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## ENHANCEMENT OF PUBLIC BUS TRANSPORT SYSTEM – A CASE STUDY OF AVKUDA

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**Abstract** — Public bus transport system is that phase of transportation engineering which deals with the planning, geometric design, facility and traffic operations of road, streets, highways, their networks, terminals, abutting lands, and relationships with other modes of transportation. Public bus transport services are generally based on regular operation of transit buses along a route calling at agreed bus stops according to a published public transport timetable. In this study various types of data carried out like, population data, boarding and alighting survey, household survey, public opinion survey, etc. Travel speed, travel time, load factor is also calculated in this boarding and alighting survey. Population forecasting is carried out by arithmetic increment method. From the collected data the highest average load factor is on route between station to vadatal, the highest average travel speed is on route between station to bandhani chokdi, the lowest travel time is on route between station to bakrol.

**Key words:** Load factor, Travel Time, Travel Speed.

### I. INTRODUCTION

Public bus transport system is that phase of transportation engineering which deals with the planning, geometric design, facility and traffic operations of roads, streets, highways, their networks, terminals, abutting lands, and relationships with other modes of transportation. The AVKUDA area is covering thirty three villages of Anand Taluka and two villages of Ghogha Taluka in addition to the Anand, Karamsad, Vallabh Vidyanagar, Boriyavi Nagarpalika and Vitthal Udyognagar, a notified area. There are about 228 Km. length of asphalt roads in Anand including link roads to state Highways and National highway.

### II. LITERATURE REVIEW

Vineet Kumar Goyal et. al. gives the Route Diversion Detection System for Public Bus Transport using WSN<sup>[1]</sup>. Fabio Duarte and Clovis Ultramar research on Making Public Transport and Housing Match: Accomplishments and Failures of Curitiba's BRT<sup>[2]</sup>. Avishai Ceder gives the measures for initiatives, effectiveness and challenges in new urban public transport system<sup>[3]</sup>. Ehsan Mazloumi et. al. research on the gain insight into public transport travel time variability using GPS data. The bus rapid transit system are also running in India's various city like, Ahmedabad, Surat, Pune.

### III. AIM & OBJECTIVES OF THE STUDY

The aim is to carry out study of bus transit characteristics of AVKUDA region for enhancement of transportation. The objective of the study is given below:

1. To propose effective measures for improving the operation of bus transit.
2. To suggest the measures for improving the efficiency in the bus transit routes.

### IV. DATA COLLECTION

#### General data

The data required for the purpose of enhancement in public bus transport system in the AVKUDA region is categorized as follows:

1. Population Survey
2. Route Survey
3. Land use characteristics
4. Boarding and Alighting
5. Household Survey
6. Public opinion survey

#### 1. Population Survey:

Population survey is secondary data which is collected by census 2011. The decadal population of the AVKUDA region is shown in below table 1 and table 2 shows decadal population density of AVKUDA region.

TABLE 1: DECADAL POPULATION IN AVKUDA (1961-2011)

| Sr. No. | VILLAGE        | 1961  | 1971  | 1981  | 1991   | 2001   | 2011   |
|---------|----------------|-------|-------|-------|--------|--------|--------|
| 1       | Anand (Bakrol) | 46785 | 67581 | 95061 | 122361 | 178832 | 198629 |
| 2       | Karamsad       | 9282  | 11678 | 15896 | 21132  | 28970  | 35298  |

|   |                    |        |        |        |        |        |        |
|---|--------------------|--------|--------|--------|--------|--------|--------|
| 3 | Vallabh Vidyanagar | 6782   | 15509  | 18197  | 21560  | 29260  | 23516  |
| 4 | Boriavi            | 8340   | 10960  | 14113  | 15033  | 17861  | 19853  |
| 5 | Vitthal Udhyanagar | 0      | 0      | 0      | 0      | 0      | 5036   |
| 6 | All Villages       | 91357  | 106987 | 148025 | 164372 | 185872 | 219204 |
|   | AVKUDA             | 162546 | 212715 | 291292 | 344458 | 440795 | 501536 |

Table 2: Summary of Population Density in AVKUDA (2001)

| Sr. No. | Area           | Population | Area as per census (Hact.) | Density (Person per Hact.) |
|---------|----------------|------------|----------------------------|----------------------------|
| 1       | Anand M/UA     | 156050     | 2113.00                    | 73.85                      |
| 2       | Karamsad       | 28970      | 1611.00                    | 17.98                      |
| 3       | V.V.Nagar      | 29260      | 230.00                     | 127.22                     |
| 4       | Boriyavi       | 17860      | 1540.00                    | 11.60                      |
| 5       | Other Villages | 208654     | 22468.76                   | 9.29                       |
|         | AVKUDA         | 440795     | 27962.76                   | 15.76                      |

## 2. Route Survey

There are total ten routes selected for the data collection of vitcos bus. The name of the route is Station to Bandhani chokdi, Vadtal, ADIT college, Karamsad, Bakrol, Mogar, Ramnagar, Valasan, Gana and Kanjari. The boarding and alighting survey is carried out on this all routes. All the survey is carried out at morning peak hour and evening hour. The table 3 shows the boarding and alighting survey on station to bandhani chokdi.

TABLE 3: Route from: Station to Bandhani Chokdi ( 20 km )

| Time: 9 to 11 am ( Morning Peak )      Bus Capacity: 30 Passengers      Date :20-5-2016 |                       |          |           |                |             |               |                 |                     |                        |
|---|-----------------------|----------|-----------|----------------|-------------|---------------|-----------------|---------------------|------------------------|
| Bus Stop No.  | Bus Stop Name         | Boarding | Alighting | Pass. On Board | Load Factor | Distance (km) | Travel Time (s) | Travel Speed (kmph) | Passenger.km Travelled |
| 1   | Station               | 25       | 0         | 25             | 0.83        | 0             | 0               | 0                   | 0                      |
| 2   | Gurudwara             | 3        | 0         | 28             | 0.93        | 0.5           | 120             | 15.00               | 12.5                   |
| 3   | Amul Dairy            | 5        | 3         | 30             | 1.00        | 0.6           | 120             | 18.00               | 16.8                   |
| 4   | Ganesh Chokdi         | 4        | 2         | 32             | 1.07        | 0.6           | 170             | 12.71               | 18                     |
| 5   | Borsad Chokdi         | 6        | 4         | 34             | 1.13        | 1.4           | 226             | 22.30               | 44.8                   |
| 6   | Janta Chokdi          | 10       | 7         | 37             | 1.23        | 2.9           | 377             | 27.69               | 98.6                   |
| 7   | Saradar Patel         | 3        | 4         | 36             | 1.20        | 0.7           | 150             | 16.80               | 25.9                   |
| 8   | Nest Hostel           | 6        | 1         | 41             | 1.37        | 0.6           | 133             | 16.24               | 21.6                   |
| 9   | Gandhi Soda           | 7        | 3         | 45             | 1.50        | 0.3           | 60              | 18.00               | 12.3                   |
| 10  | Amrut Kunj            | 1        | 0         | 46             | 1.53        | 0.8           | 170             | 16.94               | 36                     |
| 11  | Karamsad              | 9        | 12        | 43             | 1.43        | 1.3           | 228             | 20.53               | 59.8                   |
| 12  | P.T.C College         | 5        | 6         | 42             | 1.40        | 0.6           | 130             | 16.62               | 25.8                   |
| 13  | Sardar Patel Smarak   | 3        | 2         | 43             | 1.43        | 0.3           | 60              | 18.00               | 12.6                   |
| 14  | Shri Krishna Hospital | 2        | 5         | 40             | 1.33        | 0.4           | 77              | 18.70               | 17.2                   |
| 15  | Valasan               | 4        | 4         | 40             | 1.33        | 1.8           | 176             | 36.82               | 72                     |
| 16  | Nihar Agrofarm        | 3        | 9         | 34             | 1.13        | 1.1           | 144             | 27.50               | 44                     |
| 17  | Dhebakuva             | 3        | 6         | 31             | 1.03        | 1.9           | 216             | 31.67               | 64.6                   |
| 18  | Ravipura              | 2        | 2         | 31             | 1.03        | 0.8           | 163             | 17.67               | 24.8                   |

|       |                 |     |     |    |      |     |       |       |       |
|-------|-----------------|-----|-----|----|------|-----|-------|-------|-------|
| 19    | Padre           | 0   | 1   | 30 | 1.00 | 1.3 | 200   | 23.40 | 40.3  |
| 20    | Bandhani Chokdi | 0   | 30  | 0  | 0.00 | 2.1 | 310   | 24.39 | 63    |
| Total |                 | 101 | 101 |    | 1.15 | 20  | 161.5 | 19.95 | 710.6 |

3. Land use characteristics

Figure 1 shows the land use characteristics of the AVKUDA region.

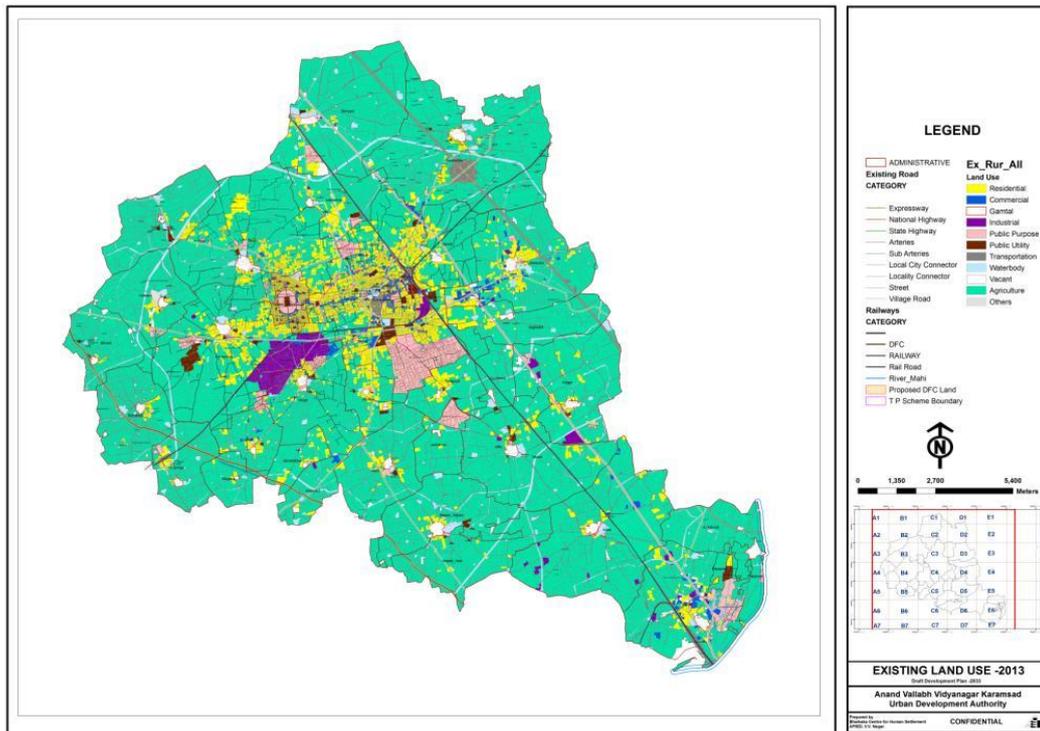


Figure 1 Land use characteristics of the AVKUDA region.

4. Public Opinion Survey

Public opinion survey is carried out by collecting survey form. The sample of this form is given below:

Table 4: Public opinion survey on all routes

| Sr. No. | Questions  | Satisfied |    |         |    |         |    |         |    |         |    |         |    |         |    |         |    |         |    |          |    |
|---------|--|-----------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|---------|----|----------|----|
|         |  | Route 1   |    | Route 2 |    | Route 3 |    | Route 4 |    | Route 5 |    | Route 6 |    | Route 7 |    | Route 8 |    | Route 9 |    | Route 10 |    |
|         |  | Yes       | No | Yes     | No | Yes     | No | Yes     | No | Yes     | No | Yes     | No | Yes     | No | Yes     | No | Yes     | No | Yes      | No |
| 1       | Are you satisfied with driving performance of VTCOS bus driver?  | 18        | 12 | 16      | 14 | 23      | 7  | 22      | 8  | 18      | 12 | 13      | 17 | 20      | 10 | 19      | 11 | 19      | 11 | 22       | 8  |
| 2       | Are you comfortable with the service attitude of city bus drivers or staff?                                    | 14        | 16 | 14      | 16 | 14      | 16 | 18      | 12 | 17      | 13 | 17      | 13 | 14      | 16 | 18      | 12 | 12      | 18 | 21       | 9  |
| 3       | Are you satisfied with the performance on environmental protection of city bus?                                | 20        | 10 | 17      | 13 | 19      | 11 | 17      | 13 | 12      | 18 | 17      | 13 | 15      | 15 | 15      | 15 | 17      | 13 | 16       | 14 |
| 4       | Are you satisfied with the timing of bus?  | 17        | 13 | 18      | 12 | 12      | 18 | 19      | 11 | 20      | 10 | 20      | 10 | 17      | 13 | 14      | 15 | 17      | 13 | 19       | 11 |
| 5       | Are you satisfied with of capacity of buses?   | 12        | 18 | 13      | 17 | 20      | 10 | 12      | 18 | 14      | 16 | 15      | 15 | 18      | 12 | 19      | 11 | 18      | 12 | 17       | 13 |
| 6       | Are you satisfied with the comfort of the buses?   | 19        | 11 | 10      | 20 | 25      | 5  | 13      | 17 | 12      | 18 | 16      | 14 | 16      | 14 | 13      | 17 | 14      | 16 | 18       | 12 |
| 7       | Are you satisfied with the passenger information of city bus about route, bus stop, fare etc.?                 | 14        | 16 | 13      | 17 | 18      | 12 | 22      | 8  | 20      | 10 | 17      | 13 | 17      | 13 | 19      | 11 | 18      | 12 | 16       | 14 |
| 8       | Are you satisfied with security and safety of buses about camera system, first aid service, fire extinguisher? | 2         | 28 | 7       | 23 | 6       | 24 | 1       | 29 | 3       | 27 | 16      | 14 | 12      | 18 | 12      | 18 | 25      | 5  | 10       | 20 |
| 9       | Are you satisfied with accessibility of bus in bus stop at regular interval of time?                           | 19        | 11 | 16      | 14 | 12      | 18 | 17      | 13 | 18      | 12 | 19      | 11 | 18      | 12 | 14      | 16 | 17      | 13 | 17       | 13 |
| 10      | Are you satisfied with no. of buses and passenger capacity in one bus?   | 13        | 17 | 8       | 22 | 21      | 9  | 14      | 16 | 11      | 19 | 13      | 17 | 21      | 9  | 22      | 8  | 18      | 12 | 16       | 14 |

**V. DATA ANALYSIS**

From the based on the data collection, the analysis is carried out which is given below:

1. Population Forecasting

The population projection is calculated by using Arithmetic Increment Method. The calculation of the population is derived from the following formula:

$$P_n = P + nI$$

Where, P = Present Population

n = no. of decade

I = Average Increment

Table 5: Population Forecasting

| Year | Population              |
|------|-------------------------|
| 2021 | 501536+(1*67798)=569334 |
| 2031 | 501536+(2*67798)=637132 |
| 2041 | 501536+(3*67798)=704930 |

2. Route Survey

The comparison of the all routes is shown in table 6.

Table 6: Comparison of all Routes

| Comparison of all Routes |           |             |                         |                         |                      |
|--------------------------|-----------|-------------|-------------------------|-------------------------|----------------------|
| Route No.                | Avg. L.F. | Length (km) | Passengers.km Travelled | Avg. Travel Speed(kmph) | Avg. Travel Time (s) |
| 1                        | 1.21      | 20          | 746.85                  | 18.28                   | 175.31               |
| 2                        | 1.22      | 14.1        | 539.73                  | 15.92                   | 130.09               |
| 3                        | 1.06      | 8.8         | 307.68                  | 17.81                   | 155.63               |
| 4                        | 0.95      | 9.6         | 299.95                  | 17.06                   | 155.74               |
| 5                        | 1.05      | 7.4         | 248.20                  | 11.99                   | 118.58               |
| 6                        | 1.05      | 9.6         | 318.65                  | 18.55                   | 176.79               |
| 7                        | 0.89      | 10          | 268.68                  | 16.24                   | 162.07               |
| 8                        | 0.99      | 13          | 410.88                  | 16.35                   | 187.34               |
| 9                        | 1.09      | 12.6        | 395.38                  | 16.41                   | 158.38               |
| 10                       | 0.92      | 8.1         | 246.83                  | 15.67                   | 163.35               |

3. Household Survey

From the data collection of household survey, the analysis is described as below:

a) Sex Ratio

Table 6: Sex Ratio

| SEX RATIO |        |
|-----------|--------|
| Male      | Female |
| 1801      | 1496   |

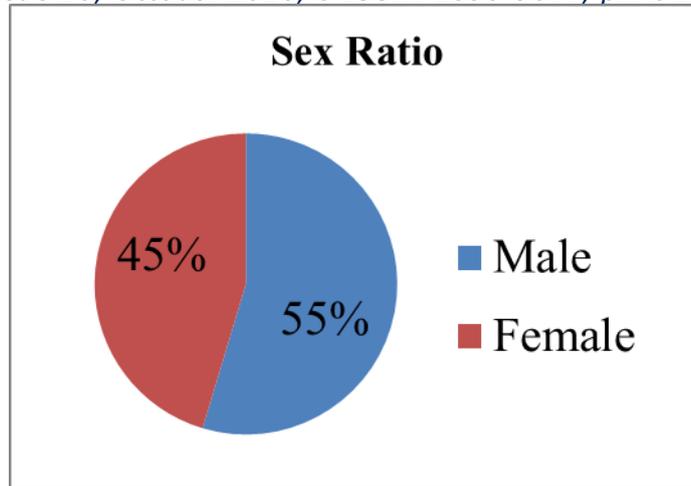


Figure 2: Sex Ratio

From the observed data from the household survey, the sex ratio is obtained as 55% is male and 45% is female which is shown in figure 2.

b) Vehicle Ownership

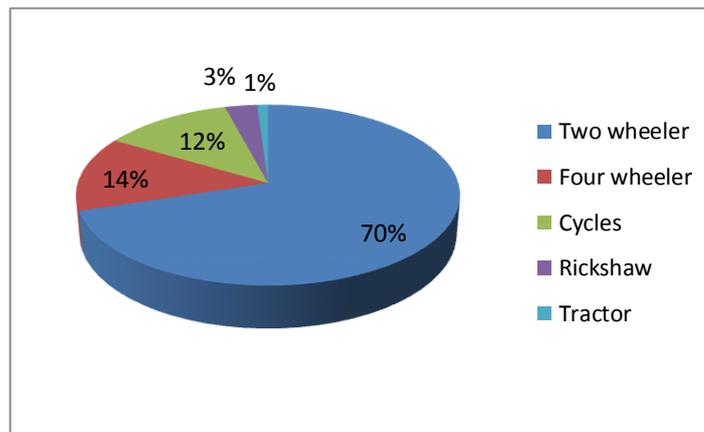


Figure 3: Vehicle Ownership

Figure 3 shows the vehicle ownership of the AVKUDA region. In this analysis two wheeler share is 70%, four wheeler share is 14%, cycles share is 12%, auto rickshaw share is 3% and tractor share is 1%.

## VI. CONCLUSION

- The highest average load factor is 1.22 which is on route between Station to Vadtal.
- The lowest average load factor is 0.89 which is on route between Station to Gana.
- The highest average travel speed is 18.28 which is on route between Station to Bandhani Chokdi.
- The lowest average travel speed is 11.99 which is on route between Station to Bakrol.
- The highest average travel time is 187.34 which is on route between Station to Ramnagar.
- The lowest average travel time is 118.58 which is on route between Station to Bakrol.

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