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Trip Distribution Analysis of Vadodara City

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Abstract

After the first stage of transportation planning i.e. trip generation, it is necessary to determine the direction of travel. The number of trips generated in various zones of the area under study has to be apportioned to the various zones to which these trips are attracted. These generated trips from each zone are then distributed to all other zones based on the choice of destination i.e. Trip distribution. This paper gives a framework for the trip distribution for the city of Vadodara based on a Household Survey, as the data is main input for O-D matrix. The trips are combination of work trips, shopping trips, recreational trips and religious trips. **Keyword- Household and trip data, Trans CAD, Transportation planning, Trip Distribution**

I. INTRODUCTION

Urbanization is an index of transformation from traditional rural economies to modern industrial one. It is taking place at a faster rate in India. The process of urbanization increases both the number and size of town and cities. With this, there is a requirement for a good transport networks. With increase in population, Vadodara started facing problems of traffic, parking, pedestrian's safety, congestion in the city. The solution may include,

- Land use and city planning controls.
- Transportation studies are to be carried out and plans for new roads and reorganization of existing network are to be formulated.
- Traffic restraint measures like restriction in parking, road charges etc.

Construction of new facility needs long time of span and generally this type of improvement is included in long range plans. So the society demands increasing care and professional competence in the planning and operation of all transportation system.

A. Need of Study

With increase in population, numbers of motor vehicles are also increase day by day. Though it gives comfort to road user, have generate certain problems like congestion, lack of safety, degeneration of environment. The situation already becomes unmanageable in many cities.

In order to understand the nature of this problems and formulate proposals for the same and efficient movement of people and goods from one place to another place, transportation planning is important.

II. TRIP DISTRIBUTION

Trip distribution is important stage in transportation planning Process. It is used to estimate present as well as future trips. A trip distribution model produces an origin-destination trip matrix to reflect trips made by population.

A. Methods for Trip Distribution

The following are the trip distribution methods:

- a) Growth Factor methods.
- b) Synthetic methods.
- The growth factor methods include:
- 1) Uniform growth factor method
- 2) Average growth factor method
- 3) Fratar method
- 4) Detroit method
- 5) Furness method
- The synthetics methods are:
- 1) Gravity model.
- 2) Intervening opportunities model.
- 3) Competing opportunities model.

The growth factor methods are based on the assumption that the present travel patterns can be projected in future for design year by using expansion factors.

Synthetic models utilize the present data to determine a relationship between trip marking, the resistance and the attractiveness of the zones for travel. Once a model is established on the basis of the present data, the model can be used to predict the future pattern of travel between zones.

B. Gravity Model

This model is originally generated from an analogy with Newton's gravitational law i.e. the attractive force between any two bodies is directly related to their masses and inversely related to the distance between them. Similarly, in the gravity model, the number of trips between two zones is directly related to activities in the two zones, and inversely related to the separation between the zones as a function of the travel time, cost and length.

$$T_{ij} = K_{ij} * O_i * D_j * F (d_{ij})$$

Where,

 T_{ij} = Future number of trips from zone-i to zone-j

 $K_{ij} = \text{constant value (initial value = 1)}$

O_i = total number of trips end originated in zone-i

Dj = total number of trips end destinated to zone-j

F(dij) = the generalized function of the travel cost, which is called deterrence function because it represents the disincentive to travel as distance, time or cost increases.

III. STUDY AREA PROFILE

Vadodara has a population of almost 1666494 (as of census 2011). Vadodara is the third largest city in the Indian state of the Gujarat. It is the administrative headquarters of Vadodara District. The two main institutions involved in planning and development in Vadodara are VMC and the VUDA.

The study area was divided into 12 zones based on population data and ward data. The zoning of Vadodara city in Trans CAD software is shown in Fig 1:



Fig. 1: Zoning of Vadodara City in TransCAD

🛃 Trans	CAD - [Dataview1 - N	lew Layer]				-							
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2.	ID	Area (zo	one no][zone name]	[total hou	se hold] (n	o of male] [no	o of fem <mark>a</mark> le	population						
	1	0.00	1 City		9274	22272	21081	43442						
	2	0.05	2 Fatepura		26758	62002	57825	119833						
	3	0.03	3 Gajrawadi		31063	73276	67762	141038						
	4	0.05	4 Singhvaimata rd		37659	82939	77199	160138						
	5	0.02	5 Shiyabaug		19353	46014	42331	88351						
	6	0.04	6 Sayajiganj		29823	63923	62514	130452						
	7	0.08	7 Fateganj		40892	111061	99398	210459						
	8	0.01	8 Raopura		21882	50741	47779	98522						
	9	0.03	9 Panigate		52860	122555	113678	236237						
	10	0.03	10 Subhanpura		41732	91268	85151	176419						
	11	0.04	11 Makrand Desai r	d	28458	62293	59331	121625						
	12	0.08	12 GIDC		31547	74072	65903	139976						

Fig. 2: Population data of Vadodara City

IV. DATA COLLECTION

Household information survey is one of the most reliable types of survey to collect data on origin and destination. The survey includes household and trip characteristics. The data collected by household interview survey are of wide range and involved high cost and also time consuming so it is necessary to standardize the procedure for such survey. The size of the sample is usually determined on the basis of the population of the study area.

Out of 3, 71,321 households, 1035 households were successfully surveyed from all zones. This data is transformed in excel sheet.

	Α	В	С	D	E	F	G	Н	1	J	K	L	М	Ν	0	Р	Q	R	S	Т	U 🛓
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2	1	3	2	0	0	2	0	0	2	PRAVIN	42	М	JOB	25000	1	11:00	11:30	00:30	22	BIKE	JOI
3	1	3	2	0	0	2	0	0	2	PRAVIN	42	М	JOB	25000	1	18:00	18:30	00:30	22	BIKE	HON
4	1	3	2	0	0	2	0	0	2	RONAK	26	М	JOB	20000	1	07:00	07:10	00:10	3	BIKE	JOF
5	1	3	2	0	0	2	0	0	2	RONAK	26	М	JOB	20000	1	17:00	17:15	00:15	3	BIKE	HON
6	1	3	2	0	0	2	0	0	2	SMITA B	39	F	OUSE WI	0	0	0	0	00:00	0	0	0
7	2	3	1	1	1	0	1	0	2	RITESH F	34	М	JOB	24000	1	13:00	13:30	00:30	18	BUS	JOF
8	2	3	1	1	1	0	1	0	2	RITESH E	34	М	JOB	24000	1	20:00	20:30	00:30	18	BUS	HON
9	2	3	1	1	1	0	1	0	2	PRINCE	9	М	STUDENI	0	1	07:00	07:05	00:05	2	VAN	STUI
10	2	3	1	1	1	0	1	0	2	PRINCE	9	М	STUDENT	0	1	12:30	12:35	00:05	2	VAN	HON
11	2	3	1	1	1	0	1	0	2	PRAGNA	31	F	OUSE WI	0	0	0	0	00:00	0	0	0
12	3	4	2	1	0	2	1	0	3	R. K. PAT	48	М	JOB	46000	1	08:45	09:00	00:15	6	BIKE	JOI
13	3	4	2	1	0	2	1	0	3	R. K. PAT	48	М	JOB	46000	1	19:00	19:15	00:15	6	BIKE	HON
14	3	4	2	1	0	2	1	0	3	SUNITA	39	F	OUSE WI	0	0	0	0	00:00	0	0	0
15	3	4	2	1	0	2	1	0	3	KETAN	24	М	JOB	15000	1	09:00	09:25	00:25	15	BIKE	JOF
16	3	4	2	1	0	2	1	0	3	KETAN	24	М	JOB	15000	1	17:00	17:25	00:25	15	BIKE	HON
17	3	4	2	1	0	2	1	0	3	KUSHAL	21	М	STUDENI					00:00			
18	4	3	1	1	1	2	0	0	3	N. C. THO	53	М	JOB	53000	1	07:00	07:30	00:30	20	BIKE	JOF
19	4	3	1	1	1	2	0	0	3	N. C. THO	53	М	JOB	53000	1	17:00	17:30	00:30	20	BIKE	HON
20	4	3	1	1	1	2	0	0	3	MENKA	50	F	OUSE WI	0	0	0	0	00:00	0	0	0
21	4	3	1	1	1	2	0	0	3	NISHIKA	21	М	STUDENI	0	1	07:00	07:45	00:45	28	BUS	STUI
22	4	3	1	1	1	2	0	0	3	NISHIKA	21	М	STUDENI	0	1	16:00	16:45	00:45	28	BUS	HON_
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Fig. 3: Excel sheet of data collection

V. ANALYSIS

Trip distribution can be understood by the matrix between zones. The matrix is called origin – destination (O - D) matrix. Matrices involve trip data like travel distance, travel time and number of trips which is important for trip distribution. A matrix contains

rows and columns. Each row is known by a row ID, and each column is known by a column ID. Each entry in the matrix is called a cell and has a value that describes something about the row and the column. For example, the value of each cell could indicate the distance, in miles, between one city (the row) and another city (the column). The excel sheet is imported in SPSS software for Origin Destination matrix and is shown in Fig.4

		DESTINATION														
		1	2	3	4	5	6	7	8	9	10	11	12	Total		
ORIGIN	1	52	43	49	26	31	29	24	31	37	16	22	19	379		
	2	43	218	61	44	49	41	76	50	35	17	22	33	689		
	3	49	61	252	39	22	42	45	22	50	16	21	53	672		
	4	26	44	39	266	47	47	38	24	35	16	14	27	623		
	5	31	49	22	47	48	10	19	18	15	5	6	9	279		
	6	29	41	42	47	10	98	33	47	38	22	32	29	468		
	7	24	76	45	38	19	33	168	45	38	40	21	34	581		
	8	31	50	22	24	18	47	45	203	30	12	13	17	512		
	9	37	35	50	35	15	38	38	30	168	22	17	30	515		
	10	16	17	16	16	5	22	40	12	22	19	10	9	204		
	11	22	22	21	14	6	32	21	13	17	10	90	14	282		
	12	19	33	53	27	9	29	34	17	30	9	14	126	400		
Total		379	689	672	623	279	468	581	512	515	204	282	400	5604		

Fig. 4: Observed Origin- Destination matrix by SPSS.

Desire lines indicates the flow of people or goods, here trips from origin to destination based on values in a matrix, such as the trips in to a CBD from surrounding zones and traffic analysis zones. The desire line diagram for observed trips is prepared in Trans CAD software by using observed O – D Matrix & study area map in Trans CAD and is given in Fig 5.



Fig. 5: Desire line diagram for observed trips

VI. CONCLUSION

The generated trips from each zone are distributed to all other zones based on the choice of destination. The distribution of trips is based on attraction of zones. The total number of trips were 5604, which include all trip purpose like work, education, social and

recreational. The desire line diagram shows that the predominant traffic is on fateganj to fatepura, fatepura to gajrawadi and raopura to fatepura.

VII. FUTURE SCOPE

The most important model for trip distribution i.e. gravity model can be framed for different types of trips with the help of various deterrence functions like trip length, cost and distance by tool available in Trans CAD. Also, for validation of the model, comparison of calculated trips and estimated trips can be done. With the help of deterrence functions, future number of trips can be estimated.

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