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ASSESMENT OF TRAFFIC CONGESTION USING TRAFFIC CONGESTABILITY INDEX FOR BENGALURU CITY –A CASE STUDY

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Abstract: Traffic congestion is one of the major problems in urban area which affects economy and safe & efficient mobilization of people and goods. Traffic scenario in Bangalore city over past decade has undergone drastic changes with the increase in number vehicles. Traffic management in and around the CBD's has become a challenging task for both traffic engineers and traffic police who are striving to minimize traffic related problems. In this regard an attempt has been made in the present work to study behavior of traffic along north-south corridor of Bangalore i.e road connecting Yelahanka and Banashankari to asses traffic congestion index.

Traffic congestion reduces the effective spatial interaction between different zones. Traffic congestion measurement is important to understand traffic condition in the city. It is important to measure network traffic congestion instead of measuring traffic congestion of single link. Present study mainly concentrates on network traffic congestion measurement. Selected study area is from Banashankari to Yelahanka. The selected network includes outer ring road from Banashankari to Yeshwanthapura, Tumkur main road,Chord road, Jalahalli road, Sandeep hunni krishan road and Mathikere road.

In the present work traffic congestion measurement was analysed considering new index property i.e. Traffic Congestability Index (TCI) which has got both quantitative and qualitative parameters. Parameters such as Average speed, delay time, Travel time and traffic volumes come under quantitative parameter. Pedestrian movement and surface condition of pavement are comes under qualitative parameters. Lower value of TCI indicates higher degree of congestion and vice versa.

Keywords: Congestion, Traffic Congestability Index,Congestion Index value, Pedestrian Weight, Surface Weight, Spatial Zones etc.

I. INTRODUCTION

Across the world urbanization is the major problem of big cities. Urbanization phenomenon indicates movement of people into urban areas from outside and this with an increasing population compel an increase in cities and consequently there is direct pressure on traffic movement. Urban traffic congestion cannot have a single meaning definition since it is both a physical as well as a relative phenomenon.

- It can be considered a situation where supply exceeds available road space.
- Traffic Congestion is a condition on transport networks that occurs as use increases, and is characterized by lower speeds, longer trip times and increased vehicular queuing.
- The level at which transportation system performance is no longer acceptable due to traffic Interference.
- A condition in which road traffic is very slow, with many queues and traffic jams.
- Traffic congestion is a critical problem which happens on roads which make traffic busy.

Bangalore is one of the fast developing urban communities on the planet, which is because of the expanded improvement in the city, for example, IT parks, increment in number of instructive foundations and because of accessibility of better offices. This fast increment in the populace builds the vehicle populace development in the city. Extra to this, Bangalore city has exceptionally contract lanes and degree for further broadening and increment in area use for the transportation is extremely hard to accomplish. This effect straightforwardly on the vehicles handling out and about i.e. clog out and about expansions hence diminishing travel time, increment in fuel utilization, increment in number of mischances and other increment in impalpable impacts

II. LITERATURE REVIEW

"NilanchalPatel,AlokBhushan Mukherjee" In this paper they proposed a new index called TCV- Traffic Contestability Value for measuring network traffic congestion. Here both quantitative and qualitative factors are considered. TCV=1/ (MCIV*MTMP) in this formula MCIV is Mean Congestion Index Value, MTMP is Mean Traffic Management Parameter. CIV is the congestion index value represent quantitative parameter. Pedestrian movement and pavement surface condition are considered as qualitative parameters.

The project on "**Mobility Indicator**" done by Aswin GSKSJTI Bengaluru. In this study the main consideration is traffic congestion measurement of a single stretch using IRC guidelines. Some of the important indexes are used to measure traffic congestion, they are Congestion Index, Parking Index, Travel Time Index, Walkability index etc.

III.OBJECTIVES AND SCOPE OF THE STUDY

Objectives

- To measure the traffic congestion of network.
- To provide the data statistical figures, this can be utilized for future study and development.

Scope

- The present study gives Information about assessment of network traffic congestion and level of service of different routes and link with in a network.
- This study useful in future to understand the traffic congestion and their impact on transport system, environment and road users.

IV.STUDY AREA

The study area considered for the present work runs through South to North Bangalore i.e. test stretch starts at Banashankari in south and ends at Yelahanka in north. Location Map enclosed

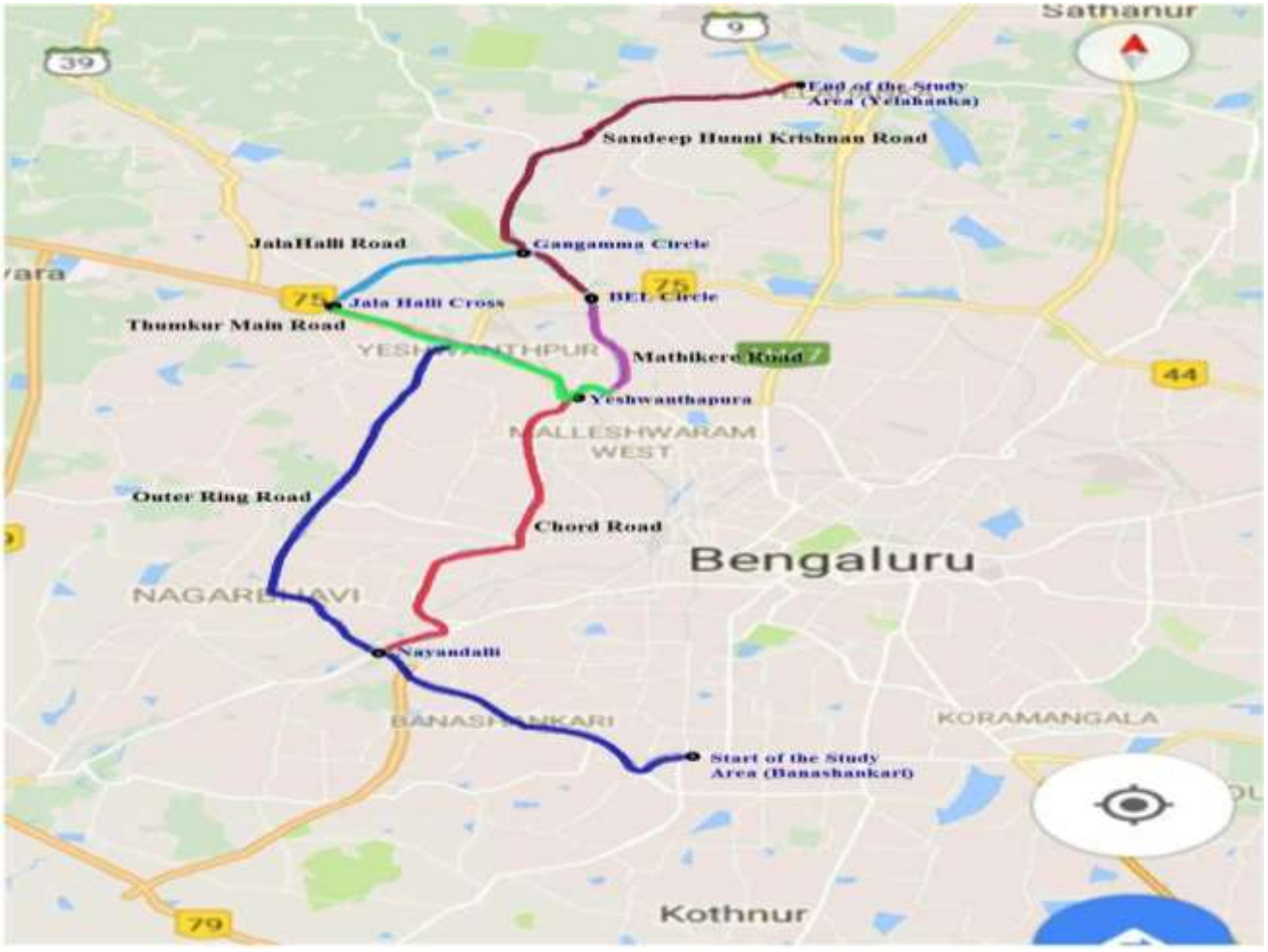


Figure 1 Location Map

V. METHODOLOGY OF THE STUDY

The research methodology consists three different parts for assessment of network traffic congestion. The study begins with selection of road network. Then a detailed field survey was done to collect the physical congestion parameter i.e., Average Speed, Free Flow Time, Total Travel Time and impact of other attributes such as Pedestrian Behavior and Road Surface Condition on different Route was assessed based empherical method. Finally calculate the Traffic Conge stability Index by using required variables.

VI. DETERMINATION OF TRAFFIC CONGESTABILITY INDEX

The assessment of traffic congestion in the study area requires information regarding the status of traffic on different routes in the city and condition of Road Surface along the routes of study area. Further the behavior of pedestrian on different routes needs to be assessed to determine the compound effect of these parameters on Traffic Congestion.

6.1 COLLECTION OF TRAFFIC DATA

Various field survey was done to assess the status of congestion, road surface conditions and behavior of pedestrian on different routes. The moving car observer technique was used to collect various parameters, i.e. free flow time, total travel time etc., on different routes of the study area. In the Moving observer technique, we drove in real time to collect physical congestion parameters using stop watch. The data was collected different time interval comprising peak hours and non-peak hours. Then status of traffic congestion i.e. congestion index value, was computed using the following formula

$$\mathbf{CIV = C\text{-}C_o / C_o} \quad \text{.....1}$$

Where,

CIV=Congestion Index Value
C= Travel Time in minutes
C_o=Free Flow Time in minutes

However it is not feasible to quantify the condition of road surfaces and pedestrian behavior in different sections of the study area. Instead of assessment of these factors was made on the basis of empirical observations.

6.2 ASSIGNMENT OF CONGESTION WEIGHTS TRO DIFFERENT ROUTES

Having determined the values of Congestion Index Values (CIV) for different routes of the study area, a congestion weight is assigned to all routes on the basis of a relative weighting. The formula for Congestion weight is as follows:

$$\mathbf{Congestion\ Weight = CIV_c / CIV_{max} \quad \text{.....2}}$$

Where,
CIV c = Congestion Index Value of Current Route
CIV max = Maximum Congestion Index Value.

The Congestion Index Value and Congestion weights for different routes are represented in the Table 1where the weight approaching 1 represent congestion condition.

6.3 IDENTIFICATION AND QUANTIFICATION OF THE TRAFFIC MANAGEMENT PARAMETER (TMP)

Irrespective of the transport infrastructure, i.e. an adequate number of routes to handle the traffic load, there are other factors which need to be considered to make traffic flow smooth. These factors could contribute to urban congestion. In the present investigation, the condition of road surfaces and pedestrian movement are seen as influencing parameters which have a direct impact over traffic flow. On the basis of empirical observations, knowledge-based weightings i.e. pedestrian weight and road surface weight (Table 1) are assigned to each and every route on a scale of 0 to 1 representing road surface conditions and pedestrian movements. A weight near 0 represents a worse situation whereas weight approaching 1 represents the best. Since both parameters, i.e. pedestrian movement and road surface conditions, can compound the degree of congestion, the mean of these weights is computed for all routes concerned and is termed the Traffic Management Parameter (TMP) (Table 1).

Table 1 Representation of Congestion Weight and Traffic Management Parameter of Different routes In the Study Area

Sl. No	Routes	CIV	CIV Weight	Pedestrian Weight	Road Surface Weight	TMP
1	Banashankari Bus Stop To Nayandalli Signal	0.38	0.58	0.7	0.92	0.81
2	Nayandalli Signal To Yeswanthapura (Outer Ring Road	0.43	0.66	0.7	0.93	0.82
3	Yeshwanthapura Bus Terminal To Jalahalli Cross (Thumkur Road)	0.65	1.00	0.5	0.95	0.73
4	Jalahalli Cross To Gangamma Circle	0.16	0.25	0.8	0.53	0.67
5	Gangamma Circle To Yelahanka Bus Terminal	0.11	0.18	0.8	0.92	0.86
6	Gangamma Circle To BELCircle	0.16	0.24	0.9	0.98	0.94
7	BEL Circle To Yeshwanthapura	0.17	0.27	0.5	0.73	0.67
8	Yeshwanthapura Bus Terminal To Nayandalli Signal (Through Chord Road)	0.27	0.42	0.7	0.93	0.82

6.4 THE CREATION OF DIFFERENT SPATIAL ZONES IN THE STUDY AREA

The whole study area is divided into three spatial zones. The zoning is done by considering land use pattern, infrastructure development and purpose of trip.Outer ring road from Banasankhari to Yeshwanthapura and West chord road from Yeshwanthapura to Nayandalli is comes under commercial zone. Because in these routes commercial buildings and shops are there in more numbers also some offices are there.Thumkur Road from yeshwanthapura to Jalahalli Cross, Jalahalli Road from Jalahalli Cross to Gangamma Circle, Sandeep hunni Kraishnan road from Gangamma circle to BEL Circle and BEL Circle to Yeshwanthapura roads are comes under indusrial zone. In these routes peenya industrial area,jalahalli airforce, Bharath Electronics Limited(BEL) and Indian institute of Science are come .From Gangamma Circle to

Yelahanka road (Sandeep Hunni Krishnan Road) is considered as mixed zone, because in this route open area is came also residential and industrial areas are there. That why this zone is considered as mixed zone.

6.5 COMPUTATION OF TRAFFFIC CONGESTABILITY INDEX

Traffic Congestability index is calculated by using Congestion Value and Traffic Management Parameters. Following formula is used for calculation of TCI-Traffic Congestabiity Index.

TCI= (1/MCIV)*MTMP ……3

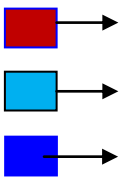
Where,

TCV=Traffic Congestability Index
MCIV=Mean Congestion Index Value
MTMP=Mean Traffic Management Parameter

Table 2 represents influencing variables of proposed formula and TCI value of different Spatial Zones in the study area.

Table 2 Influencing Variables of TCI and Traffic Congestability Index of Different Zones of the Study Area

Sl. No.	Zones	Routes	MCIV	MTMP	TCV
I	Commercial Zone	Banashankari Bus Stop To Nayandalli Signal	0.36	0.82	2.27
		Nayandalli Signal To Yeswanthapura (Through Outer Ring Road)			
		Yeshwanthapura Bus Terminal To Nayandalli Signal (Through Chord Road)			
II	Industrial Zone	Yeshwanthapura Bus Terminal To Jalahalli Cross (Thumkur Road)	0.29	0.75	2.59
		Jalahalli Cross To Gangamma Circle			
		Gangamma Circle To Bel Circle			
		Bel Circle To Yeshwanthapura			
III	Mixed Zone	Gangamma Circle To Yelahanka Bus Terminal	0.11	0.86	7.82



COMMERCIAL ZONE, TCV=2.27

INDUSTRIAL ZONE, TCV=2.59

MIXED ZONE, TCV=7.82

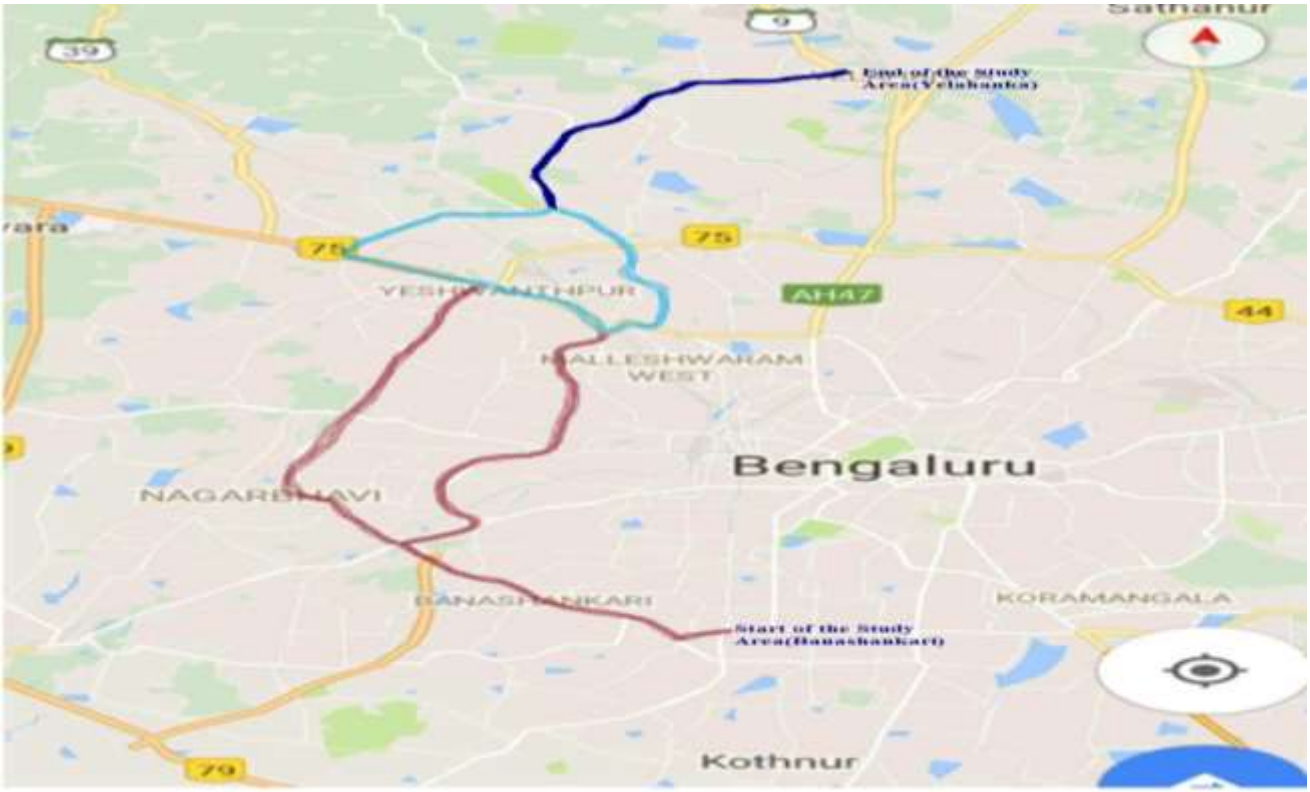


Figure 2: Representation of Different Spatial Zones of the Study Area in Google Map

VII.CONCLUSIONS

- In the present study network congestion in different spatial zones is measured through a new index value called as Traffic Congestability Index (TCI). Lower TCI indicates higher degree of congestion in a zone and higher value of TCI indicates lesser congestion in a zone.
- Effective Transportation System (ETS) depends more on Network Congestion than link flow. In this study Network congestion measurements for different zones is considered instead of link flow.
- TCI gives realistic value of congestion in a zone. Traffic Congestion Index represent realistic situation in a zone. TCI have both Micro level parameter such as Traffic flow and macro level parameter like spatial zone &infrastructure development. Because of these parameters TCI is more realistic compared to other indexes.
- The proposed TCI consist of variables representing both capacity and probable irregularities in a transport network. Number of routes represents the capacity of the transport network. Other variables like Pedestrian behavior about traffic congestion and road surface condition of different routes were used to assess the internal irregularities of the transportation network. In general variables representing capacity of transportation network remain the same across different areas. Internal regularities were considered based on study area characteristics. Thus there are no changes required in the concept of TCI. TCI formula can applicable for assessment of network congestion of different areas.
- The Results of the study clearly indicates that the First and Second Spatial Zones are the most congested with TCI values 2.27 & 2.63 respectively. Hence following measures are recommended to reduce congestion particularly in above mentioned zones:
- In Commercial zone (Zone I) constructions activities must be completed as early as possible.
- Prevention of road side parking and maintenance of foot path throughout the study stretch.
- Comparatively zone-I is experiencing more congestion than zone-II because of dense development on either side of the road, since zone-I is majorly occupied with large number of Industries trips destined and originating to and from that zone are more. Since widening of road is also difficult on this stretch in order to reduce the congestion redistribution of through traffic is necessary during Peak hours.

- Maintenance of Road surface and Foot path.
- Encouraging road users to Use of Mass Public Transportation as such Metro train and public bus transport May reduce Congestion in zone-II.
- Zone III has CIV value of 7.82 which indicates less congestion Compared to Zone I & Zone II, reason being mixed land use pattern, less road side developments and also it is far from CBD. Only foot path maintenance is recommended at this zone.

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