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Transitional Probabilities of Influencing Factors on Road Traffic Congestion on Urban Roads

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Abstract

Traffic Congestion is a phenomena occurring temporarily acting as a hurdle block in a transportation system. Congestion exhibits multiple faces when it is calibrated for its causes and effects in a study area. Traffic Congestion in Indian Roads are due to different influencing factors – Traffic Composition, Pavement Surface Condition, and Road Geometrics, Right of Way Violation, Land Use, Pedestrians, Stationed Vehicles and Functional Hierarchy of roads. Moreover, congestion and behavior of congestion does not restrict itself to a single factor. It has a tendency to transit from one factor to the other. The cities are growing at a rapid rate with reference to Business, Commercial, Educational and technological aspects; the land use pattern is also getting promoted to decentralized activities of business, educational and residential. Due to this the functionality of the road is changing but then the geometrical condition remains same which leads to many urban traffic issues. In short the traffic has become dynamic but the network characteristics remains static. As there is a rapid increase in traffic volumes which are almost all equal to or sometimes exceeding the capacity of the road the level of service is falling down. The travel time has gone upto 1.4 to 1.5 times the journey time due to congestions resulting into a burden or loss to society of about 1.44 Lakh crore as per a uber study in recent times. This can seriously have an impact in the economy of a city or a nation. Vehicle operating cost increases along with the potential of pollution due to recurring traffic congestions in the urban districts specially in central business districts in peak hours. Researchers in the recent past have suggested that the analysis of urban traffic congestion must be predicted upon theoretically consistent models using the old conventional factors. In the present study, a mechanism is proposed based on the rationality of influencing factors imparting different level of congestions and actual influencing factors leading to the congestions are identified. The study area is earmarked with the help of google earth and improvised with Qgis and Autocad to obtain a clear map or view of the study area. The change in land use and Builtup Area are studied with right of violation & stationed vehicles which have been found to be the most predominant factor of influencing the traffic congestions. It is observed that quality of traffic congestion varies with different type of influencing factor. Hence actual influencing factors which are causing the severity in traffic congestion are identified by observations and detailed network study.

Keywords: *Influencing Factors; Land Use; Right of Way Violation; Stationed Vehicles; Traffic Congestions*

1. Introduction

Transportation planning aims to provide higher level of service by reducing travel time of journeys, reducing accidents, pollution free environment, and reduced vehicle operating cost which certainly results

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in socio-economic development of region beside a healthy environment. Transportation planning plays a vital role in different fields of human life having financial, physical and well-being interference. Developing countries over the globe is facing serious challenges due to dynamic traffic congestion problem leading to inefficient and ineffective unsteady condition to the vehicles in transportation system. The analysis and evaluation of traffic congestion based on its transitional phenomena is need of hour and burning need of researchers in the field of traffic planning and maintenance measures. Quantification of traffic congestion has been the biggest challenge to researchers where in congestion occurring with regard to single factor is more emphasized. The effect of multi factor is less addressed. Much of the attention is being given to traditional factors – traveler choice of route, time and speed. The most influencing factors like Traffic Composition, Pavement Surface Condition, and Road Geometrics, Right of Way Violation, Land Use, Pedestrians, Stationed Vehicles and Non- Hierarchical maintenance of roads and others are less considered. The multi-faceted nature and transiting phenomena of traffic have warranted determining more realistic trends of traffic congestion both at midblock and intersections. In the present study, the factor influencing congestions are identified and evaluated. It has been addressed that the traffic congestion in a transportation system is not really an inherited outcome of traffic characteristics. The unplanned land use settlements, non-hierarchical utilization, maintenance and development of roads, encroachment of right of way, reduced carriage way, illegal on-street parking in a transport system is creating serious traffic congestion to the free traffic flow. An insight exposure to the dynamic traffic congestion problem is warranted for the planning and finding measures to mitigate the traffic congestion. In the present study an attempt is made to identify the congestion in a traffic flow stream. Research study shows and reveals that extensive study has been made taking into considerations the normal and regular parameters, but in actual scenario as the land-use has been changing continuously and with the presence of poor supportive infrastructure and violation of right of way, there has been a drastic change in the congestion behavior of roads. Road networks can be defined as series of nodes and links which represents spatial locations and connections exhibiting geometric variations and topological variations. As part of research many researchers have done contribution by making base of these two factors and then introducing higher attributes such as spacing, shape , orientation and geometric patterns. In the past i,e early 1960s network characteristics and structure were measured by geographers and transportation researchers (Garrison 1960, Marble 1962 and Kansy 1963) by using graph theoretic network analysis constrained by limited data. Attempts have been made in the past for implementing the concepts of fractal dimension in road network by Hausdrauff 1919 and Richardson 1961. Subsequently these concepts were more developed and made firm by Mandelbrot in the year 1967 who stated that if a straight line or a plane is absolute with Euclidean dimension having fractal dimension 1 or 2, then the spatial objects such as sea shore which bends in the plane will have a fractal dimension between 1 and 2 when urban growth pattern is more likely “concentrated” (Chen and Jiang 2010) Proposes a method to analyze the spatial structure of urban systems using ideas from fractals. Regarding a system of cities as a set of “particles” distributed randomly on a triangular lattice, a spatial correlation function of cities is constructed. Suppose that the spatial correlation follows the power law. It can be proved that the correlation exponent is the second order generalized dimension. (Chen 2013) Stated that the area-perimeter scaling can be employed to evaluate the fractal dimension of urban boundaries and the formula in common use seems to be not correct. (Thomas and Frankhauser 2013) compared the fractal dimension measured on built-up spaces with the fractal dimension measured on the street network in an urban environment. The differences are demonstrated theoretically and empirically. Fractal dimensions, curves of scaling behavior, and concordance analyses are computed for the city region of Antwerp. It is clear that the fractal dimension measured on built-up spaces is a quantity that indicates how uniformly buildings fill space when zooming to ever finer scales, while the fractal dimension measured on networks indicates the extent

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to which street segments are uniformly distributed in the study area. (Vilayath and Lakshmana Rao 2016) Visualised the fractal view of different urban areas and suggested to analyse the road network on different parameters – Accessibility, Mobility, Connectivity, Self –Similarity (Visualizing the fractal view) to improve the existing infrastructures. Behaviour and characteristics of links were studied and subsequently Transverse Corridors and Longitudinal Corridors with the feeder roads to increase the functionality of the sub-arterial roads were proposed. (Boeing 2018) stated that research in multiple literature streams has considered cities, ecosystems, and other Physical phenomena in terms of systemic complexity. (Chen and Huang 2019) demonstrated an experimental method to find parametric models for the growth curves of fractal dimension of Chinese urban form. By statistical analysis, numerical analysis, and comparative analysis, it was observed that the quadratic Boltzmann equation and quadratic logistic function can be used to characterize the fractal dimension of the urban land-use pattern of Beijing city which increases in the course of time. [1-5]

2. Methodology

The Methodology adopted for the present study is illustrated in the form of flow chart. The study area is identified and the entire road network is captured with the help of Google earth and Qgis software. The entire road network is studied in detail with respect to the functional hierarchy and all the different influencing factors are studied. The static features of the road network is be captured by video graphic survey where in high resolution cameras is used for recording the Right of Way Violation, Road Geometrics, Stationed Vehicles, Pavement Surface Condition and traffic composition. The road network accessibility, Road Density and Network Connectivity is determined by the map of the study area obtained by the Google Earth and Qgis software. Existing Land use and the Built-up area along the stretches of the road are also studied to access the change in land use with respect to the traffic volumes and compositions. Figure 1 shows Flow-Chart Illustrating the Methodology. [6-10]

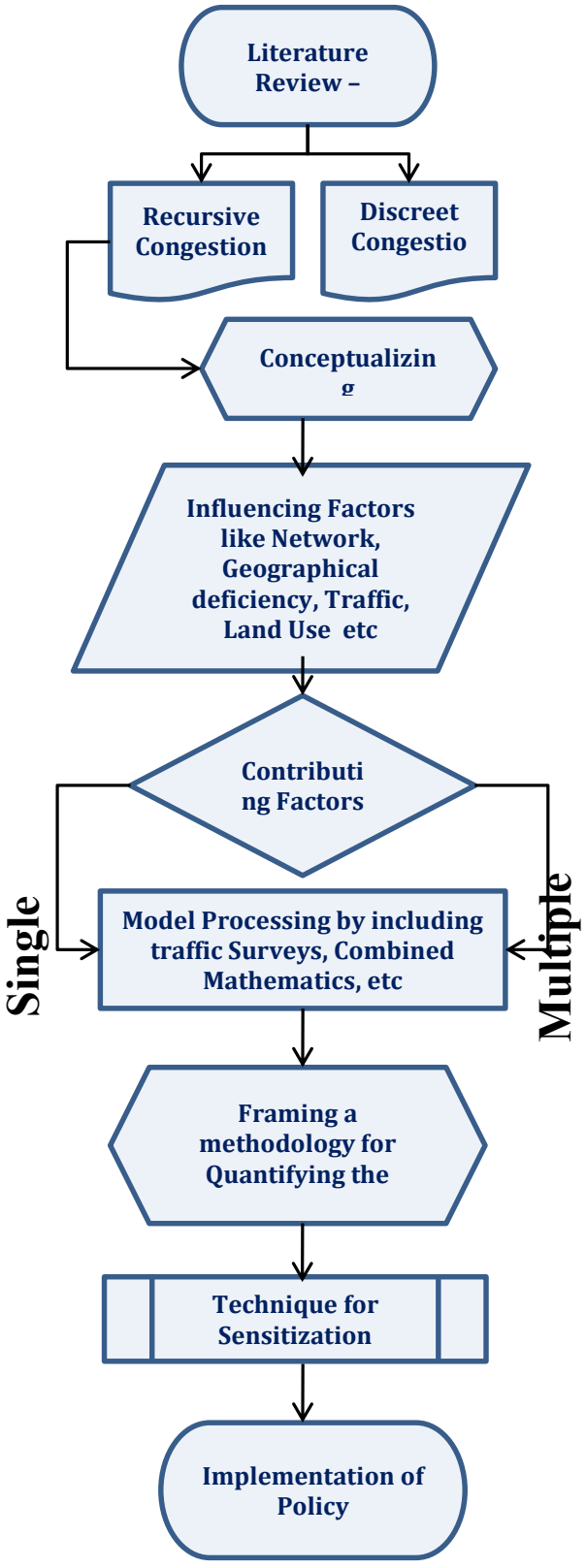

Figure 1 Flow-Chart Illustrating the Methodology

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3. Results and Discussion

The study area comprises of a circle of diameter 3 Km with Tolichowki, Hyderabad Telangana India as a centre. The study area comprises of many Commercial Establishments, Schools, Hotels, Hospitals and many other traffic attraction centers. The complete road network is divided into Arterial Roads, Sub Arterial Roads & Collector Roads which are summarized as in Table 1. (Refer Figure 2, 3)

Table 1 Detail of Roads

Details of Arterial Roads		
S.No	From	To
1	Shaikpet	Nanal Nagar
2	Nanal Nagar	Shaikpet
Details of Sub -Arterial Roads		
S.No	From	To
1	Tolichowki X Roads	7 Tombs Road
2	7 Tombs Roads	Tolichowki Road
3	Limra Food Court	Motidarwaza
4	Brindavan Colony	Apollo Hospital
5	Nanal Nagar	Khadarbagh
6	Tolichowki X Roads	Lotous Pond Road
Details of Collector Streets		
S.No	From	To
1	Md Lines	Jamali Darwaza
2	Salarjung colony	Flour Mill Road
3	Md Lines	Military Area

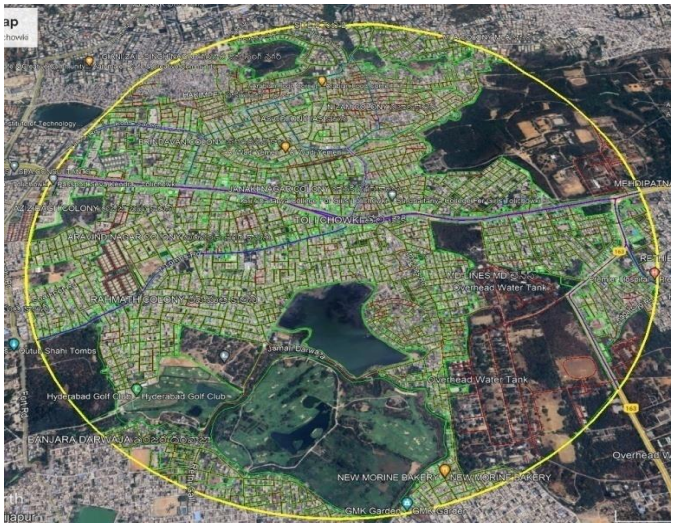

Figure 2 Image of Study Area

Table 2 Data Collected for a Part stretch of Road

S.No	Influencing factor	Condition Vailable in the Segment
1	**Traffic Composition**	Classified Counts are avilable
2	**Stationed Vehicles**	Car = 9, 2W=20, Auto=6, LCV=5
3	**Right of Way Violation**	1) ROW available for initial 150 m lenth but utilised for parking. 2) Road Side Shops - 10 Nos @ 5m X 5m each 3) Footpath 2m wide available for 150m Stretch but encroached and used by small vendors
4	**Road Geometrics**	1) Width of roads at an interval of 25 m 2) Shoulder Not Available 3) Pavement Surface - Smooth and Even 4) Kerb available
5	**Functional Hierarchical Connectivity**	For the initial 400m Stretch road is 3 lane and then reduces to single lane in the remaining 100m stretch.
6	**Supportive Infrastructure**	1) Road Markings available 2) Foot Path available 3) Sufficient Lighting Vailable 4) Road Medians/dividers are available
7	**Pedeastrians**	Pedestrians = 106
8	**Landuse**	1) Total Builtup area upto 50m adjacent of Road Line is 500 X 50 X3 = 75000 Sq m 2) Banks, Supermarkets, Fruit Shops, Restaurants, Hospitals, Shops, Showrooms,Gym, Bustops, Local Vendors, Reliance Supermarket, Illegal Parkings, Road Side Business Activities and Schools

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3.1.Discussion

The traffic composition on each Arterial, Sub Arterial and Collector Streets are recorded. The static features of all these roads – Stationed Vehicles, Right of Way Violations, and Road Geometrics are also captured. The Network Accessibility, Network Connectivity and Road Density of all types of roads are evaluated with the help of the study area map obtained with the help of Google Earth and Qgis. Table 2 shows Data Collected for a Part stretch of Road. When a detailed study is made with respect to the traffic composition and different influencing factors and the static features of the roads following points are observed:-

i. It is observed that at peak hours the capacities of the roads seems to be lesser than the volumes of traffic.
ii. Road side business activities and Stationed vehicles are impacting to large extent which is reducing the carriage way resulting to poor road geometrics
iii. Change in adjacent Land use has been noticed which is seriously resulting in the delays.
iv. Right of way Violation and absence of service roads is intruding the through traffic which is also leading to serious delays.
v. Traffic Composition and Pavement surface condition is also resulting delays and congestions at the junctions of Sub-Arterial roads and Arterial Roads.
vi. The effect of multi factors are felt which is causing traffic congestions

Figure 3 Sample of More Improvised Image

Conclusion

i. In view of the present study, it can be stated that the traffic congestions are multifaceted in nature. Rational Quantification of Congestion has been the biggest challenge, wherein congestion occurring with regard to single factor is more emphasized. The effect of Multi Factor is not addressed [11]
ii. Much of the attention is being given to only traditional factor – traveler's choice of route, time and speed and the other most influencing factors like Stationed Vehicles, Right of Way Violations, Supportive Infrastructure, Network Access and Network Connectivity are not addressed. Need to determine more realistic trends of traffic congestion both at midblock and intersections.
iii. The operational characteristic or Volume Characteristics have been used independently or singularly on urban roads for the quantification Congestion levels. A balance measure of Congestions has to be done by incorporating both Volume Characteristics and Operational Characteristics.

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