

Multimodal Interpretation and Analysis of Traffic Survey Data

Sitesh Kumar Singh¹, Ankit Bansal²

M.Tech, Department of Transportation Engineering, Final Year, Lovely Professional University, Punjab, India¹

Assistant Professor, Department of Civil Engineering, Lovely Professional University, Punjab, India²

ABSTRACT: For planning any road development or improvement project and management schemes, traffic data collection and projections thereof of traffic volumes are its basic requirements. Traffic data forms an integral part in the science of descriptive national economics and such knowledge is essential in drawing up a rational transport policy for movement of passengers and goods by both government and the private sectors. In order to analyse the traffic data, the data collection is the very first step of this approach. It is essential to know the magnitude of traffic data required or to be collected, which will then determine its quality and type of vehicle classification to be adopted. Traffic counting falls in two main categories, namely; manual counts and automatic counts. There is no distinct difference between the two methods however, the economic use or selection of an appropriate method of traffic counting is a function of the level of traffic flow and the required data quality. The multimodal analysis of the data collected includes the traffic volume study which identifies the peak flow of traffic, road use pattern which helps in identifying the pattern of the road use with respect to time and other roads, calculation of AADT, capacity and level of service describing quantitative and qualitative traffic flow characteristics, etc.

KEYWORDS: Traffic survey, data collection, traffic volume, level of service, traffic count.

I. INTRODUCTION

Traffic survey is an extensive method of collection of road traffic data which includes the vehicular count, pedestrian count, etc. with respect to time for a specified area. Traffic survey have of many types categorised under manual count and automatic count. Manual count is the process of traffic count performed with tally sheet and automatic count includes the electric method, mechanical method and electro-mechanical method. Traffic survey is performed to analyse the different features of traffic or vehicles. It gives the data of movement of vehicles and the different class of vehicles with respect to time to identify the peak hour traffic volume demand for formulation of a better transportation infrastructure development or improvement project. Traffic analysis is basically the process of intercepting and examining the number of vehicles moving on the road and inferring the pattern of traffic movement. A Traffic survey on the city area of Madhubani has been performed which comprised analysis for the study of traffic features and vehicular data for the planning of better traffic system in the city. The problem of traffic congestion, traffic accidents, travel delay, etc. in the roads of a newly developing cities are being viewed with grave concern in the recent years. The main causes for the traffic congestion, traffic delay and traffic accidents are improper planning of road network and other roadway facilities and poor traffic planning. To cope with these problems, traffic survey is an extensive approach for the analysis of different types of data. Traffic surveys are an essential constituent of a widespread traffic and transportation planning. Gratefulness of existing traffic and travel physiognomies is tremendously significant for the improvement of widespread traffic and transportation plan.

The analysis of data means the extraction or analysis of the collected data with some particular methodology of result orientation. A data collected can be analysed with several methods. Traffic survey data helps in analysing the several aspects of traffic planning such as volume study, road use pattern, traffic counts, future traffic growth, road capacity, level of service etc. Traffic volume study is the main analysis of traffic survey. It is the manoeuvrability of vehicles on the road with respect to time. Traffic volume can be counted in terms of total number of vehicles moving on the road with respect to time or passenger car unit(PCU) with respect to time. Road use pattern is the hypothetical analysis of

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

the PCU generated on a particular stretch of road sections with respect to time as in morning peak hours and evening peak hours. This study gives the analysis of the road use pattern with respect to the survey sessions. This method uses the researcher approach as the data is limited, t-test is perfect suit for the analysis of these types of data. This paper also explains the calculation of average annual daily traffic (AADT) on the basics of single day peak hour traffic volume. Calculation of traffic volume and level of service also have been focused.

II. LITERATURE REVIEW

UDIT BATRA, MANDAR V. SARODE [RATMIG, 2013, IJAIEM], Traffic surveys are an integral component of a comprehensive traffic and transportation study. So, to perform a traffic survey, various methods are adopted with respect to some specific duration of time for the area of survey. The various traffic surveys can be conducted for appreciating the existing traffic and travel demand characteristics and to prepare the transport infrastructure improvement plans such as Road inventory survey, Classified traffic volume count survey, Origin and destination survey, Household interview survey, Speed and delay, Parking survey, Pedestrian survey, Intermediate public transport operator survey, Intermediate public transport user survey. If survey data is to be used to develop predictive models of travel and activity behaviour, it therefore appears that longitudinal data, which can account for dynamic changes in behaviour, is the preferred type of data to collect (HENSHER, 1982, 1985) for further arguments to this effect. SINGH S. K., (Vol. 2, Issue 2, 2014, IJCSR), this research explains about the parking analysis, development and study of patterns. Bostwana Guideline 9 had explained the different methods of traffic survey and some methods of analysis of the traffic survey data.

III. METHODOLOGY

The set of actions to be followed for getting a result on traffic state have been practiced by traffic survey method with mathematical analysis of the data collected in traffic survey.

DATA COLLECTION

Traffic survey had been carried out on the ten major junctions of the road in session wise. i.e., morning peak hours and evening peak hours. The detailed traffic survey data with different classes of vehicles in respect to the time have been presented. Video photography mode and data sheet method had been adopted for traffic survey because in less manpower, it can be setup easily and survey can be easily done. Video photography mode includes a high quality digital camera, a tripod stands, adequate power supply at-least for half an hour. The camera has been set-up on the side of the road and video mode started. After recording the video for the desired time, the camera video transferred into the laptop. In laptop, video have been used to analyse the traffic data. The different class of the vehicles have been counted from the video and filled in the data sheet at the given time interval in the data sheet. Further, the filled data sheet has been used to analyse the data for the required result. The survey time have been taken from 9 am to 11 am as 1st session and 4 pm to 6 pm as 2nd session for continuous three days of the same sight fir the uniformity of data. The reason for selecting the specific survey time is as because at this time, there is very more traffic due to school time, office time, market time, etc. The traffic survey data collection of different class of vehicles with respect to time is shown in Table.1. and the variation of PCU with respect to time is shown in Fig.1.

DATA ANALYSIS

Data collection method explains several methods needed to execute the research. Data analysis of the obtained traffic survey data as shown in Table.1. includes some methods which can provide an analysis methodology for the data collected and necessary result needed for the research. The extensive data analysis includes the outcomes as traffic volume study as shown in table.2., road use pattern study as shown in Table.3., capacity and level of service study as shown in table.4. and traffic volume conversion study from the data of peak hour traffic as shown in Table.5. Traffic volume conversion deals with the conversion of peak hour traffic volume to the Annual Average Daily Traffic.

IV. DATA COLLECTION

Electro-manually, present traffic data have been recorded on every major intersection of road. At every site, the data were collected in two sessions, i.e., morning peak hour session & evening peak hour session. Let us consider a traffic

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

survey data of one road section in morning peak hour session from 09:00 am to 11:00 am as shown in Table.1, by the same method, traffic survey has been performed in evening peak hour session and data were recorded. As this table shows the traffic survey performed, for this research at all the major road sections of the city were surveyed in the both peak hour sessions. Fig.1. shows the variation of passenger car unit with respect to time and Fig.2. shows the composition of the PCU for different class of the vehicles on that specific road at the peak hours as per the Table.1.

Table.1. Traffic Survey Data

Time	2- Wheeler	3- Wheeler	Car	Jeep/ Van	Mini Bus	Bus	L C V	Truck	Tractor	Bicycle	Tricycle	Total	PCU
09:00-09:15	46	4	4	4	5	3	4	3	2	56	3	134	96.5
09:15-09:30	44	5	5	6	4	4	3	2	0	59	5	137	93.1
09:30-09:45	48	4	6	5	5	2	2	0	3	57	3	135	93.3
09:45-10:00	59	3	5	6	3	3	3	1	1	52	6	142	95.1
10:00-10:15	52	4	3	7	4	2	2	2	3	55	4	138	98
10:15-10:30	46	3	6	5	5	4	1	2	2	49	5	128	94.3
10:30-10:45	45	5	7	6	4	3	3	1	2	58	3	137	95.8
10:45-11:00	41	4	8	6	5	3	2	1	1	53	6	130	92.1
Total	381	32	44	45	35	24	20	12	14	439	35	1081	
PCU	190.5	38.4	44	45	49	52.8	28	26.4	56	175.6	52.5		758.2

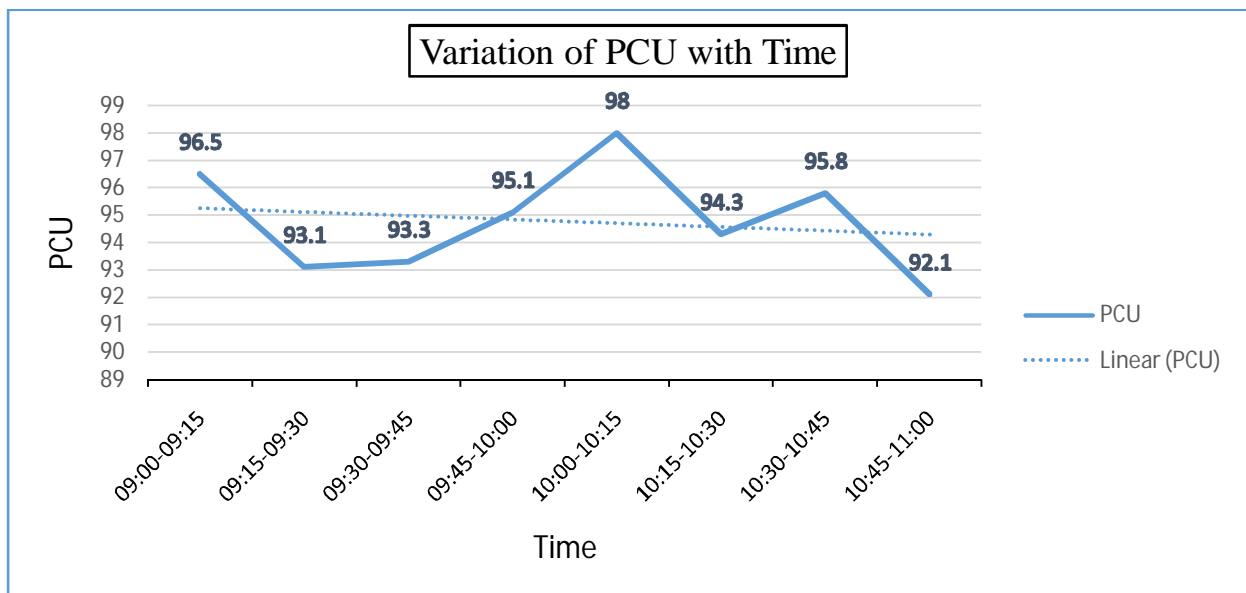


Fig.1. Variation of PCU with Time

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

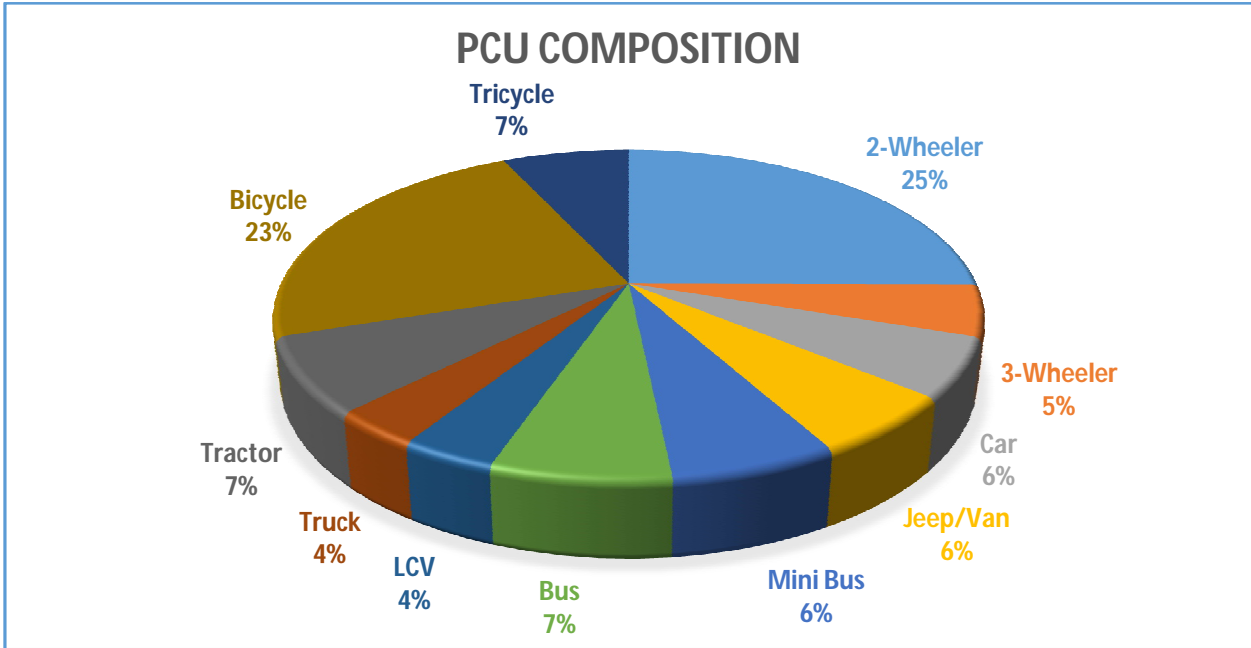


Fig.2. PCU Composition

V. DATA ANALYSIS

With the traffic survey data collection, several methodologies were adopted to analyse the data as such as traffic volume study, level of service, road use pattern and traffic count conversion. These all methods have been justified as per follow:

TRAFFIC VOLUME STUDY

Traffic volumes were calculated form the data collected in the traffic survey at the ten major roads of the city with respect to the obtained morning peak two hours and evening peak two hours expressed in total number of vehicles per hour and passenger car unit per hour as shown in Table.2.

Table.2. Traffic Volumes

Sr.No.	Road	Period	Total Vehicle/hr.	Total PCU/hr.
01	Thana Chowk Road	Morning Peak Hour	398	327.6
		Evening Peak Hour	523	321.3
02	Neelam Chowk Road	Morning Peak Hour	431	272.5
		Evening Peak Hour	441	254.6
03	Bata Chowk Road	Morning Peak Hour	313	165.2
		Evening Peak Hour	368	207.1
04	Churi Bazaar Road	Morning Peak Hour	393	213.3
		Evening Peak Hour	422	223.5
05	Mahila College Road	Morning Peak Hour	365	217.8
		Evening Peak Hour	383	219.8
06	Railway Station Road	Morning Peak Hour	551	386.4
		Evening Peak Hour	536	374.7
07	Ganga Sagar Chowk Road	Morning Peak Hour	511	374.5
		Evening Peak Hour	527	375.4

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

08	Bus Stand Road	Morning Peak Hour	443	324.3
		Evening Peak Hour	427	302.6
09	Bara Bazaar Road	Morning Peak Hour	377	260.4
		Evening Peak Hour	393	252.9
10	Chavaccha Mor	Morning Peak Hour	400	265.6
		Evening Peak Hour	429	272.2

LEVEL OF SERVICE

With the obtained data of traffic volume, level of service has been identified for each sections of the road in the city shown in Table.3. Level of service is the qualitative characteristics of the traffic flow. For the calculation of level of service, the Volume/Capacity ratio was first determined using design service volumes as per IRC: 106 and then the level of service was computed.

Table.3. Level of Service for all roads

Sr.No.	Location	Period	PCU/hr.	Width of road per lane (m)	No. of lanes	Design Service Volume (DSV)	V/C ratio	LOS
01	Thana Chowk Road	Morning Peak Hour	327.6	3.75	1	900	0.36	A
		Evening Peak Hour	321.3	3.75	1	900	0.36	A
02	Neelam Chowk Road	Morning Peak Hour	272.5	3.5	1	900	0.30	A
		Evening Peak Hour	254.6	3.5	1	900	0.28	A
03	Bata Chowk Road	Morning Peak Hour	165.2	3.5	1	900	0.18	A
		Evening Peak Hour	207.1	3.5	1	900	0.23	A
04	Churi Bazaar Road	Morning Peak Hour	213.3	3.5	1	900	0.23	A
		Evening Peak Hour	223.5	3.5	1	900	0.25	A
05	Mahila College Road	Morning Peak Hour	217.8	3.5	1	900	0.24	A
		Evening Peak Hour	219.8	3.5	1	900	0.24	A
06	Railway Station Road	Morning Peak Hour	386.4	3.75	1	900	0.43	B
		Evening Peak Hour	374.7	3.75	1	900	0.41	B
07	Ganga Sagar Chowk Road	Morning Peak Hour	374.5	3.75	1	900	0.41	B
		Evening Peak Hour	375.4	3.75	1	900	0.42	B
08	Bus Stand	Morning	324.3	3.75	1	900	0.36	A

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

	Road	Peak Hour						
		Evening Peak Hour	302.6	3.75	1	900	0.34	A
09	Bara Bazaar Road	Morning Peak Hour	260.4	3.75	1	900	0.29	A
		Evening Peak Hour	252.9	3.75	1	900	0.28	A
10	Chavaccha Mor	Morning Peak Hour	265.6	3.5	1	900	0.30	A
		Evening Peak Hour	272.2	3.5	1	900	0.30	A

ROAD USE PATTERN

Road use pattern is the hypothetical analysis of the PCU generated on a particular stretch of road section during morning peak hour session and evening peak hour session. This study gives the analysis of the road use pattern with respect to the survey sessions. This method uses the researcher approach as the data is limited, t-test is perfect suit for the analysis of these types of data. Table.4. gives the analysed road use pattern.

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{\sum (X_{1i} - \bar{X}_1)^2 + \sum (X_{2i} - \bar{X}_2)^2}{n_1 + n_2 - 2}}} \times \sqrt{\frac{1}{n_1} + \frac{1}{n_2}}$$

with d.f. = $(n_1 + n_2 - 2)$

Here, 't'-indicates the t-value, while 'X bar' denotes mean of the data. First we find out the value of degree of freedom (i.e. d.f.). For finding out this 'd.f.' we need number of sample ('n') so we will get the value of 'd.f.'. After that we will find the 't'-value (this will be t-critical value).

So, at 5 % significance level, t-Critical should be 1.9146.

By putting the values in the formula, we get t-stat. Now if t-stat will be greater than t-critical then the road use pattern is different for the both session otherwise it will be same road use pattern in 1st session and 2nd session.

We have 8 number of sample so,

d.f. = $(8+8-2) = 14$.

For d.f. = 14 at 5 % significance level, the t-Critical is 1.9146.

Table.4. Road Use Pattern Analysis

Sr.No.	Road Section	t-Critical	t-Stat	Type of Pattern
01	Thana Chowk Road	1.9146	1.93110	Different
02	Neelam Chowk Road	1.9146	1.01219	Same
03	Bata Chowk Road	1.9146	3.89234	Different
04	Churi Bazaar Road	1.9146	2.11401	Different
05	Mahila College Road	1.9146	0.52032	Same
06	Railway Station Road	1.9146	1.70496	Same
07	Ganga Sagar Chowk Road	1.9146	1.09247	Same
08	Bus Stand Road	1.9146	2.37535	Different
09	Bara Bazaar Road	1.9146	1.44192	Same
10	Chavaccha Mor	1.9146	1.82911	Same

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

TRAFFIC COUNT CONVERSION

Main input parameters to design a better road network is the study of traffic counts. So, to design a road network for a design life of 20 years, Annual Average Daily Traffic (AADT) is considered. This is the number of vehicles passing a point in both directions per day taking into account the variation in the traffic flow throughout the year and the total number of axles for the same traffic volume. Determination of the AADT from the Average Peak Flow of 2-hour traffic survey, we consider some steps to obtain average daily maximum flow. Having obtained the 24-hour peak counts, a further conversion to 24-hour normal flow may be carried out to obtain an Average Daily Traffic flow, and subsequently to Annual Average Daily Traffic.

Steps of conversion:

1. Conversion of Peak Hour Traffic (PHT) to Average Daily Traffic (ADT)

Peak hour traffic used for design is the traffic, which passes a point during the severest peak hour(s) of the counting period. In order to convert peak hour traffic to Average Daily Traffic (ADT), firstly we find Peak Hour Factor (PHF) which is the ratio of 1-hour peak volume and four times the 15-minute peak volume of the peak hour.

$$PHF = \frac{V}{4 \times V_{15}}$$

Where; V=1hr peak flow

V₁₅=15 min peak flow of 1-hr peak flow

Steps to find 1-hour peak flow:

1. There are two traffic survey sessions of all the stretches of road.
2. Consider the four maximum volume from each session of traffic survey of a particular stretch of road (15 min volume).
3. Take average of the four volumes of each session.
4. Take average of the obtained average value of each session.
5. This gives the peak hour volume of a particular road section.
6. Do the same procedure for all the 10 sections of the road.
7. Find the average of the all 10 sections of the road.
8. Consider the maximum traffic volume for 1 hour from the average value obtained.
9. Consider the maximum volume for 15 minutes from the obtained value of the 1-hour average peak volume.

After obtaining Peak Hour Factor, find the maximum rate of flow for the peak 1-hour.

$$MRF = \frac{1\text{-hour peak volume}}{PHF}$$

Maximum daily traffic (MDT) = 24 X MRF

Average Daily Traffic = MDT X Traffic conversion factor

The conversion factor is the proportion of 2nd last most value of the peak traffic flow over and highest value of traffic flow over a given peak time as it relates to that prevailing traffic counted under same traffic conditions and over a specific counting period.

2. Conversion of Average Daily Traffic (ADT) to Annual Average Daily Traffic (AADT)

Annual Average Daily Traffic is the average traffic that is expected to use a particular road over a year (365 days). The Average Daily Traffic, conversion to Annual Average Daily Traffic is determined from the following expression:

$$AADT = T\text{-ADT} / 365.$$

Where: AADT = Average Annual Daily Traffic.

T-ADT = Total Average Daily Traffic.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

Total Average Daily Traffic is basically calculated in a peak traffic survey for 1 week of every month and the summation of every month traffic is considered as total average daily traffic. But in our case of 1-day traffic survey of 1 site individually, we have total 20 traffic survey data surveyed in 20 days.

So, T-ADT = ADT X 31 X 12

Note:

1. All the traffic volumes should be expressed in PCU.
2. Methods to obtain peak hour (2 hr.) traffic data for conversion to Average Daily Traffic, the road section having the same road use pattern in both the session, for that average of peak hour of both sessions should be considered whereas the road section having different road use pattern in both session, for that the maximum peak hour session should be considered.

Calculation:

Table.5. Traffic Volume for AADT Calculation

Time	15 min	15 min	15 min	15 min	15 min	15 min	15 min	15 min
PCU	95	90	94	94.95	94.8	94.05	94.85	92.3

2-hour peak traffic volume = 749.95 PCU

1-hour peak traffic volume = 379.60 PCU

V15 = 95

$$PHF = \frac{379.60}{4 \times 95} = 0.99894$$

$$\text{Max. rate of flow for peak 1-hour} = \frac{379.60}{0.99894} = 380$$

Maximum Daily Traffic (MDT) = 24 X 380 = 9120

Average Daily Traffic (ADT) = 9120 X 0.946 (0.946 = Traffic conversion factor by BostwanaGuidline 9)
= 8627.52 PCU

T-ADT = ADT X 31 X 12

$$= 8627.52 \times 31 \times 12 = 3209437.44 \text{ PCU}$$

Average Annual Daily traffic (AADT) = T-ADT/365
= 3209437.44/365
= 8792.98 PCU

VI. RESULT

The multimodal analysis of traffic survey data gives the result on the different methodologies used to analyse the data. Traffic volume study have been analysed which express the traffic volume catered by the road section with respect to the peak hours of 2 hours in morning and 2 hours in evening in terms of total number of vehicles moving on the road and passenger car unit. The variation of traffic volume with respect to time is shown in Fig.1. and the percentage volume composition of vehicles moving on that road in same time is shown in Fig.2. Level of service analysis gives the quantitative measure of the road in terms of the ease of traffic flow in the city. The result obtained shows that on the major roads, level of service obtained is "A" which shows the excellent traffic flow characteristics of the road. Road use pattern have analysed the pattern of road use of a particular road with respect to morning peak hours and evening peak hours. The road having same road use pattern means the traffic flow characteristics of the road in morning peak hours and evening peak hours are same and the road having different road use pattern express the different traffic flow characteristics during morning and evening peak hours. The road use pattern has been analysed with the researchural approach considering t-test. If the same road use pattern should be obtained it means that the level of service for that particular road in morning and evening peak hours should be also same. The analysis of traffic count conversion gives the annual average traffic count with the help of traffic survey done in peak hours. The days considered for the analysis has been considered as 31 days in a month because it if there should be planning for traffic related parameters, the strategy should be to accommodate the maximum traffic. So, by this methodology, annual average traffic count has been calculated in terms of PCU.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 5, May 2016

VII. CONCLUSION

Based upon the analysis presented in this paper, result analysed and it had been concluded that traffic survey is a prime key for the planning of any traffic and transportation related projects. Traffic volume study have been carried out to at peak hours to analyse the demand of road development or planning to accommodate the volume on the road. The pattern of the use of different roads have been analysed by road use pattern method which signifies the usage of the roads in different time with traffic specified volumes on the same road. Traffic count conversion method have been carried out to analyse the AADT from ADT helps to decide the future AADT and level of service have been analysed to identify the ease of manoeuvrability of traffic. As being a transportation engineer, to provide a safe and reliable journey to the public should be the prime motive.

REFERENCES

1. UditBatra, Mandar V. Sarode. Traffic Surveying & Analysis, RATMIG, IJAIEM, ISSN 2319-4847, v5(4), 2013.
2. Hensher DA. Longitudinal Surveys in Transport: An Assessment. In ES Ampt, AJ Richardson & W Brög (Eds), New Survey Methods in Transport. VNU Science Press: Utrecht, The Netherlands, 1985.
3. Singh, Sitesh Kumar. "Study of Parking Patterns for Different Parking Facilities." *International Journal of Civil and Structural Engineering Research* 2.2: 35-39, 2014.
4. Goodwin PB. 'Family Changes and Public Transport Use 1984-87: A Dynamic Analysis Using Panel Data'. *Transportation*, 16, 2, 121-154, 1989.
5. Manheim, M.L. *Fundamentals of Transportation Systems Analysis*, MIT Press, Cambridge, MA, 1979.
6. IRC:106-1990. Guideline for Capacity of Urban Roads in Plane Areas, IRC, 1990.
7. Bostwana Guideline 9. Traffic Data Collection and Analysis, TRB, 2003.

BIOGRAPHY



Sitesh Kumar Singh

I am pursuing B.Tech – M.Tech (Dual Degree) in Civil Engineering specialization in Transportation Engineering from Lovely Professional University, Punjab – 144411, India. My area of interest of research is in traffic planning. Please follow me to view my researches on https://www.researchgate.net/profile/Sitesh_Singh and <https://lpu.academia.edu/Sitesh>.



Ankit Bansal

I have completed my B.Tech in Civil Engineering from PTU, Punjab and M.Tech in Transportation Engineering from PEC, Chandigarh and currently working as Assistant Professor, Department of Civil Engineering, Lovely Professional University, Punjab – 144411, India. Please follow my researches on: https://www.researchgate.net/profile/Ankit_Bansal17