International Journal of Scientific Engineering and Applied Science (IJSEAS) – Volume-7, Issue-6, June 2021
ISSN: 2395-3470
www.ijseas.com

Traffic Analysis & Capacity Evaluation

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1. ABSTRACT

Traffic density overflow is becoming a major problem not in Delhi but all over the world. So, the requirement of estimating traffic amount in a compatible way and it is needed to improve the road facilities in order to connect different areas with no loss of time. The current studies of traffic volume characteristics of Bhagawan Mahavir Marg. In the last ten years the volume of vehicles has been increased considerably because of improved economic status of people. Highly heterogeneous traffic of vehicles of extensively changing physical and operational features with no lane discipline. In this study main focus is given on traffic volume data collection and the different analysis are carried out.

Keywords: Traffic Analysis, Passenger Car Equivalent (PCE), Traffic Capacity, PCU.

2. INTRODUCTION

In overall economic development of a country Transport plays a significant role. Transportation leads into growth of infrastructure, industrialization and massive production.

For delivering enough strength, stability to road and decreasing energy used and green house fume outflows, there is a quick requirement of economical and inventive technology in roadway design and establishment. Currently, in manufacture of roadway substances and roadway establishment energy utilized and emission of greenhouse fumes are huge. The problem of getting durable zroadway and financially reducing the critical matters like energy utilization and green house fume outflows are now resolved by use of soil and aggregate.

The number of vehicles passing a specific cross- section of road in unit time is called traffic density. Usually, traffic density is computed in terms of vehicle per minute or vehicle per hour or per day vehicle count. Traffic density on a road is generally shows in terms of a standard vehicle unit and this reference unit is called passenger car unit. The traffic density is dynamic and changes each hour of the day.

Daily traffic density changes on different days in a week and different months and seasons of the year. In most of the developed countries important factors like vehicle composition of traffic stream, flow rate, splits, peak hour flow and yearly mean daily traffic are applied for design, planning and operating roadways.

In India most of the highways have heterogeneous traffic and in such heterogeneous conditions the traffic density of highways are also affected by lane change routine, driver's behaviour and

lane discipline. In operating the traffic vehicle dimension and vehicle type creates many problems.

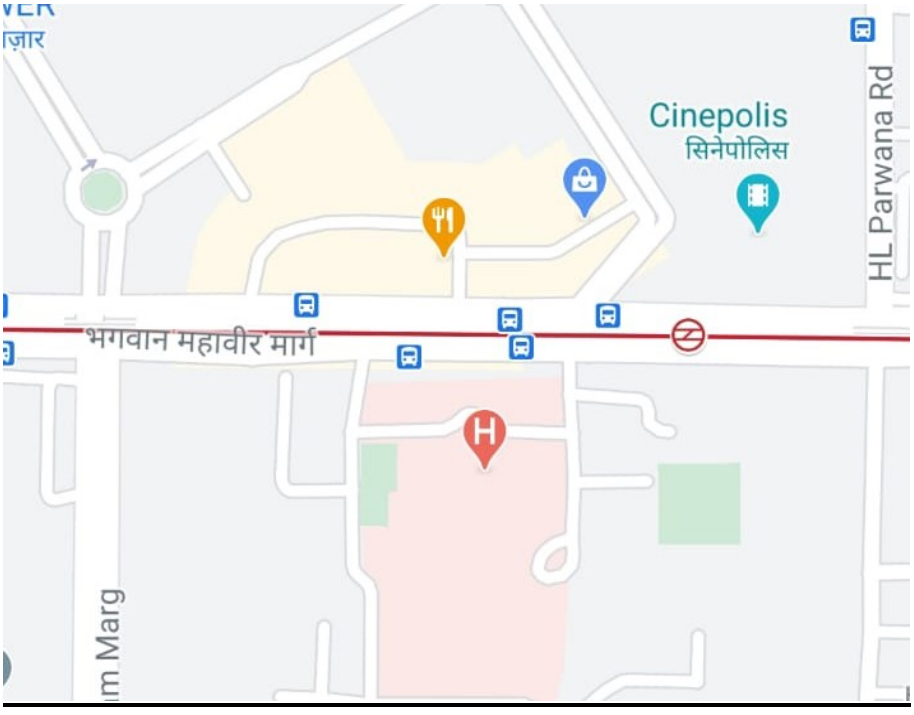
Under mix traffic flows it is difficult to estimate passenger car units of various types of vehicles on two lane separated highways. Passenger car unit values are fixed for vehicles like car, truck, tractors, rickshaws, bullock carts, motorcycle etc. and these values are given by Indian Road Congress and only depends on traffic configuration on highways. The congestion density is influenced by lane width and shoulder width on overflowing highways. The main focus of this report is on congestion density, vehicle size and passenger car units of vehicles.

The traffic flow on this road is heterogeneous with vehicles having various varying static and dynamic features. By changing the different sorts of vehicles into passenger car units and representing the number of vehicles in t hourly passenger car units, the problem of such heterogeneous has been communicated. The congestion flow density can be used for operating and managing the roadways.

3. OBJECTIVE / SCOPE OF THE STUDY

The project study incorporates the following main objective:

1. Directing traffic density flow survey to know the traffic flow running on the given project road section.
2. Finding the actual capacity (in terms of PCU) of the road and comparing it with the maximum theoretical capacity.
3. To compare the traffic capacities of the two surveys conducted.
4. Giving feedback on traffic congestion from the result obtained.



PROJECT STRETCH

Bhagawan Mahavir Marg, Swarn Jayanti Park, Sector 10, Rohini Delhi, 110085.

4. COLLECTION OF DATA

4.1 Purpose of Data Collection

For framing of road advancement and management plans congestion data collection are required. The part plays by density details is very important in the science of illustrative national economics and by use of this knowledge both government and exclusive sectors done their work by making important strategy for motion of commodities and travellers.
The role played by density volume details are salient in arranging a specific section of road grid and for successive preservation of roads. Under different circumstances, people feel motivated in terms of various configurations of vehicles on unlike highways because congestion volume samples seems inconstantly in circulation.
Satisfactorily and distinctly designs are feasible to organize and analyse regardless such type of difficulties. Road grid plans are benefited by changing tendency of congestion details collected and that plays a specific role in the assessment and governance of road grid plans.
By various organizations in Delhi, congestion density details are collected foe various motives:

The density volume is needed for important regions/ zones and they are:
a. Framing prioritization and project installation.
b. In framing preservation.
c. In traffic command.
d. In drawing project.
e. In welfare estimates of highway.

(a) In following regions/ zones, density volume details are required for establishment by scheme of rebuilding and building of brand new highways and broadening requirement of roads.

(b) Extent of service and planned volume are compared by present density flow to test the capability of the highway grid.

(c) Extent of damages and sources are related with density flow. To build this relationship and to determine the expected incidents traffic volume is used.
(d) For refinement plans of highways are required details of density volume.

(e) Financial profits that come from road refinement are evaluated by details collected.

(f) The volume and layout problem of highways and overpasses are inspected by density details collected.

(g) In refinement of already present sections of highway.

(h) Command estimates like synchronized/ co-related density pointer, halt indication and no

entrance indication are executed necessarily for density refinements.

(i) Future density movement and estimates of density volumes are reviewed.

(j) Highways are assigned according to their serviceability.

Above mentioned regions/ zones, there are also some particular requirements of gathering density details:

(a) Density data are required for preservation and recuperation of highways.

(b) Time to time investigation of picked segments and assessment of road surface are done by regular surveys.

(c) Vehicles of various categories, density dispersal are helpful to set up the road web.

4.2 Type of Density Counts

For selecting the vehicle type categorization and quality, it is necessary to realize the amount of density details collected. There are following two methods for density calculation:
(1) Manual counts/ Hand operated counts
(2) Automatic counts/ Electronic counts.

Density counting depends on amount of density volume and the needed standards for quality. These two methods are very similar to each other and however there is no such fully explained dissimilarity between them. This dissimilarity is analyzed and explained below.

4.2.1 Manual/ Hand operated Counts:

Density volume details are gathered generally by hand operated counts and that includes a human for recording volume passes over a road. However this method is costly in terms of manpower. When vehicle categorization is done by various motions taped independently like at cross-sections.

Table 1: Survey ScheduleStudy type	Place	Date of study
Density flow count	Bhagawan Mahavir Marg, Rohini	05-11-2020, 07-11-2020 14-04-2021 15-04-2021

OBSERVATIONS OF ROAD SECTION

These are following observations obtained at the time of survey.

5.1 Road Checklist

Roadway

The length of the road section surveyed is meter. The project has two lanes. Width of each lane is 3.5 meter. The road is constructed on a Binder Coarse and Wet Mix Macadam surface.

Topography

Project roadway is passed through plain ground. Design speed on the roadway is about 30-45 km per hour.

Road Situation

The whole section of the project road is in fine state. It is observed that garbage at some segments is there that covers some of the road surface.

Configuration of Road and Type

The roadway of project stretch is flexible type pavement. It has a 40 millimetre thick bituminous coating and preserved base is 300 millimetre thick.

METHODOLOGY

1) Methodology for congestion density Study on The Road.

2) Methodology of calculating average daily traffic.

3) Methodology of calculating actual capacity of road.

6.1 TRAFFIC VOLUME STUDY

Duration of survey was divided into 3 slots i.e. morning (8-10am), afternoon (1- 3pm) and evening (6-8pm).

The data were recorded on 4 days to account for variation in traffic. i.e. on **05/11/2020 , 07/11/2020 , 14/04/2021 & 15/04/2021**

Note- 24 hour traffic volume study not feasible due to limited resources and lockdown therefore we have to make some accurate approximations.

Observable vehicle dimensions and design of axles are helpful in classification by hand operated congestion density count.

Acquired vehicle categorization system for study is shown below:

able 2: Vehicle Classification

MOTORISED VEHICLE	NON MOTORISED VEHICLE
Two Wheeler(Bike)	Bi-cycle
Three Wheeler	Rickshaw Cycle
Utility Vehicles (Jeep, Van etc.)	Other non-Motorized Vehicles
Standard Bus	
Light commercial vehicle passenger	
Freight	
Multi Combination Vehicles (Truck)	
Three Axle Rigid Chassis Truck	
Multi Axle Truck Semi articulated	
Articulated	

For doing a congestion density survey following factors taken in account:
1. Density flow should not concerned by surveyor.

2. Survey point should be positioned where there is no queuing.

3. Congestion density flow survey should be done by easiest vehicle categorization i.e. minimum time consumption takes place.

6.1.1 Density Volume Count

Observational unpredictability and accountable mistakes are takes place by density volume counting. Collected density details are responsible for accountable mistakes and when vehicle categorization is not done properly the error comes out is observational error. Without obscurity vehicle categorization is not defined properly and this leads to clarification of passed density flow by data collector. Observational and accountable mistakes can be examined by adopting numerical method for density counting.
Axle distance is majorly used for vehicle categorization by electromagnetic counters. The automatic counter cannot verify between two different vehicles when they have similar axle spacing. And this leads into categorization mistake and vehicles that are not categorized by this method are dismissed. Error obtained by sufficient non categorized vehicles are more and for financial decision making motives are not benefited by data collection results.

Regularity of Traffic Counts

For determining scheduled density flow on the road networks over particular periods, we considers the fact that density counts varies significantly at each point of time period. Three types of trends are observed for seasonal differences:

(i) Hourly trends: In this pattern density volume changes 24 hours of the day.

(ii) Diurnal trends: Daily changes over the week are shown by diurnal patterns.

(iii) Annually and Monthly trends: Periodic changes over the year and month are shown by this.

We have to take care of the way by which splits and density configuration changes in analysing.

Factors Affecting Vehicle Counting

Density counting is affected by many factors and following factors are majorly responsible:
(i) Climate situation.
(ii) Density counting motive.
(iii) Type of road.
(iv) Location of counting stations.
(v) Configuration of traffic.
(vi) Level of density flow.

Motive of Traffic Counting

Density counting method are affected by data collection quality, vehicle class numbers and determination of the count period. Vehicle counting is predetermined for minimum 5 days for twelve to sixteen hours of the day to get the good standard details in major projects and less significant work should need less counting time.

Density Counting Method

Density counting method are affected by data collection quality. Vehicles crossing a section at particular breaks like one hour, 15 minutes, 30 minutes etc. are collected by hand operated counting and this is one technique for traffic counting where total density is needed. To get the effective density flow from total counted traffic heavy vehicles amount is find out. On this

behalf, before deciding the method of traffic counting , density counting ways and instructions should be managed.

Place of Counting Stations

Nature and implementation of counting traffic is different in developed regions and in the open country. For yielding the much needed concentration by data collector, congestion counting in rural surroundings has a great impact , and it is inclined to interference in developed regions. Mistakes in collected density data are depends on interference type and detected with data collection movements between place of counting stations and regions like stores. The number of data collectors needed for density counting at cross-sections is affected by configuration of density volume, predicted congestion density and cross-section type. It is necessary that a perfect and comprehensive examination of stations is directed before start of any density survey.

Density Volume Level

On high density roads the potentiality of data collectors to conduct hand operated or manual density counts are influenced by density flow level. Observational mistake is commonly experienced by the data collector when density is counted on occupied road or other than one lane. One data collector to other data collector efficiency and potentiality of density enumeration changes, where density flow is not greater than 1000 vehicles hourly in one direction can grant expected result by one data collector. For electromagnetic counters extra data collectors are needed where density flow is surplus of 1000 vehicles hourly in one direction.

Type of Road

Number of lanes and density volume level for a particular highway is affected by type of road for traffic counting. Three different ways and levels are used for density flow counting and they are:

(i) Bounded less speed and constant flow.
(ii) Usual constant flow.
(iii) Broad separated large speed flow.

There is always an supplementary preference for collection of superior standard data equivalent to more specimen size weather density is low or high. The capability for variance in the density volume flow decreases with less density volume. Over small breaks density trends enlarges for more density volume potential like grouped motion or flow. Density counting for one way roadways are managed by hand operated counting with less chance of mistake and automatic density counters are used for double roadways where speed and number of lanes may required.

Density Configuration

The technique and access which are adapted at particular counting stations for density counting impacts by density configuration. By this the standard of data needed and vehicle class numbers are identified. In order to impose the estimates needed density configuration id defined former to the beginning of the survey.

Counting Accuracy and Quality Assurance

In manual trends density counts for various vehicle classes are obtained by hand operated count details. Hand operated counts are influenced by two factors and they are, quality of manual depletion and tape recording standards. Deformation, vision angle, brightening etc. are the factors which assign the quality of photos in tape recording. Density clearance is required for locating cameras. Attempts that are made in depletion of manual data like data collector experience, decrease in speed and counting assistance i.e. mechanical counters are connected with quality of manual depletion.

Errors in Manual Counting

Number of vehicles and categorization of vehicles at particular positions and periods are determined by density counting. Density counting are done by two methods: electromagnetic and manual. Normally density counts for vehicle classes are assigned by manual counting. In a manual trend density counting at cross-sections, computation of yearly mean density and mean daily density are examples of density counting.
At the time of manual counting procedure vehicle counting and categorization is done. The error obtained are of two types:

(i) Error in counting: If we subtract the number of vehicles counted from the total number of vehicles passes in similar period interval, then the quantity obtained is error in counting. It is represented mathematically as:

$$ecount = (C_m - C_t) \quad (6.1)$$

Where C_m = manually counted number of vehicles.
C_t = real vehicles that passes in similar period interval.

(ii) Error in categorization: The number of vehicles that are categorized in false classes are known as categorization error. This error is difficult to predict. When one small vehicle is misplaced in counting it might be possible that small vehicle is categorized as large vehicle, in this case error obtained in count is -1. And we cannot confirm miss categorization by by any method. If we consider two classes of vehicle from i to j then this results into error of one vehicle in categorized counts for i and j classes and the total count is not affected by by this. Basically we can defined categorization error as, if summation of absolute categorized error is subtracted from summation of total complete error.
We have done traffic count survey for two days. The data obtained are shown below:

05/11/2020

Table 3: 1st Day Traffic Count

Time	8-9am	9-10am	1-2pm	2-3pm	6-7pm	7-8pm
2 wheeler	550	540	528	516	604	545
4 wheeler(car,taxi,etc)	588	550	540	490	630	562
Auto rickshaw	120	128	110	102	110	130
Bus	36	34	35	34	36	36
Lmv/Lcv	190	186	174	162	180	176
Others(trucks)	0	0	0	0	0	0
Total	1484	1438	1387	1304	1560	1449

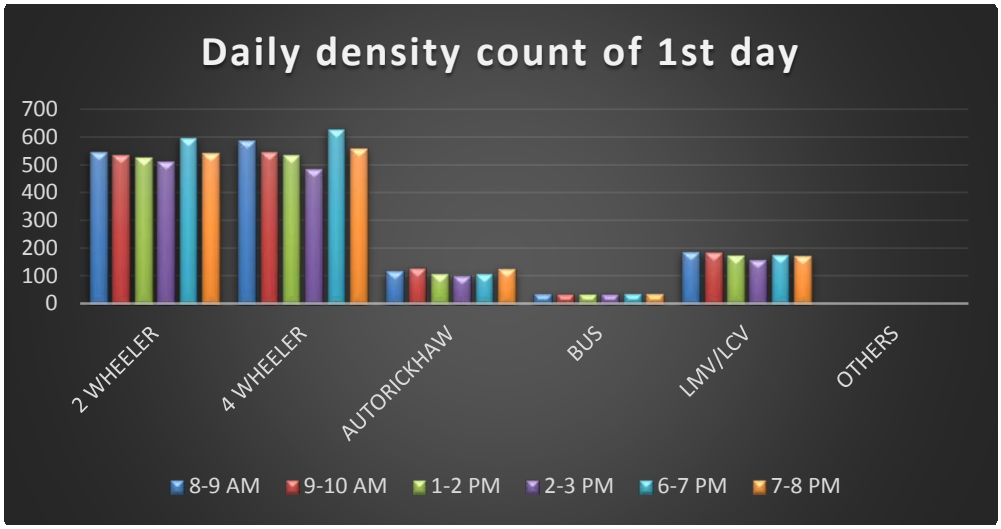


Figure 2: Daily Density Count of 1st Day

07/11/2020

Table 4: 2nd Day Traffic Count

Time	8-9am	9-10am	1-2pm	2-3pm	6-7pm	7-8pm
2 wheeler	525	532	530	503	590	548
4wheeler(car,taxi,etc)	570	568	582	510	548	528
Auto ricksaw	110	124	105	109	113	122
Bus	35	34	36	34	36	36
lcv/lmv	188	182	178	166	172	174
Others(trucks)	0	0	0	0	0	0
Total	1428	1440	1431	1322	1459	1408

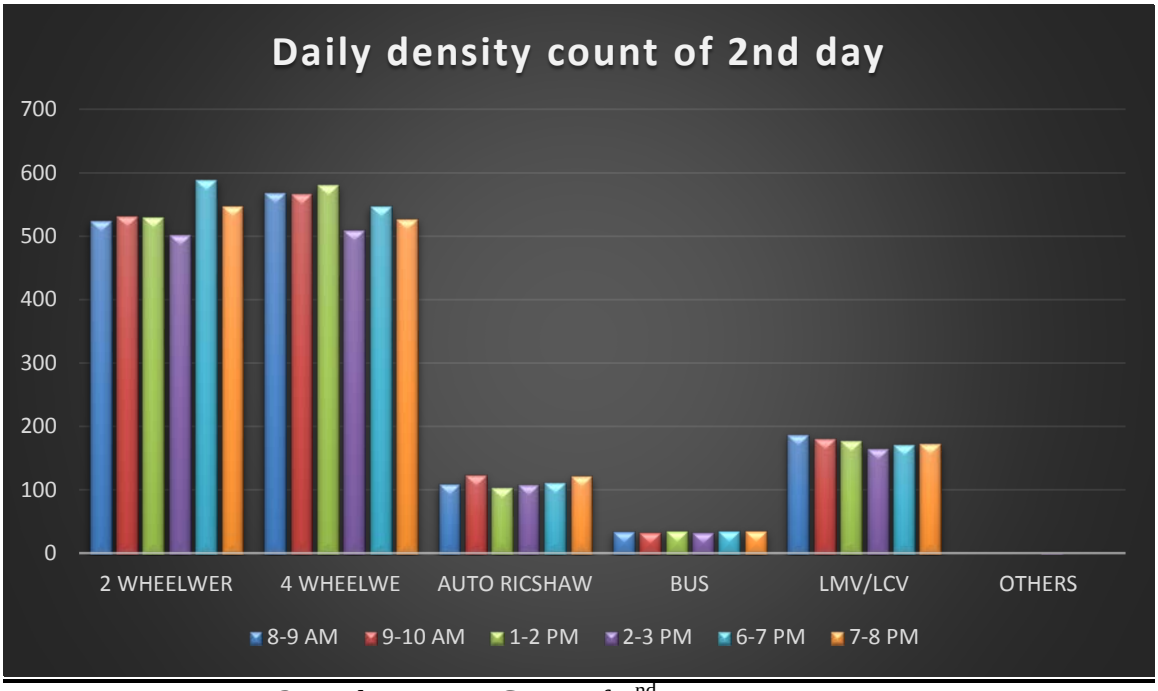


Figure3: Daily Density Count of 2nd Day

14/04/2021

Table 5: 3rd Day Traffic Count

Time	8-9am	9-10am	1-2pm	2-3pm	6-7pm	7-8pm
2-wheeler	720	690	658	627	680	674
4 wheeler (car, taxi, etc.)	630	608	612	598	645	628
Rickshaw/3 wheeler	420	418	393	392	404	390
Bus/trucks	60	58	52	53	54	54
Lmv/Lcv	130	119	116	124	118	107
Others (trucks)	0	0	0	0	0	0
Total	1960	1893	1831	1794	1901	1853

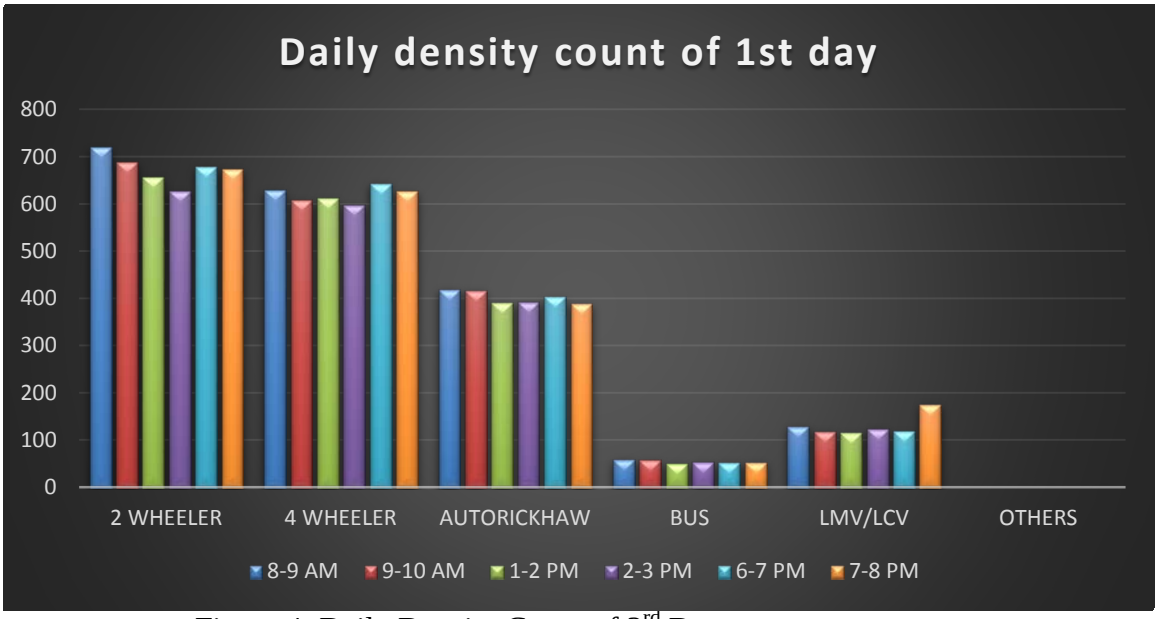


Figure 4: Daily Density Count of 3rd Day

15/04/2021

Table 6: 4th Day Traffic Count

Time	8-9am	9-10am	1-2pm	2-3pm	6-7pm	7-8pm
2-wheeler	732	697	664	643	710	687
4 wheeler (car, taxi, etc.)	621	615	604	592	636	630
Rickshaw/3 wheeler	416	425	398	386	412	396
Bus/trucks	58	59	54	53	56	56
Lmv/Lcv	126	114	126	109	114	109
Others (trucks)	0	0	0	0	0	0
Total	1953	1910	1846	1783	1928	1878

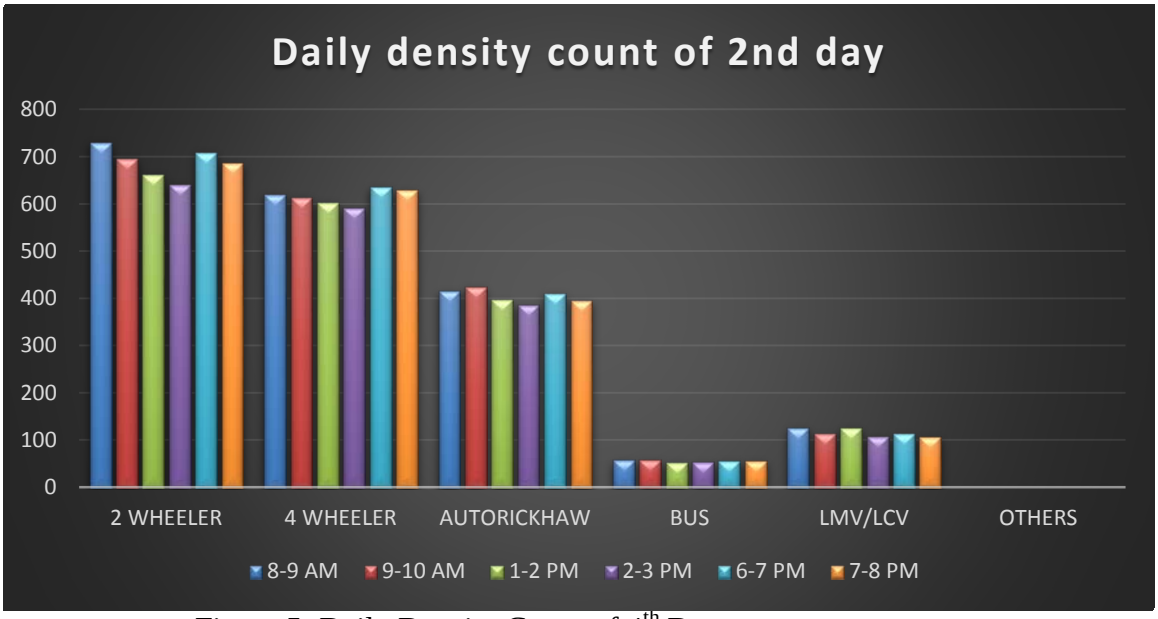


Figure 5: Daily Density Count of 4th Day

6.1.2 Interpretation of Data

Dates: 5/11/2020 & 7/11/2020

Average traffic in 8-9am: 1456

Average traffic in9-10am: 1439

Average traffic in1-2pm: 1409

Average in2-3pm: 1313

Average traffic in6-7pm: 1510

Average traffic in7-8pm: 1429

Max traffic = 1510

Min traffic= 1313

Dates: 14/04/2021 & 15/04/2021

Average traffic in 8-9am: 1957

Average traffic in9-10am: 1902

Average traffic in1-2pm: 1839

Average in2-3pm: 1789

Average traffic in6-7pm: 1915

Average traffic in7-8pm: 1866

Max traffic = 1957

Min traffic= 1789

Now we know that traffic is very heterogeneous therefore it can vary , although we need to find the peak hour traffic for our analysis and it is during morning or evening when most of people are going to or coming back from their work.

Also according to Wikipedia

Rush hour may be 6–10 am (6:00–10:00) and 6–8 pm (18:00–20:00) Therefore our analysis is much correct up to this point.

6.2 Mean Density Traffic

Average daily traffic (ADT) is the most commonly used measure of traffic volume. Theoretically, mean daily density is the highest mean density day in the whole year for 24 hours of density movement in two directions. If we divide the independently counted density of a day i.e. 24 hours by the total density obtained throughout a year then mean daily density can be anticipated. And for that roadway the value obtained is mean daily traffic.
If we collect density for 7 days or some days and prepare a sample of repeated daily density counts then mean daily density can be estimated. Periodic variation can affects that small period of density count. Mean daily traffic is generally annualized by exercising modification elements that obtained from fixed sites of counting. Mean yearly daily density is used for describing density flow features of a highway in designing circumstances.

6.2.1 Typical Conversions of Density Counts

Yearly mean daily density and progressive burdening throughout the highway outline period are major variables for outlining the highway. Generally design period for highways are twenty years. Number of vehicles that passed a section in a day in two directions affects the changes in density flow over the year and total axle numbers for similar density flow. By use of relevant altering elements, twelve hour density flow is converting into sixteen hours of density flow and from this annual mean daily density is calculated. To get the daily mean density we convert sixteen hour density flow into 24 hours density flow. Later on it is converted into yearly daily mean density. For computation of these conversions there are following factors are used:

Table 7: Typical Traffic Conversion Factors

Scenarios	Urban	Inter- urban	Recreation
High	1.016	1.115	1.271
Medium	1.000	1.060	1.141
Low	.989	1.141	.962

(i) Converting Mean Daily Density to Yearly Mean Daily Density :

The mean density flowing on a highway for a year is called yearly mean daily density. For changing mean daily density to yearly mean daily density following expression is used:

AADT = TADT /Number of days in a year

Here, AADT = Yearly mean daily density.

TADT = Total mean daily density.

(ii) Converting Peak Hour Density to Mean Daily Density:

Peak hour density is defined as the volume passed a section for peak hours of counting time for design. Firstly we convert peak hour density into twelve hour or sixteen hour density flow and later on it is converted into 24 hour density flow for counting peak hour density to mean daily density. For any stated number of vehicle if peak hour density is 10% of sixteen hour density then we use following expression for mean daily density:

Peak hour density × Alternate factor = 16 hour mean daily traffic
Then, 16 hour mean daily density × Alternate factor = 24 hour mean daily traffic.

The part of density volume over a stated peak period is called alternate factor. This factor is related to established density recorded under similar density conditions and throughout a particular time of counting.
Now we need to find Average daily traffic (ADT).

We may calculate 24-hour traffic to find ADT but due to lockdown (covid-19) we will make some correct and well-known approximations.

We know that peak hour traffic is 8-10% of ADT.

1st survey (5/11/2020 & 07/11/2020)

Therefore, min ADT will be (8%) between 13130-16143.

Maximum ADT will be (10%) between 15100-18875.

2nd survey (14/04/2021 & 15/04/2021)

Therefore mini. ADT will be (8%) between 17890-22363.

Maximum ADT will be (10%) between 19570-24463.

Here we will assume the maximum traffic and calculate capacity from that. And then compare it with theoretical capacity.

Now %classification of different vehicles.

Here we will use the basic formula % of particular vehicle:

No of that particular vehicles counted/ total no of vehicles surveyed. –

Total number of vehicles counted (05/11/2020,07/11/2020)= 17110.

The result is:

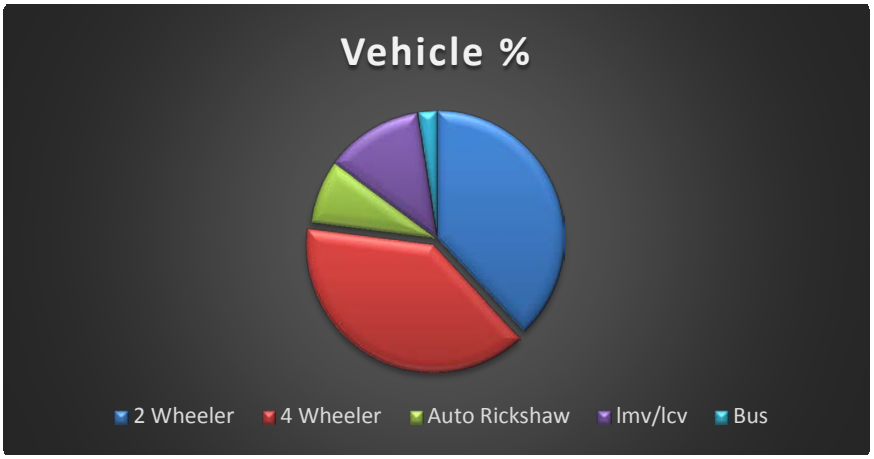


Figure 6: % of Each Vehicle

Total number of vehicles counted **(14/04/2021,15/04/2021)** = 22530.

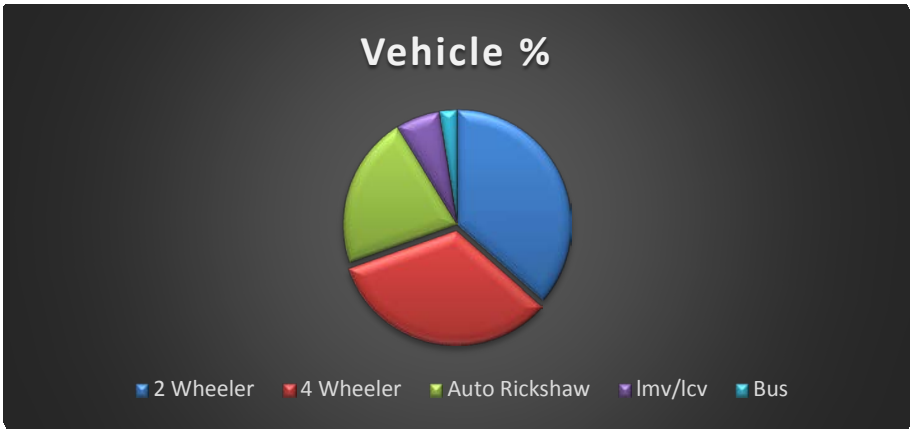


Figure 7: % of Each Vehicle

(05/11/2021, 07/11/2021) (Table 6&7)

Vehicles	Percentage
2-wheeler	38.0537
4-wheeler (car, taxi, etc.)	38.9596
Auto rickshaw	8.08299
Bus	2.4664
LMV/ LCV	12.4371
Others	Tending to 0

Table 8: % of Each Type of Vehicles

Now for Max ADT value of 18875 number of different kind of vehicle will be

Table 9: Number of Vehicles for Max. ADT

VEHICLES	NUMBER
2 Wheeler	7183
4 wheeler(car, cab ,etc.)	7354
Auto rickshaw	1526
Bus	466
LMV/ LCV	2348

(14/04/2021, 15/04/2021) (Table 8&9)

Table 10: % of Each Type Of Vehicles (11/04/21,15/04/21)

Vehicles	Percentage
2 wheeler	36.316
4 wheeler(car ,taxi, etc.)	32.929
Auto rickshaw	21.526
Bus	2.960
LMV/ LCV	6.267
Others	Tending to 0

Now for Max ADT value of 24463 number of different kind of vehicle will be

Table 11: Number of Vehicles for Max. ADT

VEHICLES	NUMBER
2 Wheeler	8884
4 wheeler(car, cab ,etc.)	8055
Auto rickshaw	5266
Bus	724
LMV/ LCV	1533

6.3 PCU MEASUREMENT

Now since vehicles have different dimensions and weight, therefore we will convert them into same unit called PCU.

Vehicle Type	Equivalent PCU Factors Percentage composition of Vehicle type in traffic stream	
	5%	10% and above
Fast Vehicles		
1. Two wheelers Motor cycle or scooter etc.	0.5	0.75
2. Passenger car, pick-up van	1.0	1.0
3. Auto-rickshaw	1.2	2.0
4. Light commercial vehicle	1.4	2.0
5. Truck or Bus	2.2	3.7
6. Agricultural Tractor Trailer	4.0	5.0
Slow Vehicles		
7. Cycle	0.4	0.5
8. Cycle rickshaw	1.5	2.0
9. Tonga (Horse drawn vehicle)	1.5	2.0
10. Hand cart	2.0	3.0

Figure 8: Recommended PCU Factors By IRC106:1990

Also PCU depends on velocity and the space occupied by vehicles.

6.3.1 PCU Determination

Highway area is divided into various density measures and various physical measurements because in all over the world traffic density is dynamic and heterogeneous. There is not a particular standard on which density can rely. Because of this estimation of passenger car unit is not easy. Following methods can be used for calculation of passenger car unit:

(i) Altered Traffic Method.

(ii) Method of Chandra.

(iii) Comparative Delay Method.

(iv) Simulation Method.

(v) Collective Linear Regression Method.

Density volume, various exterior elements and vehicle speed are deciding situation for using different values for the similar type of vehicle.

Here we will use PCU formula suggested by **Chandra and Kumar (2003)** i.e.

$PCU = (V_c/V_i) \div (A_c/A_i)$ - (6.3)

Here ,

PCU = passenger car unit value of i^{th} type vehicle

Speed ratio of the car to the i^{th} vehicle V_c/V_i

Space ratio of the car to the i^{th} vehicle is A_c/A_i

V_c = speed of car in kilometer per hour

V_i = speed of i^{th} vehicle in kilometer per hour

A_c = projected rectangular area of a car in meter square

A_i = projected rectangular area of i^{th} vehicle in meter square

Now we need the velocity and area of different type of vehicles.

Here since we cannot find out the velocity of all the vehicles included in survey, therefore we will take a sample of vehicles from this survey to find out velocity and projected area.

now to find out velocity of vehicles of the sample taken, we find there velocity using a simple formula ... velocity = dis/ time. and we know the stretch of road i.e 1000 m and then using stopwatch we find out the time taken by the vehicles to cross that stretch. in this way we find out the velocity of selected vehicles

Here we took a sample of 240 vehicles i.e.120 (40morning +40afternoon+40evening traffic) on 1st day , 2^{nd} day, 3^{rd} day and 4^{th} day.

Table 12: Average Velocities of Vehicles on 1^{st} Day

05/11/2020					
		V avg(km/hr.)			
VEHICLES	NUMBER	MORNING	AFTERNOON	EVENING	V avg of day
2-Wheeler	20	39.20	34.70	33.20	35.702
4 wheeler	14	44.60	39.70	35.15	39.814
Auto rickshaw	2	31.55	28.55	28.30	29.47

LCV	2	33.40	30.35	27.60	30.434
Bus	2	37.50	32.40	29.75	33.2167

Table 13: Average Velocities of Vehicles on 2nd Day

07/11/2020					
		V avg(km/hr.)			
VEHICLES	NUMBER	MORINING	AFTERNOON	EVENING	V avg of day
2-Wheeler	20	37.32	32.55	34.55	34.802
4-Wheeler	14	42.28	38.70	41.45	40.81
Auto rickshaw	2	34.60	30.43	32.05	32.32
LCV	2	32.50	29.37	30.35	30.74
Bus	2	36.72	31.55	30.75	33.0067

Now we find the mean velocity of different vehicles of the sample taken over the 2 days.

Table 14: Mean Velocities of Vehicles

VEHICLES	Mean velocity(km/hr)
2 wheeler	35.254
4 wheeler	40.2934
Auto rickshaw	30.8953
LCV	30.5866
Bus	33.114

Average dimensions of different vehicles (Source: google)

Table 15: Average Velocities of Vehicles on 1st Day

14/04/2021					
		V avg(km/hr.)			
VEHICLES	NUMBER	MORNING	AFTERNOON	EVENING	V avg of day
2-Wheeler	20	38.70	33.40	31.90	34.67
4 wheeler	15	43.20	38.20	33.45	38.283
Auto rickshaw	2	30.60	27.20	26.80	28.20
LCV	2	32.20	29.10	26.85	29.383
Bus	2	36.80	31.25	28.70	32.25

Table 16: Average Velocities of Vehicles on 2nd Day

15/04/2021					
		V avg(km/hr.)			
VEHICLES	NUMBER	MORINING	AFTERNOON	EVENING	V avg of day
2-Wheeler	20	35.92	31.30	32.70	33.30
4-Wheeler	14	41.10	37.25	40.10	39.483
Auto rickshaw	2	33.20	29.38	30.80	31.126
LCV	2	30.90	28.32	29.15	29.456
Bus	2	35.52	30.20	29.70	31.806

Now we find the mean velocity of different vehicles of the two days.

Table 17: Mean Velocities of Vehicles

VEHICLES	Mean velocity(km/hr)
2 wheeler	33.985
4 wheeler	38.883
Auto rickshaw	29.663
LCV	29.419
Bus	32.028

Table 18: Dimensions of Vehicles

VEHICLES	DIMENIONS(meter)		PROJECTED AREA(m2)
2-wheeler	2.29	0.99	2.261
4-wheeler	3.995	1.75	6.699
Auto rickshaw	2.625*1.3	1.3	3.4125
LCV	12ft(3.656)	6ft(1.828)	6.6868
Bus	10.5	2.5	26.25

Now using (6.3) we will find PCU factor for different vehicles on the selected road.

(05/11/2020, 07/11/2020)

Table 19: PCU Factors of Vehicles

VEHICLES	PCU
2-wheeler	0.385
4-wheeler	1
Auto rickshaw	0.664
LCV	1.315
Bus	4.768

So now we will calculate total passenger car (PCU) unit on the road section.

Capacity = 2765.455+7354+1013.264+3087.62+2221.888

= 16442.227 = **16443 veh/day**

(14/04/2021, 15/04/2021)

Table 20: PCU Factors of Vehicles

VEHICLES	PCU
2-wheeler	0.386
4-wheeler	1
Auto rickshaw	0.667
LCV	1.319
Bus	4.757

Capacity = 3429.224+8055+3512.422+3444.068+2022.027

= **20463 veh/day**

This is the actual number of vehicles coming on the road section

Now according to the highway capacity manual (HCM 2000), India on a 2lane max road capacity can be 1700 vehicles/hr.

Also, we know Design service volume is the maximum hourly volume at which the vehicle can traverse through a point

Figure 9: Recommended Design Service Volume by IRC

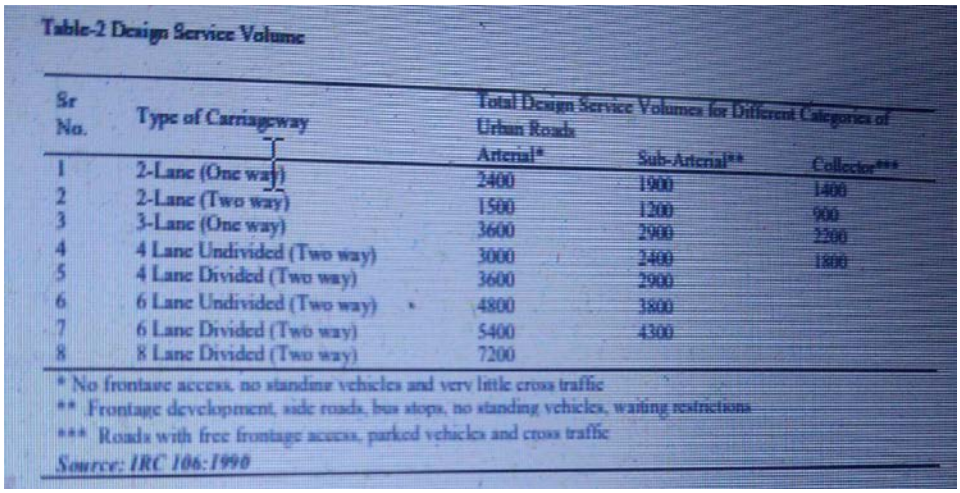


Table-2 Design Service Volume

Sr No.	Type of Carriageway	Total Design Service Volumes for Different Categories of Urban Roads		
		Arterial*	Sub-Arterial**	Collector***
1	2-Lane (One way)	2400	1900	1400
2	2-Lane (Two way)	1500	1200	900
3	3-Lane (One way)	3600	2900	2200
4	4 Lane Undivided (Two way)	3000	2400	1800
5	4 Lane Divided (Two way)	3600	2900	
6	6 Lane Undivided (Two way)	4800	3800	
7	6 Lane Divided (Two way)	5400	4300	
8	8 Lane Divided (Two way)	7200		

* No frontage access, no standing vehicles and very little cross traffic
** Frontage development, side roads, bus stops, no standing vehicles, waiting restrictions
*** Roads with free frontage access, parked vehicles and cross traffic
Source: IRC 106:1990

CONCLUSION & RESULTS.

We can easily conclude from above result that in any case the maximum capacity will be greater than actual traffic capacity. Therefore, we can say that the road section is not congested. The traffic is free flow.

The traffic capacity of the second survey has increased from the first survey and is close to the maximum traffic capacity but still did not exceeded the maximum traffic capacity. Therefore, road section is not congested and traffic is free flow.

We can see that motorbike; auto rickshaw has less PCU values than that recommended by IRC on urban road while big vehicles like bus have more PCU values than that recommended.

It is quite complex to arrive at a specific value of PCU. PCU is not as easy as it seems. It depends highly on

A) traffic data.

B) Nature of vehicles: All motorbikes do not have same PCU as there are many sub-varieties in motorbikes, same is with LCV, cars, buses, etc.

C) it also depends on type of road: since PCU depend on velocity and which depend on the with and condition of the road. Like on less width road small vehicles move relatively faster than on highway
D) we can also say that on urban roads speed differential is quite less therefore PCU depends highly on the physical dimensions of vehicles

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