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Effect of Metro Rail on Land Use: (D.N.Nagar, Mumbai)

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Abstract: Mumbai is one of the fastest growing metros in country with population of about 12.4 million as per 2011 census. As it is considered as Economic Capital of country, about 13 million people travel daily using public transport, 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. This will bring changes in distribution of people, in activity patterns or in land uses. At the MRTS stations and within 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. The present work is an effort to identify impacts of Metro on the surrounding Land use pattern. The area selected for the study is already functioning Mumbai Metro Line 1 (Versova –AndheriGhatkopar).This corridor is connects major stations of suburban railway system Andheri and Ghatkopar. During the study, the data was collected different government departments like MMRDA, MCGM etc. and primary data collection done by mapping the existing land use of the area. The analysis of available data lots of facts and figures. Recommendations and guidelines are proposed to improve the land use planning and development controls near stations and influence areas, like giving flexibility in FSI, or to permit change in Land use with certain restrictions.

Keywords: IPT-Intermediate public transport, MRVC-Mumbai Rail Vikas Corporation, MUTP-Mumbai Urban Transport Project, MMRD-Mumbai metropolitan region development authority, MCGM-Municipal corporation og greater mumbai

I. INTRODUCTION

The public transportation system does much more than merely mobilize citizens from one place to another - it plays a vital role in encouraging and controlling urban growth and also yields economic benefits. Though primary goal of the public transport is to satisfy the mobility needs of citizens, economic impacts of public transport projects accrues indirect benefits as well. The direct benefits of public transport system includes user benefits such as reduced travel time, increased accessibility, reliable service etc. while indirect benefits embrace land use changes, densification, land value increment, environmental benefits etc. The intervention in the public transport tends to impact Land use of the proximate properties. There are various examples around the world that illustrate how improvement in accessibility has led to change in Land use. Accessibility benefits by improvement in public transport give push to development. Transport investments leads to ease in accessibility in proximate areas, which further accelerates Land use change. Integrated transportation-land use planning is the most important tool available to urban planners to create agglomeration-augmenting, congestion-minimizing and resource generating cities.

A. Transit Oriented Mumbai

The main reason for the growth and development in Bombay – Now Mumbai – has been transportation. It was the fact that 'Bombay' could be better port that prompted the shift of the East India Company from Surat in Gujrat to 'Bombay'. 'Bombay' was originally a cluster of seven islands, today known as Mumbai was planned & developed by the British as one of their strategic and commercial centre. Due to the deep sea on eastern coast, it was considered one of the best all-weather harbors for trading by the East India Company. For fast movement of raw material and finished products first railway tract was laid from Thane to the docks in 1853. As trade and commerce grew, wholesale markets of all types were started locating in South Bombay. In the wake of prosperity the tertiary sector – Banking, offices, financial institutes, insurance houses etc. also located themselves in the same area. Many cotton textile mills were developed in the southern part of island city. The ancillary industries to textile mills were also developed in the surroundings areas. Mumbai, once a land of fishermen, was therefore slowly developed with storied structures constructed in the heart of Island City, mainly to cater the housing requirements of workforce required for the Bombay Port and textile mills. Industrial and commercial uses began to edge residential uses away from the Central Business District (CBD), along

the railway tracks. People began settling at increasing distance from the CBD, along the tracks. The growth was therefore along the tracks, and because of the Tracks.

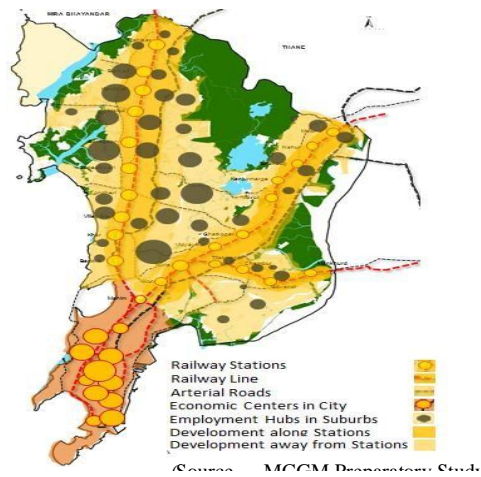


Fig. 1 Transit Oriented Mumbai

B. Travel Pattern of Mumbai

Due to the people's affordability they have significant reliance on the public transport. The city is predominantly served by railways, buses, taxis and auto-rickshaws. Suburban railway carries approximately 7.3 million passengers daily. The Bombay Electric Supply and Transport (BEST) is the sole public bus transport provider for Mumbai, serving urban, sub-urban and nearby Municipal Areas. The BEST buses carry approximately 4.5 million Passengers daily.

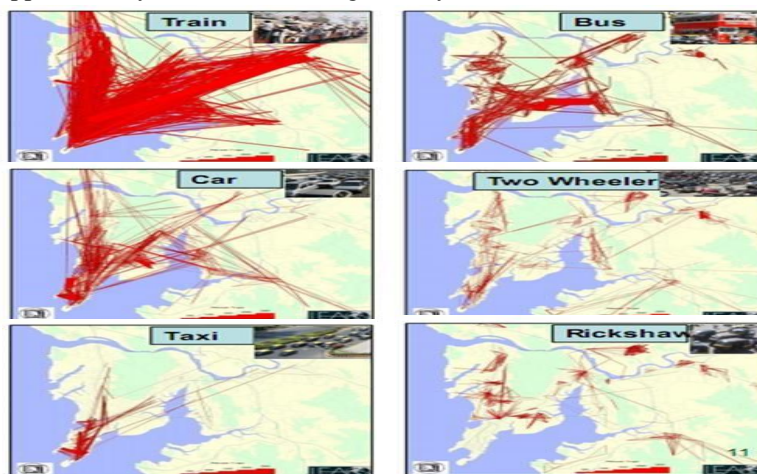


Fig. 2 Commuting Pattern of Mumbai

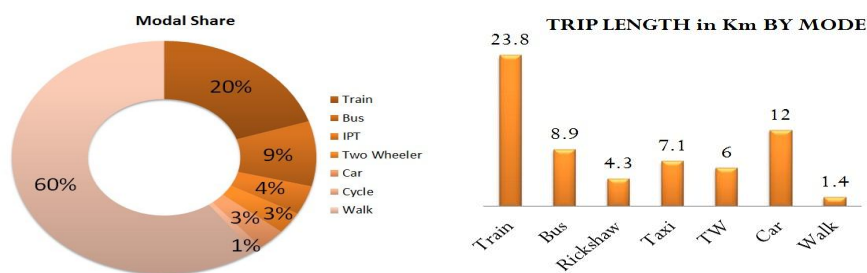


Fig. 3 Trip Length by Mode in Mumbai

As seen from above chart about Modal share of walk is 60% and average length of trip by walking is 1.4km whereas are Modal share of Train and Bus combined is 29% and average length of trip by train is 23.8km and by Bus is 8.9km. Model share of Private Vehicles such as Cars and Two Wheelers combined is 6% and average length of trip by two wheelers is 7.1km and by Car is 12km. Increase in number of private vehicles on roads has increased in traffic congestion. Public Transports like Train and Bus are overcrowded and carrying passengers beyond the standards in peak hours.

- 1) 13.0 million people travel daily using Public Transport
- 2) Many areas in city and suburbs are not served by rail based system
- 3) Expansion of Rail network is lesser as compared demand resulting in severe congestion on road network & Environmental pollution.
- 4) Rail network expansion failed to keep pace with demand resulting in severe congestion on road network which increased Environmental pollution.
- 5) Suburban rail traffic increased by 6 times while the capacity increased by only 2.3 times. In spite of 18% addition in capacity by MRVC still there is mismatch in demand & supply.

II. OVERVIEW OF “MUMBAI METRO PROJECT”

Metro Rail was augmented with the objective of achieving a balanced modal mix and to discourage personalized transport. The purpose for metro incorporates reduced journey times, cutting fuel use, accident reduction and lower pollution.

A. Objective of Mumbai Metro

- 1) *More N-S Corridors:* Presently Mumbai has Western Railway and Central Railway both running parallel in North South Direction. Alignment of Eastern and Western Express High Way in Mumbai is also in North South Direction. Areas along these are having high density. There is need of
- 2) *Capacity Augmentation Along Main Travel Axis:* In spite of this North South connectivity due to increase in no. of passengers and increase in no. of private vehicles this infrastructure is already overloaded. There is need of additional North South Transport infrastructure which will provide mass transit system.
- 3) *Provide East-West Connectivity:* As discussed above Mumbai has linear network of Railway and Highways in North – South Direction. There is no transport link which connects Eastern Suburbs to Western Suburbs except three arterial roads Jogeshwari-Vikroli Link road, Andheri-Ghatkopar Road and Santacruz-Chembur Link Road, which are already have very heavy traffic load. There is need of transvers connectivity in East West direction which will provide easy and fast mode of travel between Eastern and Western Suburbs.
- 4) *Serve Areas Not Served By Suburban Rail:* Due to space constraint expansion or new provision of suburban rail network in Mumbai is difficult. Due to New developments in areas away from network there is necessity of provision of MRTS in unserved areas by suburban rail.
- 5) *Stations Within Walking Distance:* As a home buyer is concerned about the commute distance to work place and a business person wants to invest at a location which is comparatively more accessible. Introduction of high speed, high capacity transportation system such as Metro, Bus Rapid Transit System etc. results in an increased accessibility, particularly in the areas of immediate vicinity of stations/stops. Requirements of Intermediate Public transport like Autos and Taxi and also private vehicles decreases if the station is within walking distance from Home or work place.
- 6) *Second Mode Of Transport:* Presently Mumbai has Suburban Railways are considered to be lifeline of Mumbai city. Any delay or non-functioning of Suburban Railways make city stand still. This causes major Economic losses to the city. To avoid this and reduce the dependence Suburban Railways there in need of another effective mode of transport like Metro Rail.
- 7) *Improve overall mobility:* Introduction of Metro will provide additional means of Mass Public transport to city. Layout Plan of Metro is such that it will all unserved areas which were presently not connected with Public Transport system.



Fig 3. Mumbai Metro Master Plan (Source: MMRDA)

III. MUMBAI METRO LINE I (VARSOVA - ANDHERI – GHATKOPAR)

All paragraphs must be indented. All paragraphs must be justified, i.e. both left-justified and right-justified.

A. Overview of Mumbai Metro Line 1

Metro Line-1 project is opened for public use on 8th June, 2014.

- 1) Versova-Andheri-Ghatkopar Metro corridor is 11.40 km elevated corridor.
- 2) This corridor connects densely populated areas of western & eastern suburbs.
- 3) Connects two important suburban railway stations, Andheri Station on Western and Ghatkopar Station on Central Railway.
- 4) This corridor provides much needed transverse connectivity to Mumbai in East West direction.
- 5) There are total twelve New Station along this metro route. These twelve new stations have provided twelve nodes for development.
- 6) This corridor passes near to MIDC, SEEPZ & other commercial areas which has provided much needed effective, fast, easy and economical public transport system to these employment centres.
- 7) Total time taken to travel from Versova to Ghatkopar by road is about 71 min due to heavy traffic on road. This journey time is now reduced to 21 min between Versova & Ghatkopar.

B. Project Features of Mumbai Metro Line 1:

- 1) Length of the route : 11.07 km (Elevated)
- 2) Car Depot /Area: D. N. Nagar (13.8 Ha.)
- 3) No. of stations : 12 (Elevated)
- 4) Max. Speed : 80 kmph
- 5) Average Speed : 35 kmph
- 6) Environment in Coach : Air Conditioned
- 7) Length of the Platform(6 Coaches) : 135 m

TABLE I

MUMBAI METRO LINE

Year	Daily Ridership	Hourly Ridership	PHPD*
2008	4,75,046	38,004	17,356
2011	5,13,338	41,067	18,580
2021	6,64,703	53,176	23,321
2031	8,82,533	70,603	30,491

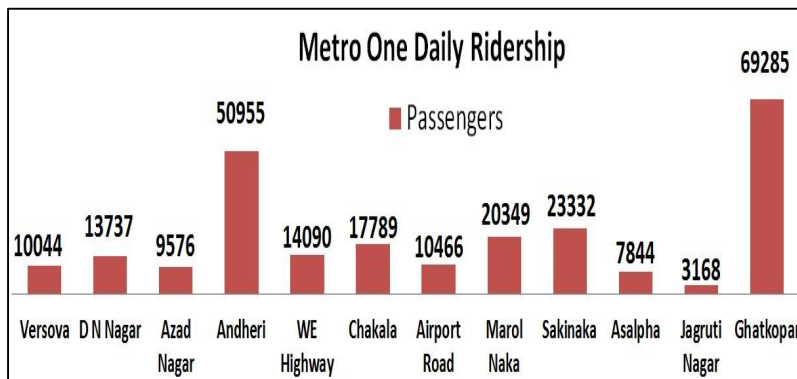


Fig. 4 Metro Line 1 Daily Ridership for all Stations

Above table 2 shows that the expected daily ridership of Metro Line 1 in 2008 is around 4.75 lacs passengers which are expected to reach 8.82 lacs.

Chart 3 shows present ridership on all 12 Metro stations, it seen that Andheri and Ghatkopar stations have highest passenger ridership as these stations are connected to suburban railway and these are used as interchanging stations between Suburban railway and Metro Line. Versova, D N Nagar and Azad Nagar are residential localities which show less numbers of ridership. Asalpa and Jagruti Nagar are station located in Middle of Slum area, hence ridership on these stations are very less.

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Every word in a title must be capitalized except for short minor words such as “a”, “an”, “and”, “as”, “at”, “by”, “for”, “from”, “if”, “in”, “into”, “on”, “or”, “of”, “the”, “to”, “with”.

Author details must not show any professional title (e.g. Managing Director), any academic title (e.g. Dr.) or any membership of any professional organization (e.g. Senior Member IEEE).

To avoid confusion, the family name must be written as the last part of each author name (e.g. John A.K. Smith).

C. Existing Land use along Metro Line 1

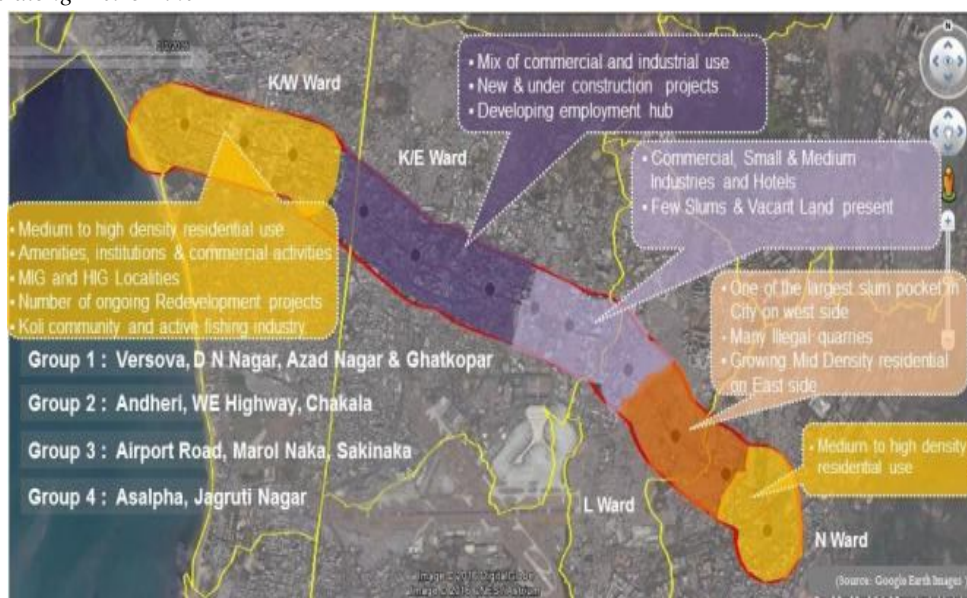


Fig 5.Existing Land use along Metro Corridor

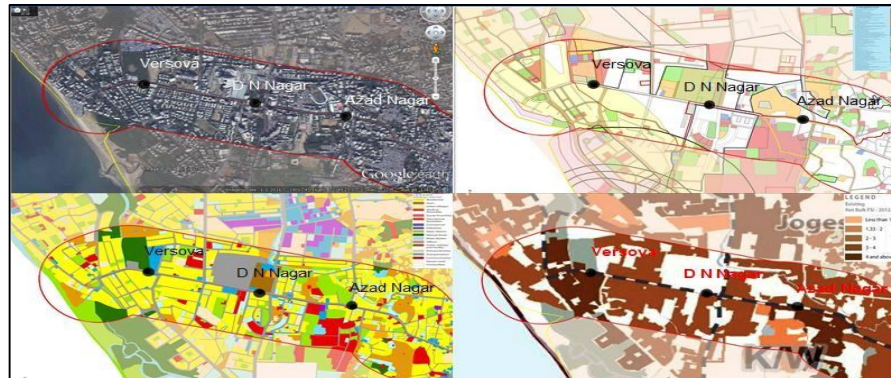
Mumbai Metro Line I can be divided into four groups depending on existing land use situation. Residential area of Versova, DN Nagar, Azad Nagar and Ghatkopar forms group 1, Mix use character and presence of Service and IT Sector industries form Group2 with Andheri, WE Highway and Chakala Stations. Airport road, Marol Naka and Sakinaka forms Group 3 which have Commercial & small scale industries and Hotels. Group 4 area near Asalpa and Jagruti Nagar station is majority slum area.

- 1) **Group 1 Area:** Versova, DN Nagar, Azad Nagar & Ghatkopar - This is predominantly residential area having high to medium density residential use. It has Educational amenities like school, college and Engineering colleges. Shahaji Raje sports complex is major sports activity center provided by MCGM. This area has MIG and HIG localities. Active fishing industry is also seen near Versova.
- 2) **Group 2 Area:** Andheri, WE Highway & Chakala – This area shows predominantly mix use character near Andheri. WE Highway and Chakala area shows presence of service sector and IT industries. Andheri station and WE Highway area very important areas in terms of Public transport activity. Location of Chakala station in very near to MIDC & SEEPZ area.
- 3) **Group 3 Area:** Airport Road, Marol Naka & Sakinaka areas show presence of Hotels due to vicinity of Airport. Many Small & Medium scale Industries are present in this area.
- 4) **Group 4 Area:** Asalpa and Jagruti Nagar stations are surrounded by slums. There is lack of basic infrastructure and public amenitie

IV. STUDY AREA IDENTIFICATION

A. Study area Identification:

- 1) *Group 1 Area:* Versova, DN Nagar, Azad Nagar is considered for further study and analysis of Land use change. Primary Survey of this area indicated following



Source: Google Image & MCGM DP 2034 Preparatory Studies

B. Area Characteristics

- 1) Predominantly Residential Area.
- 2) Medium to high density residential neighborhoods.
- 3) Residential areas predominantly high to middle income.
- 4) Many Old Building constructed in 1960s
- 5) Balanced distribution of amenities and institutions.
- 6) Presence of primary and secondary educational institutions.
- 7) Presence of Degree Colleges and Engineering College.
- 8) Recreational institutes like Andheri Sports Complex.
- 9) Recreational Versova beach attracts many visitors.
- 10) Aaram Nagar in Versova is an employment hub for film industry.
- 11) Versova village is home to Koli community and has an active fishing industry.
- 12) Opportunities:
 - 13) Potential for redevelopment as many building are more than 50 yrs old.
 - 14) Planned connection of Metro Line 2 which will connect to Dahisar, Charkop, D N Nagar, Bandra, and Mankurd.
 - 15) Potential to be a recreation destination due to the presence of the Versova beach.
 - 16) Opportunity to leverage presence of several commercial and entertainment anchors in the vicinity through place making strategies.
 - 17) Existing Net Bulk FSI Consumption is 1.33 to 3

Out of these three stations Area around D N Nagar Station is considered for detail survey and analysis. Circle of influence of radius 500 m is considered for details study.

C. Reason for selection of Area around D N Nagar Station

- 1) Area around D N Nagar Station is now undergoing massive change because of redevelopment of old building and construction of new buildings.
- 2) Major transformation is seen in Residential, Commercial, Socio Economic, traffic and Property rates around this station area.
- 3) Proposed Metro Line 2 i.e. Charkop Bandra Mankhurd is passing through this area, this Metro line is further planned to connect to Metro Line 3 and 4, which will establish direct connectivity of D N Nagar to up to Dahisar towards Northern side, up to Colaba towards southern side and Mankhurd towards Easter side.
- 4) Due to location of D N Nagar on proposed Metro Map, after implementation of complete network of Mumbai Metro, D N Nagar will potentially become Transit Hub.
- 5) Due to its future connectivity with all parts of the city after implementation of Metro Network this area has tremendous potential of attracting various businesses and eventually become Secondary Business District.

V. STUDY AREA ANALYSIS

Study Area Analysis: D N Nagar Station Area

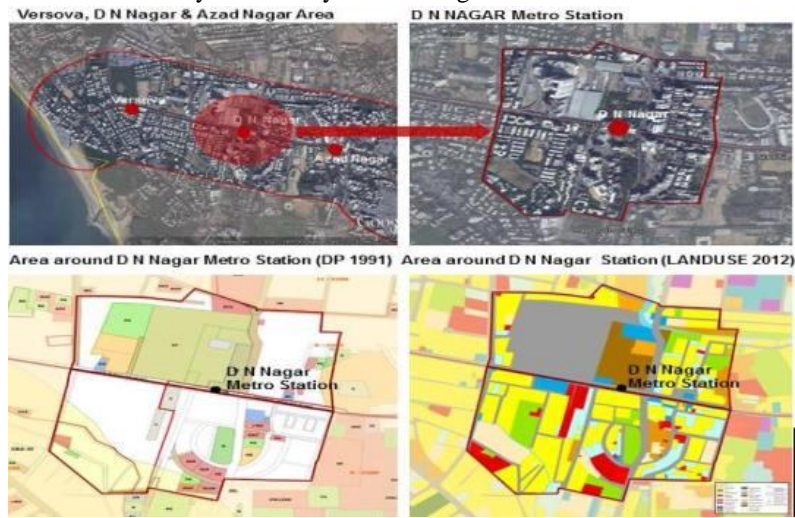


Fig 6. Study area

A. Area Characteristics

- 1) This area is named after Great Indian Leader Dadabhai Naoroji.
- 2) This area predominantly Residential Character.
- 3) There are five localities in this area namely D N Nagar, Four Bungalows, Sahayog Nagar, Sahakar Nagar and part of Azad Nagar.
- 4) Development of this area started in year 1960's when G+3 or G+4 Residential Building were constructed for middle class housing.
- 5) Presently this area has Middle to High Income group locality.
- 6) There are good numbers of Educational Amenities in vicinity of this area.
- 7) Presence of Recreational Grounds and Play Grounds.
- 8) Implementation of DP199 reservations is followed in majority of Area.
- 9) Redevelopment projects are seen at various locations.

B. Existing Land use Analysis

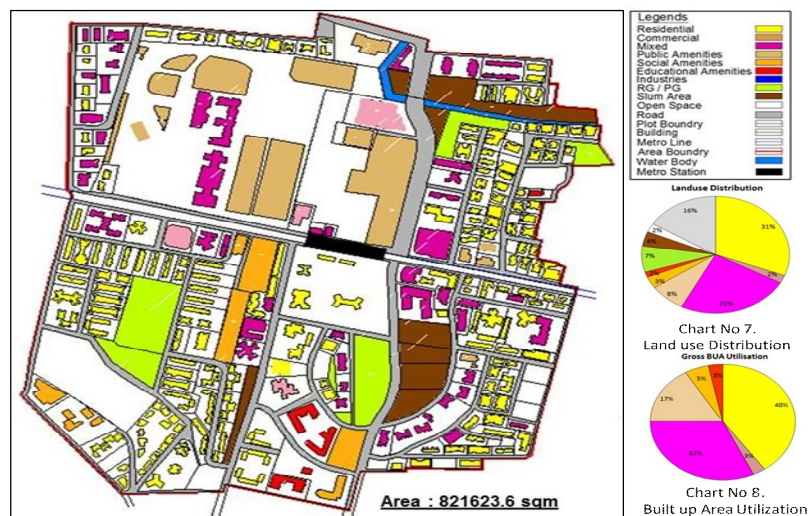


Fig 7. Study Area land use Map

- 1) Properly Planned layout, no haphazard development seen.
- 2) Nearly 1/3rd of Total Area is residential.
- 3) 1/4rd of total area is seen as mixed use, but commercial component in these buildings is just 5 to 7 %.
- 4) Buildings are having Ground floor or G+1 as commercial and rest upper floors are residential.
- 5) RG / PG and amenity spaces are developed as per reservations in DP 1991 • Well-developed road network.
- 6) Few slum pockets seen, which are under process of redevelopment under SRA.
- 7) Land under commercial use is only 2 %.
- 8) Less than 2 % of Open land is available. • Industries are absent.

C. Land use & Building Age Analysis

- 1) 51 % existing residential buildings are constructed in 1960's and 70's.
- 2) 75 % existing mixed use buildings are constructed in last five years or are under construction.
- 3) Majority of New Buildings which are constructed under redevelopment project are having Ground & G+1 floor as commercial.
- 4) About 80% of the commercial space available is built in last 15 years. 30% Out of which is built in last five years.
- 5) No upcoming commercial development is seen in this area.

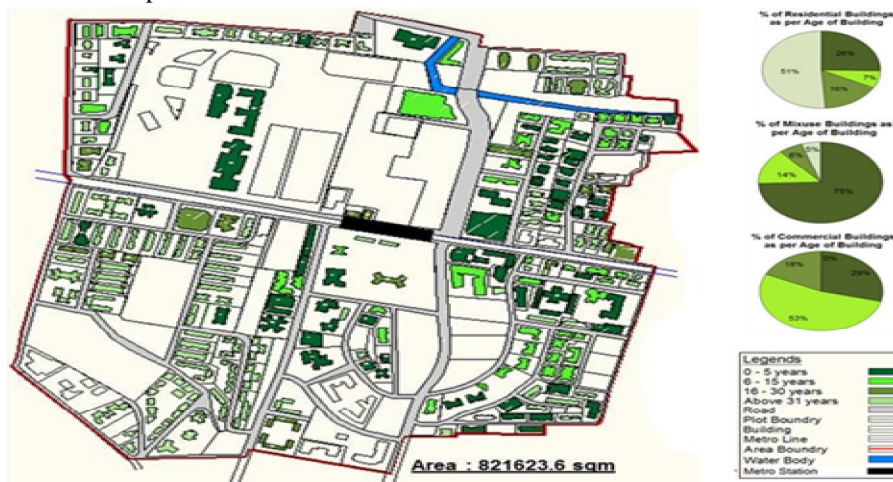


Fig 8. Study Area Building Age Map

D. Land use & Building Height Analysis

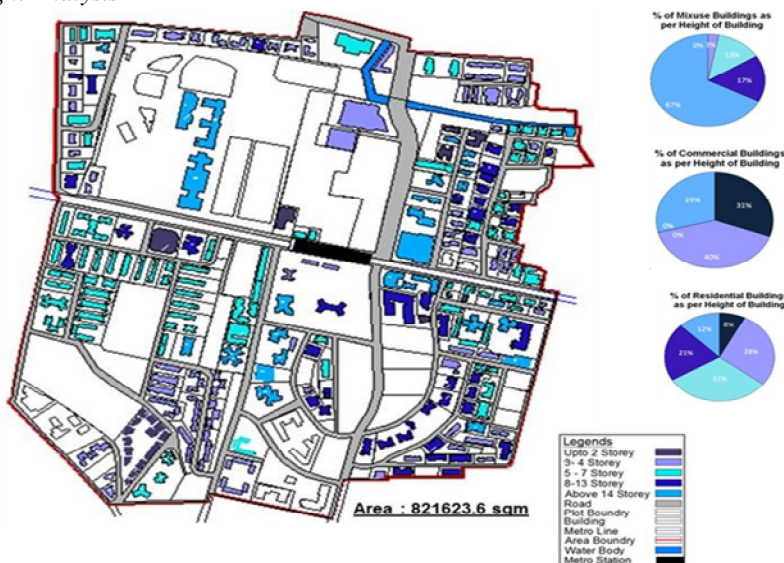


Fig 9. Study Area Building Height Map



- 1) 33 % of Residential Buildings are High rise, were as 84 % Mixuse Buildings are High rise.
- 2) Mixuse buildings are having Ground floor or G and G+1 floor as commercial.
- 3) 3-4 Storey Residential building are built in 1960's and most of them are under process of redevelopment
- 4) Trend of Redevelopment is towards High rise Mix use Buildings.
- 5) Commercial buildings up to 3 floors are shopping malls.

E. FSI Consumption Analysis

- 1) Avg. Bulk FSI consumption for New and Under construction residential Buildings is 4.68.
- 2) Avg. Bulk FSI consumption for New and Under construction Mixeduse Buildings is 5.23.
- 3) Old buildings constructed in 1960's & 70's are having Bulk FSI range between 1.15 to 1.60.
- 4) Overall Bulk FSI Consumption is 2.28.
- 5) For Residential it is 2.32.
- 6) For Mixuse it is 3.68.
- 7) For Commercial it is 2.19.

VI. CONCLUSION

A. Station Area Recommendations

- 1) Provide Transit Plaza with Seamless Intermodal Connections.
- 2) Enhance Passenger's Transition from Metro Station to Station Area.
- 3) Provide Bus stops within 100m of station, with Mini Buses having ring route covering area of 1km to 1.5 km radius from station giving last mile connectivity.
- 4) No parking zone for 200 m radius from Metro Station.
- 5) Provide denser street network closer to station.
- 6) Prohibit compound walls within 200m of Metro Stations, which will disperse high pedestrian traffic.

B. Development Recommendations

- 1) Plan for Highest Built-up Densities with provision of Higher FSI within 300m radius of Metro Station.
- 2) Provision of Smaller Size Residential Units of Area between 30sqm to 50 sqm within 500m radius of Metro station
- 3) Plan for rental housing project with private ownership and assured Government Rental
- 4) Encourage Mixed use development
- 5) Mixed use development should be encouraged to provide space of offices for various tertiary sectors by giving incentive FSI.
- 6) Developments with high share of transit users must develop footbridges offering direct connections to Metro station concourses.
- 7) Minimum or NO parking provisions for construction within 300m radius of Metro Station.

C. FSI Recommendations

- 1) Allow FSI > 3.5.
- 2) Allow Affordable Housing Incentive FSI over the base FSI within 500 m radius of Metro Station.
- 3) Parking constructed at grade & above grade should be included in calculation of FSI within 300m radius of Metro Station.
- 4) Allow only below grade (basement) parking to be free of FSI.

D. Parking Recommendations

- 1) Prohibit any parking provision within 300-400 from Metro station.
- 2) Modify parking provisions to 0.35 parking per 100sqm within 400-1 km of Metro stations.
- 3) Shared parking structures at a 5-10 minute walking distance from stations to serve the parking needs of Park & Ride Commuters.

E. Revenue Generation Recommendation

- 1) Area Enhancement Tax – On developments within influence area of Metro Stations.
- 2) Taxation on underutilization of Land.



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