IMPACT OF TRANSIT PROJECT ON LAND VALUES AND LAND USE PATTERN: A CASE STUDY OF DELHI METRO

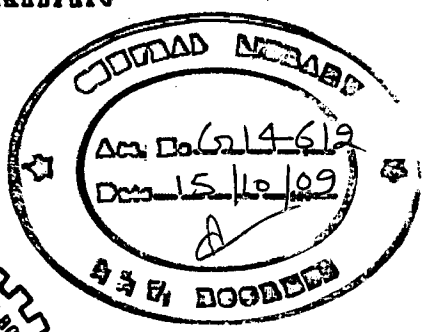
A DISSERTATION

Submitted in partial fulfillment of the requirements for the award of the degree of

MASTER OF URBAN AND RURAL PLANNING

By

SAAD ALAM KHAN



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CERTIFICATE

Certified that this report entitled **"IMPACT OF TRANSIT PROJECT ON LAND VALUES AND LAND USE PATTERN: A CASE STUDY OF DELHI METRO"**, which has been submitted by **Mr. SAAD ALAM KHAN**, in partial fulfillment of the requirements for the award of the degree of ***MASTER OF URBAN AND RURAL PLANNING***, submitted in the Department of Architecture and Planning, **Indian Institute of Technology Roorkee, Roorkee** is the student's own work carried out by him under my supervision and guidance. The matter embodied in this dissertation has not been submitted by him for the award of any other degree of this or any other institute.

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CANDIDATE'S DECLARATION

I hereby certify that this report entitled **"IMPACT OF TRANSIT PROJECT ON LAND VALUES AND LAND USE PATTERN: A CASE STUDY OF DELHI METRO",** which has been submitted in partial fulfillment of the requirements for the award of the degree of ***MASTER OF URBAN AND RURAL PLANNING***, in the Department of Architecture and Planning, **Indian Institute of Technology Roorkee, Roorkee** is an authentic record of my own work carried out during the period from July 2008 to June 2009, under the supervision and guidance of Dr. Ashutosh Joshi and Dr. Nalini Singh, Department of Architecture and Planning, Indian Institute of Technology Roorkee, Roorkee, India.

The matter embodied in this dissertation has not been submitted by me for the award of any other degree of this or any other institute.

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(Saad A. Khan)

ABSTRACT

Delhi is one of the fastest growing metros in country with population of about 138 million as per 2001 census. As it is an administrative city and major work center, about 3 million people traveled to city daily, leading pressure on the transportation system. To improve the transportation system now rail based mass transit system got implemented in city called metro rail, with high capacity and high accessibility levels and technically advanced features. MRTS will bring changes in distribution of people, in activity patterns or in land uses. At the MRTS stations and with in influence area, the impact of rapid accessibility can be felt in form of informal sector, congestion, parking problem, increased land value followed by the transformation of land use. It may lead to unplanned development, so to have planned development there should be proper integration of development with MRTS called as the Transit supportive development.

The present work is an effort to identify the causes and impacts of Metro on the surrounding land values and Landuse pattern. The area selected for the study has a totally different character in comparison to the other areas where metro rail has been implemented. The corridor between two major interchanges of MRTS i.e, Kashmere Gate and Rajiv Chowk is an underground section passing below the old city of Delhi, Shahjahanbad. The area is characterized by low rise high density, with the implementation of metro in the walled city has further deteriorated the area.

During the study, the data was collected in form of maps from the previous studies and primary data collection done by mapping the existing land use of the area and carrying out surveys. For conducting the primary survey, stratified random sampling was done and the strata's that were formed were based upon the area under pure residential use and area under mix of residential and commercial use. The survey findings revealed lots of facts and figures and the improvement that the people in the area wanted and the changes that they desired should have been taken care of.

In order to have transit oriented development, recommendations and guidelines are laid to improve the land use planning and development controls at nodes and influence area like giving flexibility in FAR, or to permit change in Landuse with certain restrictions so as to restore the heritage character of the study area.

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Chapter 1.0 INTRODUCTION

1.1 Introduction

For a city to be productive it is vital that it has a very sound infrastructure and services. Urban Transport is a crucial component of urban infrastructure. It provides access to opportunities, supports urban economic activities, and facilitates social interactions. A good network of roads and an efficient Mass Urban Transport System makes significant contributions to improve the working efficiency of a city and its environs. A poor urban transport system not only constraints urban economic growth but also degrades quality of life through congestion, pollution, accidents etc. The extent to which the Indian cities can maximize economic performance and reduce poverty will be closely linked to how efficiently the transport system moves people and goods upon which their socio-economic activities depend. The rapidly growing urban population exerts an increasing pressure on the urban transport system. The resultant deterioration in the urban transport system will be reflected in lower economic productivity which is why urgent measures, are necessary to tackle this problem.

1.2 Background

Delhi has experienced phenomenal growth in population in the last few decades. Its population has increased from 62 lakhs in 1981 to 138 lakhs in the year 2001 and the projected population for the year 2021 is 234 lakhs.

For want of an efficient mass transport system, the number of motor vehicles has increased from 5.4 lakhs in 1981 to 51 lakhs in 2007 and is increasing at the rate of 6.21 per annum. The number of motor vehicles in Delhi is now more than that of Mumbai, Calcutta, Chennai put together. The result is extreme congestion on Delhi roads, ever slowing speeds, increase in road accidents fuel wastage and environmental pollution.

Today the traffic on roads of Delhi is a heterogeneous mix of cycles, scooters, buses, cars and rickshaws jostling with each other. This has resulted in a chaotic situation so much so that due to road accidents, the average number of persons killed per day has increased to 5 and of those injured to 13. The position is expected to deteriorate further in the years to come.

To rectify this situation the Government of India and the Government of National Capital Territory of Delhi, in equal partnership have set up a company named Delhi Metro Rail Corporation Ltd. under the Companies Act,1956 which has already commissioned a 65.10 kms route in Phase-I and is proceeding ahead with another 121 kms in Phase –II.

1.3 Mass Rapid Transport System

Mass Rapid Transport System (MRTS) forms part of the overall transport development scheme of Delhi State. This project will provide services to a total area of 1486 sq. km with an urban area of about 500 sq. km. The first concrete step in the launching of an Integrated Multi Mode Mass Rapid Transport System (MRTS) for Delhi was taken when a feasibility study for developing a multi-modal MRTS system was commissioned by the Government of the National Capital Territory of Delhi (GNCTD) at the instance of the Government of India in 1989 and completed by Rail India Technical and Economic Services Limited in 1995 (RITES, 1995a, 1995b).

The Delhi Metro (DM) planned in four phases is part of the MRTS. The work of Phase I and part of Phase II is now complete while that of phase III is in progress. The first phase of DM consists of 3 corridors divided in to eight sections with a total route of 65.1 kms, of which 13.17 kms has been planned as an underground corridor, 47.43 kms as elevated corridors and 4.5 kms as a grade rail corridor. The second phase covers 53.02 kilometers of which the underground portion, grade and elevated section are expected to be 8.93 kilometers, 1.85 kilometers and 42.24 kilometers respectively. The construction of the first phase of DM was spread over 10 years during 1995-96 to 2004-05 while that of the second phase, which started in 2005-2006 is expected to be complete by 2010-11. The total capital cost of DM at 2004 prices for Phase I and Phase II are estimated as Rs. 64,060 and Rs. 80,260 million, respectively. Phases III and IV of DM will cover most of the remaining parts of Delhi and even extend its services to some areas such as Noida and Gurgaon belonging to the neighbouring states of Delhi. Table 1 provides some of these details.

Table 1.1: Overview of the MRTS

	Phase I (1995 - 2005)	Phase II (2005 –2011)
Distance	65.10 km	53.02 km
Corridors	1) Shahdara - Barwala (22)	1) Vishwa Vidhyalaya- Jahangirpuri (6.36)
	2) Vishwa Vidhyalaya- Central Secretariat (11)	2) Central Secretariat- Qutab Minar (10.87)
	3) Barakhamba Road - Dwarka (22.8)	3) Shahdra- Dilshad Garden (3.09)
	4) Barakhamba Road – Indraprastha (2.8)	4) Indraprastha- New Ashok Nagar (8.07)
	5) Extension into Dwarka Sub city (6.5)	5) Yamuna Bank- Anand Vihar ISBT (6.16)
		6) Kirti Nagar- Mundka (18.47)
Investment	Rs 6406 crores (2004 prices)	Rs 8026 crores (2004 prices)
	Phase III	**Phase IV**
Distance	62.2 km	
Corridors	1) Rangpuri to Shahabad Mohammadpur	1) Jahangirpuri to Sagarpur West
	2) Barwala to Bawana	2) Narela to Najafgarh
	3) Jahangirpuri to Okhla Industrial Area Phase I	3) Andheria Mod to Gurgaon
	4) Shahbad Mohammadpur to Najafgarh	

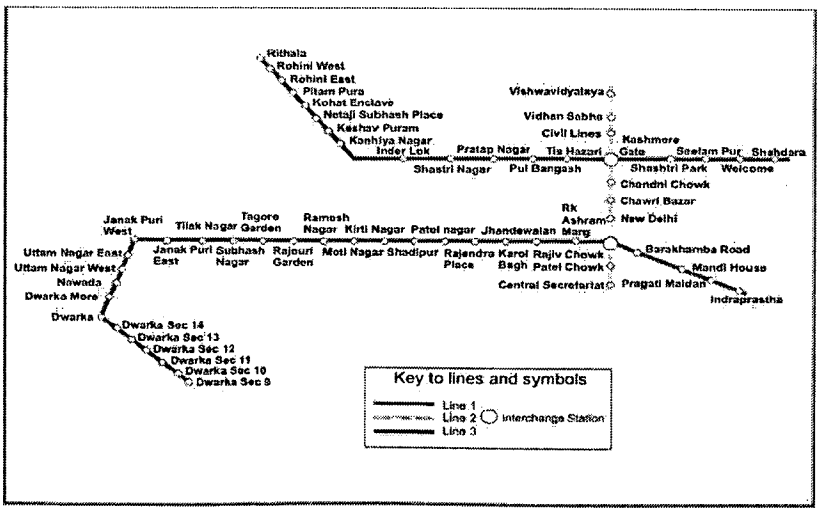
Source: *RITES Gurgaon*

1.3.1 Phase I Network

Table 1.2: Description of lines for Phase I of Delhi Metro Rail project

Line	Length (Kms)	No. of Stations
Line No.1- Shahdara-Tri Nagar-Rithala	22.06	18
Line No.2- Vishwa Vidyalaya-Central Secretariat	10.84	10
Line No.3- Indraprastha-Barakhamba Road-Dwarka Sub City	32.10	31

Source: *Delhi Metro Rail Corporation*



Map 01: Delhi Metro map for Phase I

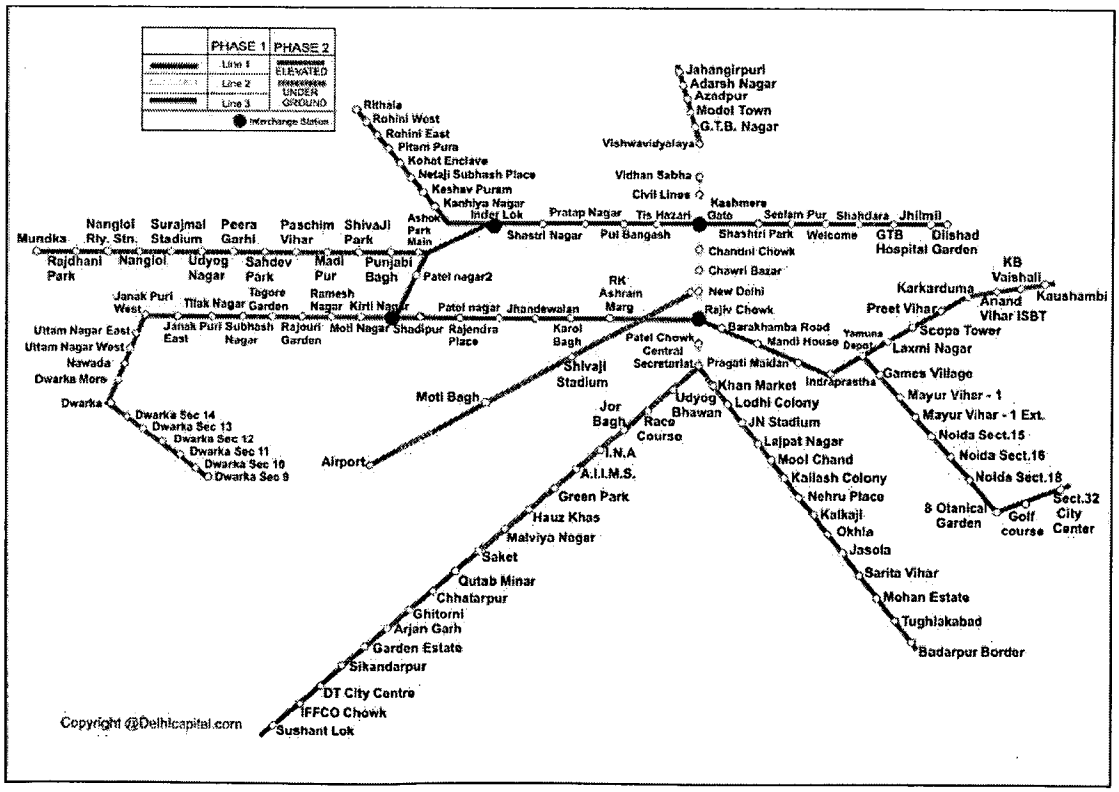
Source: *Delhi Metro Rail Corporation*

1.3.2 Phase II Network

Table 1.3: Description of lines for Phase II of the Delhi Metro Project

Line	Length (Kms)	No. of Stations
Shahdara – Dilshad Garden	3.09	3
Indraprastha – Noida Sector 32 City Centre	15.07	11
Yamuna Bank – Anand Vihar ISBT	6.17	5
Vishwavidyalaya – Jahangir Puri	6.36	5
Inderlok – Kirti Nagar -Mundka	18.46	15
Central Secretariat – Sushant Lok	27.45	19
Dwarka Sector 9 to Dwarka Sector 21	2.76	2
New Delhi – Airport	19.20	4
Anand Vihar – KB Vaishali	2.57	2
Central Secretariat – Badarpur	20.04	15
Total	**121.17**	**81**

Source: *Delhi Metro Rail Corporation*



Map 02: Delhi Metro map for Phase I
Source: *Delhi Metro Rail Corporation*

1.4 Need of The Study:

By the year 2021 the projected population of Delhi is about 23 million. The natural resources are limited, land as an important resource is already scarce due to rapid urbanization and infrastructure including transport system is at verge of breakdown.

NCT of Delhi has a total area of 148,639 ha. Out of which about 64,000 ha is included in urbanisable limits i.e. 45% of the land used for urban development. So to accommodate 23 million population by 2021 Delhi needs to utilize more land resource. In such a critical situation it is necessary to rethink on the planning aspects of our cities.

MRTS creating major impact on accessibility, travel pattern, land use and land values etc. it can act as a catalyst for the urban redevelopment. On the other hand if MRTS corridors are not attended well for planned development, chaotic urban transformation will take place as a result of increased accessibility and consequently, increased in land values take over by market forces. Results would in the form of degraded urban centres.

So it is the need of the hour to analyze the transformation pattern of land use and impacts of transit projects during its proposal stage, design stage, construction stage and the operational stage, to guide the future development in planned fashion.

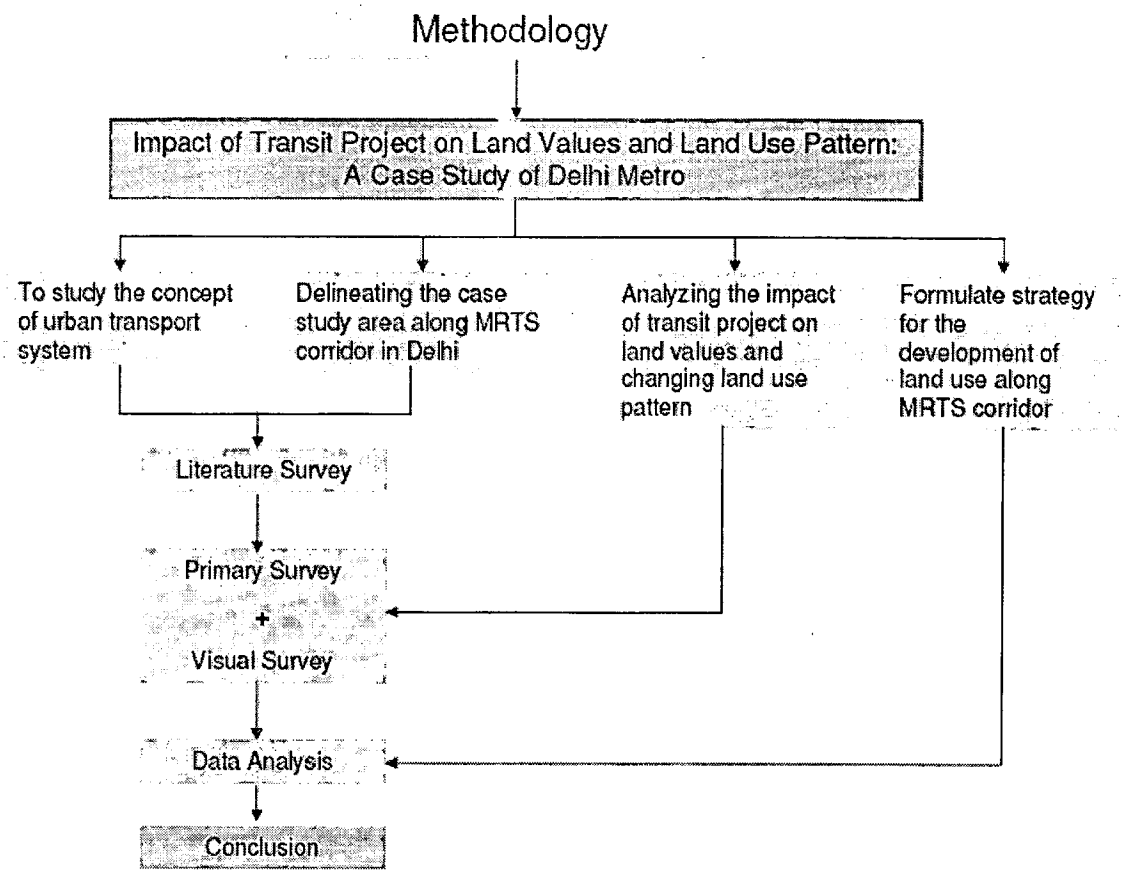
1.5 Aim

To formulate the strategy for land use and development along metro corridor: Kashmere Gate to Rajiv Chowk interchange.

1.6 Objectives:

1. To study the concept of urban transport system as basic infrastructure in global context.
2. To study the land values and land use pattern in the selected case study area
3. To delineate the case study area along MRTS corridor in Delhi.
4. To analyze the impact of transit project on land values and changing Land use pattern in it.
5. To formulate strategy for the development of land use in the case study area.
6. To prepare a proposal plan/ blue print.

1.7 Methodology:



1.8 Scope of Study:

1. To study the impact of Transit projects on land component
2. To identify the development issues on study area and formulation of development strategy for planned development along metro corridor.

1.9 Limitations:

1. Study will be based on primary & secondary sources of information and visual survey which may have limitations regarding to accuracy.
2. The study will be limited to the stretch selected, ie; Kashmere Gate to Rajiv Chowk interchange.

Chapter 2.0 LITERATURE REVIEW

2.1 Land Value & Property Value

The land value is guided by the economic principle of the highest & best use which produces the highest net return over a period of time. The property value is function of the structural attributes, the land value & rental value (both of which are guided by the land use & location) of the property. No two properties are same, the vacant plot & the constructed one in a similar area cannot be valued at same rate. On the other hand similar structures on similar plots in different areas may have dramatically different values. Each plot is unique due to specific attributes it has, such as land use, location, aesthetics, development status etc.

To set the stage for empirical analysis, the primary monetary value to the owner or user of property is considered. This is the market value of the property and is also referred to as the price at which the willing seller would sell & the willing buyer would buy in full knowledge of the market conditions. The property value of the property is the direct indicator of the land value, since the building cost is the smaller component & is uniform all over the city according to the quality of construction. Hence both the terms are used to convey similar meanings.

2.2 Determinants of Land Value

a) **Physical attributes**: Quality of location, fertility and climate; convenience to shopping, schools and parks; availability of water, sewers, utilities and public transportation; and patterns of land use, frontage, depth, topography, streets and lot sizes.

b) **Legal or governmental forces**: It includes type and amount of taxation, zoning and building laws, planning and restrictions.

c) **Economic forces**: It includes value and income levels, growth and new construction, vacancy and availability of land. It is the influences of these forces, expressed independently and in relationship to one another that help the people and the assessor measure value.

d) **Demand Factors**: The presence of exceedingly high demand for land over available supply causes an increase in property value. The demand generally outpaces the available supply of property, if it is spurred by major demographic changes. In anticipation of the increase in value, in practice, the values rise several years before change in use. Anticipation of high yields may also induce hold outs & create false scarcity thereby increasing values. The rapid expansion of towns & cities increase with it the locational advantage of properties at any time within the urban boundaries & hence causes economic values to be increased. For any site there are certain points of transition in use, closely associated with the infrastructure & other services, where jumps in property value are likely to happen.

e) **Supply factor**: It is known economic principle that the decrease in supply creates scarcity & hence an increase in value. This may be the case when the agency/ authority responsible for the supply is greatly constrained in supply. The constraints experienced by the agency could be because of the - High development cost, Scarcity of developable land, the material & infrastructure cost, Minimum standards to be met, not reflecting ground realities of affordability, Administrative delays, and Political considerations.

f) **Infrastructure development**: The level of infrastructure services, physically as well as socio economic, available in a particular area in a significant determinant of land values. The access to basic services such as water supply, sewerage, drainage, garbage removal & electricity; & socio economic facilities such as educational, medical, commercial & institutional; is an essential ingredient of the living environment. The quantity & quality of these is usually in direct proportion to the levels of land values in the area.

g) **Location and Transport Linkages**: The properties located in the area of high level of infrastructure facilities or the ones located in or adjacent to the areas of economical intensive activities such as markets or industries

have higher values. Transport linkages are also important since they govern the mobility & ease of movement to & from the area. Clearly defined hierarchy of roads, efficient public transportation, and lack of congestion are some of the desired transportation attributes of any residential area. Residential land values are also observed to be in direct proportion to the hierarchical order/ right of way of the abutting road.

h) **Social Factors**: These are basically a result of irregular changes in the political or social order and have little or no relevance to the demand & supply factors. The political pressure for regularizing an unauthorized colony leads to increase in land values. Similarly, at times the political set up may be cause.

2.3 Theories related to Land Value

2.3.1 Land & its Prices

In a market economy, most of the urban land can be freely sold or purchased. Thus land economics are concerned about how the price of urban land is fixed and how this price will influence the nature, pattern and distribution of land uses.

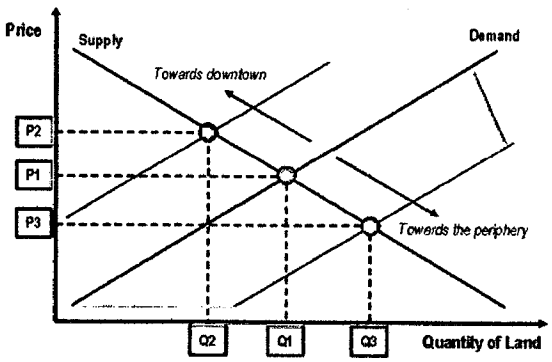


Figure 2.1: Relationship between Quantity and Land Price

Fig.2.1 provides some basic relationships between the quantity of land and its price. This mechanism follows the standard market relationship between supply and demand, where an equilibrium price is reached. A quantity of land Q1 would be available at a price of P1. However, what is particular to cities is that the supply is fixed since there is a limited amount of land available.

- When land is reasonably available (Q1), the price (P1) will be moderate.
- Moving towards the downtown the demand rises, land becomes scarcer (Q2) & the price goes up (P2)
- Moving towards the periphery, more land is available, demand drops (Q3), and so does the price (P3).

Obviously, not every type of activities can accommodate a price equal to P1. Some activities may even need a price lower than P3. High land values impose a more intensive usage of space so the highest number of activities can benefit from a central location. The logic behind the construction of skyscrapers is therefore obvious.

2.3.2 Land Rent Theory

Three concepts are at the core of the land rent theory:

- **Rent**. A surplus (profit) resulting from some advantage such as capitalization and accessibility. The rent is the highest for retail because this activity is closely related to accessibility.
- **Rent gradient.** A representation of the decline in rent with distance from a center. This gradient is related to the marginal cost of distance for each activity, which is how distance influences its bidding rent. The friction of space has an important impact on the rent gradient because without friction all locations would be perfect locations. Retailing is the activity having the highest marginal cost, while single-family housing have the lowest marginal cost.

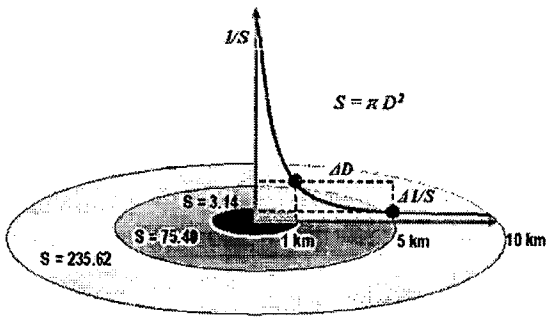


Figure 2.2: Rent Gradient

- **Bid rent curve function.** A set of combinations of land prices and distances among which the individual (or firm) is indifferent. It describes prices that the household (firm) would be willing to pay at varying locations in order to achieve a given level of satisfaction (utility/ profits). The activity having the highest bid rent at one point is theoretically the activity that will occupy this location.

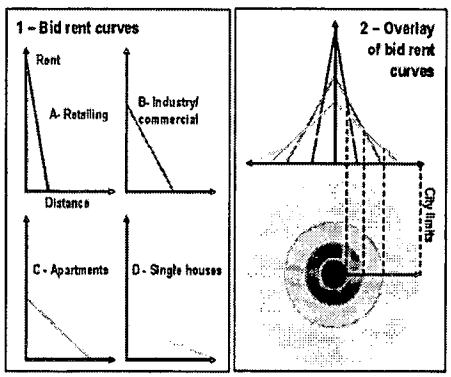


Figure 2.3: Bid Rent Curve

Figure 2.3 illustrates the basic principles of the land rent theory. It assumes a center, which represents a desirable location with a high level of accessibility. The closest area, within a radius of 1 km, has about 3.14 square kilometers of surface ($S=\pi D^2$). Under such circumstances, the rent is a function of the availability of land, which can be expressed in a simple

fashion as 1/S. As we move away from the center the rent drops substantially since the amount of available land increases exponentially.

2.3.3 Land Rent & Land Use

Land use is thus determined by the rent-paying ability of different economic functions in urban areas, such as retailing, industry and residence. The optimal location, where accessibility is optimal, is the central business district. Every activity, including least producing activities, would like to be located there, but they do not have the same capacity to afford this optimal location. Section 1 on the above figure, depicts the tolerance of economic activities to rent.

By overlapping the bid rent curves (section 2 on the figure 2.3) of all the urban economic activities a concentric land use pattern is created with retailing in the CBD, industry/commercial on the next ring, apartments farther on and then single houses.

When a city grows, more remote locations are being used, making the rent of most accessible places increase, inducing higher densities and productivity. This generally occurs by "expulsing" some activities outside and by attracting more productive activities. Density and rent are closely related.

2.4 Micro Economic Theories of Urban Land Values

Economic theories of urban land values date back to Ricardo and Von Thunen. Von Thunen was essentially concerned with the location of agricultural activities, but his ideas were applied to the location of urban activities, by Hurd (1903) and later on by Haig (1926).two concepts that emerged prominently from these studies were that of relationship between land rent and transportation accessibility.

Alonso (1964), Wingo (1961) and Muth (1969) were some of the other researchers in the development of the theory. The major assumptions of these were threefold. First, a household or firm determines its location in the city according to its total budget which enables it to pay the cost of a 'market based' comprising of a unique combination of residential transportation and all other commodities consumed. Second, in location choice, there is set of 'market baskets' among which each household is indifferent. And third, the household or firm optimizes by selecting a 'market based 'from all conceivable sets which help to maximize its savings. Both Alonso and Wingo produce explicit models based on these premises.

2.5 Land Value Measurement

Three Approaches to Valuing Land

The highest and best use of the site, based on criteria such as: physically possible, legally permissible, financially feasible, and maximally productive is firstly determined, then a analysis is made, based on:

- Highest & best use, if the site is vacant;
- Highest and best use of the site as improved, or if undeveloped as proposed to be improved.

The three standard approaches to estimating market value are:

a) **Cost approach:** It is based upon the principle that the informed purchaser would pay no more than the cost to produce a substitute property with the same utility as the subject property.

b) **Sales comparison approach:** It utilizes prices paid in actual market transactions of similar properties to estimate the value of the site. This appraisal technique is dependent upon utilizing truly comparable market or sales data which have occurred near enough in time to reflect market conditions relative to the time period of the appraisal.

c) **Income approach.** It is applied in appraising income-producing properties. Anticipated present and future net operating incomes, as well as any future reversions, are discounted to a present worth figure through the capitalization process. This approach also relies upon market data to establish current market values and expense levels to arrive at an expected net operating income. The resulting indications of value from the three approaches to value are correlated into a final estimate of value for the site. It is not always possible or practicable to use all three approaches to value. The nature of the property being appraised, and the amount, quality, and type of data available, dictate the use of each of the three approaches.

2.6 Classification of Impact of a Transit System

A large-scale transportation infrastructure will have a hierarchy of impacts that can be classified as follows:

1. **Primary**: Changes in people's travel pattern or Modal shift
2. **Secondary**: Effects on activity centers or Accessibility
3. **Tertiary**: impacts like land use and land value changes

The primary impact of a transit system is the purpose or basic intent of introducing the new system. Once this modal shift is achieved it will trigger the other changes the land system surrounding it. This work involves in taking a closer look at the tertiary impacts of a transport system, which can further be classified as direct and indirect land-use impacts.

- **Direct land use Impacts**

Occur in the short-run (usually during construction, as residences and businesses are displaced) and adjacent to transportation improvement. It also includes the actual conversion of productive land to transportation use. The removal of existing uses to accommodate the facility and any immediate changes to the overall character of the affected area.

- **Indirect land use impacts**

Attributes to long- run and widespread changes to development patterns and planning that are induced by the transportation improvement. Indirect or secondary impacts of transportation projects on land use tend to occur, over a long period and may involve changes in the overall development and growth of an area. These impacts will vary depending upon the nature of the transportation improvement and other characteristics of an area that affect growth rates.

2.7 Land attributed impact

Land uses impacts are changes in how land is used that are directly or indirectly related to accessibility.

Population and employment growth may demand new or rehabilitated space, leading to land development or redevelopment, which is a land use impact. A transit project has an

impact on a business by changing the performance of the transportation system and that change in performance affects business profitability, and that change in profitability gets capitalized (to a greater or lesser degree) into property values which then stimulates changes in land use.

The goal is to be able to describe how a transit system will contribute to changes in the use of land (the pattern of development) from what it would have been without it.

The key variables that might contribute to considerable changes in development patterns in response to transit are:

1. **Change in accessibility:** This is the variable that most affects land use by changing average trip time, volumes, and mobility/density change.
2. **Change in property value:** Such estimates are another count of the potential created by the travel improvement (The improved accessibility of the transportation improvement makes the land more valuable and creates potential for it to be used more intensively).
3. **Expected growth:** A growing city experiences pressure to develop where good access and services are available.
4. **Relationship between land supply and demand:** How much vacant, buildable land is there in the study area compared to the rest of the city or larger region? What is the demand for land at the regional, city and study area level? How does the study area buildable land compare to available land region- wide? The more limited the supply is relative to demand, the more likely improve access would increase the probability of development.
5. **Availability of other services:** The case studies demonstrated that access alone was not sufficient to trigger development: other key public facilities like sewer and water had to be available at reasonable cost. If they are, access improvements are more likely to facilitate land use change.
6. **Other market forces:** Where has growth been going and where do local real estate experts expect it to go? How does the study area market compare to markets in other sub areas? What is the extent of under building relative to allowed densities? Is accessibility (travel time) a limiting condition on development in the study area?

7. **Public policy/ Land use policy:** All the previous factors are indicators of the potential for land use change; most are market driven. But for that potential to result in change it must not only be big enough, it must also be allowed. There is ample evidence of areas where land use near high capacity transportation facilities in urban areas has not changed despite changes in accessibility. A key reason is that public policy does not allow land uses to change because, for example, a park is a public trust, or a neighborhood does not want its zoning changed to increase density. Public policy makers can clearly resist pressure for development. The question for the land use analyst is whether policies exist on the books to offer that resistance, and whether those policies will be enforced, bent, ignored, or changed.

But certain factors must be considered when determining the extent of land value impacts caused from transportation investments. There are four of these factors:

- Land use changes- distinguishable from economic growth
- Level of intensity- technological improvements
- Level of analysis- local, region or both
- Longevity and durability of urban structure

Chapter 3.0 INRODUCTION TO MRTS

3.1 Introduction

Transport is a messy problem. Moving around in the cities has increasingly become a problem. As the space crunch for residential and offices grows, so the demand for roads and other transport means. Road surface occupy large proportion of land in city fabric and continuous pressure has been deteriorating the quality of city life.

The world is truly affected by the development in transport technology and infrastructure. The dense development attributed to such networks plays a central role in shaping the city. Movement is the lifeline of any urban area. Movement generated varies from education, work; shopping, healthcare etc. increasing number of automobiles can contribute more to mismanagement rather than true development and is unable to cater to city growing population.

The term rapid transit has been defined as meaning any form of public transport separate from other transport operating at high frequency to carry large no of people at high consistent speed.

3.2 What is MRTS?

MRTS – MASS RAPID TRANSIT SYSTEM

MRTS are operating in almost 100 cities in the world and these networks are being expanded constantly with cities having population b/w two million to over 6 million. MRTS is a High Capacity Based, High speed, Mass Rapid Transport System based on State of Art technology. It operates on guide rails. It is most suited for travel demands higher than 20,000 persons are during peak hour. Each MRTS bus can carry up to 3000 passengers at average speeds of 50-60 km/hour. The operating system of this system can reach up to 80,000 persons per hour in each direction.

MRTS with its superior characteristics as a transport system has the potential to change the urban form to a compact one with higher population density, less fuel consumption and less pollution, for the same give load of urban activity represented by demand for traffic movement.

MRTS can comprise of-

1. Ring rail systems
2. Metro rail corridor
3. Dedicated bus transport corridor

Typology of movements and stations

1. At grade
2. Below surface
3. Elevated

3.3 What is a Metro?

A 'Metro' can perhaps be best defined as a high-frequency, urban, rail-based mass rapid transit system that operates totally independent from other modes of traffic. It can be underground, at-grade, elevated or a combination of any of the above

According to German Metro enthusiast Robert Schwandl, Steel Wheels, Rubber Tyres, Double-rail, Monorail, Overhead Wire Electrification, Third Rail Power Supply, Narrow Gauge, Standard Gauge, Broad Gauge, Automatically-driven, Driver-driven... a 'Metro' can be based on a combination of any of the above systems.

3.3.1 World Metro Scenario

Cities in Europe have an average 38 kms of metro rail per million of population. The corresponding figure in Asia is 10 kms.

Table 3.1: World Metro Scenario

Continent	**Length of Lines**
Europe	38
North America	23
South America	8
Africa	1
Asia	10
India	2
World average	**19**

Source: *Feasibility report for phase I DMRC project*

3.3.2 In Context of Delhi

Delhi has experienced phenomenal growth in population in the last few decades. Its population has increased from 57 lakhs in 1981 to 120 lakhs in 1998 and is poised to reach 137 lakhs by the year 2001. In the absence of an efficient mass transport system the number of motor vehicles has increased from 5.4 lakhs in 1981 to 30 lakhs in 1998 and is projected to go up to 40 lakhs by 2001, The number of motor vehicles in Delhi is now more than that of Bombay, Calcutta and Chennai put together. The result is extreme congestion on Delhi roads, ever slowing speeds, increase in the number of road accidents, fuel wastage and environmental pollution. The motor vehicles alone contribute to about two-thirds of the atmospheric pollution. Delhi has now become the fourth most polluted city in the world. Presently, the traffic on the roads of Delhi is a heterogeneous mix of cycles, scooters, buses, cars and rickshaws jostling each other. This has resulted in a chaotic situation, which has lead to road accidents, the average number of persons killed per day has risen to 5 and of those injured to 13 per day. This scenario can be expected to deteriorate in the years to come.

A feasibility study for introduction of Mass Rapid Transit System in Delhi (by RITES) completed in 1991 had recommended a network aggregating to 198.5 kms to meet the traffic demand for horizon year 2021.To rectify the present congested and chaotic situation, the Government of India and the Government of National Capital Territory of Delhi (GNCTD), in equal partnership have set up a company named Delhi Metro Rail Corporation Limited, under the Companies Act, 1956 which has been given a mandate to construct the first phase of the mass rapid transit network consisting 55.3 kms by 2005.

3.3.3 Cost and Funding Plan

The total mass transit project's cost was estimated at April 1996 price level. The cost break up of the network is as follows.

Table 3.2: Corridor Wise Cost Breakup

Type	**Cost (in Rs)**
Surface Corridor	2,542 Crores
Metro Corridor (Underground)	2,318 Crores
Total	**4,860 Crores**

Source: *Delhi Metro Rail Corporation*

It has been finalized that the project will be financed by way of equity contribution from the Government of India and Government of National Capital Territory of Delhi, back to back soft loan from the OECF (Japan), subordinate loan to meet the cost of land needed for the project and property development. The break up of the funding of the project is as below:

Table 3.3: Financing Institutional Setup

Institution	Percentage
Government of India.	15%
Government of National Capital Territory of Delhi.	15%
Property Development	6%
OECF Loan.	56%
Interest free subordinate debt towards Land Cost	8%

Source: *Delhi Metro Rail Corporation*

Feasibility study for Delhi MRTS (by RITES) completed in 1990, recommended a three component system comprising of Rail corridors, Metro corridors and a dedicated Bus-way for a total network of 193.5 kms where alt above ground sections, At-grade and elevated viaducts, operated EMU coaches of Indian Railways are designated as Rail corridors. All under ground sections operated with special coaches are designated as Metro corridors.

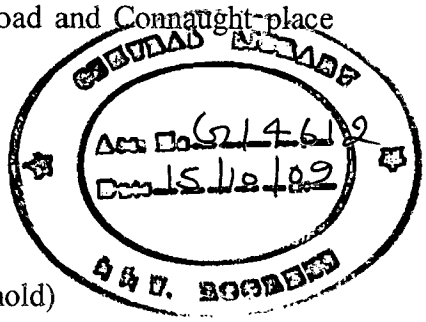
3.3.4 Phasing

Delhi MRTS Master plan currently comprises 245 kms network of 9 lines to be implemented in 4 phases. Total capital cost involved is of Rs 315.50 Billion at April 2001 price level.

I-Phase

First phase of the project consist of three lines covering 68.3 kms with 59 stations. It includes 28 kms surface corridor from Shahdara in the east to Barawala in the north west with 21 stations. An 11 kms underground corridor linking vishwa vidyalaya. In the north with central secretariat in central Delhi with 11 stations 23.16 kms underground- cum

surface corridor connecting the central hub of Barakhamba road and Connaught-place with Dwarka in the South-west.



Line 1 (Elevated/at grade) - 28 Km

Trinagar - Rithala (East-West) - 8.8 Km by March 2004

Rithala - Barwala (East-West) - 61 Km (proposed to be put on-hold)

Line 2 (Underground) - II Km

Vishwa Vidyalaya - ISBT (Kashmere Gate) (North-South) - 4.0 Km by December 2004

ISBT (Kashmere Gate) - Central Secretariat (North-South) - 7.0 Km by September 2005

Vishwa Vidyalaya - Azadpur (North South) - 40 Km (elevated) - under consideration

Line 3 (Elevated/at grade/underground) - 29 5 Km

Barakhamba Road - Kirti Nagar (East-West) - 7.2 Km by June 2005 Kirti Nagar

Dwarka (East-West) - 16 Km by September 2005

Dwarka Subcity Extension (East-West) - 6.5 Km (schedule yet to be decided)

Barakhamba Road - I.P.Estate (East West) - 4.0 Km – construction completed.

Table 3.4: Line Lengths, Phase I Delhi Metro

Phase I- Lines	**Length (Kms)**	**No. of Stations**
Line No 1 Shahdara - Tri nagar - Barwala	28	21
Line No-2 Vishwa vidyalaya - Central Secretariat	11	10
Line-3 Barakhamba Road - Connaught Place - Dwarka	22.8	22
Total	**61.8**	**53**

Source: *Delhi Metro Rail Corporation*

Table 3.5: Route Distance, Phase I Delhi Metro

Route	**Distance**	**Completion Schedule**
Shahdara - Tis Hazari	8.3 km	December, 2002
Tis Hazari - Tri nagar	14.8 km	September, 2003
Tri nagar - Rithala	8.8 km	March, 2004

Rithala - Barwala	6.1 km	March, 2005
Vishwa Vidyalaya - ISBT	40km	December, 2004
ISBT - Central Secretariat	7.0km	September, 2005
Connaught Place - West Patel Nagar	7.0km	September, 2005
West Patel Nagar - Dwarka	16.5 km	September, 2005

Source: *Delhi Metro Rail Corporation*

II- Phase

As part second phase of construction it is proposed to have three new lines totalling 42.1 kms. The second phase includes:

The 8.6 km Vishwa Vidayalaya- New Azadpur Sanjay Gandhi Nagar Corridor.

The 18.2 Kms central Secretariat – Vasant Kunj corridor

The 15.3 Kms Barakhamba road- Indraprastha-Noida corridor.

Work on the second phase begins in early 2005 and will be completed by 2010.

Table 3.6: Line Lengths, Phase II Delhi Metro

Phase II - Lines	**Length (kms)**
Line I: Vishwa Vidyalaya - New Azadpur – S G Transport Nagar	8.6
Line 2: Central Secretariat - Vasant Kunj	18.2
Line 3: Barakhamba Road - Indraprastha - Noida	15.3
Total	**42.1**

Source: *Delhi Metro Rail Corporation*

3.3.5 Transfer Stations for the Metro System

Inter-State Bus Terminus (ISBT), also known as Kashmere Gate, for Lines 1 and 2, (ISBT is the main terminus for buses running between Delhi and neighbouring towns and is also a major hub for city buses) Connaught Place for Lines 2 and 3 (Central Business District of the city) New Delhi Railway Station and Delhi Main Railway Station on Line2

These are the major long-distance train stations that also have suburban EMU train services from satellite towns.

Shahdara station on Line I would also serve as a link to suburban trains from satellite towns like Ghaziabad and Sahibabad in the East.

Trinagar would link with trains to Gurgaon in the South. Delhi Metro Rail Corporation plans to provide park-and-ride facilities at most Metro stations

3.4 Benefits of the Project

The Delhi MRTS is essentially envisaged as a social sector project which will benefit wide sections of Delhi's economy and people. Estimated 31.85 lakh commuters will be siphoned off the roads, which would result in,

- 3500 less buses on the roads.
- Saving of 26 lakh man-hours per day due to reduced journey time.
- Saving in fuel cost, worth Rs 500 crores per year.
- More comfortable and safe travel for the commuters.
- Reduction in atmospheric pollution and accident rates.
- Reduction in journey time by 50 to 75 percent.
- Increase in average speed of road buses from 10.5 kmph to 14 kmph

Table 3.7: Atmospheric Pollution Measurement est. in 2005

	SPM (PPM)	SO2 (PPM)	NO2(PPM)	CO (PPM)
Without MRTS	3840	250	360	50,000
With MRTS	2030	125	180	25,000
Acceptable	500	120	120	5,000

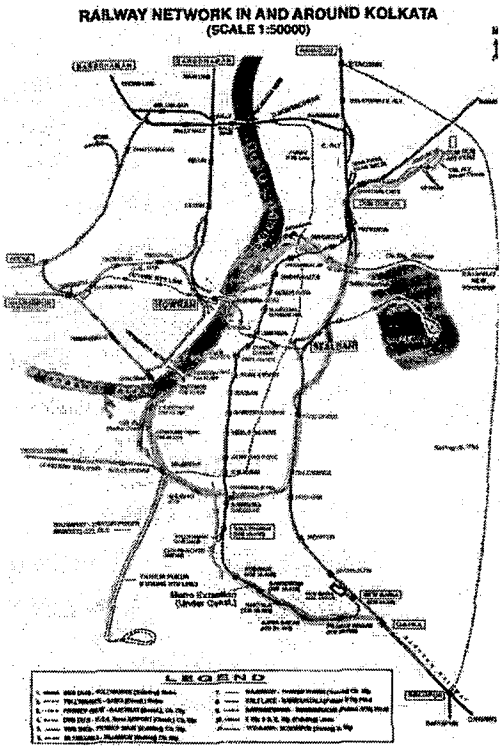
Source: *EIA report Delhi Metro Rail Corporation*

Chapter 4.0 CASE STUDIES

4.1 CASE STUDY 1: CALCUTTA METRO AND ITS IMPACT

4.1.1 Introduction

The city is linear pattern and the movement largely dictated by dictated by the flow of river Hoogly. The city has primarily two movement corridors – the Barrack pore trunk road on the East and GT road on the west, which serves as major entries to the CBD. At present 6% of the urbanized area under transportation. The city served by multimodal transport system with Tram, Metro, Bus and rail serving for the public transport.



Map 03: Railway network in Kolkata

Source: *Urbanrail.net*

Map 04: Physical map of Kolkata

Source: *maps of India*

4.1.2 MRTS Profile

There are about 17 stations in the metro line and total of around 4 crore passengers travel daily. Out of the 17 stations, Tollygunge and the central station account for around 26% of the volume of passengers followed by esplande, which is 12 % Dum-Dum and Tollygunge have a high density and low raise commercial activities.

4.1.3 Impacts

Work place relationship accounts for the major movement in a city. This relationship when understood properly can lead to efficient utilization of a transport network with minimizing the effort and time to arrive at the destination, which leads to further activities thus movement and activity for an essential part of the whole cycle which is important to understand the relationship between land use and transportation.

Table 4.1: Station Information, Kolkata

Station Name	Present Use	Changes Observed
Bhawanipore	Predominantly, Residential, Institutional, Commercial	Increase in land values densification of residential
Kalighat	Commercial and informal activities	Increase in land values, addition in floor spaces
Rabindra Sarovar	Predominantly Residential, Institutional, Commercial	Increase in land values, addition in floor spaces
Esplande	Commercial, retail and informal activities	Reduce in residential population, increase in informal activities in station areas

4.1.4 Case Study – Dum –Dum

The Dum-Dum station area is located in the northern end of the city of Calcutta corporation area and at the periphery of the south Dum-Dum municipality. The Dum-Dum Station at present is the terminal station of metro line and an elevated one.

The number of daily commuters was 170000 in 1990.

4.1.4.1 Land Use Distribution

The land use distribution of the area and the change in the last 20 years at the cost of open space primarily by unauthorized commercial growth. The other land uses have not undergone any change because the ownership of is not under any private hands

Table 4.2: Land use breakup of Dum Dum station area

Land Use	% Area - 1981	% Area –2000
Residential	9	9
Commercial	14	22
Institutional	1	1
Market	38	38
Cinema	4	4
Open Space	34	25
Total	**100**	**100**

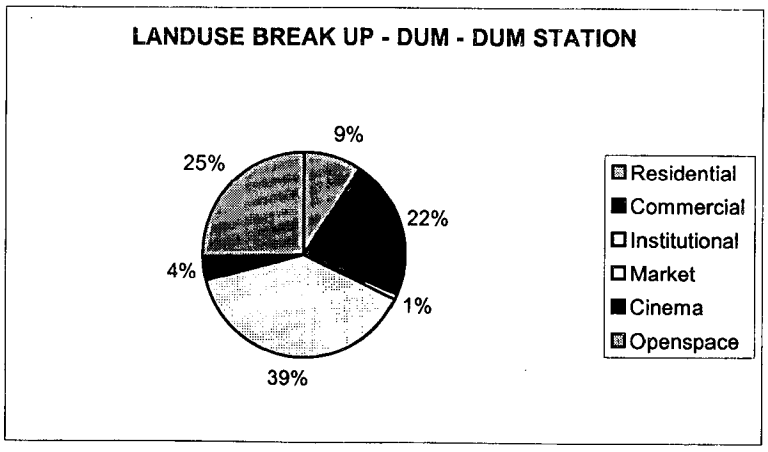


Figure 4.1: Land Use breakup for Dum Dum Station area

4.2 CASE STUDY 2: MUMBAI

4.2.1 Introduction

Mumbai, presently India's leading commercial and port city offers enormous employment opportunities, which serve as a major attraction for migrants all over India. It presently has a population of approximately 15 million. The estimated population of BMR in the year 2001 is 22.4 million. The incremental process of economic growth and population has left the transport provisions lagging far behind. In the past 40 years the, no. of trains in the suburban rail system have increased by 2.5 times whereas the commuters dependent on the network have increased about six fold. This has resulted in increased loads on the transportation network for e.g. A 9 car EMU rake which has a normal capacity of 1700-1800 persons and a dense crush capacity of 2600 persons (sitting and standing) presently carries around 3500-4000 commuters on some routes. In Mumbai approx. 70% of passenger kilometers are currently provided by suburban rail system, which basically serves the middle and poor income groups. The travel demand in Mumbai is likely to be over million passengers/day by the year 2001, while presently the suburban rail network carries around 5.14 million passengers per day. Recognizing, this, the improvement of suburban rail services and optimization of existing services on a significant scale has been emphasized upon in the second Bombay Urban Transport Project.

Mumbai is served by two of the Indian Zonal Railways, the Western railways (WR) and the Central railways (CR). The suburban rail network consists of five corridors, each corridors comprises of two tracks, one each for the up and down trains. Out of the five corridors two are on the Western railway and three are on the Central railway.

4.2.2 Central Railway

The two corridors out of three of the Central railway connects Chatrapati Shivaji terminal (Victoria Terminus) and Kalyan. The third corridor on the Harbour side between Bombay VT and Bandra / Kurla, runs parallel to the harbour from Masjid to Wadala and deviates from Rawli junction towards Mahim-Bandra section of western railway, its other section joins Kurla to Rawli and a small section connects Mankhurd and Kurla to Belapur.

4.2.3 Western Railway

Both the corridors of western railway connect Church Gate to Borivali and one of them further extends into Virar.

Optimization of existing rail services has been considered under the short-term plans of the railways to reduce the pressure on the existing network. These plans include:

- Reduction of headway between trains from 4 min. to 3 min. on western railway. This phase of 3-min. headway between trains is under operation on certain sections.
- On the Central railway the headway was to be reduced from 5 min. to 4min. and later to 3 min., its first phase of 4 min. Headway between trains has been introduced on some sections.
- A 12-car rake has been considered instead of a 9-car rake, which could increase the capacity of a rake by 33% straight away. However in this case remodeling of stations is required to accommodate the extra rolling stock as length of platforms and commuter dispersal would pose immediate problems. Andheri, Bandra, Dadar, Mumbai Central. Grant road, Chami road, Marine lines and Church Gate are the stations where remodeling to accommodate longer rakes has been planned. (Estimated cost - 43 crores)

To cater to the growing need of commuter traffic demand two more additional corridors have been proposed as a long-term plan to augment the suburban rail network.

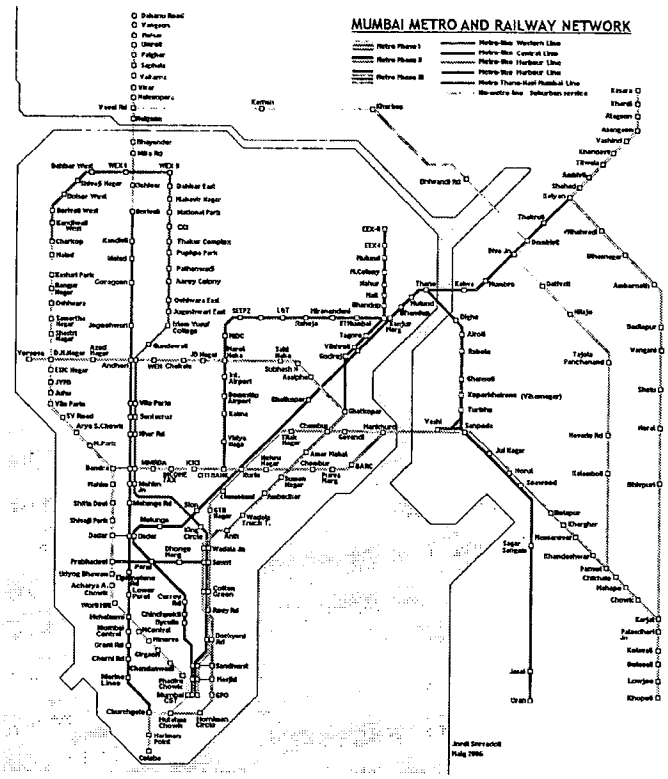
One of these corridors (rail corridor) comprises of rail lines from Fort market to Rawli junction and two flyovers at Rawli from Bandra to Goregaon and from Vikroli to Bhandup.

The metro corridor consists of underground lines between Cofaba and Mahalaxmi, from Mahalaxmi to Bandra and from Bandra to Kurla with a branch leading to the airport.

Reviews of these corridors show that with the inclusion of the sixth and seventh corridor, the commuter volume on the western railway will reduce considerably. Bandra, Kurla, Dadar (WR & CR) and Chatrapati-Shivaji terminal will have varying reductions in their commuter volumes (ranging from 23% to 56%) whereas at Church gate terminal the commuter volume will increase by 13%. This reduced commuter traffic will relieve the above mentioned stations and their surrounding areas from congestion and lead to appreciable increase in the speed of vehicular traffic.

4.2.4 Station Area Traffic Improvement Scheme

Mumbai is particularly suited to rail as it has a linear corridor of development and has road congestion. Rail provides much quicker travel for intra city journeys and accounts for approximately 70% of the trips for e.g. a parallel bus service exists between Andheri and Church gate but it has negligible effect on rail usage as it takes much longer and is a little more expensive than train. The main modes used to access stations are walk, bus, cycle, two wheeler, car and taxi [wherever auto rickshaws are not available]. Station areas have good accessibility and offer high attractiveness for users but due to unplanned development the station areas have areas deteriorated into congested land pockets. Thus suburban railway station areas are unable to cope with the commuter dispersal problems due to extreme congestion. The presence of hawkers, shopping areas and incremental spontaneous development has added on more complex cities to the present situation. In light of this Mumbai Municipal Corporation in consultation with Western and Central railways have identified 13 critical railway stations where it intends to carry out up gradation and re-development schemes. The Central railway stations, which have been identified, are Wadala road, Kurla, Chembur, Ghatkopar, Borivili, Dadar, Byculla, Mulund and the Western railway stations are Grant road, Bandra, Santacruz, Andheri and Goregaon. The total estimated cost for this project including the railway up gradation arrived at by B.M.C. is approximately 40 crores. .



Map 05: Mumbai Metro and Railway Network

Source: *Delhi Metro Rail Corporation*

Railways have also proposed commercial exploitation of air space and adjacent land at the following sites: Carnac Bunder [35 Ha], Kuria Terminus [50 Ha], Bandra [East] [4.2

Ha], Wadala [2.6 Ha], Dadar [Central and Western Railway], Kuria Terminus, Ghatkopar [17 Ha], Kalyan [0,81 Ha] etc.

Table 4.3: Mumbai Rail Land statistics

S.No.	Particulars	Area in hectares	Area in hectares
1	Railway land available	1155.39	647.53
2	Land under operation use	1141.67	589.53
3	Railway land not in use	13.72	58
4	Land required for future plans	13.72	43.03
5	Surplus land available	Nil	Nil
6	Extent of encroachments	27.39	13.60

Source: *BMC*

Although there is no surplus land available with the railways but there are ample opportunities to exploit the airspace, overhead bridges and the service lanes for development of commercial establishments, as these spaces are encroached by the informal sector, which operates at the city level (wholesale and retail). The introduction of such transit supportive land use development at the station sites will help in decentralizing the concentrated and congested land pockets and discourages unorganized development.

New Bombay is said to be the largest such project even undertaken in the world, located on the mainland across Thane Creek, just East of Greater Bombay, the city is built on what was formerly underdeveloped land, large tracts of which comprised swamp and soft pan lands. Work on New Bombay project commenced in 1970 and was entrusted to the 'City and Industrial Development Corporation of Maharashtra Limited (CIDCO), a Company owned by the State Government of Maharashtra.

The total area of New Bombay is about 344 sq. km comprising of 19,397 ha. of privately held land including salt pan land. In addition Government land comprise of 10,137 ha

New Bombay has been developed as an independent, self-contained city to act as a counter magnet to Bombay. It is located across the Bombay harbour and is being developed by City and Industrial Development Corporation of Maharashtra (CIDCO). It has all the strategic locational advantages of Bombay and has the potential to become a major future business city.

New Bombay presently has a population of 1 million and it is estimated to cross 2 million by the year 2004. New Bombay is envisaged to have a 157 km. long 6-corridor railway

line and is presently being served by the 18 km long section of the fifth corridor of Central railway. On this corridor there are five stations namely: Vashi, Sanpada, Nerul and Belapur.

Table 4.4: Fact file for Mumbai

Area	
Greater Bombay	433 Sq. km
New Bombay	344 Sq. km
Population	
Greater Bombay	9,920,000
New Bombay (1995)	769,000
New Bombay (2003)	2,000,000
Nodes: Developed & Underdeveloped	Airoli, Ghansoli, Koparkhairane, Vashi, Sanpada, Nerul, Belapur, Kharghar, Ulwe Kalamboli, New Panvel, Jui-Kamcthe, Kopar, Dronagiri.
Housing (Constructed and Under const.)	166,000

Source: *CIDCO*

In New Bombay, CIDCO is appointed as New Town Development Authority. It is the nodal agency to whom all the land is handed over by the government acquisition, for using it as a prime resource. It was expected that CIDCO shall finance the development of New Bombay by using land. Since value of land in 1970 was very low, especially since the site was not agriculturally rich and lacked urban infrastructure, it was primary task of CIDCO to enhance the value of land so as to us it as a resource for generating finances.

4.2.5 Planning of New Bombay

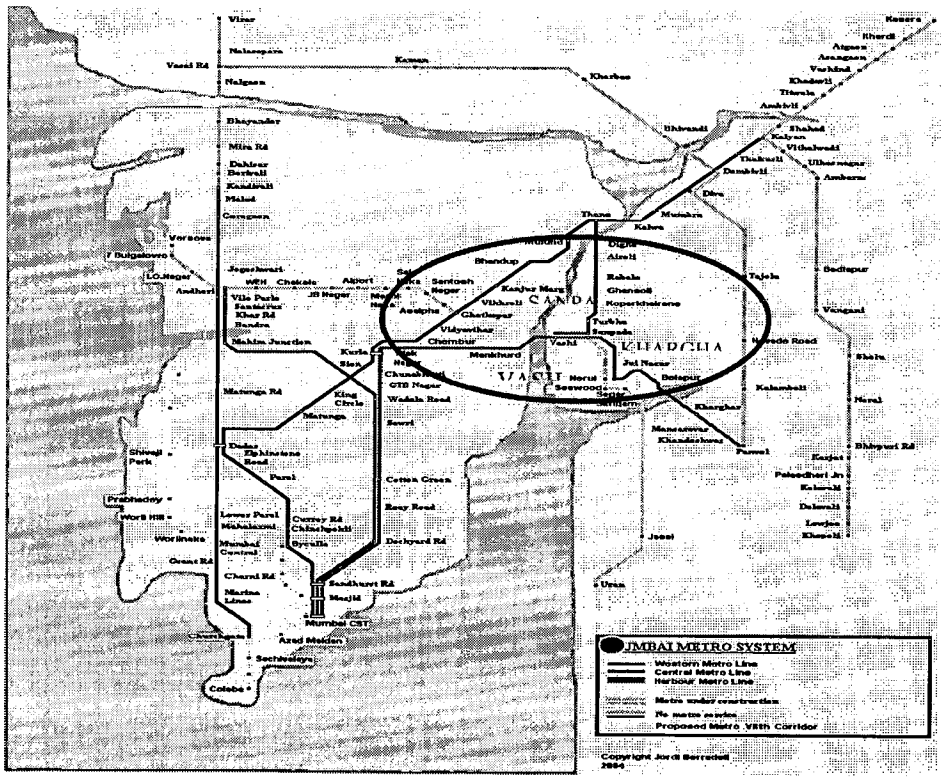
New Bombay city is perhaps the largest New Town anywhere and hence, there is a lot to learn from the experiences gained while planning this new city, and will be of great help to other places especially in the developing world.

The problems faced by the Greater Bombay are mainly attributed to its peculiar physical form and the concentration of jobs at one single place. These parameters necessitated that a different planning concept should be the basis for the city of New Bombay Thus the fundamental concepts of spatial planning adopted for New Bombay are;

- **Polycentric Pattern of Development**
- **Spatial Dispersal of Employment Centers -**

Use of land use zoning and development control as tools for better environment creation. Emphasis was laid on convenience in living & traveling to work, economy in the use of resources, and reducing the disparities for the under privileged. Depending upon the location of major employment centers, each node is planned to have its own residential accommodation along with all necessary urban amenities so that it can be a self-contained township.

The gross residential density adopted in New Bombay at city level is 125 ppha and the per capita open space norm is 5-sq.m.However, the residential density doubles at nodal level, and a maximum density of 550 ppha. is allowed on net residential plots.



Map 06: New Bombay Rail network

Source: *Internet*

Table 4.5: Land Use at Various Nodes

Node	Year	Gr. Area	Resi.	Com.	Ind.	Open	Roads	Public	Total
Vashi	1994	291.5	77.4	9.64	1.96	21.25	44.48	13.85	**168.58**
Sanpada	1995	1048.9	317.5	17.55	9.68	156.5	135.93	149.6	**786.9**
Khargar	1994	261.00	99.93	13.99	0.00	32.85	49.54	35.31	**231.6**

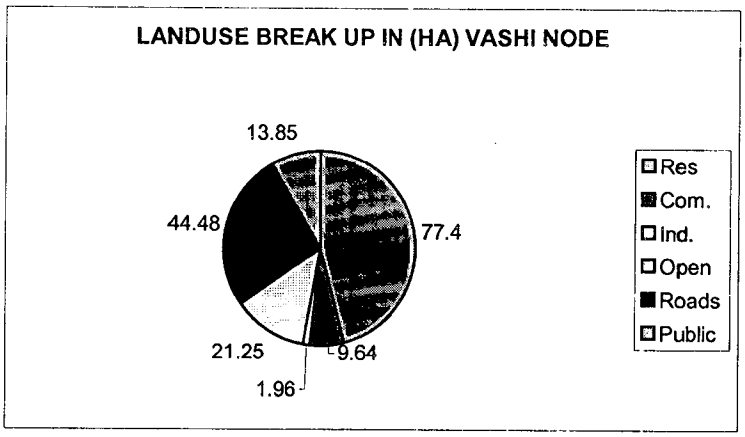


Figure 4.2: Land useVashi node

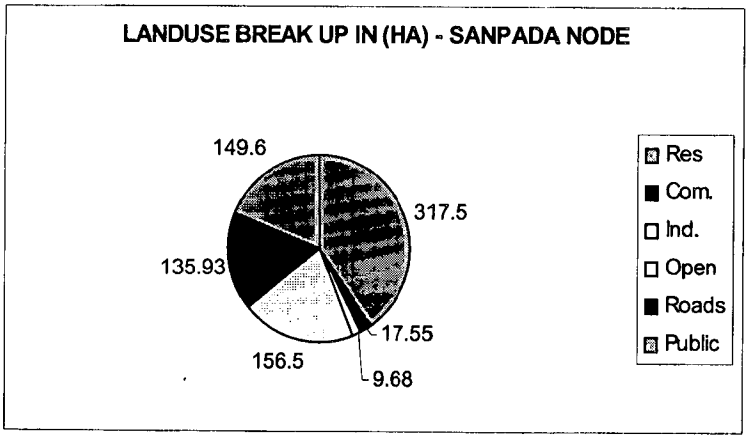


Figure 4.3: Land useSanpada node

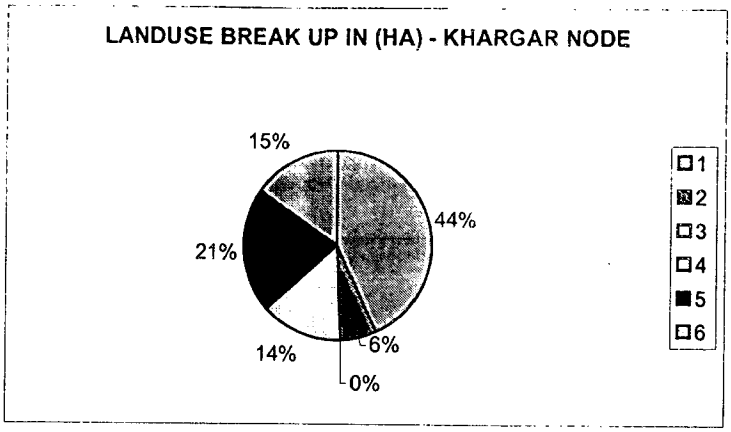


Figure 4.4: Land useKhargar node

Floor Space Index (FSI) is other main norm prescribed in the GDCR. for various land-uses. The maximum FSI permissible for different Landuses are:

Resi. Inst. & Industrial: 1.00

Commercial & Comm.+ Resi.: 1.50

Service Industrial:0.50

Public / Semi Public: 1.00

4.2.6 Station Area Characteristics

4.2.6.1 Vashi Node

It was the first nodal township taken up for development by CIDCO as part of the New Bombay project in early 70's, which spreads over a planned area of 854 ha. The development of Vashi commenced soon after the opening of the Thane Creek Bridge in 1972 and commissioning of Mumbai - Pune Expressway. In the initial years up to 1980's the development of Vashi in terms of provision of housing, commercial social, physical infrastructure and other related activities were at a low key. However, since 1980 development activities like planned development of a large Whole Sale Agriculture Produce Market at Turbhe, development of DBC (District Business Centre) at Sector 17, Development of large scale cold storage, warehousing, service industries and other activities, Construction of houses for various income groups by CIDCO & private sector, all attributed to the sudden spurt in the multi-faceted development of Vashi, Commissioning of Mankhurd-Vashi, commuter railway line on 9th May 1992, was a turning point in the development of New Bombay in genera! and Vashi in particular.

Table 4.6: Gross Land Use Statement

S. No	Land Use	Area in ha	Area in %
1	Residential	185.17	21.68
2	Commercial	165.18	19.34
3	Social Facilities	53.11	6.21
4	Public Utility	53.14	6.22
5	Roads	183.83	21.52
6	Open Spaces	92.39	10.81
7	**Net Developable Area**	**732.82**	**85.80**
8	**Non Developable Area**	**121.49**	**14.20**
9	**Gross Area**	**854.31**	**100**

Table 4.7: Developable Area Land Use Statement

S. No	Land Use	Area in ha	Area in %
1	Residential	185.17	25.26
2	Commercial	165.18	22.54
3	Social Facilities	53.11	7.24
4	Public Utility	53.14	7.25
5	Roads	183.83	25.35
6	Open Spaces	92.39	12.60
7	**Net Developable Area**	**732.82**	**100**

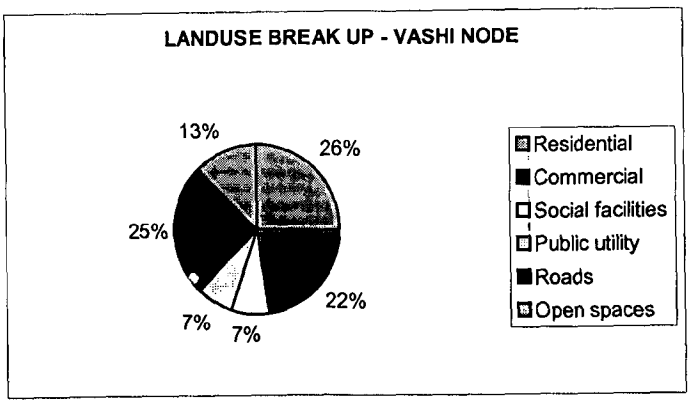
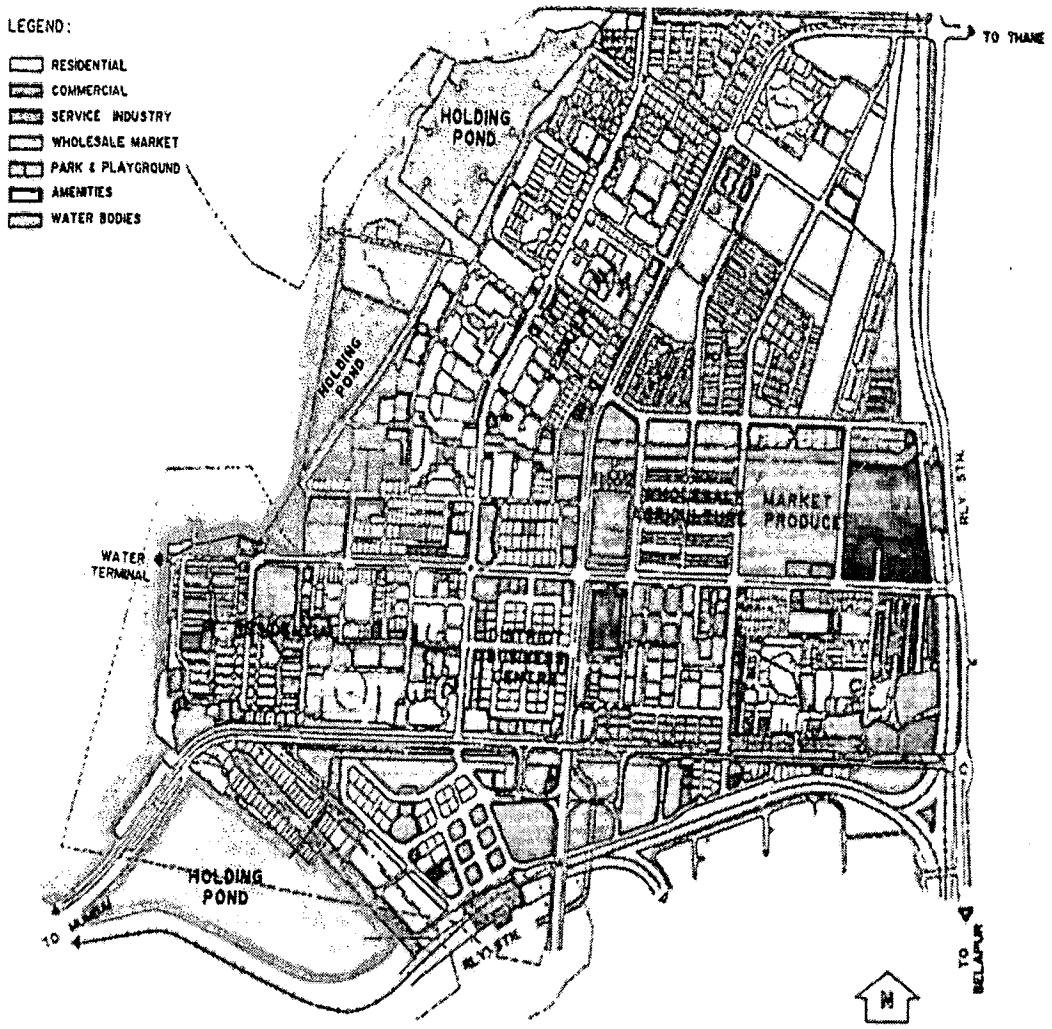


Figure 4.5: Developable area Land Use Vashi node



Map 07: Vashi Land Use Map

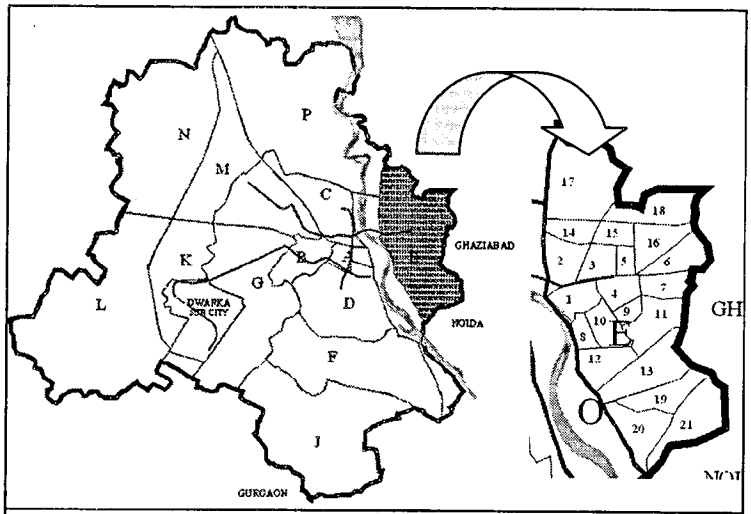
Source: *CIDCO*

4.3 CASE STUDY 3: DELHI

4.3.1 Zone E- East Delhi

The planning zone compromises of the area of 8797 hect.(approx) .it is surrounded on the three sides by state of up and on the fourth side by river Yamuna. The zone has been developing through master plan 1962, 2001and now 2021. The zone is a heterogeneous character where the unplanned and planned area co exists.

Population (in thousands)
MPD 2001-1789(holding)
2001-2798(existing)
MPD 2021-2800(holding)



Map 08: Zone E –East Delhi

Characteristics of the Zone

Position up to 1962

Up to 1960, it had a very small area like Shadara, which was inhabitated. Connected to other parts by only one road cum Railway Bridge near Red Fort. In addition, one pantoon bridge was also used.

Position from 1962-1981

Pre 1962 era the large part of area remained vacant except for some old developments like Shahdara, Geeta colony etc .As per master plan 1962, and this area was planned for a balanced development to contain 7.5-lakh population. Large part of area in close proximity to bridges gave rise to unauthorized colonies, which was meant, for public and other such facilities like recreational centre.

The intervention on this situation by the authorities to improve it, has led to mix of planned and unplanned areas as it is being analyzed today also.

Position between 1993-2007

During the period, some of the infrastructural initiates taken were:

1. Parallel bridges on river Yamuna at ITO and Nizammudin
2. DND flyover
3. MRTS network

4.3.2 Shahdara Region

Shahdara, New Delhi is a suburb of Delhi. It consists of old markets. Shahdara is a part of both East and Northeast Delhi. It is like a small town in itself and one the oldest settlements in Delhi. This place quite a known part of East Delhi. It sets adjoining to the borders of Uttar Pradesh

4.3.2.1 Situation before Metro (on basis of land use)

1. High density residential area
2. Large movement of people as there is a railway station there i.e. due to wholesale market nearby.
3. High level of informal activities like roadside hawkers, vegetable markets etc.
4. Commercialization is more of a small-scale heavy metal work being done by labours.

4.3.2.2 Situation after Metro

Movements

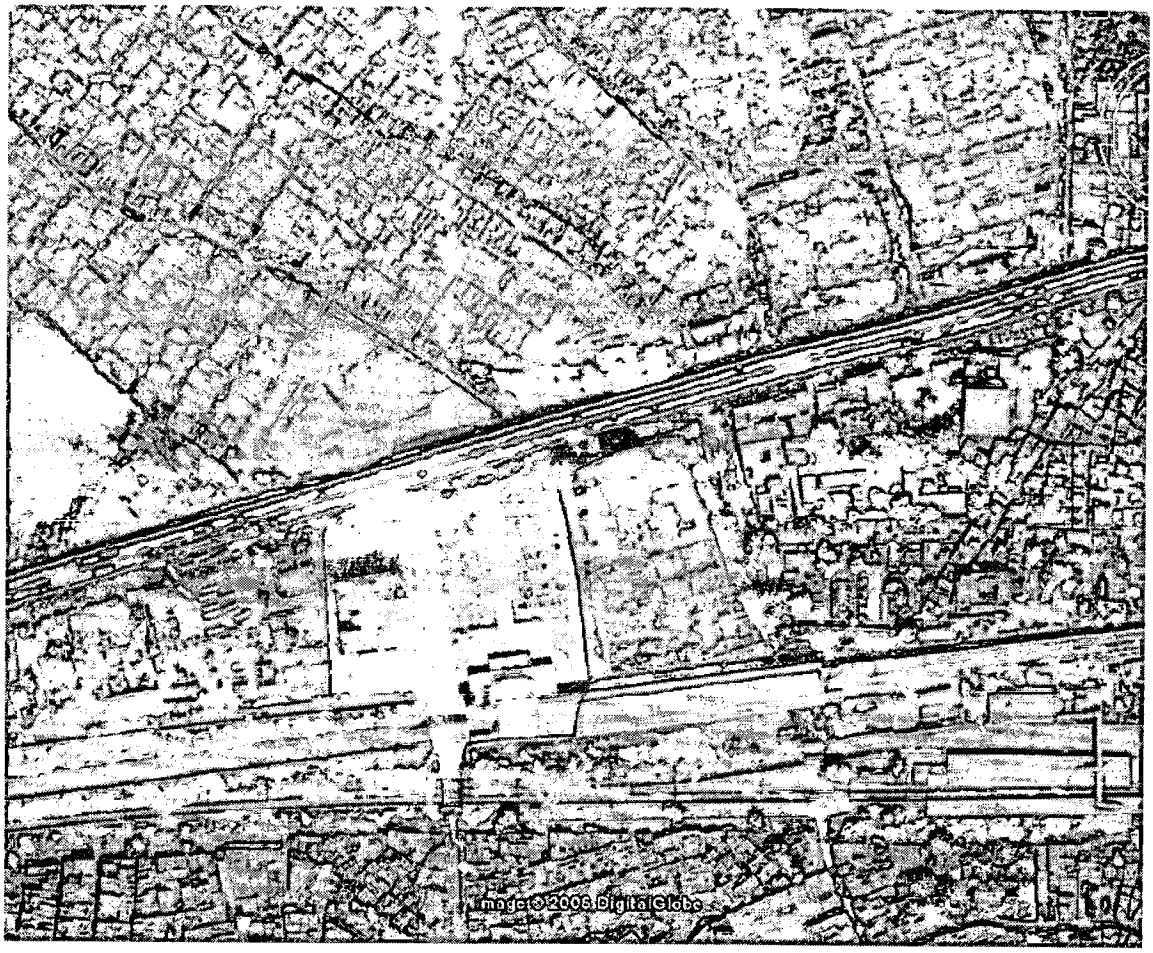
1. After being connected to rest of Delhi with a speedy and reliable mode of transport the area is experiencing large chunk of automobile trips hence a generator of activity.
2. The feeder vehicular traffic has increased in vicinity to metro station.
3. More number of pedestrianised movement due to metro after increased commercialization along with a railway station, another generator of space activity.

Activities

1. There have been changes in activities, in terms of land use, i.e. substitution has taken place
2. Commercialization is more formal now, as the heavy machinery shop has shifted to inner core, after metro station informal activity has been confined to streets.
3. New shopping malls also create activity space.

Spaces

1. The land values have increased.
2. There has been significant addition of floor spaces.
3. The space requirements for the commercial activities have also changed.



Map 09: Situation before Metro, Shahdara Region

Source: *Google earth image, rendered by Author*

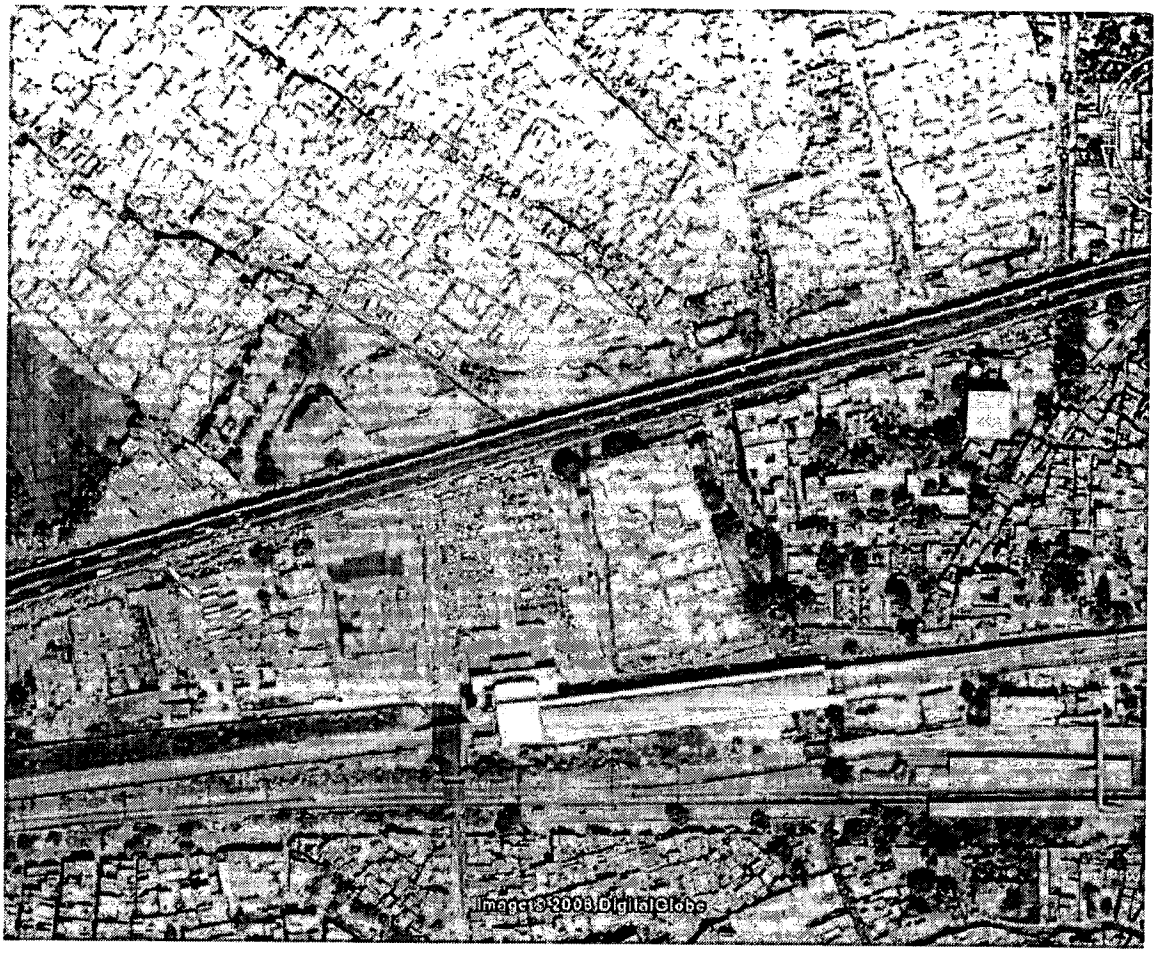
Index

Residential

Commercial

Green space

Informal activity like vegetable market



Map 10: Situation after Metro Construction, Shahdara Region

Source: *Google earth image, rendered by Author*

Index

- Residential
- Commercial
- Green space
- Informal activity like vegetable market

4.3.2.3 Observation on site

The industrial activity has gained importance here and has led to major violation of zoning regulation on site. The lower class people are the dominating category existing on site, major involvement with industrial skill

1. Unorganized built form
2. Encroachment
3. Lack of physical and social amenities
4. Maximum impact in region of 300mt
5. After coming of metro accessibility increased, few new developments are going around the metro nodes.

Table 4.8: Land use changes

	Category	before metro	after metro
1.	Residential	57..5%	66.93%
2.	Transportation	4.7%	2.5 %
3.	vacant	7.35%	3.10%
4.	public utilities	2.2%	2.5%
5.	religious	1.61%	1.61%
6.	Commercial	3.6%	6.30%
7.	Public/semi public	10 %	2.1%
8.	industrial	3.70%	2.0%
9.	park/open spaces	12 %	4.06%
	TOTAL	100%	100%

Source: master plan 2001, 2021

4.3.3 Transformation likely due to introduction of metro:

1. Density increase from 450 to 600 pph. High densities in vicinity of Metro stations.
2. Land use change from mono to mix and multi use.
3. Built form in vicinity of station shows distinct high rise character

4.4 CASE STUDY-4 (International): CALIFORNIA, USA

4.4.1 Introduction: St. Rose of Lima Park Station

The St. Rose of Lima park station provides a good example of how to integrate a light rail station into an urban streetscape. The train arrives along a pedestrianized street where train tracks are set flush with the street's attractive brick pavement. Although the station is unenclosed, the use of ample trees and benches create a comfortable place to wait. In addition to ticket and change machines, there is a staffed transit information center where passengers can obtain transit passes, schedules, maps and personalized transit information.

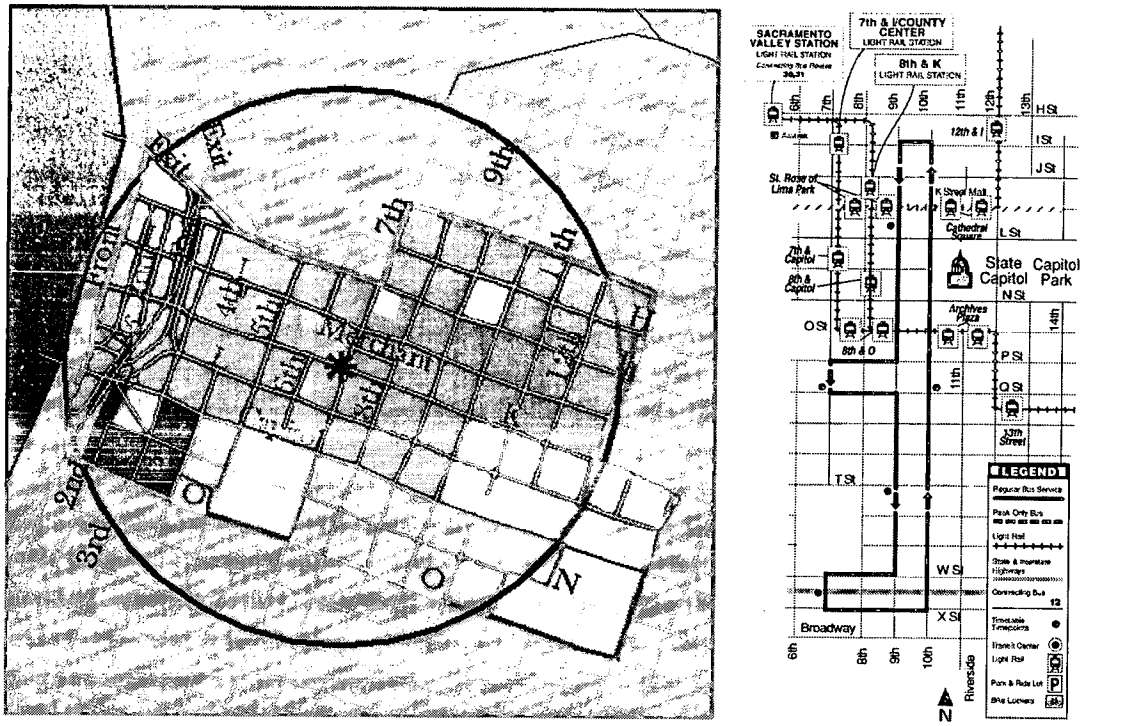
Figure 4.6: View of St. Rose of Lima park Station

Source: *New York City subway resources*

The St Rose of Lima park light rail station is located in the central business district of Sacramento. The adjacent downtown plaza is a successful regional mall with over 100 shops, a multiplex theatre and several restaurants. St Rose is situated within the street mall, which has offices above street level retail closed to automobiles and open only to pedestrians and the occasional light rail train or motorized trolley. With in the station area there is old Sacramento, the state railroad museum, an IMAX theatre, the state capital and park, the Sacramento Convention center, several multistoried hotels, a Grayhound station, and a historic Amtrak rail depot. Before the introduction of light rail in the late 1980s, this area was underdeveloped and problem area for crime. There is now a lot of foot traffic in and around station throughout the day as government and other office workers shop, eat lunch, browse or otherwise stroll down the pedestrian thoroughfare. At night there still is significant transit and pedestrian activity from patrons and tourists.

4.4.2 Station Area

"Station area" refers to an area of approximately ½ mile radius around a transit station. This area includes land uses within a comfortable walking distance to transit, taking into account physical barriers such as roadways, river, etc. The station area boundary for this TOD is shown on the street map.



Map 11: Map showing Land Use for Downtown Plaza-St. Rose of Lima Park Station

Source: *New York City subway resources*

- Residential-Low Density
- Residential-Medium/ High Density
- Mixed-Residential/ Commercial
- Office
- Commercial/ Retail
- Mixed-Office/ Retail
- Mixed- Three or more Uses
- Industrial
- Institutional
- Green/ Open Space
- Park-and-Ride Lot
- Park-and-Ride Structure
- Vacant
- Water
- Transit Station
- 1/2 Mile Radius
- Station Boundary

The land use break up within ½ mile radius of the station is as given below:

Table 4.9: Land Use Breakup of St Rose of Lima Park Station

Land Use	Area % age
Residential	9
Commercial	13
Pub/Sp	67
Industrial	5
Greens/Open Space	4
Circulation	2
Total	**100**

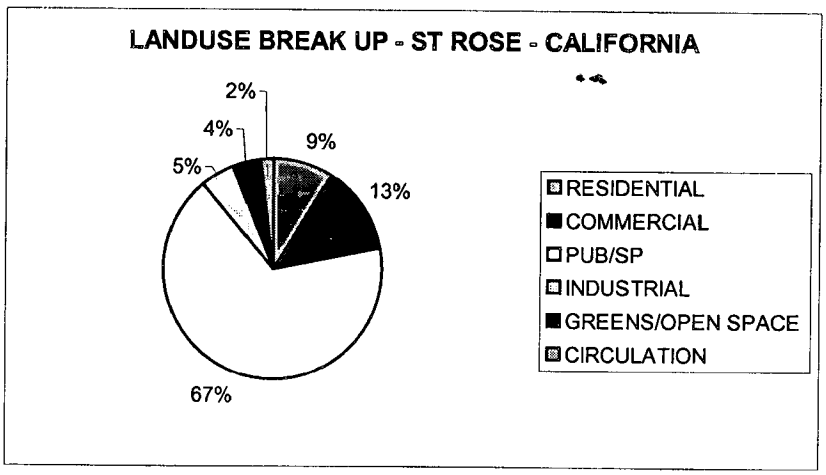


Figure 4.8: Land Use breakup of St Rose of Lima Park Station

Source: *New York City subway resources*

Table 4.10: Facilities at the Station

Transit Access (2001)		**Other Transportation Information (2001)**	
Primary type of transit	Light rail	Number of parking lots in Station area	9
Peak hour headways (time between transit vehicles)	15	Number of parking structures in Station area	19
Average daily weekday boardings	3260	Number of parking spaces in structures in parking area.	14218
Average daily weekday alightings (deboardings)	3008	Is there a freeway within ½ mile of station area.	Yes
Year Transit Service began	1987	Is there a parking District around Transit.	Yes
Is real time transit information available	No		
Is there a bus international station present.	Yes		

Table 4.11: Community Services and Facilities at the Transit Station

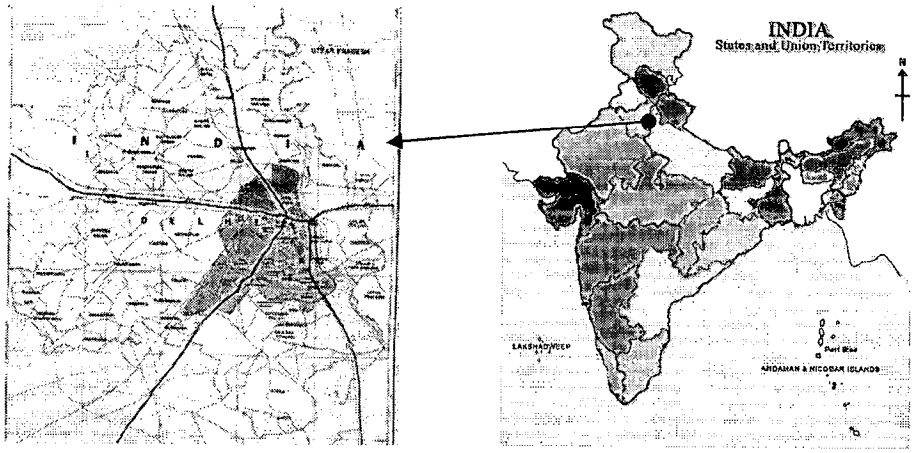
Services easily found in the vicinity of the Transit station (2001)	
ATM Machine	Yes
Pay phone	No
Bank	Yes
Grocery store	Yes
Retail drug store	Yes
Restaurant/Café	Yes
Park/playground	Yes
Museum	Yes
Hotel	Yes
Movie theatre	Yes
Performance/ live theatre	Yes
Convention center.	Yes
Community services found in the vicinity of the Station	
School	Yes
Community Center	No
Religious place	Yes
Child care	Yes
Library	Yes
Post office	Yes
Police station	Yes
Medical services	No

Chapter 5.0 STUDY AREA CHARACTERISTICS

5.1 Delhi: City Profile and Characteristics

Delhi has been the most important administrative center and a major center for trade and commerce. The Delhi Metropolitan Area comprise of an area of 3182 sq. km. The total area of Union Territory of Delhi is 1486.39 sq. km out of which 447.77 sq. km had been earlier included in the urbanisable limits. To accommodate the increasing population, 40 sq. km of area was acquired in 1981 and was termed as Urban Extension. This area was to be increased to 240 sq. km by 2001 subjected to requirements. {Master plan for Delhi, August, 1990; DDA}

As per the 1991 census overall density of 133 ppha. In the past few years there has been 37% increase in density which means there is a concentration of population in the urban area which was also one of the goals of the master plan which desires a density of 180ppha.



Map 12: Map of Delhi

Source: *Internet*

5.2 Review of Master Plans, Delhi

5.2.1 Master Plan Delhi [1962 - 81]

While formulating the plan it was realized that Delhi consisted of a number of cities quite separate in character, origin, and to a great extent in function. It is the overcrowded old Walled City, with its over spill into crowded and haphazard Paharganj, Naya Bazar, Sadar bazar, with no open spaces and almost no proper community facilities. It is the dignity of Civil-lines to the north, with its great university, and its own over spill of

colonies largely refugee in the origin. It is the prestigious official New Delhi with its westernized Connaught shopping center, which it was sought to keep entirely aloof from the old areas. It has its own recent over-spilt, of colonies refugee and other, to the south and west.

The basic pattern or scheme of the Urban Delhi Plan, was to organize all new developments, and reform old areas, on the basis of large District [A to H] relatively self-contained for daily purposes and needs: housing, employment, district and neighborhood, centers for recreation, shopping, commercial, cultural activities. This close locational relationship is of over-riding importance in greatly diminishing the demands and costs of transport. The Delhi Plan was prepared to meet the following objectives:

The best possible location of employment center and housing facilities which involves creating the optimum distribution of work centers of different types in such a way so as to

1. Make employee housing both accessible to such centers and also protected from any deleterious influences that might derive from their unplanned juxtaposition.
2. Ensure the location of employment centers, which are in, places accessible to needed facilities and services.
3. Obviate the necessity of costly new transport line & to have provision for ring roads & loops.

5.2.2 Master Plan [1981 - 2001]

The second Master Plan for Delhi takes into account the basic postulates of the previous master plan. The major features of the plan are discussed as following,

The Master Plan proposed that the future development of Delhi to be low rise and high density i.e. the residential development to be compact and with low rise structures. An increase in the residential and over all city level density was proposed. The residential intensity was proposed in the range of 350 to 400 ppha and the gross city level density was proposed at 100 ppha.

To achieve the above target for the population density the distribution pattern proposed was to increase the population holding capacity of the areas within urban sable limits declared till [DUA -81] and extension or urban sable limits to accommodate additional population. The work centers were planned to be decentralized by development of district

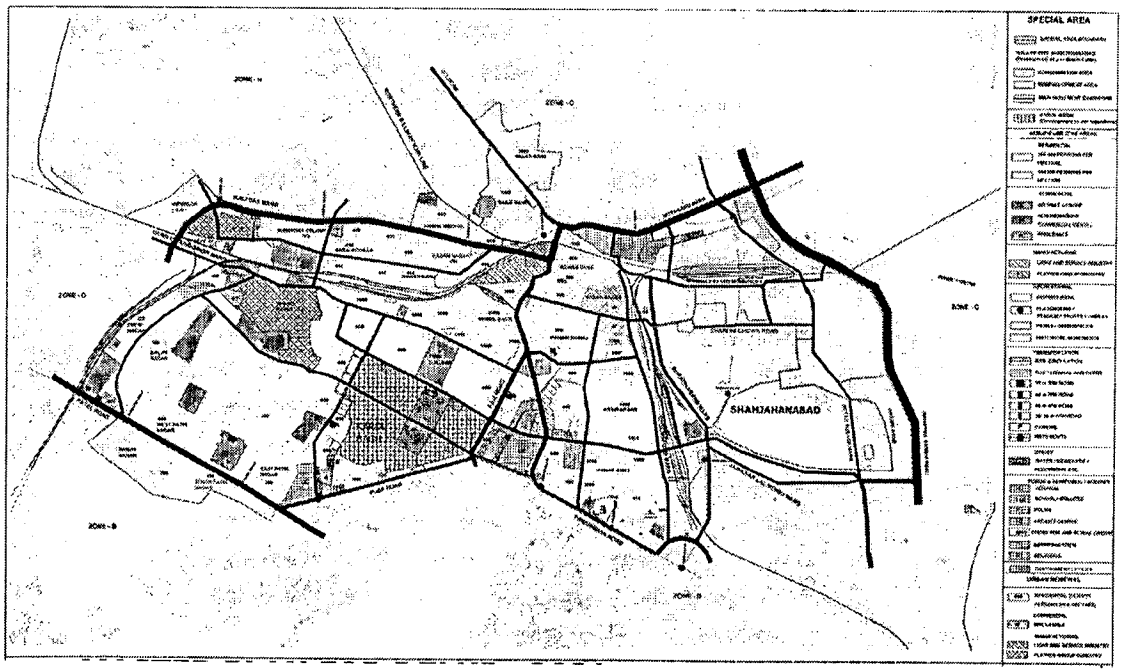
centers for each district. Apart from this, two sup central business district centers at sub city level were proposed one in the Trans-Yamuna area and other in the Urban Extension.

5.2.3 Master Plan 2021 (Provision for Land Development along the Corridor)

The new master plan has proposed the redevelopment of 500 metre wide belts on either side of Metro tracks as economic corridors. Shopping malls, Cineplexes, Food Courts, Pubs, Games Centres, Service Apartments, Hotels, Hi Tech parks are proposed along the metro corridors. The parking demand in these areas won't be high as most of the users will commute by the mass rapid transport system (MRTS).

The exact product mix in each stretch of the corridor will be worked out through market surveys at the time of planning and development. Enhanced floor area ratio or built up area will be permitted along the economic corridor.

MRTS network when completed will serve 109 lakh passengers per day or about 50 to 60 per cent of city's population.



Map 13: Master Plan Delhi 2021 (Special Area)

Source: *MPD 2021, DDA*

5.3 Population profile of Delhi Urban area

Delhi is the third most populous city in India and it is one among the fastest growing cities. The prevailing trend of population growth of Delhi and the expected population as per existing growth trends and plan estimates are stated.

The population of Delhi was 94.20 lakhs in 1991. The total population of Delhi has been constantly growing at the rate of 51-53% every decade since 1951. However the annual growth rate of population during the previous decade 1981-91 was 4.24%. This is slightly less than the growth rate of the earlier decade 1971-81: which was 4.36%. Nevertheless, despite the decreasing annual growth rate during the last decade, the net addition in terms of population of Delhi is considerably contributed by the in-migration to Delhi. This indicates that the population of Delhi would not decrease drastically. The considerable reduction of growth of population can only be achieved through preventive measures.

The first master plan for Delhi briefed in 1962, which guided the development during 1961-81, has assigned the total re-densified population to be accommodated in Urban Areas as 52.60 lakhs by 1981. The actual urban population of Delhi enumerated by the 1981 Census was 57.68 lakhs. Although the difference between assigned population and actual population was marginal. Similarly, the Master Plan for Delhi-2001 (MPD-2001) forecasts that population of Delhi may range between 125 and 130 lakhs for the year 2001.Thus, considering of land, infrastructure, transport, etc., this plan has assigned the population of Delhi to be 128 lakhs. The plan assumed the annual growth rate to be 4.0%tiff 1991 and then drop down to 3.5% in 1996 and in 2001. It has estimated the population in 1991 to be 91.02% lakhs and it is observed that the actual population of 2001 could exceed the assigned-estimated limit in the prevailing growth trends.

Average household size in the city is 5.34, Population in Bungalows – 54.47%, Population in HIG : 6%, Population in MIG : 13%, Population in LIG : 15%, Population in EWS : 16%, Average household income is 4471 with 46% having monthly incomes between Rs.2000 – Rs.5000.

Table 5.1: Demographic Profile

Year	Population (Lakhs)
1901	4.06
1911	4.14
1921	4.88
1931	6.36
1941	9.18
1951	17.44
1961	26.59
1971	40.66
1981	62.2
1991	94.17
2001	137.82

Source: *MPD 2021, DDA*

Table 5.2: Comparison of Plan Population with actual population of Delhi

Category	Population 1991	Population 2001
MPD 2001	91.02	137.82
NCR 2001	92.56	132 (P). 112 (A)

A: Assigned

P: Projected

Source: Population estimates for MPD 2021. DDA

Considering the 1991 census population characteristics as the base various agencies have estimated the population of Delhi for a period up to 2021. This estimated population for the year 2021 varies from 207 lakh to 319.11 lakh

5.4 Land Use Profile of Delhi

The total area of the Union Territory of Delhi is 148,639 ha, out of this 44,777 ha. Had been earlier included in urbanisable limits prescribed in the plan. This area as per 1981 census accommodated 54.51ac urban population. The balance urban population resided in 17 settlements declared as towns in the 1981 census and Najafgarh & Narela. To accommodate the 122 lac population, a two pronged strategy was recommended:

Increase the population holding capacity of the existing urbanisable limits i.e. Delhi Urban Area (DUA) - 1981. By this way the population holding capacity could be increased to about 82 lacs. Extension of present urban limits to the extent necessary i.e. Delhi Urban Area (DUA) - 2001.

Studies revealed that in-order to accommodate the balance 40 lac population an extension of DUA - 1981 to the tune of approximately 18,000 - 24,000 ha. was required. This would form DUA-2001 i.e. the proposed urban extension. The extension plan to accommodate Delhi's changing requirements named as "Urban Extension Plan".

Table 5.3 Land use profile of Delhi

This plan was entailed development of three sub-cities namely Rohini. Dwarka, Narela

Land Use profile of Delhi	**Area 1961- 1981 (ha)**	**% Area**	**Area 1981 – 2001 (ha)**	**% Area**
Residential	17998	40.2	30445	47.0
Commercial	586	1.3	2591	4.0
Public/Semi- Public	3079	6.9	4534	7.0
Industrial	2234	5.0	4534	7.0
Greens/Open Spaces	9715	21.7	12955	20.0
Circulations	5373	12.0	7773	12.0
Total	**44777**	**100**	**64777**	**100**

Source: *MPD 2021, DDA*

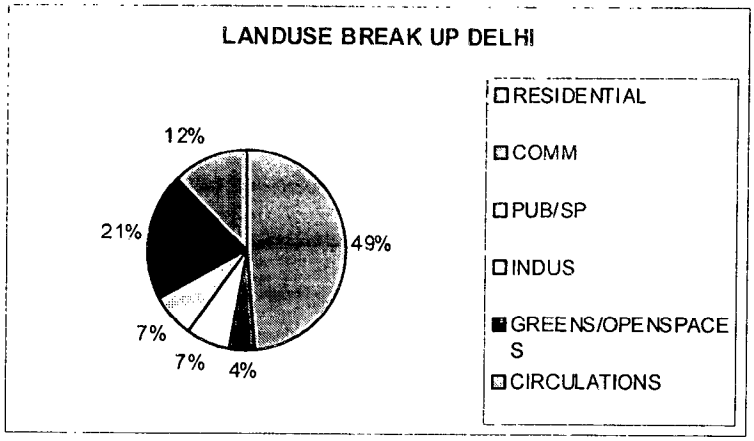


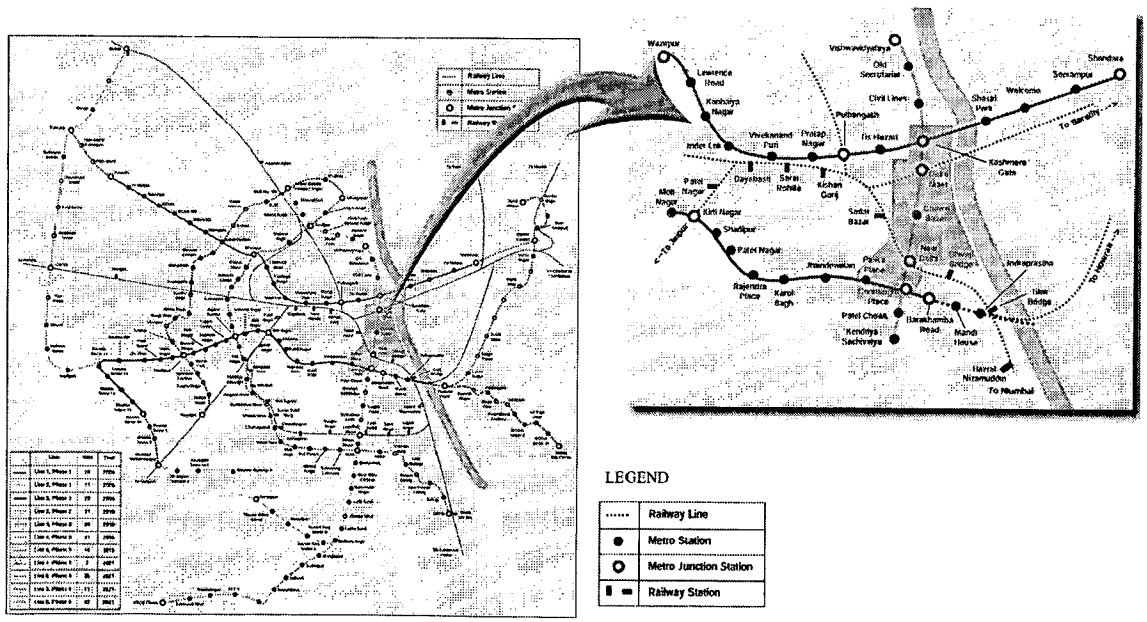
Figure 5.1: Land Use breakup of Delhi

Source: *MPD 2021, DDA*

5.5 Introduction to Case Study Area:

The stretch selected for the study i.e. Kashmere Gate to Rajiv Chowk interchange, is a major section of MRTS corridor of Line 2 from to Vishwa Vidhyalaya to Central secretariat which is an underground section of 11km in length.

The major part of the underground section comes under the Zone A, part of Zone C and partially in Zone D of National Capital Territory of Delhi.

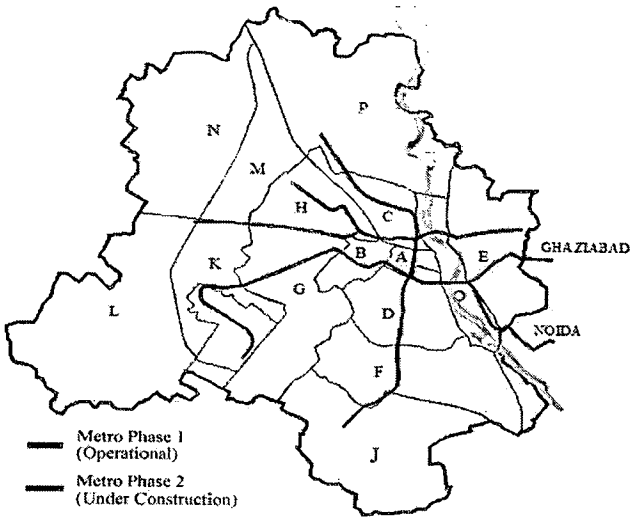


Map 14: Metro Rail Corridor Map

Source: *DMRC, Rendered by Author*

5.5.1 Zone A

As per the Master Plan for Delhi-2021, notified on 07.02.07 the National Capital Territory of Delhi has been divided into 15 zones from A to H and J to P, of which 8 Zones are in the urban area, one in Riverbed and remaining 6 in the rural area. The zones K & P are subdivided into two part zones. The designated Special Area in MPD 2021 comprises of zone A (Walled city), Zone A (Other than Walled City) and Zone B.



Map 15: Zones in Delhi with Metro routes Map

Source: *DMRC*

i) **Walled City**: (Sub-Zones A-13 to A-27 & Sub-zone C-1 Part)

Walled City, an Old built up and historic area, has a special character and therefore, zonal Plan for the same has been prepared separately.

ii) **Other than Walled City** (Sub-Zone A-1 to A-12).

Other than Walled City area also has a special character and therefore a separate zonal plan has been prepared. The area of the Zone is 559.13 hacts. and the population is 2.44 lacs as per MPD 2001.

Zone A (Other than Walled City)

The Zone is divided into 12 Sub-zones A-1 to A-12 (earlier named zones). Status of approval of Sub-zonal plans and the Sub-Zone wise area is given in Table 5.4:

Table 5.4: Sub-zone wise area and status

Sub-Zone	Name of Area	Area in Ha.
A-1	Pahar Ganj	48.68
A-2	Pahar Ganj	38.05
A-3	Aram Bagh	29.42
A-4	Jhandewalan Extn.	28.25
A-5	New Delhi Railway. Station & Surroundings	140.00
A-6	Qadam Sharif	70.00
A-7	Motia Khan	45.33
A-8	Jhandewalan	30.04
A-9	Sadar Bazar	25.59
A-10	Bara Hindu Rao	54.40
A-11	Chamelian Road	15.37
A-12	Azad Market	34.00
	Total	**559.13 Ha.**

Source: *Zonal Development Plan (other than Walled City), DDA*

5.5.2 Location, Boundaries, Area:

5.5.2.1. Zone-A (Other than Walled City) is part of the Old City and located in Central Delhi and encircled by the boundaries of Walled City-part of Zone-A in the East, Zone-C in the North, Zone B in the West and Zone-D in the South.

5.5.2.2 The total area of the zone works out to 559.13 ha. and is designated as Special Area as per MPD 2021.

5.5.3 Population:

As per MPD 2001, the holding capacity for Zone A is 4.2 Lacs and the existing population in 2001 is 5.7 Lacs. The stipulated holding capacity for 2021 for Zone A is 5.7 Lacs. The MPD 2021 has recommended no addition in the existing population as on 2001. The population for Zone A (Other than Walled City) is as per notified Zonal Development plan is as follows:

Population as per Census 1981	2,48,086
Population as per Census 1991	2,87,533
Population as per MPD-2001	2,08,400

Sub-zone wise population 1981, 1991 and projected for 2001 in the zone is given in Table 5.5:

Table 5.5: Sub-Zone wise Population

Sr.No.	Sub-Zone	Population		
		Census 1981	Census 1991	Proposed 2001/ Holding Capacity
1.	A-1	21,212	24,585	17,818
2.	A-2	26,495	30,725	22,257
3.	A-3	11,953	13,854	10,044
4.	A-4	1,725	2,000	1,250
5.	A-5	2,581	3,000	2,167
6.	A.6	60,937	70,629	51,183
7.	A-7	18,452	21,386	15,712
8.	A-8	843	1,000	500
9.	A-9	20,552	23,810	17,255
10.	A-1O	43,684	50,619	36,678
11.	A-11	12,348	14,800	10,357
12.	A-12	27,304	31,635	22,924
	Total	**2,48,086**	**2,88,043**	**2,08,145**

Source: *Census-2001*

5.6 ZONAL LEVEL PLAN:

5.6.1 Land Use Plan:

Consistant with the MPD framework, the Zonal Plan 2001 has detailed out the provisions and proposals of the Master Plan particularly with reference to various Use Zones-Circulation, public & Semi Public facilities utilities and Recreational etc. The Landuse analysis at Master Plan and Zonal Plan Levels are given in the table 5.6:

Table 5.6: Landuse Distribution of Zone-A at Master Plan Level

S. No	Landuse	Proposed in ZDP 2001	
		Area in ha.	%
1.	Residential	309.68	55.4
2.	Commercial	35.0	6.3
3.	Manufacturing	9.75	1.7
4.	Recreational	21.35	3.8
5.	Public & Semi Public	23.35	4.2
6.	Transportation	157.00	28.1
7.	Utility	3.00	0.5
	Total	**559.13**	**100**

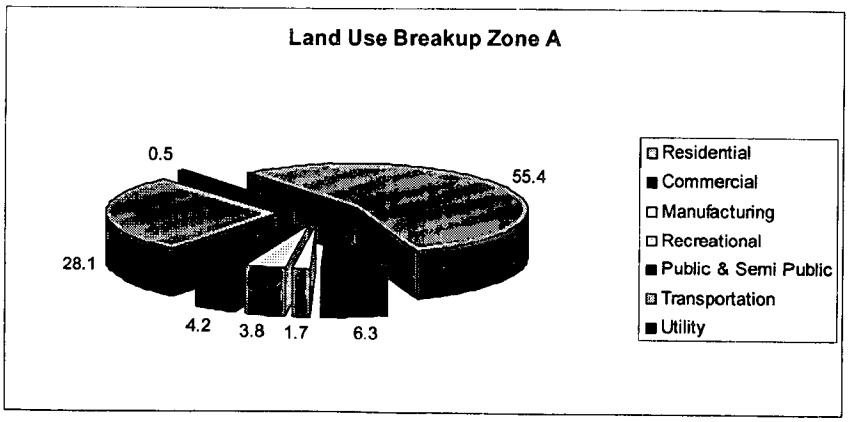


Figure 5.2: Landuse breakup of Zone A

Source: *Zonal Development Plan, DDA*

5.7 Zone A (Walled City)

The present Zonal Plan for the Walled City consists of 15 sub-zones of Zone-A and one subzone of Zone-C. Walled City has been taken up as a separate Zone due to special character and zonal Plan for the same has been prepared separately. Total area of the Walled City is 569 ha.

5.7.1 Sub-Zones

The walled City comprises of 16 sub-zones. Fifteen sub-zones are part of Zone-A and one subzone is part of Zone-C. The area of the Sub-Zone varies from 14.4 ha. to 76.6 ha.

Table 5.7: Sub-Zones as per MPD-1962

Sub-zone	Area (Ha)	Locality
A-13	27.1	Kucha Pati Ram
A-14	23.9	Chitli Qabar
A-15	37.9	Matia Mahal & Pataudi House
A-16	27.8	Churi Walan, Sita Ram Bazar
A-17	28.3	Farash Khana, Lal Kuan
A-18	14.4	Naya Bans, Fatehpuri
A-19	23.6	Tilak Bazar, Bara Dari, Peeli Kothi
A-20	52.5	Daryaganj, Ansari Road
A-21	22.1	Jama Masjid, NetaJi subhash Park
A-22	35.4	Balli Maran, Charkhey Walan
A-23	35.9	Malliwada, Kinari Bazar
A-24	33.6	Katra Neel, Town Hall Gandhi Ground
A-25	21.1	Lajpat Rai Market Bhagirath Palace
A-26	76.7	Red Fort, Salim Garh Fort
A-28	46.4	Railway Station RailWay Yard
C-1	62.3	Ram Bazar, Kashmere Gate G.P.O.

The Zonal Plan for Walled City when approved it would supersede the earlier plans.

5.7.2 Location, Boundaries, Area:

Zone-A (Walled City) is part of the Old City and located in Central Delhi and encircled by the boundaries of Zone-A (other than Walled City) in the West, Part of Zone-C in the North, River Yamuna & Zone O on the East and Zone-D in the South.

The total area of the zone works out to 569.0 ha. and is designated as Special Area as per MPD 2021.

5.7.3 Population

5.7.3.1 Population in 1981, 1991, 2001:

The following is the growth of the population in the walled City.

1981 (Census)	399915 persons
1991 (Census)	350159 persons
2001 (Projected as per MPD-2001)	235160 persons

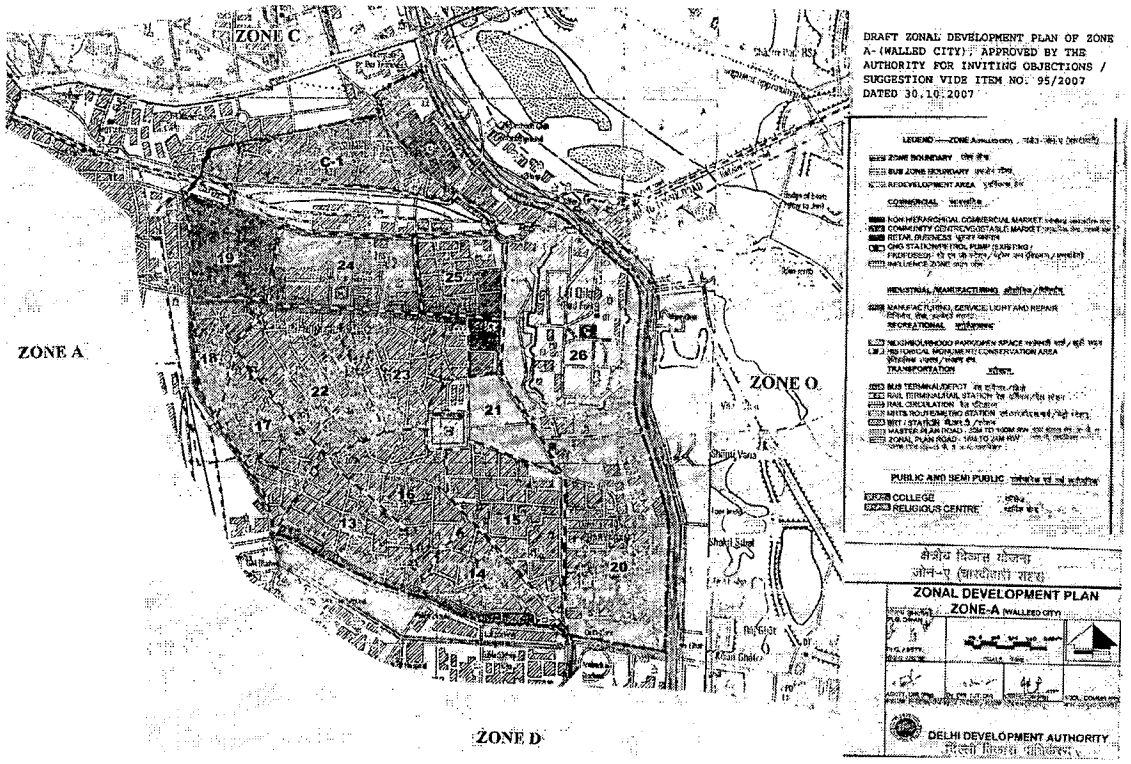
5.7.3.2 Population distribution in different sub-zones 2001

Table 5.8: Sub Zone Wise Population Distribution (2001)

Sub-zone	Population
A-13 (Kuncha Pati Ram)	23100
A-14 (Chitli Qabar)	16040
A-15 (Matia Mahal, Pataudi House)	20670
A-16 (Churi Walan, Sita Ram Bazar)	23400
A-17 (Parash Khana, Lal Kuan)	20160
A-18 (Naya Bans, Fatehpuri)	9400
A-19 (Tilak Bazar, Bara Dari, Pee Ii Kothi)	8800
A-20 (Darya Ganj, Ansari Road)	44500
A-21 (Jama Masjid, Netaji Subhash Park)	----
A-22 Balli Maran, Charkhey Walan)	18390
A-23,(Malliwada, Kinari Bazar)	5700
A-24 (Katra Neel, Town Hall, Gandhi Ground)	7800
A-25 (Lajpat Rai Market, Bhagirath Palace)	5200

A-26 (Red Fort, Salim Garh Fort)	---
A-28 (Railway Station, Railway Yard)	---
C-1 (Ram Bazar, Kashmere Gate, G.P.O.)	32000
Total:	**235160**

Source: *MPD-2001*



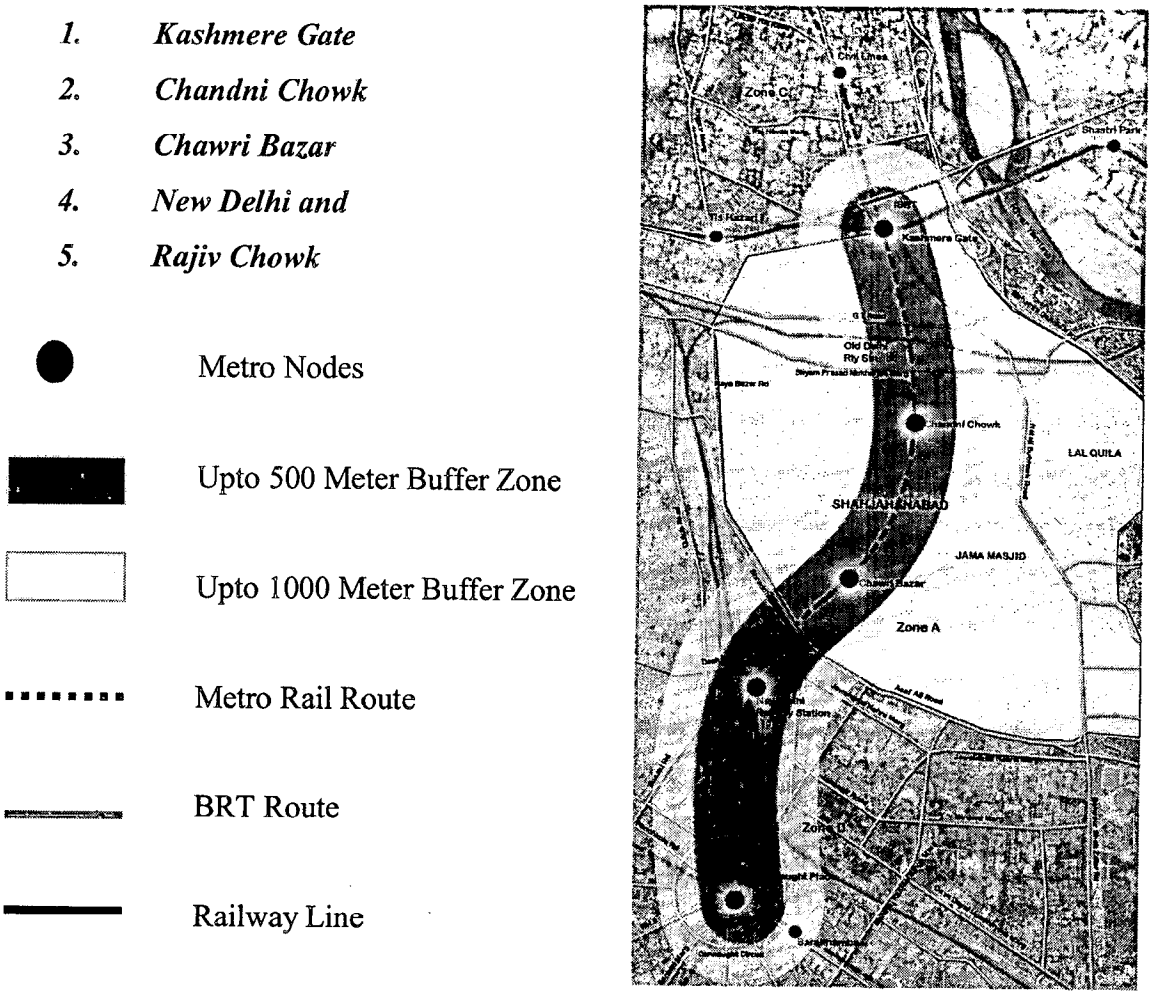
Map 16: Zonal Plan for Walled City

Source: *Draft Zonal Development Plan, DDA*

5.8 Station Area Characteristics

Metro Nodes for the study:

1. ***Kashmere Gate***
2. ***Chandni Chowk***
3. ***Chawri Bazar***
4. ***New Delhi and***
5. ***Rajiv Chowk***



Map 17: Zone of Influence along Metro corridor

Source: *Digitized by author*

5.8.1 Kashmere Gate

It was the area around the North gate of the Laal Quila, the Red Fort of Delhi, the gate was facing towards Kashmir, so it was named as Kashmere Gate. It has been an important road junction as the Red Fort, ISBT and Delhi Junction railway station lie in its vicinity.

With the implementation of MRTS in the city, it got a major Metro station as an interchange for two metro corridors of Shahdara to Rithala and Vishvidhyalaya to Central Secretariat. It also serves as the Headquarters for Delhi Metro.

5.8.1.1 Surrounding:

Kashmere Gate lies in the old city of Delhi. To its south, lies the Guru Gobind Singh University formerly known as the Indraprasth university, Mori Gate and the Old Delhi Railway Station. Maharana Pratap ISBT lies in the north of the area.

The area is characterized by high density with a mix of commercial and residential land use. This area is experiencing high commercial activities running through the metro corridor and in the vicinity with the development of MRTS.

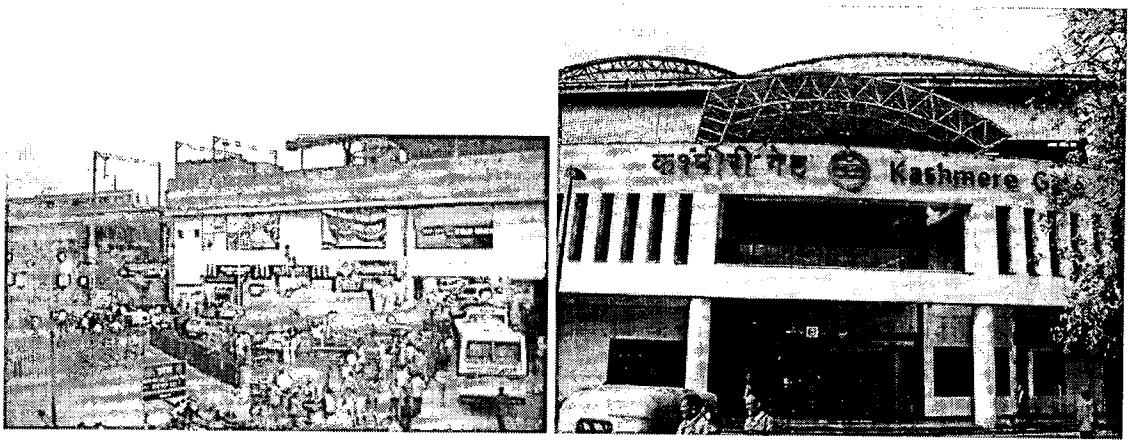


Figure 5.3: View of Kashmere Gate Metro Interchange

Source: *Google search images*

Presently, a stroll through the sprawling 6,000 square meters, or 65,000 square feet, of the multilevel Kashmere Gate station seems like a walk in a shopping arcade. In addition to a mall that is being built on the site, there are more than a dozen small outlets inside the station, including photo studios, gift shops, mobile phone stores, finance companies, bookstores, music shops, and even clothing retailers. This has invited people from far flung areas as has the potential to consumers.

The impact of the Delhi Metro's expansion also has been an important factor for developers who build on its properties. Land values have been risen up by tenfold in the recent years. Developers like Parshvanath are interested in these sites because location around the station itself develops.

Table 5.9: Existing Land use

S.No.	Land Use Type	Area Sq km	% age
1.	Settlement (temporary/ permanent)	65.78	42.73
2.	Open scrubs	3.45	2.24
3.	Water bodies	6.54	4.25
4.	Roads	35.25	22.90
5.	Railways	2.67	1.74
6.	Vacant Land	40.24	26.14

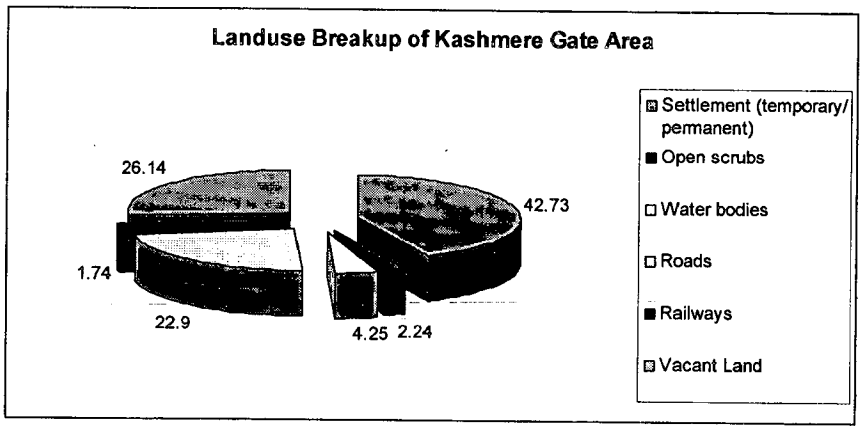


Figure 5.4: Land use for Kashmere Gate station area

Source: *DDA*

5.8.2 Chandni Chowk

5.8.2.1 Introduction

Chandni Chowk is the major street in the walled city of Old Delhi, which was originally called Shah Jahanabad. The walled city which includes the Lal Qilla Red Fort of Delhi was established in 1650 AD, by the Mughal Emperor, Shah Jahan and designed by his daughter Jahanara Begum Sahib, who also made significant contributions in the landscaping of her father's new capital of Shahjahanabad.

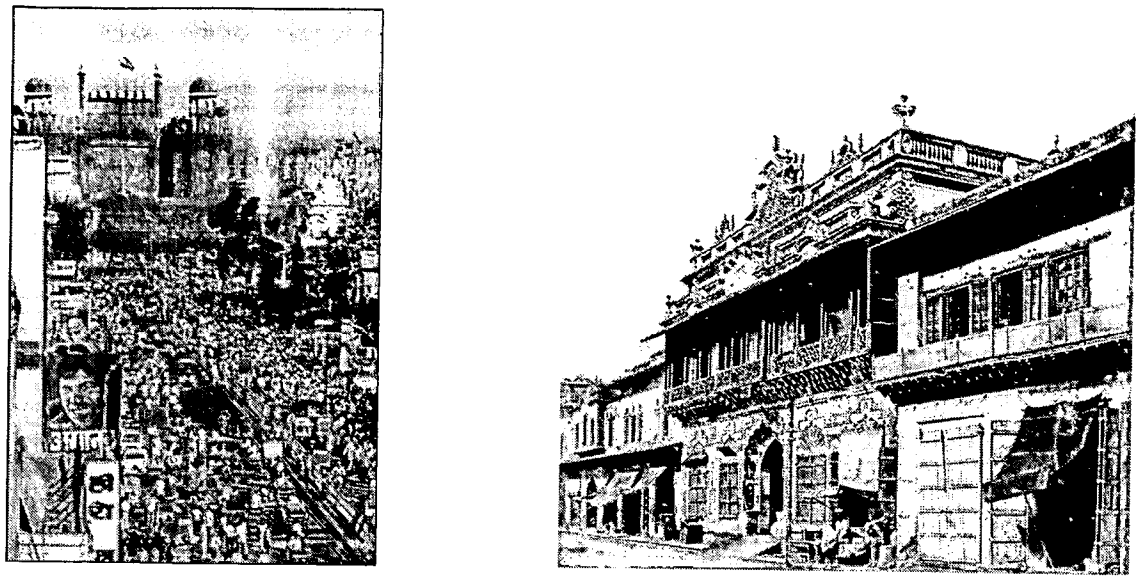
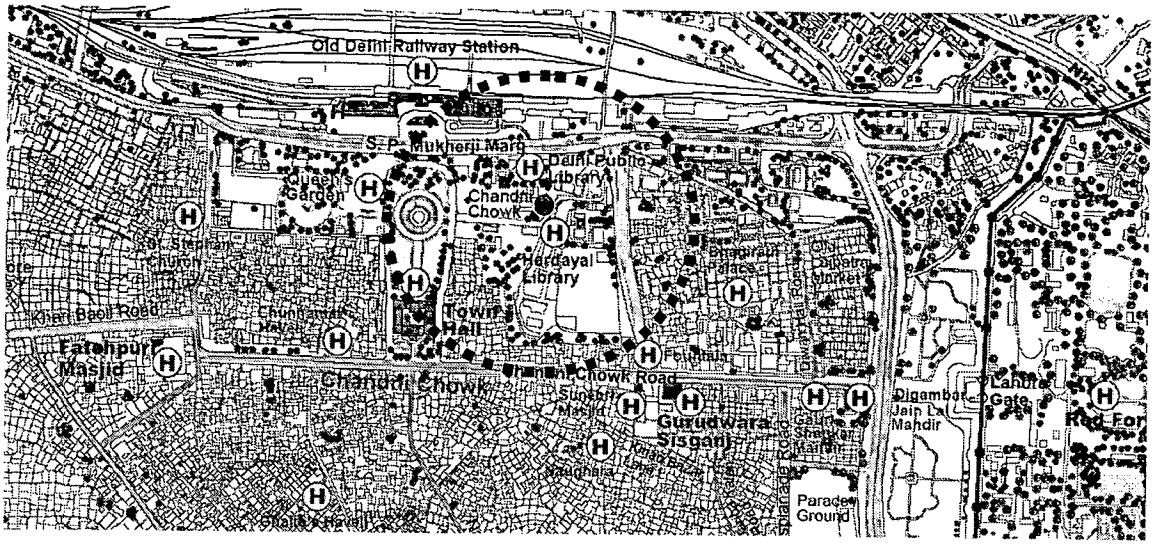


Figure 5.5: Busy Street of Chandni Chowk as of today and an earlier view
Source: *Internet*

Chandni Chowk runs through the middle of the walled city, from the Lahori Darwaza (Lahore Gate) of the Red Fort to Fatehpuri Masjid. Originally a canal ran through the middle of the street as a part of the water supply scheme. It was originally divided into three sections:

1. Lahori darwaza to Chowk Kotwali (near Gurdwara Shish Ganj): This section closest to the imperial residance, was called Urdu Bazar, i.e. the encampment market. The language Urdu got its name from this encampment. Ghalib noted the destruction of this market during the disturbances of the Indian Rebellion of 1857 and its aftermath.
2. Chowk Kotwali to 'Chandni Chowk': The term Chandni Chowk originally referred to the square that initially had a reflecting pool. It was replaced by a clock-tower (Ghantaghar) that was damaged and demolished in the 1960s. This section was originally called Johri Bazar.
3. 'Chandni Chowk' to Fatehpuri Masjid: This was called the Fatehpuri Bazar.

It is said that moonlight reflecting on its canal, earned it its name, 'Chandni (Moonlit). Chandni Chowk was once the grandest of the markets in India.



Map 18: Plan of Chandni Chowk and surroundings

Even though today Chandni Chowk appears choked with congestion, it retains its historical character. The following terms are generally used to describle the buildings and the streets.

- Haveli: a mansion. A normal Haveli would have a big courtyard (atrium) surrounded on four sides by spacious rooms and often another walled courtyard around the exterior as well.
- Kucha: a zone with houses whose owners shared some common attribute usually their mode of occupation. Hence the names *Maliwara*, the gardeners' neighborhood and *Ballimaran*, the oarsmen's neighborhood.
- Katra: refers to a separate wing of tradesmen and craftsmen belonging to the same trade. They usually lived and worked together. A system similar to the Guild housing in Amsterdam.

5.8.2.2 Station area Characteristics

Chandni chowk is predominantly a commercial street through ages and still is the heart of city. At times it is called that The city of Delhi lies in the lanes of Chandni chowk. The Metro station lies between the SP Mukherjee marg and the main street of Chandni chowk near Mahatma Gandhi park.

The area is characterized by high density low rise building generally of G+2, includes all sort of shops, eatery joints, offices, clinics etc.

Table 5.10: Landuse for the Walled city

S. No.	Landuse	Area in ha.	Percentage
1.	Residential	181.00	31.8
2.	Commercial	66.80	11.7
3.	Warehousing	22.43	03.9
4.	Manufacturing	9.60	01.7
5.	Transport, Utilities	131.70	23.1
6.	Parks and open spaces	96.87	17.0
7.	Public and semi-public use	41.9	7.5
8.	Govt. and semi- Govt.	18.7	3.3
	Total:	**569.00**	**100**

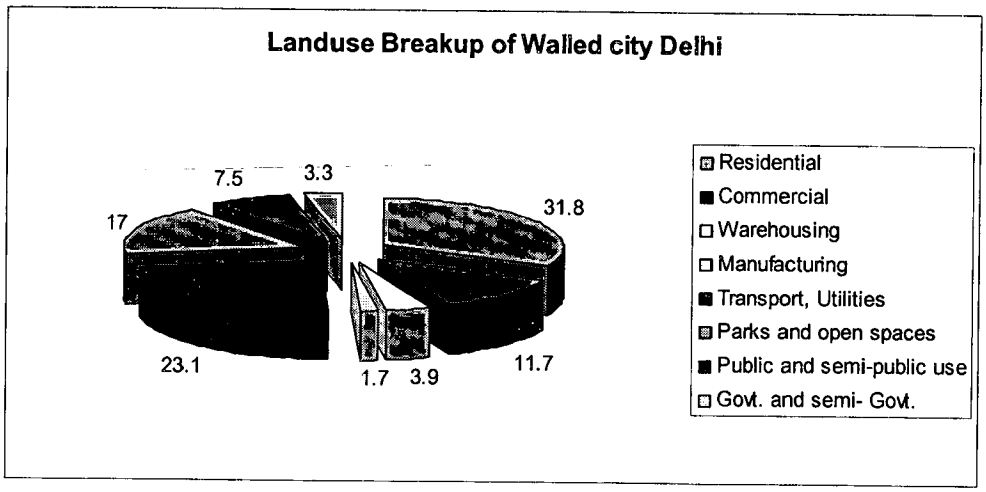


Figure 5.6: Land Use breakup of Walled City

Source: *Zonal Development Plan, DDA*

Fig 5.7 a: Entrance to Metro station

Fig 5.7 b: Metro station Chandni Chowk

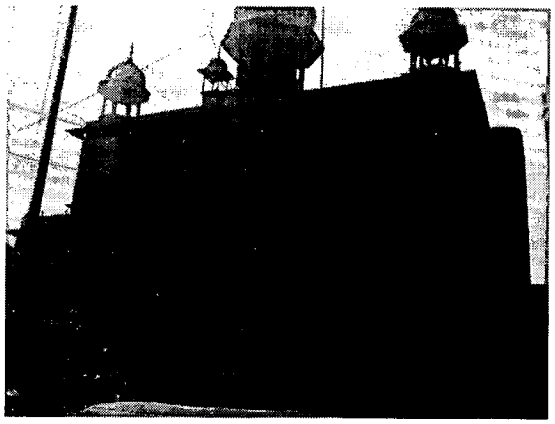


Fig 5.7 c: Gurudwara Shish Ganj

Fig 5.7 d: Main Road

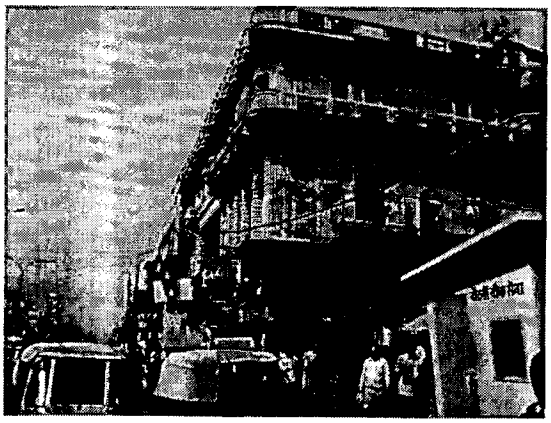


Fig 5.7 e: Mixed Land Use

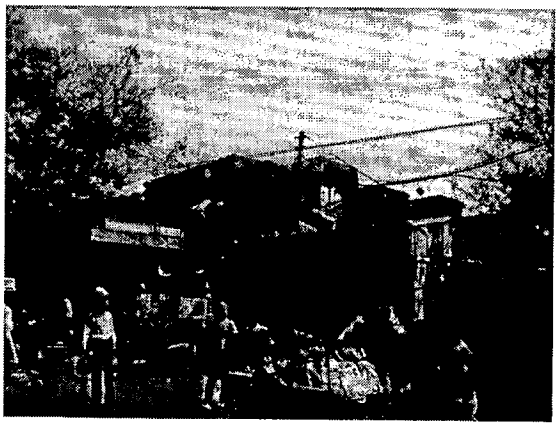


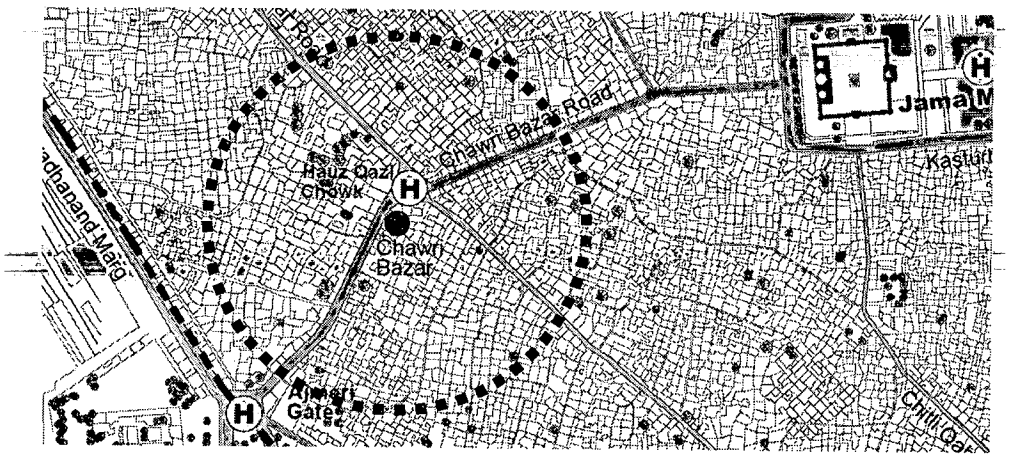
Fig 5.7 f: View of temporary structures

Source: *Visual Survey, Author*

5.8.3 Chawri Bazar

5.8.3.1 Background

To the west of Jama Masjid in Delhi, lies the specialized wholesale market of brass, copper and paper products, popularly known as **Chawri Bazaar**. It can be reached by taking the street just near the middle projection of Jama Masjid's western (rear) wall. Once popularly known for its bewitching dancing girls in the 19th century, the street is named after a Marathi word 'chawri', which means meeting place. The street got this name mainly because here a 'sabha' or meeting would take place in front of a noble's house and he would try settling the disputes before it would reach the emperor. A second reason is probably that a gathering used to get organized when a respected dancer performed and showed the finer nuances of her skill. The whole ambience of the street however got changed after the 1857 war when British destroyed many huge mansions of the nobles.



Map 19: Plan of Chawri Bazar Station Area

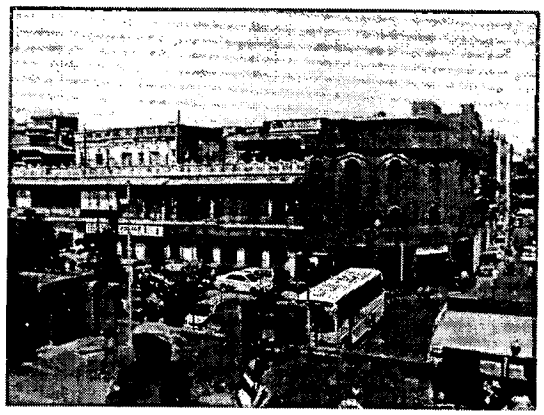
Source: *Digitized by Author*

5.8.3.2 Present Condition:

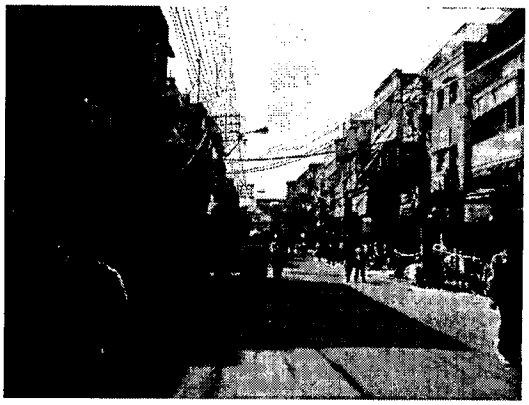
Chawri Bazaar is a very busy road as laborers with their laden backs, cars, rickshaws, scooters and walkers almost battle for the passage during the peak market hours. At present Chawri Bazaar is more known as the wholesale market of paper products than copper or brass. From beautiful wedding cards to attractive wallpapers to nice greetings to any types of papers required for any use, everything is available here in retail as well as in wholesale.

Chawri Bazar is a road which have Jama Masjid on one end and **Hauz Kaji** on the other end. Now there is a metro station at Hauz Kazi by the name of Chawri Bazar. Nai Sarak which is famous for Books and Ladies Garments joins it at Bad-shah Bulla. Beside Nai Sadak there is another way through Ballimaran which connect chawri bazar to Chandni Chowk.

a) Procession outside Jama Masjid



b) Parking outside Jama Masjid (N) Gate



c) Chawri Bazar

d) Electric wires hanging- Vista disturbed

Figure 5.8 e & f: Busy Streets of Nai Sarak and Chawri Bazar

Source: *Visual Survey, Author*

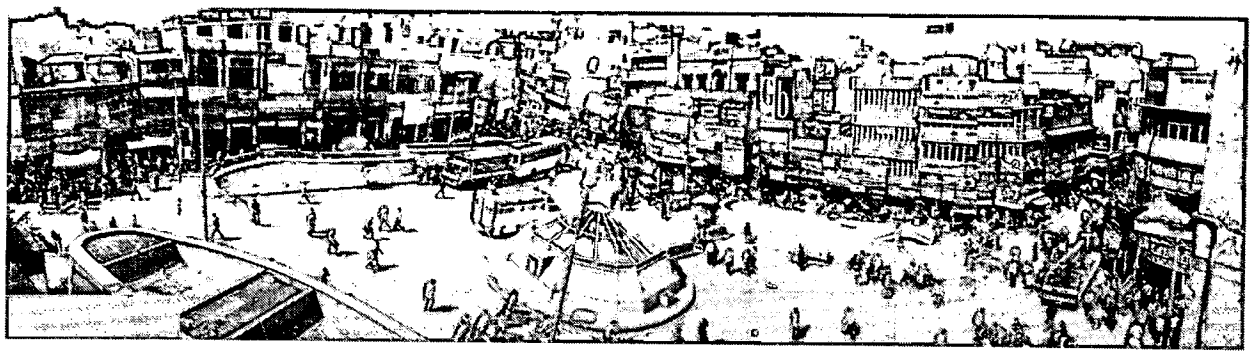


Figure 5.9: Panoramic View of Chawri Bazar Metro Node

Source: *Photograph taken by Author*

With the implementation of MRTS in the area, the business activity has grown by 15-20 %. It is an economic centre for Delhi and act as a sub CBD. Delhi Metro has made easier for people from all around Delhi to get entered right in the heart of Shahjahanabad resulting in the increase in pressure on roads. Increased pedestrian movement having conflict near metro stations, traffic congestion. The area will find more changes in the years to come when the phase II of MRTS will complete which will fetch more crowd to the city.

5.8.4 New Delhi:

New Delhi being one of the busiest railway centre of North India. Large portion of the area comes under the Railway yard. To its east lies the Ajmeri Gate and to the west lies the Paharganj terminal. Introduction of MRTS in the area has released heavy pressure on the Bus services. This gives the commuter a fast, safe and comfortable solution to reach his further destination.

The area comes under the sub zone A5 of the zone A in other than walled city area having an area of 148 ha.

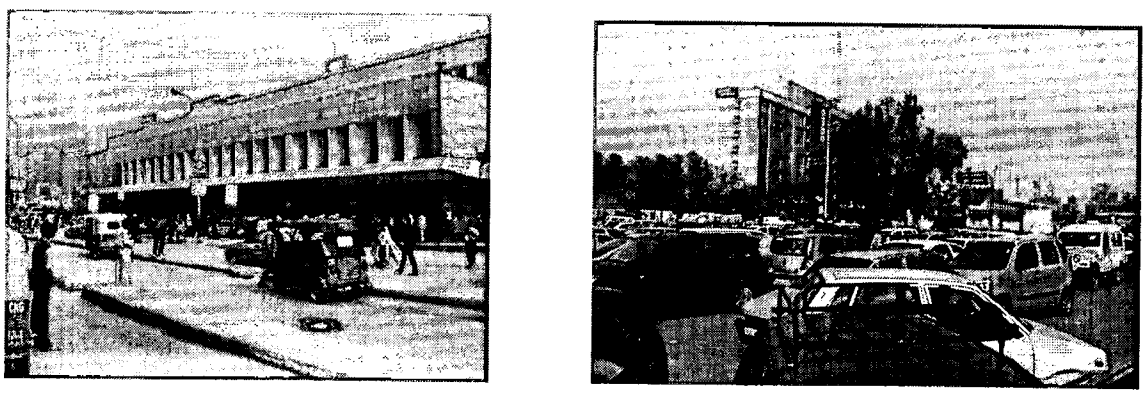


Figure 5.10: New Delhi Railway Station area

5.8.5 Rajiv Chowk- Cannaught Place

Connaught Place and its surroundings occupy a place of pride amongst the heritage structures of Delhi. It was developed as a showpiece of Lutyens' Delhi featuring a Central Business District. Named after the Duke of Connaught, the construction work was started in 1929 and completed in 1933. The Connaught Place of today is one of the most vibrant business districts of Delhi. But with the development have also come certain problems, like dispute over property rights, encroachments, haphazard development, unauthorized construction, traffic congestion and others. The underground metro station is a major interchange for metro line. The area is highly commercial in nature with Govt. and semi-Govt. offices, embassies of various countries.

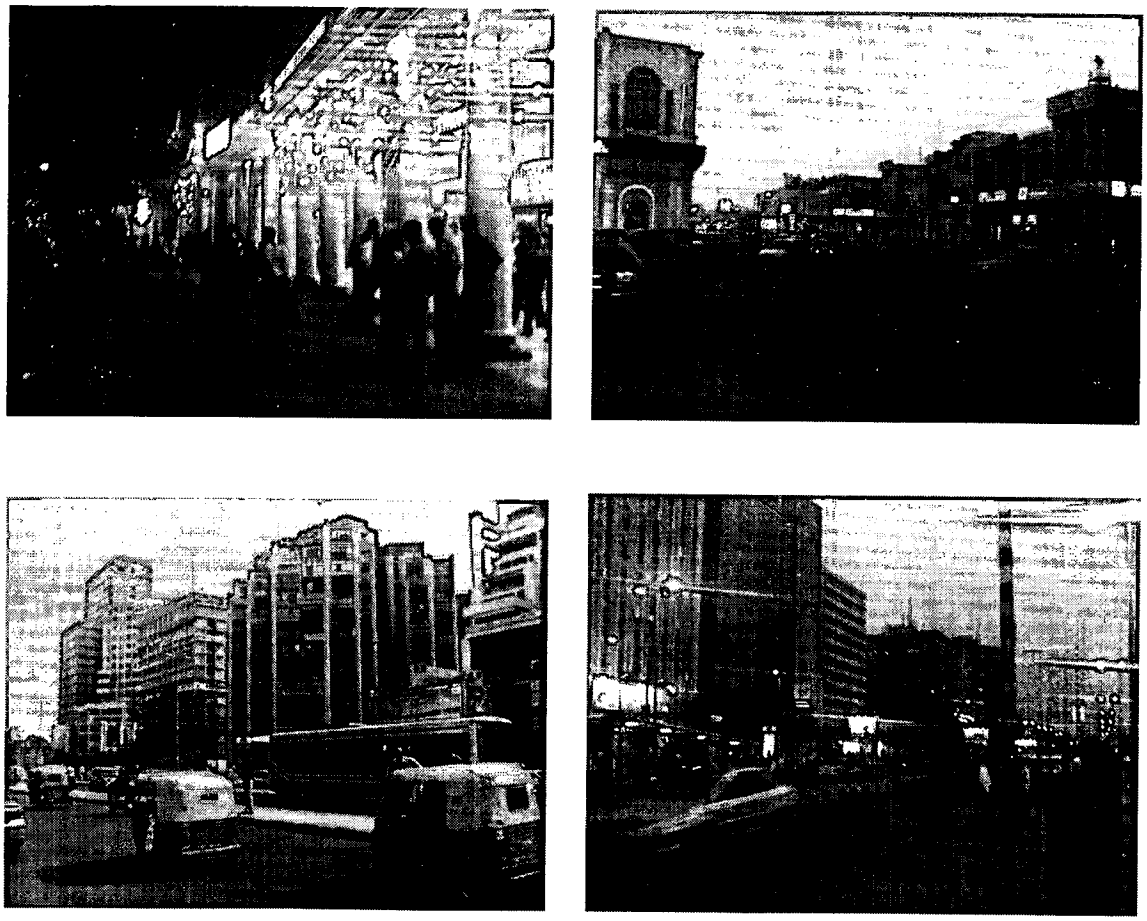
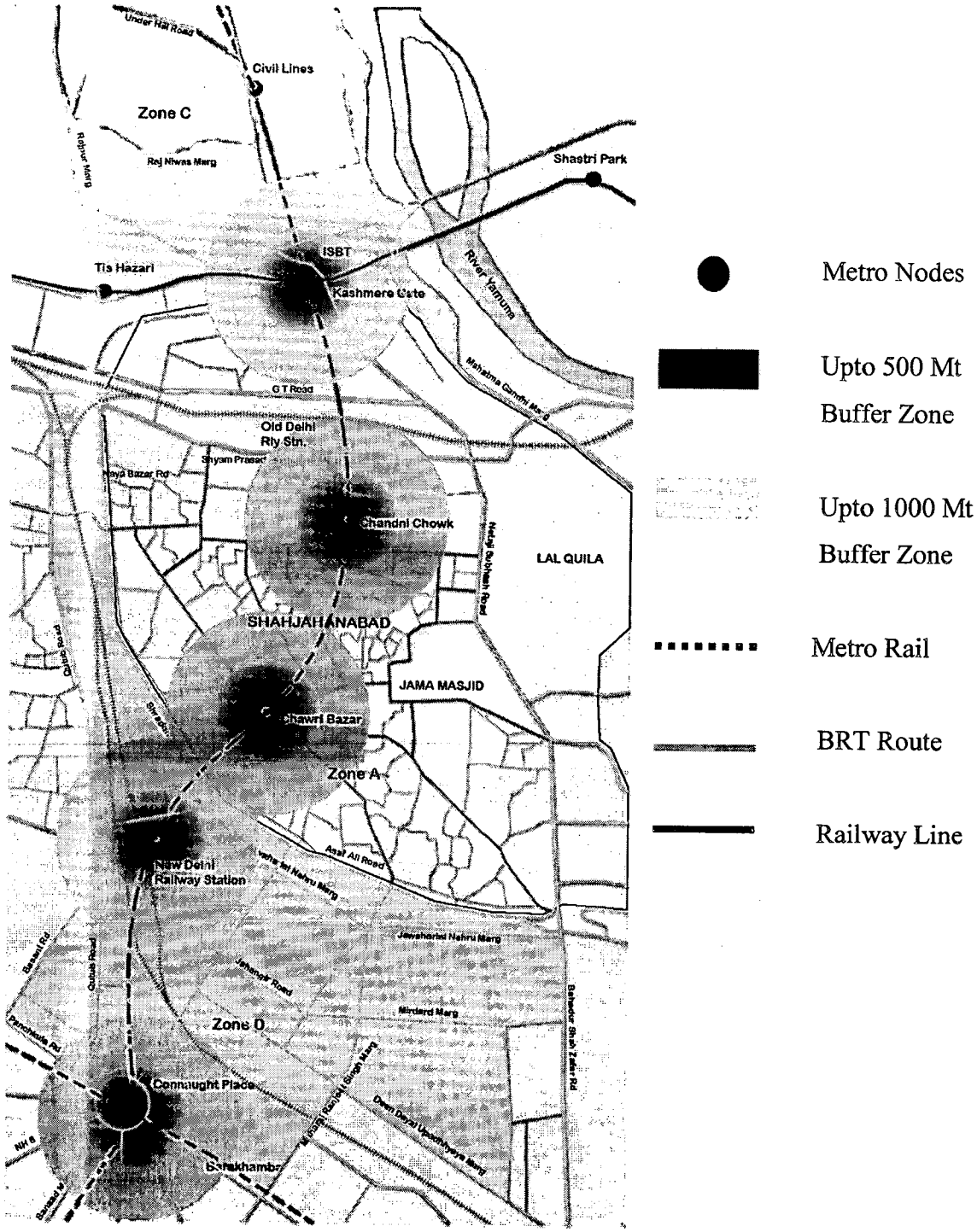


Figure 5.11: Connaught Place at a glance

Source: *Visual Survey, Author*



Map 20: Zone of Influence for Metro Nodes (Radial)

Source: *Rendered by Author*

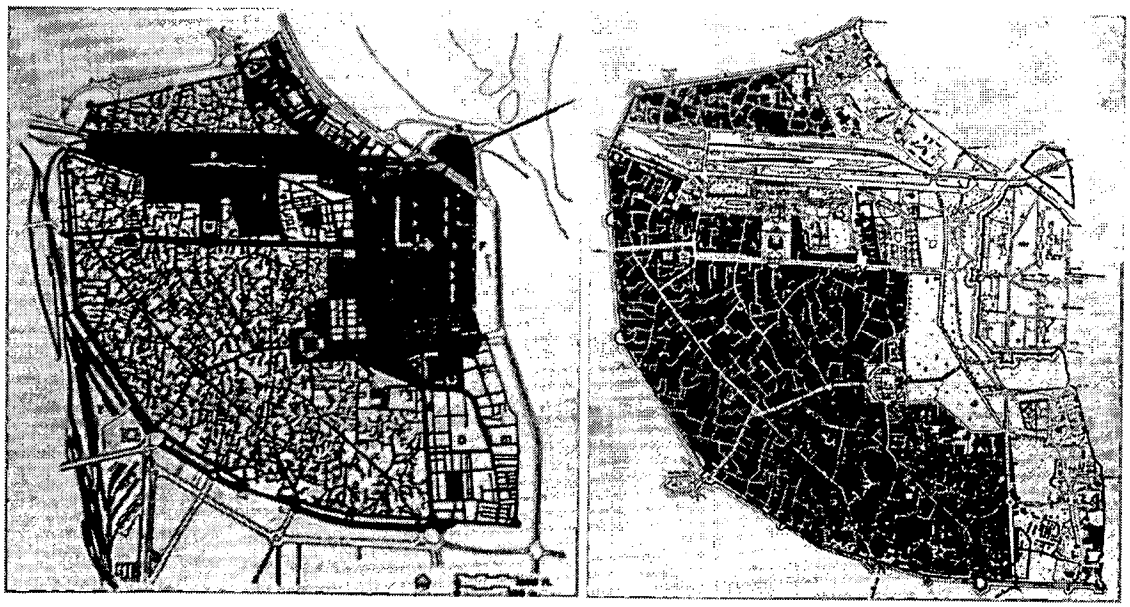
5.9 SHAHJAHANBAD

Historical Overview:

Shahjahanabad, the incarnation of Delhi survives today as the splendid Red Fort, Jama Masjid with some crumbling mosques and temples, broken walls and *koochas* and *mohallas*. Shahjahanabad lives on as a culture which has been dimmed since the 1930's, the advent of British rule in India and hence the urban sprawl of New Delhi. Since then it has become increasingly difficult to recapture its spirit.

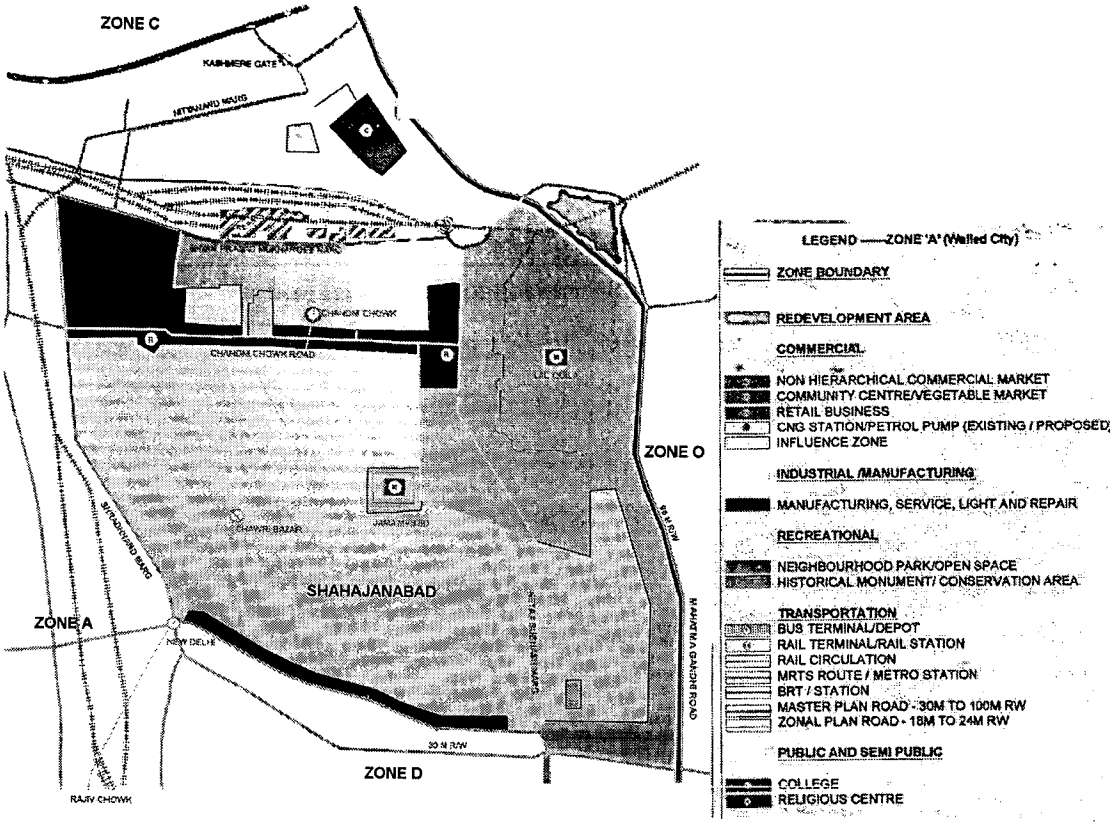
Post-colonialism, the impact of British rule can be divided into three stages chronologically, before 1857, the period between 1857 and 1860, and the phase between 1860 and 1947. These changes were both, tectonic and mental. Among others, they were characterized by economic development in favor of the British, introduction of factories, mills, sanitization and the railroad, the emergence of private accommodation and property, and the birth of a new class of Indians educated in European English and scientific methods1.

In 1863, the Mughal emperor Shah Jahan occupied the present city of Old Delhi with two focal points: the Red fort and the business district of Chandni Chowk. The area in the south west and the west of the palace gradually developed into a huge urban settlement as a result of continuous development and the changing pattern of land use.



Map 21: Mughal Shahjahanabad and Colonial Shahjahanabad

Source: *Master Plan Delhi, DDA*



Map 22: Walled City Plan and Distribution of Land Use

Source: *Rendered by Author*

5.10 Observations

- A large volume of pedestrianised traffic has been generated.
- Conflicts in movement have been created around station points where there are facilities for modal interchanges.
- The informal commercial activities have also started concentrating at the station points.
- The heritage character of Shajahanabad is deteriorating.
- There seems to be a conflict about which culture to follow.
- Increased influx of people has shown its impact on the retail market.
- Markets like Chawri Bazar and Chandni Chowk are witnessing a rise in the socio-economic profile owing to the increased accessibility provided by the MRTS.
- Probable prospects of expansion of retail in the areas near Metro.
- The land value for the property has been increased significantly.

- Because the city has retained some of the traditional values, it is popular among those who seek them.
- The tourists identify this place as an image of India and so Shahjahanabad can be projected as a symbol of a progressive India.
- The network of MRTS has provided easy access into this place from other tourist hot spots.

5.11 Inferences

Sayed S. Shafi – Metro Rail System and Delhi's Heritage- Journal of Landscape Architecture –Winter 2002-03:

"The advent of rail based rapid transit system for Delhi, popularly called as the Metro rail, would have far reaching repercussions for the national metropolis, both in short and long terms. Indeed, the metro would be the single most important factor determining the future form and pattern of the national capital and subsequently, its metropolitan region as well. Due to the nature of its permanent of way, the influence of the MRTS (Mass Rapid Transit Systems) would have a decisive impact in restructuring the metropolis from now on."

It is quite expected that there will be an uneven distributional impact that the metro will have in Delhi. The possible transformation would first appear in the built mass and built form of the area. The new vocabulary of building will be introduced; a positive vocabulary or a negative vocabulary.

In a city with such a disparity between rich and poor already, the development pattern consciously stimulated by the metro, risks driving a further chasm between the classes. The educated, the wealthy and the powerful are being invited to turn their gaze to the world, to sit down for a Big Mac or a slice of pizza and take advantage of the new employment opportunities in the information technology parks that are being stimulated by the metro. The poor, on the other hand, are seeing their homes disappear for a development they do not have the skills or the income to benefit from; metro fares were raised making it harder for them to afford to ride, and their income earning prospects as hawkers were made illegal.

But again, the Metro has made it much easier for the people to commute in and out of Shahjahanabad. Thus, there will be a major phase of migration. People coming to live inside Shahjahanabad will increase as well as people going out of Shahjahanabad to live, will also increase. Once the flow of movement is speculated, then we require additional infrastructure for the area. The possible changes in the infrastructure facilities would include more parking space, bringing in new technology like wireless communication, changes in the built form (kind of accommodation may change), there will also be a need to facilitate the needs of the people coming from the Metro. Like maybe in the years to come the number of food joints may increase in the area around the Metro outlet. The Metro has already started showing its impact on the built use as well. The land values have started to change. The economics of the city is influenced, the real estate. This may cause the problem of gentrification also, thereby concentrating rich people in the areas of close proximity to the Metro stations. Because of the ease of coming into Shahjahanabad now, there is an increase in the capacity of Shahjahanabad. Thereby, increasing the congestion and the traffic. The Old City's saturation point has been time tested again and again and now has been raised further.

Chapter 6.0 DATA ANALYSIS

6.1 Travel Characteristics in Delhi

6.1.1 Per Capita Trip Rate

As per the household travel survey conducted bye the RITES in the study area in the year 2001, a total of 176 lakh trips were estimated. The per capita trip rate in the study area has been estimated at 1.27 (PCTR of 1.1 in 1993-94). The per capita trip rate for vehicular trips was observed as 0.87 against a PCTR of 0.76 in 1993-94. Also the study conducted in the year 1993-94 projected the PCTR for vehicular trips to be 1.1 in the year 2001. Thus the actual realisation of vehicular trips was not as high as expected.

6.1.2 Modal Split

The report says, about 33% trips were estimated to be walk trips. Among the vehicular trips, the maximum (60%) trips were being performed by buses which also includes the chartered and school buses plying in the study area. The personalised modes of transport were carrying about 27% of vehicular trips in the study area. The modal share of the passenger trips in the study area is presented in **Table 6.1.**

Table 6.1: Modal share of Passenger Trips, 2001

	Incl. Walk		**Excl. Walk**	
Mode	**Daily Trips**	**Percentage**	**Daily Trips**	**Percentage**
Bus	7063682	40.2	7063682	59.8
Car/Jeep	1216645	6.9	1216645	10.3
Two-Wheeler	2031679	11.6	2031679	17.2
Auto	366175	2.1	366175	3.1
Cycle	626041	3.6	626041	5.3
Train	82685	0.5	82685	0.7
Other	425235	2.4	425235	3.6
Walk	5741369	32.7	-	-
Total (With Walk Trips)	**17553511**	**100.0**	**11986860**	**100.0**

Source: *Primary Survey report RITES, 2001*

6.1.3 Trip Purpose

The distribution of trips by purpose in the study area is presented in Table given below. Of the total trips, work accounts for about 25 %, education about 22 % and others account for about 4 % of the trips. Among the work trips, about 87 % are vehicular trips and 13 % are walk trips while this distribution is 42 % and 58 % for education trips and 94 % and 6 % for other purpose trips respectively.

Table 6.2: Purpose wise Distribution of Trips, 2001

Purpose	No. of Trips/day (in Lakh)	Percentage
Service	33	18.8
Business	11.4	6.5
Education	39	22.2
Others	6.7	3.8
Return Home	85.4	48.7
Total	**175.5**	**100.0**

Source: *RITES Primary Survey Report*

The various important system performance parameters for total Metro network as estimate for 2011 and 2021 for both phases are shown in the **Table 6.3.**

Table 6.3: Daily Traffic on Metro network of Delhi (Ph I + Ph II corridors)

S. No.	ITEM	2011	2021
1	Number of originating passengers/day (in lakhs)	26.17	41.47
2	Passenger km/day (in lakhs)	354.42	601.99
3	Passenger km/km (in lakhs)	3.05	5.19
4	Average Trip length (in km)	13.66	14.52

Source: *Delhi Metro Rail Corporation*

It can be observed that the total Metro network proposed to be commissioned by the year 2011 would meet daily travel demand of the order of 26.17-lakh in the year 2011 and 41.47-lakh in the year 2021. A total of 354 lakh and 602-lakh passenger kilometers would be carried in the years 2011 and 2021 respectively. The intensity of utilization (pkm/km) is expected to be 3.05-lakh and 5.19-lakh in 2011 and 2021 respectively. Incremental traffic due to phase-II corridors is expected to be 11.07 lakh passengers per day and pkm 188 lakh per day in 2011.

6.2 Traffic Demand Statistics for the chosen Metro Network (Ph1 + Ph2)

Section Loads in the table gives the section loads in terms of daily passengers and peak hour peak direction trips for the total metro network for the years 2011 and 2021.

Table 6.4: Section Loads on selected corridor of Delhi Metro Network (Ph I + Ph II)

Station From	Station To	2011		2021	
		Daily	PHPDT	Daily	PHPDT
Vishvavidhyalaya- Central Sectt. Corridor					
Vishwa Vidalaya	Vidhan Sabha	292888	16648	410852	23353
Vidhan Sabha	Civil Lines	310509	17649	435123	24732
Civil Lines	Kashmere Gate	320661	18226	446286	25367
Kashmere Gate	Delhi Main	775678	44090	1015782	57737
Delhi Main	Chawari Bazar	836733	47560	1097571	62386
Chawari Bazar	New Delhi	845067	48034	1133546	64431
New Delhi	Connaught Place	826691	46989	1137574	64660
Connaught Place	Patel Chowk	429327	24403	649477	36916
Patel Chowk	Central Secreteriat	423026	24045	642876	36541

Source: *Delhi Metro Rail Corporation*

6.3 Case Study Area Survey Analysis

In view of the fact that it has been about four years since the Chawri Bazaar Metro Station has been operational, it is likely that some of the transitions, triggered by the metro would already be taking place. To assess such changes, if any, especially how the profile of commercial development around metro is changing and simultaneously how the users are responding to Metro as a mode of conveyance as well as a catalyst of urban profile around it, a survey was conducted.

Before Metro was introduced, the major sequence of commuting from residence to office and back for the residents of Shahjahanabad used to be either on foot or by rickshaw to the Kashmere Gate DTC depot, and from there either by bus or by auto rickshaw to their respective destinations. This resulted in development of major markets along all the major traffic arteries leading from various residential areas up to DTC depot. And now the Metro station is located right at the heart of the busy bazaar street, major changes in the movement pattern of users is expected. However, the commercial facilities that are being planned near station are definitely going to affect the shopping pattern/habits of the users. Keeping such factors in mind a questionnaire was prepared and a survey was conducted for users and the people owning commercial places around metro stations, the results are as followed.

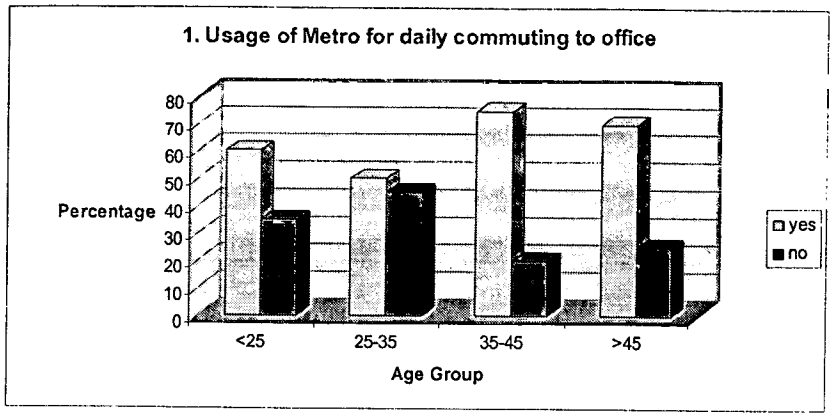


Fig 6.1: Graph showing usage of Metro for daily commuting to office

Source: *Primary Survey, Author*

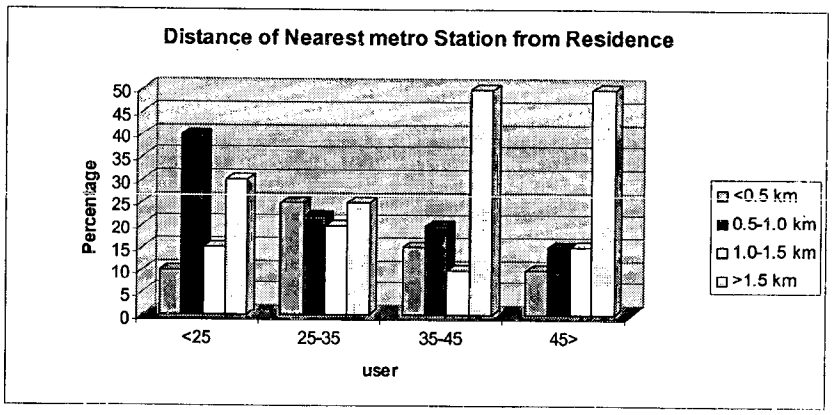


Fig: 6.2: Graph showing distance of nearest metro station from residence

Source: *Primary Survey, Author*

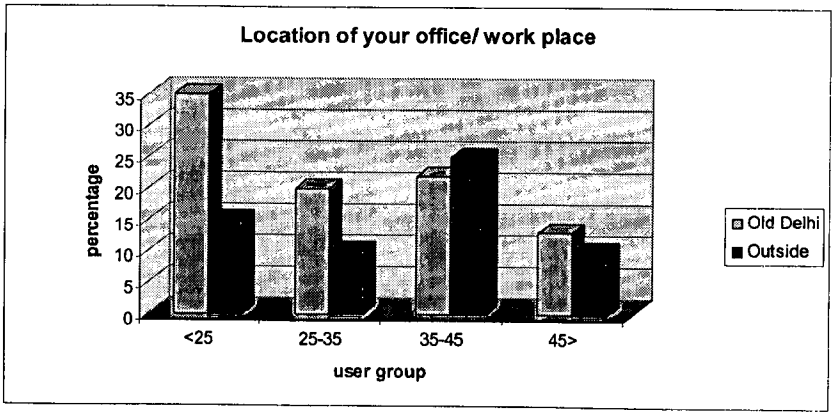


Fig: 6.3: Graph showing Location of work place/office

Source: *Primary Survey, Author*

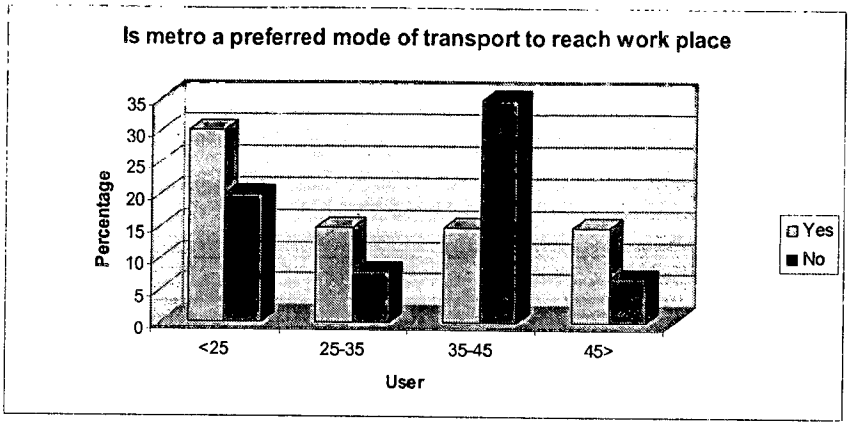


Fig: 6.4: Graph shows whether Metro is preferred mode of transportation

Source: *Primary Survey, Author*

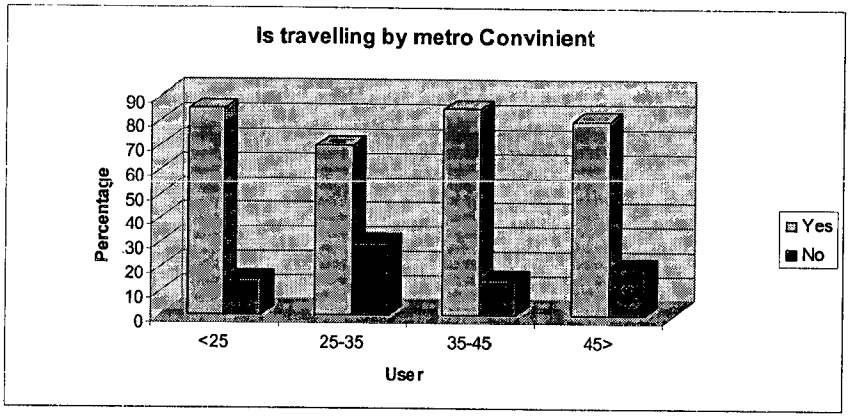


Fig: 6.5: Graph showing whether traveling from Metro is convenient

Source: *Primary Survey, Author*

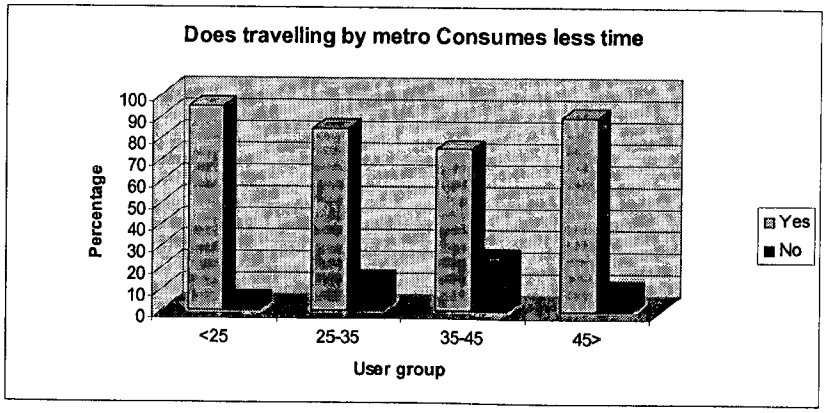


Fig: 6.6: Graph shows traveling by Metro consumes less time

Source: *Primary Survey, Author*

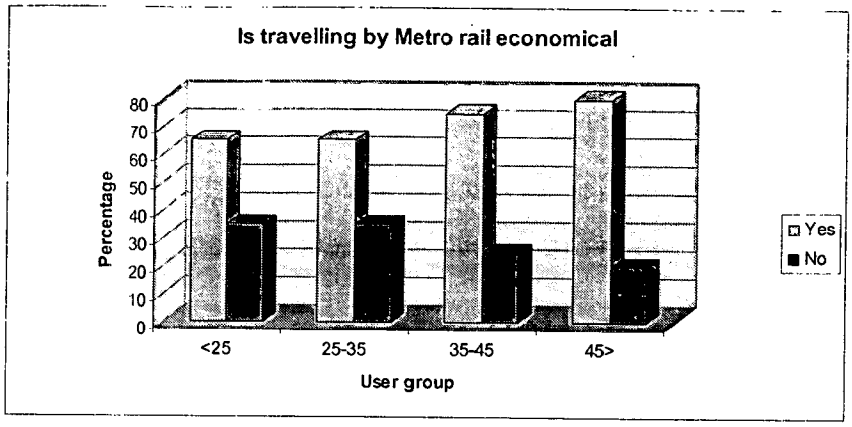


Fig: 6.7: Graph for traveling by metro is Economical

Source: *Primary Survey, Author*

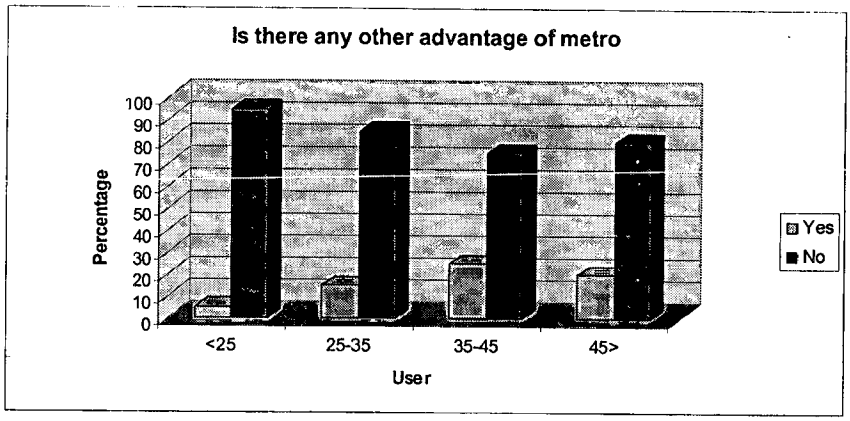


Fig: 6.8: Graph showing other advantage of Metro for user

Source: *Primary Survey, Author*

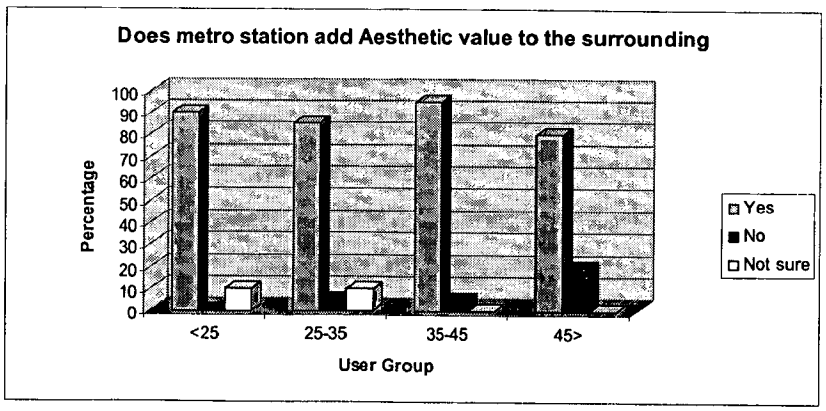


Fig: 6.9: Graph showing percentage for aesthetic value in Metro vicinity

Source: *Primary Survey, Author*

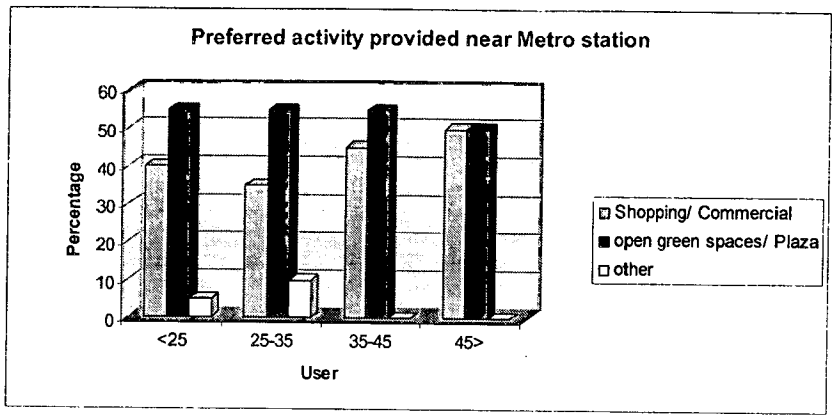


Fig: 6.10: Graph for activities be given near Metro Station

Source: *Primary Survey, Author*

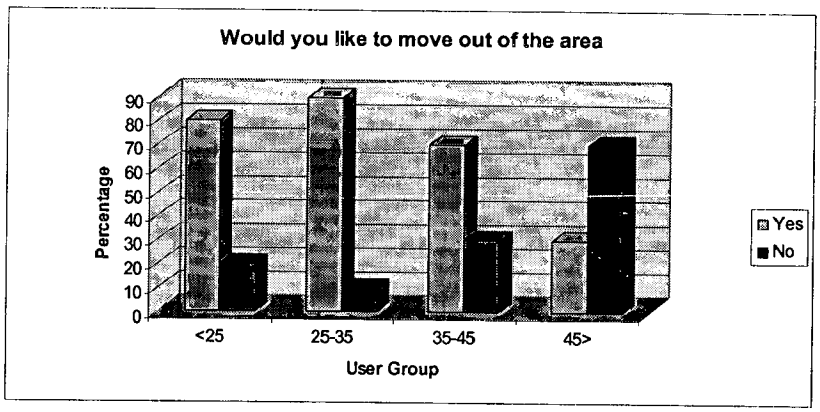


Fig: 6.11: Graph showing the % of people wants to move out of the area

Source: *Primary Survey, Author*

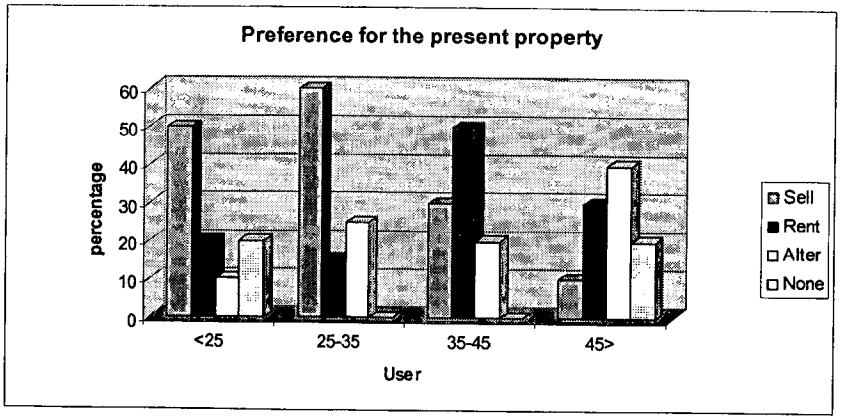


Fig: 6.12: Graph for preference for the present property

Source: *Primary Survey, Author*

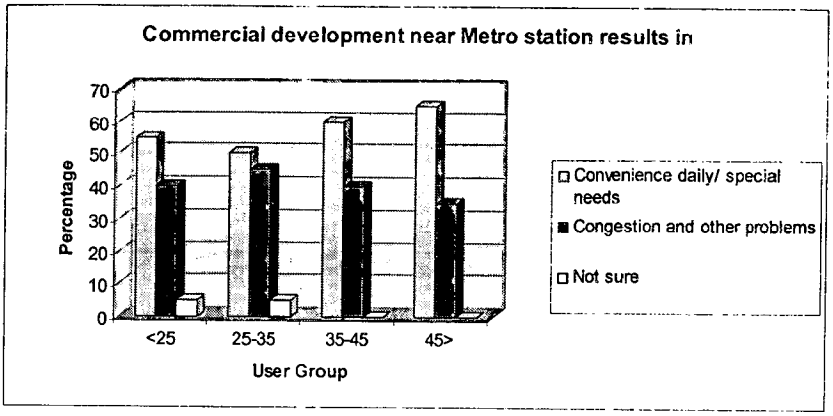


Fig: 6.13: Graph for results near Metro having commercial development

Source: *Primary Survey, Author*

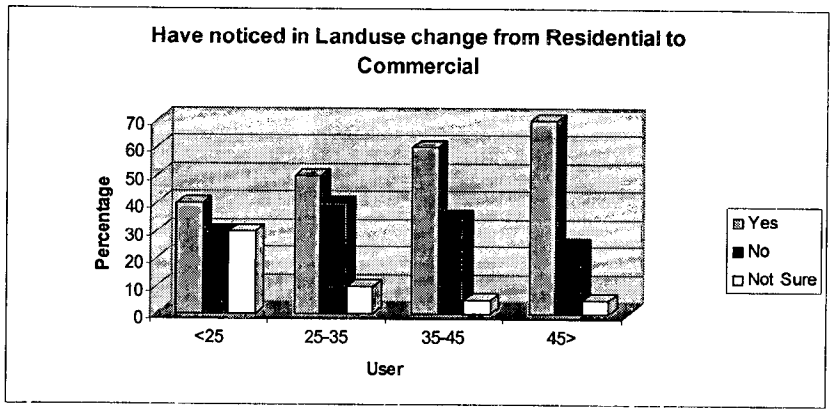


Fig: 6.14: Graph showing change in Land Use

Source: *Primary Survey, Author*

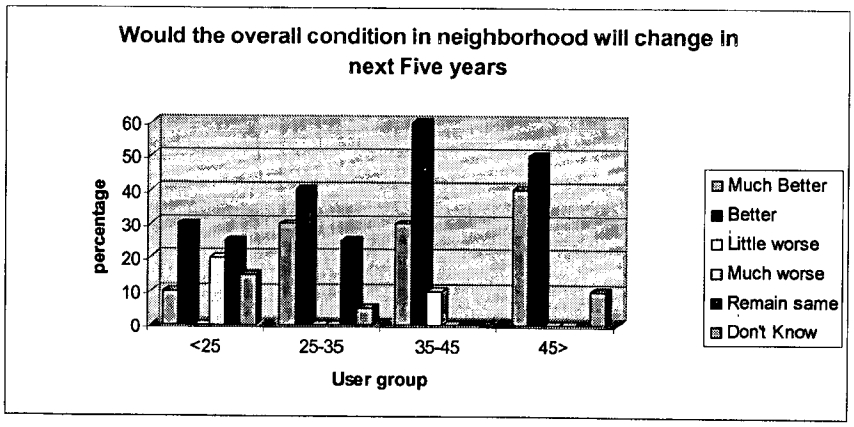


Fig: 6.15: Graph showing condition for the next five year

Source: *Primary Survey, Author*

6.4 Conclusion

- Most of the teenagers and young people preferred the development of shopping complex near the Metro station. When asked where the space is, they had no hesitation in replying, "remove the slums".
- For most of the older people, the idea of parks or greens seemed a good idea for providing the choked streets with some breathing space.
- With the prospects of new office spaces coming up in the area, around 20% of the working men were keen on having office spaces near the Metro stations.
- The Metro does seem like a preferred mode of travel because of which the mobility has been eased and people do travel long distances for work inside or outside Shahjahanabad.
- Because of the comfort with which a person can reach here, the traditional food joint in the area are being revived into becoming major hang out places for the teenagers.
- Because of the proximity to the Delhi University, Shahjahanabad may be able to provide cheap and affordable houses for the students on rent, which could increase the demand for advanced infrastructure.

Chapter 7.0 STRATEGIES

7.1 Transit Supportive Development: An approach

On the basis of the case studies the prime constituents of Transit supportive development have been defined as under.

- It is a dense, mixed-use development, designed for pedestrians and multiple modes of transportation- Each of these characteristics of transit supportive development is described below:
- Medium- to high-density development concentrated in business districts and neighborhoods and served by high-quality transit. The concentration of jobs, commercial services, and housing generates high levels of pedestrian activity and transit use.
- Mixed-use development combines retail and commercial services, offices, entertainment, and residential uses within easy walking distance. People are more likely to choose transit if they can easily walk between many destinations at the beginning and end of the trip. Mixed use adds vitality to business districts by offering customers a greater choice of goods and services in one place. Mixed use also contributes to the livability of neighborhoods by supporting a walkable environment where people can easily interact with one another.
- Development designed for pedestrians provides a safe, convenient, and attractive environment for walking. Well-designed development projects reduce conflicts between pedestrian and vehicular traffic and add to an area's attractiveness.
- Streets designed for multimodal access and circulation accommodate the needs of cars, transit vehicles, bicycles, and pedestrians, thus offering people more choices to meet their various transportation needs.

7.2 Why Transit Oriented Development is not prevalent in Indian Cities

- No working definition of transit-oriented development exists
- Transit-oriented development must deal with the tension between node and place That is, it must achieve a functional integration of transit and the surrounding uses The need for transit-oriented development to function as both node and place

affect virtually every aspect of the station area, from physical layout and design to the appropriate development program Yet as the discussion of the first challenge makes clear, the multitude of actors and goals to be found in any TOD project makes integration of node and place extremely difficult

- Planners have no guidelines for translating the concept of location efficiency into concrete prescriptions for TOD in different settings

- TOD requires synergy among many different uses and functions, but this synergy is extremely difficult to achieve. As a result, TOD almost always involves more complexity, greater uncertainty, and higher costs than other forms of infill development 5. Transit-oriented development typically occurs in a very fragmented regulatory and policy environment. There is often no comprehensive plan or vision, and many local governments suffer from a significant leadership gap

7.3 Major elements of Transit Oriented Development

The main identifiable features of transit supportive development are

- Increasing density
- Mixed landuse
- Pedestrian –oriented design
- Multimode street design

7.3.1 Benefits of Increasing Density

A central strategy for accommodating regional growth is to attract new jobs and housing into centers and corridors, which should be, identified in the future Growth Plans. As a result of this strategy, the density in centers and corridors will gradually increase over time. The region will benefits from this approach in several ways:

- It reduces the need to expand the Urban Growth Boundary (UGB) and protects farmland and open space. If some of the projected growth is directed into centers and corridors it will promote vitalization of business districts and neighborhoods by directing investment into existing and emerging areas.

- A compact UGB helps stimulate economic growth in regional centers, town centers, station communities, main streets, and corridors. As population and employment growth occurs within the UGB, existing market areas intensify, increasing the attractiveness of centers and corridors for economic investment.
- As the economics of infill redevelopment improve, higher density development projects become increasingly more feasible. Supports better transit service. The concentration of jobs and housing provides a larger base from which to draw transit customers. The larger customer base promotes
- More frequent transit service throughout the day. As a result more frequent transit service attracts additional customers, particularly customers sensitive to time and convenience factors.
- Uses existing public investments more efficiently. Infill and redevelopment can often utilize existing sewer and water systems, schools, etc., thus reducing the need to make new public investments.

7.3.2 Benefits of Mixed Use

Mixed-use business districts and neighborhoods bring together a variety of complementary land uses within easy walking distance of one another. The mix may include retail businesses, aches, commercial services, entertainment centers, restaurants, and a variety of residential uses. The most direct form of mixed use is to combine multiple uses in a single development project, either vertically or horizontally. Mixed use can also be achieved by linking single-use developments with a system of safe, convenient, and attractive pedestrian walkways- some of the benefits of mixed use are:

- Supports walking, ridesharing, cycling, and transit use by enabling people who use these travel modes to run errands, go out to lunch, and make other trips conveniently. Consequently, vehicle trips and dependence on cars are reduced.
- Generates off-peak transit use because trips to and from mixed-use developments occur throughout the day and night. As a result, higher transit frequencies can be sustained all day, further increasing the attractiveness of transit.
- Adds to the economic vitality of business districts by increasing the diversity of retail and commercial services offered. Mixed-use districts attract visitors who

enjoy exploring the diversity of unique business districts. Also, they provide a convenient mix of goods and services to employees during the day and residents in the evening. As a result, many businesses have a steady flow of customers all day.

- Contributes to neighborhood livability by providing activities within easy walking distance of neighborhoods. Residents in or near mixed-use areas can combine exercise (walking), errands (food shopping, shoe repair, video rentals), and entertainment (dining out, movies, live music). With these choices available, residents tend to walk more in their neighborhoods, increasing the area's safety, friendliness, and livability.

7.3.3 Benefits of Pedestrian-Oriented Design

Providing for the safety, convenience, and comfort of pedestrians is a basic goal of transit supportive development. Each new development project or transportation improvement provides an opportunity to improve the environment for pedestrians. Some of the benefits of pedestrian-oriented design are:

- Encourages transit use by providing safe and direct connections between transit stops or stations and destinations in the zone.
- Enhances all transportation choices because, with few exceptions, all other travel modes involve a pedestrian element.
- Reduces the impact of large land uses, such as shopping centers, apartment complexes, or entertainment centers, by designing these projects to Wend visually and functionally with adjoining development.

7.3.4 Benefits of Multimodal Street Design

To assure regional mobility in the future, an extensive network of multimodal streets is needed. Multimodal streets balance the needs of pedestrians, bicycles, cars, trucks, and transit vehicles in a way appropriate to the particular function and location of a road or street. Some roads may give more priority to cars and trucks; others may give priority to transit vehicles and pedestrians. Some of the benefits of multimodal street design are:

- Preserves mobility by encouraging transportation facilities and development patterns that make walking, bicycling, and buses competitive choices compared with private mode driving.
- Encourages more efficient movement of people in roadways, rather than the addition of more vehicles.
- Increases the capacity of the existing street system.

7.4 Planning Considerations

To ensure quick and easy transfer

Adequate transport access at transfer points! parking areas

Facilitate free circulation to all modes

Terminal size and location should reflect

Land costs availability

- Passenger interchanges volume
- Peaking pattern
- Origin-destination and dispersal modes
- Traffic condition
- Parking requirements

The following features/ activities enable the use of a transit station in the above Mentioned manner:

- Park and ride
- Inter change facilities
- Kiss and ride
- Para transit stands
- Allied facilities like shops, retails, offices

7.5 Possible impacts of property development on MRTS stations

7.5.1 Land Use

The station, being a highly accessible transportation node coupled with development over the Station would lead to a change in Land Use of the surrounding area to give way to higher intensity of development. The higher intensity of development might be as a result of Qualitative change in land use from residential to commercial, or as a result of Quantitative change in land use from residential to commercial, or as a result of Quantitative change in term of increased building bulk, FAR, height etc. It is, therefore, essential to take cognizance of the potential changes and develop suitable programme in order to either prevent the change or to plan for the change.

7.5.2 Land Value

The next consequence of the change in land use would be an increase in land values in the vicinity of the Stations. Thus it becomes imperative to plan in a manner so that the benefit of rise in the real estate values accrues to the MRTS, in order to meet the expenses for funding the system.

7.5.3 Traffic

The trips attracted to and generated from the station would lead to greater volume of traffic in the locality surrounding the station Parking on the street, encroachment by the informal sector would reduce the effective carriageway of the access roads. The access roads to the Stations unless properly planned for would be choked due to insufficient capacity. Displacement of slow moving modes, increase in speeds, air and noise pollution are the other traffic-related impacts of the Station on the surrounding area.

7.5.4 Concentration of Activities

As is evident from the case studies, there would be concentration of activities like retail shopping restaurants around the station and hawkers all along the pedestrian movement corridors.

7.5.5 Visual

Property development on the station being a high-rise development would dominate the skyline of the surrounding area and would act as a landmark. Apart from this congested surroundings, informal sector, hoardings would add to the visual characterizes of the area.

7.5.6 Socio Economic Impacts

Development of such a nature would lead to change in the changed, socio economic profile of the population in the surrounding area. Due to increase in land values, it is highly probable the high-income group would replace that low-income category. Apart from this the station complexes would provide jobs and opportunities

Chapter 8.0 CONCLUSION AND RECOMMENDATIONS

8.1 Conclusion:

Some facts recognized and inferences drawn are as follows:

a. Transit oriented development should be promoted and adopted.
b. Need for an integrated land use and transportation plan, proposing a high density corridor along MRTS alignment and be detailed for the node area development.
c. The development controls and bye laws will need to be made more transit supportive and flexible.
d. Mixed land use must be given recognition
e. Redevelopment of the area should be done with due care without affecting the architectural character and heritage of the study area.
f. Road network should be bicycle friendly particularly in the core areas.

8.2 RECOMMENDATIONS

The following are the recommendations of the thesis:

8.2.1 City Level

8.2.1.1 Relocation of CBDs and Sub CBDs

Relocate CBD, sub CBDs, and district centers, which have not been implemented so far in the vicinities of, proposed station locations and should be supplemented by redistribution of activities and landuse.

8.2.1.2 Change in Land Use

The present landuse with 58 %residential, 10 % commercial, 7% circulation and with FSI 1.25 will not work under the development of stations and would pose serious problems in terms of traffic and finance generation from property development.

8.2.1.3 Need for Feeder Road Network and Efficient Public Transport System

Land development around the station node would lead to high traffic volumes therefore the feeder road network and public transport system should be upgraded suitably.

8.2.1.4 Land Acquisition

To modify the existing physical infrastructure in terms of roads, water supply, sewage and to accommodate the Landuse shift, it is require to acquire the properties at market prices.

Other expenditures include premium on increased FSI's, transfer of development rights, fees on Landuse conversions.

8.2.2 Area Level

8.2.2.1 Preparation of Comprehensive Urban Renewal Schemes

There should be proper integration of the development of the stations with the development of the locality.

8.2.2.2 Commercialization at the Stations

Assessment of market is required in terms of demand and supply for the intense commercial use at the stations.

8.2.3 Station Node Development

Detailed Land Use Plan for Stations Nodes

Detailed Landuse plan may be prepared for each station and surrounding zone specifying the type and intensity of use and other building and zoning regulations

8.2.4 Modification of Building Bye Laws and Land Use Controls

New or modified building bylaws should be implemented to accommodate the change in Landuse and vertical and horizontal expansion of the buildings

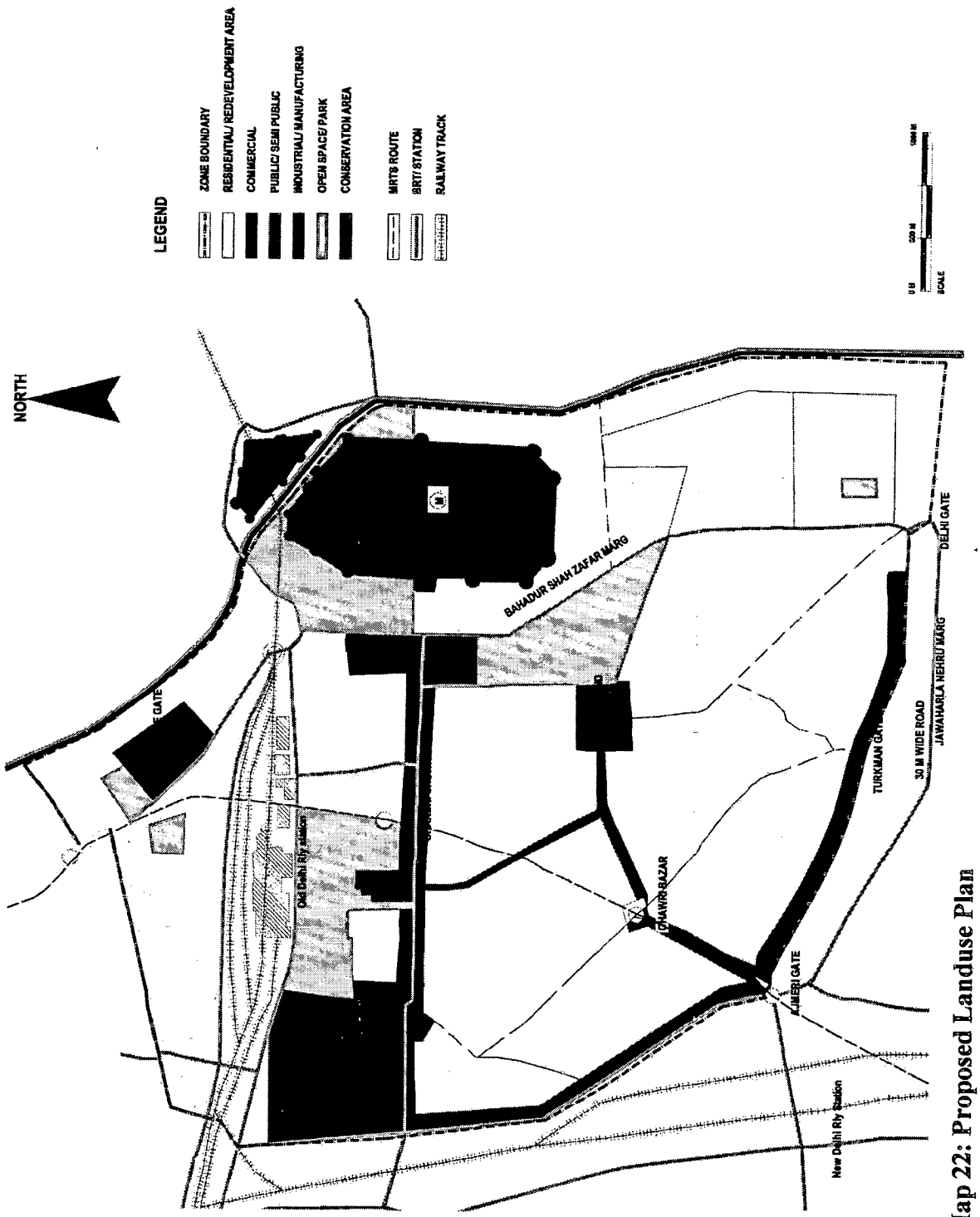
8.2.5 Check Unauthorized Development

Concentration of informal sector and unauthorized development should be curbed and alternate arrangements to be made.

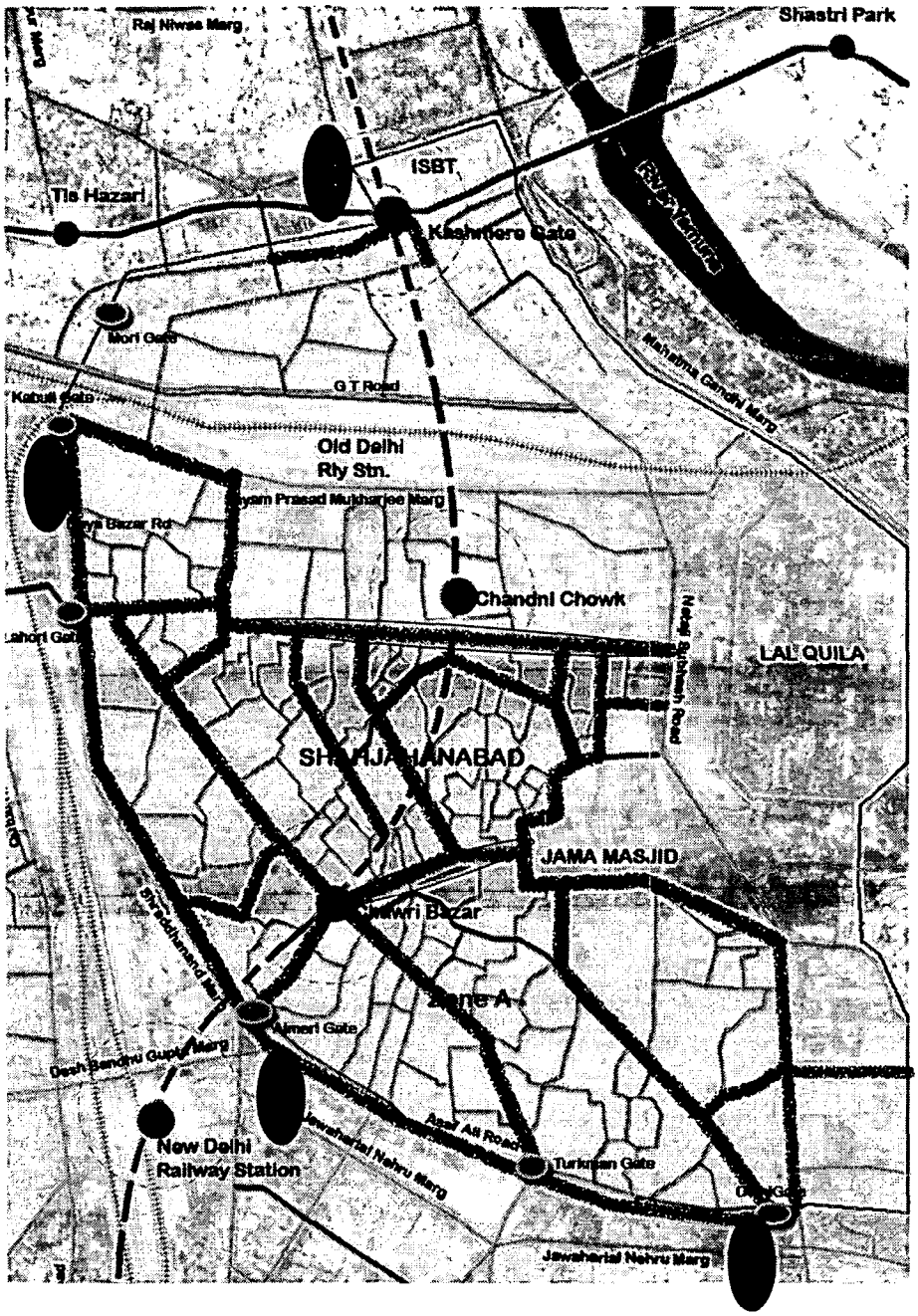
8.3 Proposal

Further, the proposal can be summarized as below:

1. Conservation approach should be adopted to retain the overall traditional character of the Shahjahanabad.
2. MRTS station areas are to be dealt as per specific Urban Design schemes and be declared as pedestrian zones.
3. Multilevel Parking should be provided at the periphery of Shahjahanabad, like at Ajmeri gate, Delhi gate and many more areas so as to stop the motorized vehicle to get entered into the core.
4. For short and medium trip length, bicycle and rickshaw should be used and segregated lanes be provide with safe parking provision on the arterial raods .
5. Many areas in Shahjahanabad could be pedestrianised and made completely free of vehicular traffic so as to restore the human scale and convenient living. For example: Pedestrianisation of Chandni Chowk to impart grandeur to the monuments and street from Chawri Bazar heading to the Jama Masjid.
6. Activities such as traditional/craft bazaar, heritage walk/rides could be introduced to attract tourists.
7. Judicious use of existing spaces for development of open recreational uses.
8. Wholesale market could be shifted to the periphery of walled city
9. Redevelopment schemes should be made for Govt.. owned Katras/ evacuee properties and hence Landuse can be altered and can be used as public spaces.
10. Industrial activities should be closed down and such industries should be moved out from the walled city



Map 22: Proposed Landuse Plan



Map 23: Streets identified for mixed land use and other proposals

Source: *Author*

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