Congestion Causes in CBD Areas and its Mitigation Measures: A Review

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Abstract

Nowadays, all the world's cities face congestion problems throughout the day, especially during peak hours. This study consists of analysing the traffic characteristics such as volume count, spot speed of the vehicles to find out the travel time index of the road corridor. Various software such as VISSIM, geo tracker, VISUM etc., has been used to find out further the LOS, delay and travel time of the road corridor. After analysing the problems caused by the congestion, mitigation measures are given in various researches that could help regulate the traffic and reduce the causes of congestion.

Keywords: *- Congestion, CBD area, Travel time index, Delay, Level of service*

INTRODUCTION

Congestion

Traffic congestion is a situation where slow vehicular speeds, increased travel time, increased delay, and increased vehicular queueing are seen. When traffic demand is high enough that the flow between vehicles slows the pace of the traffic stream, this results in congestion.

Congestion is usually the number of vehicles that pass through a point in a period or a flow. Traffic congestion occurs when a traffic volume or modal demand for space is greater than the available street capacity, called saturation. Several specific situations cause or lead to congestion. Most of them reduce the capacity of a road at a given point or over a stretch or increase the number of vehicles required for a given volume of people or goods. Wasted fuel increases air pollution and carbon dioxide emissions, leading to improved acceleration and braking, which are adverse effects of congestion.

Traffic congestion can be caused by various reasons such as on-street parking, the inability of traffic wardens, weather conditions etc.

CBD Area

A central business district (CBD) is the commercial and business centre of a city. In larger cities, it is often synonymous with the city's "financial district".

Geographically, it often coincides with the "city centre" or "downtown", but the two concepts are separate: many cities have a central business

district located away from its commercial or cultural city centre or downtown, or even several CBDs at once.

The CBD area of Vadodara consists of areas such as Raopura. These areas are flooded with traffic almost all the time of the day.

Delay

The additional time experienced by the road user in comparison to the free-flow travel time.

Delay = free flow time – peak hour flow time

Measures of traffic congestion

Measures of traffic congestion can be categorised into four major groups.

a. Basic measures
b. Ratio measures
c. Level of service
d. Indices

(A) Basic measures

These are normally related to delay estimations. E.g., volume to capacity (V/C), free-flow speed, percentile speed, etc.

(B) Ratio measures

These are developed by dividing one travel time or delay element by another, such as delay rate, relative delay rate,

Delay ratio, DRA = DR/TRap

Where,

Travel rate (TR) = TT/Ls= 60/v

Ls= segment length (miles)

V= travel speed (mph)

TRac = actual travel rate (minutes per mile)

TRap = acceptable travel rate (minutes per mile)

(C) Level of service measures

The LOS of a facility is determined by traffic flow characteristics such as vehicle density, volume-to-capacity ratio, average speed and intersection delay.

(D) Indices

Index measures have been developed by including several congestion-related elements in an equation to produce a single measure. The congestion index is the ratio of the link delay (the difference between actual and acceptable travel time) to the acceptable travel time.

Travel Time Index (TTI)

It was proposed in the Urban Mobility Report by Lomax and Schrank in 2005. Peak period travel and free-flow travel are compared in this index both by re-occurring and incident conditions. Travel time in free-flow conditions and travel time in peak hour conditions. It can express congestion concerning speed as well as space.

Travel Time Index (TTI) = peak period travel time / free flow travel time

Traffic congestion- Causes and solution: Kota city by Harish Uniyal and Dr Hemlata Gandhi (2018).

In this paper, the authors conducted a videography survey in twelve different areas of Kota city situated in Rajasthan, namely Bajariya market, Nayapura, Arya Samaj Road, Gandhi Chowk, Chaar Khamba and Agrasen market, Old vegetable market, Shripura market, Gumanpura market, Chhawani, Aerodrome Circle, Commerce college road and Satoshi Nagarchauraha. An inventory survey was conducted, and the delay, traffic volume, LOS, queue length was obtained. The analysis of all the areas was carried out, and the causes of congestion were noted. Most of the places are the victims of the encroachment of roads by the local shopkeepers, and shortage of

parking space encourages the people to park their vehicles on the main road that also causes congestion. NH12 and NH76 pass through Nayapura, making the area more prone to accidents. Solutions proposed by the authors include improving road infrastructures, road capacity expansion, restricting rickshaw routes, providing a separate place for the fruits and vegetable vendors, providing a space specifically for parking. Etc.

Traffic congestion at road intersections in Ilorin, Nigeria by Tolu Isaac Atomode (2012)

In this paper, the author conducted a manual traffic volume count at seven intersections of Ilorin, Nigeria, namely Sawmill/airport, Surulere/Agbooba, Oloje/Mount Carmel College, Taiwo/ Ita Amodu, Murtala/Amilegbe, Tanke/tipper garage and Gaa-Akanbi/Offa garage. The volume count was conducted two times a day, i.e. in the morning and afternoon peak hours. The volume count provided them with the composition of the traffic and the delay (in minutes). According to the analysis done by the authors, traffic wardens cause a problem in delay due to a lack of modern traffic management techniques. The parking leads to the narrowing in the road, causing a problem in turning manoeuvres. All the approaches of the intersections can be made broad for up to 200-300 meters to avoid obstruction to side turning vehicles by the straight moving vehicles. Public transportation like high-capacity buses can be increased that will lead to fewer vehicles on roads.

Determination for congestion charge for car users in CBD area of Thiruvananthapuram city by Tina Maria Sunny and Jomy Thomas (2015)

The authors selected six major corridors in this paper, namely Sreekaryam, Sasthamangalam, Vellayambalam-Peroorkada, Pappanamcode overbridge Palayam-Chakai and Attakulangara-LMS. The moving car observer method was used to determine the journey speed and delay. The time taken to travel each of the stretches was noted using a stopwatch. A questionnaire of the origin-destination survey was also conducted, and the purpose of the trip was also collected. Interviews of public and private firm employees were also shown to obtain their views about the congestion. Travel time cost, pollution cost and fuel cost of the vehicles were also calculated for the peak hours. The co-efficient of the Bureau of Public Roads (BPR) model for travel time data were calculated using SPSS (Statistical Packages of Social Sciences) software. The variation of external cost and demand elasticity curve for users were plotted, and the congestion charge was estimated. The travel time index (TTI), fuel cost and pollution cost were obtained. The value of travel time for car users was estimated to be Rs.102.93 per hour. The Mahatma Gandhi Road, the CBD area of Thiruvananthapuram has the highest travel time index value of 4.45. Providing alternative routes can also be beneficial in reducing congestion.

Modelling of Congestion: A tool for Urban Traffic Management in Developing countries by B. Maitra, P. K. Sikdar and S. L. Dhingra (2004)

In this paper, the authors wanted to understand the effects of different types of vehicles on congestion. These effects can be understood based on marginal congestion. The marginal congestion was captured using the congestion models for different road widths, traffic compositions, and on-street parking levels. For assessing the operating conditions for other roads based on comparable quantitative

measures, the marginal congestion caused per Passenger car unit (PCU) of mixed traffic streams has been estimated by marginal congestion index (MCI). Traffic management measures like restricting the entry of heavy vehicles or enforcing variable pricing in diverse traffic operations.

Traffic congestion in Urban Roads Network using GIS technology by Waheeda Mustafa Omer and Dr Abdul Khalik.

Service (LOS) and Volume to capacity (V/C), also known as the demand to supply ratio. The current study is limited to the highway capacity volume (HCM 2000). They have used microscopic flow models as well as macroscopic flow models. GIS technology was used to analyse the data collected over all the stretches. The author stated that GIS is a powerful tool for analysis as a congestion performance measurement. The authors proposed some measures to reduce congestion which are stated below:-

- Reducing trip generation demand on the road network at peak hours.
- Reducing at-grade junctions on-street network.
- Giving priority to bus lanes at signalised intersections for movement before other traffic services by allocating lanes for HOV.
- To use ITS by putting movable median barriers to add capacity during peak hours, optimising signal timing etc.

Road traffic congestion measurement considering impacts on travellers by Liang Ye, Ying Hui and Dongyyuan Yang (2013)

In this study, the survey was carried out as it was in the previous researches. Still, apart from that, they conducted a questionnaire survey asking the people about several members, their educational background, occupation, income etc. They also used three congestion indicators like Transportation environment satisfaction (TES), traffic congestion frequency and feeling (TCFF) and travel time satisfaction (TTS) to estimate urban traffic congestion based on travellers. Data of traveller's attitude towards the congestion and trip information was collected using survey in Shanghai, China. The feelings and the attitude towards the congestion can be estimated by the congestion indicators can be known by the government then appropriate transportation policy can be applied to cope up with the congestion. From the questionnaire survey it was found that 30% respondents were unsatisfied with the transportation facilities and 23% respondents said that they were unsatisfied with the travel time of most of the trips. Pedestrians also cause congestion at a great extent, so proper pedestrian crossings and signals can be provided to reduce the same.

Congestion Indicators and Congestion Impacts: A study on the Relevance of Area-wide Indicators by Carlos A. Moran Toledo (2011)

Congestion indicators like Excess delay (ExD), Travel time index (TTI), Relative speed reduction (RSR) (weighted average and networks as a link), Queue indicator were used, and the simulation was carried out using VISSIM (PTV 2009). Regression analyses have been used to identify indicators that better describe delay and pollutant emissions. When considering NOX emissions, none of the hands worked satisfactorily, and when considering multiple areas, RSR performed best, followed by ExD and TTI performed best when single networks were considered. The LOS, delay and emissions can be obtained by VISSIM (PTV 2009) for giving results and conclusions.

Traffic congestion in Dhaka city and its impact by Sonjoy Chakraborty (2016)

The current study has been conducted to estimate the total traffic congestion cost of Dhaka city, Bangladesh and to analyse the impact of traffic congestion. The study is mainly based on a literature survey. To calculate traffic congestion cost, the component travel time cost (TTC), Deadweight loss (DWL), EC (travel delay externality cost), vehicle operating cost (VOC), environmental externality cost (EC), road traffic accident cost (RTAC). After calculating the components, the author proposed a few mitigation measures to reduce congestion.

- Introducing U-loop systems at the intersection points can help reduce congestion.
- Introducing a job housing balance policy can reduce congestion.
- Developing bicycle networks can help in reducing congestion.

CONCLUSION

Day by day, the congestion increases due to the increasing demand for vehicles and the rise in population. By studying the above papers, I conclude that various mitigation measures given in the papers can help reduce congestion and make the traffic flow easy and smooth. The researchers state that minor changes in traffic and rules implementation can go a long way in regulating traffic and congestion problems.

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