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A STUDY IN INTERMEDIATE PUBLIC TRANSPORT AS A FEEDER SYSTEM TO METRO:

A CASE OF THANE CITY, MAHARASHTRA

Er. Rakesh Jagtap
P.G STUDENT

Prof. Kunal Pawar
Assistant Professor

DEPARTMENT OF CIVIL ENGINEERING, SANDIP UNIVERSITY NASHIK

ABSTRACT –

Transportation system in the city is often one of the epochs - making aspect one looks into also this subject has got my interest. Innovations are never ending outcome of our thought process. Metro System is been built to provide the service to its people and scale up the facility provided, this would also require the response of people and shift from their mode of transportation. With heavy transportation and day-to-day increase in the traffic on road there is a need to use the Public Transportation. Government has initiated the project of mass transit in metropolitan cities also have predicted the estimated ridership but Last Mile Connectivity has not been given the importance it desires. Proper Integration of various modes of commute would succor in providing the last mile connectivity people desire.

The Detailed Project Report (DPR) for Pune Metro was made in the year 2008, but there is no feeder plan yet, this gives an opportunity to study this respective field. Thus, administration can effectively implement feeder plans and promote seamless transportation. This dissertation aims at getting to know the responses of the commuters of the metro and also of the operators in the catchment area thus providing an efficient last mile connectivity with the Intermediate Public Transport modes available thereof, the catchment area has been selected in accordance with the Metro Policy, 2017. I have used SPSS software to analyses the relationship between the parameters so selected. Road Inventory survey of the area gives a detail information about the physical condition present and help to decide the feeder route. In conclusion, this dissertation will provide a convenient way so as to improve the ridership of metro.

The outcome of the dissertation is to provide a last mile connectivity to the paramount areas in the vicinage of the metro stations under consideration. The routes are selected in such a way that these areas are covered and the road width so selected for routes is predominantly above 12 meters. Further the applicability of feeder routes can be increased in line with the physical infrastructure present in the respective area. Dissertation also provides a conclusion that the feeder system shall be operated by the metro authority, integrating the operators underneath. Further it also says about the facility that shall be given to the operators thus gaining the trust of operators and making the last mile commute smoother.

Key Words: paratransit, integrating, feeder, mode choice, developing countries

1.INTRODUCTION

In metropolitan cities of developed and developing countries suburban railway and public buses are most common public transport modes. commuter dissatisfaction toward public transport stems from increased travel time, poor levels of comforts, uneconomical operations and higher out of vehicle time especially at transfer points. these problems can be solved by appropriate coordination between major public transport, modes

- The traveler ability to transfer freely and conveniently between modes
- Distinct services area between each mode thereby minimizing duplication of the services
- Adjustment and interrelationship of schedules
- Joint fare structure

A flexible comfortable easily and reliable bus services may encourage shift from private vehicles to public transport. since travel demand varies over time and space public transport systems often have underutilized capacity at no peak hours and high load factor in peak hours. The objective of an efficient system is to met the diverse

demands and minimize operator's loss. this requires that the optimizing routing scheduling and synchroning problem are given special attention while designing an efficient system

Transportation system capacity is unbale to match increasing travel demand due to imbalance in model split, inadequate transportation infrastructure and less connection between land use and planning a well-integrated feeder bus /rapid public transport system reduces paring requirement at the railway stations, thereby reducing the required capital cost for the rail system.

2. AIMS AND OBJECTIVES

The aim of this paper is to study To Integrate Intermediate Public Transport (IPT) as a feeder service along Metro route

The objective of this paper is to examine the existing Last Mile Connectivity (LMC) Available in other cities and also in case study area.

- To analyses the immediate area aspects like network and infrastructure.
- To identify the potential of IPT with regard to Last Mile Connectivity.
- To Prepare Strategy and Policy Guidelines to strengthen Last Mile Connectivity

3. SCOPE AND LIMITATION:

- The study shall to develop an optimum set of feeder routes to provide feeder service to an identified line of thane metro
- To determine the scheduling of the feeder buses coordinated with the timetable of the existing thane metro
- To determination of feeder bus capacities and stop spacing
- To determine performance for feeder bus services network parameter such as travel time from origin to destination on a feeder route by using modeling software vissim
- To determine the headways for the routes based on the ridership. the cost function is optimized to determine the optimum headways of the feeder routes.

4. PROBLEM DEFINITION

The generalized cost is defined as the sum of the operator cost and user cost .operator cost is consists of cost of operation and maintains and user cost cab be defined as waiting time cost travel time cost and fare .optimum the cost of the system the headway of feeder transmit capacity of the transit and the distance between the feeder stop are determined for the coordinated scheduling available metro scheduling data is taken as base data depending on this data schedule for feeder route transmit will be designed using optimization of the cost function .for the feeder route assignment as the first influence area around each station is to be decided .then within the influence area potential destination are selected as per the existing bus stop and the population density of each TAZ (Traffic analysis zones).thus feeder routes to all potential destinations are developed and demands of the intermediate stops are satisfied .then transit will be assigned from that assignment new demands data will be collected and again optimize to satisfy the demands .the procedure will continue until good result is obtained .then we will get an efficient and fast metro service coordinated with feeder route transit system.

5. METHODOLOGY

To fulfill basic objectives of this study methodology is to be designed carefully.

Generation of feeder routes

At first select the metro station for which routes to be generated. Details of that individual station are marked and used for feeder route generation. Then same procedure can applied to other stations of the metro corridor, and it can be extended for whole thane metro network

Identification of influence area

Influence area is the zone which can be served the metro station. For thane metro corridor influence area for each station is taken as circular area around the station with radious 5 km. in this work it is assumed that all industrial area, residential areas, shopping malls, markets schools etc. within this influence area are chosen on basis of non-overlapping criteria, i.e., the influence area of one metro station should not have the influence of neighboring stations.

Identification of Potential Destination

For selection of destinations or potential stops it should be taken carefully that stops must be distributed properly all around the metro station within its influence area. Well distribution of the stops will provide good door to door service over the area. Influence area of each destination stops is assumed as 150m radius circular area around node, as per convent walking distance. There should not be more than 50% overlap then the combination of those two destinations are considered as a single stop.

Identification of route set

Route set for zone can be identified applying different criteria. One of the most popular ways to identify the routes sets is to determine shortest paths to each extreme stop. The routes covering maximum number of stops are adapted here. With help of route cost evaluation model route cost for both the path are determined. It is found that combined cost of shortest path and the cost to serve the uncovered area is more than the cost of the route covering maximum stops. Travel time is also saved due to less transfer. The frame work for feeder route generation.

6.LITREATURE REVIEW

Metro Railway Study

Metro railway is unique transportation system, considered most appropriate for the world most crowded cities. The British ran the first underground train in 1863 in London. The Calcutta metro, India's first underground railway, is the 85th tube service in the world offering transport which is highly efficient, safe, comfortable, and fast and environment friendly. It moves people faster than road transport. This makes it the preferred mass transport system for cities.

In Thane, number of two-wheeler are cars continue to rise. Despite construction of flyovers and roads, the roads continue to face congestion at peak hours. In spite of the roads occupying 21 percent of the total city area, this large number of motor vehicles causes extreme congestion on roads, ever slowing speed, fuel wastage, environmental pollution and an unacceptable level of road accidents. Thane metro has been planned to reduce congestion on thane roads and augment the current public transport, which is primarily buses. Mumbai metro rail corporation(mmrc) indicates a number of benefits to metro. These are time saving for commuters, reliable and safe journey, reduction in atmospheric pollution, reduction in accident, reduced fuel consumption, reduced vehicle operating costs, Increase in the average speed of road vehicles, etc.

Metro railway in India

ADVANI ET AL (2005) had evaluated public transport system as case study with Delhi metro. In this paper they analyzed the methodology and arguments used to justify invested MRTS/LRT systems in Kolkata, Delhi and Chennai. The paper presented evaluation of Delhi metro in terms of capacity, travel time and accessibility to the system and evaluation indices reflecting commuter's perspective. This includes accessible stations, minimum affordable time loss at interchanges, safer and reliable services. They evaluated Thane metro as per following criteria: influence zones, feeder route and integrated ticket facility, luggage handling facilities, parking facilities, convince to reach the stations and speed. In this article they had shown how passengers from other modes can be shifted towards the metro.

Feeder Route Assignment

There will be various route and timetables for the feeder buses from various Thane metro stations. The goal of the feeder route assignment is a more effective and faster route network that serves the present needs of the inhabitants.

Anand Singh, Dr. Prabhat Shrivastava, Dr. A. R. Kambekar, Pallavi Kulkarni-Government of Maharashtra is pursuing to improve urban mobility in Mumbai through MMRDA, responsible for planning and implementation of Mumbai Metro Masterplan. To begin with, the Government of Maharashtra has approved 118 km metro corridors for implementation, out of total 275 km of metro corridor under consideration.

Gadepalli Ravi, 2016 Visakhapatnam, the largest city in Andhra Pradesh, is a medium sized city with a significant urban agglomeration. Both city buses and IPTs are extensively used by the commuters. The IPTs in Visakhapatnam comprise three-wheeled auto rickshaws with a capacity of three as well as six. Although City buses were observed to have a wider range of coverage and larger passenger capacity but the IPTs were much more efficient in terms of operations and availabilities. Road access to city bus services at 32 per cent of the road network whereas that of the IPT being only 15 per cent, but apart from the road coverage the revenue obtained from the IPT system is more than that from Public transportation.

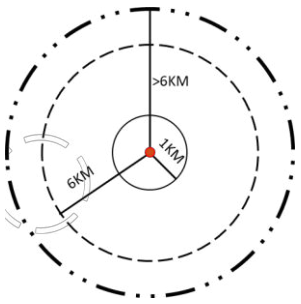
Table 2: Comparison of Input and Output Parameters of Bus and IPT Operations

Type of Parameter	Parameter	Bus	IPT
Operational characteristics	Number of routes	92	Dynamic
	Daily hours of operation	16	10.4
	Network length (km)	201	91
	Monthly km operated/vehicle	8,864	1,678
	% road length covered	32	15
	Average vehicle capacity	56	4.5
System performance parameters	Average occupancy	33	4.35
	Average % occupancy	59	97
	Passengers/vehicle/day	891	243
	Revenue/vehicle/month (Rs)	6,952	8,469

Figure 2. Revenue comparison between Bus and IPT in Vishakhapatnam

Feeder System for Mass Transit

Feeder services are mandatory provisions that shall not be overlooked for metro rail projects. For optimizing the metro rail usage, the passengers carry an extra weightage, thus the catchment area of the utility must be expanded to its suitable limit for the beneficial working of the transport system as well as for the ease of passengers for which the system is built. Hence all DPRs for the Metro Rail shall include proposals for the feeder system. The catchment area for each metro station canbroadentoatleast6KM



7.SOFTWARE FOR ANALYZING INTEGRATED OPERATION OF PUBLIC TRANSPORT SYSTEM

VISSIM

The program can analysis private and public transport operations under constraints such as lane configuration, traffic composition, traffic signals, PT stops, etc., thus making it a useful tool for the evaluation of various alternatives based on transportation engineering and planning measures of effectiveness. VISSIM can be applied as a useful tool in a variety of transportation problem settings. The following list provides a selective overview of previous applications of VISSIM:

- Development, evaluation and fine-tuning of signal priority logic:
- VISSIM can use various type of signal control logic.
- In addition to the built-in fixed-time functionality there are several vehicles- actuated signal controls identical to signal control software package installed in the field

GEOGRAPHICAL INFORMATION SYSTEMS

A typical GIS can be understood by the help of various definitions given as “A geographic information system GIS is computer-based tool for mapping and analyzing things that exists or an event that happen on earth”. GIS is also defined as set of tools for collecting storing retrieving at will transforming and displaying spatial data from the real world for a particular set of purpose

TRANSCAD

TransCAD combines a unique set of capabilities for digital mapping, geographic database management and presentation graphics with tools to apply sophiscated transportation, operations research and statistical models, TransCad was designed to aid transportation professionals in their daily work, and to provide transportation organizations with a strategic data management tool.

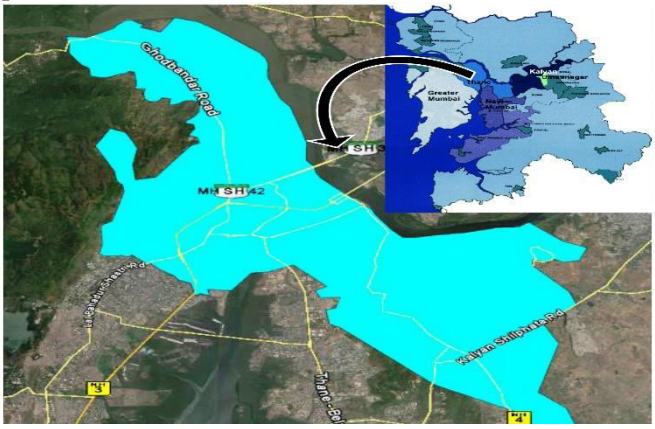
TransCAD for transportation planning

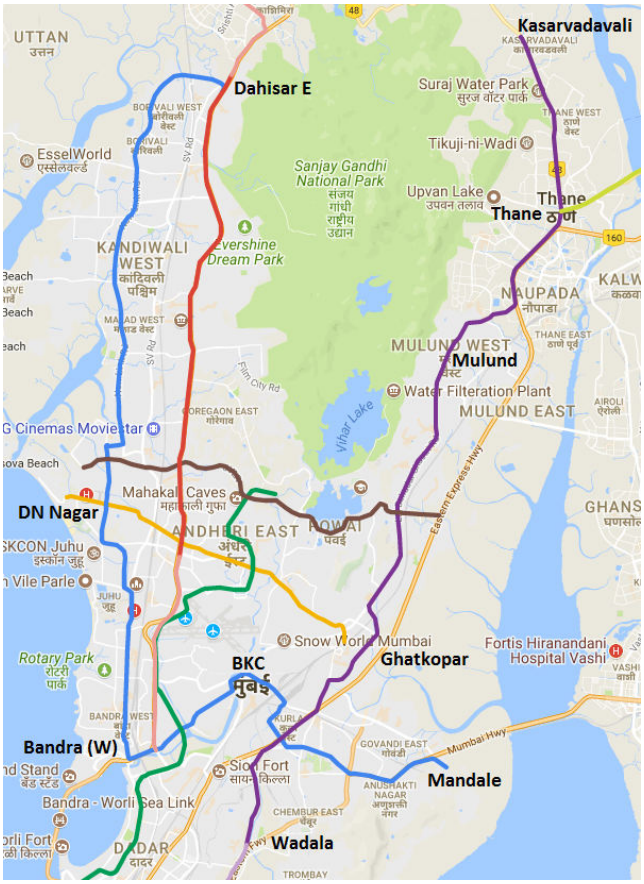
Transcad is the first and only geographic information system (GIS) designed specifically for use by transportation professionals to store, display, manage, and analyse transportation data. Transcad combines GIS and transportation modeling capabilities in a single integrated platform. Providing capabilities that’s are unmatched by any other package. Transcad provides:

- A powerful GIS engine with special extensions for transportation
- Mapping, visualization, and analysis tools designed for transportation applications

8.STUDY AREA -

Thane is the 15th most populated city in India with a population of 1, 89,000 (census 2011), city structure of thane is of radial nature and the same applies to the road network. when public transport moving on a corridor with a travel density during the peak hours exceeds the threshold of 8000 persons per hour per direction (pphpd), the average speed of buses comes down, journey time increases air pollution goes up and the commuters are put to an increase level of inconvenience. thus, when a traffic density crosses this threshold value a need rail-based mass transport, i.e., metro system should be considered. A buffer area of about 3-4 km on either sides of the metro line is considered for the study. The city has a developed and complex public transport system, which is undergoing rapid modernization and expansion.





The thane metro provides a number of benefits. The major benefits are identified as:

- The new metro system will reduce the traffic congestion on thane roads and reduce the travel times on various road sections.
- The new mass rapid transit system will fill the gap between various sections of thane metropolitan city with improved services
- The metro system will reduce the number of accidents on thane roads and reduce the atmospheric pollution in thane
- Due to operation of metro in thane there is reduction in operating costs
- Lower maintenance costs for the infrastructure

SALIENT FEATURES

- Feeder bus facilities are provided for some metro stations to increase the metro rider ship.
- Entries to these stations will be through subways provided at different locations.
- Feeder buses are environmentally friendly with CNG engine bharat stage 3 buses. Aesthetics and safety are the important features.
- All metro stations are having good interchanges facilities with other modes of transport
- All metro stations are provided with automatic fare collection system and will be access controlled.
- Feeder buses have global positioning system (GPS) equipment for real time tracking and online alerts
- Control centers are set up to monitor the movement of vehicles and will have the traffic inspectors, traffic managers and control room operators.
- Every feeder bus is accompanied with the public address system
- Minimum fare is Rs 10 and maximum fare is Rs 15 in the feeder buses
- The buses can have a seating capacity 20 people with standing capacity of 10 people.

DATA COLLECTION

The following three primary surveys were conducted during the thane metro feeder bus route survey.

1. Stated preference survey
2. Traffic volume count at cordon points of thane
3. OD survey in the influence area

VALUE OF TRAVEL TIME

In classical economic analysis of transportation system, several cost items considered are the capital cost of the building facilities, maintenance cost and the road users cost which include vehicle operating cost. The cost borne directly by the user are travel time and fare which is a component of total cost. Of these, the fare is not maintenance cost including subsidies. Travel time is the single most heavily weighted factor in economic evaluation of transportation plans. The value of travel time is the amount of money that a traveler is prepared to spend in order to save one unit of travel time.

The preference of commuters varies not only in which service attributes they consider important but also the relative values they place on various attributes.

Zone System

The area under study has to be divided into homogenous and smaller areas called as traffic analysis zones (TAZ). As it is very difficult to satisfy the ideal requirements the ideal zoning is not possible. Division of thane city into some number of zones based on the divisions made by census of India.

Bus Route Network

The network layer that is to be used in this study is obtained from the Thane GIS data. The layer taken was not properly Geo- referenced therefore the layer was again geo-referenced. The network layer having number of links with attributes like Capacity, free flow speed, link type, value of alpha and beta, bus capacity etc.

TransCAD allows creating any number of networks from a single line layer. The transport network considered in the present study was essentially a composite network comprising of road, metro and additional links. TransCAD provides the facility of enabling and disabling the links, so that a composite network can be prepared consisting of all types of links and enable only those links which are required for analysis. The created networks are then set for link types so as to classify links by types to distinguish facilities that have different performance characteristics or to facilitate reporting of link characteristics. The network developed for public transport consists of all road links comprising expressway including major roads, minor roads & service roads and metro links. The road network is properly connected to all zone centroids by means of dummy links.

STATED PREFERENCE SURVEY

Stated preference survey determines the commuter behavior with respect to the mode of travel. It will also determine commuter preferences and willingness of shifting to the existing feeder bus services from the existing IPT services. The survey was conducted at Majiwada metro station. SP survey of commuters is required to model the generalized cost of travel as perceived by them along with their willingness to opt for better services. Without any doubt the existing metro corridors will provide better quality service in terms of more comfort and reliability. It will also offer a marginal reduction in travel time.

Therefore, in order to arrive at the realistic demand for the metro corridors it is essential to calibrate the base year models using a generalized cost of travel comprising waiting time, travel cost, and discomfort. A sample of around 250 people was taken for the survey. In the present context, attributes of metro system like travel cost, travel time, waiting time, frequency of feeder service would play major role in attracting he passengers from the existing modes like bus, auto rickshaw, two-wheeler, etc. various details were taken from the passengers who are boarding the metro at

Majiwada metro station. The travel time, waiting time, travel cost and the income group of the person and demographic characteristics are taken in the survey. The origin and destination data was taken from all the passengers who are travelling through Majiwada metro station.

DATA ORGANIZATION

Total thane metropolitan city was divided in to number of zones as per census data of 2001. Among these zones thane is having number of traffic area zones according to the position of census circles. Using zone to zone O-D values, the travel demand modeling can be done for the whole city. For the feeder route assignment of thane metro, the proposed Majiwada station is focused in this study,

Firstly, it is operating with red line metro

Secondly, in Majiwada mostly all types of trips in different modes can be observed due to coexistence of industrial complex as well as residential complex, sports complex, market and shopping area etc.

For generation of feeder routes around Majiwada station, an area with radious 5 km is selected as influence area of proposed Majiwada station. It is assumed that Majiwada station can be serve within area with 5 km.

Feeder routes are generated to connect the proposed metro station with all places within the defined influence area. Existing passenger loaf is collected from the field on coordinated scheduling between feeder bus service and existing metro system. From that data, trip pattern for feeder mass service for the proposed Majiwada metro station is determined. The demands for each feeder stops are determined from the population data and the trip rate of the zones related to the concerned stops. Thus, total demands of different feeder routes are calculated. The peak hour ridership of different feeder stops is estimated. Then minimizing the generalized cost (user cost and operator cost) the optimum headway, feeder transit capacity and optimum feeder stop spacing are determined. From the operator survey the operating cost of feeder bus services has beend found out. Based on SP survey data the mode wise binary logit models were developed. From binary logit model analysis, the coefficients of attributes are computed. Using these coefficients the value of travel time, riding time .

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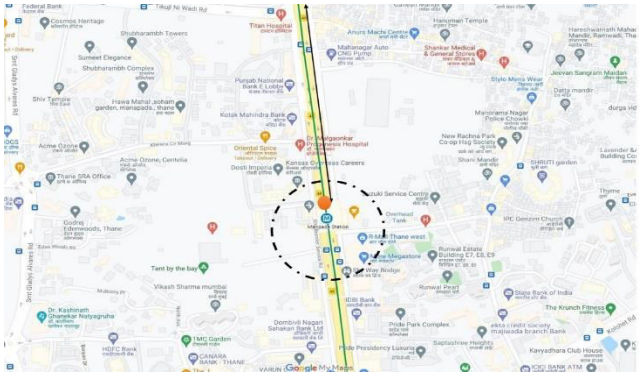
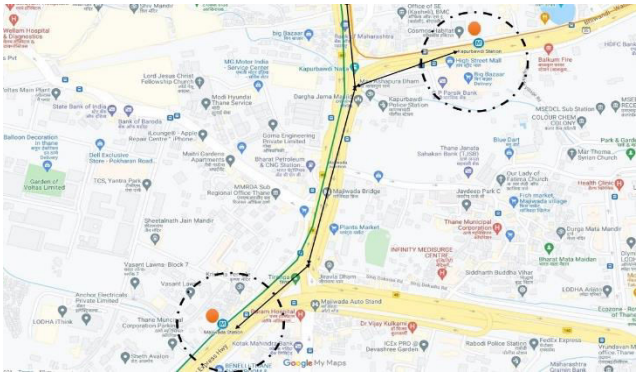
sets is to determine shortest paths to each extreme stop. It is found that combined cost of shortest path and the cost to

serve the uncovered area is more than the cost of the route





covering maximum stops. Travel time is also saved due to less transfer. The frame work for feederroutegeneration.

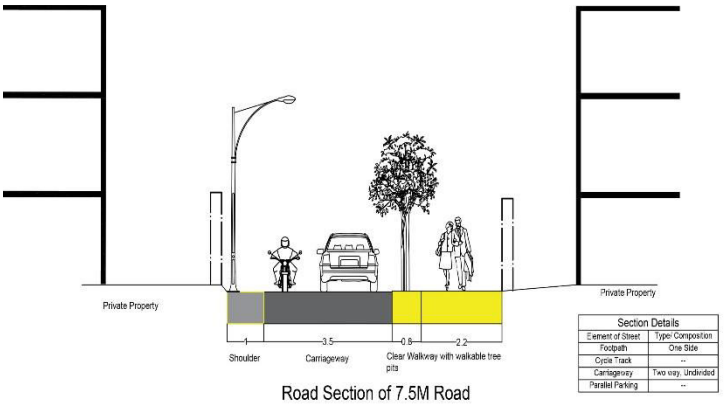
ROUTE-ANAND NAGAR BUS STOP TO KASARVADAVLI METRO

ROUTE-MANAPADA STATION TO MAJIWADA STATION

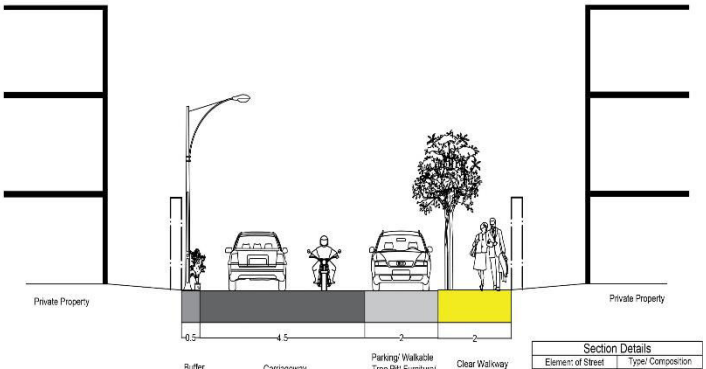
ROUTE MAPPING-ArcGIS Online is the web-based platform which allows the user to 'Plan Routes' according to the condition one wants to imply on and for a particular route. The potential drop points which can act as a stop for a feeder system can be added as a point type shapefile. The objective of doing so is to connect various essential locations and thus execute the function of last mile connectivity.

WALKABILITY -As Both the Commuters Have Stated to Walk for About 500-800 Meter Hence Walkability Facility Shall Be Enchanted Around the Metro Station for About 500 Meter

FEEDER SYSTEM AND INCLUSIVENESS



Road Section of 7.5M Road



Road Section of 9M Road

ROUTE-KASARVADAVLI TO MANPADA METRO STATION
ROUTE-MAJIWADA STATION TO TENH HAATH NAKA

9.PROPOSAL

The main objective of this thesis is to emphasize the importance of Last Mile Connectivity which can efficiently be achieved by Integrating Intermediate Public Transport as a feeder system to the named metro stations.

10.CONCLUSION AND RECOMMENDATIONS

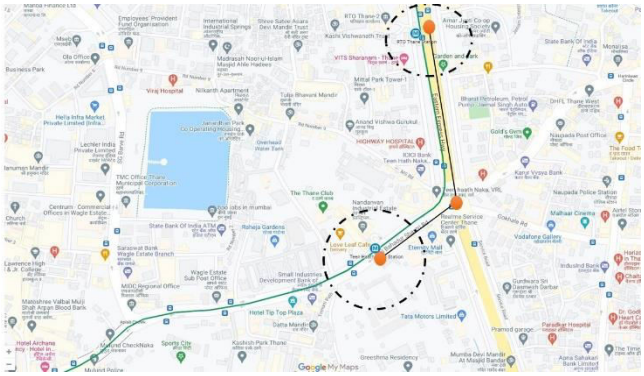
General:

This section deals with the conclusions that are derived from the study and recommendation for future work. Both the conclusions from design of feeder routes for Majiwada metro station of thane city and simulation of feeder routes in VISSIM is given in under this section. the chapter also list out the limitations and future scope of the study.

Conclusions:

1.the schedule coordination sub model is able to identify optimal coordinated schedules for feeder bus operation, by optimizing the generalized cost (summation of user and operator cost) subject to constrains for the number of buses, stop spacing, travel time, waiting time and walking time. For the route selection process, the generalized cost model used to evaluate and decides they require feeder route set. Routes are selected that cover maximum number of stops. the benefits of the selections are:

- Saving of travel time
- Minimizing the operator and user cost
- Serving the maximum area-well accessibility for



the proposed mass transit system

2. After developing the feeder routes the feeder assignment is to be done.to assign feeder transit the headway of each of the route are calculated. Consider all other parameter constant the generalized cost of each route is optimized with respect of headway of the feeder transit. Optimum headway is determined. After decide the optimum headway optimum feeder transit capacity is calculated. The capacity is defined as a produv = ct of the ridership per unit time and headway. This entire feeder bus stop spacings are calculated.

3.Initially shortest paths are generated in Trans cad which are covering minimum stops for covering a particular path. Then the shortest path are modified into max node covering path and which are taken as feeder route. Out of eight routes some routes are seems to be cost effective and the remaining routes are not cost effective, but all the routes are time effective.

4. The waiting time cost is more than the in vehicle travelling time travelling time cost from the field it is observed that the travelling time is ess the waiting time. The buses which are operating presently at Majiwada metro station are not operating as per the frequency.

5.The flow in the maximum node cover path is almost double to that of shortest path flow the feeder route number 3 and the feeder route number 6 are covering maximum nodes directly in the shortest path itself. When the headways of route number 3 and 6 are compared with the VISSIM Headways the calculated headways are less than simulation headways.

6.The travel times from the majiwada metro station to various potential destinations of route number 3 and route number 6 were been find out from VISSIM simulation model.by varying the input volume on different links of feeder route the travel time will change according to vehicle speeds.

7.with the travel times calculated using VISSIM for route number 3 and 6 the headways are calculated for the route number 3 and 6 and there is increase in the headways and travel time.

Recommendations:

- The steps followed for the majiwada station be extended for whole network. All the proposed metro stations should be integrated with the feeder transit system.
- Presently the capacity of the feeder buses is not sufficient to peak hout conditions, so there is need to change the bus frequencies and capacities as per peak hour and off-peak hout.
- The travel time should be found out for all the routes for proper operations of feeder buses on feeder routes using VISSIM simulation model.

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BIOGRAPHIES

Master in Transportation & planning
Department of civil and planning
Er. Rakesh Sahadeo Jagtap

Since Joining the University of SANDIP University, I Have Been Involved with Studies Related to Transportation Planning and Approaches Towards the Sustainable Cities Challengers