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Literature Review for Study ofCharacteristics of Traffic Flow

Dr. Nina R. Dhamge[1], Janhvi Patil[2], Monali Dhakate[3], Harsh Hingnekar[4]
8th Semester, B. E. Civil Engineering Department, K. D. K. College of Engineering, Nagpur

Abstract: ***Traffic engineering is the implementation of engineering concepts and techniques to the safe and efficient circulation of individuals as well as goods on roadways. To make the flow of people and products on highways safe and timely, traffic engineering employs technical principles and procedures. People and products must be moved in a safe and timely manner, which depends on traffic flow, which is directly related to traffic characteristics. The volume, speed, and density of a traffic flow are its three primary determinants. Congestion is one of the most widespread and critical global issues, with severe economic, social, and environmental consequences. In this regard, we have developed a systematic literature review study on the magnitudes of congestion that will attempt to address this issue by presenting the causes of traffic congestion, economic, sociological, and environmental difficulties, potential methods to minimize traffic congestion, and ultimately measures to be performed. On a daily basis, traffic congestion is one of the most apparent, ubiquitous, and immediate transportation challenges facing not only India's but also the majority of the world's cities. It has an impact on all types of transportation, particularly highways, as well as all socioeconomic categories. Some of the key reasons for congestion are rapid population growth, increased urbanization, inadequate or unplanned transportation infrastructure, bad public transportation systems, and an increase in the number of personnel vehicles. This literature review paper focuses on studies made on traffic parameters of traffic volume, traffic congestion, including literature on its consequences as well as methods for measuring and rating these effects. Various metrics for measuring traffic congestion have been discussed. These metrics are divided into three categories: travel time, speed and degree of service. Congestion data collection approaches used in various research projects have also been discussed.***

Keywords: Congestion, speed, density of traffic, traffic flow, travel time.

I. INTRODUCTION

Overall functionality of cities and roads are greatly influence by traffic studies. As a consequence of rapid urbanization, the tremendous increase in vehicle numbers is frequently accompanied by an increase in traffic volume and heavy traffic congestion on roads. Almost every city in India is facing traffic problems like congestion, pollution, delay, accidents, parking, etc. This problem lead to lose of manpower, fuel consumption, causes mental stress and creates bad environment for driver. Since traffic congestion has been one of the significant obstacles that most of the cities are facing, it is thought that recognition of congestion characteristics is the first step for developing the systematic approach for traffic congestion relief measures. Traffic congestion wastes time and energy, causes pollution and stress, decrease productivity and impose cost on society. The similar function is served by volume in transportation. Volume is the most important need for transportation system planning, design, and operation. Volume is just the total number of cars that pass a certain stretch of route. When there are multiple different types of vehicles with significantly varied speeds, it is improper to express traffic volume as the number of vehicles passing a certain length of road or traffic lane per unit time. By translating the various types of vehicles into comparable passenger cars and expressing the volume in terms of Passenger Car Units (PCUs) per hour, the challenge of measuring the amount of such heterogeneous traffic has been solved. A traffic study is a thorough research and rigorous analysis of the local transport network, underpinned by a large body of data. Traffic studies are typically performed to investigate a persistent transportation issue and to suggest a solution that will result in less traffic and congestion in that specific location.

II. WHAT IS CONGESTION?

In many cities throughout the world, traffic congestion has become a daily occurrence and one of the largest issues. Congestion refers to a situation where there is an excess amount of demand for a particular resource or service that exceeds its capacity to handle it efficiently. This can happen in various contexts, such as transportation (e.g., traffic jams on a highway), computer networks (e.g., internet traffic overload), and communication (e.g., crowded public spaces or phone lines). In general, congestion can cause delays, reduce efficiency, and increase costs for both providers and users of the affected system.

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Congestion can also lead to safety concerns, as overcrowding or traffic congestion can increase the risk of accidents and other incidents. To manage congestion, various strategies can be employed, such as expanding capacity, implementing congestion pricing, promoting alternative modes of transportation, and utilizing technology to improve efficiency. Traffic congestion has many adverse impacts on people and the environment, ranging from long travel time, high travel cost for commuters and shipping companies, to high energy and carbon emission, air and noise pollution, high commuter stress, lack of physical activity, and consequently a dampening impact on economic growth.

III. BACKGROUND STUDY

During 1950s, traffic volume studies were primarily conducted using manual methods such as visual observations and counting vehicles with mechanical counters. These studies were limited in scope and accuracy due to the lack of technology and data processing capabilities available at the time. And traffic volume studies in the 2000s have benefited from advanced technologies such as automatic traffic counters, GPS tracking, and remote sensing. These tools enable the collection and processing of large amounts of data, providing a more comprehensive and accurate picture of traffic patterns and trends. The Nagpur Road Conference of 1943 was an important event in the history of road development in India which were mentioned in the book. The Nagpur Road Conference road development in India was largely focused on connecting major cities and towns, with little consideration for the needs of rural areas. The conference was attended by representatives from various government agencies, including the Public Works Department, the Indian Road Congress, and the Ministry of Communications. The conference recommend to develop a national road network that would connect all parts of the country. The conference helped to shift the focus of road development from urban areas to rural area

Hall and Pendleton (1990) investigated the association between hourly crash rates and the traffic volume-to-capacity ratio on rural roadways. They discovered that when traffic volume grows, so does the rate of traffic crashes on roadway sections. However, the data required to support this association was widely dispersed. The authors believe that the premise of a link between traffic crash rates and traffic volume is correct, but the precise nature of the relationship is uncertain.

Chandra, S Kumar, et. al. (1995) conducted a detailed analysis of urban road capacity. It was emphasized that passenger car unit values for vehicle types are dynamic in nature and depend on all elements influencing vehicle behavior in traffic. Data acquired in various mid-block parts of Delhi was utilized to investigate the dynamic nature of a vehicle type's passenger car unit. They discovered that the passenger car unit for a vehicle falls as its fraction in the traffic stream increases.

With recent developments in urbanization, traffic demand is also increasing, leading to more traffic congestion in cities. As urbanization increases and traffic demand continues to grow, new ways to understand and calculate traffic congestion are essential. Real-time traffic monitoring, predictive analytics, machine learning, alternative transportation modes, and dynamic pricing are all effective strategies for reducing traffic congestion and optimizing traffic flow. These approaches can help create a more sustainable and efficient transportation system in the face of increasing urbanization. Overall, these recent developments in urban transportation planning and technology aim to reduce traffic congestion, improve air quality, and make transportation more efficient and sustainable in urban.

IV. LITERATURE REVIEW

1) Mr. Udit Batra and Mr. Mandar V. Sarode (2013) monitored and investigated the traffic patterns on Sadar Main Road (Anjuman College Square and Liberty Square) and WHC Road (Law College Square and Shankar Nagar Square) for the aim of an origin and destination study. The researchers used a combination of manual counting and video recording method for data collection of traffic. The actual capacity of selected route was measured during the peak hour. The authors concluded from their study that public transportation needed to be strengthened and due to presence of school and residential houses the more traffic was observed during school hours. Two wheeler vehicle was the preferred mode.

2) S. R. Samal, P. Gireesh Kumar, J. Cyril Santhosh, and M. Santhakumar's (2002) observed their selected stretches and analyzed the received data in terms of travel time index, buffer time index, planning time index and alsodetermined road capacity while referring IRC 106. Their study highlighted impact on economy, health and environment and respective mitigation measures were suggested on the similar. Implementation of strict laws, controlling road side activities and provision of adequate parking space was suggested.

3) Nuzhat Nueery Haque, Sanchari Halder, et. al. (August 2013) examined service flow rate, directional distribution, vehicle composition, flow fluctuation, and flow stability and provided recommendations and limitations in accordance with their findings. Additionally, they recommended doing a speed flow analysis on urban road links for upcoming projects.

4) Jithin Raj, P. Vedagiri, et. al. (2022) evaluated and comprehended the urban road LOS using two approaches, perception and non perception. The study used percent free-floe speed(PFFS) as service measure which is similar to existing manuals. As a result, by studying the perspectives of both engineers and travelers, the comparative analysis offered in this work will contribute to the efficient evaluation and design of urban roadways.

5) Pratik U.Mankar and Dr. B.V. Khote (2016) the authors studied data obtained form field traffic surveys on chosen road sections, Hingna road and Wardha road. 30 meter patch was studied on weekdays for peak and off-peak hours for preliminary surveys followed by capacity estimation by traditional methods and micro simulation method using computer simulation (VISSIM). It was observed that the difference between actual and simulated capacity was +/- 5%. Both the road's PCU value and its carrying capacity have grown.

6) Somesh Chaudhary and Prajakta Kamble (June 2020) conducted preliminary surveys based on which most obvious and common problem and solutions were stated. They also used various computer software/simulation to calculate cost of alternative solution and its impact on traffic flow. It was concluded in this study that different traffic management techniques have their own advantages and disadvantages.

7) S. Velmurugan and Errampali Madhu (3 November 2011) analyzed speed and flow data to get traffic volume count to derive speed-flow relationship. This study was done for the first time in the country (till2017), where free speed profiles and speed equations for various vehicle types on eight-lane divided urban motorways we r e established using microscopic simulation models. Following this, the roadway capacity has been estimated with a respectable level of authenticity for the current heterogeneous traffic conditions. On these eight-lane split urban motorways, the lane change behavior of various vehicle types has also been thoroughly investigated, and its effects on available road space have been carefully considered.

8) Seelam Srikanth, Arpan Mehar (2017) used different methods given in the literature used to calculate PCU value of vehicle types. It was found that these values are not realistic under traffic flow conditions observed in field data. However, homogenization method and dynamic PCU method provides better results.

9) Mehnaz Soomro, Hina Marvi, and Rabia Khaskheli (2021) assessed the routes leaving Hyderabad's Qasim Chowk in terms of traffic volume, intersection conditions, and traffic patterns. For the affected routes, a thorough examination was conducted, and manual and video image detection, digital readings were compared. Surveys were taken between the hours of 12:30 pm t0 1:00pm at respective locations. It was concluded that manual counting method is less precise than video image detection methods and suggestion for road sections were given by the authors.

10) Nuzhat Nueery Haque, Sanchari Halder, et. al. (September 2013) studied traffic data and analyzed for stretch Tejgaon to Shatrasta where characteristics like spot speed and travel speed were determined and studied. The authors at the end provided recommendations for future work and also suggested the idea of conducting a speed flow study on urban road links.

11) Upama Bomzon, Uden K Sherpa et al. (2021) determined the PCU values for mixed traffic conditions along the undivided stretch of National Highway 10 in East Sikkim. Using video graphic survey and speed area method PCU values of different vehicles were estimated. The study shows that when the speed area method approach is applied, the traffic condition has little or no effect on the PCU values. The speed area approach is found to be better suited for determining PCU in steep terrain.

12) Puvvala, R., Ponnu, B., Arkatkar, S., & Velmurugan, S. (2013) used the VISSIM micro-simulation model to estimate the highway capacity for an eight-lane divided Delhi-Gurgaon urban expressway under mixed traffic conditions. The simulation model was calibrated and validated using field data and used to calculate Passenger Car Unit (PCU) values and capacity values for various vehicle types. It was determined that for uncongestion regime the PCU value for each of the vehicle category decreased with increase in flow of vehicles.

13) Ariful Islam, Ullah et al. (2019) evaluated the level of service (LOS) using the Peak Hour Factor (PHF) method, and the traffic conditions at the Vhanga junction in Faridpur. The authors determined the traffic parameters such as peak hour factor, passenger car unit and level of service. It was observed that the lane and shoulder widths were insufficient for the traffic that is present and he non-existence of signal system caused problems such as congestion as well as accidents. Respective remedial measures were provided.

14) Arpan Mehar, et. al. (December 2015) developed the speed-flow curves to determine the simulated capacity values for different combinations. VISSIM software was used to estimate highway capacity under mixed traffic conditions using data from a divided four-lane, six-lane highway after its calibration. The authors did microscopic study using the VISSIM model, the effect of traffic mix on capacity of traffic was studied. The capacity model discussed in this paper is useful for estimating the volume to capacity ratio on a roadway, which is an alternative metric of congestion and service quality.

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15) Budi Hartanto Susilo and Ivan Imanuel (2018). This paper was studied in detail. The authors studied the traffic characteristics in order to reduce traffic congestion issues, they chose some areas to offer a modified classification on the issue. The Time Travel Ratio (TTR) and Degree of Saturation (DS) were used to calculate the congestion matrix. Traffic congestion analysis employing travel time ratio and degree of saturation on road sections in Palembang, Bandung, Yogyakarta, and Surakarta" this study aims to present a modified classification on traffic congestion in order to alleviate the congestion problem. Traffic congestion is determined by two factors in this research review: the travel time ratio and the degree of saturation. Basic framework of this study is as given below in Fig. 1

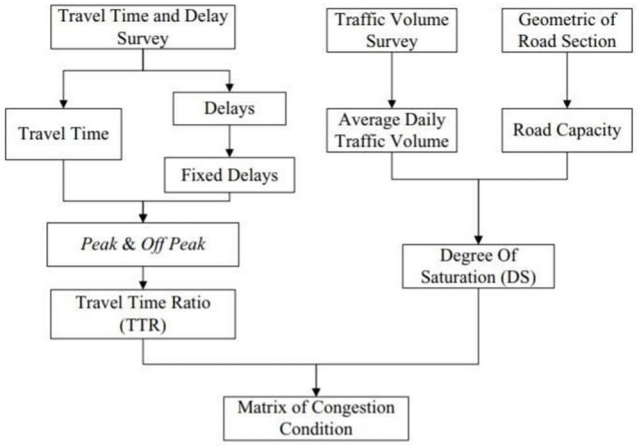


Fig.1 Study Framework

Travel Time Ratio (TTR) well known as ratio of travel time between various transportation modes or comparison between travel time on a road section during peak hours and off-peak hours.

$TTR = TT_P/TT_O$
Where,
TTR = travel time ratio
TT_P = travel time during peak hour (s) TT_O = travel time during off-peak hour (s)
Using this formula Travel Time Ratio (TTR) values were calculated for the selected cities in Indonesia.

Name of Road Section	Direction	Real Travel Time (s)		Fixed Delay Time (s)		Corrected Travel Time (s)		TTR
		TS_P	TS_0	FD_P	FD_0	TT_P	TT_0	
Kol. H. Burlian	South	1071	627	113	48	958	579	1.65
Kol. H. Burlian	North	865	637	84	82	781	555	1.41
Jend. Sudirman	South	1599	888	217	147	1382	741	1.87
Jend. Sudirman	North	1083	822	366	175	717	647	1.11
Residen Abdul Rozak	West	216	166	0	0	216	166	1.30
Residen Abdul Rozak	East	177	151	0	0	177	151	1.17
Basuki Rahmat	West	362	290	19	44	343	246	1.39
Basuki Rahmat	East	521	232	16	31	505	201	2.51
Demang Lebar Daun	West	649	757	64	451	585	306	1.91
Demang Lebar Daun	East	753	493	85	61	668	432	1.55

Fig. 2(i) Travel time ratio values for city Palembang.

Name of Road Section	Direction	Real Travel Time (s)		Fixed Delay Time (s)		Corrected Travel Time (s)		TTR
		TS_P	TS_0	FD_P	FD_0	TT_P	TT_0	
Soekarno-Hatta	East	4080	3600	1080	960	3000	2640	1.14
Soekarno-Hatta	West	5400	3720	2100	1080	3300	2640	1.25
Kebon Jati	East	314	240	16	0	298	240	1.24
Ahmad Yani	East	674	704	227	290	447	414	1.08
Ahmad Yani	West	888	652	244	128	644	524	1.23
Jakarta	West	159	129	0	0	159	129	1.23
Sudirman	West	867	795	102	89	765	706	1.08

Fig. 2(ii) Travel time ratio values for city Bandung.

Name of Road Section	Direction	Real Travel Time (s)		Fixed Delay Time (s)		Corrected Travel Time (s)		TTR
		TS_P	TS_0	FD_P	FD_0	TT_P	TT_0	
Janti	North	3180	2700	258	231	2922	2469	1.18
Janti	South	3180	2700	258	231	2922	2469	1.18
Jend. Sudirman	West	4500	4440	241	411	4259	4029	1.06
Jend. Sudirman	East	4500	4440	241	411	4259	4029	1.06
Laksda Adi Sucipto	East	2670	2340	211	269	2459	2071	1.19

Fig. 2(iii) Travel time ratio values for city Yogyakarta.

Name of Road Section	Direction	Real Travel Time (s)		Fixed Delay Time (s)		Corrected Travel Time (s)		TTR
		TS_P	TS_0	FD_P	FD_0	TT_P	TT_0	
Laksda Adi Sucipto	West	2580	1680	106	253	2474	1427	1.73
Kolonel Sugiyono	East	4500	4440	241	411	4259	4029	1.06
Kolonel Sugiyono	West	4500	4440	241	411	4259	4029	1.06
Malioboro	South	4500	4440	241	411	4259	4029	1.06
Ring Road Utara	East	780	780	127	182	653	598	1.09
Ring Road Utara	West	2880	2700	198	308	2682	2392	1.12

Fig. 2(iv) Travel time ratio values for city Yogyakarta.

Name of Road Section	Direction	Real Travel Time(s)		Fixed Delay Summary (s)		Corrected Travel Time (s)		TTR
		TS_P	TS_0	FD_P	FD_0	TT_P	TT_0	
Slamet Riyadi	East	485	628	27	227	458	401	1.14
Slamet Riyadi	West	613	382	167	97	446	285	1.56
Kol. Sutarto	East	148	126	46	45	102	81	1.26
Kol. Sutarto	West	374	126	64	5	310	121	2.56
Ir. Sutami	East	269	239	36	60	233	179	1.30
Ir. Sutami	West	278	238	16	72	262	166	1.58
Veteran	East	569	226	202	13	367	213	1.72
Veteran	West	428	250	140	0	288	250	1.15
Yosodipuro	East	240	207	56	74	184	133	1.38
Yosodipuro	West	427	138	62	9	365	129	2.83

Fig.2(v) Travel time ratio values for city Surakarta.

Figure 2 (i), (ii), (iii), (iv), (v) shows Travel time ratio values calculated of cities Palembang, Bandung, Yogyakarta and Surakarta respectively.

Degree of Saturation (DS) is the ratio of traffic volume by the road capacity. It can be denoted as 'DS' and written as:

DS = V/C

Where,

DS = degree of saturation

V = traffic volume (PCU/hour)C = road capacity (PCU/hour)

Using this formula Degree of Saturation (DS) values were calculated for the selected cities in Indonesia.

Name of Road Section	Direction	V (PCU/hour)	C (PCU/hour)	DS
Kol. H. Burlian	South	2506	4299	0.58
Kol. H. Burlian	North	2494	4299	0.58
Jend. Sudirman	South	3990	4153	0.96
Jend. Sudirman	North	3892	4153	0.94
Residen Abdul Rozak	West	1963	2884	0.68

Fig. 3(i) Degree of saturation values for city Palembang.

Name of Road Section	Direction	V (PCU/hour)	C (PCU/hour)	DS
Residen Abdul Rozak	East	1775	2884	0.62
Basuki Rahmat	West	3322	2884	1.15
Basuki Rahmat	East	2930	2884	1.02
Demang Lebar Daun	West	6339	4481	1.41
Demang Lebar Daun	East	5771	4481	1.29

Fig. 3(ii) Degree of saturation values for city Palemband.

Name of Road Section	Direction	V (PCU/hour)	C (PCU/hour)	DS
Soekarno-Hatta	East	3865	5860	0.66
Soekarno-Hatta	West	4080	5860	0.70
Kebon Jati	East	2723	4206	0.65
Ahmad Yani	East	1236	2058	0.60
Ahmad Yani	West	1128	1029	1.10
Jakarta	West	4999	5042	0.99
Jend. Sudirman	West	2162	4206	0.51

Fig. 3(iii) Degree of saturation values for city Bandung.

Name of Road Section	Direction	V (PCU/hour)	C (PCU/hour)	DS
Janti	North	3422	3935	0.87
Janti	South	2549	3935	0.65
Jend. Sudirman	West	3499	2596	1.35
Jend. Sudirman	East	2999	2596	1.16
Laksda Adi Sucipto	East	2601	2650	0.98
Laksda Adi Sucipto	West	2498	2426	1.03
Kolonel Sugiyono	East	1196	2568	0.47
Kolonel Sugiyono	West	2602	2568	1.01
Malioboro	South	2713	2400	1.13
Ring Road Utara	East	2588	4033	0.64
Ring Road Utara	West	2372	4033	0.59

Fig. 3(iv) Degree of saturation values for city Yogyakarta.

Name of Road Section	Direction	V (PCU/hour)	C (PCU/hour)	DS
Slamet Riyadi	East	1374	2183	0.63
Slamet Riyadi	West	998	2183	0.46
Kol. Sutarto	East	1442	2769	0.52
Kol. Sutarto	West	1789	2769	0.65
Ir. Sutami	East	1588	2411	0.66
Ir. Sutami	West	1703	2411	0.71
Veteran	East	834	1756	0.47
Veteran	West	925	1756	0.53
Yosodipuro	East	841	1529	0.55
Yosodipuro	West	1053	1529	0.69

Fig. 3(v) Degree of saturation values for city Surakarta.

Figure 3(i), (ii), (iii), (iv), (v) shows Degree of saturation values calculated of cities Palembang, Bandung, Yogyakarta andSurakarta respectively.

Parameter	High TTR	Low TTR
High DS	Peak-hour congestion	Lengthy congestion
Low DS	Momentary congestion	Smooth traffic

Fig.4 Matrix of Congestion Condition

According to the matrix of congestion conditions in Fig.4 based on the level of saturation and trip time ratio Four categories of congestion conditions exist, namely:

1) Peak hour congestion is a type of traffic jam in which there is heavy traffic and activity between the hours of 0 and 5 that causes lengthy delays and low speed.
2) Long-lasting congestion is a type of congestion that lasts longer than two hours a day and is characterized by heavy trafficand activity.
3) Momentary congestion is a type of congestion in which the volume of traffic is generally low throughout the day but occasionally spikes for a brief period of time.
4) Smooth traffic is the absence of obstructions on a road section throughout the day.

Figure 4 gives tabular explanation of relationship between tavel time ratio and degree of saturation for determining the congestion matrix.

Name of Road Section	Direction	DS	TTR	Congestion Condition
Kol. H. Burlian	South	Low	High	Momentary congestion
Kol. H. Burlian	North	Low	High	Momentary congestion
Sudirman	South	High	High	Peak-hour congestion
Sudirman	North	High	Low	Lengthy congestion
Residen Abdul Rozak	West	Low	Low	Smooth traffic
Residen Abdul Rozak	East	Low	Low	Smooth traffic
Basuki Rahmat	West	High	Low	Lengthy congestion
Basuki Rahmat	East	High	High	Peak-hour congestion
Demang Lebar Daun	West	High	High	Peak-hour congestion
Demang Lebar Daun	East	High	High	Peak-hour congestion
Soekarno-Hatta	East	Low	Low	Smooth traffic
Soekarno-Hatta	West	Low	Low	Smooth traffic
Kebon Jati	East	Low	Low	Smooth traffic
Ahmad Yani	East	Low	Low	Smooth traffic
Ahmad Yani	West	High	Low	Lengthy congestion
Jakarta	West	High	Low	Lengthy congestion
Jend. Sudirman	West	Low	Low	Smooth traffic
Janti	North	High	Low	Lengthy congestion

Fig.5 (i) Identification of Congestion Condition in cities of Palembang and Bandung.

Name of Road Section	Direction	DS	TTR	Congestion Condition
Janti	South	Low	Low	Smooth traffic
Jend. Sudirman	West	High	Low	Lengthy congestion
Jend. Sudirman	East	High	Low	Lengthy congestion
Laksda Adi Sucipto	East	High	Low	Lengthy congestion
Laksda Adi Sucipto	West	High	High	Peak-hour congestion
Kolonel Sugiyono	East	Low	Low	Smooth traffic
Kolonel Sugiyono	West	High	Low	Lengthy congestion
Malioboro	South	High	Low	Lengthy congestion
Ring Road Utara	East	Low	Low	Smooth traffic
Ring Road Utara	West	Low	Low	Smooth traffic
Slamet Riyadi	East	Low	Low	Smooth traffic
Slamet Riyadi	West	Low	High	Momentary congestion
Kol. Sutarto	East	Low	Low	Smooth traffic
Kol. Sutarto	West	Low	High	Momentary congestion
Ir. Sutami	East	Low	Low	Smooth traffic
Ir. Sutami	West	Low	High	Momentary congestion
Veteran	East	Low	High	Momentary congestion
Veteran	West	Low	Low	Smooth traffic
Yosodipuro	East	Low	Low	Smooth traffic
Yosodipuro	West	Low	High	Momentary congestion

Fig.5 (ii) Identification of Congestion Condition in cities of Yogyakarta and Surakarta.

As shown in Fig.5 (i) and Fig.5 (ii) all the road sections in the respective four cities, Palembang, Bandung, Yogyakarta and Surakarta as per values of travel time ratio (TTR) and degree of saturation (DS) the congestion condition according to Congestion condition matrix fig. 4 were determined.

At the end it was concluded that traffic congestion conditions were classified for the road sections of Palembang, Bandung, Yogyakarta, and Surakarta. Further they were classified into four categories on basis of Travel time ratio (TTR) and Degree of Saturation (DS) as:

a) Peak-hour congestion, if TTR $\geq$ 1.40 and DS $\geq$0.75.
b) Lengthy congestion, if TTR < 1.40 and DS $\geq$ 0.75.
c) Momentary congestion, if TTR $\geq$ 1.40 and DS < 0.75.
d) Smooth traffic, if TTR < 1.40 and DS < 0.75.

Traffic congestion analysis using travel time ratio and degree of saturation on road sections in Palembang, Bandung, Yogyakarta, and Surakarta" was to provide a modified classification on traffic congestion in order solve the congestion problem. It was observed that the traffic congestion for the road stretches in respective four cities were variable. The city of Palembang had Peak hour congestion, Bandung had Lengthy congestion, Yogyakarta had Momentary congestion and Surakarta had Smooth congestion.

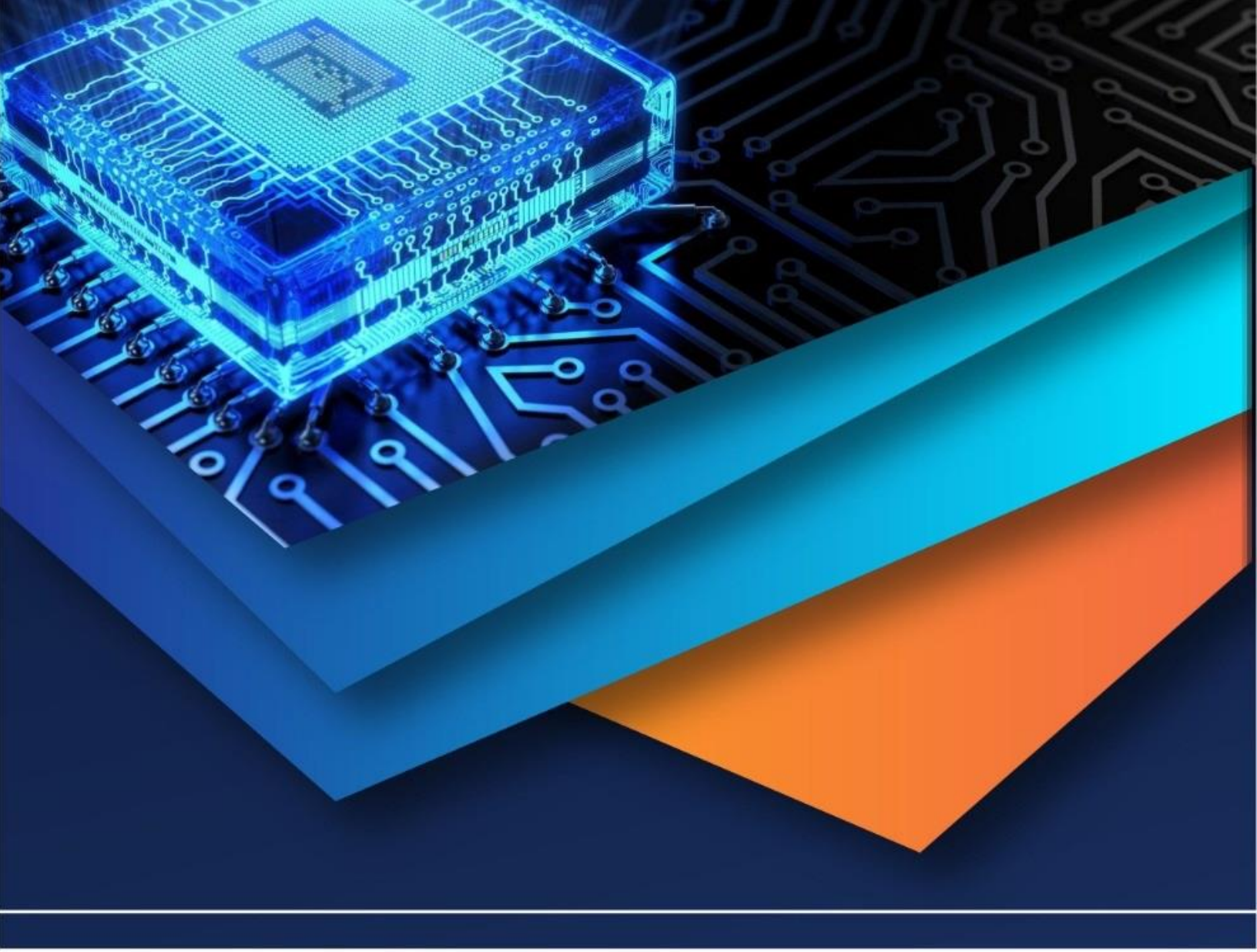
V. CONCLUSION

Various literature reviews were studied. It was observed that the manual counting method as well as video filming method were the most common data collection methods used by the researchers with a few opting for computer simulation (VISSIM) method. The traffic parameters required for the study of traffic volume were identified and studied by the researchers. Various software for analyzing traffic volume digitally are accessible.

Similarly surveys which need to be done prior as well as during the study were also identified and studied by the researchers. Preliminary surveys, vehicle count survey were the basic surveys done commonly. It was felt that the zero level congestion condition cannot be technically achieved and there is no easy fix or easy solution To it. Provision of alternate route or construction of new roadway may improve the mobility but the financial constraints still remain the problem. Also the need to educate and bring to attention to people about traffic rules, speed signs and safety is plays an important role in reduction of congestion. The solution for congestion does not solely depend on technological aspect but also on human nature. The study of traffic flow characteristics in literature has given an insight into the problem of traffic congestion. Thus, the methodology for conducting traffic congestion study has been evolved.

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