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Role of Land Use in Bus Ridership – A Case of Vadodara

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Abstract

Transportation plays a vital role in providing transport services for the public in most of the cities. Urban travel demand is influenced by number of factor, primary and important one is increase in the size of population that results into rise in number of trips by them to reach their destinations. The built environment is related, directly and perhaps indirectly, with levels of perceived crash risk and with levels of actual crash risk. Amongst built-environment features, the urban design and land-use diversity factors were positively related with the decision of mode choice selection. An attempt is made in the present study to identify the effect of various parameters of land use on a selection of public transit as travel mode and suggest a way to increase its ridership. From the study recommendation has been provided for policy measure at a new and existing route of public transit to increase its ridership. This study will be helpful to transportation planner and urban planner during finalising the routes and service of public transit.

Keywords: Public Transit, Built Environment, Land-Use, Mode Choice, Ridership

Introduction

Urbanisation is the process which leads to change in urban form of cities significantly over the decades. Hence, with the time gradually there is increase in vehicle ownership, alarming rise in private automobile dependency, traffic congestion, increase in traffic accident risk and rise in pollution levels have compelled more and more cities in India to opt for public transit systems. Transportation plays a vital role in providing transport services for the public in most of the cities. Safety is a main concern for improving the level of services of transportation. Certain efforts are being made to offer public transports which are as safe as possible. For the proposed effects efforts, it is necessary that people's perceptions of the safety for different travel modes are in accordance with the actual risks. Otherwise, people may not choose the transportation modes connected with the smallest risks in the long run. Low risk of being involved in a traffic accident is however barely enough for a transport mode to be considered safe.

"Land use" typically refers to the distribution of activities across space, including the location and density of different activities, where activities are grouped into comparatively coarse categories, such as commercial, residential, office, industrial, and other activities. The built environment is related, directly and perhaps indirectly, with levels of perceived crash risk and with levels of actual crash risk. Amongst built-environment features, the urban design and land-use diversity factors were positively related with the decision of mode choice selection. Vicinity to high population densities and commercial land uses are associated with higher number of crashes because they increase pedestrian and bicyclist exposure. However, individuals may perceive such high density and mixed-use neighbourhoods as more safe or walkable than low density.

In designing a socially desirable and environmentally sustainable transportation system in line with people's preferences, transportation planners must increase their understanding of the hierarchy of preferences that drive individuals' choice of transportation. Understanding mode choice is important since it affects how efficiently we can travel, how much urban space is devoted to transportation functions as well as the range of alternatives available to the traveller.

Aim of the Study

Aim of this study is to understand the influence of different type of land use on bus ridership. This will help transportation planner to choose

the bus locations and bus routes such that maximum ridership can be derived.

Review of Literature

Many current planning initiative aimed in reducing the use of car as a travel mode by the relationship detected between urban form of a city and travel behaviour of individual. A study investigates the potential links between urban form and travel behaviour. Some of the land use strategies suggest that by reducing the distance between the street locations, by providing mix land use and by providing various alternatives for transportation. Basic methodology of study was similar to other studies; namely to regress trip behaviour variables on explanatory variables that include measures of land use. The dependent variable in model measures either the number of non-work automobile trips or the choice between automobile and non-automobile modes. There are three independent variables in model. First, the income of the individual or household and the expense of travel. Second, several socio-demographic variables were included. Third, measure of land use and urban design characteristic near the residence of the individual were considered. (Marlon Boarnet, Randall Crane, 2000) Authors observed that links between urban design and travel behaviour are complex. Land use and design proposals influence travel behaviour by changing the price of travel. It was noticed that persons choose their residential location based in part of their desired driving pattern. Person who dislike driving might both drive less and choose to live in a high density, mixed use neighbourhood that support transportation alternatives other than location choice of individuals.

Dissanayake D and Morikawa T. (2002) conducted study using household travel data (Bangkok) from Urban Transport Database and Model Development Project. They have studied travel behaviour based on vehicle ownership, mode choice and trip chain behaviour. They found good relationship in trip chain with proximity of destinations and time of travel.

Crane R. (2000) written an article that proposes a scheme for categorizing research addressing neighbourhood design based on traffic. It then presented a detailed discussion of several past studies of urban form and travel behaviour. The research strategies employed and the data, methods, and results of these studies are evaluated in detail. He has notices that some relationships between land use and travel appear straight forward, such as that between density and trip length, but these simple observed correlations were not so simple upon closer examination. Rather, they represented the complex interactions of many factors. Land/travel link ages were both multidimensional and difficult to deconstruct, and little if any hard evidence indicates how the built environment can reliably manipulate travel behaviour.

Data

The primary data used in the study has been collected in 2016 in Vadodara as a part of academic project. The socio-economic profile and travel diary data has been collected from more than 800 households. The study area of Vadodara is considered with same zones as twelve administrative wards.

The sample shows 31% of the respondents from age between 18 to 30 and 42% of the respondents have age between 30 and 60 years, which is working age group. It has been observed that that 64% of the households have total family member between 3 to 6 and 30% have between 1 to 3 total family members. Average family size of respondent household is 4.5.

Figure 1- Trip Purpose

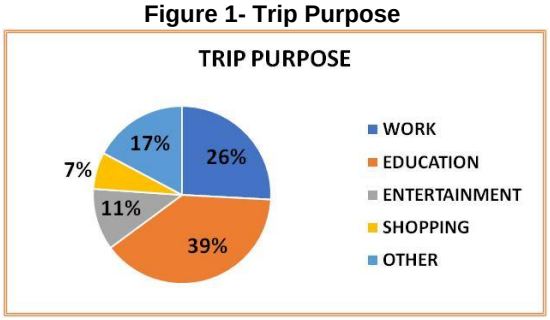
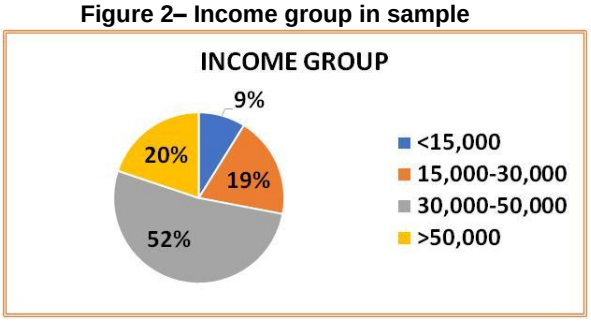


Figure 2– Income group in sample



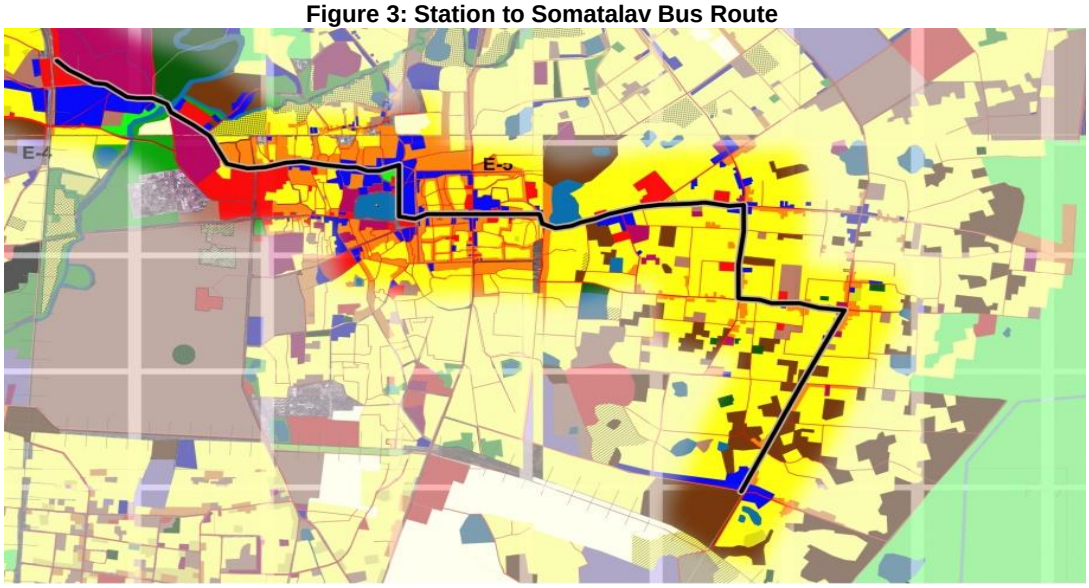
About 65% people are travelling for work and education purpose. The share of middle income (15000 to 50000) group people observed is 71% in sample.

Research Methodology

There are around 60 bus routes in city, two routes were selected (one route with higher ridership and another with lower ridership) to know the real time data including number of commuters travelling in a bus for a different time of a day and to find the impact of land use on public transit ridership. From these two routes three bus stops from each routes were selected where more number of people board and from different land use. Bus stops were selected on the basis of land use, ridership. Station to Somatalav route (Route no- 9) is busiest route of Vadodara having higher ridership, on that route Mandvi, Parivar Char Rasta and Somatalav were selected which is comprise of mixed land use, residential, commercial etc.. Another route is Station to Rameshwar (Route no - 21) is least use route having lower ridership, on that route Chakli Circle, Harinagar and Rameshwar were selected which is comprises of residential, public building, commercial etc. To know the number of commuter travelling in a bus for a different time of day, data of commuters travelling in morning, noon and evening were collected from Vinayaka Logistic.

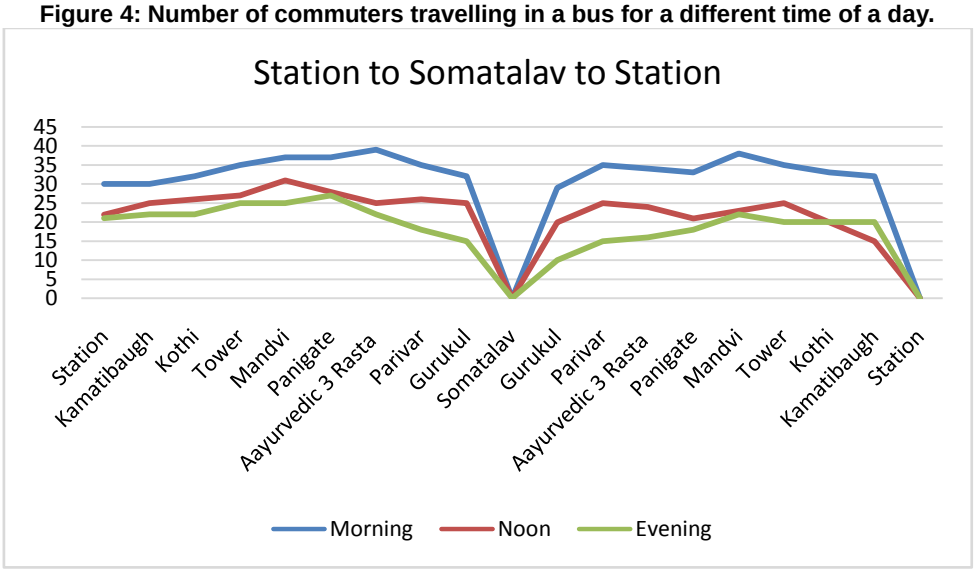
Higher Ridership Route: Station To Somatalav – Route No. 9

Figure 3: Station to Somatalav Bus Route



(Source: Vinayaka Logistic**)**

Figure 4: Number of commuters travelling in a bus for a different time of a day.



(Source: Vinayaka Logistic)

Bus Stop 1: Mandvi

Figure 5: Mandvi Bus Stop.

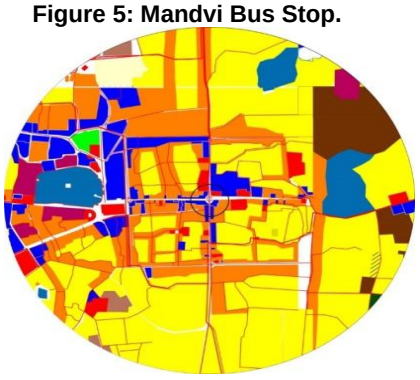
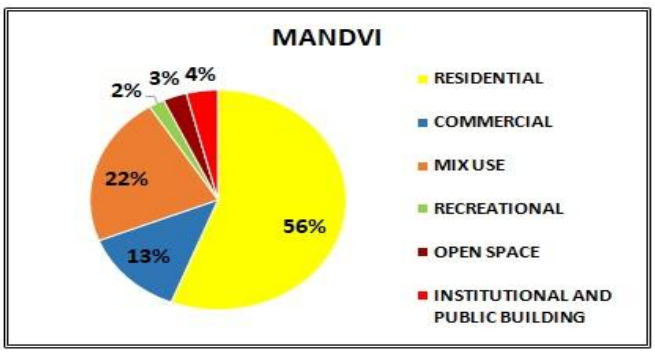


Figure 6: Percentage of Land Use at Mandvi Bus Stop.



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Mandvi bus stop surrounded by predominantly residential and commercial land use, hence mixed land use has been observed. It is part of CBD area of Vadodara, where all kind of commercial activities happening and also this area works as medical hub for Vadodara. In commercial activities; major share is of garment shops. It also connects four important areas of Vadodara city.

Bus Stop 2: PARIVAR CHAR-RASTA

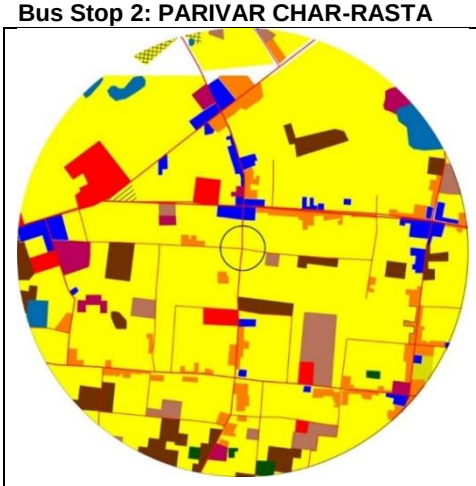


Figure 7: Parivar Char-Rasta Bus Stop.

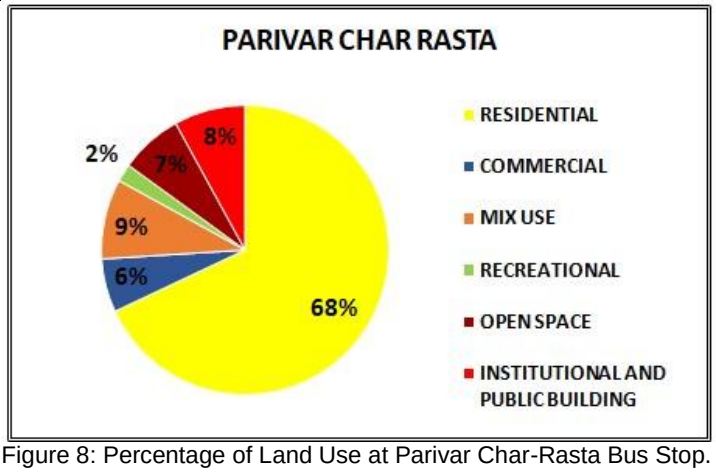


Figure 8: Percentage of Land Use at Parivar Char-Rasta Bus Stop.

Parivar char-rasta bus stop surrounded by predominantly residential land use followed by mixed land use and very less area with commercial activities. It is an area where more numbers of college going students reside.

Bus Stop 3: SOMATALAV

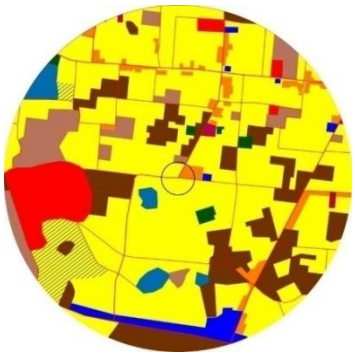


Figure 9: Somatalav Bus Stop.

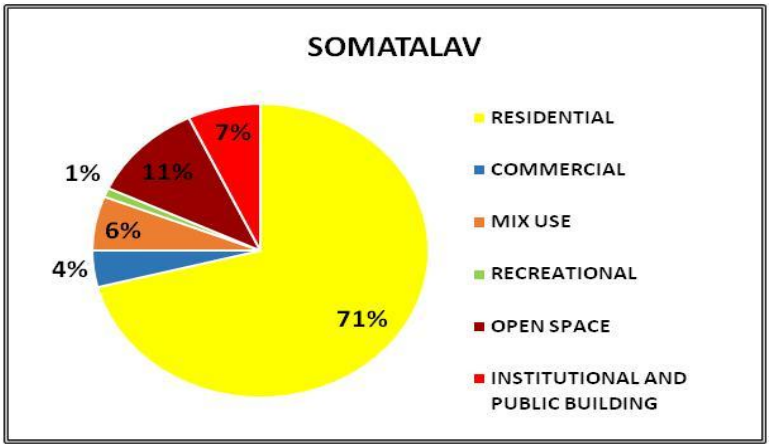


Figure 10: Percentage of Land Use at Somatalav Bus Stop.

Somatalav bus stop surrounded by predominantly residential area and very less area with commercial activities and mixed use.

Lower Ridership Route: Station To Rameshwar – Route No. 21

Figure 11: Station to Rameshwar Route.

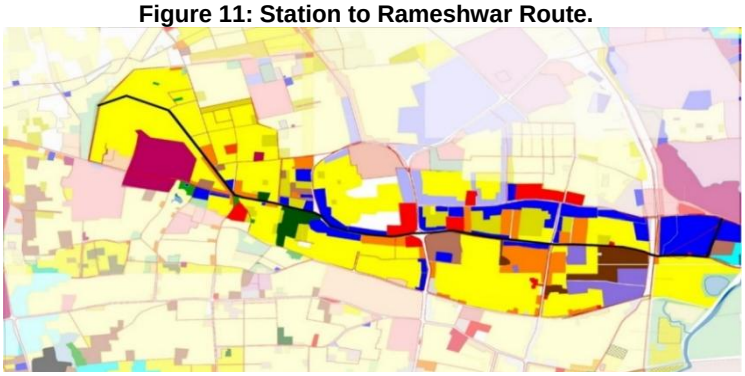
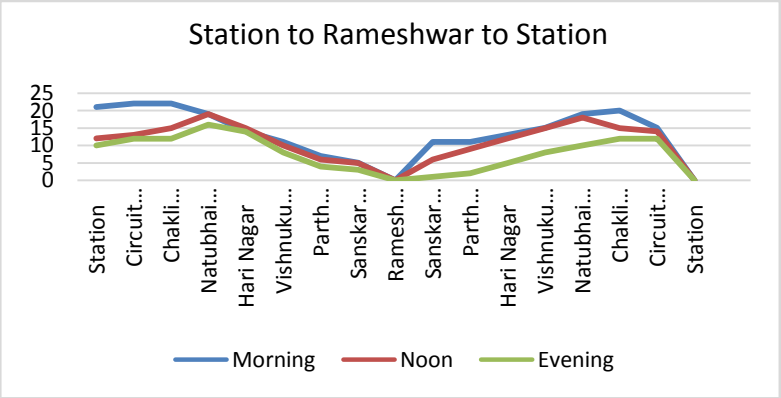


Figure 12: Number of commuters travelling in a bus for a different time of a day



Bus Stop 1: CHAKLI CIRCLE

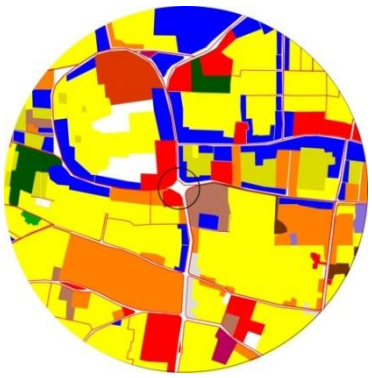


Figure 13: Chakli Circle Bus Stop.

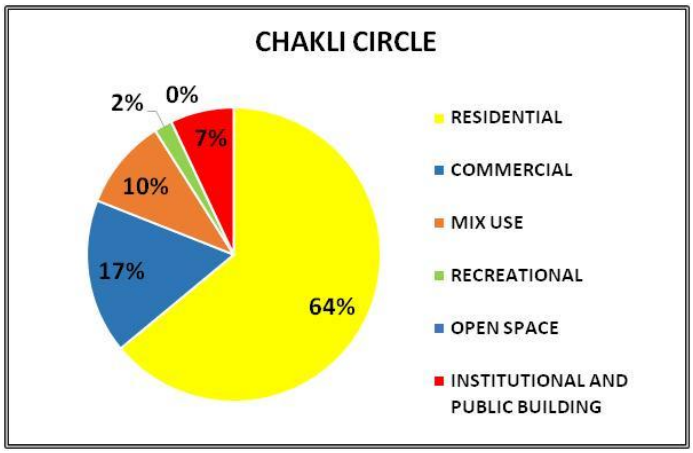


Figure 14: Percentage of Land Use at Chakli Circle Bus Stop.

Chakli circle stop surrounded by all kind of land uses like residential, commercial, mixed, institutional, recreational, public buildings etc. Major area with commercial activities and public building nearby these stop.

Bus Stop 2: HARI NAGAR

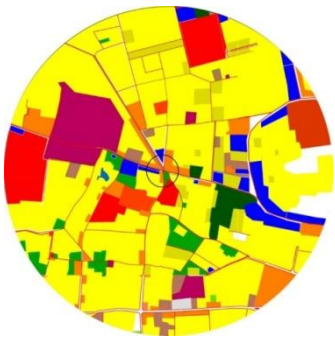


Figure 15: Hari Nagar Bus Stop.

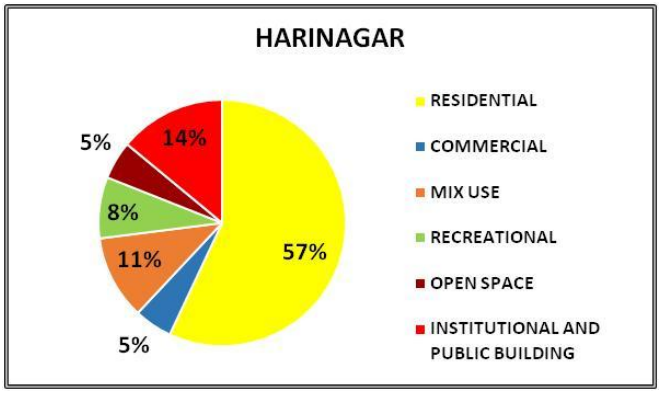


Figure 16: Percentage of Land Use at Hari Nagar Bus Stop.

Harinagar bus stop surrounded by predominantly residential and followed by mixed land use, recreational and very less area with commercial activities.

Bus Stop 1: RAMESHWAR

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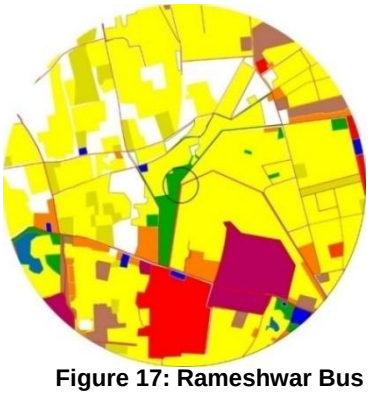

Figure 17: Rameshwar Bus Stop.

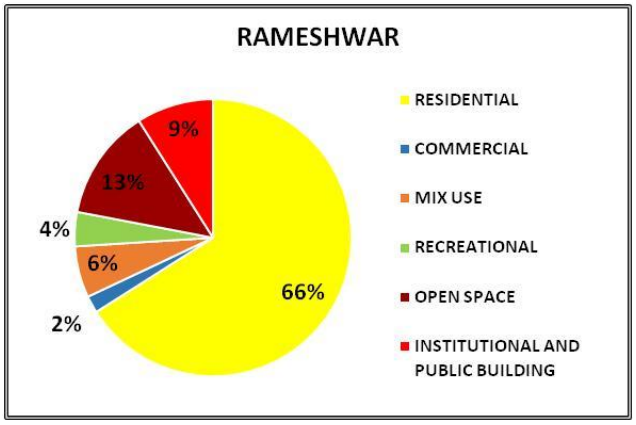

Figure 18: Percentage of Land Use at Rameshwar Bus Stop.

Rameshwar bus stop surrounded by predominantly residential land use and followed by mixed land use.

Results

Based on passenger data supplied by Vinayaka Logistic, number of passengers boarding and alighting on each station have been calculated. Sample calculation for Mandvi station is explained below:

Mandvi Bus Stop

Number of passengers Boarding per square meter residential and mix land-use

Total Area in % = (Residential + Mix Use) = (56 + 22) = 78 %

Total Area in sq. m = ((0.718 * 560) + (0.282 * 220)) = 464.12 sq. m

Total number of passenger Boarding per day= 926

Therefore, number of passenger Boarding per sq. m residential and mix land-use are = 2 passenger per day

Number of passengers alighting per square meter commercial, public building/institutional and mix land-use

Total Area in % = (Commercial + public building/institutional + Mix Use) = (13 + 4 + 22) = 39 %

Total Area in sq. m = ((0.33 * 130) + (0.10 * 40) + (0.57 * 220)) = 172.3 sq. m

Total number of passenger Alighting per day = 1138

Therefore, number of passenger Alighting per sq. m commercial, public building/Institutional and mix land-use are = 6.6 passenger per day

Similarly, analysis is carried out for other selected bus stops, i.e. Parivar Char Rasta, Somatalav, Chakli Circle, Hari Nagar and Rameshwar. Results are summarised in below Table 1.

Table 1: Number of passenger boarding and alighting per day per sq. km at bus stops

Number of passenger boarding and alighting per day per sq. km at bus stops.		
Selected Bus Stop	**Number of passengers Boarding per square meter residential and mix land-use**	**Number of passengers alighting per square meter commercial, Public building/ institutional and mix land-use**
Mandvi Bus Stop	2 passengers/day	6.6 passengers/day
Parivar Char Rasta Bus Stop	0.8 passengers/day	5.3 passengers/day
Somatalav Bus Stop	0.7 passengers/day	6.2 passengers/day
Chakli Circle Bus Stop	1.1 passengers/day	4.1 passengers/day
Harinagar Bus Stop	0.8 passengers/day	3.2 passengers/day
Rameshwar Bus Stop	0.4 passengers/day	3.3 passengers/day

Conclusion

Increasing trends of population growth and expansion of Municipal Corporation area are clearly show why need of public transport is so important to cater future traffic demand of city. A survey provide important insight that in Vadodara mode share of public transport is only 7%, while private automobile dependency have a mode share of 70-80%. Also, around 60% - 70% of total people surveyed were found to be travelling for the work and the educational trips and among them 60% people using either two-wheeler or auto rickshaw. If proper planning has been made then many trips can be shifted to public transport.

The study has revealed that lack of connectivity in the fringe areas of city such as Chhani, Harni, Jambuva, Makarpura etc. comprising around 61 sq. km area indicate high walking time to reach nearby bus stop which have directly resulted into underutilization of existing public transport. Most of the people give the preference to the lack of exact time information is the major reason for not able to utilize the public transport. Thus, by some means we need to increase information displaying facility which may helpful to them to reduce waiting time at bus stop. Higher transit ridership routes are 3, 4, 10, 11, 18 & 31, while lower transit ridership route are 19 and 21.

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