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Planning Of Integrated Transport System to Namma Metro at Byapanahalli – A Study

S.A Kanalli, H.S Satish, R.Satyamurthy

Summary: ***Mass Rapid Transit is one of the major Transportation system proposed in metropolitan city like Bangalore in order to be beneficial in reducing various traffic problems and result in reduction of Travel time etc. The efficiency of this system can be increased by attracting more number of Trip makers by a suitable Integrated Transport System. Feeder system is one of these techniques proposed for Namma Metro in Bangalore which includes Feeder bus (Minibus) operating throughout the radial areas of Metro stations. The present study includes the necessity of these buses as par with Public Transport Buses currently operating in these areas with respect to the willingness of commuters, Frequency and Travel Time.***

I. INTRODUCTION

Bangalore is the fifth largest metropolis in India. It is not only the administrative and commercial capital of the State but also the IT capital of India. Due to the rapid growth of major cities there has been vast increment in population which has resulted in the traffic growth rate. There has been a 10% fold increase in the number of vehicles in the last 20 years. These have lead to various traffic problems like Narrow roads heavily congested with a mixed type of traffic and little possibility of widening of these roads or laying new roads due to heavily built-up area, frequent traffic jams at road intersections, high atmospheric pollution levels and high rate of accidents. Therefore Mass Rapid Transit is one of the major transport systems which have been proposed in metropolitan cities. The system leads to several positive impacts like Reduction in traffic density on road, Reduction in Travel time and safety, fuel consumption, urban air pollution and road accident, Employment opportunities and improvement in rural economy, Enhanced rural economy, saving in productive man-hours due to rapid mode of transport, reduced need for expansion of roads, laying new roads. The commuters using these systems can then be increased by using proper Transport Integration Technique. Feeder system is one of the Integration Techniques have been implemented to attract more number of commuters from the surrounding radial area so as to increase the revenue of the MRT system and to reduce the traffic problems. Four Feeder routes has been planned at Swami Vivekananda station and Byapanahalli Metro terminal (two routes connecting each station) where Public transport services are operating on the same routes.

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*****Correspondence Author(s)
Sowmya R*, Research Scholar, Department of Computer and Engineering, Bangalore Institute of Technology, Bengaluru, Visvesvaraya Technological University, Belagavi (Karnataka), India. E-mail: sowpu29@gmail.com
Dr. Suneetha K R, Professor, Department of Computer and Engineering, Bangalore Institute of Technology, Bengaluru, Visvesvaraya Technological University, Belagavi (Karnataka), India. E-mail: suneetha.bit@gmail.com

Question now arises, why Feeder buses are required when Public transport are already available for the commuters to reach Metro station. Therefore it is necessary to carry on study to support the necessity of Feeder buses with regard to commuter's willingness, Travel time and Frequency.

1.1 Objectives of Study:

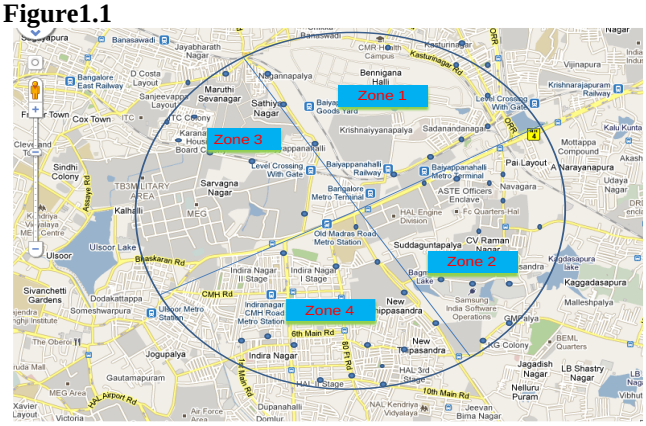
The main objectives of this study are:

I. To locate the feeder network to the metro station covering the attraction point situated in the area, where large assessment of the commuters are available.
II. To consider the plan of the existing roads in the study area to adjudge the movement of the feeder bus to attract large numbers of commuters to use the system.
III. To estimate the number of feeder service (Minibus or Share Auto) required for each route taking in to consideration the frequency of the Mass rapid transit per hour and the loading to be catered by the system.
IV. To appraise the necessity of Integrated Transport System with regard to the willingness of commuters in the area.
V. To calculate the Travel time of Feeder Bus.
VI. To evaluate the occupancy of Public Transport Trip.
VII. To study the requirement of separate Feeder bus with par to Public Transport service currently operating.

II. APPROACH AND METHODOLOGY

2.1 Study area and Site plan.

Swami Vivekananada station and Byappanahalli Metro terminal (Henceforth referred to the site) is located near Byappanahalli region. All areas falling within a radius of 3 kilometers from the Site was considered for the study (radial influential area). The radial influential area was then divided in to four equal parts and named as zone1zone2, zone3 and zone4 respectively. The site location have been shown in **Figure1.1**



Location of study area

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2.2 Site reconnaissance survey:

In order to understand the site, a site reconnaissance survey is essential. This survey was done for the study area to capture the road characteristics like available Right of Way and carriageway width. Land use in the site vicinity was surveyed. Major establishments and trip generators were identified. The locations of the major infrastructures in the locality were noted.

2.3 Traffic volume survey:

The Traffic volume survey was done at the intersection to know the volume of traffic in each moment of the area in order to calculate the V/c ratio so as to know whether is it feasible to run feeder vehicle in the route.

Both peak hour and off peak hour volume were taken and V/C ratio was been calculated for every route based on the ratio of peak hour volume and the standard capacity values for different category of roads as per IRC code 106.

2.4 Opinion survey:

Opinion survey elucidates the opinion of the people regarding their willingness to use the feeder service to catch the metro. It also includes their opinion regarding the type of feeder service they are likely to use so as in the case Minibus or Share Auto, and the amount they would like to pay for the journey. This survey plays an important role in deciding the probable loadings in the area.

The survey was conducted at signals and bus stops within the study are by issuing a form to the commuters, containing various questionnaire.

2.5 Mapping:

The mapping stage follows right after the analysis of the conducted survey. It consists mainly of two stages:

- Location of station
- Aligning the route

2.5.1 Location of Station

The stations were located by drawing a series of circles measuring 150m radius through out the study area.This helps in allocating the position of the station where people can merge through 150m from all the sides. The below figure shows the method followed to locate the station at a specified distance. Once the circles were drawn imaginary center points were marked such that the center to centre distance from the circles was 300 meters. Based on the centre points a grid network was considered and this was the base points where in the feeder service needed to be provided. Considering the existing road network pattern and the proposed base points the nearest feeder service bus stations were proposed.

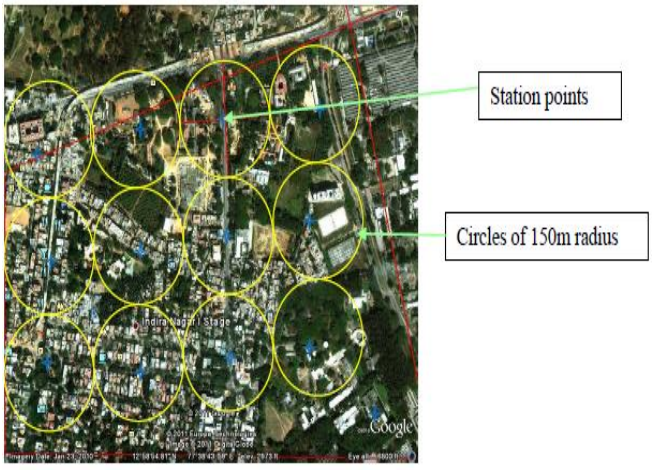

Fig 1.2: Location of Feeder station points

2.5.2Alignment of routes:

No sooner the stations are located, the next stage is to locate the feeder routes keeping in view, the route should not have V/C ratio exceeding one. The connectivity should attract more number of trip makers and should connect some of the important Infrastructures of the study area so as to get the higher trip numbers provided the route should be as small as possible and there should be least travel time for the trip makers.

2.6 Travel Time:

The time required for the feeder bus from the farthest distance of the proposed route to the metro satation is essential in order to know, wheather the time taken by the feeder bus to reach the metro station is less than the currently running public transport,so that the commuters will not make use of the public transport service to catch the metro.

Following assumptions are made to calculate the travel time:

- Speed of the feeder bus is 20KMPH.
- Additional 5 minutes has been considered as time elapsed in stoping the vehicle at the feeder bus station.

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}} \text{ X } 60 + 5$$

Additional 5 minutes has been considered as time elapsed in stoping the vehicle at the feeder bus station.

2.9 Number of trips and feeder bus :

Calculation of number of feeder buses were made based on certain assumptions.

- 70% of the total population of the study area will use the Metro.
- Capacity of the minibus being 30.
- 70% of the total feeder buses will run on the routes where trip rate is high and 30% of the feeder buses where there is less trip generation.
- The number of commuters at any station is the summation of boarding and alignting of passengers..Therefore the loading of commuters at a particular station was considered as the 50% of the total number of commuters.

Number of trips requred for each roue is given by:

$$\frac{\text{Number of trip makers in feeder bus}}{\text{Capacity of feeder bus X Frequency}}$$

Assuming feeder bus will take ten trips per day the number of feeder bus required will be obtained by dividing total trips by ten.

2.10 Bus Occupancy Survey:

The overall objective of the survey was to assess the extent to which public transport operators across the study areas were meeting legal requirements and operational policy guidelines. Specifically the surveys sought to identify, how many buses exceed the legal maximum capacity? This survey is carried by travelling in the bus from the starting point noting down, the no of persons travelling and the no of occupants.

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Boarding and alighting at every intermediate station, and finally making a note of the people inside the bus at the end point of the radial area. The number of occupants at the final point indicates the type of occupancy in the route. The **Table 2.1** indicates the values of the type of occupancy. The routes opted for the Bus occupancy survey has been shown in **Figure 2.2.**

Table 2.1: Type of occupancy indicated with their values

Type of occupancy	Value
Very small occupancy	0-15
Small occupancy	16-30
Medium occupancy	31-49
Full occupancy	50 & above

III. SURVEY FINDINGS AND ANALYSIS

3.1 Traffic Volume Count:

The traffic volume count was carried at the intersection and PCU values (movement wise) were calculated. The peak hour volume obtained and the type of carriage way was considered to get the V/C ratio.. Peak hour has been taken between 9AM to 10AM.

Table 3.1: V/C ratio of various routes along with the peak hour volume

Route	Total Vehicles (both way)	PCU value	Peak Hour PCU	TDS Value	V/c Ratio
H.A.L - INDIRANAGAR	1610	8222	1813	1200	1.51
H.A.L-KASTURINAGAR	412	3337.6	506	1200	0.42
H.A.L- K.R PURAM	849	10680.65	932	1200	0.78
K.R.PURAM – KASTURINAGAR	0	0	0	1200	0.00
K.R.PURAM – INDIRANAGAR	9673	54188.1	11793	2900	4.07
INDIRANAGAR – KASTURINAGAR	1179	9318.45	1391	1200	1.15

The results of the survey indicate that the route towards Indiranagar from Kasturinagar, HAL, and KR Puram i.e. the Old Madras Road is exceeding the V/C ratio 1.0 by a large margin and therefore it is defiant to provide the feeder service on this route.

3.2 Opinion Survey:

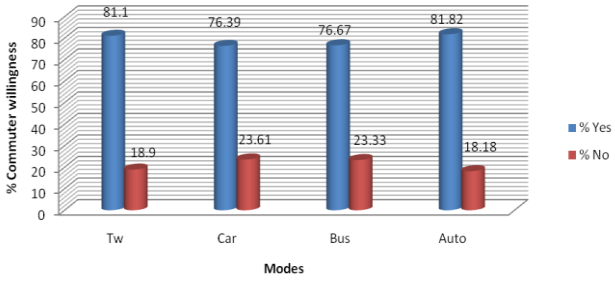

Figure 4.2 : Graphical representation of the Opinion survey (Mode wise)

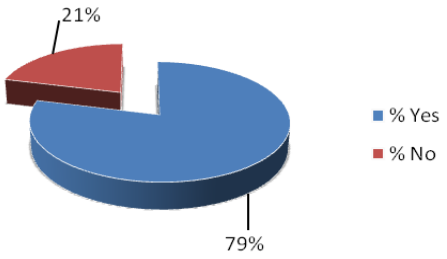

Figure 4.3 : Graphical representation of the opinion survey(Total result

3.3 Willingness to pay:

Table 4.6: The amount people are willing to pay

Mode	Rs 5	Rs5-10	Rs 11-15
Percent	49.58	44.73	5.70

3.3.1 Type of feeder service:

Share Auto	Minibus
14.56%	85.44%

3.4 Bus Occupancy Survey :

The Bus occupancy survey was conducted along the various routes of the study area to assess the extent of travel by the commuters were generating using the Public transport. This survey was carried out both at peak hour and off peak hour. **Table 3.2** and **Table 3.3** shows the details of occupancy of the study area at off peak hour and peak hour respectively.

Note:

In the above table 3.2 and 3.3 the Route code stands for the following designation.

Route Code	Route Designation
JBN	Jeevan Bhima nagar
MJ	Majestic
MR	K R Market
KR	KR Puram
IG	Indiranagar
KLN	Kalyannaar
DRDO	DRDO Township
GM	GM Palya
SHN	Shivajinagar

Table 3.2 : Details of the occupancy of study area (Peak hour)

Feeder Connectivity to Metro at Baiyapanahalli																			
Bus Occupancy Survey (Peak Period)																			
				IS1*		IS2		IS3		IS4		IS5			Type of Occupancy				Frequency (min)
NO	Bus	Route	First	B*	A*	B	A	B	A	B	A	B	A	FS	Very Small	Small	Medium	Full	
1	314	JBN-MJ	44	6	0	4	3	3	0	6	2	5	8	55				1	30
2	315	KN-MJ	32	5	0	4	2	5	0	9	1	0	0	52				1	30
3	313	KN-MR	28	3	0	5	0	6	2	10	1	0	0	50				1	30
4	138	JBN-MR	32	4	0	6	0	7	3	8	2	4	3	53				1	30
5	314-B	DRDO-MJ	20	6	0	2	1	7	2	9	1	0	0	40			1		40
6	314-B	DRDO-MJ	22	8	0	4	0	2	1	7	1	0	0	41			1		40
7	317	KR-MJ	37	6	2	6	3	8	2	11	5	0	0	56				1	30
8	316	KR-MR	33	7	2	3	1	6	0	8	1	0	0	53				1	30
9	8	KLN-IG	27	13	0	6	10	13	0	10	0	0	0	59				1	60
10	314-D	GM-SHN	46	3	0	8	0	3	0	6	0	0	0	66				1	40
11	314-D	GM-SHN	24	4	0	3	0	1	0	6	4	0	0	34			1		40
Total															0	0	3	8	
%															0	0	27.3	72.7	

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Table 3.3 : Details of the ocupancy of study area (Off peak hour)

Feeder Connectivity to Metro at Baiyapanahalli																		
Bus Occupancy Survey (Peak Period)																		
				IS1*		IS2		IS3		IS4		IS5			Type of Occupancy				Frequency (min)
NO	Bus	Route	First	B*	A*	B	A	B	A	B	A	B	A	FS	Very Small	Small	Medium	Full	
1	314	JBN-MJ	30	6	0	10	3	3	0	1	1	5	2	50				1	30
2	315	KN-MJ	6	3	0	4	0	6	2	10	2	-	-	25		1			30
3	313	KN-MR	15	2	0	5	0	2	2	8	1	-	-	29		1			30
4	138	JBN-MR	10	4	0	3	0	6	2	2	1	4	1	25		1			30
5	314-B	DRDO-MJ	12	8	0	3	1	6	2	8	1	-	-	33			1		40
6	314-B	DRDO-MJ	16	8	0	2	0	2	1	6	1	-	-	32			1		40
7	317	KR-MJ	40	6	2	6	3	8	2	6	5	-	-	54				1	30
8	316	KR-MR	35	7	2	3	1	6	0	8	1	-	-	55				1	30
9	8	KLN-IG	22	6	0	6	5	3	1	10	0	0	0	41			1		60
10	314-D	GM-SHN	21	3	0	9	0	3	2	5	3	0	0	36			1		40
11	314-D	GM-SHN	25	2	0	6	0	1	2	9	4	0	0	37			1		40
Total															0	0	3	8	
%															0	0	27.3	72.7	

IV. RESULTS

Feeder routes were plannd based on the analysis of the various survey conducted under the study, the site conditions.This section also includes various feeder routes their length, the feeder station and the frequency of the feeder service for both peak hour and off peak hour at variuos time interval.

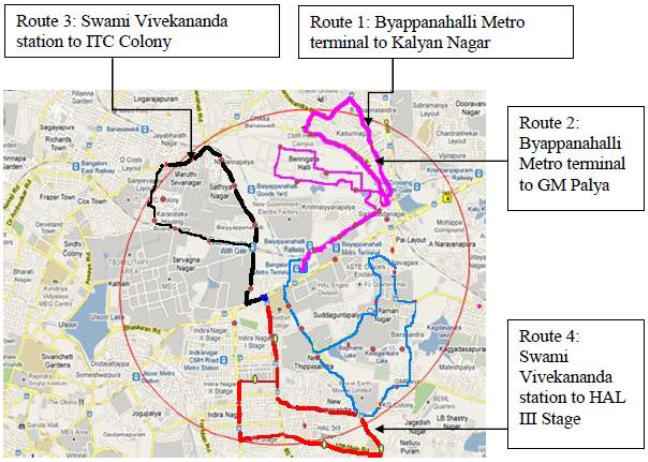

Figure 5.1 : Proposed sketch of the feeder routes

Route 1: Byappanahalli to Kasturinagar stop.

Route 2: Byappanahalli to G.M Palya.

Route3: Swami vivekanaanda station to ITC Colony**.**

Route4: Swami Vivekananda station to HAL III stage.

3.1 Number of Trips and Feeder Bus:

The number of trips required in each trip is estimated for the various frequency of Metro. The total number of feeder bus is calculated assuming that each bus will make ten trips per day.

3.1.1 Route number 1 (Byappanahalli Metro Terminal to Kasturinagar):

Number of feeder buses for Route number 1

Length of the route: 12.21km

Route No	Route	Stations	Frequency	No of Trips	No of Feeder bus
1	Byappanahalli to Kasturinagar stop	2'nd main stop, Sadanandnagar stop, Benaganahalli, Kasturinagar stop, New Horizon college stop, Lalbahadurnagar stop, Channasandra stop, CMR Law colege stop	5	14	2
			10	7	1
			15	5	1

3.1.2: Route number 2(Byappanahalli Metro Terminal to GM Palya):

Table 5.10 : Number of feeder buses for Route number 2
Length of the route: 7.74km

Route No	Route	Stations	Frequency	No of Trips	No of Feeder Bus
2	Baiyapanahalli to GM Palya	BWSSB stop, ADEC stop, Chruch street stop, BEML stop,KG Colony, GM Palya, Bairasandra stop,Bhuvaneshwarinagar, Navagara stop, aaASTE stop, CV Raman nagar stop LRDE stop	5	33	4
			10	17	2
			15	11	1

3.1.3: Route number 3 (Byappanahalli to ITC Colony):

Table 5.11 : Number of feeder buses for Route number 3

Length of the route: 5.95km

Route No	Route	Stations	Frequency	No of Trips	No of Feeder Bus
3	Baiyapanahalli to ITC Colony	Baiyapanahalli, Sathiya nagar, Naganana Palya, Banaswadi stop, Sanjeevappa stop,ITC colony stop, ITC stop, KHB colony stop, Baiyapanahalli last stop	5	27	3
			10	13	2
			15	9	1

3.1.4 Route number 4 (HAL III stage to Old Madras Road station):

Table 5.12 : Number of feeder buses for Route number 4
Length of the route: 8.0km

Route No	Route	Stations	Frequency	No of trips	No of feeder bus
4	Old Madras Road station To HAL III stage	Indiranagar I stage, New Tipsandra, HAL III stage, HAL II stop, Jevan Bhima nagar	5	61	7
			10	31	4
			15	21	3

V. CONCLUSIONS

Following conclusions could be drawn from the various studies conducted and the analysis done for the study area:

I. Majority of commuters traveling by Metro are willing to use the feeder service from their point.

II. Minibus was considered as the feeder service based on the opinion of the trip makers.

III. The bus occupancy survey focused on the type of occupancy in the study area in both peak and off peak hour. Thus it was concluded that there was a full occupancy of people using the public transport at peak hours and medium occupancy at off peak hours.

IV. To cater more number of people to use the feeder service it was necessary to keep the waking distance to the bus station from their origin point. Therefore a radial distance of 150m was located before fixing the station so that the people may not walk more than 150m from their origin point.

V. Four routes were designed for the feeder service based on the V/C ratio of the road and the maximum no of trip attraction likely to occur ex: Some of the important infrastructure of the locality including College, Hospital etc.

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VI. The trip makers would always like to use the nearby station for their trip. For this purpose in order to reduce the journey of the people in feeder bus two routes were connected to Baiyapanahalli Metro terminals and remaining two were connected to Old Madras Road station.

VII. The trip generators likely to occur from an individual route were assumed and 30% of the total required bus were made to run on route1 and route3 and 70% of the buses was made to run on route2 and route4 where route1, route2 and route3, route4 was connected to Baiyapanahalli Metro Terminal station and Old Madras Road station respectively.

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