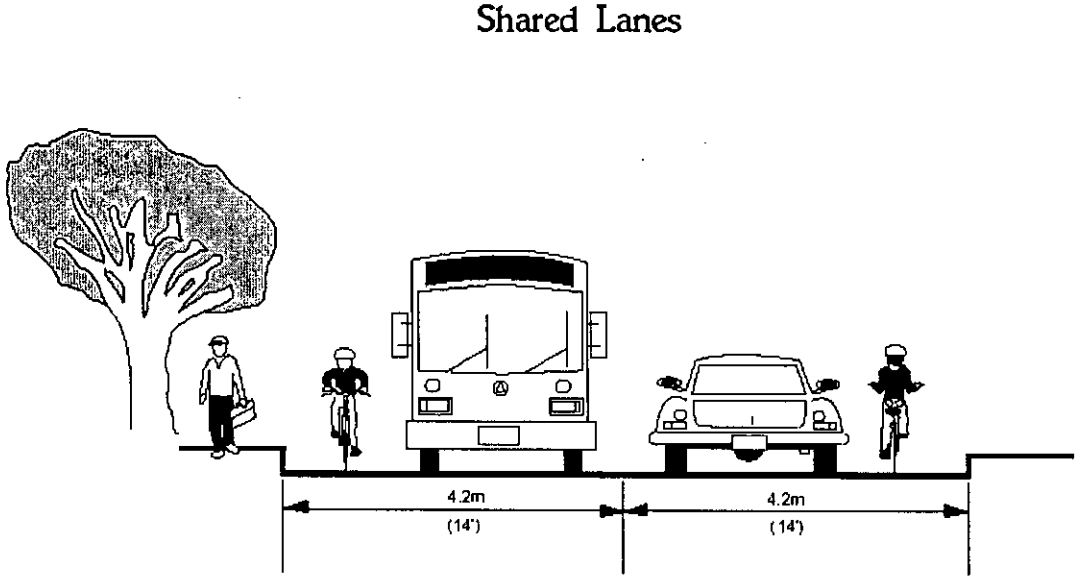


Fig. 4.5 Shared Lane

Source: Adapted from Idaho Bicycle and Pedestrian Transportation Plan 1995

facilities are common on city street systems and roads with limited right-of-way. It can be considered an acceptable solution when there is inadequate width to provide bike lanes or shoulder bikeways.

A lane with 4.2 meters (14 feet) of usable width is desired in an urban setting which allows a motor vehicle and a bicycle to operate side by side. Usable width would normally be from curb face to lane stripe, but adjustments need to be made for drainage grates, parking, and longitudinal ridges between pavement and gutter sections (as shown in Fig.4.5).

Widths greater than 4.2 meters (14 feet) may encourage the undesirable operation of two motor vehicles in one lane. In this situation, consideration should be given to striping a bicycle lane or shoulder bikeway. Where bicycle travel is significant these roadways may be signed as bicycle routes (Idaho, 1995).

4.20.2 Shoulder Bikeway

Smooth, paved roadway shoulders provide a suitable area for bicycling conflicting little with faster moving motor-vehicle traffic (Photo 4.5).

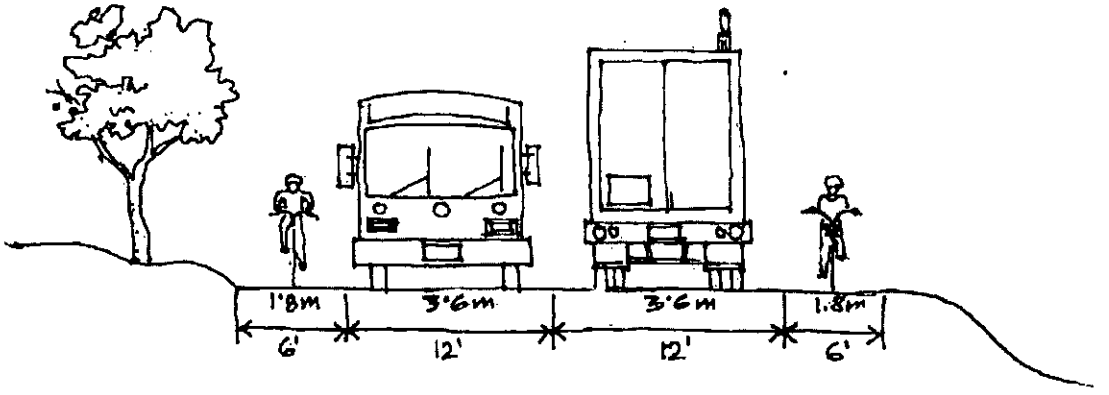


Fig. 4.6 Shoulder Bikeway

Source: Adapted from Idaho Bicycle and Pedestrian Transportation Plan 1995

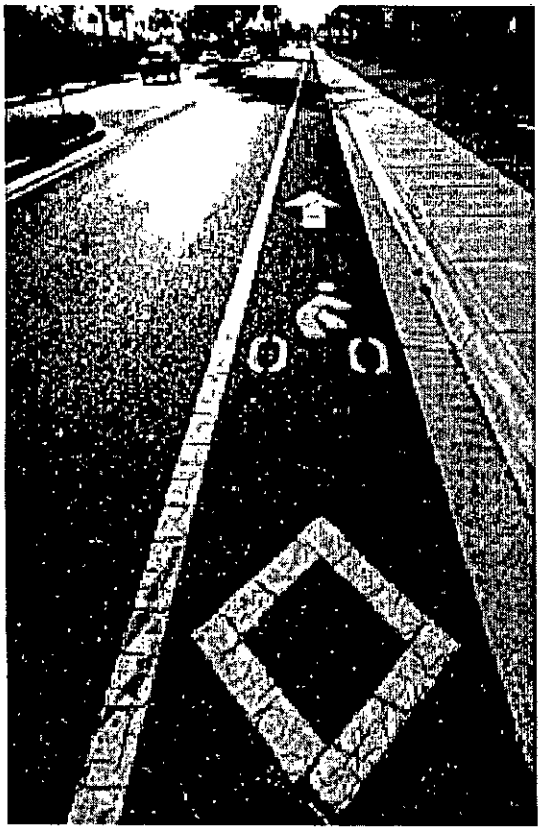


Photo 4.5 Paved roadway shoulder as bike lane

Roadway shoulders for bikeways should be 1.8 meters (6 feet) wide or greater. This provides ample width for bicycle traffic. If there are severe physical width limitations a minimum 1.2 meter (4 feet) shoulder may be adequate. Shoulder areas against an ordinary curb face should have a 1.5 meter (5 feet) minimum width or 1.2 meters (4 feet) from the longitudinal joint between a curb and gutter and the pavement edge. Shoulder widths of 1.5 meters (5 feet) are recommended from the face of a guardrail or other roadside barriers (as shown in Fig.4.6).

4.20.3 Bicycle Lanes

Where bicycle travel and demand are substantial, a portion of the roadway is designated for preferential use by bicyclists. Bike lanes are common in urban areas. Bike lanes must always be well marked and signed to call attention to their preferential use by bicyclists.

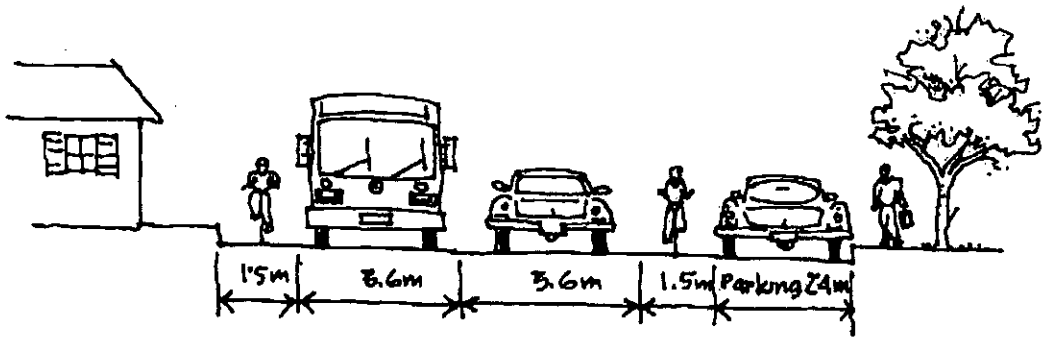


Fig. 4.7 Bicycle lane

Source: Adapted from Idaho Bicycle and Pedestrian Transportation Plan 1995

Bike lanes are established on urban arterial and major collector streets. The minimum width for a bike lane is 1.2 meters (4 feet), or 1.5 meters (5 feet) from the face of a curb or guardrail. There should be a clear riding zone of 1.2 meters (4 feet) if there is a longitudinal joint between the pavement and the curb-and-gutter section. Bike lanes in excess of 1.8 meters (6 feet) wide are undesirable as they may be mistaken for a motor vehicle lane or parking area. Refer to the Idaho Traffic Manual or the MUTCD for detailed specifications for pavement striping, stencils, and signing of bicycle lanes. If parking is permitted, the bike lane must be placed between the parking area and the travel lane and have a minimum width of 1.5 meters (5 feet) (see Fig 4.7).

Bike lanes must always be one-way facilities and carry bicycle traffic in the same direction as adjacent motor vehicle traffic. Bike lanes on one-way streets should be on the right side of the roadway, except in areas where a bike lane on the left will decrease the number of conflicts (i.e., those caused by heavy bus traffic or dual right-turn lanes, for example).

4.20.4 Separated, Multiple-Use Path

A multiple-use path is a bicycle facility that is physically separated from motor vehicle traffic by an open space or barrier, and it may be within the roadway or independent right-of-way.

Separated paths are normally two-way facilities. Where a separated path must be parallel and near a roadway, there must be a 1.5-meter (5-foot) minimum width separating them, or a physical barrier of sufficient height [usually 1.4 meters (4.5 feet) minimum is adequate] must be installed.

Three meters (10 feet) is the standard width for a separated multiple-use path. Paths

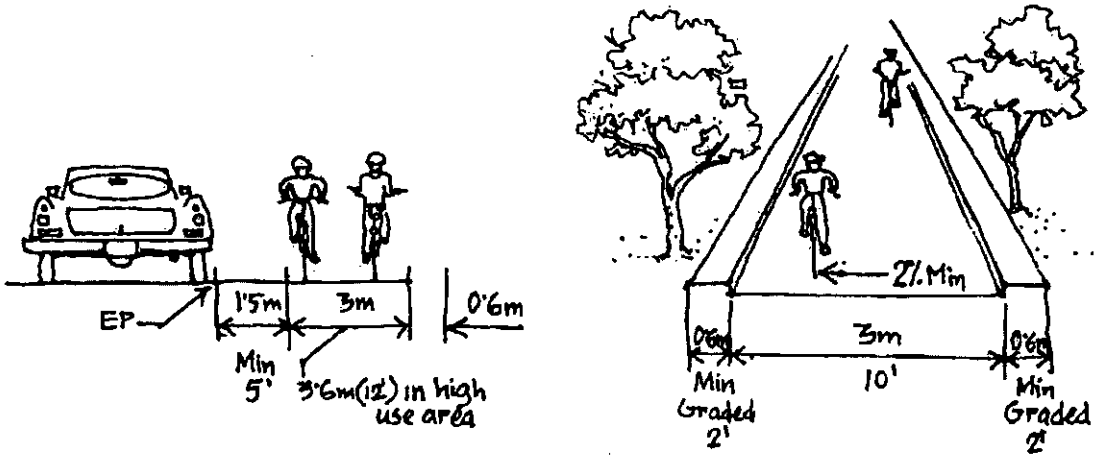


Fig. 4.8 Separated, Multiple-Use Path

Source: Adapted from Idaho Bicycle and Pedestrian Transportation Plan 1995

should be 3.6 meters (12 feet) wide in areas with high bicycle volume or where they are used by a combination of bicyclists, pedestrians, skaters, and joggers. A minimum 0.6-meter (2-foot) graded area should be maintained adjacent to both sides of the pavement to provide clearance (shy distance) from poles, trees, fences, and other obstructions (see Fig. 4.8). Multiple-use paths provide excellent bicycle transportation, especially where the path is truly isolated from motor vehicles. Special care must be taken to limit the number of at-grade crossings with streets or driveways. Paths with two-way bicycle traffic should not be placed on or adjacent to roadways.

4.21. Amenities

Because pedestrians and bicyclists travel using their own power, it's important to provide opportunities for them to rest, to shield themselves from the weather or sun, to refresh themselves with a drink of water or to provide an illuminated route of travel.

Therefore, amenities that provide these benefits should be considered and included as essential components of every project.

Following items should be considered for comfort, sense of security and convenience of bicyclists and pedestrians:

Lighting
Trash receptacles
Information and directional signing
Benches and street furniture
Information kiosks
Drinking fountains
Public telephones
Transit shelters
Distance markers
Bicycle parking
Restrooms
Picnic tables and protective shelters
Ramps and stairways

Items to soften and enhance the pedestrian and bicycle environment should be considered:

Grassy areas and buffer strips
Shade trees
Planters.
Textured walkway surfaces.
Statuary or artwork (sculpture, etc.)
Ornamental fountains
Selective relocation of utility poles or burial of utility cables
Uplighting of trees, monuments and gazebos.

4.21.1 Lighting

Consideration should be given to the need for lighting on paths used by commuters or college students during twilight and nighttime hours and for any path at a street crossing. Special consideration should be given to lighting at pedestrian street crossings. Lighting should also be considered in underpasses, overpasses and tunnels and where nighttime security could be an issue.

4.21.2 Trash Receptacles

Along walkways paths trash receptacles should be provided taking into account the nature of the surroundings and environment. Which reduces maintenance along paths.

4.21.3 Information and Directional Signing

Pedestrian-oriented signs should be developed to assist visitors and even residents who may not realize that the best route on foot is shorter than using motorized vesicle. Examples of key destinations to include are libraries, post offices, government offices, transit centers, schools, museums, entertainment centers, shopping centres, parks, public rest rooms, and tourist attractions.

Signs should be unobtrusive, easy to read, aesthetic. Place only enough signs to lead a pedestrian confidently to the destination by the best route.

4.21.4 Benches and Street Furniture

Signs, street furniture, and other items that could be considered obstacles should be placed outside of the Pedestrian Though Zone. All items installed for pedestrian use should be accessible. Disabled and elderly pedestrians appreciate benches at regular intervals along all public streets, especially where sidewalks slope steeply. Benches should be placed on level, paved surfaces.

4.21.5 Information Kiosks

Because pedestrians and bicyclists expend their own energy getting to a destination, it is important to maximize way finding opportunities to reduce the possibility of out of direction travel. In addition, destinations that are familiar to a resident may be unknown to a visitor. Frequently spaced information kiosks and directional signs can alleviate these problems and make the environment more inviting to walking and bicycling.

4.21.6 Drinking Fountains

Wheelchair-accessible and standing-height drinking fountains should be combined when installed on public sidewalks and paths. Both drinking fountains and telephones need to be carefully located to avoid projecting into a circulation route.

4.21.7 Public Telephones

Where public pay telephones are grouped in a public space, at least one instrument should be installed at a wheelchair-accessible height while another should be mounted higher to enable pedestrians who have difficulty bending or stooping to use it easily.

4.21.8 Bus Stops and Transit Shelters

At bus stops, transit stations and other locations where pedestrians must wait, a shelter makes the wait more comfortable. Shelters should provide undercover seating including enough space for wheelchairs.

Transit shelters should always be erected on a paved surface and connect the transit shelter to the pedestrian network via a paved walkway. It require enclose three sides of the shelter to provide maximum weather protection. Provide windows or use transparent material on the sides of the shelter for maximum visibility and security. Illumination is required to the shelter and area around the shelter for nighttime use. Bus schedules and route maps within each shelter.

When locating transit stops, consideration should be given to placing the stop on the far side of an intersection instead of on the near side of an intersection. For pedestrian safety and maximizing sight distance at intersections, far side stops are preferred.

4.21.9 Distance Markers

Provide kilometer or mile markers to orientate path users. Distance markers are especially beneficial to those engaged in fitness activities.

4.21.10 Bicycle Parking

Lack of secure parking facilities is frequently cited as a deterrent to bicycling in urban or village settings. People may avoid bicycling when:

- There is no place to park their bicycles at their destination
- They perceive their bicycle or components may be subject to theft or vandalism or they have to walk too far to a building's entrance
- Their equipment will be exposed to weather
- The parking area is poorly lit or perceived as unsafe

The principle considerations for bicycle parking are:

- Appropriate level of security required for the anticipated parking period
- Location of the bicycle parking area
- Spatial requirements
- Signing and identification of the parking area and devices.

4.21.11 Public Restrooms

Conveniently located restrooms are welcomed by both residents and tourists and take the pressure off business owners from having to provide sanitary facilities for the general public.

4.21.12 Picnic Tables and Protective Shelters

Shelters and picnic tables with roofs and protected seating areas are required where to be greater exposure to the sun and other elements.

4.21.13 Stairways

Where a connection is needed to a destination or another path at a different elevation, a stairway can be used where the terrain is too steep for a path. To accommodate bicyclists, a 75 mm (3 in) groove (wide enough to accept a bicycle tire) can be provided in the top of the stringer on both sides of the stairway so bicyclists can easily guide their bicycles up or down the stairway.

4.21.14 Other Amenities

Other items commonly found on sidewalks and along paths — fire pull stations, mailboxes, information and sales kiosks, and fixed vending. The placement or installation of such items should not narrow the minimum clear, unobstructed sidewalk and path width. Particularly at turns, access points and ramps and in places that require additional maneuvering space.

CHAPTER 5

NEIGHBORHOOD PLANNING AND DESIGN

CHAPTER 5

NEIGHBORHOOD PLANNING AND DESIGN

5.1 Introduction

This chapter mainly intends to discuss how the neighborhood can be planned and designed to create a pedestrian and bike friendly environment. For that intention this chapter describes, the concept of neighborhood design and theories developed and practiced throughout the world. It also describes the design elements of the neighborhood. Street network, street design, separate biking and walking systems as a part of a part of the build environment of the neighborhood, which are also part of the transportation system, are discussed critically. Perception of street by the pedestrians, bicyclists and children also discussed. Urban area street classification, residential area street classifications are discussed. Finally the discussion focuses on the pedestrian oriented site design, on which central focus is pedestrian.

5.2 Neighborhood Concepts

A good neighborhood, among other factors, is directly related to efficient and well-planned street network. Because transportation and mobility issues not only influence travel behavior, they also affect the health of the neighborhood residents. The different transportation system within the neighborhood – sidewalks, transit routs, roads, bicycle lanes, pedestrian paths, etc should be examined. These systems should be reviewed to determine how these functions within the neighborhood and how will they connect to the rest of the city. As neighborhood plans are developed, pedestrian routes, pedestrian-oriented traffic calming measures, lighting, and the placement of amenities such as benches should be studied, taking into consideration each neighborhood's pedestrian travel desire lines and the location of gathering places.

Neighborhood is a distinct physical unit within which internal planning provides for the provision and orderly arrangement of all those facilities which are shared in common by the residents. The facilities are grouped so far as possible, thereby adding to the convenience of the residents and providing a nucleus for the development of the local social life of the neighborhood (Brown & Sherrard, 1959).

Gallion in his book 'The Urban Pattern' states that –the neighborhood unit is not some sociological phenomenon: it embraces no particular theories of social science. It is simply a physical environment in which a mother knows that her child will have no traffic streets to cross on his way to school, a school which is within easy walking distance from home. It is an environment in which the housewife may have an easy walk to a shopping center where she may obtain the daily household goods, and the man of the house may find convenient transportation to and from his work. It is an environment in which a well-equipped playground is located near the home where the children may play in safety with there friends, the parents may not care to maintain intimate friendship with their neighbors, but children are so inclined and they need the facilities of recreation for the healthy development of their minds and spirit (Gallion, Eisner, 1989).

5.3 The Original Neighborhood Concepts

The neighborhood concept was undoubtly one of the major landmarks in twentieth century urban planning. Two different original ideas appeared in the same year, 1929. First, there was the idea for neighborhood by Clarence Stein and Henry Wright. Secondly, there was the neighborhood unit idea of Clarence Perry.

The design of the Radburn neighborhood model was in essence a hierarchical one comprising four levels- enclave, block, super block, and neighborhood Figure 5.1. The fundamental concept was an enclave of twenty or so houses. There houses were arrayed in a U-formation about a short vehicular street called a 'lane' really a cul-de-sac with access to individual garages. While the back of each house faced this court, the front of the house had a garden. Three or more of these enclaves were lined together to form a block. Enclaves within the block were separated from one another by pedestrian pathway that ran between the front gardens of all the house. The blocks, usually four in number, were arranged around the sides of a central parkway in such a manner so as to enclose the open green space. The clustered blocks together with the central parkway comprised what Stein and Wright termed a superblock. Four to six superblocks commonly formed a neighborhood that was bounded by major roads or natural features.
Perry identified six neighborhood unit design principles, Figure 5.2. First, the unit was ideally to be a shape in which all sides were fairly equidistant from the centre, and its size was to be fixed.

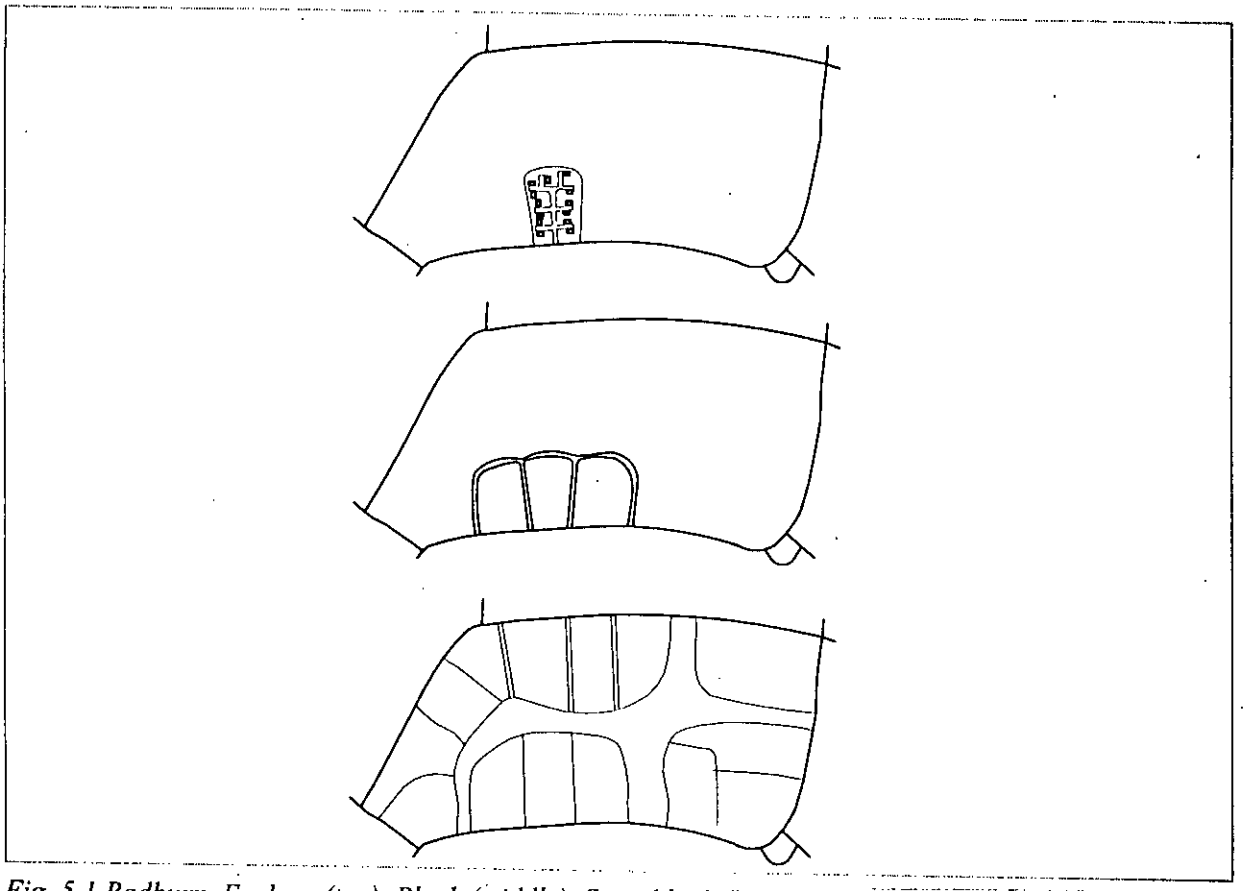


Fig. 5.1 Radburn, Enclave (top), Block (middle), Superblock (bottom)

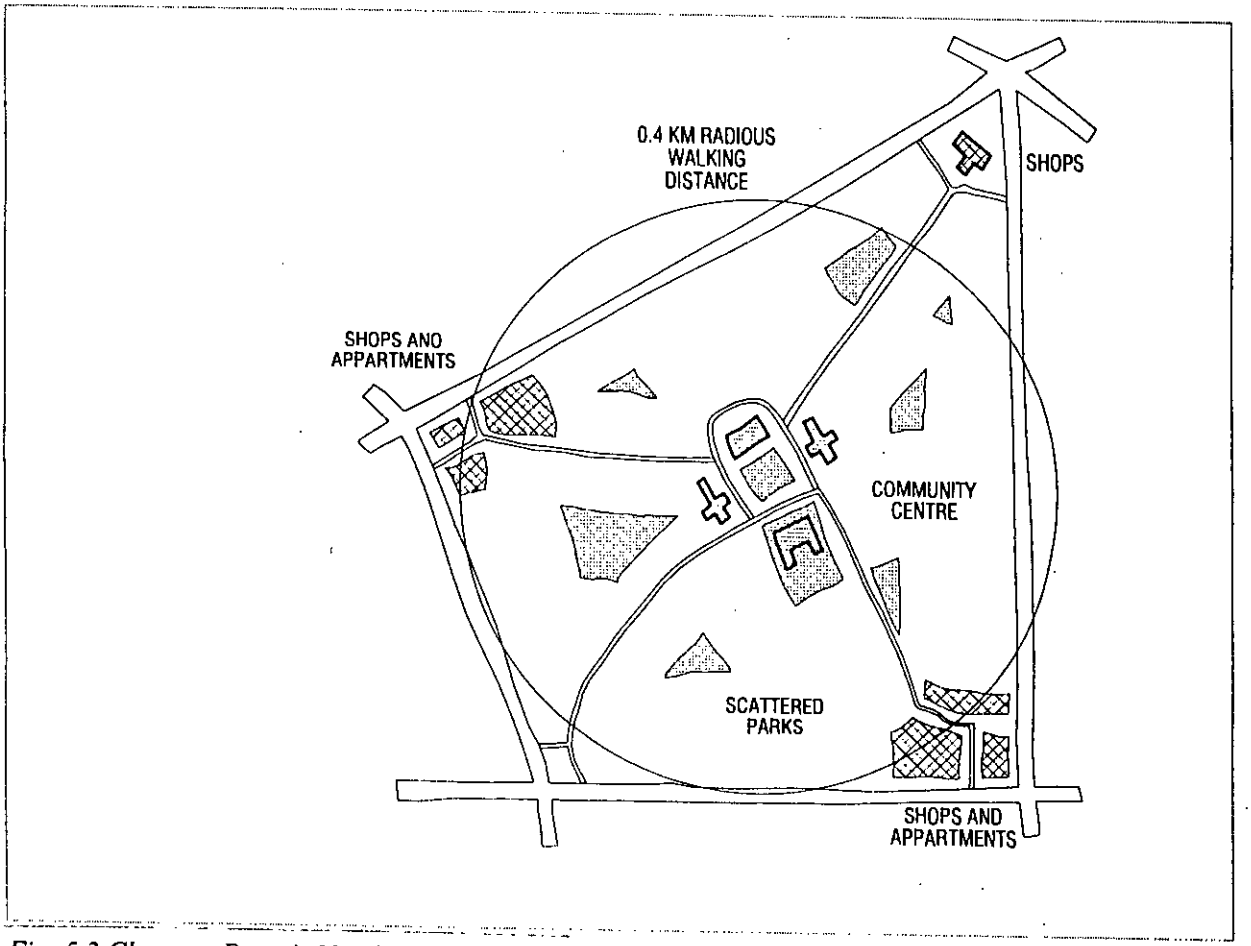


Fig. 5.2 Clarence Perry's Neighborhood Unit

Secondly, a central neighborhood or community centre was to contain various, institutional sites including a school, grouped round a central green space. Thirdly local shopes or shops and apartments were to be located at the outer corners of the neighborhood. Fourthly, scattered small park and open spaces, located in each quadrant of the neighborhood, were to form 10 percent of the total area. Fifthly, arterial streets were to bound each side of the neighborhood, sixthly the layout of the internal streets was to be a combination of curvilinear and diagonal roads to discourage thrush traffic. Vehicular and pedestrian traffic were to be segregated.

One of the similarities between their two models were the inclusion of a significant amount of open space, a neighborhood centre that would include the school, and a road system that was safe for pedestrians and did not allow thorough traffic.

However, the principle of fixed size would not apply today. With today's mobility, neighborhood boundaries do not have the force they did early in twentieth century. Fixed size is invalidated by demographic changes, by school systems where children are brought in by bus form a wide area, or driven to school by a parent, or where parents are allowed a choice of local schools, not necessaries the nearest. (Patricios, 2002).

It shows the importance of mobility, accessibility and safety of neighborhood residents in our present urban context. The objective of circulation system of the neighborhood is to provide safe and efficient movement of the people and the goods. For that to achieve the objectives the principles guiding development of neighborhood are- residential area shall be planned on a neighborhood basis, major highways should pass around residential neighborhoods. Primary street should connect the centers of neighborhoods

and secondary streets should provide access to residential streets of loop of cul-de-sac. Independent of vehicular routes, a system of pedestrian greenways should be provided to connect houses, schools, recreation etc areas. Schools should be accessible by walkways. Communal buildings should be provided in each neighborhood. Local and neighborhood shopping centers should be strategically located.

Design elements of a neighborhood are the pattern of street layout, land division, and planned open spaces. Site-planning handbooks generally recognize a classification of street types- arterial streets or highways; collector streets which feed the highways; minor streets which feed the collectors; marginal access streets which parallel the highways; and alleys.

3.4 Build Environment of the Neighborhood

The built environment of the neighborhoods can influence walking and bicycling patterns in many ways. The built environment can be broken down into a large number of categories. Transportation systems and land development patterns are two categories of the built environment those influence walking and bicycling.

Transportation systems include the network of streets in a city, the design of individual streets and highways, transit systems, and separated systems for nonmotorized users. Streets form the system on which most modes of travel (automobiles, buses, bicycles, and pedestrians) operate; here the central focus is on street layout and design.

Land development patterns are the spatial arrangement and design of structures in the built environment. Land development patterns include residential and commercial density and the mixture of uses over a given area, as well as the design of buildings and sites.

Transportation systems can be analyzed on at least three levels- street networks, street design, separated biking and walking systems. Those are discussed below.

5.4.1 Street Networks

Street networks influence trip route and modal choice through the ways in which trip origins and destinations are connected. Networks can be rated as either high in connectivity, where there are a large number of blocks and intersections per some unit of area, greater number of straighter streets, or low in connectivity, where there are fewer blocks and intersections over the same area.

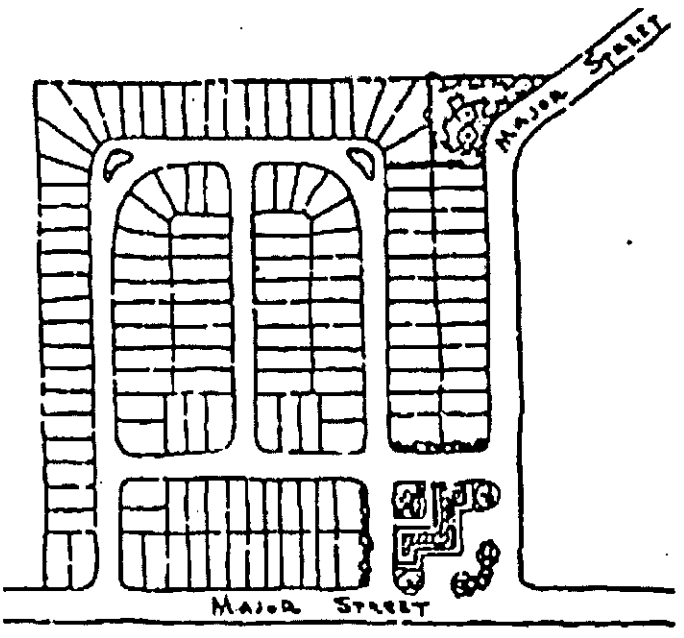


Fig.5.3 Good street layout - Access streets planned to discourage undesirable through traffic

Good planning is based on purpose or function. Streets should be designed of width suitable to the traffic they will have to carry, and should be laid out with due regard to the configuration and other natural features of the site. Geometrical planning is superficial and lacking in purpose The observance of these principles will almost inevitably mean a complete break away from the old chequer-board system and from a uniform width for all streets (Brown & Sherrard, 1959).

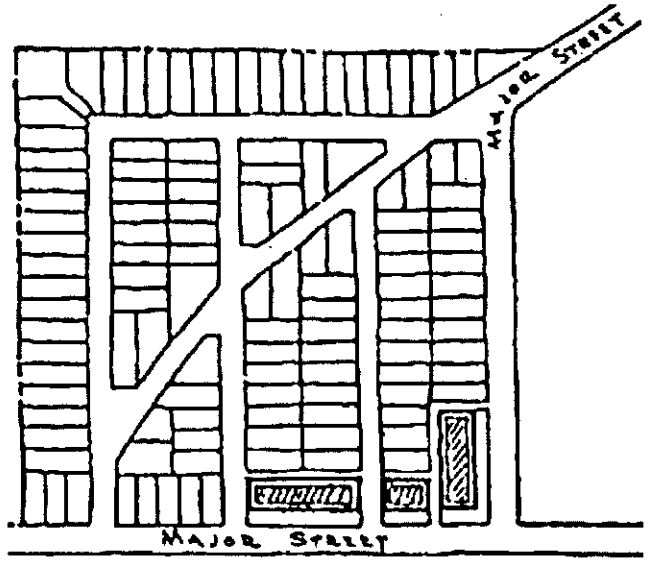


Fig.5.4 Bad street layout - Access streets planned to encourage undesirable through traffic

Brown and Sherrard classified streets within a residential area into two broad classifications- (a) distributive streets and

(b) access streets, Distributive streets usually lead from main arterial road to the access streets, whose sole function is to provide access to the houses. The distributive streets serve to collect the traffic from access streets and should be so laid out that traffic is drained easily and naturally from the area in the direction which will be most convenient. The distributive streets may, and usually do provide frontages for houses and their width and general design will vary according to circumstances. Access streets are those which lead off the distributive streets. They may be turned or looped streets or culs-de-sac.

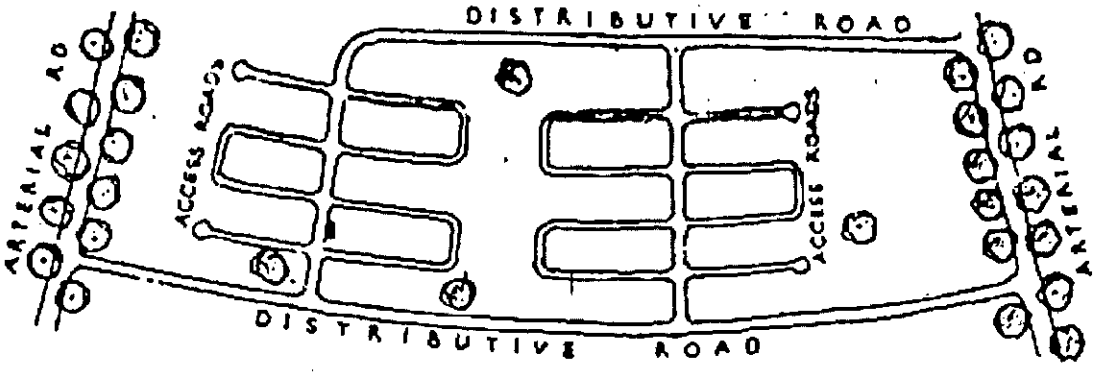


Fig.5.5 Plan of distributive and access roads

In the general layout of a street system for a residential area, due regard must be paid to contours, both in order to facilitate drainage and to ensure that road gradients will not be excessive. In this type of topographical condition, it is important to consider the pedestrian accessibility, continuity requirement and for that requirement stair, ramp etc can be introduced for better pedestrian accommodation. Where natural slopes are steep, streets will generally need to be almost parallel to contours, but where slopes are moderate it may often be preferable for streets to be normal to the contours. This gives a symmetrical street cross- section, and results in cheaper street construction, simpler vehicular entrances and easier sewer reticulation and surface water discharge into gutters.

In planning a street system, consideration should also be given to the direction of prevailing winds, and wherever possible streets should not run parallel to such winds. Different type of street system has merits and demerits that affects pedestrian friendly environment, those are stated below.

5.4.1.1 Curvilinear Street System

A street pattern that is curved. This type of street system is often characterized by a large number of cul-de-sacs. Traffic is channeled from neighborhood streets to busy and often very wide arterial roads. This street pattern is usually not conducive to creating a pedestrian-friendly neighborhood.

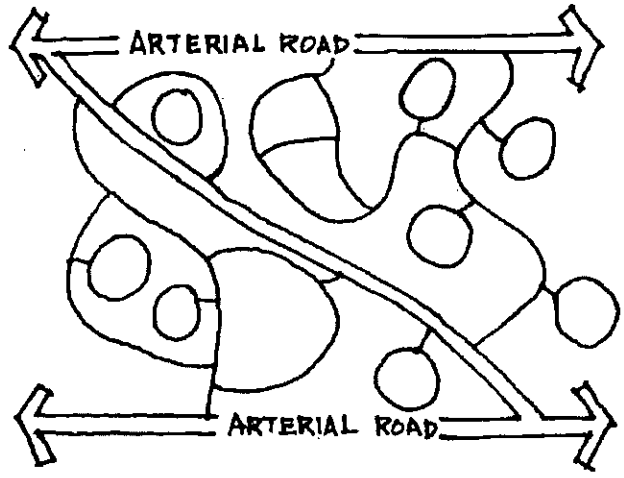


Fig. 5.6 Curvilinear Street System

5.4.1.2 Grid Street System

A street pattern that is composed of regular, rectangular blocks resulting in four-way

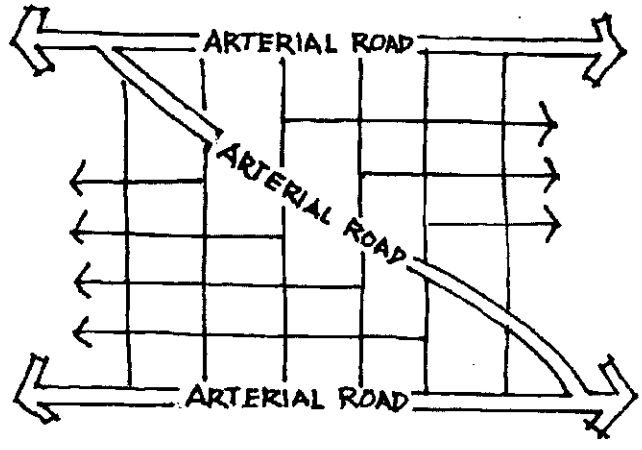


Fig.5.7 Grid Street System

intersections. This street pattern is common in older small towns and in older sections of larger cities.

This pattern is popular due to its more pedestrian-friendly design and scale, and ease of access. The grid system also makes mixed use development more practical due to its

pedestrian-friendly nature and scale. The grid network does have drawbacks. Topographical features such as creeks and hilly terrain can limit it.

5.4.1.3 Radial Street System

A street pattern where the streets converge on a central point or area. From the air it may like similar to a spider web. Like the grid pattern it has a pedestrian friendly design and scale, and ease of access. Many famous cities have radial or modified radial street patterns—Paris, Washington D.C., Boston, and Bolgna, Italy.(Austin,2002)

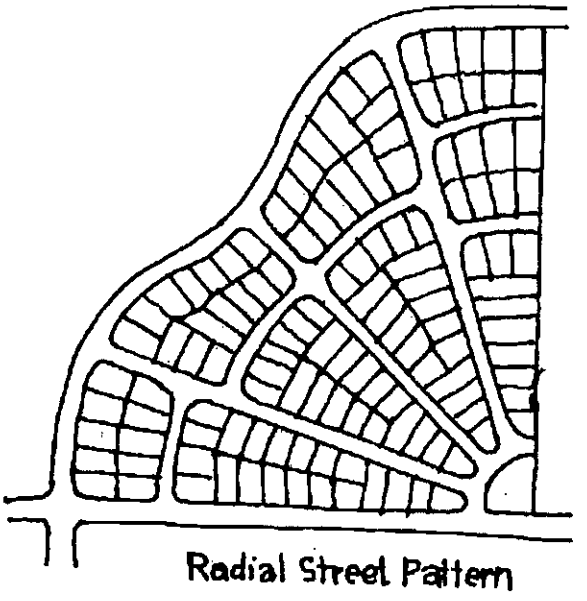


Fig.5.8 Radial Street Pattern

Generally speaking, the junction of one street with another should be at right angles or should approximate a right angle. Acute junctions or intersection not only result in awkwardly shaped allotments, but also increase traffic hazards. The required criteria for the junction or intersection are stated in section 5.9 of this chapter.

The monotony of the grid street system or chequer- board street system is no departure is made from the straight street. There is nothing essentially wrong with the straight street, however, it is simply a matter of its suitable employment. It can be used with very satisfactory results in judicious combination with curved streets of adequate radius. The exclusive use of curves may become as monotonous as the invariable straight street. When straight streets are used, they should not be of undue length and the end of the

vista should be terminated by some point of interest, either natural or artificial. Long straight streets and roads that disappear on an open horizon are to be avoided.

The straight street lends itself to one order beauty, and the curved street to another. Valuable lessons can be learned from a study of mediaeval curving streets, which usually produced pleasant street pictures. Almost always it will be found that the curve is very slight, having a large radius where it happens to be set out as the arc of a circle. The large radius not only lends itself to good results from the aesthetic point of view but, in comparison with the small radius curve, facilitates the construction of underground services such as sewers.

The question of street widths and their subdivision into footpaths, grassed margins and vehicular pavements, is one on which there is divergence of opinion. Grass margins should be laid out, the most usual arrangement being to place them between the carriageway and the footpath. This permits of tree planting and facilities access to service pipes, which may be placed under the margins.

The grid pattern is the archetype of the high connectivity network. The gridiron is a simple system of two sets of parallel streets crossing at right angles to form square or rectangular blocks. Streets are non-hierarchical, that is, there is less differentiation of streets by traffic volume.

Grids are theoretically capable of increasing walking and biking trips in two ways. Grids have a large number of intersecting streets, thereby reducing the distance between trip origin and destination. Grid patterns also provide for a large number of alternative trip routes, allowing pedestrians and bicyclists to vary their routes for variety, safety, and convenience.

In contrast to grids, hierarchical, curvilinear street networks are lower in connectivity. In these types of systems, which have a number of variations, streets are curvilinear, often following landscape contours. Streets are deliberately ordered into a hierarchy. Residential streets often loop back upon themselves or are cul-de-sacs. Residential streets feed into major arterial roads, which are designed for heavy traffic volumes and often feature no pedestrian or bicycle amenities. These networks are characterized by a

low number of blocks and intersections per unit of area. Theoretically, they discourage walking and biking by increasing trip length and decreasing both route and modal choice (Southworth and Owens 1993; Frank 1999). Figure 5.9 Graphically illustrates the major differences between systems that are high and low in connectivity. In between the purest grid pattern and the most disconnected, hierarchical pattern there are a large number of variations. In the successive postwar decades, in USA, planners and developers greatly expanded the street network design principles, increasing the degree of hierarchy, curvilinearity, and disconnectivity in residential neighborhoods.

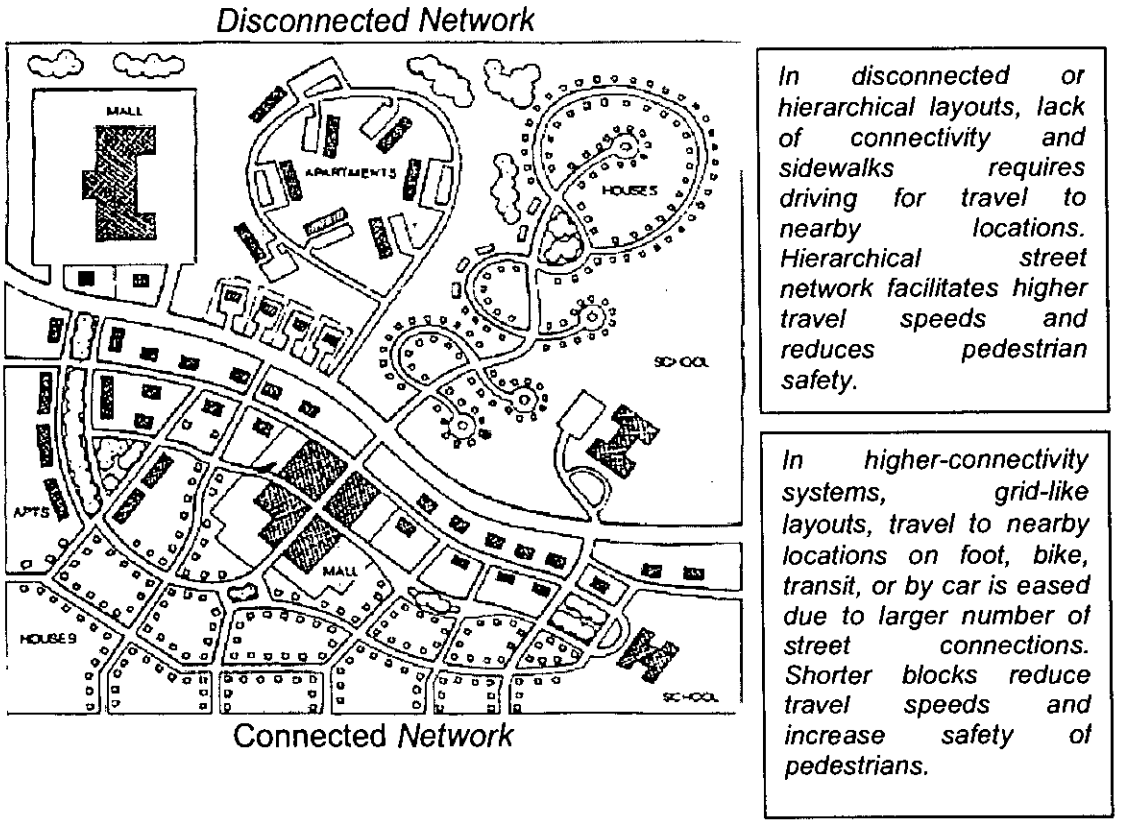
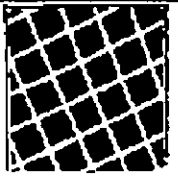
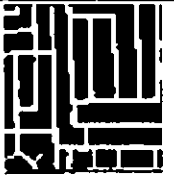
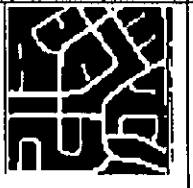
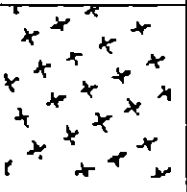
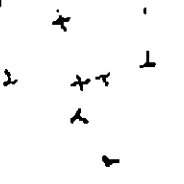


Fig 5.9 Forms of Street Network Configuration - major differences between systems that are high and low in connectivity.

Southworth and Owens (1993) provide a spatial analysis of the design characteristics of San Francisco Bay area suburban communities that were developed at different points in the century. The authors formulated design typologies for eight study areas, and at three scales: the community, the neighborhood, and the individual street and house lot. Table 5-1 provides a typology of the different street networks found in their study areas. As the figure illustrates, over time street network design patterns in the San Francisco Bay area transitioned from the rigidly geometric to the extremely disconnected and curvilinear. The gridiron layout, built in neighborhoods at the turn of the century,

contains the most amount of street frontage, the greatest number of intersections, the greatest number of blocks, the greatest number of access points, and the total absence of loops and cul-de-sacs. In contrast, the postwar communities examined by the authors contain street networks with fewer intersections, blocks, and access points and a greater number of loops and cul-de-sacs. In the view of the authors, these trends reflect an increasing desire to improve neighborhood traffic safety, especially for children, and increase residents' sense of privacy.

Table 5-1: Comparative Analysis of Neighborhood Street Patterns in California Suburbs

	Gridiron (c. 1900)	Fragmented Parallel (c. 1950)	Warped Parallel (c. 1960)	Loops and Lollipops (c. 1970)	Lollipops on a Stick (c. 1980)
Street patterns					
Intersections					
Linear feet of streets	20,800	19,000	16,500	15,300	15,600
No. of Blocks	28	19	14	12	8
No. of Intersections	26	22	14	12	8
No. of Access points	19	10	7	6	4
No. of Loops & Cul-de-Sacs	0	1	2	8	24

Source: Southworth, M. and P. Owens. 1993. The Evolving Metropolis: Studies of Community, Neighborhood, and Street Form at the Urban Edge. *Journal of the American Planning Association* 59(3): 271-87, Figure 13.

The scaled, curvilinear, disconnected street network design philosophy recently has come under a good deal of scrutiny. Planning at the neighborhood level has resulted in

the creation of a set of physical barriers for movement across and between neighborhoods and different parts of the city. The separation of neighborhoods by arterials creates islands for local residents, in effect walling them off and making travel across neighborhood boundaries on foot or by bicycle dangerous (Untermann 1987). Further, as the number of automobiles has increased in society, the car has come to dominate even the internal residential streets, also to the detriment of bicyclists and pedestrians (Wolfe 1987).

The neo-traditional school of design, frequently referred to as 'New Urbanism', has recently challenged the design philosophy behind the disconnected street network. Neo-traditional design deliberately attempts to recreate those characteristics of the older sections of American cities and, simultaneously, reject those design principles that are dominant considerations in contemporary suburban development. Within the category of neo-traditional design, 'traditional neighborhood design' (TND) and 'neo-traditional development' (NTD) seek to harmonize architectural form, civic purpose, historic style, and street layout. The emphasis is on the creation of walkable, livable neighborhoods. Another variant, the 'pedestrian pocket' concept (also known as 'pedestrian oriented design' [POD] or 'transit oriented development' [TOD]), places less emphasis on controlling architectural and historic style but retains an emphasis on walkability and convenient access to shopping and transit. In all of these variants of neo-traditional design, the emphasis is on reducing the distances between trip origin and destination. Design schemes generally include the creation of gridlike street patterns but retain the focus on the neighborhood, including the acceptance of arterials at neighborhood boundaries (Southworth 1997).

5.4.2. Street Design

The second major way in which transportation systems influence walking and bicycling is through street design. Street design refers to the actual layout and design of individual streets themselves, including the street surface and the immediately adjacent off-street space. As with street networks, certain types of street designs will encourage walking and biking, while others will discourage it. Streets that particularly encourage walking and biking should have features that 'calms' traffic, usually by providing barriers to motorized vehicles in order to reduce speeds.

5.4.3 Perceiving the Street

Different users of the street have different perceptions of it. These perceptions influence travel behavior in subtle but important ways. Motorists and pedestrians perceive street design features differently, as do children and adults.

5.4.3.1 Perception of Motorists and Pedestrians

A study by Rapoport (1987) addressed the question of which perceptual qualities influence pedestrians. use of streets. Walking, Rapoport asserts, is a function of culture, the physical characteristics of a street, and the perceptual characteristics of different users of the street. Physical environments can either support or inhibit cultural predisposition to walking. Fundamental to an understanding of travel behavior is that drivers and pedestrians process information at different rates of speed. Because drivers usually are moving at much higher rates of speeds than pedestrians, their ability to process detail in the environment is much more limited. Driving is fast and demands concentration, leaving little time or capacity to appreciate the nuances of the environment. The ideal environment for fast-moving vehicles is thus one that is low in complexity. Conversely, pedestrian travel, being much slower, affords the walker the ability to appreciate environmental detail. To safely perform tasks at higher speeds, motorists require streets that are wide, low in visual detail, and contain no abrupt corners. Conversely, a rich pedestrian environment is one which maintains the pedestrian's visual and sensory attention; streets that are abrupt, irregular, complex, and changing will be more highly valued by a pedestrian (Table 5-2).

Table 5-2: Perceptual characteristics of streets suited to motorists and pedestrians

Motorists	Pedestrians
▪ Gradual curves and long views	▪ Sudden changes in direction and short views
▪ Regular rhythms	▪ Irregular rhythms
▪ Wide streets and spaces	▪ Narrow streets and spaces
▪ Symmetry of roadside objects	▪ Asymmetry of roadside objects
▪ Simple buildings	▪ Complex buildings
▪ Gradual modulation and small complexity range	▪ Sudden changes in modulation and large complexity range

Source: Rapoport (1987)

Street environments that are interesting from a car are boring to the pedestrian. Conversely, streets that are interesting to the pedestrian will in all likelihood be unmanageable at high speeds to the motorist. Thus, providing safety to pedestrians and bicyclist. These divergent user requirements lead Rapoport to believe that high-speed and pedestrian environments are incompatible.

5.4.3.2 Perception of Children

Moore (1987) desegregates the pedestrian category, distinguishing between the ways in which children's perceptions of streets vary from those of adults, and how these differences carry significant implications for street design. Children, Moore reports, have been shown to make substantial use of street spaces, not only for personal travel but, most importantly, for play. Streets are especially attractive play areas because of their high degree of accessibility to children of both genders and all ages. They are close enough to home to be used daily by children who live under parental time constraints. They are available as play areas between the end of the school day and dinnertime, between dinnertime and sundown, and between waking and family outings. Streets are important social areas for children, places that are easily accessible for meetings. They are also amongst the few environments children have that are relatively free of play rules (parents, for example, often constrain noise and types of play in enclosed areas).

Moore believes that the attractiveness of streets as playgrounds makes banning play on them useless. Playgrounds, designed by adults, usually fulfill only part of a child's play needs and are in most cases relatively far from home. Streets, in contrast, are not only more immediate than playgrounds but are often more interesting as well. The areas on and along streets offer a host of design features that make for creative play, including:

a. curbs;
b. gutters and storm drains;
c. sidewalks and sidewalk verges;
d. trees;
e. parked cars;
f. stoops;
g. fences and fence vegetation;
h. mail boxes;
i. patches of grass and dirt;
j. cement for hard-surface games;
k. low walls;
l. interesting people and vehicles.

The result of this is that it is unlikely that children will stop using streets for play, even when they are heavily trafficked (Moore 1987).

5.5 Separate Street for Pedestrians and Bicyclists

The third way in which transportation systems influence walking and bicycling is through the creation of physically separated biking and walking systems, a transportation systems dedicated solely to the pedestrian and bicyclist in heavily urbanized areas.

What street design criteria are believed to impact the propensity to walk and/or bike? A consensus seems to be emerging amongst practitioners and advocates that a handful of key variables influence the decision to walk or bike using public roads. Ewing (1997)

maintains that trip distance and route safety and attractiveness are the key variables. The Project for Public Spaces (1993) adds to this list pedestrian amenities or street furniture such as trees, telephones, bus stations, and sculpture, as well as the attractiveness of the trip destination. Untermann (1987) stresses route safety, which is a function of both traffic speed and the presence or absence of bicycling and pedestrian facilities. To slow vehicle speeds, he stresses roadway redesign, including the introduction of reduced road, driveway, and intersection radius widths and angled parking. To improve bicycle/pedestrian facilities it requires the sidewalks in residential areas, the creation of pedestrian islands to ease street crossings, and the more extensive use of pedestrian-friendly traffic signals. The Federal Highway Administration, USA, (FHWA, 1994) stresses similar themes. The FHWA summarizes the six design factors believed to have the greatest effect on bicycle use:

a. Traffic volume. Higher motor vehicle traffic volumes represent greater potential risk for cyclists and contribute to their sense of fear.

b. Average motor vehicle operating speed. The average operating speed is more important than the posted speed since the two frequently are not the same.

c. Traffic mix. The regular presence of trucks and buses inhibits cycling.

d. On-street parking. The presence of on-street parking increases the width needed in the adjacent travel or bike lane to accommodate bicycles.

e. Sight distance. A lack of sight distance sufficient to allow motorists to slow or avoid bicyclists when passing causes safety problems.

f. Number of intersections. Intersections create problems for cyclists and pedestrians, especially when bike lanes or separate paths are involved.

5.6 Urban Area Street Classification

Urban area roads may be classified in four categories according to their service function: local streets- minor and major, collector streets – minor and major, arterial roads, freeways (Chiara& Koppelman, 1984).

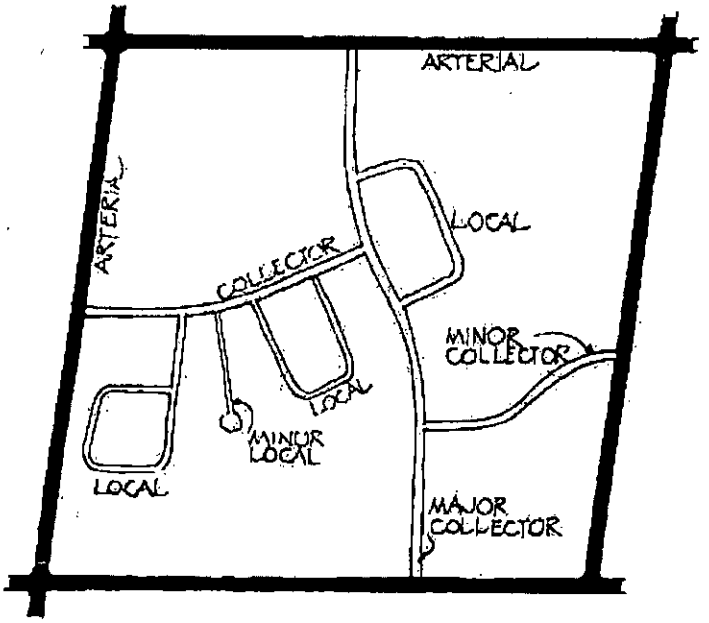


Fig 5.10 Street classification at the subdivision scale

5.6.1 Local Streets

Local streets are characterized by carrying at low speed limited traffic volume, local streets provide access to abutting property and parking on these streets is usually permitted. The main function of these streets is to link the collector/ arterial system and the low- density residential development. Also, a few business and industrial streets can be considered in this class. However because of the potential for increased development along these streets should be designed as collectors.

5.6.2 Collector Streets

Collector streets are the highest order of residential street. Designed to carry traffic volumes of 3000 ADT (average daily trips), a collector generally connects approximately 150 dwelling units each or connects a neighborhood and an activity area.

No residential lots front directly onto these streets, and parking on them are usually prohibited.

There are four types of collector streets: residential, commercial, industrial, and neighborhood.

5.6.2.1 Residential Collector Streets

Residential collectors are designed to handle traffic volume of up to 2000 vehicles per day, while providing access to abutting property and on- street parking. Such streets are necessary adjacent to multifamily residential developments, schools and local retail and public facilities. They are required also when more than fifty dwelling units or residential lots must utilize the streets for access to the collector/ arterial street system. Major entry streets to a residential community normally will be set up as residential collector streets. The right- of -way should be 60 feet wide and the pavement 44 feet wide.

5.6.2.2 Industrial/ Commercial Collector Streets

A Commercial or industrial collector is one serving as principal access to a commercial development or an industrial site. The length of such a street should not exceed 2 miles. Direct residential frontage should be discouraged to prevent a conflict between residential and commercial traffic. Multifamily development can ample off- street parking is provided and access is limited. For industrial streets, the right-of-way and pavement widths are 80 and 64 feet, respectively and for commercial streets, 60 and 44 feet, respectively.

5.6.2.3 Neighborhood Collector Streets

A neighborhood collector street is designed to traverse distances from ½ to 2 miles, to serve a variety of land uses, and to handle traffic volume of up to 8000 vehicles per day. On street parking usually is prohibited or restricted on neighborhood collectors; access to abutting property is limited, and uses may include multifamily dwelling units; schools; and retail, office and community service facilities. Streets in a residential area

serving more than 200 dwelling units should be designed as neighborhood collector streets, The right-of-way should be 10 feet wide and the pavement 44 feet wide. At major intersections, turn lane may be required in addition to four through lanes. Where turn lanes are required, pavement must be 64 feet wide with an 80 feet wide right-of-way.

5.7 Residential Streets

Residential streets usually have four classifications:

5.7.1 Place

A place is a short street cul-de-sac, or court, whose primary function is to conduct traffic to and from dwelling units to other streets within the neighborhood. Usually, a place is dead-end, with an ADT of less than 100 and and with limited on-street parking.

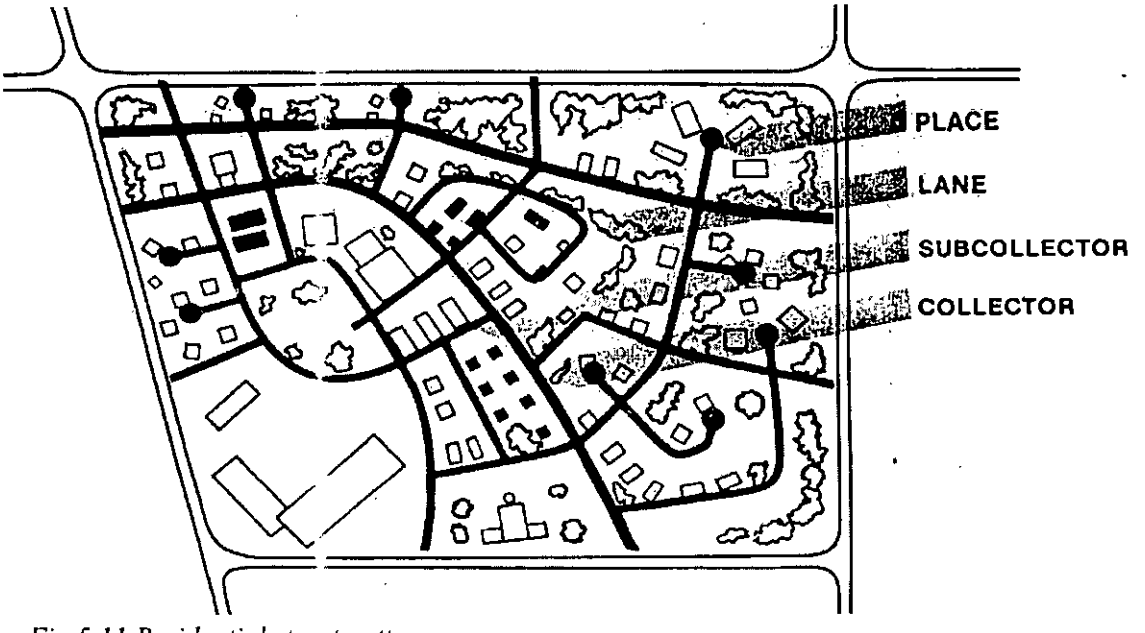


Fig.5.11 Residential street patterns
Source: Reproduced from Time-Saver Standards for Site Planning, Chiara & Koppelman, 1984.

5.7.2 Lane

A lane is similar to a place in design and function, the primary difference being that a lane occasionally branches to connect two or three other lanes or places. Like a place, a lane does not serve thorough traffic, but its ADT range (75 to 350) is higher than that of a place.

5.7.3 Subcollector

A subcollector with an ADT ranging between 200 and 1000, provides access to places and lanes and conducts traffic to an activity center or to a street of higher classification. The subcollector may be a loop connecting one collector or arterial street at two points, or it may be a fairly straight street conducting traffic between collector and/ or arterial streets.

5.7.4 Collector

A collector conducts traffic between arterial street and or activity centers. It is a principal traffic artery within residential area and carries a relatively high ADT, ranging between 800 and 2000 vehicles.

5.7.5 Residential Access Roads

Residential access roads are intended to carry the least amount of traffic at low speeds while providing immediate access to homes. Designed for 200 ADT, residential access road may permit perking if twenty to twenty-five dwellings are served and front on the street. The standard criteria for subcollector and residential access roads do not differ.

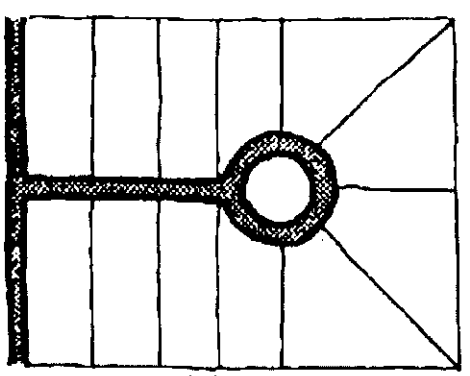


Fig. 5.12 Cul-de-sac

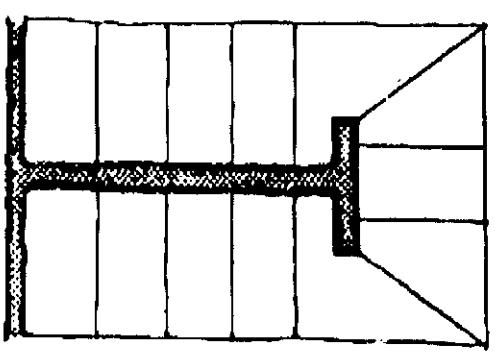


Fig. 5.13 T-type turnabout

5.8 Culs-de-sac

Culs-de-sac, or turnarounds, are a type of access road designed to permit free turning for the largest service vehicles regularly servicing a neighborhood, Fig 5.12. A number of

alternatives to culs-de-sac are possible, depending on the lot sizes, configurations, and total number of lots served by the road. The T-type turnaround shown in Fig.5.13 requires less pavement area space than a cul-de-sac but it also usually serves fewer lots.

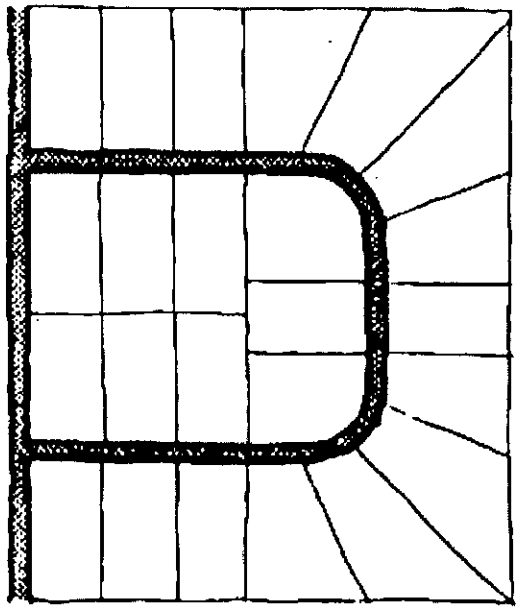


Fig. 5.14 Loop road

Another alternative is the loop road, which is used either when more lots are to be served or when a conventional cul-de-sac does not fit the topography. A smaller loop road can simply have a central green space with lots surrounding it, Fig.5.14. shows a larger loop street with lots in the central space. Cul-de-sac, T-type turn around or loop road provide quiet environment in the neighborhood as well as for the pedestrians. As this type of access roads are generally used only by the residents of the adjacent plots and thus traffic volume is less, which provides opportunity for the use of access roads as play area by the children and it also creates the environment for social interaction.

The cul-de-sac possesses the following advantages:

- It provides quiet sites for homes, by reducing the noise and danger from traffic to a minimum.
- It reduces the dust nuisance to a minimum.
- It is economical in pavement construction.
- It facilitates development where blocks are irregularly shaped.

The cul-de-sac can be used to best advantage on level or nearly level sites, but is not appropriate on hilly sites. If it is employed on undulating land, care should be taken to see that the blind end is uphill and that the main axis runs roughly normal to the contours. This facilitates drainage and gives the best to appearance when houses are erected.

For convenience, the length of a cul-de-sac should not exceed about 350 feet. Longer lengths when used, and sometimes shorter lengths, are usually provided with a footway leading into the next street. It must be possible to turn vehicles at the end of a cul-de-sac, and for this purpose a bulbous end is often constructed.

5.9 Intersections

Intersections are important physical part of the street for both pedestrians and bicyclists

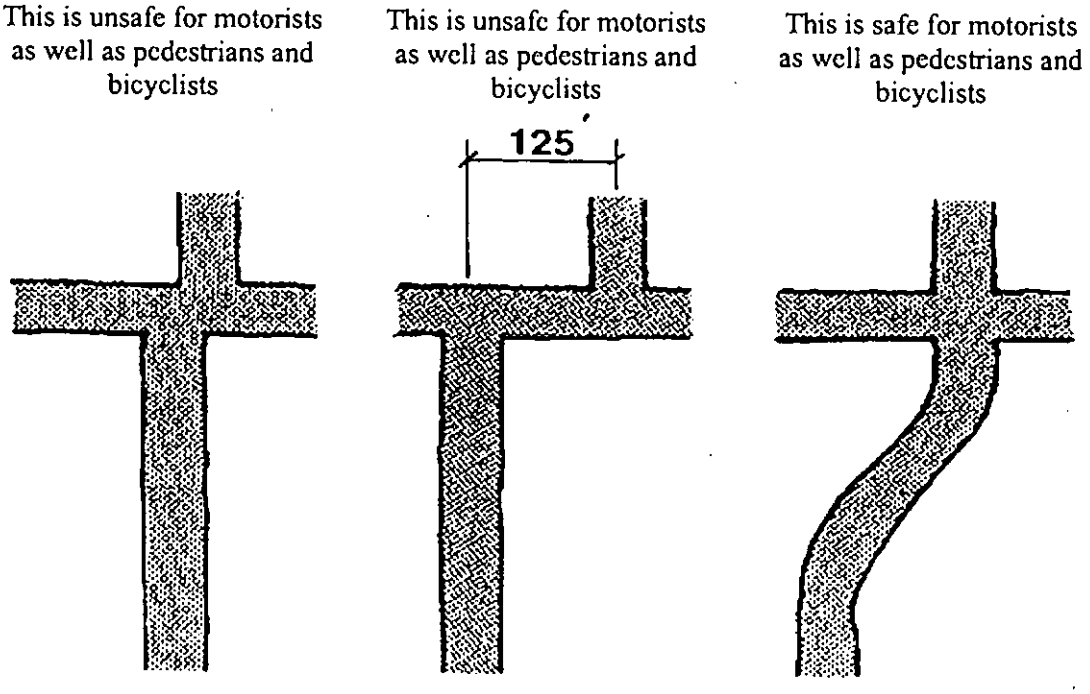


Fig. 5.15 Intersection spacing

Source: Reproduced from Time-Saver Standards for Site Planning, Chiara & Koppelman, 1984.

and also for automobile users. In terms of physical design criteria intersections should be carefully engineered according to design speeds, visibility, and terrain requirements.

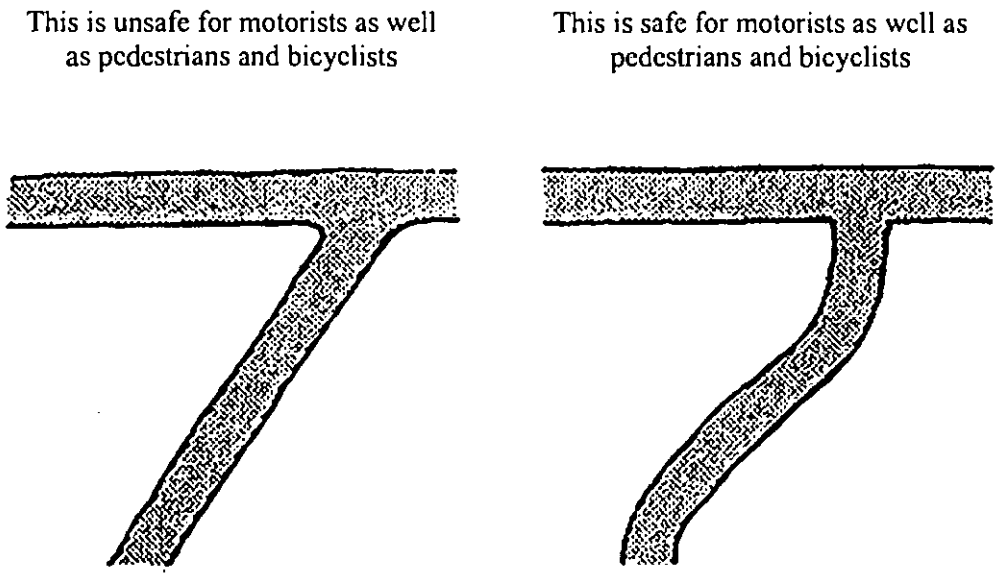


Fig.5.16 Intersection angles

Source: Reproduced from Time-Saver Standards for Site Planning, Chiara & Koppelman, 1984.

In order to prevent dangerous jogs and turning movements, intersections are required to be either aligned directly opposite one another or offset by a minimum distance. The 125-feet (38 meter) offset, shown in Figure 5.15, is considered a minimum by some sources; adjustments may be required to suit local conditions. It is also unacceptable to allow streets to intersect at a narrow angle. As shown in Figure 5.16 streets should intersect at a 90-degree angle for a minimum of 50 feet (15 meters) from the intersection (Chiara& Koppelman, 1984). This will increase visibility between pedestrians, bicyclists as well as motorists and thus increase safety of street users.

Energy- Efficient strategies:

The total number of girded intersections should be reduced by using street layouts that arranged in hierarchies.

When appropriate, properly designed jogged intersections should be used to discourage through traffic.

5.10 Driveways

For the safety of pedestrians, bicyclists as well as motorists, proper location of driveways and setback from the subcollectors streets are important to consider. Driveways are typically 10 to 20 feet (3 to 6 meter) wide. Usually a setback distance to 40 feet (12 meters) between an intersection and a driveway is established as a safety factor designed to avoid traffic conflicts at intersections.

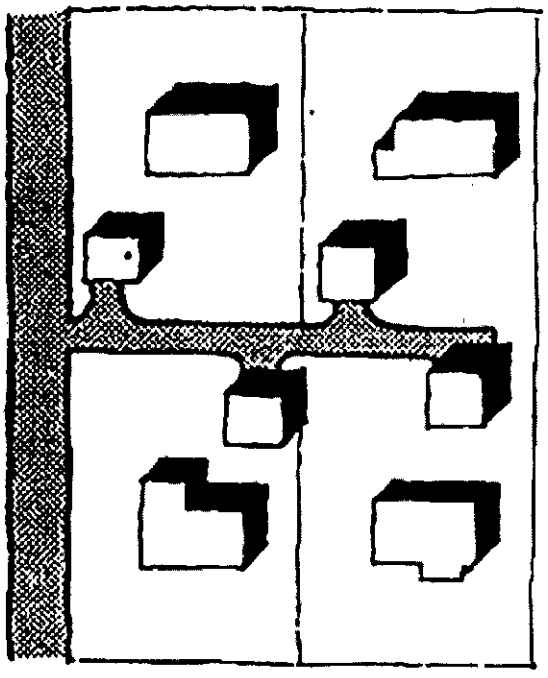


Fig. 5.17 Common driveway

Energy- Efficient strategies:

Shared driveway access should be promoted where possible to reduce the total paved area and the numbers of intersections with subcollectors, and thus reduce the conflicts between pedestrian and vehicles. Although a maximum of four units per driveway has been recommended by the Bucks Country Plan as shown Figure 5.17, utilities could serve six to eight units adequately. Narrow driveways are recommended 10 feet (3 meters) for one house, 16 feet (4.8 meters) for multiple- house service.

5.11 Street Patterns

Street pattern in the superblock is one of the controlling factors, which determines the traffic flow within the superblock. Simple rectangular grid pattern allows the unwanted or thorough traffic within the superblock and thus increase the conflicts between pedestrians or bicyclists and motorists.

By modifying the rectangular grid pattern it is possible to reduce unwanted thorough traffic penetration. Penetration of moving vehicle within the residential area is bringing its own peculiar penalties of accidents, anxiety, intimidation by large and fast vehicles that are out of scale with the surroundings, noise, fumes, vibrations, dirt and visual

intrusion on a vast scale. By the careful design of the neighborhoods some of the nuisances may be eliminated and thorough traffic may be reduced considerably in some of the neighborhoods (Nabi, 1971).

5.11.1 Simple Rectangular Grid Pattern

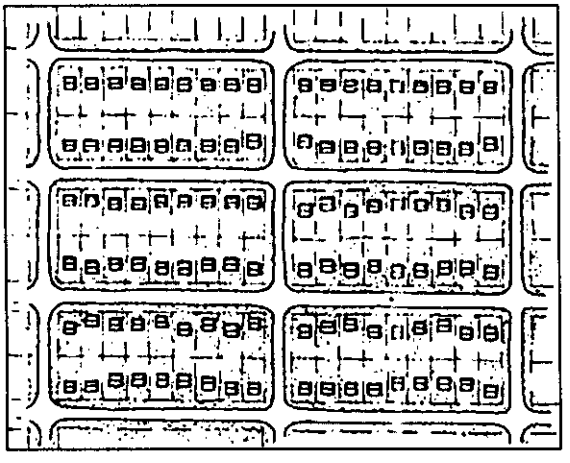


Fig.5.18 Typical grid pattern

It is the simplest layout of streets in the superblock (Fig 5.18). The simple rectilinear grid pattern used too frequently in the past. Rectilinear grids are basically suited to flat land. This simplest street pattern converges thorough traffic and thus increases conflicts between non-motorized and motorized transport with in the neighborhood. Modifying the simple grid pattern as shown in Fig. 5.19 and Fig. 5.20 may solve this problem.

5.11.2 Modified Grid

It is possible to avoid the monotony of the grid system (Fig.5.18) by modifying the street pattern. A few simple street alterations can provide interesting grouping possibilities that eliminate the tediousness of the straight street and provides green areas within the groups.

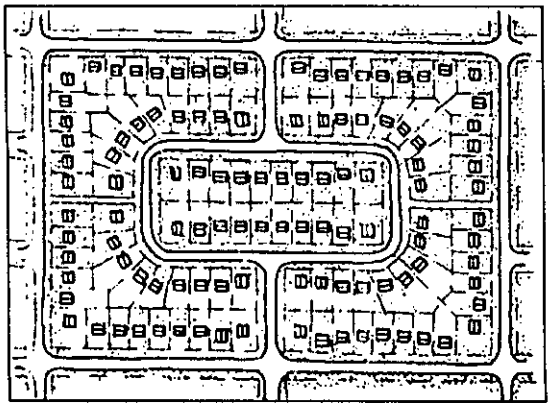


Fig.5.19 Modified grid

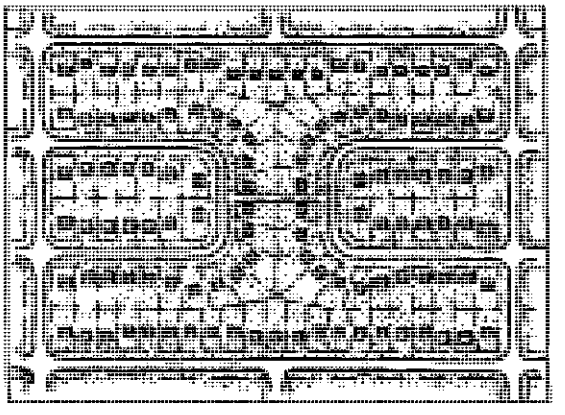


Fig.5.20 Modified grid

Fig.5.19 shows the arrangement of street with a central loop, which creates interesting grouping possibilities and relieves the traffic load by setting up a resistance to thorough traffic.

Fig.5.20 suggests another design for the same six-block area of a typical grid pattern. In this case, instead of a central loop, two outside loops have been formed.

5.12 Road Way and Location of Shopping Facilities

Shopping facilities are among the essential components of a well-organized neighborhood and careful consideration should be given to this aspect of planning in regard to the number and type of shops to be provided, their location in relation to the homes and the general sitting and setting of the shopping centers.

The placing of shops along main thoroughfares, as in many existing suburbs, inevitable results in a high traffic accident rate. In addition, the traffic congestion which occurs, both vehicular and pedestrian, eventually in some cases reaches a point where it reacts to the prejudice of the shopkeeper, as shoppers seek safer and less crowded centers. This process speedily leads to a deterioration of the shopping area, and some of the shops become superfluous and cease to be kept in repair.

In locating a shopping area, convenient access should be the first consideration. The grouping of shops round a center, near but not main traffic arteries, is very much to be preferred to the linear development, and is a normal feature of the well planned neighborhood. As with local parks, shops should be within easy walking distance from all homes which they serve. Shopping centers placed at one-mile intervals bring them within about half a mile of all homes. A somewhat closer spacing may, in some cases, be justified and in addition to the shops at the neighborhood center, smaller groups of shops for day- to- day needs may be disposed at suitable points elsewhere in the neighborhood.

Grouping and general layout of shops offers scope to the town planner and architect. Attractive results can be realized by various groupings, one popular arrangement being

to plan shops round a garden where children can play while their elders do the shopping. In such a case there is no roadway in front of the shops, vehicular access being only from the rear, and special parking areas, recessed from the adjacent street, are provided for shoppers.

5.13 Pedestrian Oriented Site Design

There is widespread belief that pedestrian travel is influenced by the characteristics of buildings and other site-level design attributes. Pedestrian-oriented site design is an integral component of the neo-traditional design philosophy. Neo-traditionalists wish to place the pedestrian at the very center of the neighborhoods and communities they seek to create. Neo-traditional communities foster walking through relatively high levels of residential density, a mixture of commercial and residential uses, a narrow, highly connected street network, and, above all, a design philosophy that is inviting and interesting to the pedestrian. In the neo-traditionalists' view, the incorporation of short building setbacks, distinctive, region-specific architecture, and attractive open spaces such as village greens in neighborhood designs are necessary components of a successful design strategy to recreate livable, walkable communities in urban areas (Berman 1996; Corbett and Velasquez 1994).

In 1991, a group of noted architects including Peter Calthorpe, Andres Duany, and Elizabeth Plater-Zyberk assembled a set of design principles to articulate the neo-traditional design philosophy. These principles include the following (Corbett and Velasquez, 1994):

1. All planning should be in the form of complete and integrated communities containing housing, shops, work places, schools, parks and civic facilities essential to the daily life of the residents.
2. Community size should be designed so that housing, jobs, daily needs and other activities are within easy walking distance of each other.
3. As many activities as possible should be located within easy walking distance of transit stops.
4. The community should have a center focus that combines commercial, civic, cultural and recreational users.

5. The community should contain an ample supply of specialized open space in the form of squares, greens and parks whose frequent use is encouraged through placement and design.
6. Public spaces should be designed to encourage the attention and presence of people at all hours of the day and night.
7. Streets, pedestrian paths and bike paths should contribute to a system of fully connected and interesting routes to all destinations. Their design should encourage pedestrian and bicycle use by being small and spatially defined by buildings, trees and lighting; and by discouraging high speed traffic.
8. Materials and methods of construction should be specific to the region, exhibiting continuity of history and culture and compatibility with the climate to encourage the development of local character and community identity.

5.14 Barrier Free Site Planning for Handicapped

Everyone should have the right of access to services and facilities. To ensure all people to enjoy such access it requires pedestrian facilities used by general public to be planned, designed, constructed, and maintained for use by a wide range of people, including people with disabilities.

No material on site planning and the pedestrian facility would be complete without an overview of the guidelines necessary to provide access for the handicapped. It is important to recognize the facts that the built environment had, create unnecessary barriers, which limited the accessibility of the physically handicapped persons to public and private facilities.

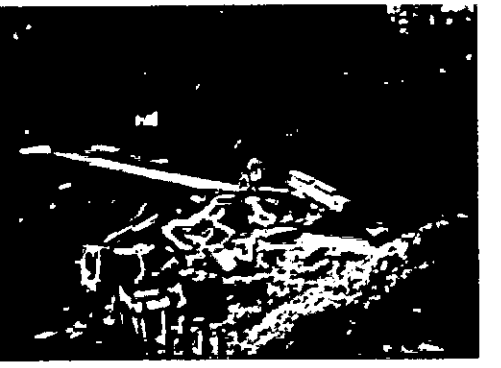
The obvious objective in very site planning should be to develop the site, paths, and walkways in such as way as to allow the greatest diversity of people access to buildings and facilities, safely and unhindered. Most common issues such as topographical changes, and alignment, lighting and signs can also harbinger problems for the physically impaired persons. There should have code addressing paths, walkways, ramps, and signs design criteria associated with handicapped access. Public sidewalk and street crossing must accommodate people with disabilities so they may use the pedestrian routes that connect buildings, facilities, and transportations modes.

CHAPTER 6

CASE STUDY AND ANALYSIS: DHANMONDI AND KALABAGAN AREA

Image 6.1: Dhanmondi and Kalabagan Residential Areas

Photo shows existing condition



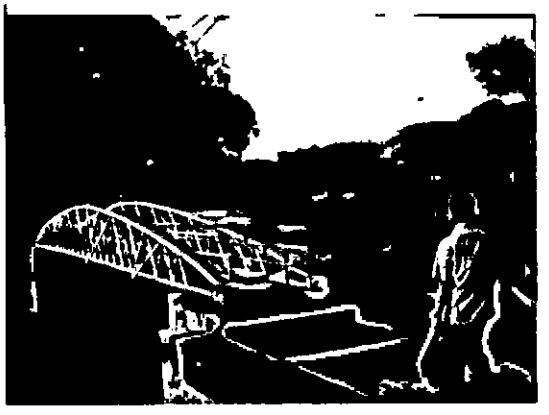
Existing walkway to cross the lake, it reduces the walking distance from west to east and vice versa

This Photo shows pedestrian and vehicular access from east to west and vice versa

Bridge that connects east and west part of the area; Vehicular and Pedestrian access

Bridge that connects east and west part of the area; Vehicular and Pedestrian access

This Photo shows pedestrian access from east to west and vice versa



CHAPTER 6

CASE STUDY AND ANALYSIS: DHANMONDI AND KALABAGAN AREA

6.1 Introduction

Previous two chapters –Chapter 4 and Chapter 5 – elaborately described the standards or practiced planning, design aspects and environmental conditions, facilities required for pedestrians and bicyclists. Based on the aspects discussed in previous two chapters, problems and prospects for the accommodation of pedestrians and bicyclists in Dhanmondi and Kalabagan areas are carefully examined and analyzed in this chapter. For the study purpose demographic, social, economic conditions of the residents as well as their views and opinions regarding walking and biking are also considered and analyzed. This chapter also described the present walking and biking network system and conditions with the aim of probable recommendations for the solutions of the problems.

The purpose of this research was to study the existing environment for pedestrian and bicyclists in the residential neighborhoods of Dhaka and to offer recommendations based on analysis of existing conditions. By using both inventory and public opinion results proposed recommendations are made.

The study was designed and administered to produce statistically valid data. Study is needed to know the primary strengths and opportunities as well as the problems and constraints in the existing conditions for bicyclists and pedestrians. A survey was conducted to help gauge the public's interest in supporting the need for accommodating pedestrians and bicyclists. It has undergone several phases of data collection in order to develop this thesis and recommendation for bicycle and pedestrian environment improvements. For the research a neighborhood wide inventory of all roads, and a random questionnaire survey conducted to obtain additional insight on the public's perception of bicycle and pedestrian needs. In addition to these tasks, talked with key people from organizations involved in planning. In comparison with the standards

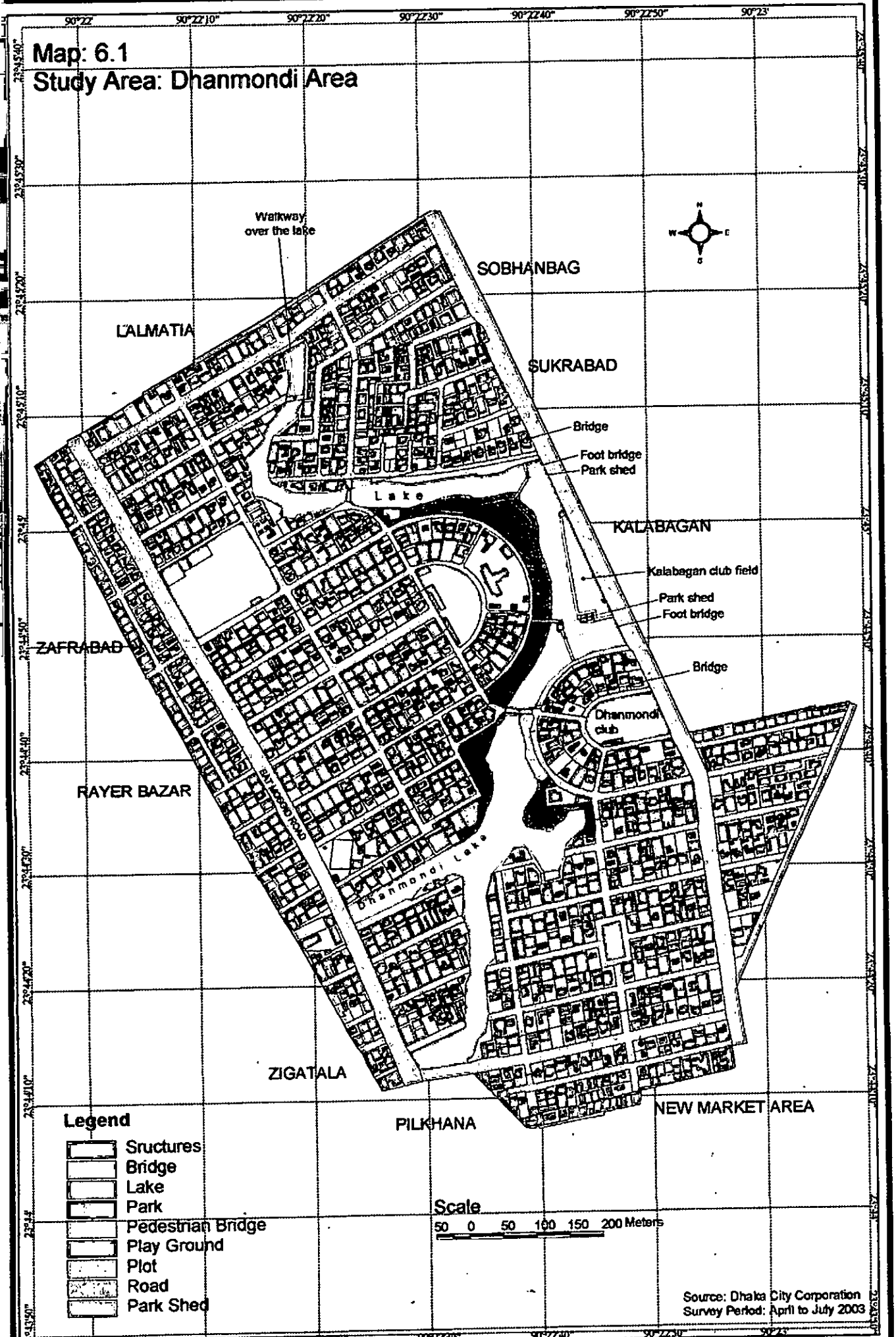
required or followed for the planning and designing the (walk able) walking and biking friendly environment it is found that the neighborhoods of Dhaka do not have walking and bicycle friendly environment.

6.2 Physical Characteristics of the Areas

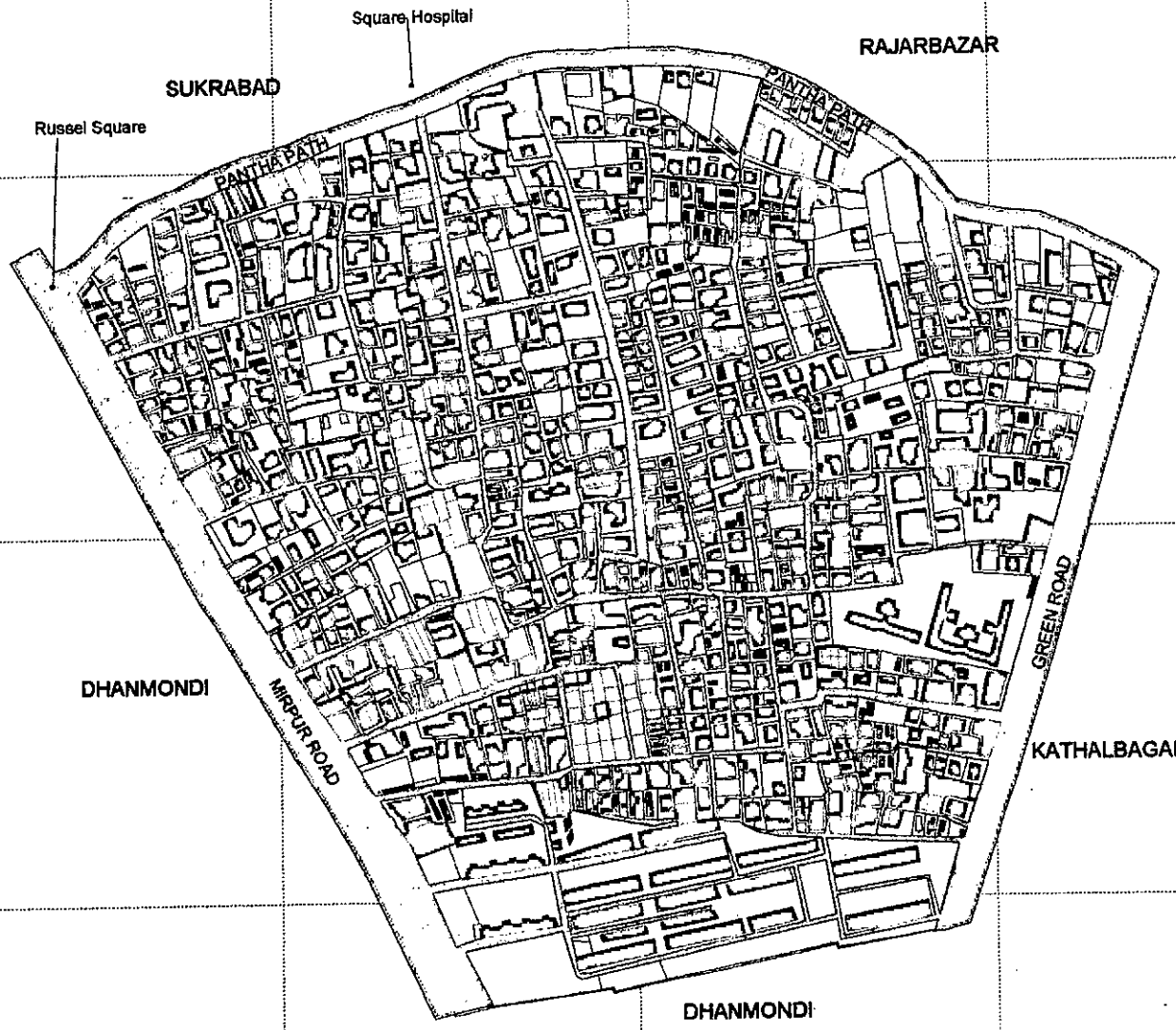
The study was conducted on two neighborhoods, one planned (Dhanmondi) and the other (Kalabagan) unplanned. The study areas Kalabagan and Dhanmondi are located besides the arterial Mirpur Road face to face. Kalabagan is located between Kathalbagan on the east and Dhanmondi on the west, Sukrabad and Rajarbazar on the

Photo 6.1 Part of Dhanmondi Area –North-West Direction from Near Russel Square

north and a small part of Dhanmondi on the south. Dhanmondi is located basically between Kalabagan on the east and Zigatola and West Dhanmondi on the west, Lalmatia on the north and Dhaka College area on the south. Kalabagan falls within the jurisdiction of the Dhaka City Corporation (DCC), Ward No.51 and Rajdhani Unnayan Katripakha (RAJUK). In terms of police station, Kalabagan and Dhanmondi are within the Mohammadpur and Dhanmondi police station area respectively. Dhanmondi is with in the jurisdiction of DCC Ward no.49.


Map: 6.1
Study Area: Dhanmondi Area
Walkway over the lake
SOBHANBAG
LALMATIA
SUKRABAD
Bridge
Foot bridge
Park shed
Lake
KALABAGAN
Kalabagan club field
Park shed
Foot bridge
ZAFRABAD
Bridge
Dhanmondi club
RAYER BAZAR
BIT ROAD
Dhanmondi Lake
ZIGATALA
PILKHANA
NEW MARKET AREA
Legend
Sructures
Bridge
Lake
Park
Pedestrian Bridge
Play Ground
Plot
Road
Park Shed
Scale
50 0 50 100 150 200 Meters
Source: Dhaka City Corporation
Survey Period: April to July 2003

Map 6.2
Study Area: Kalabagan



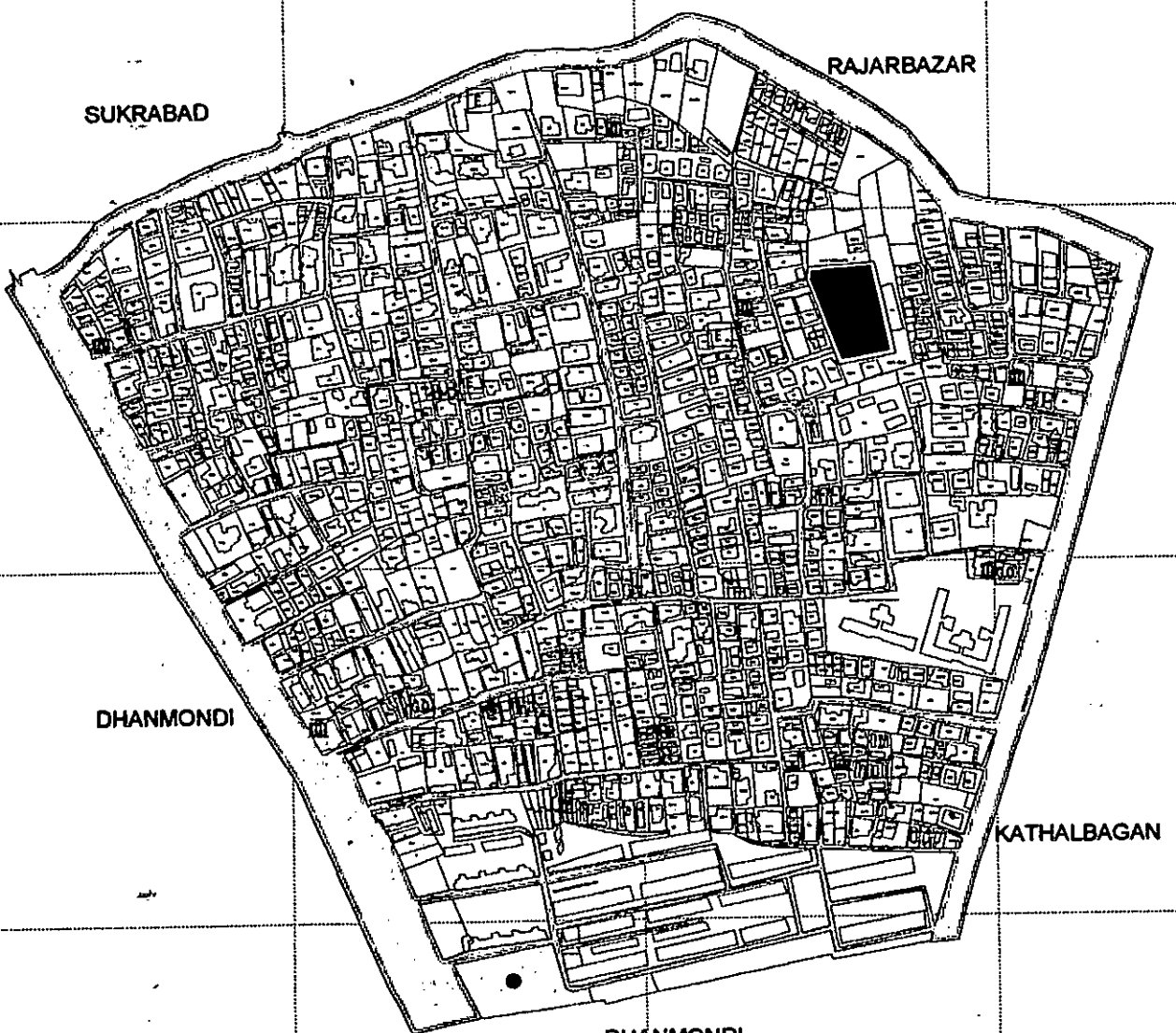
N
W E
S

Legend

- Street Network
- Build-up Area
- Build Form

Source: Dhaka City Corporation
Survey Period: March to May, 1999

Map 6.3
Height of Structures: Kalabagan Residential Area

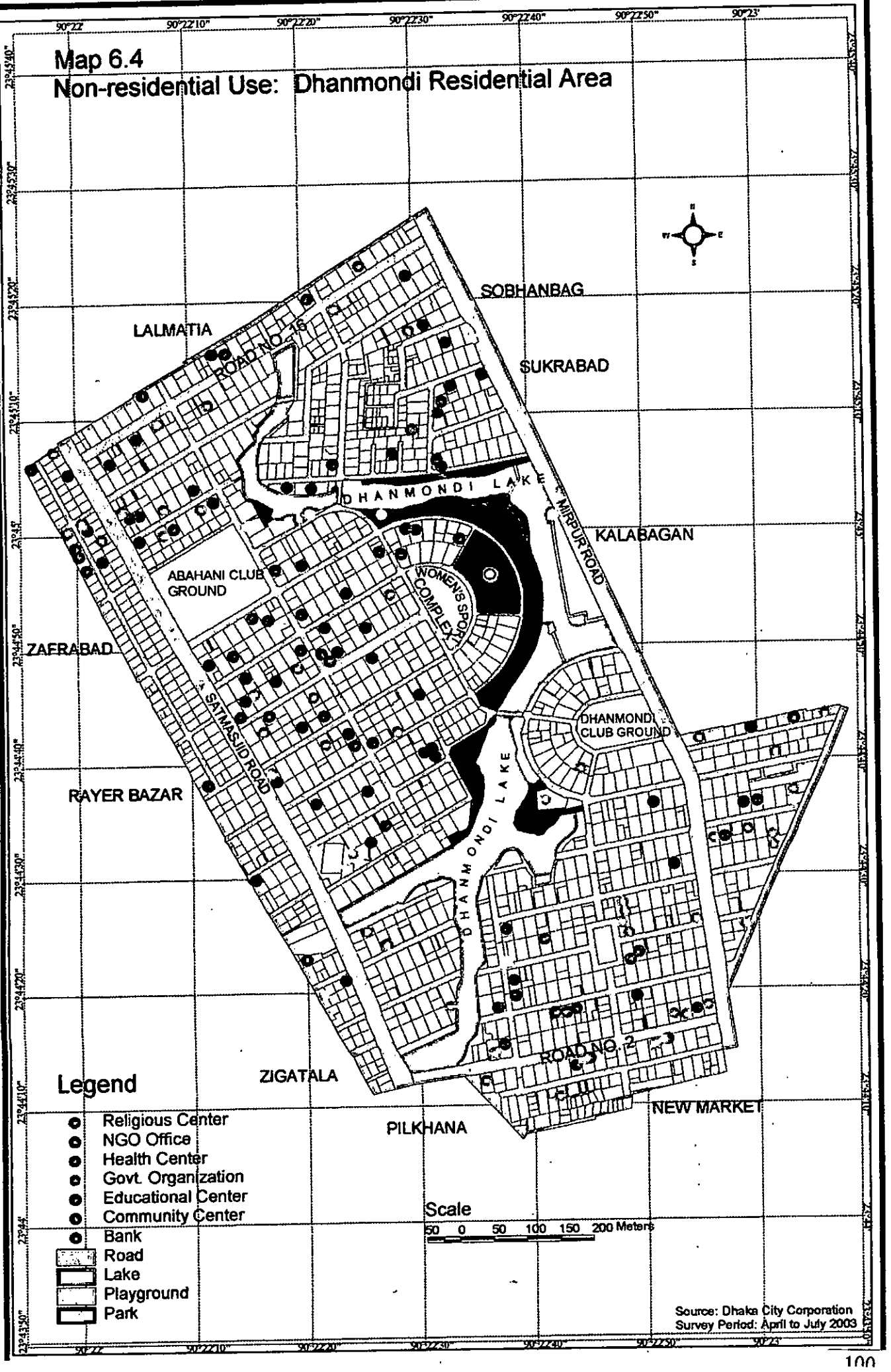


LEGEND

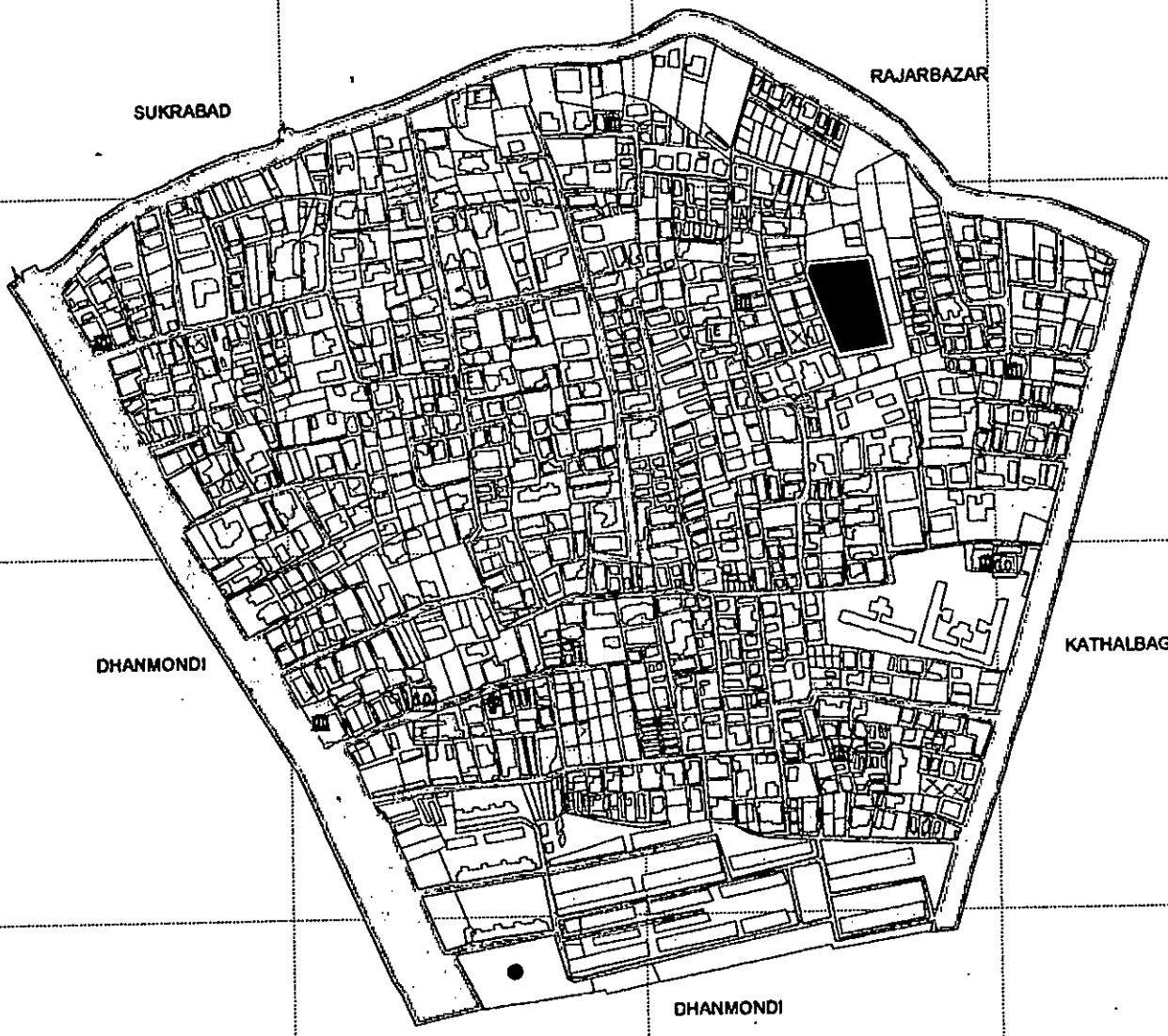
- Plot Boundary
- Road
- One Storeyed
- Two Storeyed
- Three Storeyed
- Four Storeyed
- Five Storeyed
- Six Storeyed
- Above Seven Storeyed
- Pond
- Open
- Educational Institute
- Hospital
- Mosque
- Club
- Dustbin
- Community Centre
- Play Ground / Park
- GO Govt. Office
- NGO Non Govt. Organization
- Petrol Pump

N
W E
S

Source: Dhaka City Corporation
Survey Period: March to May, 1999


Map 6.4
Non-residential Use: Dhanmondi Residential Area
90°22'
90°22'10"
90°22'20"
90°22'30"
90°22'40"
90°22'50"
90°23'
23°45'40"
23°45'30"
23°45'20"
23°45'10"
23°45'
23°44'50"
23°44'40"
23°44'30"
23°44'20"
23°44'10"
23°44'
SOBHANBAG
LALMATIA
ROAD NO. 16
SUKRABAD
DHANMONDI LAKE
MIRPUR ROAD
KALABAGAN
ABAHANI CLUB GROUND
WOMEN'S SPORT COMPLEX
ZAFRABAD
SATMASJID ROAD
DHANMONDI CLUB GROUND
DHANMONDI LAKE
RAYER BAZAR
ROAD NO. 2
ZIGATALA
NEW MARKET
PILKHANA
Legend
Religious Center
NGO Office
Health Center
Govt. Organization
Educational Center
Community Center
Bank
Road
Lake
Playground
Park
Scale
50 0 50 100 150 200 Meters
Source: Dhaka City Corporation
Survey Period: April to July 2003

Map 6.5
Landuse: Kalabagan Residential Area



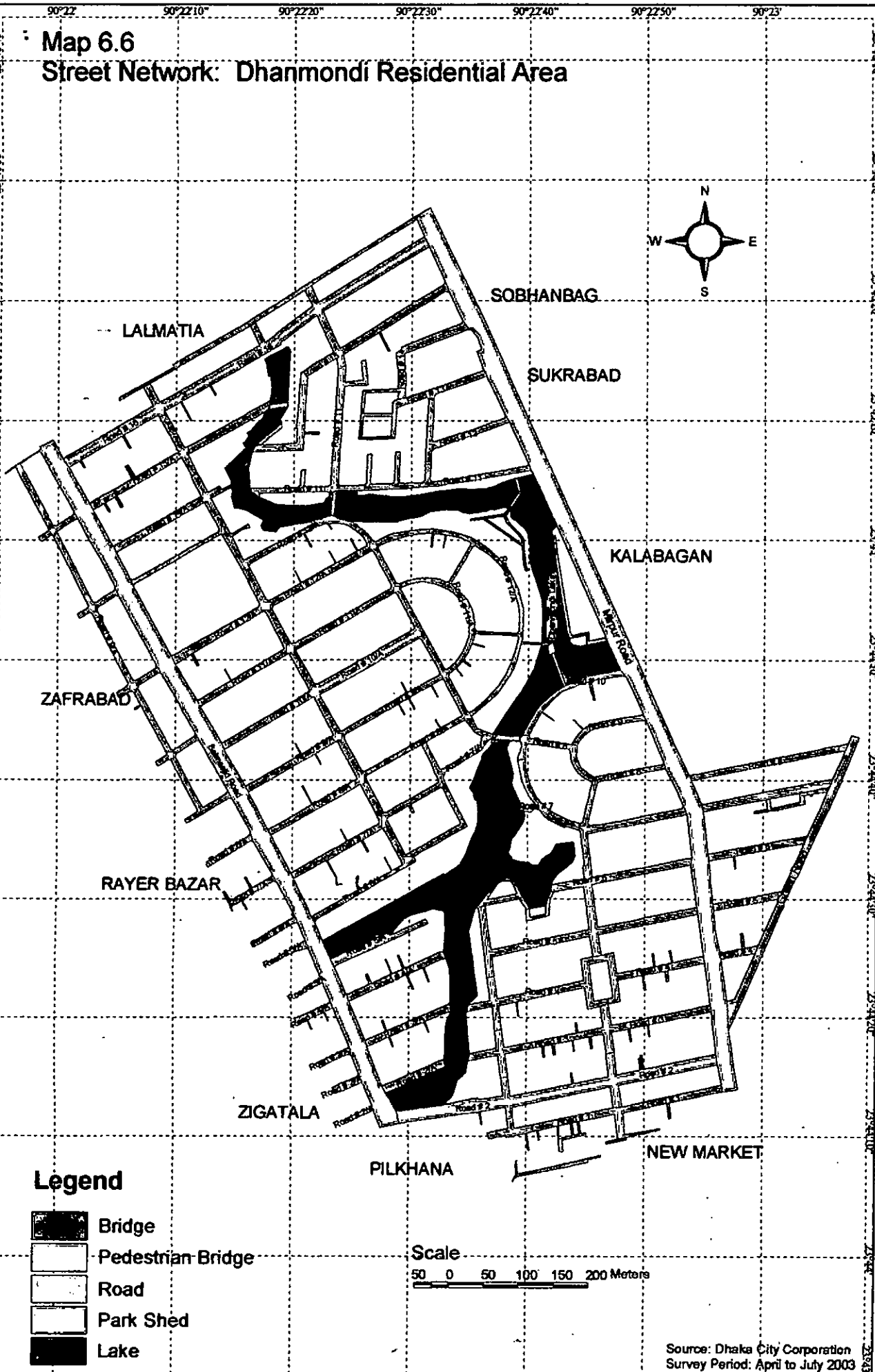
LEGEND

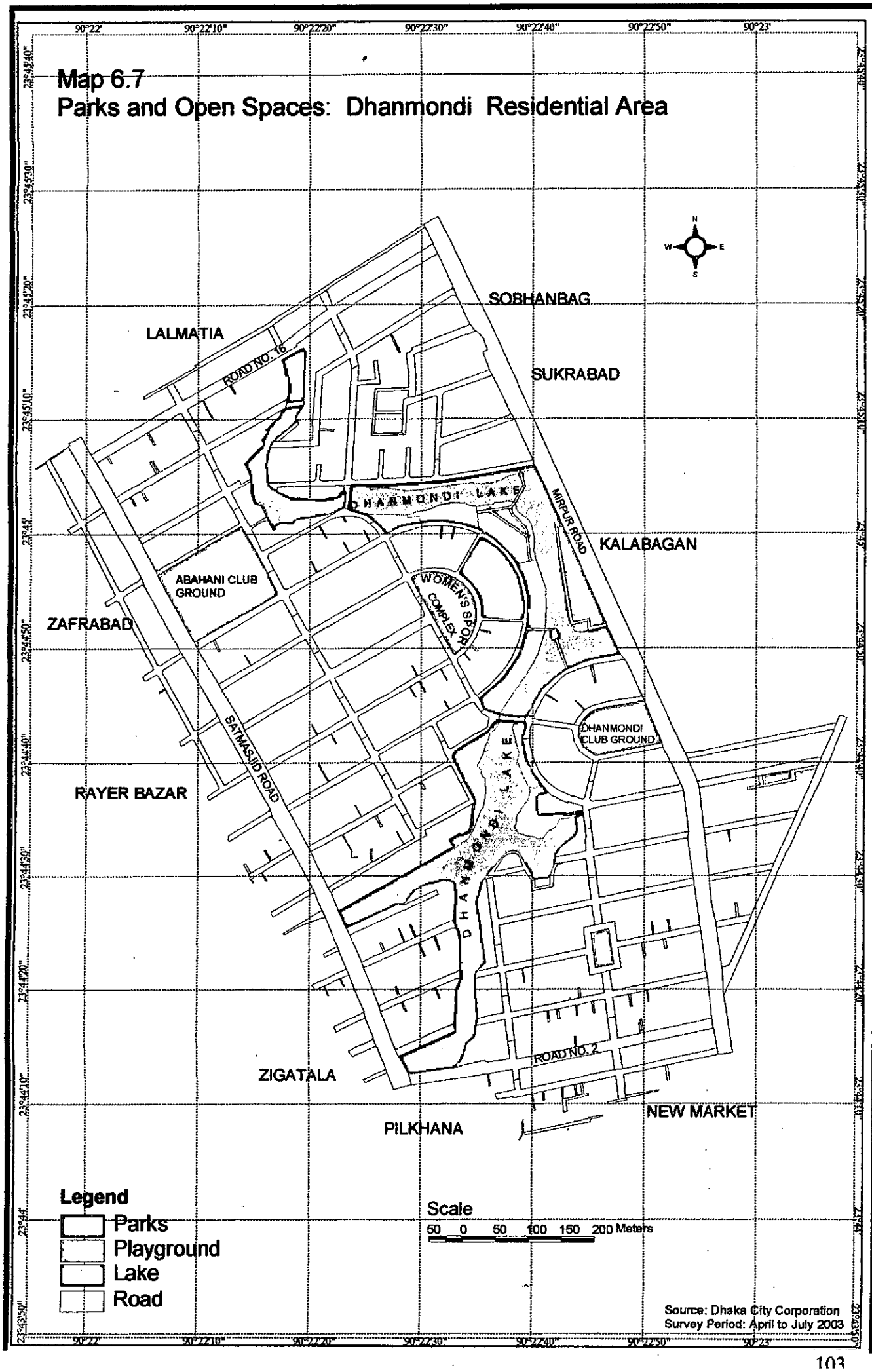
- Plot Boundary
- Road
- Pond
- Commercial
- Commercial & Residential
- Residential
- Open
- Slum
- Community Use
- Educational Institute
- Hospital
- Mosque
- Club
- Play Ground / Park
- Govt. Office
- Non Govt. Organization
- Post Office
- Petrol Pump

N
W E
S

Source: Dhaka City Corporation
Survey Period: March to May, 1999

Map 6.6
Street Network: Dhanmondi Residential Area




Map 6.7
Parks and Open Spaces: Dhanmondi Residential Area
90°22'
90°22'10"
90°22'20"
90°22'30"
90°22'40"
90°22'50"
90°23'
23°45'40"
23°45'30"
23°45'20"
23°45'10"
23°45'
23°44'50"
23°44'40"
23°44'30"
23°44'20"
23°44'10"
23°44'
23°43'50"
N
W
E
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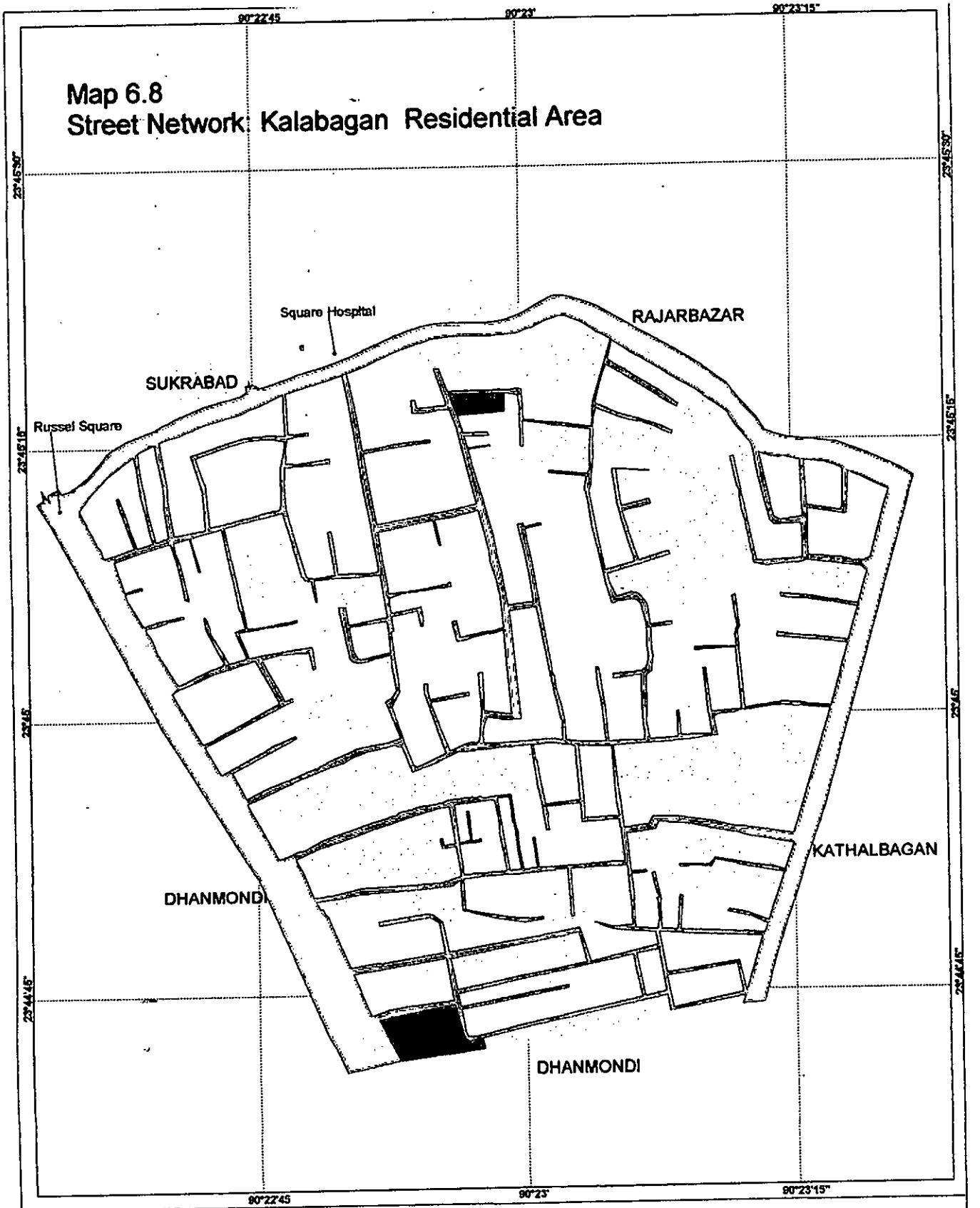
SOBHANBAG
LALMATIA
ROAD NO. 16
SUKRABAD
DHANMONDI LAKE
MIRPUR ROAD
KALABAGAN
ABAHANI CLUB GROUND
WOMEN'S SPORT COMPLEX
ZAFRABAD
SATMASJID ROAD
DHANMONDI CLUB GROUND
DHANMONDI LAKE
RAYER BAZAR
ROAD NO. 2
ZIGATALA
NEW MARKET
PILKHANA
Legend
Parks
Playground
Lake
Road
Scale
50 0 50 100 150 200 Meters
Source: Dhaka City Corporation
Survey Period: April to July 2003

Map 6.8
Street Network: Kalabagan Residential Area



Source: Dhaka City Corporation
Survey Period: March to May, 1999

The area experiences a tropical humid climate with a mean annual rainfall of 74 inches and an annual mean temperature of 73° F. In general the topography of the area is flat.

6.3 Parks and Open Spaces

Though Dhanmondi is a planned residential area, the area has lack of sufficient parks and open spaces. In original plan there were provisions for open spaces and parks for the use of residents here, but in later years those spaces were devoted to use by specific institutions or organizations. For example Abahani Club Ltd. playground and Women Sports Complex ground are not for the use of general public at present. In Dhanmondi only lake side areas are accessible for general people.

In Kalabagan area the situation is worse, as the area is developed in an organic way. The area developed by the individual plot owners there has no spaces for common use. Except the staff quarter playground, there is no open space for the general people in Kalabagan area. A small chunk of open land exists near the Panthapath road inside Kalabagan area, local community uses this open space as playground (Photo 6.2a).

Photo 6.2a A small open space used as play area by the local residence, Lakecircus, Kalabagan

6.4 Development of Dhanmondi Residential Area

Dhanmondi residential area was planned in the style of site and service scheme with a regular system of roads to provide residential accommodation for the high and higher middle-income groups during the early 1950's. Dhanmondi area has gridiron pattern of street network. The major thoroughfares passing through Dhanmondi are the Mirpur

Road and Shatmasjid Road. To form a gridiron pattern of street network a number of access roads emerge from both sides of the thoroughfares. Total project area was subdivided into 1000 plots. The size of the plots was originally ranging from 15 to 33 decimal (Hashem, 2001). According to the original plan the building height was restricted up to three storied. There was no provision for community facilities such as school, retail shops for daily necessary goods, health care facilities etc., that are necessary requirements for a planned neighborhood. The planning concept of Dhanmondi Residential Area was such that community facilities would be provided from outside the residential area. For example, New Market at Azimpur was considered as the facility meeting the requirements of the residents of Dhanmondi (Nawaz, Islam, Hossain, 2004). The original plan is shown in Map 6.9. Monotony of the grid iron pattern is minimized by the shape of the lake which was originally a *khal* or water canal. Public Works Department, Government of the (erstwhile) East Pakistan developed this Dhanmondi area with an area of 485.9 acres.

6.5 Demographic Characteristics

It is important to know the demographic characteristics of the household because it plays an important role in activity pattern and trip making. Family size, age structures of the study area Dhanmondi and Kalabagan are stated in the following sections.

6.5.1 Household Size

In the study area, it is found that the average size of the household consists of 4.5

Table 6-1 Household Size of the Study Area

Family Size	Dhanmondi			Kalabagan			Total		
	Frequency	Percentage of respondent	Average size	Frequency	Percentage of respondent	Average size	Frequency	Percentage of respondent	Average size
2	4	2.8		6	2.2		10	2.4	
3	31	22.0		96	35.8		127	31.1	
4	41	29.1	4.5	107	39.9	3.9	148	36.2	4.1
5	37	26.2		48	17.9		85	20.8	
6	19	13.5		9	3.4		28	6.8	
7	5	3.5		1	0.4		6	1.5	
8	2	1.4		0	0		2	0.5	
9	2	1.4		1	0.4		3	0.7	
Total	141	100		268	100		409	100	

Source: Field Survey, 2005

persons in Dhanmondi area and in Kalabagan area the size is 3.9 persons. The family with 4 members is highest in both Dhanmondi and Kalabagan area. It is found that about 80% household size is with 5 persons or below 5 persons in Dhanmondi area. In Kalabagan area the number of household with 5 persons or less is about 96%. The household size ranges from 2 persons to 9 persons. Table 6.1 shows the distribution of household size.

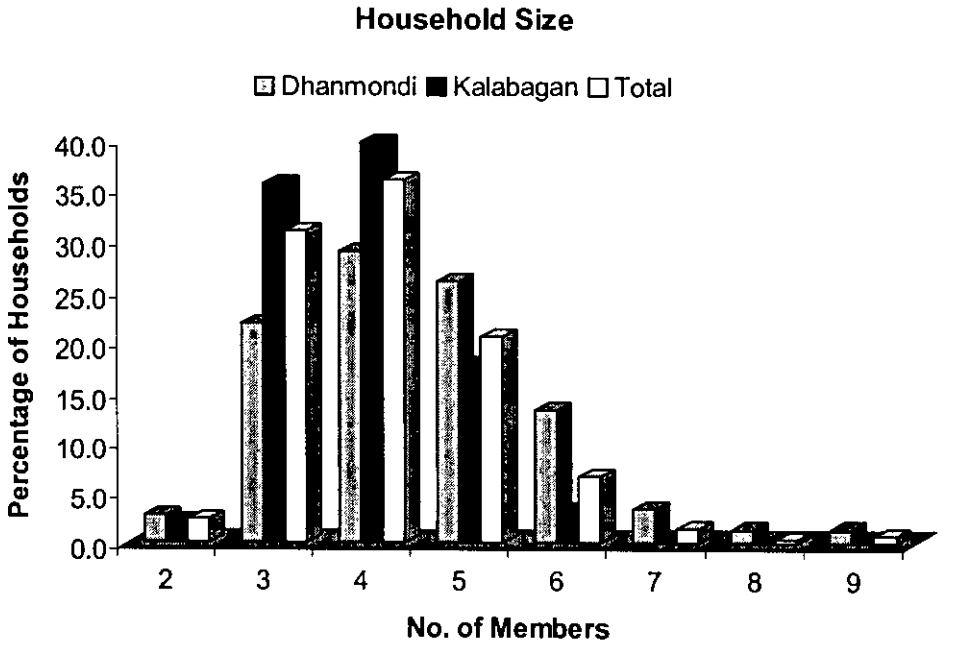


Figure 6.1 Distribution of household size in Dhanmondi and Kalabagan Area.

6.5.2 Age Structure of the Respondents

Different age group produces different patterns of activities and movement in the neighborhood and effects on the streets and other activity areas, for this reason age structure of the population was taken into consideration. Table 6-3 shows different age group of the study area.

A person's age, physical ability and cognitive capacity influence how they behave and react when walking (Table-6.2). Children have limited capacity to process the information they receive and may not make appropriate decisions about prudent behavior and risk management on the street.

Map 6.9 Original Plan of Dhanmondi Residential Neighborhood

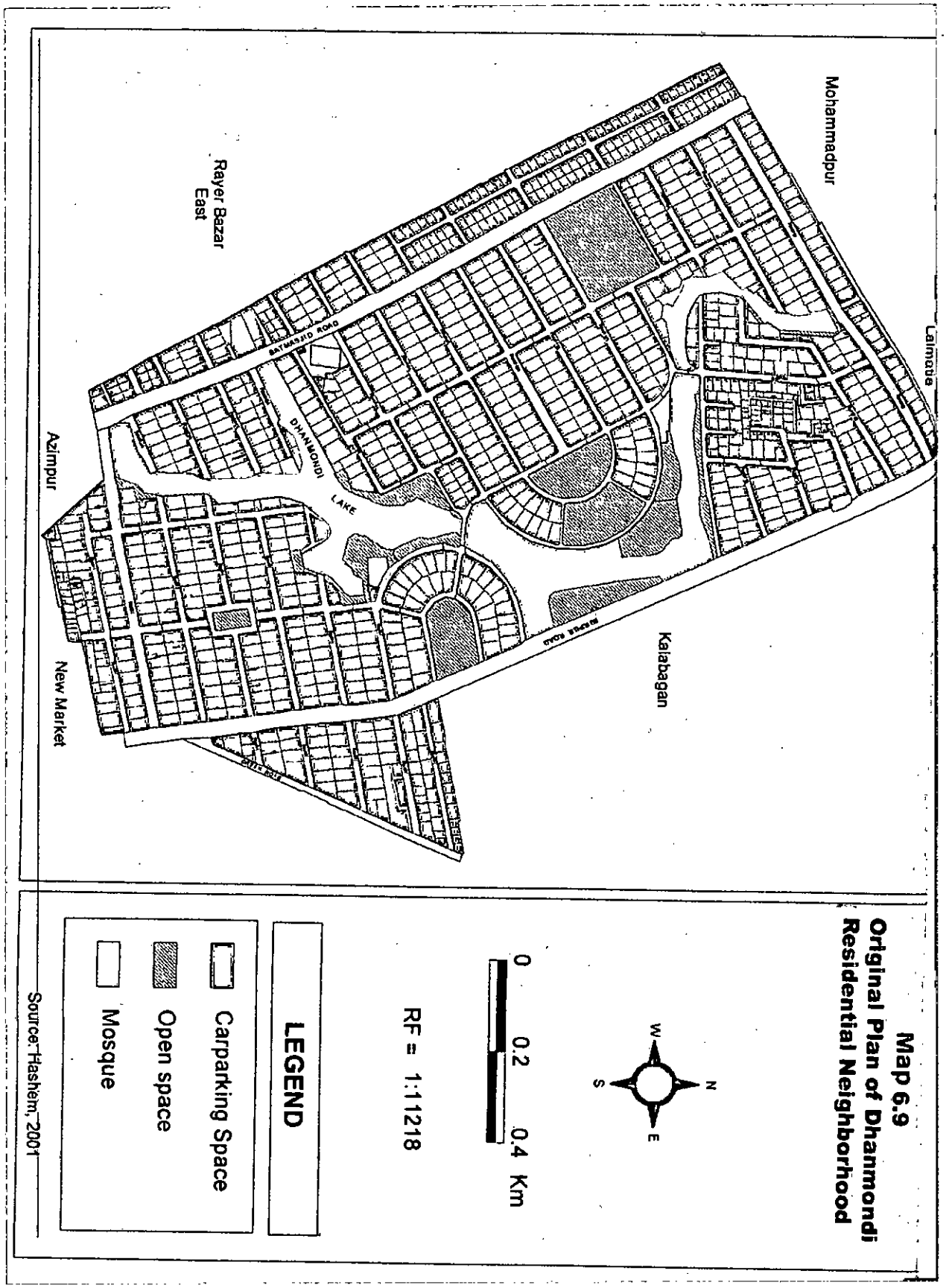


Table 6-2 Common Pedestrian Characteristics by Age Group

Age Group	Common Pedestrian Characteristics
Age 0 to 4	• Learning to walk • Requires constant parental/adult supervision • Developing peripheral vision and depth perception
Age 5 to 8	• Increasingly independent, but still requires supervision • Poor depth perception
Age 9 to 13	• Sense of invulnerability • Poor judgment • Susceptible to "dart out" intersection type crashes
Age 14 to 18	• Improved awareness of traffic environment • Poor judgment
Age 19 to 40	• Active, fully aware of traffic environment
Age 41 to 65	• Reflexes begin to slow
Age 65+	• May cross streets with difficulty • May have poor sight • May have difficulty in hearing vehicles approaching from behind • High fatality rate if involved in a crash

Source: Guide for the Planning, Design and Operation of Pedestrian Facilities (Draft), 2001.

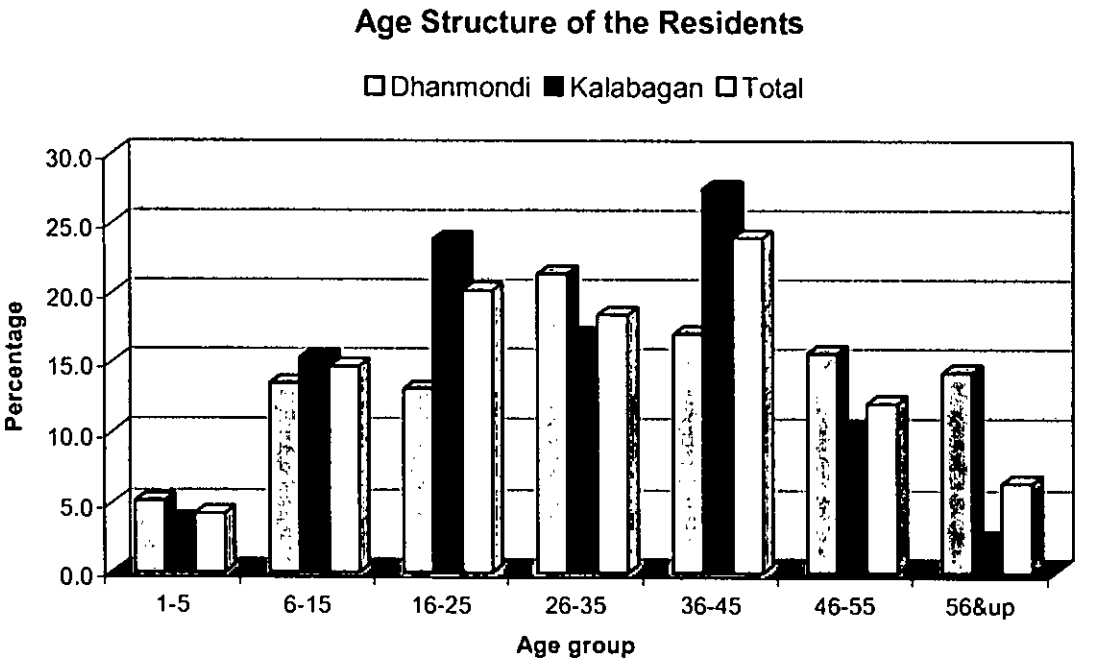


Table 6-3 Age structure of the population

Age group	Kalabagan		Dhanmondi		Total	
	Frequency	Percentage of respondent	Frequency	Percentage of respondent	Frequency	Percentage of respondent
1-5	37	5.1	26	3.8	63	4.2
6-15	150	13.5	68	15.9	218	14.7
16-25	234	13.1	66	23.9	300	20.2
26-35	166	21.4	108	16.9	274	18.4
36-45	270	17.0	86	27.5	356	24.0
46-55	100	15.6	79	10.2	179	12.0
56 & above	24	14.3	72	2.4	96	6.5
Total	981	100	505	100	1486	100

Source: Field Survey, 2005

If adequate provisions for walking are not available, individuals may become transportation-dependent; that is, they will be forced to rely on others for their transportation needs.

From the above table, it is found that most of the populations of the areas are young enough to walk or biking. The age group of 36 to 45 years occupies about 24 percent of the total respondents. In general this group make more trip and physically capable to walk or biking. It is found that the age group of 56 and above is more (14.3%) in Kalabagan than Dhanmondi area (2.4%). From the observation it is found that the older persons are less in number walking, they themselves and family members are more concern about the safety on the street. Though this age group needs to walk for physical and mental health they are much more confined in home, because of lagging walking environment and facilities.

6.6 Present Land Use in Dhanmondi Area

The once serene Dhanmondi area has lost much of its residential characteristic due to

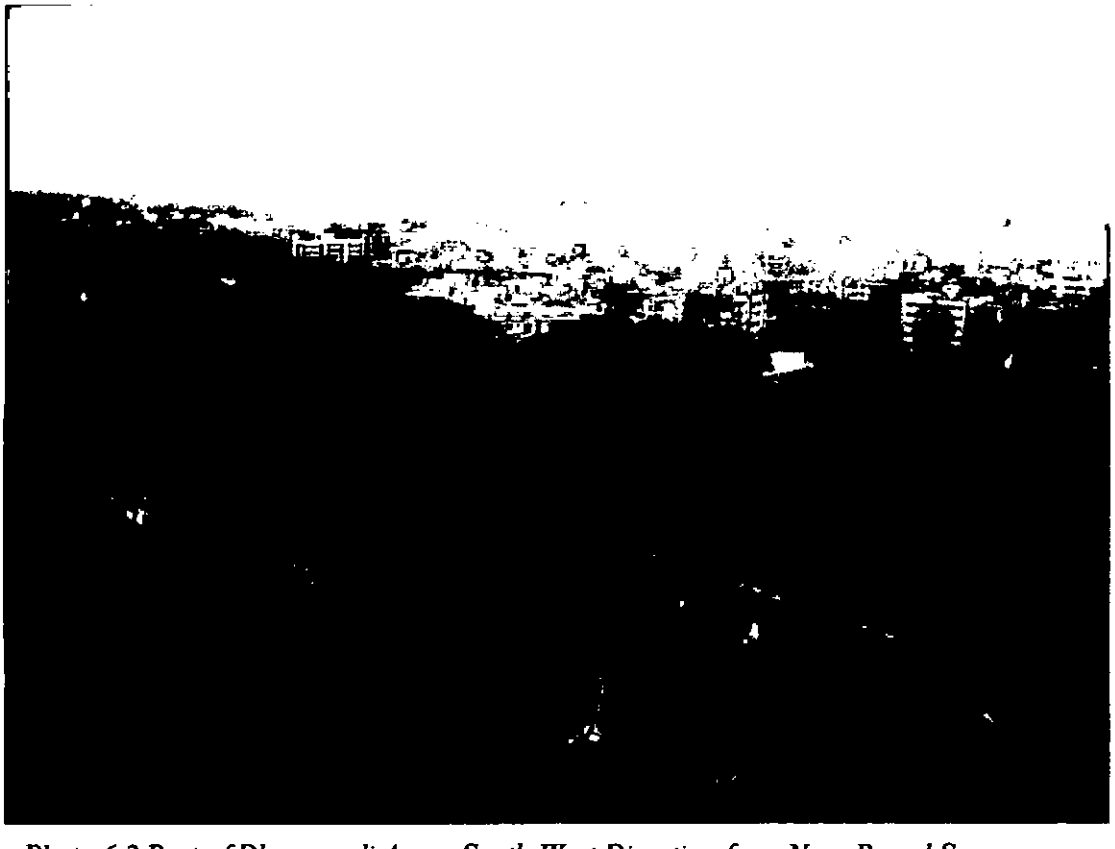


Photo 6.2 Part of Dhanmondi Area –South-West Direction from Near Russel Square

gradual invasion of non-residential and commercial organizations. According to several studies there are least 296 non-residential and commercial organizations existed in the area. Dhanmondi was a quiet residential area in the 1950's when it was being developed

but an increase in its population led to establishment of numerous multistoried apartments. These apartments and also the independent residents houses different commercial activities. Some organizations have built their own commercial or office buildings in the area. At least 142 among the 296 commercial organizations marked in the 2003 survey were educational institutions. The rest included hospital, clinics, offices of business firms and NGOs, pathological laboratories, community centers etc. Easy access, serene environment, lack of strict zoning ordinance, absence of necessary commercial facilities in the Masterplan of the area are the factors responsible for rapid commercialization of the area (Dhanmondi Paribesh Unnayan Jote, 2003; Murshed, 2005; Nancy, 2004).

Basically the growth of Dhanmondi residential area has not been properly guided with planning principles. Nabi states that-" the growth of Dhanmondi Residential Area has not been properly guided with planning principles. Though it is a residential area, its development was not based on the principles of neighborhood planning. It is just a vast area subdivided into residential plots for the construction of dwelling houses. No attention was given to the provision of community facilities. The area does not have planned shopping center, corner stores, play ground, community center, clubs etc. No well- defined boundary has been delimited and no focal point has been developed for the identity for the area. The Dhanmondi Lake lying in the middle of the area has not been properly integrated to the area for which the unity of the entire development has been lost. Due to the absence of any logical boundary, unity and identity, the community bond is not strong enough to guard against undesirable developments with in the area. As a result, invasion has already started on the New market side and Rayer Bazar side by the slow creeping of offices, hotels, restaurants and shops, More offices and shops are likely to come up along the Mirpur Road. The area is gradually losing its sanctity and importance as a first class residential area" (Nabi, 1971).

Photo 6.3 Shows the dense of development of Kalabagan area

As the nonresidential activities are not only serving the residents of the Dhanmondi area but also serving other neighborhoods of the city. This brings in extra, unwanted traffic in to the neighborhood, as a result traffic situation of the area deteriorating with the time. It has become impossible to commute especially during the peak hours in Dhanmondi area. Traffic situation worsened after the Mirpur Road had been made off-limit to rickshaws.

4.6.1 Dhanmondi as a School Neighborhood Area

Pedestrian accidents among children are an important transportation issue especially near the schools. Traffic patterns near neighborhood schools are under-documented when compared with what is required for an analysis of pedestrian safety or determinants of pedestrian safety near schools.

School neighborhoods for example in Dhanmondi area, typically have prominent but short-lived peak traffic flows. Some schools are in on low-traffic streets of this residential neighborhoods, but during the periods immediately before and after the beginning and end of the school day, streets near these schools experience much higher traffic levels as caregivers use these roads to drop off and pick up children. Similarly, pedestrian activity near schools also typically has pronounced but short-duration peaks when classes begin and end.

Traffic characteristics during the before-school and after-school "peak" periods have a strong influence over the pedestrian-automobile conflicts. Roads near schools are on residential streets and traffic flows near schools include congestion and the possibility of many pedestrian-automobile conflicts. Because of many streets in Dhanmondi area accommodate more traffic than the designed capacity, traffic problems exacerbated by factors such as congested parking area or no parking space. It requires taking measures to control traffic flow or speed to reduce pedestrian-automobile conflicts.

To reduce the pedestrian safety problems near a school i.e. conflicts between pedestrians and vehicles, and to reduce the environmental variables on the risk of pedestrians, as stated in Section 2.3 of Chapter 2, it requires a spectrum of neighborhood design changes, including the installation of sidewalks and curb ramps, the inclusion of pedestrian signals and crosswalks at signalized intersections, and the installation of traffic calming measures such as traffic circles and speed humps.

6.7 Street Network of the Areas

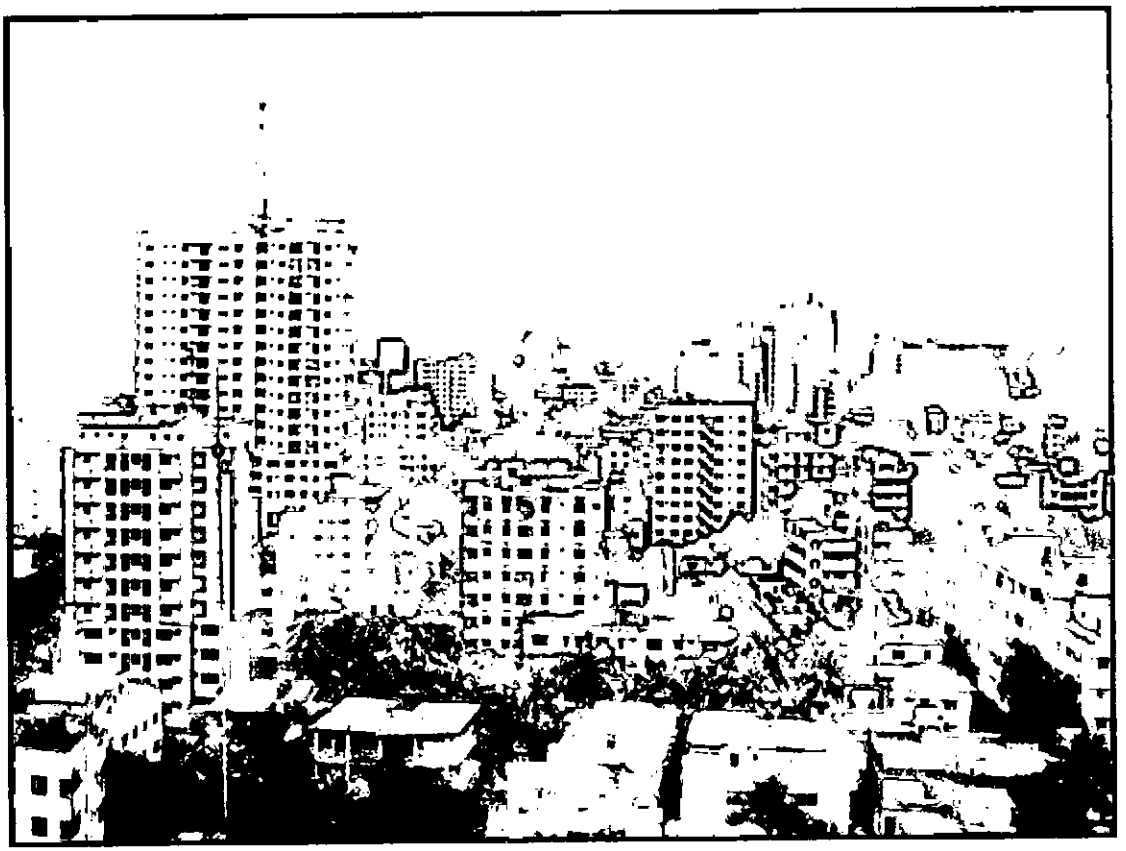


Photo 6.4 Kalabagan area, with Panthapath on the left, showing Sheltech Tower, Concord Tower

From the inventory of the study areas it was found that the street network of Dhanmondi is totally different from Kalabagan area. Streets in Dhanmondi are arranged basically in grid iron pattern with some semicircular layout streets shaped by the configuration of the lake and lake side green areas. The grid pattern is the archetype of high connectivity network. Grids are theoretically capable of increasing walking and biking trip in two ways. Grids have large number of intersecting streets, thereby reducing the distance between trip origin and destination. Grid patterns also provide a large number of alternative trip routes, allowing pedestrians and bicyclists to very their routes for variety, safety and convenience. On the other hand in contrast to grid street network of Dhanmondi area, streets of Kalabagan area was developed in an organic way. Streets of Kalabagan are not developed in a systematic way. Basically maximum streets of this area emerged as an outcome of strips of land donated by the individual plot owners for the street to get access to the adjacent individual plots. Street network of this area is characterized by dead end streets. Main thoroughfares within this area linking Mirpur

Road on the west and Green Road on the east side. One of the main thoroughfares of the area is Basiruddin Road, which is connected with the other thoroughfare roads (have no specific name or number which also discourages walking) from the Panthapath (on the east side or Sheltech tower, starting point on the opposite side of Square Hospital) in the north-south direction that meets with the Bashiruddin Road. Basically this road acts as a prime connector of this area with the Panthapath i.e. with the other parts of the city. Another thoroughfare like street starts from the Mirpur Road near the Lazz Pharma pharmaceutical shop and by the south side of a mosque, that also meets with the Bashiruddin Road. All this thoroughfare and thoroughfare like streets are served by dead end streets.

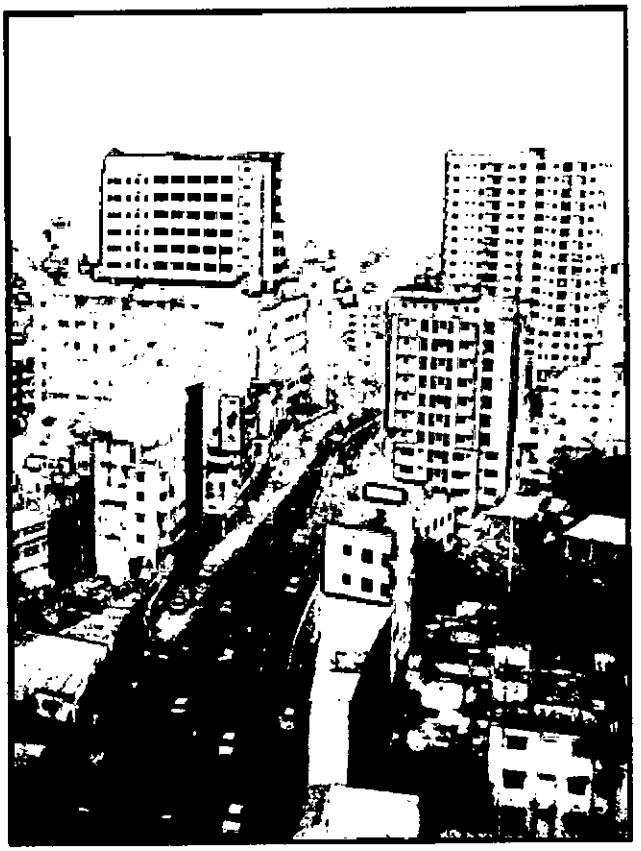


Photo 6.5. Panthapath Road on the north of Kalabagan, showing Square Hospital, Concord Tower, Sheltech Tower

Before early 1980's Panthapath was a water canal and it was connected to the Dhanmondi Lake. At that time canal side areas were occupied by makeshift structures-*basti* – for the accommodation of people with very low-income. At that time streets from Kalabagan area ended up to the canal, so there were no access to Kalabagan area from present Panthapath road. Access to Kalabagan area was only from Mirpur road and Green road.

In 1988 when the canal was converted into a street by making box curvet along the canal, development along the both sides of Panthapath exhilarated. With the inception of Panthapath, inner areas of Kalabagan also developed as an influence of Panthapath. Few streets, which were initially dead end type, were connected to Panthapath road. By this time the growth of population in the area was significantly increases. The

population of Kalabagan was 29176 in 1991 and 12,793 in 1981. Household number increased from 1841 in 1981 to 4521 in 1991 (Population census, 1981 and 1991). Though the population become more than double (128%) within ten years, there was basically no creation of new streets within the area and the street network remain same.

Photo 6.6 Bashiruddin Road, showing scope of walkway accommodation

Photo 6.7: Bashiruddin Road, showing scope of walkway accommodation

So the same street networks have been serving the increased population. From the very beginning there was no pedestrian walkways, the living population has to use the streets sharing with vehicles and other transport, but at present, with the increased population and traffic volume, it is very difficult to walk or biking safely.

Maximum streets are too narrow to cross two cars by each other. In some locations the width of the street is enough to accommodate two lanes and space to walk. For example, the width of Bashiruddin Road, from the connecting point at Mirpur Road to about half Kilometer length, is about 25 ft, at some segment of the street the width is enough to accommodate free movement of vehicles and pedestrians. But the width of the

Photo 6.8 One way crossing for rickshaw at Mirpur Road

Photo 6.9 Street connecting Kalabagan to Panthapath Road

remaining length is about 20ft. At some points of the street the width is made narrower with unplanned placement of electric, telephone poles, open drain etc.

Commercial activity along the side of the street, loading unloading of goods, storage of construction material etc has made the streets more inefficient. Poor maintenance of the street surface, unplanned underground utility development and upgradation activities worsened the situation, which is a common phenomenon in Dhaka city. There seems to be let up in development work on the city roads. If WASA has finished laying down pipes, then comes DESA and when DESA finishes the cable line work comes T&T for installing telephone cables and then DCC for putting road barriers. What is the most shocking, none of those organizations has any co-ordination in their plans. Recently, the traffic situation deteriorated after the Mirpur Road had been made off-limit to rickshaw. As the rickshaw is allowed to cross the Mirpur Road at the intersection point of Dhanmondi Road No. 10 to Kalabagan and eastern area of Kalabagan, the volume of

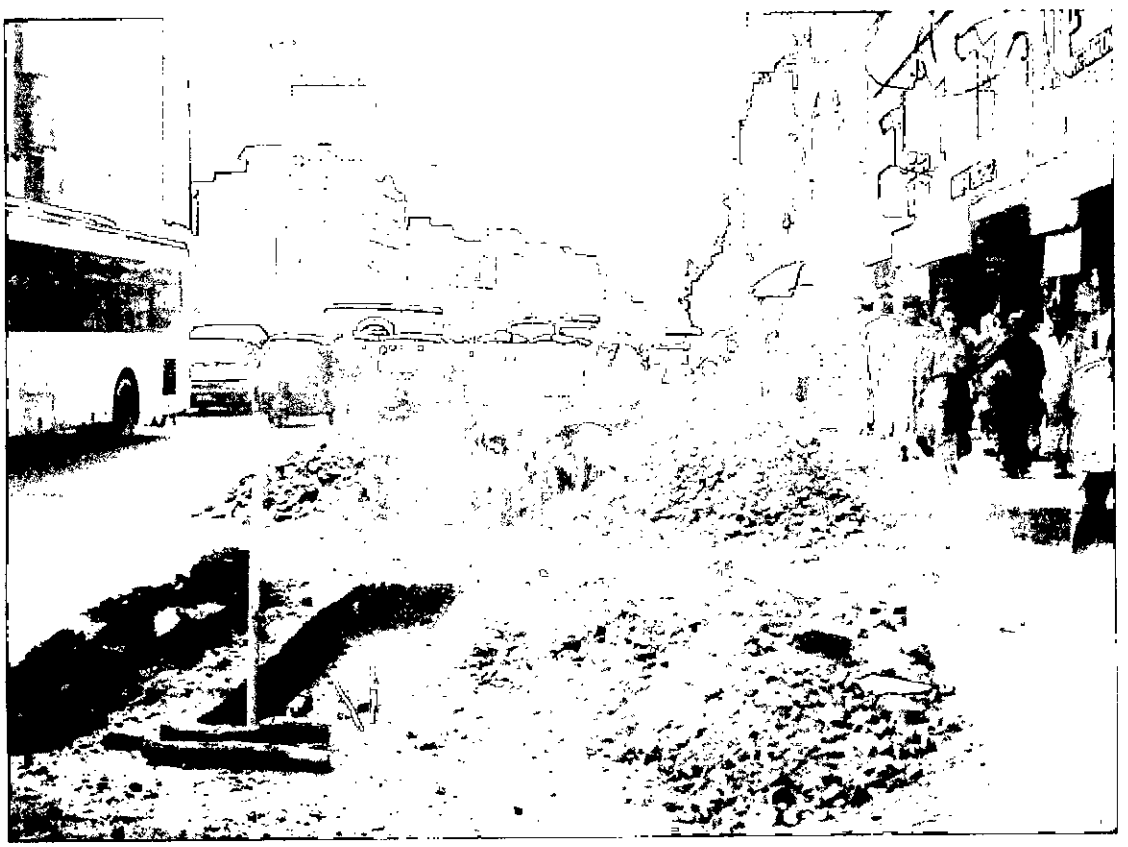


Photo 6.10 Underground utility development works, Mirpur Road

rickshaw is very high in 'Second Lane' Road. Consequently the situation for the pedestrian using this road had been worsened. Although rickshaws do create a major problem by clogging up the traffic in Dhaka's streets, they are not the only problem.

Other cities that do not have rickshaws have also to experience severe traffic congestion due to the natural proliferation of vehicular traffic and this is the principal problem in Dhaka. The number of cars, buses and trucks on the road is increasing steadily in Dhaka at a much faster rate than one can imagine, with little or no construction of new roads (Ali, 2003).

As stated in section 5.8, Chapter 5, dead end or loop streets have some merits or advantages; residents of Kalabagan enjoy this type of advantages. There are some loop streets in Kalabagan, with limited vehicular movement, used basically by residents living along these streets. As these types of streets have limited traffic volume, children

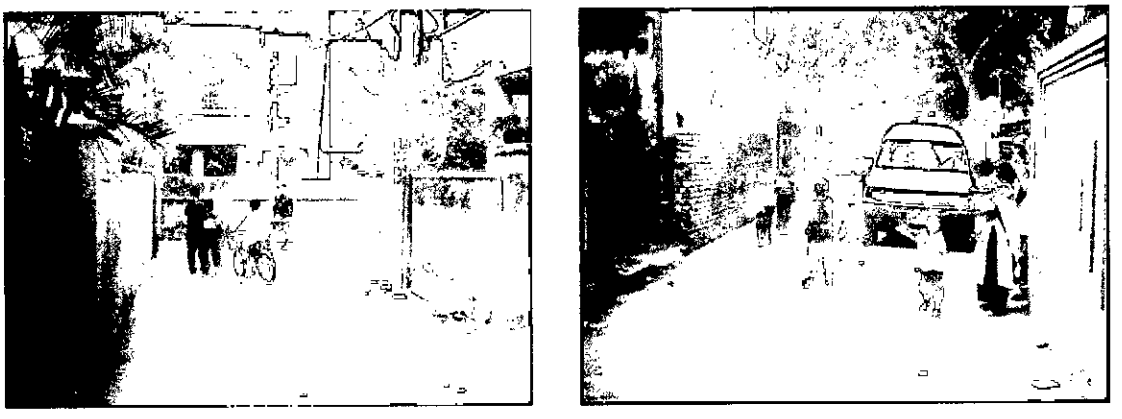


Photo 6.11 Loop street used as play fields, Kalabagan area

use these streets as play lots. These streets are especially attractive as play areas for children because of the high degree of accessibility to the children of both genders and all ages. Due to scarcity of open areas and playfields the streets play an added role of playfields. They are close to home to be used daily and creates the opportunity of social interaction for the children as well as for the adults. Dead end streets are also attractive for the children to play and easily accessible for meetings.

6.7.1 Street network and Build form in Kalabagan Residential Area

The study shows that most of the buildings in Kalabagan area were constructed keeping in line with the RAJUK (Building Construction Act, 1996) setback rules at least with regards to the ground floor. Existing RAJUK setback rule for the plots size of 268sqm or above, it is mandatory to keep 1.25m wide open space on both sides of the building and a minimum of 1.50m off the property line i.e. from the street edge.

It was observed that most of the buildings were constructed keeping approximately 1.5m wide open space in front of the building within the boundary wall. Structural columns were placed about 1.5m away from property line on the ground floor, but the top floors were projected as cantilever to encroach this 1.5m strip area making the street narrower.

Characteristics of Kalabagan Residential Area

- A major part of Kalabagan was part of a canal and its influence area, which existed till the1980s.
- Residential development was made by landfill and subdivision by the personal initiatives of the landowners.
- Thus, a haphazard and unplanned development is evident in this neighborhood.
- The existing street pattern evolved long before the Kalabagan land was filled up and turned into the present road, i.e., the Panthapath.
- Blocks of land were subdivided resulting in dead-end streets and without segregated from pedestrians.

Photo 6.12 Blank walls are intimidating, Boundary wall of Abahani Club Ground Road No.13A, Dhanmondi

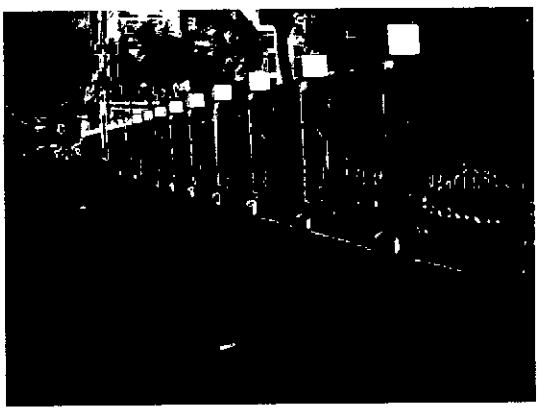


Photo 6.13 Transparent walls are more inviting, Boundary wall of Agora, Road No.2 Dhanmondi

6.8 Pedestrian Network in Dhanmondi and Kalabagan Area:

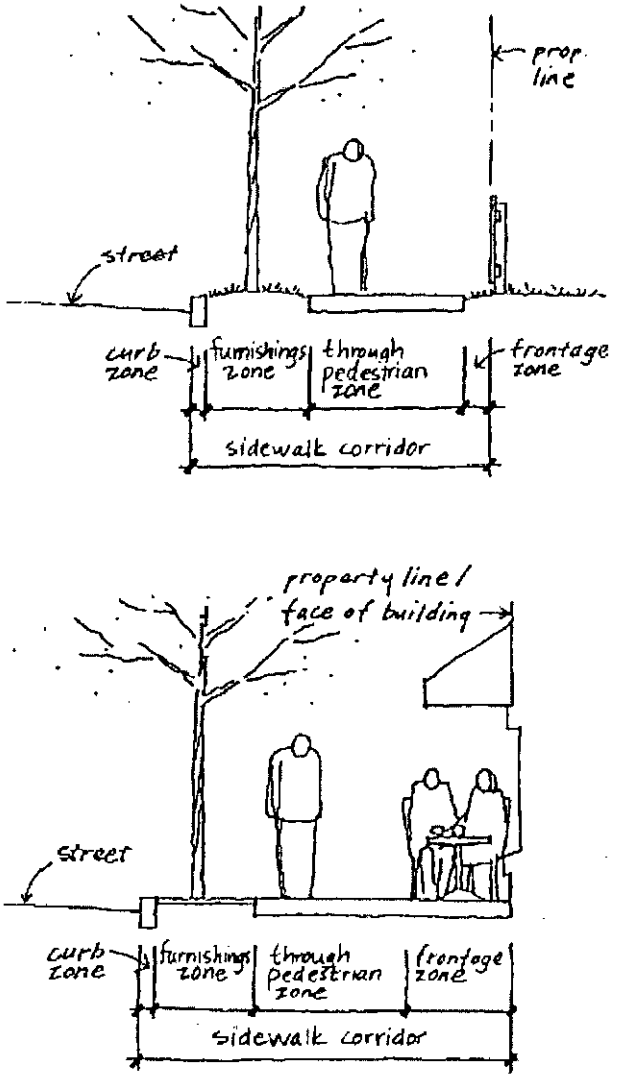


Fig. 6.1 Sidewalk corridor

For every pedestrian friendly environment the pedestrian design principles should be followed. A pedestrian system should be safe, accessible to all with high connectivity. Sidewalk corridors, street corners, crosswalks are the elements of the pedestrian network. Conditions of the adjacent areas to the walkway are an important factor for the pedestrian environment. Solid or blank walls may create alienating environment for pedestrians (Photo 6.12,6.13,6.14). Conditions of these elements in Dhanmondi and Kalabagan are stated below. In Kalabagan area there is no separate walkway for pedestrians, for that reason pedestrian elements mentioned above are discussed below considering Dhanmondi area.

6.8.1 Sidewalk Corridor

Sidewalk corridor is the portion of the pedestrian system from the edge of the road to the edge of the right-of-way, generally along the sides of the streets, between street corners. Sidewalk corridor contains four distinct zones - curb zone, furnishing zone, through pedestrian zone and frontage zone (Fig 6.1).

In Dhanmondi area most of the streets have sidewalk corridor on both sides of the street with variable widths, in some locations existing sidewalk corridors are too narrow to allow free pedestrian flow. For example walkways parallel to the Mirpur Road are so crowded for the convenience of walking. Segments of walkways, in front of the shops, markets etc. are more crowded than other areas.

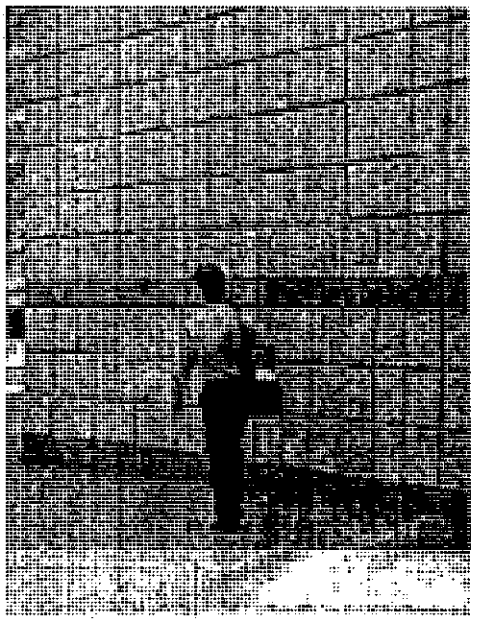


Photo 6.14.Blank walls create an alienating environment.
Source: Cambridge Pedestrian Plan – 2000

6.8.1.1 Curb Zone

Curb zone of the pedestrian corridor in Dhanmondi area are not of standard size. Standard width of the curb should be 6" and 6" in height in residential areas, and 7" in height for commercial areas (Portland, 1998). In the study area height of the curb is so low in some locations, that it permits vehicular movement or parking on the sidewalk area. But recommended curb height should not be less than 4" following routine asphalt overlay of the street (Portland, 1998). In contrast to very low curb height, in Mirpur Road average curb height is more than 12" without curb ramp as shown in Photo 6.15. It is very difficult for young people to use the walkway, not to speak of aged people because of the curb height. To avoid uncomfortable curb height people prefer to walk through the segment of the street parallel to the walkway (street shoulder). So there is a need to follow design standards, as shown in Figure 6.2, consider the walkway uses of different ages and disabilities.

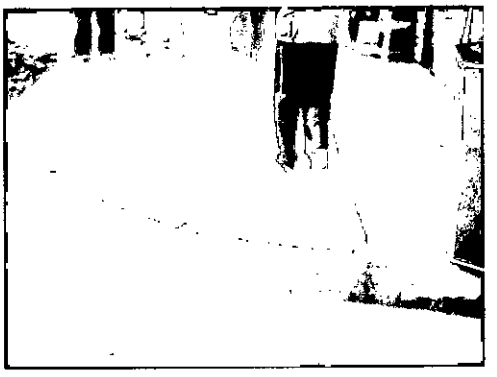


Photo 6.15 Excessive curb height and sudden change of grade is risky for pedestrians, especially for children, aged & disabled, Mirpur Road, Sukrabad.

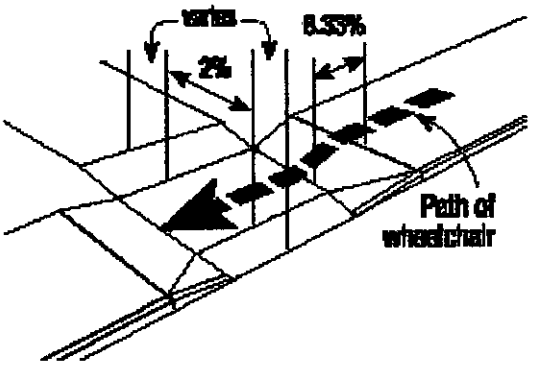


Fig. 6.2 Standard Sidewalk Dip convenient for walking people as well as wheelchair users
Source: Reproduced from Vermont Pedestrian and Bicycle Facility Planning and Design Manual, 2002

One of the basic function of the curbs is to discourage vehicles from driving over the pedestrian space, other functions of curb zone is to prevent water in the street gutter from entering the pedestrian space, make it easy to sweep the streets, defines the pedestrian environment within the streetscape. In Dhanmondi area it is found that walkway with curb and without curb are both frequently occupied by unauthorized parking (Photo 6.16 & 6.17). It is observed that walkways with curb are used as parking area by constructing ramp between walkways and street. So an appropriate design solution along with creating awareness and strict enforcement of necessary laws are required.

Photo 6.16 Walkway without curb used as car parking, Road No.8, Dhanmondi.

Photo 6.17 Walkway with curb used as car parking, Road No.11, Dhanmondi.

6.8.1.2 The Furnishing Zone

The furnishing zone buffers pedestrians from the adjacent roadway and is also the area where elements such as street trees, signal poles, utility poles, street lights, controller boxes, hydrants, signs, driveway aprons, grates, hatch covers and street furniture are properly located. This is the area where people alight from parked cars.

Photo 4.18 Electric pole on the middle of through pedestrian zone, Lakeside, Satmasjid Road, Dhanmondi

Photo 4.19 Careful continuity of through pedestrian zone, Lakeside, Road No.13A, Dhanmondi

In the study area the sidewalk corridors do not have any defined furnishing zone. Street trees, signal poles, manhole covers, etc. are located in a haphazard and unplanned manner. In some locations those elements are placed on the middle of the through pedestrian zone (Photo 6.18).

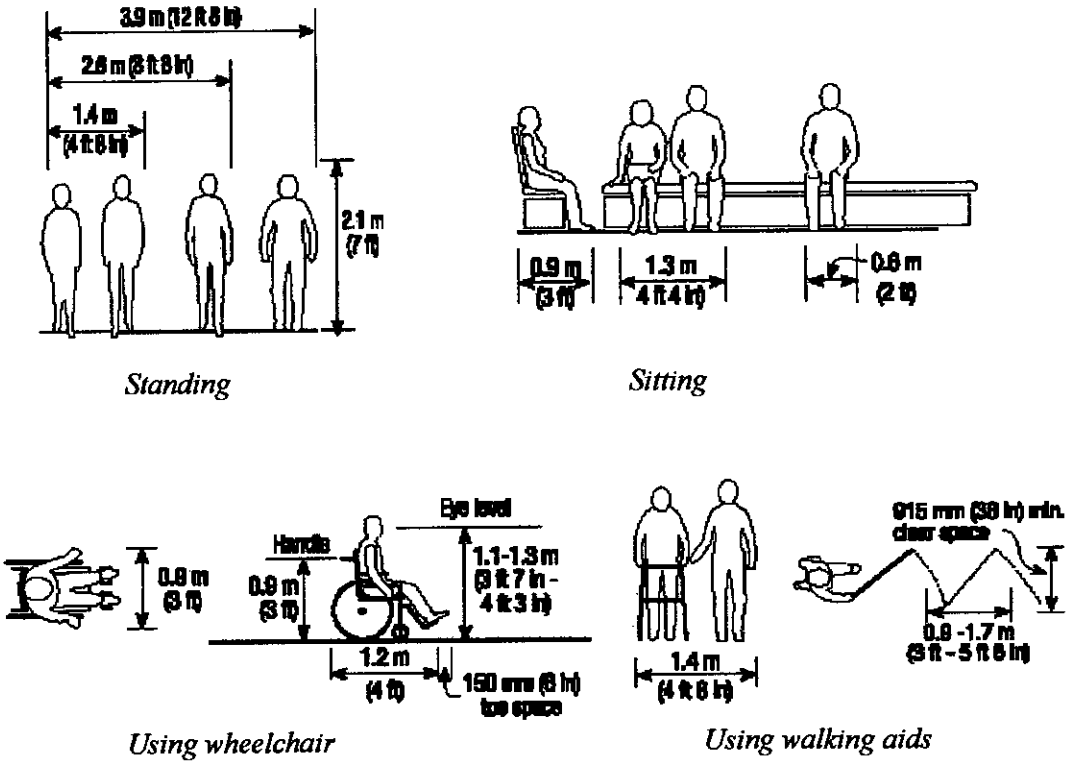
In Dhaka few roads have defined furnishing zone. Bijoy Sharani Road is one of the roads that have defined furnishing zone and other sidewalk elements. The road is well planned having wide sidewalk corridor on both sides. Street trees, utility poles, signs etc. are placed within the furnishing zone.

Photo 6.20 Narrowing through pedestrian zone, Lakeside, Road No.13A Bridge, Dhanmondi

Photo 6.21 Obstruction on of through pedestrian zone, Mirpur Road, Kalabagan

6.8.1.3 Through Pedestrian Zone

The through pedestrian zone is the area intended for pedestrian travel. This zone should be entirely free of permanent and temporary objects. The minimum width of the through



Standing *Sitting*

Using wheelchair *Using walking aids*

Fig.6.3 Space required by people
Source: Source: Reproduced from Vermont Pedestrian and Bicycle Facility Planning and Design Manual, 2002

Photo 6.22 Ill-designed, steep driveways provide barrier to smooth walkways, Road no.5, Dhanmondi

Photo 6.23 Very ill-planned and designed sidewalks, Road no.5, Dhanmondi

pedestrian zone should be 5 ft to make space to cross two persons each other and to ensure space for persons using wheelchair. Fig 6.3 shows the standard space

requirements for pedestrians with different physical abilities. In Dhanmondi area the widths of the through pedestrian zones (though not defined) vary in different locations, in some locations the width of through pedestrian zone is so narrow to accommodate pedestrians. The situation has worsened by the placement of telephone poles, telephone junction boxes, light poles, etc. within the zone. Walking surfaces are not firm and stable, which is not suitable for the people using canes, wheel chairs. In terms of colour, texture or pattern the walking surfaces are monotonous and unpleasant.

Photo 6.24 Colorful and well-designed pavements can make walking interesting, pavement of commercial buildings, Satmasiid Road, Dhanmondi

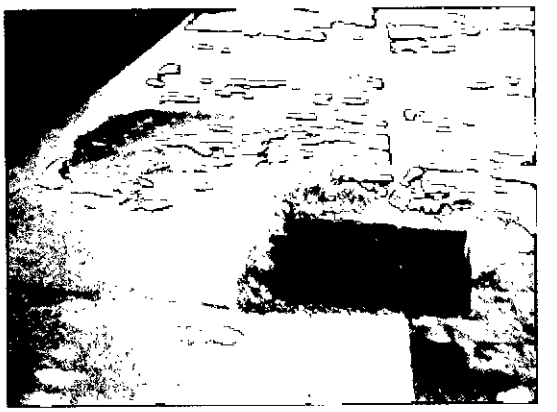


Photo 6.25 Potholes and open sewers pose risks to pedestrian, Road No.11A, Dhanmondi

Slope for accessibility routes on private property or driveway is very steep which creates discontinuous, uncomfortable and unsafe pedestrian movement (Photo 6.22).

6.8.1.4 Frontage Zone:

Photo 6.26 Frontage zone with open drain and foul smell, Dhanmondi

Photo 6.27 Walkway lacking maintenance, open drain, Dhanmondi

The frontage zone is the area between the through pedestrian zone and the property line. In Dhanmondi area maximum frontage zone is used as open drain or covered drain.

Frontage zone with covered drain are not well maintained and used as a space for storage of construction material or debris. A limited portion of the frontage zone is kept well-maintained and with some greeneries. Frontage zone segments with open drains poses high risk to pedestrians. In case of plots with commercial use, such as shop, this frontage zone is used as an extension of shop. Maximum frontage zones are kept dirty and not maintained that degrades the quality of the sidewalk environment.

6.8.2 Street Corners

Pedestrian activities are concentrated at the street corner. These are the place where the ways converge, where walkers wait for crossing opportunities, and where people is most likely to stop and converse with other. Clear space i.e. corners should be clear of obstructions, visibility, legibility, accessibility and separation from traffic are the five attributes for good street corner.

In Dhanmondi area different street corners are lagging of different attributes. Utility poles occupy the area, which should be obstruction free. Accessibility standards are

Photo 6.28 Planned street corner to facilitate street crossing at Russel Square, Kalabagan

disregarded maintained by not providing curb ramp, which are essential for the wheel-chair users. From the observation it is found that vehicle speed on some streets of Dhanmondi are high enough to acts as a barrier for pedestrian crossing at the street corner. Road No. 8 and Road No. 11 (No.32 old) near the bridges over Dhanmondi Lake are such street corners with high vehicle speed. Basically, these intersections are in important position for crossing vehicles from east to west or from west to east of the lake. To facilitate safe pedestrian crossing at street corner, design of the corner is an important aspect to consider.

For that purpose few street intersections had been designed and developed. For example to facilitate pedestrian crossing at the intersection of Rasel Square curb extension , refuge islands have been introduced. Since the corner area must accommodate a concentration of pedestrian activities, and since sight line need to be maintained for all street users, it is important to maintain an area that is free of obstructions. At Russel Square to cross the Panthapath Road from the direction of Sukrabad to Kalabagan, the boundary wall of New Model School obstructs visibility and it is very risky and unsafe to cross the road. To solve the problem it requires creating larger obstruction free area at the corner. To facilitate pedestrian crossing at the intersection of Russel Square curb extension, refuge islands are introduced. Curb extensions (bulb-outs) have many benefits for pedestrian, they reduces the crossing distance, provide additional space at the corner, and allow pedestrians to see and be seen before entering the crosswalk.

Different socio-economic characteristics of the residents produce different movement pattern. Relevant and useful items of information on the demographic and socioeconomic characteristics of the residents are presented in the following sub-sections.

6.9 Socio-Economic Characteristics

Socio-economic characteristics have strong influence on the trip making and type of transport used. For this monthly household income and level of education of the population of the study area are stated below.

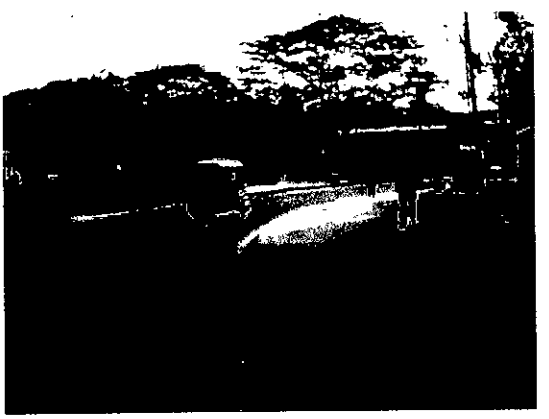


Photo 6.29 Curb extension or facilitate street crossing, Russel Square, Kalabagan

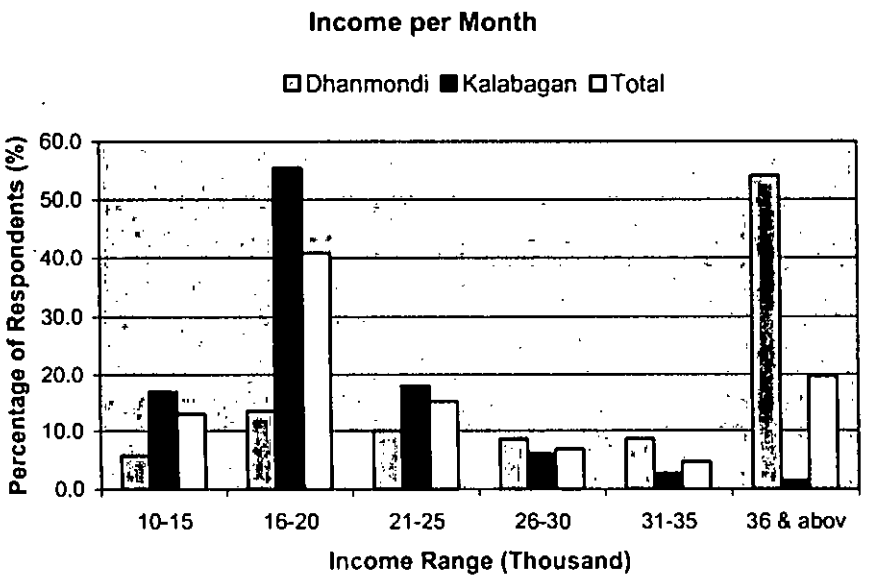
6.9.1 Monthly Household Income

Household income is one of the most important factors that shape the trip making and mode selection. If we divide the household income into three ranges, it is found that the income range of 16-20 thousand Taka is leading (55.2%) in Kalabagan area. But in Dhanmondi area income

Table 6-4 Monthly Household Income

Income range (in thousand)	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
10-15	8	5.7	45	16.8	53	13.0
16-20	19	13.5	148	55.2	167	40.8
21-25	14	9.9	48	17.9	62	15.2
26-30	12	8.5	16	6.0	28	6.8
31-35	12	8.5	7	2.6	19	4.6
36 to above	76	53.9	4	1.5	80	19.6
Total	141	100	268	100	409	100

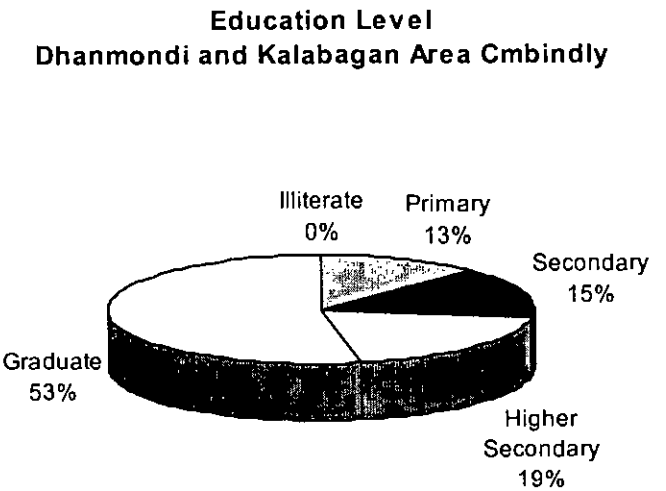
Source: Field Survey, 2005

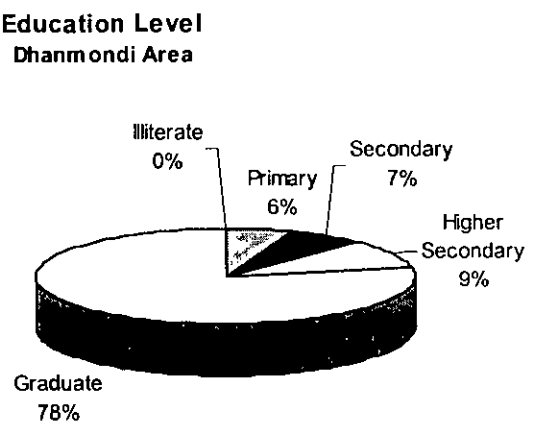


range 36 thousand or above is prominent (53.9%). Table 6.4 shows the income distribution of respondents of the study areas. From the above table, in combine Dhanmondi and Kalabagan area, it is found that about 42 % of the households' income range is16 to- 20 thousand Taka. About 19.6 % household's income range is 36,000 and above.

6.9.2 Education Level

Education level of the population of the study area is shown in Table 6.5. It shows that the population with graduate level or Bachelor's Degree education is highest in





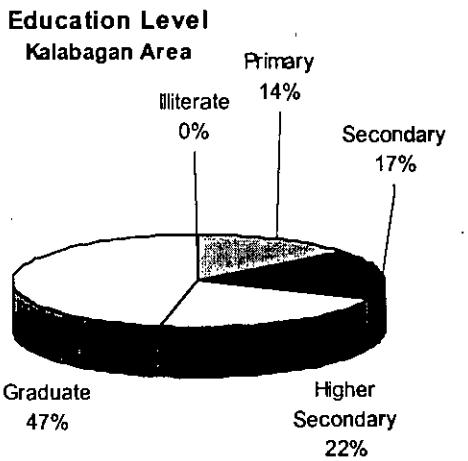


Table 6-5 Education Level

	Dhanmondi		Kalabagan		Total	
Levels of Education	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
Primary	13	5.7	128	14.2	141	12.5
Secondary	15	6.6	154	17.1	169	15.0
Higher Secondary	21	9.3	198	22.0	219	19.4
Graduate	178	78.4	421	46.7	599	53.1
Illiterate	0	0	0	0	0	0
Total	227	100	901	100	1128	100

Source: Field Survey, 2005.

Dhanmondi area that is followed by higher secondary level with 9.3 percent. In Kalabagan area the population with graduate level education is about half of the Dhanmondi area. Among the respondent population in both areas the percentage of illiterate is zero.

6.10 Transport Ownership

It is found that 24.7 percent of the households in the two study areas as a whole have personal transport. Among the household of Kalabagan only 4.1 percent households have personal transport. In contrary to Kalabagan, 63.8 percent households of Dhanmondi area have their personal transport. Ownership pattern of personal transport of the two areas indicates the dependency on public transport for the population of Kalabagan area is more. Those do not have personal transport, they are more dependent on walk, to go to work place or to get a suitable transport to make trip. Accessibility and connectivity to public transport is more desirable in Kalabagan area to get and use public transit.

Table 6-6 Transport Ownership Pattern by Type

	Dhanmondi		Kalabagan		Total	
Types of Transport	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
Car	105	80.2	6	54.5	111	78.2
Jeep	15	11.5	0	0	15	10.6
Microbus	11	8.4	0	0	11	7.7
Motorcycle	0	0	0	0	0	0
Bicycle	0	0	5	45.5	5	3.5
Total	131	100	11	100	142	100

Source: Field Survey, 2005.

Cars, Jeep, Microbus are the types of transport owned by the residents of Dhanmondi. About 70 percent of the household those have personal transport are with one vehicle, 20 percent households are with two vehicles. Table 6.6 shows types of vehicle owned by the respondents. It shows about 80 percent vehicles are car in Dhanmondi area.

Table 6-7 Transport Ownership Pattern by Number

	Dhanmondi		Kalabagan		Total	
Number of Transport owned	Frequency	Percentage	Frequency	Percentage	Frequency	Percentage
1	63	70.0	11	100	74	73.3
2	18	20.0	0	0	18	17.8
3	7	7.8	0	0	7	6.9
4	1	1.1	0	0	1	1.0
5	0	0.0	0	0	0	0
6	0	0.0	0	0	0	0
7	1	1.1	0	0	1	1.0
Total	90	100	11	100	101	100

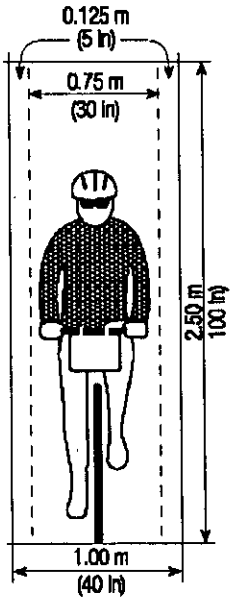
Source: Field Survey, 2005.

Though the bicycle is non-polluting and quiet, requiring no fuel and using a smaller fraction of road space; and are substantially cheaper on a per kilometer basis of travel than any other form of wheeled transport, the ownership of bicycle is negligible. Through the survey, a small number of bicycle ownership was found. Among 268 households in Kalabagan area only 5 households have bicycles, which is about 1.9 percent of the household surveyed in this area. But in Dhanmondi area there were no bicycle owners among 141 households surveyed. Though the bicycle ownership was found smallest among the sample household (because of the methodological limitation of survey), it was observed that there is substantial number of bicycles playing on the streets of the study areas. However, in Dhaka the proportion of travel by bicycle is very small compared to any other cities of Asia. According to Greater Dhaka Metropolitan Area Integrated Transportation study (DITS) there are less than 50,000 bicycles in Dhaka city compared with 2 million in Delhi. The Passenger Car Equivalent (PCE) for bicycle is 0.5 compared with car or Jeep is 1.0, i.e. the effect of bicycle in mixed traffic condition on road is relatively less. Table 6-8 shows the Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU). The PCE values are not static for all locations or conditions.

Table 6-8 Passenger Car Equivalent (PCE) or Passenger Car Unit (PCU).

Vehicle type	PCE
Car, Jeep, Pick-up, Microbus	1.0
Truck	3.0
Bus	3.0
Auto-rickshaw	1.0
Motorcycle	0.5
Bicycle	0.5
Rickshaw	1.5
Pushcart	6.0

Source: Kiwan, 1988



6.11 Mode of Travel

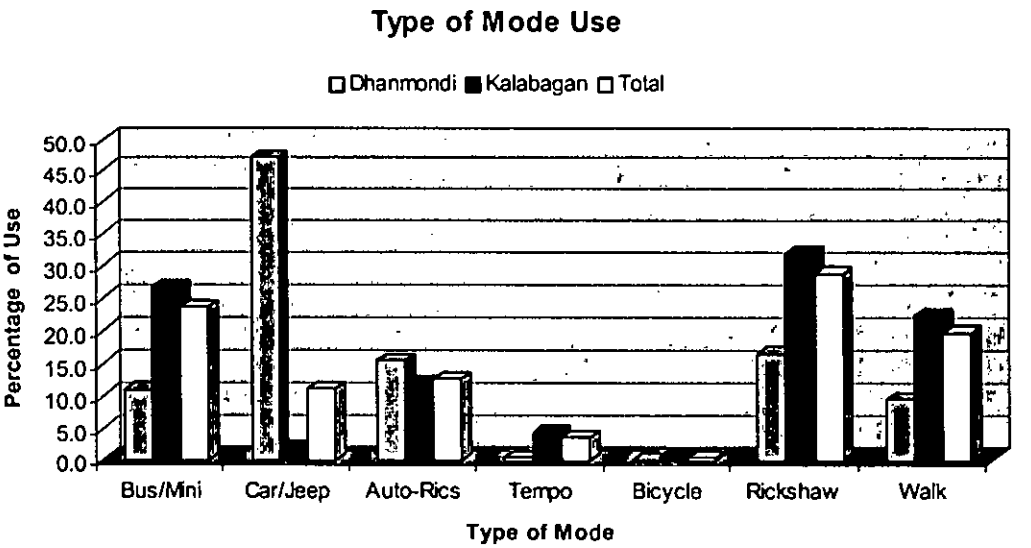
The different types of vehicles operating in Dhaka are bus, mini-bus, car/jeep, taxicab, auto-rickshaw, tempo, rickshaw etc. Among those rickshaw is the most popular mode of transport available to render house-to-house service. But recently, as the use of

Table 6-9 Mode of Travel

	Dhanmondi		Kalabagan		Total	
Type of Mode	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
Bus/Minibus	22	11.0	212	26.8	234	23.6
Car/Jeep	94	47.0	16	2.0	110	11.1
Auto-rickshaw	31	15.5	94	11.9	125	12.6
Tempo	1	0.5	35	4.4	36	3.6
Bicycle	0	0	5	0.6	5	0.5
Rickshaw	33	16.5	253	31.9	286	28.8
Walking	19	9.5	177	22.3	196	19.8
Total	200	100.0	792	100.0	992	100.0

Source: Field survey, 2005

rickshaw is restricted in some arterial road, it has become difficult to make short trips by rickshaw specially when crossing the road with restricted rickshaw use. So dependency on walk is increased for short trips. As public buses and minibuses are operating on



limited roads and personal vehicles are also limited, walking and rickshaw are the major mode of transport in Dhaka. Table 6-9 shows the mode used for trip, it shows that walking trip made by the residents of Kalabagan is about 22 percent compared with 9.5 percent of Dhanmondi area. But according to DUTP, 1999, study report, estimated trip task by walk was 60.22 percent of all modal trips in Dhaka and estimated trip using bicycle was 0.9%.

6.12 Residents Opinion

Residents opinion regarding transport fare, safety conditions, views regarding walking and biking, acceptable walking distance, bike lane provision, desire to use bicycle, desired conditions for walking and biking; benefits of walking and biking which includes social, mental, health, economic; etc are stated below.

6.12.1 Transport Fare

Pedestrian friendly environment could reduce the transport fare. According to the opinion of the residents they will walk instead of using rickshaw to go to the public

Table 6-10 Travel Cost Reduction

	Dhanmondi		Kalabagan		Total	
Type of Mode	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
Yes (will reduce the cost for transport fare)	128	90.8	263	89.1	391	95.6
No (will not reduce the cost for transport fare)	13	9.2	5	10.9	18	4.4
Total	141	100.0	268	100.0	409	100

Source: Field survey, 2005

transport stoppage point, to get a bus or minibus etc., and thereby reducing the transport cost. According to the residents' opinion as shown in Table 6-10, about 96 percent respondents believe that cost for transport fare will be reduced if walking and biking environments are developed.

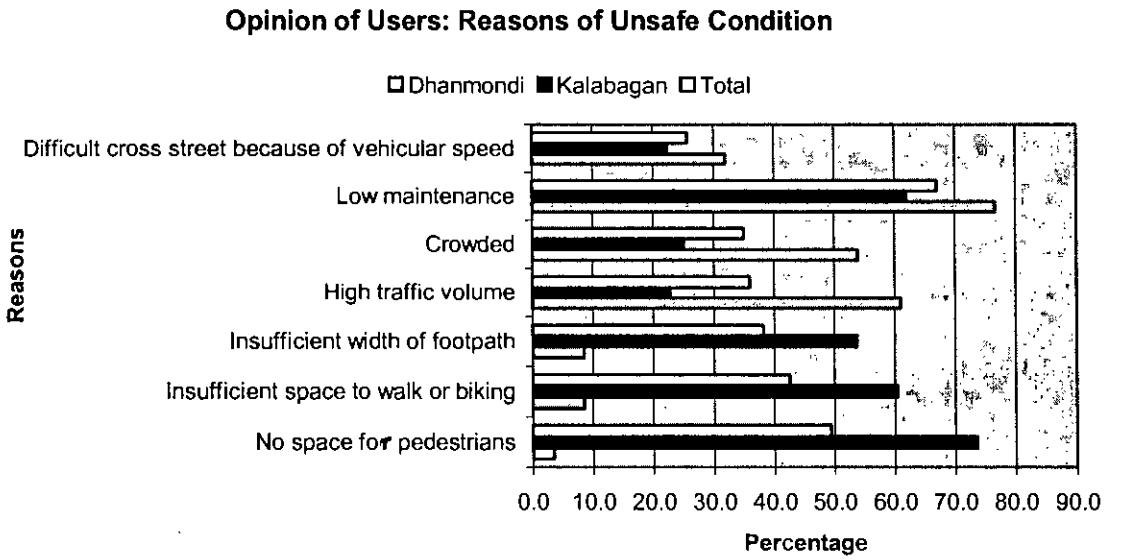


Table 6-11 Safety Condition for Bicycling and Walking

Reasons	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of opinion	Frequency	Percentage of opinion	Frequency	Percentage of opinion
No space for pedestrian	5	3.5	197	73.5	202	49.4
Insufficient space to walk or biking	12	8.5	162	60.4	174	42.5
Insufficient width of footpath	12	8.5	144	53.7	156	38.1
High traffic volume	86	61.0	61	22.8	147	35.9
Crowded condition	76	53.9	67	25.0	143	35.0
Low maintenance	108	76.6	166	61.9	274	67.0
Difficult cross street because of vehicular speed	45	31.9	60	22.4	105	25.7

Source: Field survey, 2005

6.12.2 Safety Condition of Bicycling and Walking

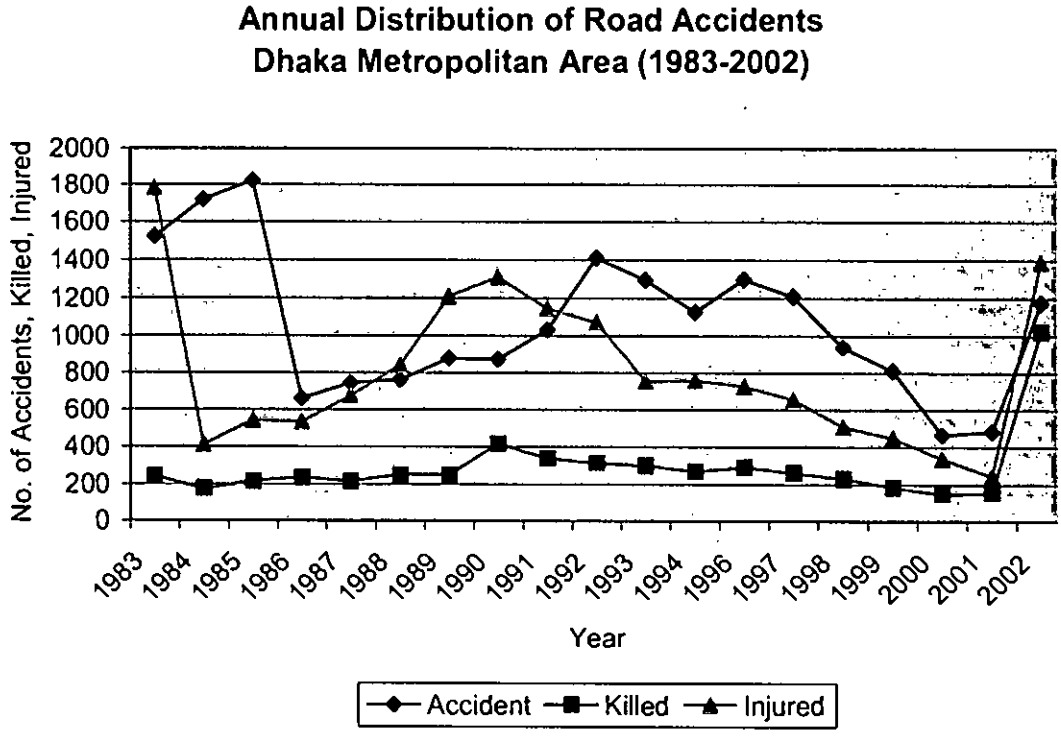
When asked about the safety condition of bicycling and walking the majority of respondents replied that both bicycling and walking in general are unsafe in Dhaka. It was found that 86.1 percent of the respondents feel unsafe to walk or biking for the reason of poor physical condition of the walking and biking facilities. This information indicated that people feel more strongly about pedestrian safety issues probably because more people walk to conduct daily activities. Table 6.11 shows the reasons of unsafe conditions for walking and biking. According to their opinion high traffic volume, crowded condition, low maintenance are the prime reasons of unsafe condition. As the streets of Kalabagan are narrow and there is no separate footpath, residents are more concern about the insufficient space to walk.

Table 6-12 Number of Road Accident in Dhaka Metropolitan Area

Year	Accident	Person	
		Killed	Injured
1983	1524	244	1782
1984	1721	176	410
1985	1824	218	544
1986	662	236	534
1987	747	217	675
1988	762	251	842
1989	880	251	1209
1990	873	417	1309
1991	1031	337	1145
1992	1411	314	1073
1993	1294	300	754
1994	1127	270	761
1995	-	-	-
1996	1298	293	727
1997	1209	262	657
1998	939	230	508
1999	813	188	448
2000	464	151	337
2001	483	160	246
2002	1176	1023	1391

Source: Police Directorate
(According to 2002 Statistical Year Book of Bangladesh, 23rd Edition and 1998 Statistical Year Book of Bangladesh, 19th Edition, Bangladesh Bureau of Statistics.)

Safe pedestrian crossing is an important issue for the walking people especially on high-speed and high traffic volume arterial roads. Pedestrians are concern about the safe street crossing. About 26% respondents' opinion is that it is unsafe because of the faster speed of the motorists. Studies have indicated that the faster a motorist drives, the higher the risk of fatal injuries to a pedestrian. Therefore, considering the pedestrian fatalities, it is necessary to reduce the speed with appropriate evaluation, to provide higher safety for pedestrians. For that purpose of safety roadway design elements and techniques can be used to reduce the speed or volume of traffic to levels consistent with road function. In addition to traffic calming measures, which blends engineering, planning and urban design to minimize adverse effects of motor vehicle speed and volume, supporting techniques that raise driver awareness and improve streets for pedestrians and bicyclists should be used. Table 6-12 shows annual distribution of road accidents, fatalities and injuries in Dhaka metropolitan area. Among fatalities and injuries pedestrians are the foremost victim that occurs at the time of street crossing.



Note: Data of the year 1995 is not available.

6.12.3 Benefits of Walking and Bicycling

Residents' opinion survey revealed that almost every respondent is aware of the benefits of walking and bicycling. Though the residents are concern about social, economic,

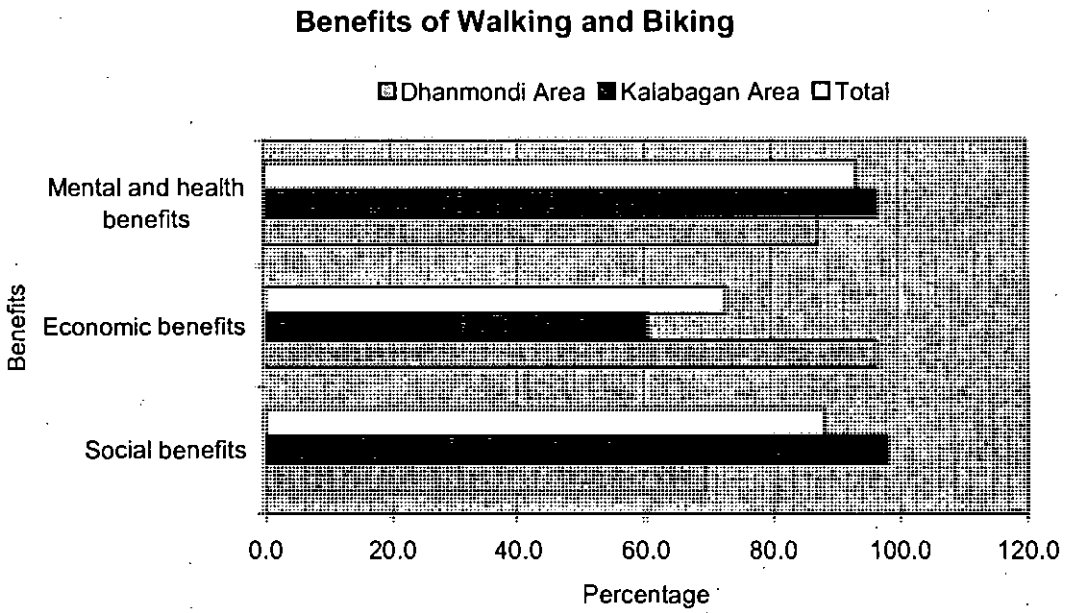
Table 6-13 Benefits of Walking and Biking

	Dhanmondi		Kalabagan		Total	
Type of Benefits	Frequency	Percentage of support	Frequency	Percentage of support	Frequency	Percentage of support
Social benefits	98	69.5	263	98.1	361	88.3
Economical benefits	136	96.5	162	60.4	298	72.9
Mental and health benefits	123	87.2	259	96.6	382	93.4

Source: Field survey, 2005.

mental and health benefits, they are not getting opportunity to walk or use bike because of the favorable walking and biking condition. Table 6-13 shows the type of benefits

that the residents would get if they have walking and biking environment. About 69.5% and 98.1% of the respondents of Dhanmondi and Kalabagan respectively support the social benefits as an outcome of walking and biking enhancement. 87.2% respondents of Dhanmondi and 96.8% respondents of Kalabagan feel that they will be benefited mentally and health wise.



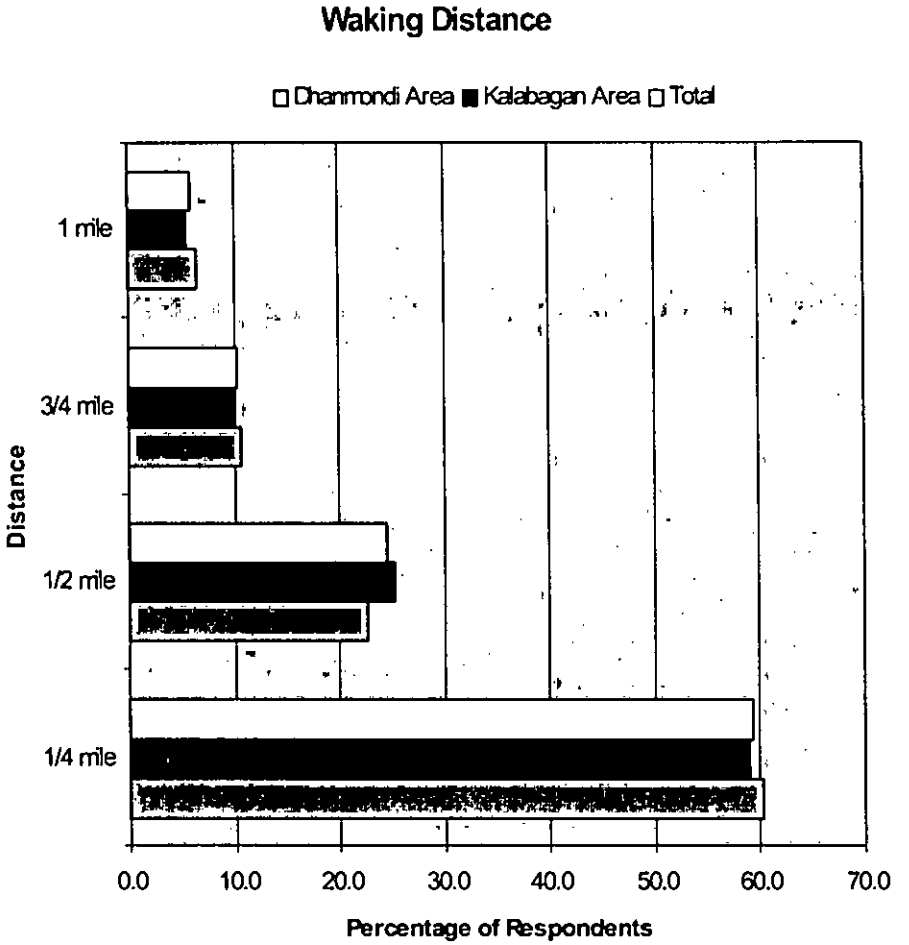
6.12.4 Walking distance

Table 6-14 Walking Distance

Distance	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of respondent	Frequency	Percentage of respondent	Frequency	Percentage of respondent
¼ mile	85	60.3	158	59.0	243	59.4
½ mile	32	22.7	68	25.4	100	24.4
¾ mile	15	10.6	27	10.1	42	10.3
1 mile	9	6.4	15	5.6	24	5.9
Total	141	100.0	268	100.0	409	100.0

Source: Field survey, 2005.

Travel time or how long it takes to reach a destination is one of the factors that influence a person's decision whether to walk or use other transport. About 80% residents like to walk one quarter of a mile. About 15% residents like to walk ½ mile. This suggests that a significant number of trips could be made on foot rather using other



travel mode if walking conditions were better. This walking distance determines the size of major grouping or hubs in a neighborhood. For placement of shopping facility, transit points etc this scale should be considered.

6.12.5 Provision of Bike Lane and Desire to Use Bike

Bike lane means a portion of a roadway, which has been designated for the preferential or exclusive use of bicycles. It is distinguished from the portion of the roadway for motor vehicle traffic by a paint strip or, similar device. Paved road shoulders are

Table 6-15 Support To Provide Bike Lane

	Dhanmondi		Kalabagan		Total	
Opinion	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
Yes (desire to have bike lane)	90	63.8	262	97.8	352	86.1
No (no desire to have bike lane)	51	36.2	6	2.2	57	13.9
Total	141	100.0	268	100.0	409	100.0

Source: Field survey, 2005

Table 6-16 Support To Provide On-street of Off- street Bike Lane

	Dhanmondi		Kalabagan		Total	
Opinion	Frequency	Percentage of respondents	Frequency	Percentage of respondents	Frequency	Percentage of respondents
On-street bike lane	61	72.6	196	74.8	257	74.3
Off-street bike lane	23	27.4	66	25.2	89	25.7
Total	84	100.0	262	100.0	346	100.0

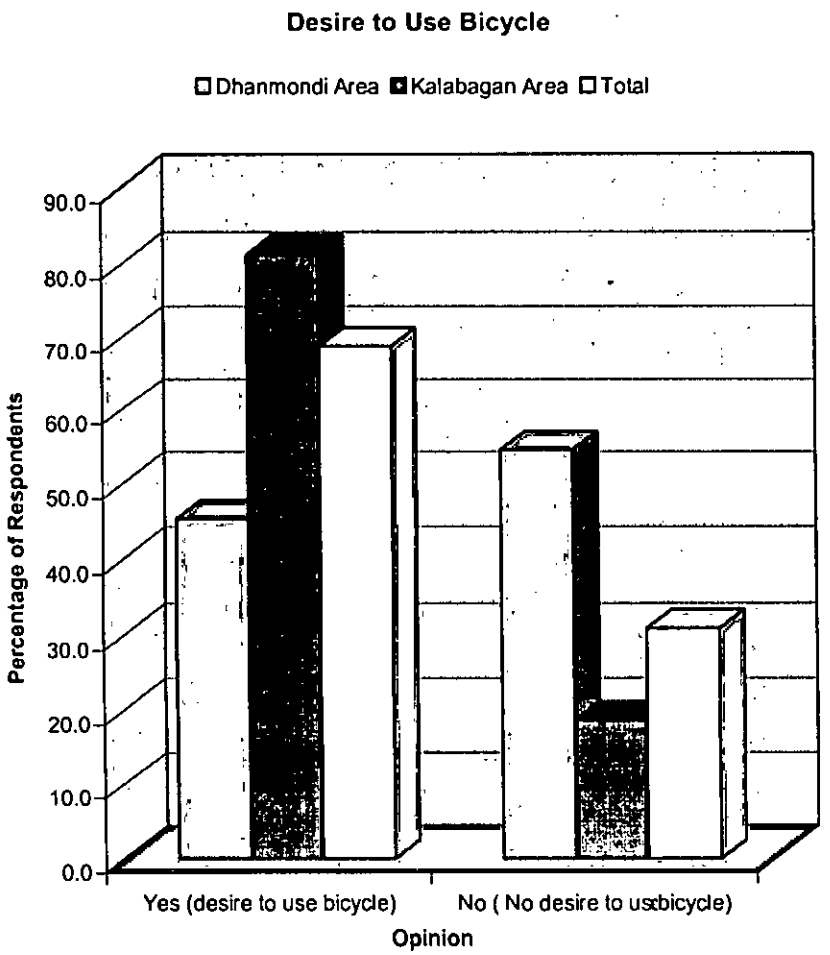
Source: Field survey, 2005

Table 6.17 Desire to Use Bicycle

Opinion	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of respondent	Frequency	Percentage of respondent	Frequency	Percentage of respondent
Yes (desire to use bicycle)	64	45.4	218	81.3	282	68.9
No (No desire to us bicycle)	77	54.6	50	18.7	127	31.1
Total	141	100.0	268	100.0	409	100.0

Source: Field survey, 2005.

considered as bicycle lane, about 63.8% and 97.8% percent respondents of Dhanmondi and Kalabagan area support to have bike lanes in the street network respectively. About 73% and 75% percent respondent of Dhanmondi and Kalabagan area respectively desire to have on-street bike lane. As a whole about 26% percent respondent of Dhanmondi and Kalabagan area desire to have on-street bike lane, because they are afraid of using on-street bike lane, they are more concern about violation of traffic rules by the drivers; drivers unawareness about the bicyclist's right of way. Regarding the use of bicycle, when they were asked whether they will use bicycle if bike lanes are provided, about 45% and 81% respondents of Dhanmondi and Kalabagan area respectively answered positively.



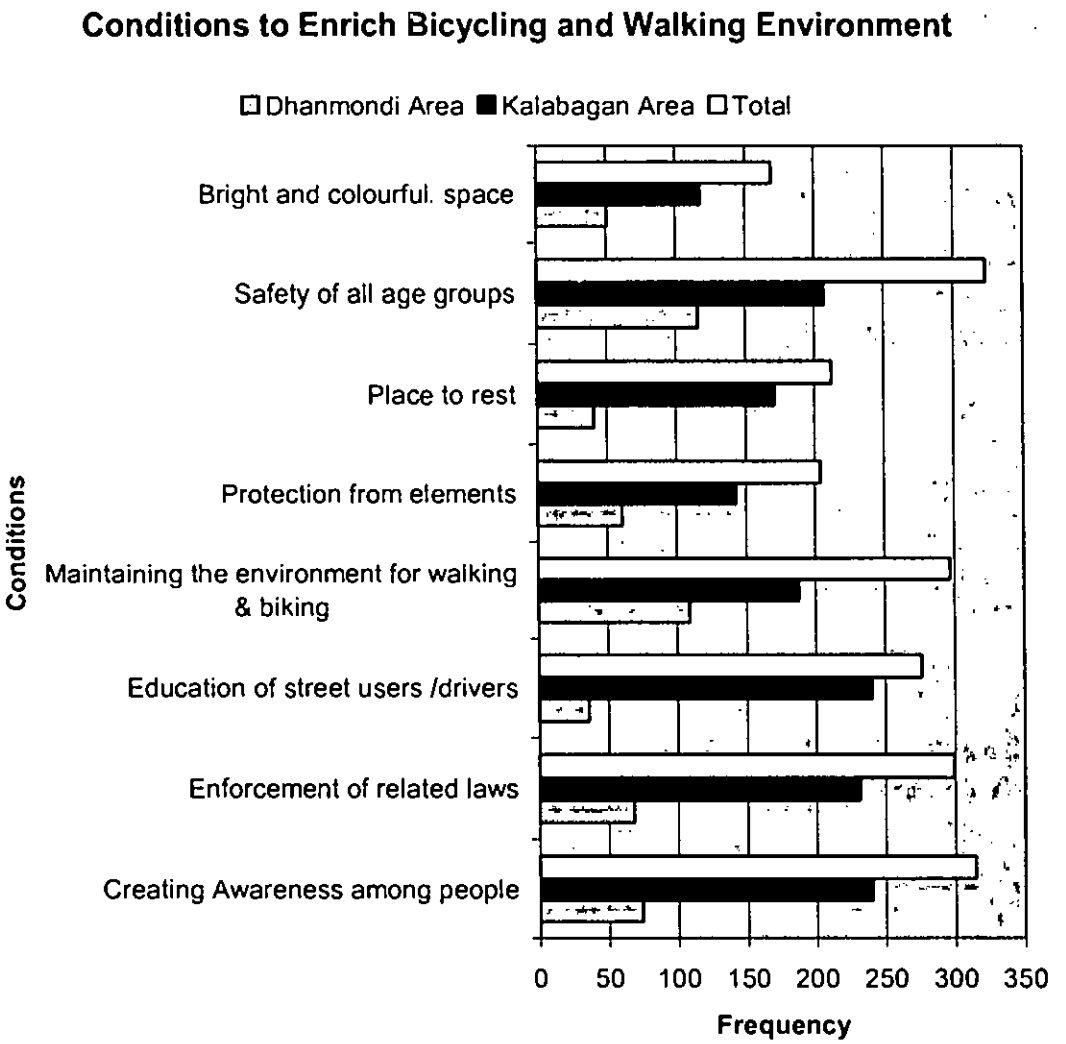
6.12.6 Desired Conditions for Walking and Bicycling

Tables 6-18 Desired Conditions for Walking and Bicycling

Conditions	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of response	Frequency	Percentage of response	Frequency	Percentage of response
Creating awareness among people	74	52.5	240	89.6	314	76.8
Enforcement of related laws	68	48.2	231	86.2	299	73.1
Education of street users /drivers	36	25.5	240	89.6	276	67.5
Maintaining the environment for walking & biking	109	77.3	188	70.1	297	72.6
Protection from elements	61	43.3	143	53.4	204	49.9
Place to rest	41	29.1	171	63.8	212	51.8
Safety of all age groups	116	82.3	207	77.2	323	79.0
Bright and colourful space	51	36.2	118	44.0	169	41.3

Source: Field survey, 2005.

Pedestrian and bicyclist oriented street network planning and design; education and awareness of the street users both motorist and non- motorist; traffic related laws and their enforcement; promotion and encouragement for walking and biking are the prerequisite for the development of pedestrian and biking situation. When asked the respondents about the conditions to enrich the walking and biking environment they responded as shown in Table-6.18. Creating awareness among people is the highest-ranking opinion for enrichment of walking and biking environment.



6.12.7 Social Bonding and Neighborhood Environment

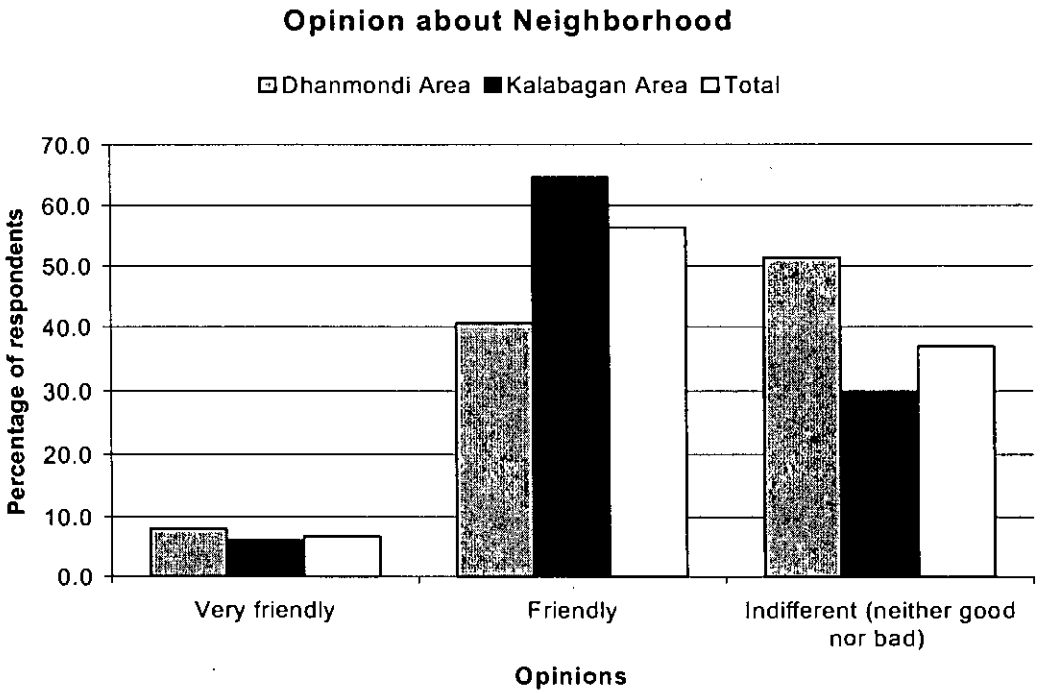
Social interaction allows people to communicate with one another, and helps to build a sense of community. As walking offers opportunities for personal interaction with the neighbors, it creates social bonding. When asked for the opinion about the neighbor

Table 6-19 Opinion regarding the Neighbors

Opinions	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of respondent	Frequency	Percentage of respondent	Frequency	Percentage of respondent
Very friendly	11	7.8	16	6.0	27	6.6
Friendly	56	39.7	173	64.6	229	56.0
Indifferent	74	52.5	79	29.5	153	37.4
Total	141	100	268	100	409	100

Source: Field survey, 2005.

with three options - very friendly, friendly and indifferent most of the respondents' answered 'Friendly'. Table 6-19 shows the respondents feelings about their neighbors. As a whole more than one third of the respondent of Dhanmondi and Kalabagan says that the relation with the neighbor is neither good nor bad. Interaction with the neighbor is one of the important aspects for development of social relationships, social bonding, at the same time neighborhood feelings. As stated in section 4.10.3, Chapter 4, the more people meet each other on the street, the stronger and safe the neighbors. But presently such a feeling is totally lacking in the neighborhoods.



Regarding the enrichment of social bonding, when the residents were asked, whether

Table 6-20 Opinion Regarding Social Bonding

Opinions	Dhanmondi		Kalabagan		Total	
	Frequency	Percentage of respondent	Frequency	Percentage of respondent	Frequency	Percentage of respondent
Yes (will create social bonding)	131	92.9	262	97.8	393	96.1
No (will not create social bonding)	10	7.1	6	2.2	16	3.9
Total	141	100.0	268	100.0	409	100.0

Source: Field survey, 2005.

walking and biking environment in a neighborhood can offer the opportunity for more people to meet each other i.e., the interaction among the neighbors and thus develop friendly relationship and develop a strong social bonding.

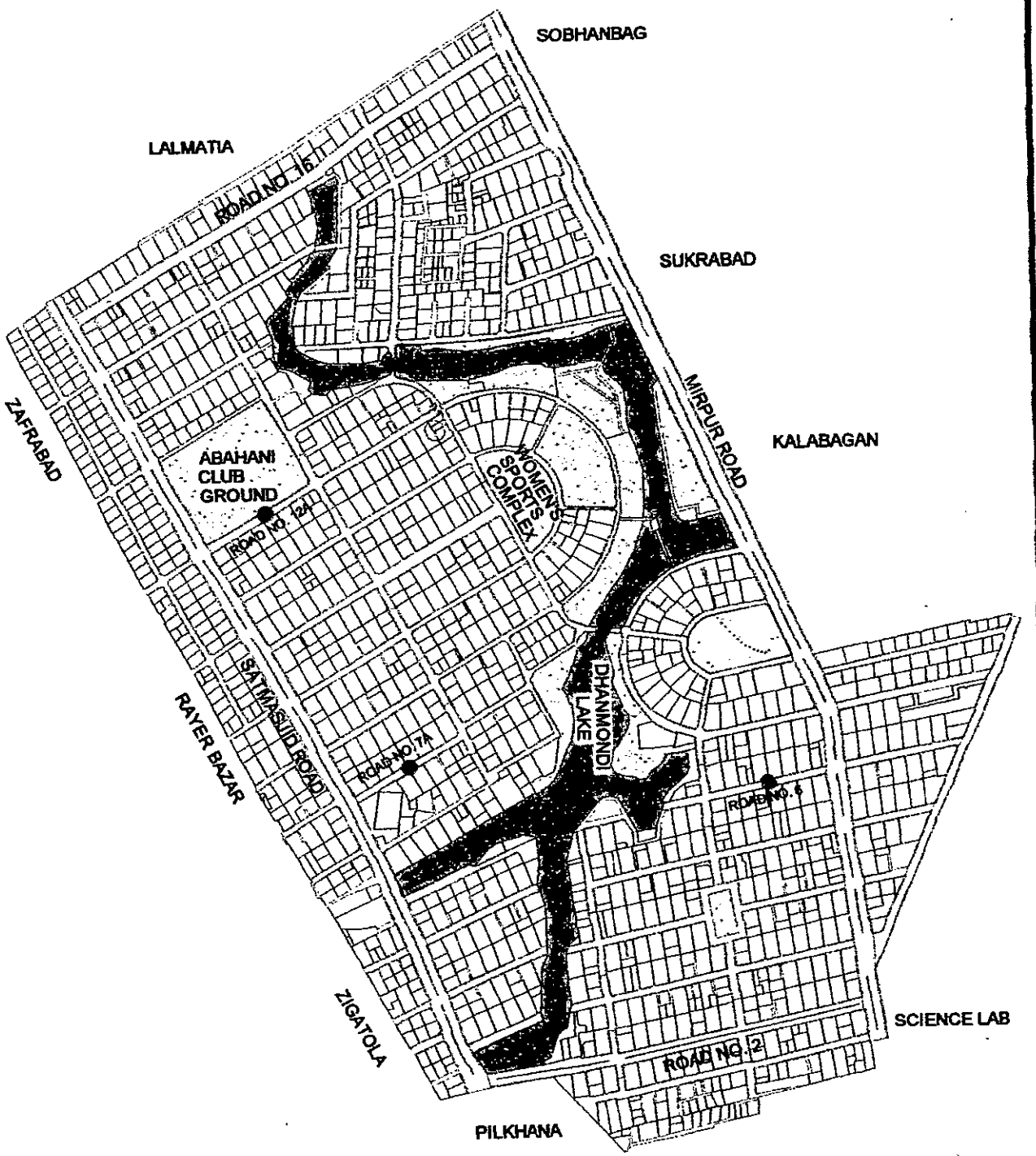
6.13 Pedestrian Level of Service (LOS) in Dhanmondi Area

For pedestrian traffic, LOS is a measure of adequacy of walkway facilities. Design procedures for walkways are referenced to LOS standards. Five walkways were selected here to find LOS in Dhanmondi area. Effective walkway width is an important component to find LOS. The width of a walkway that can effectively be used by pedestrians is called as clear walkway width or effective walkway width. Poles, signs and benches, for example reduce the effective walkway width. Typical obstructions and the estimated width of walkways that they preempt are provided in Appendix- D, Table D-1, and an example of walkway widths curtained by curbs and buildings are shown in Appendix- D, Figure- D-1. An average effective width of the walkway of the study walkway is 2ft.

To count the pedestrian flow five "points" were selected in Dhanmondi area. Two points were selected at Road No. 11 and Road No. 8 near the bridges. Other three "points" were selected at Road No 12A, 7A, and 6. In all cases pedestrian flow on only one side of the street on the walkway was taken into consideration (see Map 6.9). In Kalabagan area street network is without separate walkways for pedestrians, pedestrians and vehicles use the same carriageways simultaneously. Diagrams on the next pages shows 15-minutes period pedestrian flow in Dhanmondi area.

Based on the level of service standards as shown in Appendix-D, Fig. D-2, the survey data were analyzed and calculated LOS at different "points" are shown in Table 6-21. Here peak 15-minute period of flow was used as the basis for analysis.

Map 6.9
Dhanmondi Area Map Shows
Location of Survey "Points".



LEGEND

● Survey "Points"

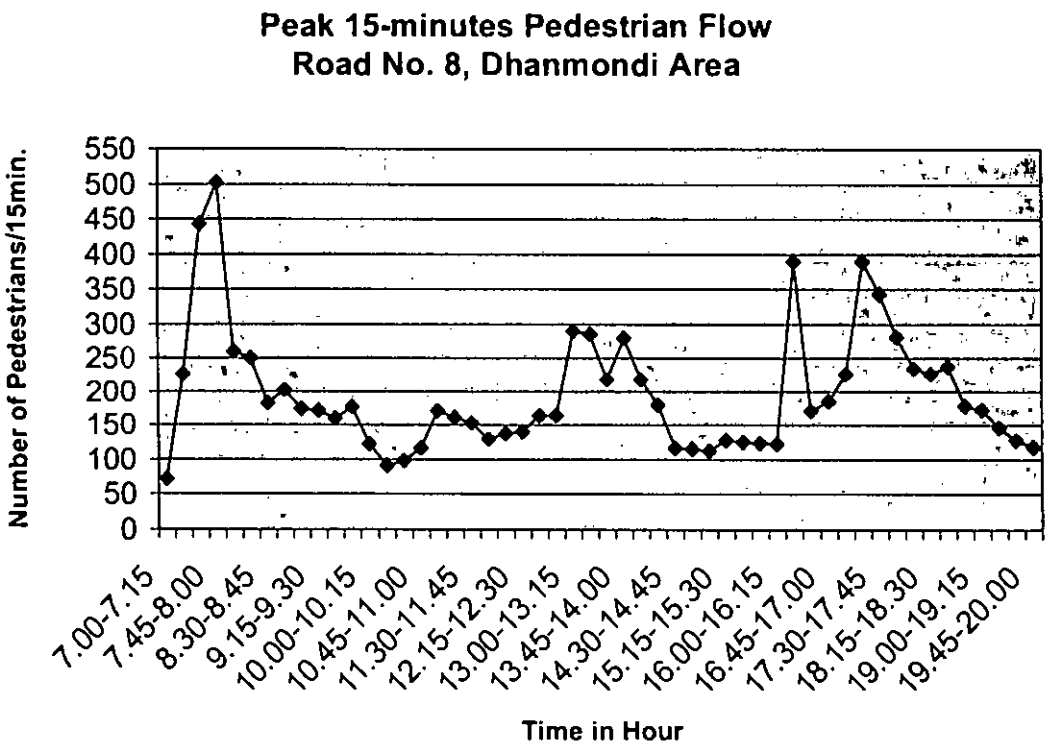
Table 6-21 Sidewalk Level of Service (LOS) in Dhanmondi Area

Survey "points"	Flow rate (ped/min/ft) [a]	Level of service (LOS)
Road No.8	16.73	E
Road No.11	6.77	B
Road No.12A	6.20	B
Road No.7A	10.77	D
Road No.6	4.47	A

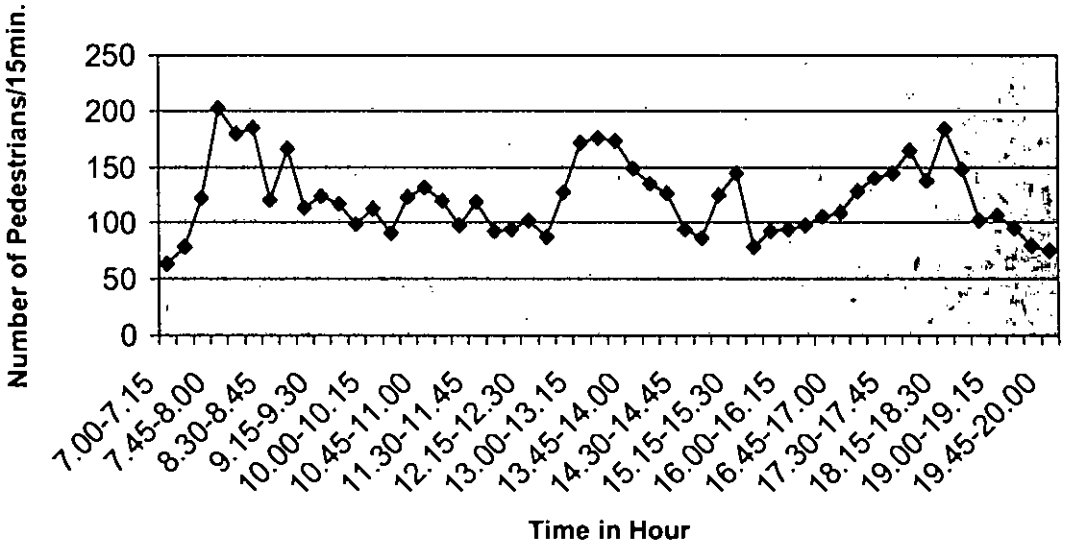
[a] Peak 15-minutes period of pedestrian flow.

Source: Field survey, 2005.

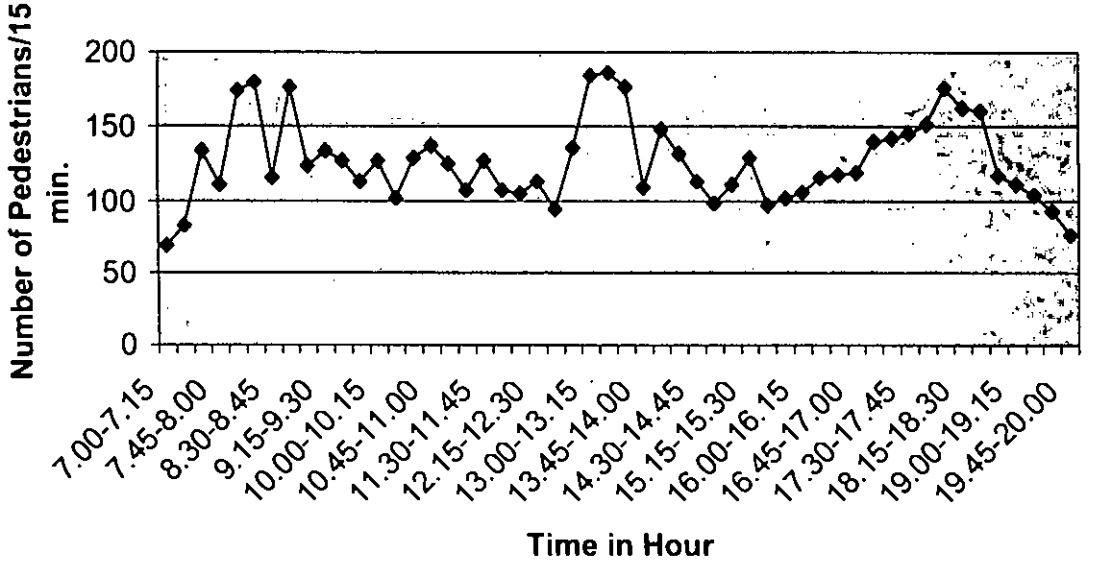
From the graphical illustration it is found that peak time varies for different walkways in Dhanmondi area. Pedestrian flow is intensive in morning especially between hours 7.30 and 8.15, because most people start traveling to their work places. From the observation it is found that the pedestrian flow is intensified by the garments workers using the walkways of Road No. 8 and Road No 7A. Walkway of Road No 8 is in LOS –E, in this level of service virtually all pedestrians restrict their normal walking speed, frequently adjusting their gait. Space is not sufficient for passing slower pedestrians. Crossing flow or reverse flow movements are possible only with extreme difficulties.

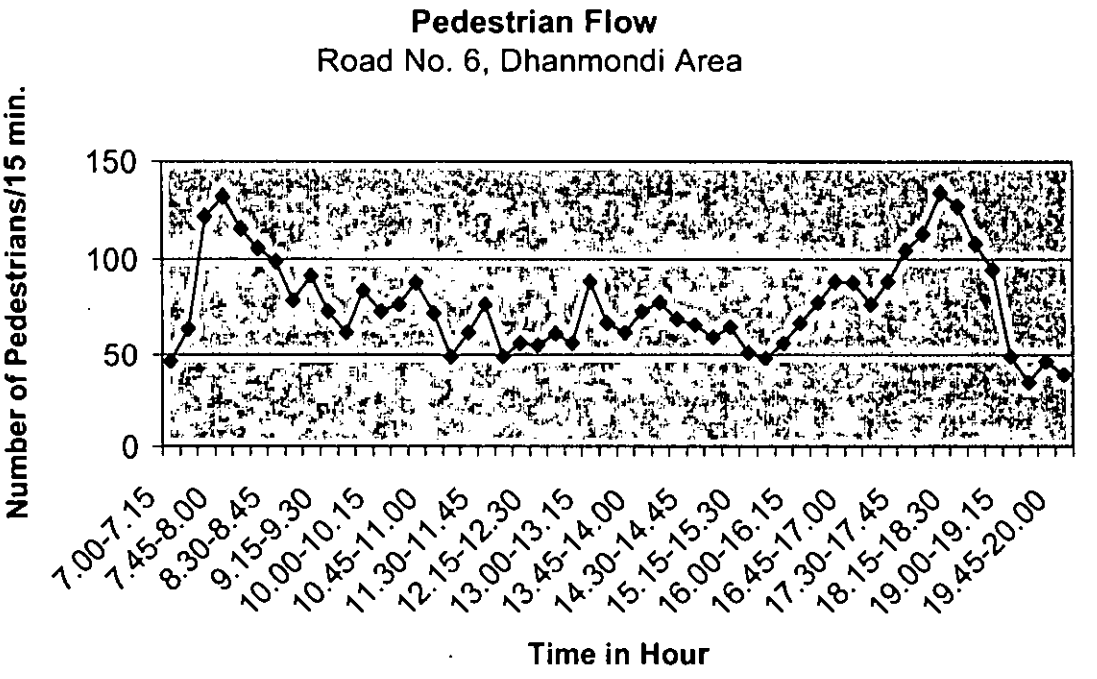


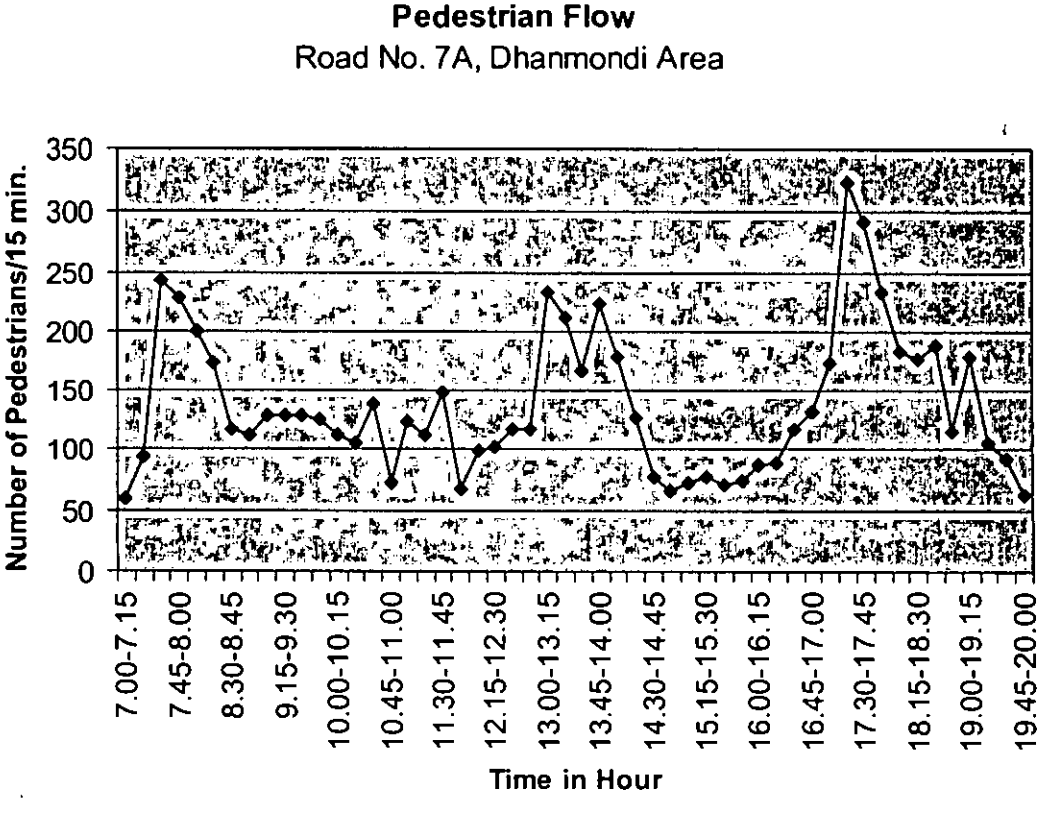
Pedestrian Flow
Road No. 11, Dhanmondi Area



Pedestrian Flow
Road No. 12A, Dhanmondi Area







Above graphs show the pattern of pedestrian flow in different walkways in Dhanmondi area. These show the patterns of pedestrian flow in different walkways are deferent from each other. Pedestrian flow is more on walkways of Road No 8 near the bridge, as

these walkways are used to cross the area from west to east and vice versa. Pedestrians from Zigatola area use these walkways to go to Kalabagan and Green Road area. Though the level of service standards (LOS) of the walkways are relatively in good position, according to users opinion in average the discontinuity of walkways, low maintenance, unauthorized occupy are more common factors responsible for undesirable walking condition in Dhanmondi area.

CHAPTER 7

CONCLUSION AND RECOMMENDATION

CHAPTER 7
CONCLUSION AND RECOMMENDATION

7.1 Introduction

This chapter contains recommendations based on the findings of the study. The recommendations are specifically for the two study areas i.e., Dhanmondi and Kalabagan but which can be applied for the overall improvement of pedestrians and bicyclists environment in Dhaka. The major purpose of this research was to investigate the prevailing conditions of pedestrians and bicyclists environment in the residential neighborhoods of Dhaka and to search means for accommodating them. A comparison was made with standards required for planning and designing walkable and biking friendly environment with the existing conditions prevailing in the neighborhoods. This study revealed that neighborhoods of Dhaka, specially Dhanmondi Residential Area and Kalabagan Residential Area, are not pedestrian nor biker friendly environment.

An extensive literature survey provided substantial evidences in support of bicycling and walking that promotes environment friendly modes of transportation and which also greatly enhances personal and social well-being. It has been seen from previous reports and studies that both act as important modes of transportation for utilitarian and recreational purposes and consequently affect public health, social, and economic well-being. Surveys of the two residential neighborhoods reveled that, automobile ownership is not always an option for the citizen of Dhaka, most people have no choice but to walk or use bicycle and the number of these people is quite large. For these reasons it is desirable to facilitate and create a desirable environment for walking and bicycling.

Thus, this study affirms the need to provide a safe, convenient and accessible environment for bicyclists and pedestrians that will be used for utilitarian and recreational purposes. To ensure a desirable environment for pedestrians and bicyclists all transportation projects, neighborhood development projects, etc should take into consideration and consider bicyclist and pedestrian needs. Bicycle and pedestrian systems should provide mobility and links with other transportation network and modes,

to enhance mobility within the city and quality of the community, and to improve the overall quality of life in the city.

With these in view recommendations are based on the following facts,

i. to accommodate the pedestrians and the bicyclists in Kalabagan;

ii. to accommodate the pedestrians and the bicyclists in Dhanmondi;

iii. legal and policy measures required to make all plans workable;

iv. the need for community/ local peoples' active involvement.

The first two points need to be spelled out with maps and diagrams, so that the process of accommodating the pedestrians and bicyclists in the neighborhoods is easily understood and rendered implementable.

Photo 7.1 Street without walkway-This street is wide enough to provide walkway for pedestrians, Kalabagan.

Since Kalabagan is an unplanned area, it will be evident from the following sections, that local peoples' involvement is absolutely necessary to accommodate the pedestrians and bicyclists in the neighborhoods of Kalabagan and Dhanmondi. Some legal and policy measures will also need to be adopted to work out a plan to accommodate the pedestrians and bicyclists in the residential neighborhoods of Kalabagan and Dhanmondi. This chapter now begins by showing means of accommodating the pedestrians and bicyclists in Kalabagan and Dhanmondi residential area.

7.2 Process of Accommodating the Pedestrians and Bicyclists in Kalabagan

From the study it was found that vehicle ownership in Kalabagan is low. Among the household surveyed, only 4.1% households have their own transport. Residents are more dependent on public transport. To access public transports they use to walk or use rickshaw to go to the main streets or transit spots to avail them. A small number of bicycle ownership was also found in Kalabagan. Pedestrians' opinions indicate that they are eager to walk or use bike to make trip, indicating that if walking and biking environments are improved it may be possible to make the community walking friendly that will also enhance social interaction and social bonding as well among the local residents

To make the community pedestrian friendly, it is required to develop and improve the physical condition of the streets. The following points need to be taken in mind while planning to accommodate pedestrians and bicyclists.

- Some streets of Kalabagan are wide enough to provide walkway for pedestrians, see Photo 7.1.
- Where streets are not wide enough, to provide walkway, a wall may be required to be demolished or the open drains covered.
- Restriction should be placed on the use of adjacent plots for commercial use that generates activities creating manifold problems for the pedestrians.
- Streets need to be paved to remove potholes and sewer-covers leveled down to the street to facilitate smooth flow of all kinds of traffic.
- Interlinking dead-end streets with the nearest to facilitate pedestrian movements. (e.g. provided with Figure 7.1 and Figure 7.2)
- Creating temporary parking space between buildings and prohibit on-street parking.
- Relocate boundary wall between adjacent properties to facilitate accommodation of parking space.
- Relocate boundary wall to accommodate continuous walkways.
- Ask residents to lower heights of boundary walls or create see-through walls to enhance visibility, vigilance, etc.
- Street to be widened where required by relocating walls.

7.2. 1 Interlinking Dead End Streets

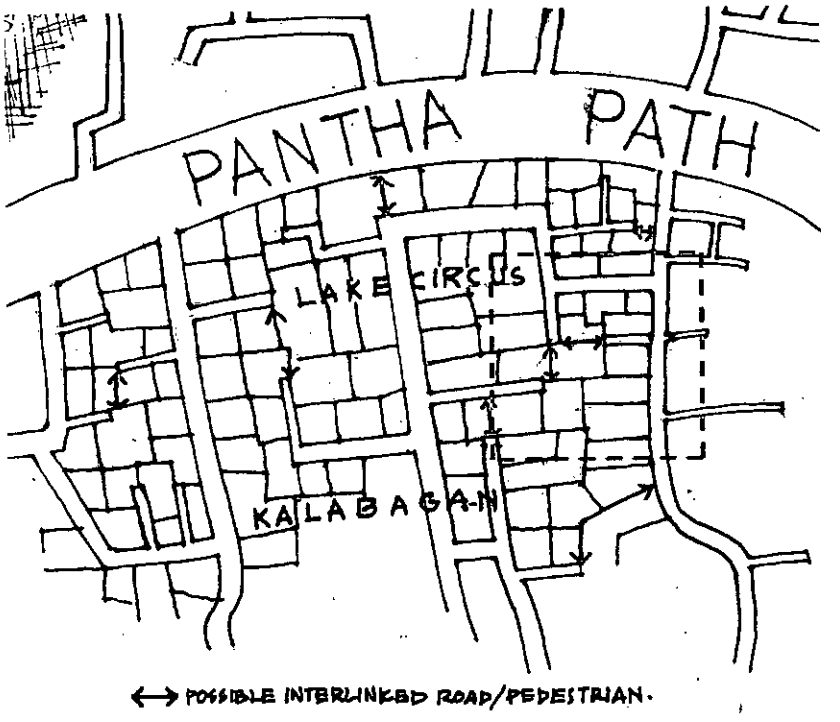


Fig 7.1 Most of the streets are of dead end type which should be linked with each other to enhance mobility for pedestrians.

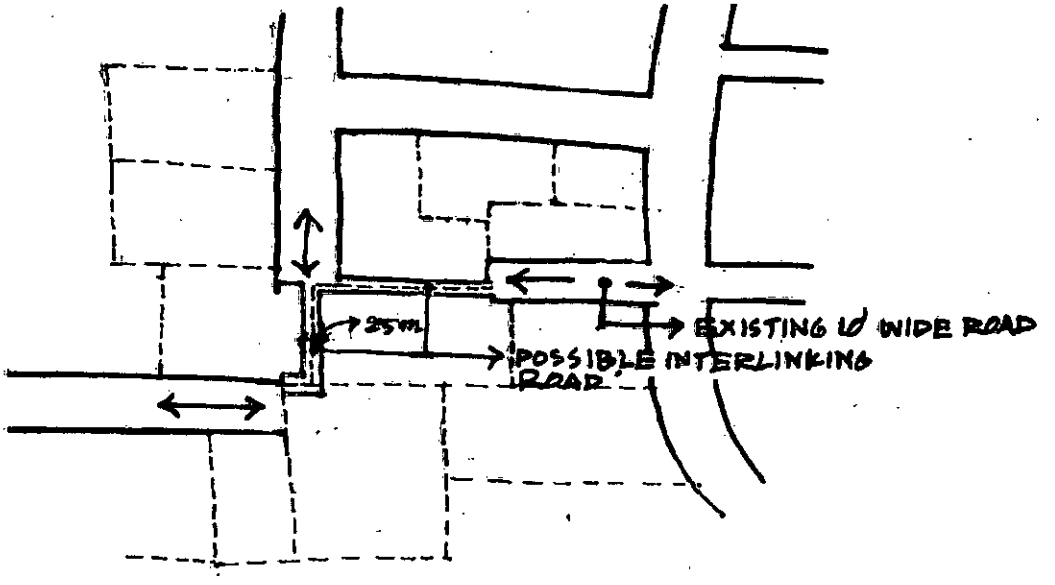


Fig. 7.2 Blowup area of Fig. 7.1 showing dead end street with probable linkages

From the study on Kalabagan area it was found that most of the streets here are of dead end type. A pedestrian has to walk more loop distances to commute from one location to another, though they are in close proximity, as shown in Figure 7.1.

To reduce the walking distance it is recommended to link the dead end streets by relocating the adjacent boundary wall which could link the dead end streets with keeping the plot demarcations same. This is shown in Figure 7.1 and Figure 7.2.The proposed linking of streets will not only accommodate pedestrian and bicyclists but also enrich community vigilance and social interactions.

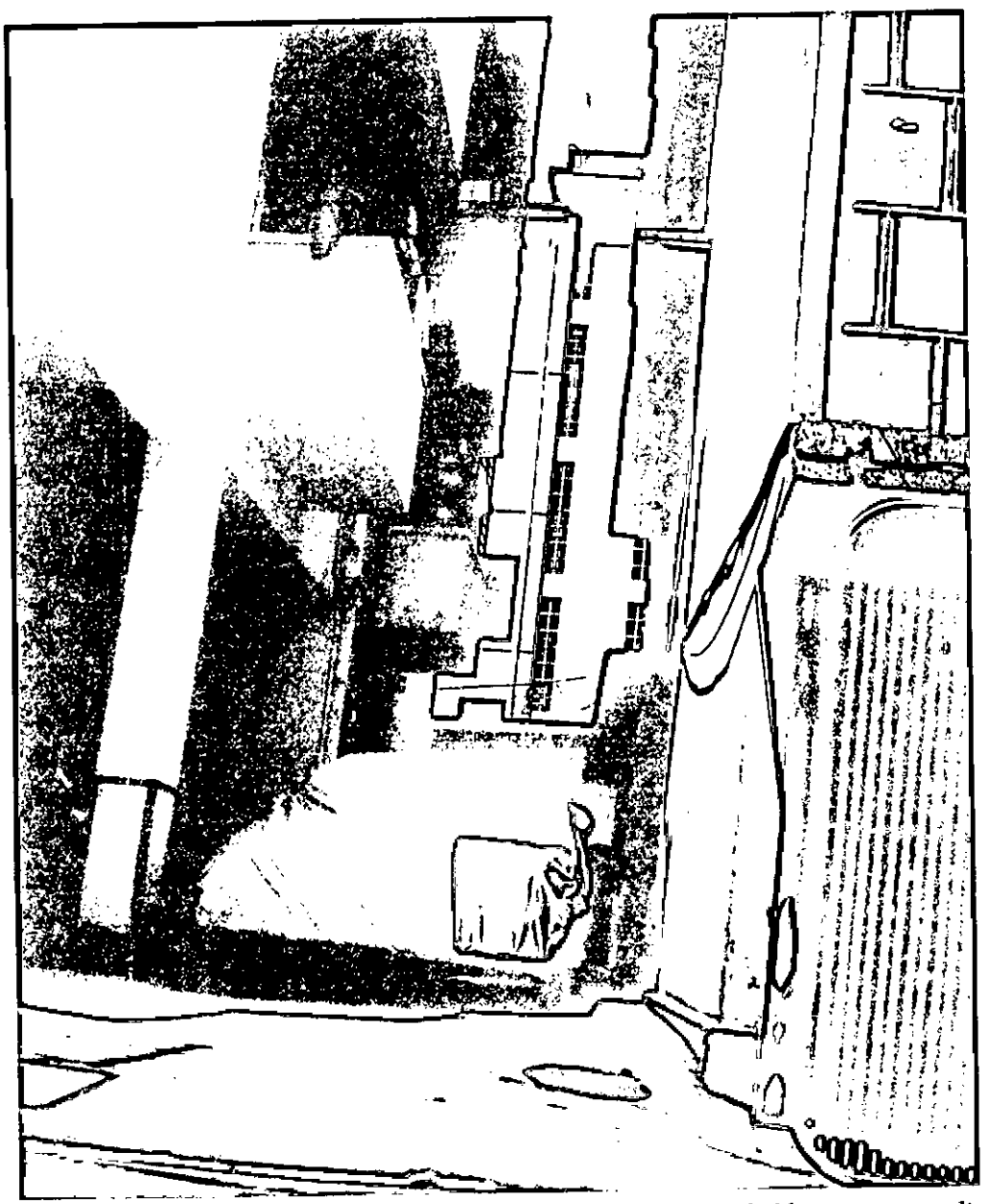


Photo 7.2 Short time or occasional parking space can be provided between two adjacent plots in Kalabagan area

7.2.2 Creating Space for Short Time or Occasional Parking

Fig 7.3 A typical streetscape of Kalabagan area showing probable accommodation of short term or occasional parking space between two adjacent plots

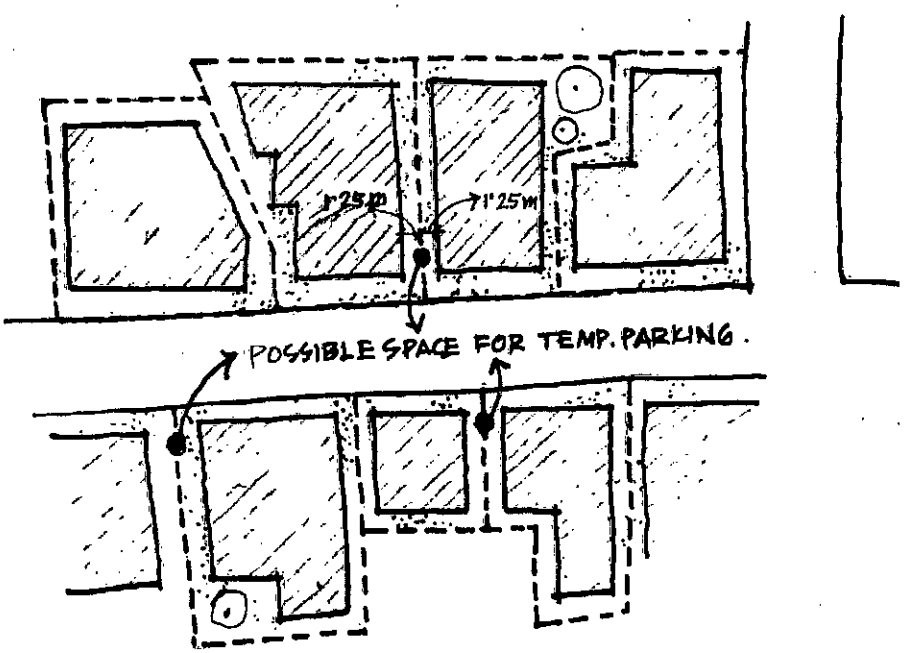


Fig 7.4 Layout plan shows probable accommodation of short term or occasional parking space between two adjacent plots

The study shows that usual road side or on-street parking hampers smooth flow of walking people as well as other transports. To minimise this problem it space for short time or occasional parking needs to be created. Existing RAJUK setback rule [Building Construction Act, 1996, Section 18(4)] for the plots size of 268sqm or above, it is

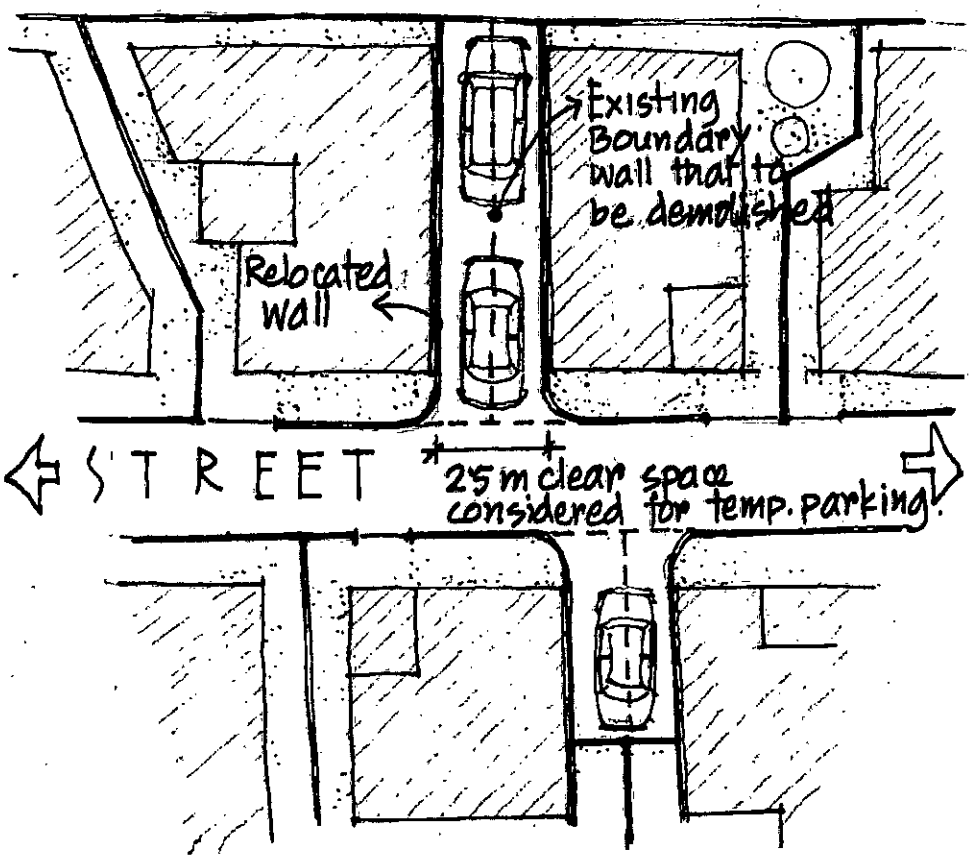


Fig 7.5 Blowup of Fig.7.4 shows the accommodation of short term or occasional parking

mandatory to keep 1.25m wide open space on both sides of the building. Together it becomes a total of 2.50m wide open space between two adjacent buildings (Fig. 7.4 &7.5). By relocating or removing the common boundary wall between two adjacent plots will generate 2.50m wide strip of land which can be used for short time or occasional parking. Such parking space will allow short time or occasional parking problem and also minimize the roadside parking problem. Local children can also use these spaces as play areas.

7.2. 3 Creating Wide Street Affect

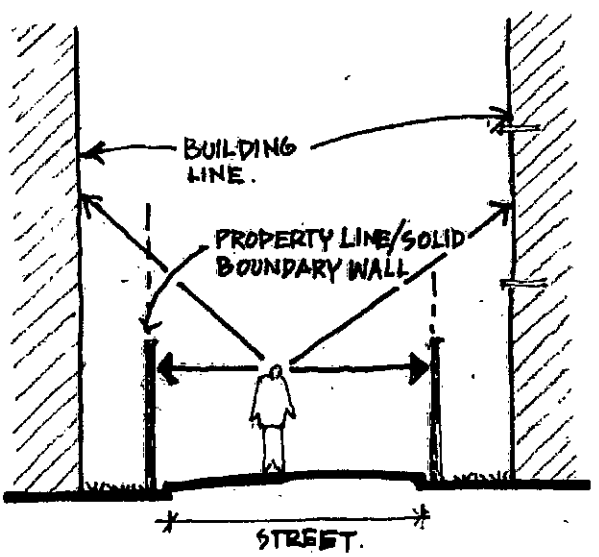


Fig.7.6 High or solid boundary walls by the sides of a narrow street create constricted or a tunnel effect

High and solid boundary walls by the sides of a narrow street create constricted or a tunnel effect and also reduce daylight on the streets, which degrades walking and biking environment (see Figure 7.6). To produce a visually wide street and allow more natural light on the street the height of boundary walls may be lowered or made see-through. Height of solid boundary walls height should not exceed 1.5 m and higher boundary walls which are more than 1.5m high should be transparent or see-through. This will create positive lively walking environment and increase community vigilance.

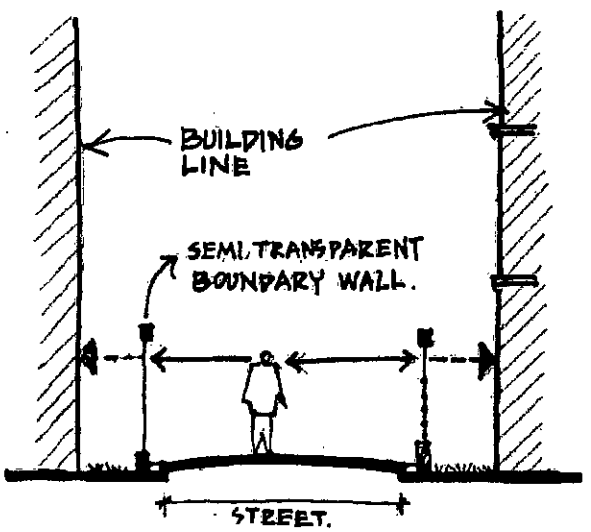


Fig.7.7 Boundary walls should be transparent or see-through to give wider street affect

- Enlarging the expanse of the existing street by creating low and more transparent walls. This will also have positive effects on pedestrians and bikers. This will also encourage more interaction among neighbors.
- Modification of setback rule for the particular neighborhood for the pedestrians and bikers.

7.2. 4 Creating Walkways in Existing Street Network

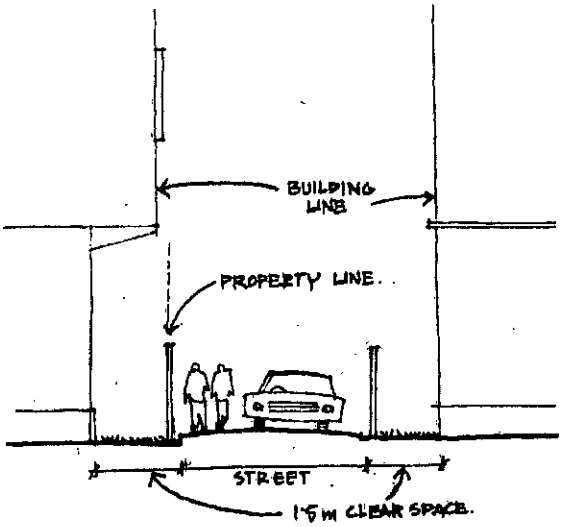


Fig.7.8 Existing setback of 1.50m strip of land may create opportunity for accommodating walkways

According to existing RAJUK setback rules [Building Construction Act, 1996, Section 8(5)] it is mandatory to keep the building minimum 1.50m off the property line i.e. from the street edge. As the streets of Kalabagan area do not have any walkways, it is recommended that this 1.50m strip of land be contributed for creating for pedestrian walkways. This type of street modification or development not only separate pedestrians

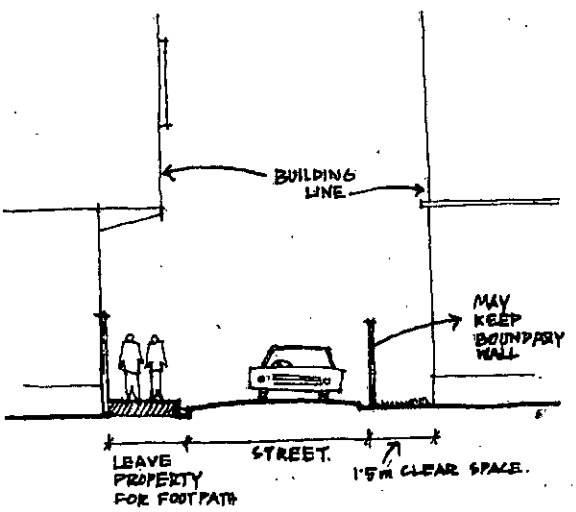


Fig.7.9 Relocation of boundary wall may create opportunity for accommodating walkways.

from vehicles but also help generate space for biking and thus reduce the conflict between non-motorized transport and motorized transport. In order to encourage local people to contribute their land for walkway accommodation certain degree of holding tax rebate provision may be introduced for limited time.

It was observed that most of the buildings were constructed in Kalabagan area keeping approximately 1.5m wide open space in front of the building within the boundary wall. At least structural columns are placed about 1.5m away from property line in ground floor but some buildings are projected up to the property line by 1.5 m above the ground floor. Walkways may created under the projected part of building with active community participation and law enforcement.

To implement the above recommendations it may require minor modification of use or functional arrangement of ground floor area. Those functions, which require less privacy, such as parking area, storage etc are may be arranged in ground floor. There are previous examples of street widening by local people around Dhanmondi area; because people are eager to create livable environment in the community.

Photo.7.3 View of a street to in Lakecircus, Kalabagan deserves accommodation of walkway

Fig.7.10 View of a street to in Lakecircus, Kalabagan with probable accommodation of walkway

7.3 Process of Accommodating Pedestrians and Bicyclists in Dhanmondi Residential Area

In Dhanmondi residential area pedestrian facilities are better than Kalabagan. The streets are wide enough and have walkways on both sides. As the street layout of the area is in grid iron pattern, it provides more options to the pedestrians and bicyclists. As some streets of the area are being used as thoroughfare, it generates unwanted traffic

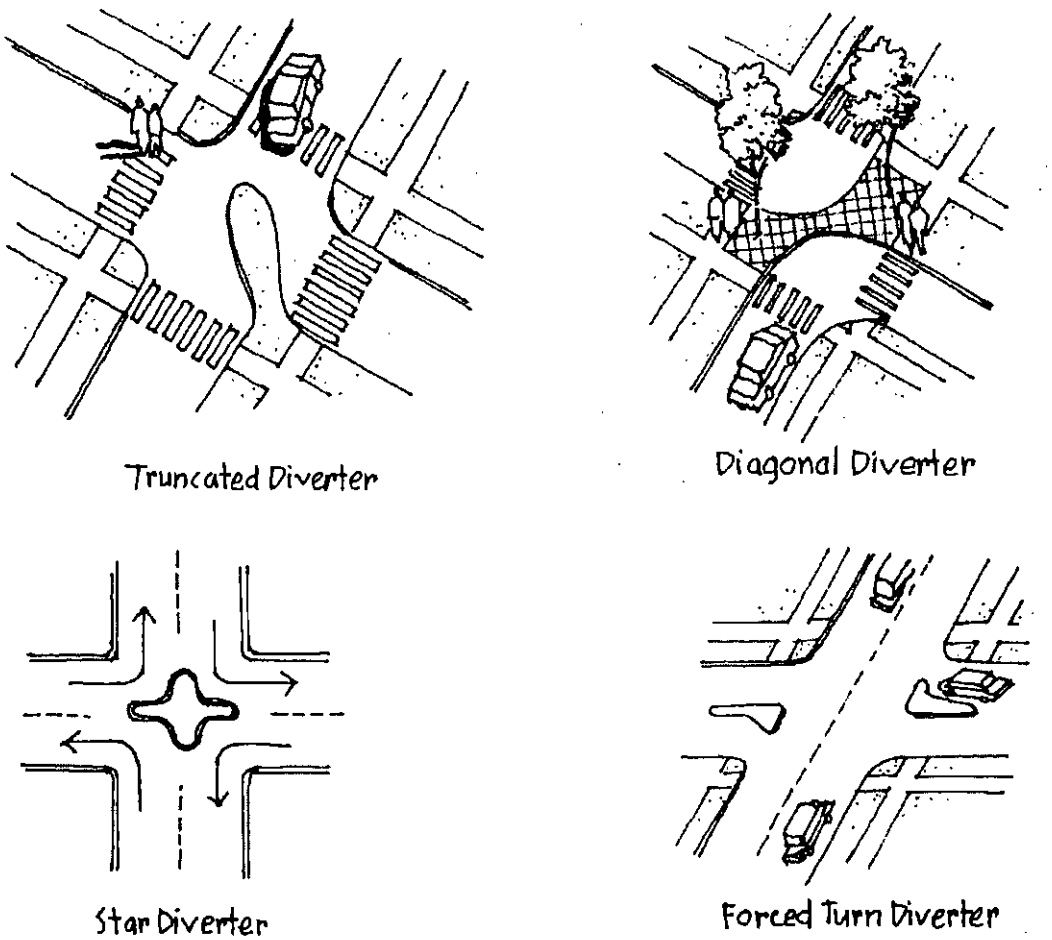
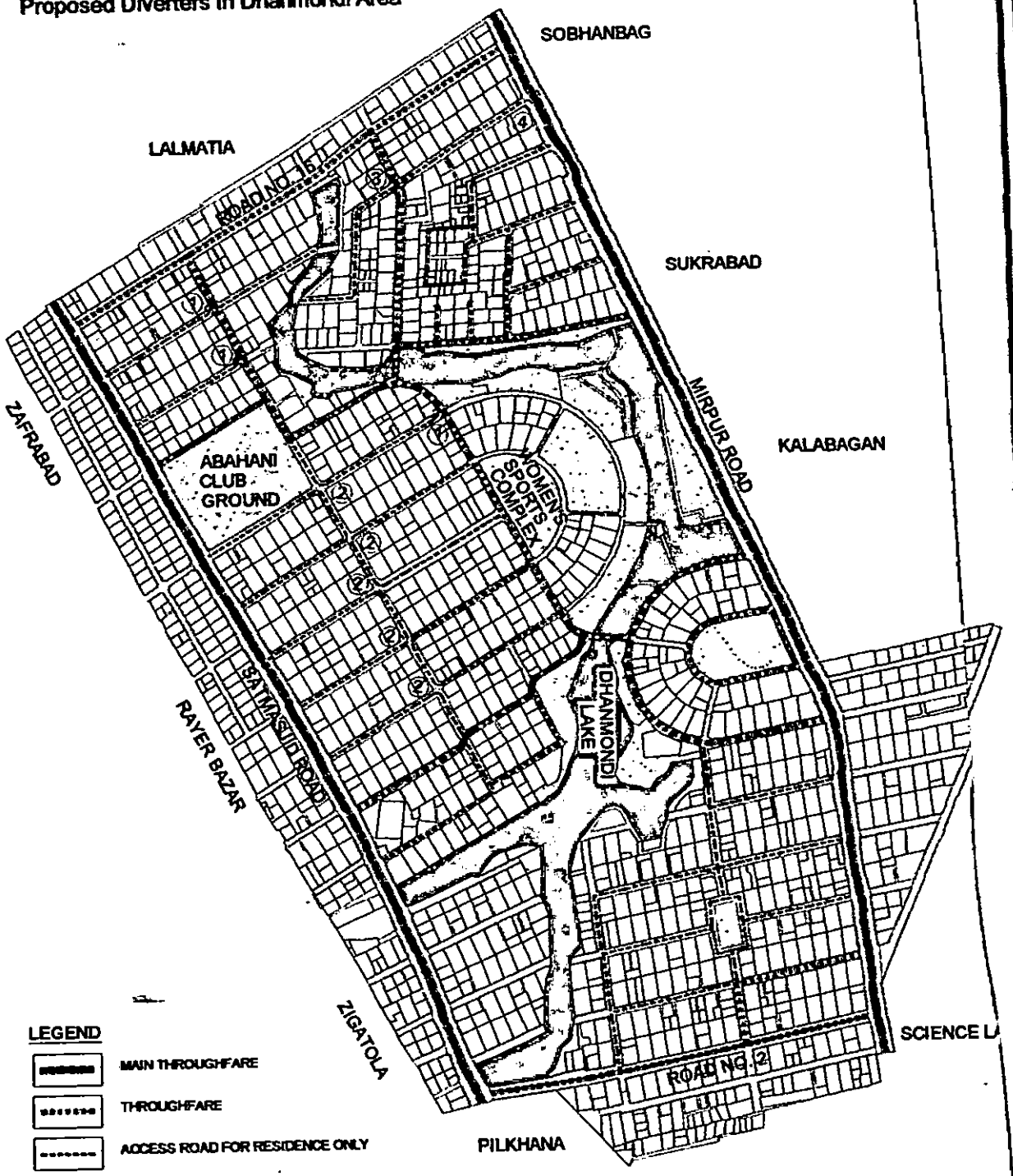


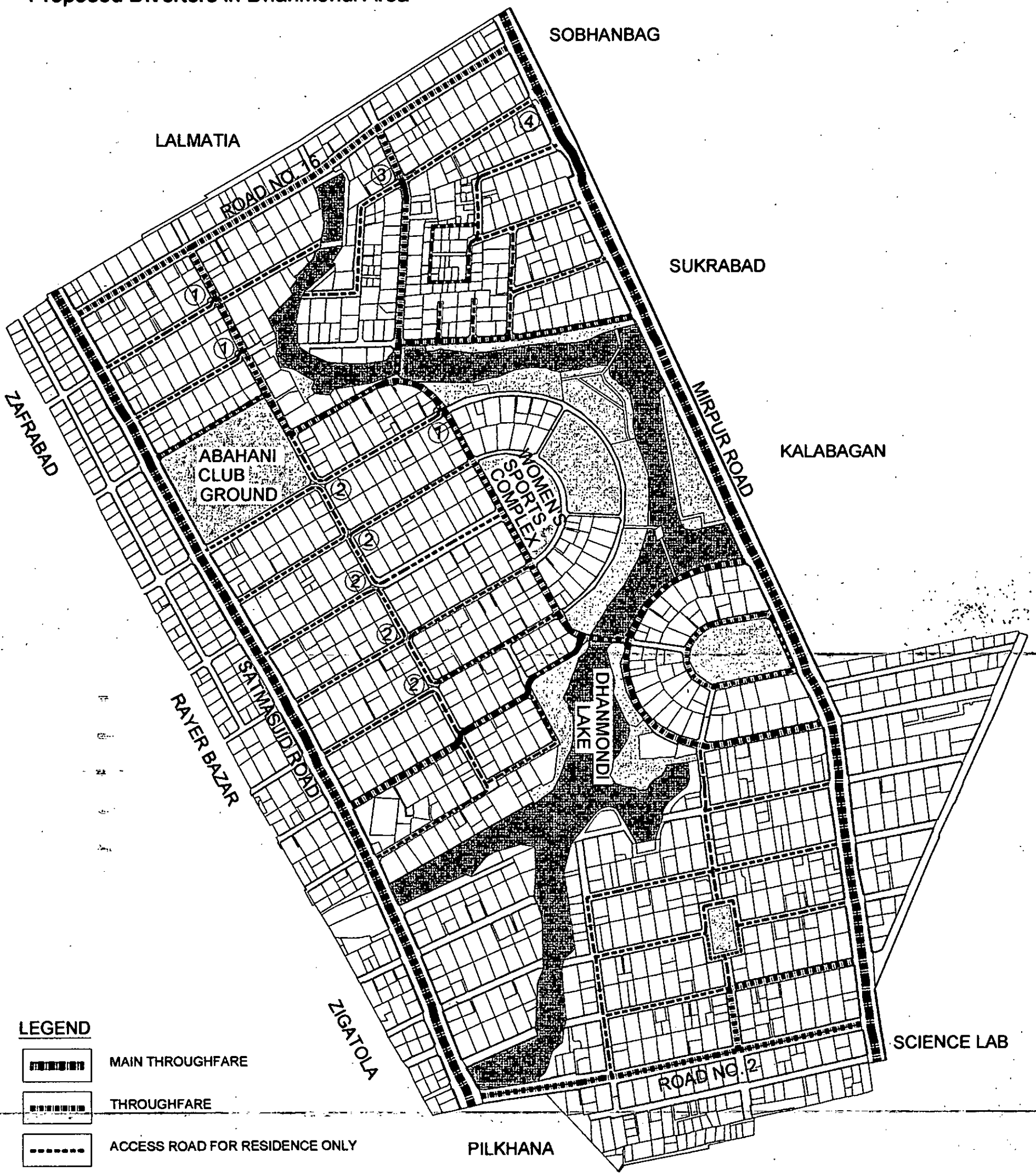
Fig 7.11 Four types of Diverter

volume and speed and thus deteriorates walking and biking environments. To minimize unwanted thorough traffic following measures should be taken through proper study and investigation. Map 7.1 shows a possible circulation pattern in Dhanmondi area using diverter, street dividers.

Map 7.1
Proposed Diverters in Dhanmondi Area



Map 7.1
Proposed Diverters in Dhanmondi Area



7.3.1 Diverters

A diverter is an island built at a residential street intersection that prevents certain through and/or turning movements. Discourage or prevent traffic from cutting through a neighborhood. Diverters effect people living in the neighborhood more than anyone else.

Fig.7.11 shows four types of diverters - diagonal, star, forced turn, and truncated. A diagonal diverter breaks up cut-through movements and forces right or left turns in certain directions. A star diverter consists of a star shaped island placed at the intersection, which forces left turns from each approach. A truncated diagonal diverter is a diverter with one end open to allow additional turning movements. Other types of island diverters can be placed on one or more approach legs to prevent through and right-turn movements and force vehicles to turn left.

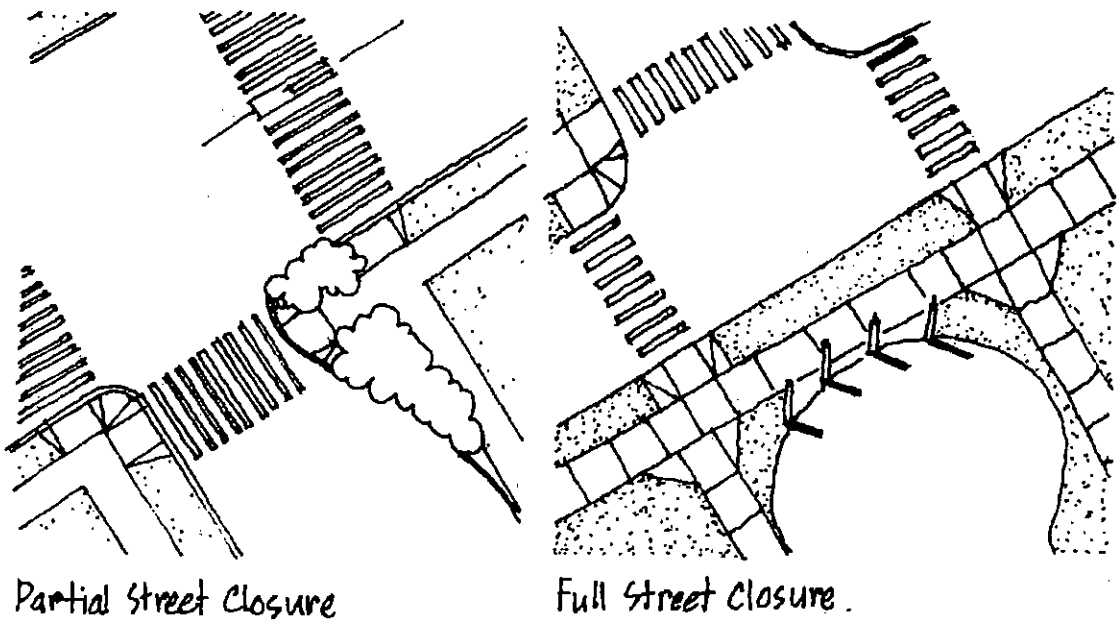


Fig 7.12 Partial and Full Street closer

As with other traffic management tools, diverters must be used in conjunction with other traffic management tools within the neighborhood street network. Any of these diverters can be designed for bicycle and pedestrian access.

7.3.1.1 Full Street Closure

A full street closure is accomplished by installing a physical barrier that blocks a street to motor vehicle traffic and provides some means for vehicles to turn around, Fig.7.12.

7.3.1.2 Partial Street Closure

A partial street closure uses a semi-diverter to physically close or block one direction of motor vehicle travel into or out of an intersection; it could also involve blocking one direction of a two-way street, Fig.7.12. Partial street closures at the entrance to a neighborhood or area should consider the traffic flow pattern of the surrounding streets as well. The design of this measure should allow for easy access by bicyclists and all pedestrians. It prevents turns from an arterial street onto a residential street and reduces cut-through traffic.

7.3.1.3 Linking East and West Part of Dhanmondi

As the area is divided in to two parts by the lake it requires walking long distance to go from one side to another. To link east and west part of Dhanmondi it requires to construct additional pedestrian bridges near the road No. 14A to road No.11 and 12A to Kalabagan play ground, as shown in Figure 7.13, over the lake.

7.4 Recommendations for Creations of Pedestrian and Bicycle Friendly Environment

It is seen from the above texts that some changes need to be made to the existing planning and construction rules and it requires incentives to the local people to create an environment for the pedestrians and bicyclists. In order to accommodate the pedestrians and bicyclists in the two neighborhoods studied in this thesis, specifically in Kalabagan, following suggestions are put forward.

- **Acquisition of Land:**
  Land will need to be acquired in order to widen the streets and accommodate walkways. In this regard, taxes may be waived for a certain period in order to encourage local people to actively participate in the process of accommodating the pedestrians and the bicyclists in the locality.

- **Setback and Construction Rules:**

  Setback and construction rules need to be changed and /or modified, so that walls may be relocated to widen streets and /or accommodate pedestrian ways.

- **Local Peoples' Participation:**

  Active participation of the local people is absolutely necessary in order to successfully implement such a project. Local people should willingly contribute land and take active interest to enhance pedestrian and bicyclist environment.

- **Creating Awareness Among Local People:**

  Awareness needs to be created by local influential people; experts and planners among the local people so that willing participate in the process of accommodating the pedestrians and bicyclists. Continuous publicity needs to be made regarding the walking and bicycling and to encourage and initiate active participation of the local people. Local people need to be apprised of the increased community vigilance that will be enhanced by an improvement in the pedestrian and bicyclist environment.

- **Changes in Master Plans, Local Plans etc.:**

  Adequate and specific changes need to be made in the master plans and their details worked in the local plans.

7.5 Recommendations for the Overall Pedestrian and Bicyclists Accommodation in Dhaka City

7.5.1 Coordinated Effort Towards Pedestrian Planning and Design

Street network are a principle element of quality-built environments in that they provide a means for walking and biking transportation. In order to attain and maintain these potentials, pathway planning, implementation, and development must keep pace with the changing urban environment and changing needs of its citizens. A commitment to planning, implementation, development, maintenance, and funding of these elements is the first step to the realization of a successful pedestrian and bicyclist communication within the neighborhood.

-In response of the general demand of the people of Dhaka for a quality environment for the pedestrian and bicyclist both public and private sectors active participation is required. It is therefore recommended to establish an interdisciplinary approach in which interdisciplinary different groups, social organizations, professions such as transport planners, planners, engineers, architects, and landscape architects' full participation.

- Develop master plans of bicycle and pedestrian considerations and adopt them to be included as the transportation element of comprehensive land-use plans. The plan should consider current and potential non-motorized destinations; identify necessary improvements for existing roads, removal of major barriers; providing linkages to public transportation, safe bicycle parking at major destinations.

-As most of the neighborhood/ areas of Dhaka are not linked with the routes of mass transit, it is recommended to develop a functional and efficient mass transit system that will connect neighborhoods and will ensure continuity of the trip. There should have accommodation for bicycle on the transit vehicle for longer distance. The network of transit should link the places of pedestrian activity areas with point of interchange such as shopping centres, recreational centres, tourist attractions, public transport services, car perks and other amenities.

-In transportation planning it should be considered that bicyclists should have the same mobility need as every other uses of the transportation system and use this as there primary means of access to jobs, services and recreational activities. In any transportation programme it should consider bicycle travel as integral part of the programme.

-Good walking conditions for pedestrians are important inducement to use public transport, since most public trips include a walk at one or both ends. Conversely good public transportation that run regularly and is reliable is essential to achieving a pedestrian friendly neighborhood. So it is necessary to develop the public transportation environment in parallel with walking environment.

-To increase bicycling trips ensuring accessibility to major destinations and by improving the comfort level of those who commute, it is recommended to improve or modify the existing transportation infrastructure for bicycles. Improving the existing

transportation infrastructure involves- removing hazards and barriers (drainage grades, unresponsive traffic signals, inadequate roadway maintenance, poor surface condition) to bicyclists, providing space for both cars and bikes on roads. To accommodate a wide range of bicyclists in shared roadway situations it require- sharing, shifting, and creating new roadway spaces.

- Set up standard procedures for addressing on-going pedestrian and bicycle needs which includes adoption of bicycle/pedestrian-friendly roadway design standards; develop design and construction guidelines for pedestrian and bicycle facilities. If necessary develop or modify land-use policies and planning and zoning to make short nonmotorized trips more feasible and useful.

7.5.2 Education and Responsibility

Planning, designing or facilities alone cannot reduce the conflicts between bicyclists/pedestrians and motorists. Education is the key in reducing the number and severity of accidents. In addition to basic rules of the road, there is also education on safe riding techniques and maneuvering out of a particular situation. There needs to be a realization that bicycling is not *riding* but *driving*.

Public health organizations should publicize physical inactivity related problem. They need to media campaign more in order to encourage walking and cycling, and to improve the conditions for walking and cycling to mitigate existing problems.

Education and awareness are key ingredients to safely accommodate bicyclists and pedestrians and encourage the use of these modes. Education efforts in pedestrian and bicycle planning should encompass training and education of planning and engineering professionals, planning commissions, transportation maintenance workers, school boards, and educators, as well as law enforcement officials, including bicyclists, pedestrians, and motorists.

- Provide instruction in lawful, responsible behavior among bicyclists, pedestrians, and motorists which includes teaching bicycling and walking *rules of the road* to children, adults, educating drivers relating to bicycle and pedestrian information.
- Convey safety messages through print and electronic media designed for different targeted audiences and develop a self-safety (use of bicycle-helmet) promotion targeted all ages group including school-aged children.

7.5.3 Law and Enforcement

Predictability is the key to harmony on the roadway. Sometimes bicyclists will make a maneuver unexpected by a motorist and a conflict occurs. On the other hand, motorists sometimes feel bicyclists do not belong on the roadway and treat them as such. Motorists and bicyclists have rules and responsibilities by which they must abide. A rigorous enforcement technique is education but sometimes it is also necessary to consider other active methods of law enforcement.

- For the above reason review and, if necessary, modify / improve existing traffic laws that affect bicyclists and pedestrians. Enforce laws that impact bicycle and pedestrian safety

- Develop programs to reduce the incidence of crimes against pedestrians and bicyclists. To mitigate the problem enforce pedestrian and bicycle patrols in appropriate areas.

7.5.4 Promotion and Encouragement

People desire mobility options. The simplest way to encourage other modes is simply not to discourage. For decades, planners and engineers have sought ways to accommodate the mobility of cars. Today we recognize a need and value for walking and bicycling as well. Encouragement then is the culmination of the engineering roads that are safe and convenient; educating motorists and non-motorists of conventional rules and the importance of predictability and harmony; and enforcement for those who choose to follow unlawful behavior.

-It is recommended to enhance recreational bicycling opportunities, because people most often begin bicycling for recreation, there exists great potential for creating modal shifts from motor vehicles to bicycles by encouraging recreational bicyclists to use their bicycle for utilitarian transportation. Indeed, most utilitarian bicyclists first develop cycling skill and confidence riding in traffic as recreational bicyclists. Therefore it makes sense to enhance recreational cycling opportunities to increase the potential for transportation oriented cycling.

-Public/Private organizations, citizen groups, or civic organizations can play an important effort for publicize walking and bicycling activity - efforts may include joint sponsorship of a bike day/ bike week. Local businesses often contribute prizes and goods including free or reduced price bike helmets.

- Encourage employers to create incentives for bicycling and walking modes. Adding walking and bicycling options to agency/company motor pools, and produce balanced transportation plans, trip-conversion programs for their employees' commuting needs.

- Provide casual introduction to bicycling and walking as transportation to non-participants. Include bicycling and walking activities in local recreation programs. Promote utilitarian non-motorized transportation through introductory special events. Offer key target audiences detailed information on non-motorized travel.

-To promote use of bicycle financial assistance, incentive, encouragement for bicycle use by the university students is recommended.

- Use electronic and print media to positive messages about the benefits of walking and bicycling through public-service announcements, special-events promotion, and news releases.

7.5 Conclusion

The recommendations are interrelated and they must be seen or considered as such. Emphasis on one recommendation without due thought to another may not produce the desired result. To accommodate pedestrian and bicyclist in the neighborhood of Dhaka the approach should be directed towards the goal of increasing safe and convenient travel by pedestrians and bicyclists. It must combine the efforts of many people at all levels of government with full participation and support by the public.

The problems with proposals to increase walking and cycling are, their current danger and inconvenience in most areas of Dhaka city. Moreover, the lack of proper pedestrian and bicycling facilities makes walking and cycling not only unsafe but also inconvenient, slow, unpleasant, and infeasible in most places.

Improved walking and biking conditions would not only reduce pedestrian and cycling fatalities and injuries, they would also allow people to bike or walk for some of their short trips and thus obtain healthful exercise in the course of daily life. More walking and cycling would also help alleviate traffic congestion, reducing use of automobiles i.e. save energy, reduce air and noise pollution, conserve land, and produce various other environmental benefits yield further public health and the overall level of traffic danger. So there is a need to adopt policies to make walking and cycling safer, more convenient, and more pleasant.

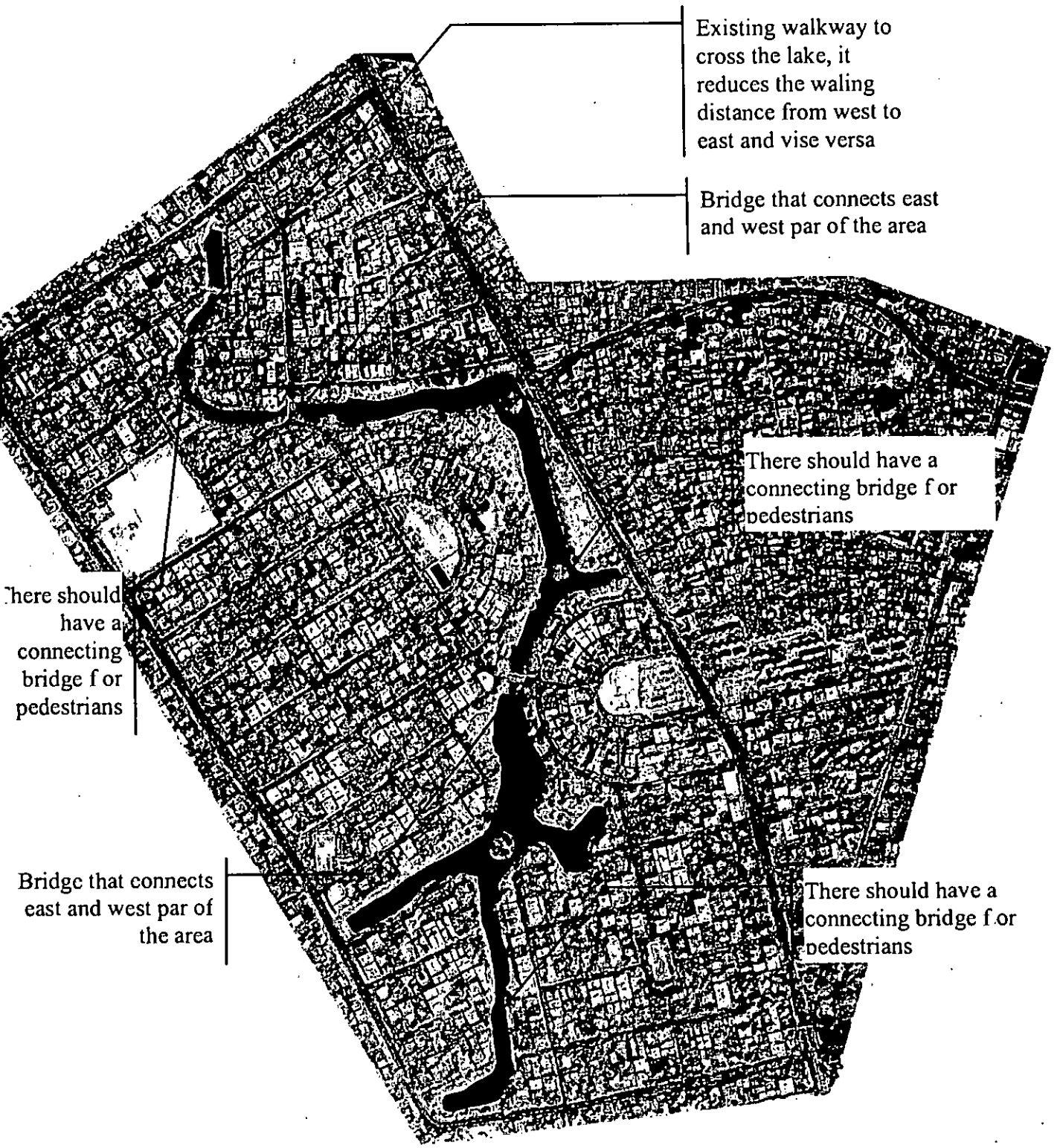


Figure 7.13 Linking Eastern and Western Part Through Pedestrian Bridges

APPENDIX

Appendix-A

Appendix-B

Appendix-C

Appendix-D

Appendix -A

Calculation of use of space:

Pedestrians:

To accommodate two people walking side-by-side or passing each other while traveling in opposite directions, the average width required is 1.4 m (4 ft 8 in). Considering the minimum width for a sidewalk is 1.5 m (5 ft) and all sidewalks should be constructed to at least this width.

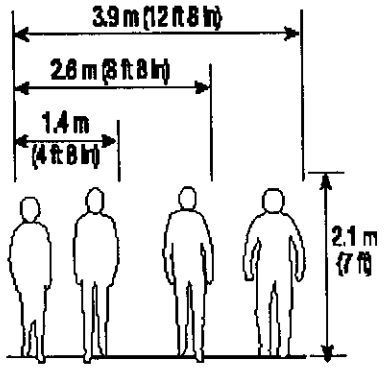


Fig. A-1 Human Dimensions, Walking.

Automobiles:

For example taking a 100 m typical undivided urban road strip with 9 m (30ft) roadway and having 1.5 m (5ft) sidewalk on both sides, for the calculation of proportionate use by the pedestrian and vehicles, it shows that the area devoted for the pedestrian is only 25% of the total road strip. Mathematically it can be represented as follows-

$$\text{Percentage of sidewalk} = \frac{2 \times \text{sidewalk width} \times 100\text{ m} \times 100}{(\text{roadway width} + \text{sideway width}) \times 100\text{ m}}$$

$$= \frac{2 \times 1.5\text{m} \times 100\text{ m} \times 100}{(9\text{ m} + 2 \times 1.5\text{ m}) \times 100\text{ m}}$$

$$= 25\ \%$$

Percentage of streets for vehicles = 75%

But the streets of Dhaka have sidewalk of less than 1.5 m width. In most cases they are not provided at all.

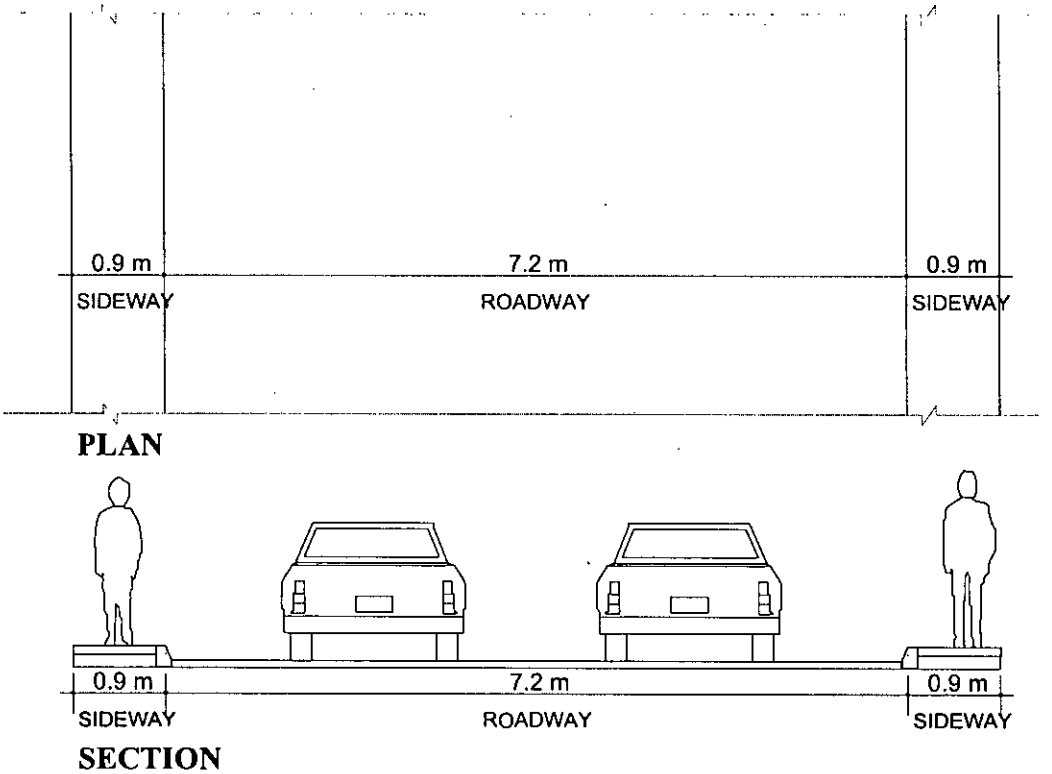


Fig. A-2 Typical Section of a Street

Spaces used by the pedestrians and vehicles shown on the above diagram are as follows-

Percentage of streets for vehicles = 80%

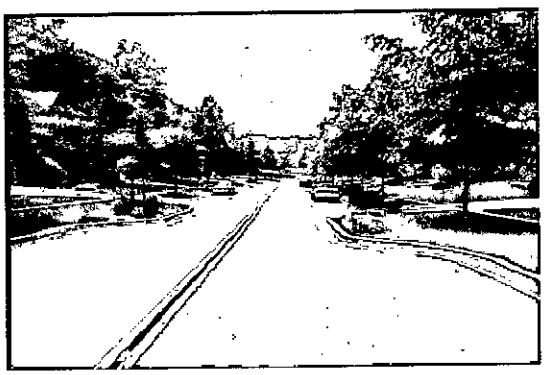
Percentage of sidewalk = 20%

Appendix -B

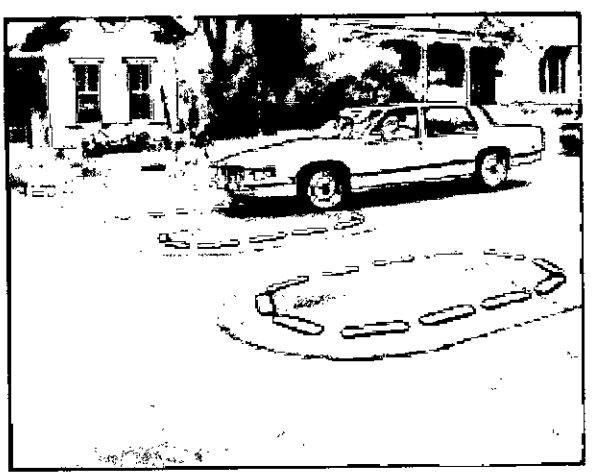
Traffic Calming Measures

Some of the traffic calming measures to facilitate pedestrian crossing are stated below.

Chicane Series of fixed objects usually extensions of the curb that alter a straight roadway into a zigzag or serpentine path to slow vehicles.



Choker A narrowing of the street, often in mid-block, sometimes at an intersection. May be done with curb extensions, landscaping, or islands set in the street.



Speed Cushions Consist of either recycled rubber or asphalt, raised about 3 inches in height. The length of the cushion is about 10 ft. The spaces between the cushions allow emergency vehicles to partially straddle the device. They can slow traffic, reduce the volume of traffic on a street, and causes minimal impact to emergency response times.

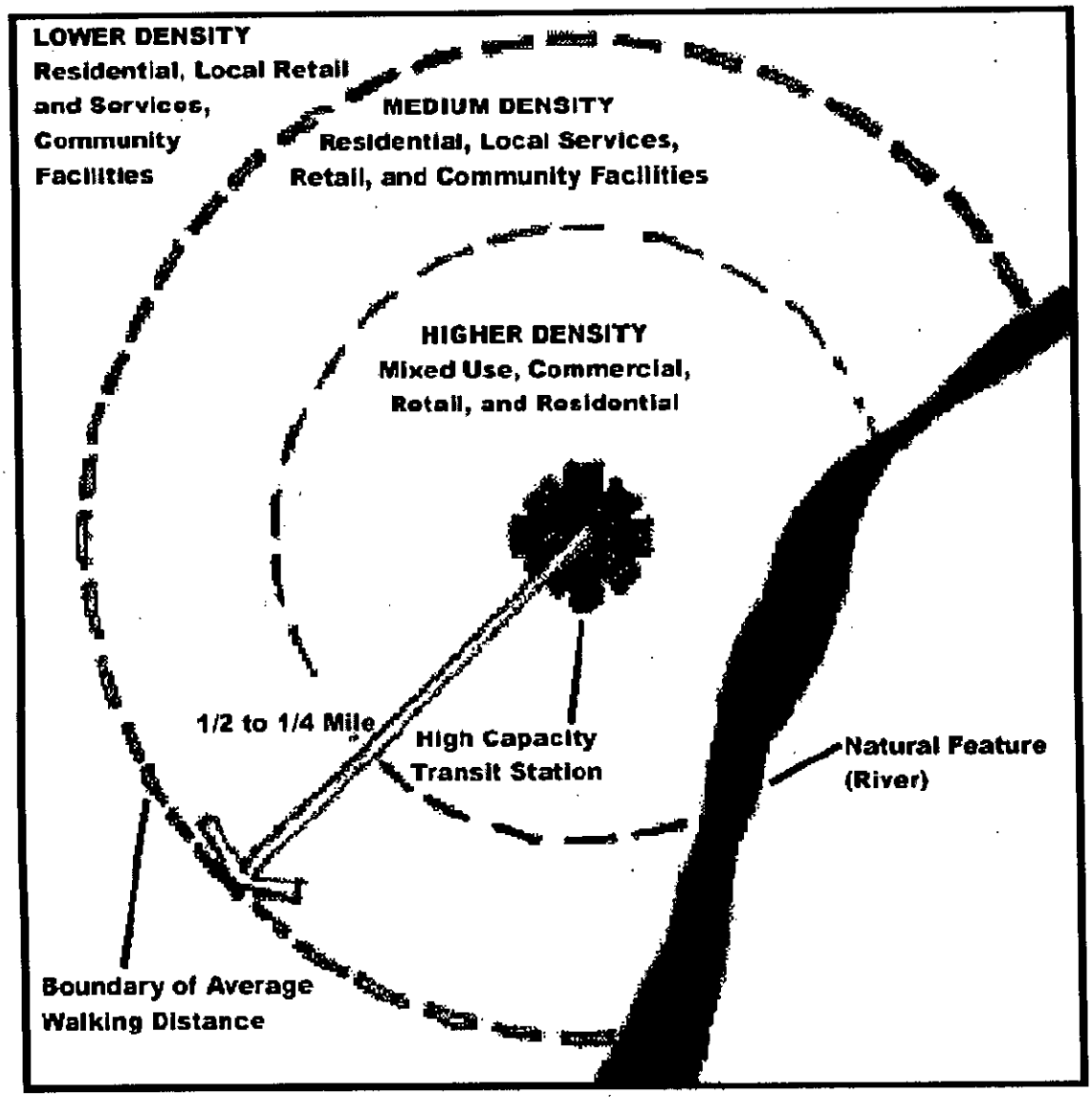
Speed Humps Raised sections of pavement across the street. These devices are 22 feet in length and approximately 3 to 4 inches high. They reduce vehicle speed, reduce traffic volumes, and do not restrict on-street parking. However, they can slightly increase emergency vehicle response times.

Traffic Circle A small island in mid intersection, as small as 16 to 25 feet in diameter, that forces traffic to slow and negotiate the curve. Mostly used in residential areas, they can be landscaped for aesthetic or barrier purposes, and may have mountable curbs to facilitate emergency vehicles. A "rotary," the larger, wider circle that often merges motor vehicle traffic on arterial roads or highways (Austin, 2002).

Transit Orientated Development (TOD)

A form of development that emphasizes alternative forms of transportation other than the automobile such as walking, cycling, and mass transit as part of its design. The focal point of this type of development is a major transit facility adjacent to mixed land uses. Transit- Oriented Development locates retail and office space around the transit stop. Given the proper density of people, transit can be a highly efficient means of transportation that serves both land and air quality. Sprawl development works against transit by spreading people and destinations over great distances.

Well-planned community design can support transit services through in-fill development and integrating the community around transit facilities. The viability of



transit use through transit-oriented design can eliminate automobile trips and provide access for all members of society.

Transit-oriented design projects attempt to attract people to the transit system by creating an atmosphere that is safe, convenient and easily accessible by foot, bicycle, or transit. If people can safely walk to the transit stop and bank, buy groceries, and return library books on their way home from the station, they are more likely to use the transit system (Austin, 2002).

Appendix-C

Accommodating the Pedestrians and Bicyclists in the Neighborhoods of Dhaka: An Investigation of Existing Situations

SURVEY OF RESIDENTS' OPINION (as a part of research for the degree of Master of Urban and Regional Planning)

Department of Urban and Regional Planning,
BANGLADESH UNIVERSITY OF ENGINEERING AND TECHNOLOGY
DHAKA-1000

1.Name of the head of the household ----------

Address House No---------- Floor----------

Road No.---------- Area----------

2. Number of member of the family member, age, location of travel

a)Number member ☐

b)Age ☐ ☐ ☐ ☐ ☐ ☐ ☐

Education ☐ ☐ ☐ ☐ ☐ ☐ ☐

c)Location of travel

---------- ---------- ----------

---------- ---------- ----------

---------- ---------- ----------

2.Net household income per month ----------

3. Number of vehicle(s) owned ----------

4. Type of Vehicle ----------

5. Location of the work place ----------

6. What type of transport you use to go to workplace or school? How much fare per month?

Bus/Minibus	☐	----------	Car/Jeep	☐	----------
Auto-rickshaw	☐	----------	Tempo	☐	----------
Bicycle	☐	----------	Rickshaw	☐	----------
Walk	☐	----------			

7. Do you think a pedestrian friendly environment could lower the amount spent for transport fare?

Yes ☐ No ☐

8. What is your opinion about safety of bicycling and walking in your neighborhood?

Safe ☐

Unsafe ☐

if unsafe , reasons are -

No space for pedestrians ☐

Insufficient space to walk or biking ☐

Insufficient width of footpath ☐

High traffic volume ☐

Crowded ☐

Low maintenance ☐

9.a) Do you think that in any new neighborhood development of bicycle and pedestrian accessibility should be considered?

Yes ☐ No ☐

b) Do you think provision of walking and biking have benefits?

Yes ☐ No ☐

if 'Yes', what kind of benefits?

Social benefits ☐

Economic benefits ☐

Mental and health benefits ☐

Others ----------

10. a) Do you support the provision of bike lane?

Yes ☐ No ☐

b) What type of lane do you prefer for biking?
(Explain On- street and Off -street bike lane)
On-street ☐

Off- street ☐

c) If on-street or off-street bike lane are provided, will you use bicycle to go to work place / school?

Yes ☐ No ☐

11. What are the conditions do you think may enrich the walking and bicycling environment?
Creating Awareness among people ☐

Enforcement of related laws ☐

Education of street users /drivers ☐

Maintaining the environment for walking & biking ☐

Protection from elements ☐

Place to rest ☐

Safety of all age groups ☐

Bright and colourfull space ☐

Others ----------
Please specify ----------

12. What is your opinion regarding your neighborhood as a whole?

Very friendly ☐

Friendly ☐

Indifferent (neither good nor bad) ☐

13. As walking and bicycling offer opportunities more people meet each other on the street. Do you think walking and bicycling may enrich social bonding?

Yes ☐ No ☐

14. Do you want to leave this neighborhood?

Yes ☐ No ☐

If yes what are the reasons?

For poor environmental condition ☐

Distance from school, work place, shopping centre ☐

Distance from bus stop ☐

15. How far distance you wish to walk?

0.25 mile ☐

0.50 mile ☐

0.75 mile ☐

1.0 mile ☐

Appendix-D

Table- D-1 Fixed- Observer- Width Adjustment Factor for Walkways

Obstacle		Approximate Width Preempted (ft)
	Street furniture	
Light poles		2.5-3.5
Traffic signal pole and boxes		3.0-4.0
Fire alarm boxes		2.5-3.5
Fire hydrants		2.5-3.0
Traffic signs		2.0-2.5
Parking meters		2.0
Mail box (1.7 ft by 1.7 ft)		3.2-3.7
Telephone booths (2.7ft by 2.7 ft)		4.0
Wastebaskets		3.0
Benches		5.0
	Landscaping	
Trees		2.0-4.0
Planting boxes		5.0
	Commercial uses	
Newsstands		4.0-13.0
	Building protrusions	
Column		2.5-3.0
Stoops		2.0-6.0
Cellar doors		5.0-7.0

Source: TRB, 2000

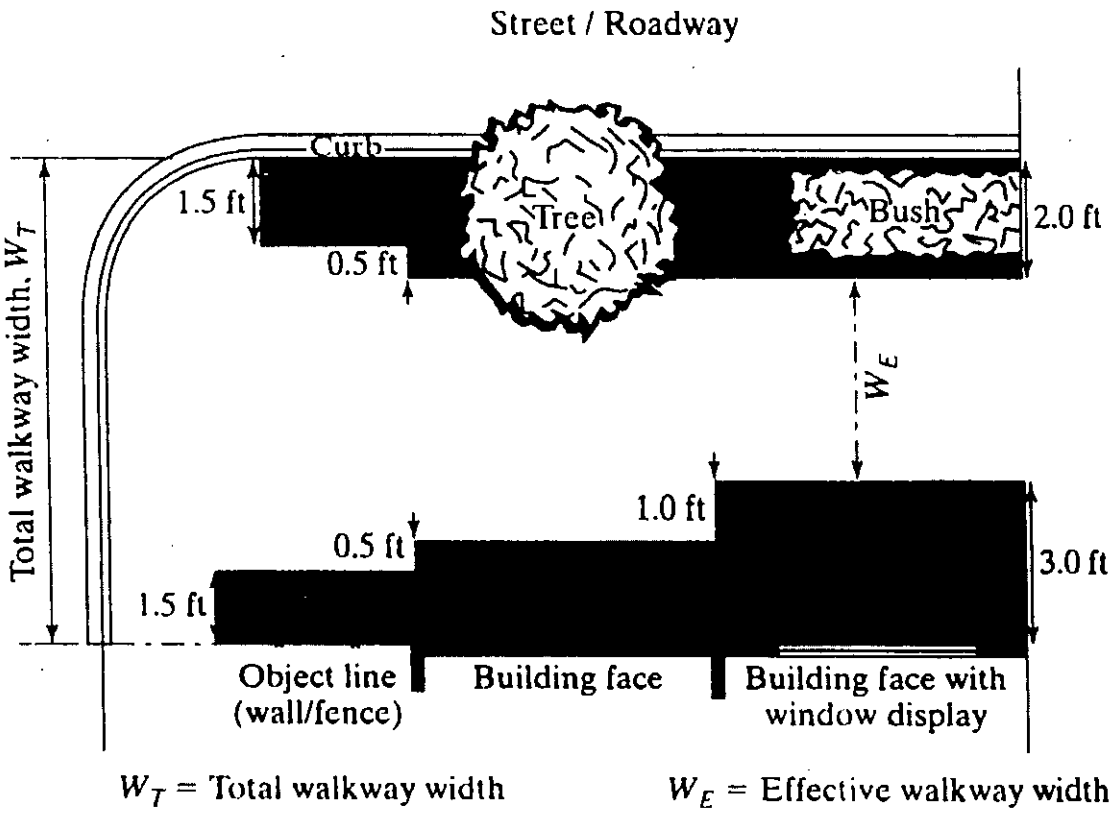


Fig. D-1 Preemption of walkway width

Source: TRB, 2000.

Table –D-2 Average Flow LOS Criteria for Walkways and Sidewalks [a]

Level of service	Space (ft^2/ped)	Flow Rate (ped/min/ft)	Speed (ft/sec)
A	>60	≤5	>4.25
B	>40-60	>5-7	>4.17-4.25
C	>24-40	>7-10	>4.00-4.17
D	>15-24	>10-15	>3.75-4.00
E	>8-15	>15-23	>2.5-3.75
F	≤8	Variable	≤2.50

[a] Average Condition for 15 minutes.

Source: TRB, 2000.

Table –D-3 Pedestrian Flow in Dhanmondi Area

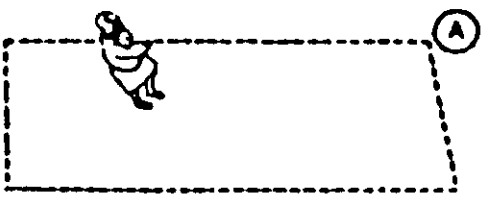
	Road No.8	Road No.11	Road No.12A	Road No.7A	Road No.6
7.00-7.15	72	63	69	59	46
7.15-7.30	227	78	83	94	64
7.30-7.45	443	122	134	243	122
7.45-8.00	502	203	111	228	132
8.00-8.15	260	180	174	199	116
8.15-8.30	251	185	179	173	106
8.30-8.45	183	120	116	118	99
8.45-9.00	202	167	176	112	79
9.00-9.15	175	113	124	128	92
9.15-9.30	172	124	134	128	73
9.30-9.45	161	117	127	129	62
9.45-10.00	177	98	113	125	84
10.00-10.15	122	112	127	112	73
10.15-10.30	92	90	102	105	77
10.30-10.45	98	123	129	138	88
10.45-11.00	117	132	137	73	72
11.00-11.15	171	119	125	123	49
11.15-11.30	162	97	107	113	62
11.30-11.45	153	118	127	149	77
11.45-12.00	130	92	107	67	49
12.00-12.15	138	94	105	99	56
12.15-12.30	141	102	113	103	55
12.30-12.45	165	87	94	117	61
12.45-13.00	165	127	136	118	56
13.00-13.15	290	172	184	232	89
13.15-13.30	285	176	186	211	67
13.30-13.45	218	174	176	167	62
13.45-14.00	280	149	109	223	73
14.00-14.15	218	135	148	178	78
14.15-14.30	180	126	132	127	69
14.30-14.45	117	94	113	78	66
14.45-15.00	115	86	98	66	59
15.00-15.15	112	125	111	73	65
15.15-15.30	128	145	129	77	51
15.30-15.45	125	78	97	71	48
15.45-16.00	124	92	102	75	56
16.00-16.15	123	94	106	87	67
16.15-16.30	390	97	116	89	78
16.30-16.45	172	105	118	118	89
16.45-17.00	185	109	119	132	88
17.00-17.15	227	128	140	173	77
17.15-17.30	390	140	142	323	89
17.30-17.45	343	145	145	292	105
17.45-18.00	282	165	151	233	113
18.00-18.15	235	138	175	183	134
18.15-18.30	226	184	162	177	127
18.30-18.45	238	148	160	188	108
18.45-19.00	178	102	117	116	95
19.00-19.15	173	106	111	179	49
19.15-19.30	146	95	104	106	35
19.30-19.45	128	79	93	93	46
19.45-20.00	118	75	76	62	39

Source: Field survey, 2005.

LEVEL OF SERVICE A

Pedestrian Space >60 ft²/ped, Flow Rate ≤ 5 ped/min/ft

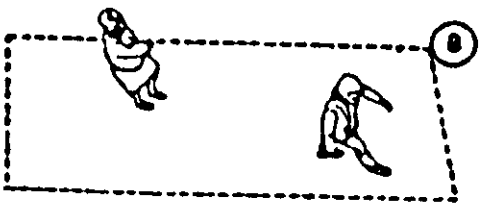
At walkway LOS A, pedestrians move in desired paths without altering their movements in response to other pedestrians. Walking speeds are freely selected, and conflicts between pedestrians are unlikely.



LEVEL OF SERVICE B

Pedestrian Space >40-60 ft²/ped, Flow Rate >5-7 ped/min/ft

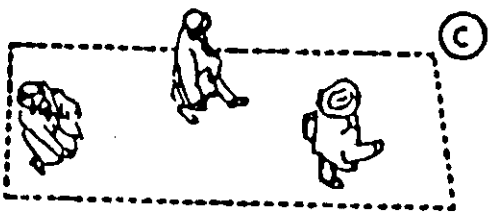
At LOS B, there is sufficient area for pedestrians to select walking speed freely to bypass other pedestrians, and to avoid crossing conflicts. At this level, pedestrians begin to be aware of other pedestrians, and to respond to their presence when selecting a walking path.



LEVEL OF SERVICE C

Pedestrian Space >24-40 ft²/ped, Flow Rate >7-10 ped/min/ft

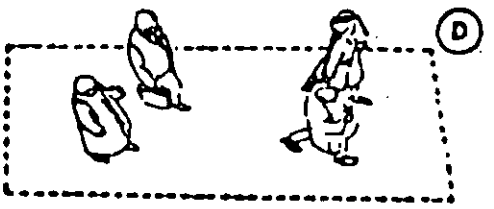
At LOS C, space is sufficient for normal walking speeds, and for bypassing other pedestrians in primarily unidirectional streams. Reverse-direction or crossing movements can cause minor conflicts, and speeds and flow rate are somewhat lower.



LEVEL OF SERVICE D

Pedestrian Space >15-24 ft²/ped, Flow Rate >10-15 ped/min/ft

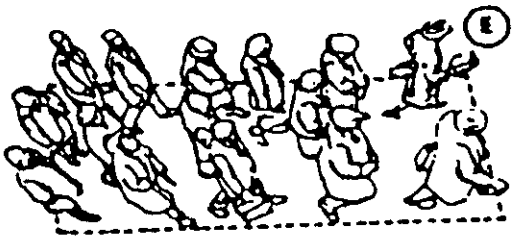
At LOS D, freedom to select individual walking speed and to bypass other pedestrians is restricted. Crossing or reverse-flow movements face a high probability of conflict, requiring frequent changes in speed and position. The LOB provides reasonably fluid flow; but friction and interaction between pedestrians is likely.



LEVEL OF SERVICE E

Pedestrian Space >8-15 ft²/ped, Flow Rate >15-23 ped/min/ft

At LOS E, virtually all pedestrians restrict their normal walking speed, frequently adjusting their gait. At the lower range, forward movement is possible only by shuffling. Space is not sufficient for passing slower pedestrians. Cross- or reverse-flow movements are possible only with extreme difficulties. Design volumes approach the limit of walkway capacity, with stoppages and interruptions to flow.



LEVEL OF SERVICE F

Pedestrian Space ≤ 8ft²/ped, Flow Rate varies ped/min/ft

At LOS F, all walking speeds are severely restricted, and forward progress is made only by shuffling. There is frequent, unavoidable contact with other pedestrians. Cross- and reverse-flow movements are virtually impossible. Flow is sporadic and unstable. Space is more characteristic of queued pedestrians than of moving pedestrian streams.

Fig. D-2 Walkway Level of Service (LOS)

Source: TRB, 2000

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