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EVALUATING TRAFFIC CONGESTION AND ITS REMEDIAL MEASURES

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Abstract - *Traffic congestion continues to remain a major problem in most cities around the world, especially in developing regions resulting in massive delays, increased fuel wastage and monetary losses. Due to the poorly planned road networks a common outcome in many developing regions is the presence of small critical areas which are common hot-spots for congestion. Poor traffic management around these hot-spots potentially results in traffic congestions which ultimately causes elongated traffic jams. Traffic congestion creates negative impact on society and it becomes a necessity to control it. In the recent past, traffic congestion has emerged as one of the main challenge for engineers, planners and policy makers in urban areas.*

The present studies are carried out to evaluate traffic congestion on NH-152 which connects the two cities Dera Bassi and Zirakpur which is a stretch of 9.00 km. Dera Bassi and Zirakpur are the two cities of Chandigarh consisting a total population of almost 1,22,538. Factories, markets, shopping malls, hospitals and residential areas are existing on this stretch. The traffic volume on this stretch is high. This stretch remains quite busy due to continuous traffic movement leading to traffic congestion. The main aim of this study is to evaluate traffic congestion and to propose necessary remedial measures.

Key Words: **Traffic, Congestion, Adil, Remedies, traffic volume, Traffic flow, Traffic capacity**

1.INTRODUCTION

Road became important means of transportation during the reign of Roman Empire. At that time man, animals, chariot were used as major carrier in road transportation. But the invention of the motor vehicle meant that roads were no longer meant for pedestrian, chariots and animals. This lead to the construction and improvements of roads.

Cities and traffic have developed hand-in-hand since the earliest large human settlements. Rapid industrialization and the consequent urbanization is taking place since last few decades in all over the world, India is no exception. Transport demand in most Indian cities has increased substantially due to increase in population as a result of both natural and migration from rural areas and small towns. Availability of motorized transport has also increased. But the demand and the construction of new highway capacity to accommodate this growth has not kept pace leading to congestion.

There is no single, broadly accepted definition of traffic congestion. One of the principal reasons for this lack of consensus is that congestion is both:

i. A physical phenomenon relating to the manner in which vehicles impede each other's progression as demand for limited road space approaches full capacity.
ii. A relative phenomenon relating to user expectations *vis-à-vis* road system performance.

Both operational and user perspectives are important in understanding congestion and its impacts. Traffic congestion is a condition on transport networks that occurs as use increases and is characterized by slower speeds, longer trip times and increased vehicular queuing. When traffic demand is great enough that the interaction between vehicles slows the speed of the traffic stream this results in some congestion. Congestion is a possibility for any mode of transportation. As demand approaches the capacity of a road or of the intersection along the road, extreme traffic congestion sets in. When vehicles are fully stopped for periods of time, this is colloquially known as traffic jam or traffic snarl-up.

Most of us at some point in our lives have had the misfortune of experiencing the effect of a congested roadway. For a majority of commuters, traffic congestion has become something that they endure on a regular basis during their morning and evening commutes. However, aside from the frustration and aggravation of creeping through slow moving traffic, congested roadways exert both private costs in wasted time and fuel and social costs in the from increased travel times for all commuters as well as the release of pollutants and greenhouse gas emissions into the air.

Traffic in developing countries like India, is however very different in its form and characteristics. Two-wheeler motorbikes, three-wheeler auto-rickshaws, four-wheeler cars and heavy vehicles likes buses and trucks ply together on the same road intermingled with each other without any lane discipline. Such non-lane based disorderly traffic with high heterogeneity of vehicles cause traffic congestion.

Traffic congestion may be of two types:

1. Recurrent congestion: This congestion generally occurs at the same place, at the same time every weekday or weekend day. This is generally the consequence of factors that act regularly or periodically on the transportation system such as daily commuting or weekend trips. Recurrent congestion is predictable and typically occurs during peak hours. It displays a large degree of randomness in terms of duration and severity.
2. Non-Recurrent congestion: This congestion is the effect of unexpected, unplanned large events like road works, accidents and special events and so on that effect transportation system more or less randomly. This type of congestion cannot be predicted easily.

1.2 TRAFFIC CONGESTION C+AUSES:

i. Too many cars for roadway due to inadequate mass transport system.
ii. Obstacles in the road causing a blockage like double parking, road work, an accident etc.
iii. Malfunctioned traffic signals.
iv. Too many pedestrian crossings not permitting cars to turn.
v. Overdevelopment in areas where the mass transport system is already overcrowded.
vi. Inadequate road system.

1.3 TRAFFIC CONGESTION EFFECTS:

i. Loss of valuable time due to unexpected traffic.
ii. Increase in travel time.
iii. More consumption of fuel thereby causing fuel loss.
iv. One of the most harmful effects of traffic congestion is its impact on environment.
v. Drivers who become impatient may be more likely to drive aggressively and dangerously causing accidents.
vi. Negative impact on people's psychological state, which may affect productivity at work and personal relationships.
vii. Increase in vehicle maintenance cost due to wear and tear on mechanical components of vehicle.
viii. Decrease in road surface lifetime.

The summation of all these effects yields a considerable loss for the society and the economy of an urban area. The overall effects of traffic congestion can be broadly be categorized under; Health effects, Environmental effects and Economy effect. Roads serve the important function of carrying people and goods around the city. These are like blood vessels circulating nutrients to feed our body. If we do nothing to contain congestion, it will continue to erode the environment, sustainability, quality of life and competitiveness of our city. Immediate action is warranted.

2 METHODOLOGY AND DATA COLLECTION

2.1 METHODOLOGY

The concept of evaluating traffic congestion and its remedial measures has become clear to some extent in the first chapter of this dissertation. The methodology used to reach the goals of this dissertation has been discussed in this chapter. Below given flow chart shows the methodology adopted:

The data is collected by indirect method in which videography is used as a sub method. In this method a high resolution camera is used. This camera setup is having 24-megapixel (f/2.2, 1.25-micron) resolution and it is capable to record full HD 1080p video on 30 frames per second. The camera is placed on a tripod stand in order to keep it in stable position while recording video.

With the help of high resolution camera, data is collected for at least 30 minutes interval at each station during peak hour. A section of 10 meters length is selected by placing markers on both sides of the road for each location. Then the camera is placed at the centre of the section so that the entire station was covered. Since it is a 4 lane divided highway, the data is collected separately for upstream and downstream vehicular moments for each selected locations. The data collected by video camera was then decoded in the computer by playing the video with the help of video player.

The data is collected from three selected stations. These three stations selected are having high volume of mixed traffic. The various stations of the study area are enlisted below:

i. For Station 1:
   a) Location A1 is on RHS
   b) Location A2 is on LHS
ii. For Station 2:
   a) Location B1 is on RHS
   b) Location B2 is on LHS
iii. For Station 3:
   a) Location C1 is on RHS
   b) Location C2 is on LHS

The road stretch of 9.00 km between Dera Bassi to Zirakpur located on NH-152 has been selected for evaluating traffic congestion and its remedial measures. These are the suburbs of Chandigarh. From Chandigarh Dera Bassi lies at a distance of 20.00 km and Zirakpur lies at a distance of 11.00 km. Factories, markets, shopping malls, hospitals and residential areas exists on this stretch. The traffic volume on this stretch is high. Due to the high volume of traffic this stretch remains quite busy leading to

congestion. It becomes necessary to evaluate traffic congestion on this stretch. Based on the evaluation of traffic congestion necessary remedial measures shall be implemented in order to remove or reduce the traffic congestion.

2.2 BASIC PARAMETERS OF TRAFFIC MOVEMENT

2.2.1 FLOW

It is also known as volume, which is the number of vehicles passing a specified point during a stated period of time. Flow of traffic is denoted by "q".Traffic flow is usually measured by observing a road and noting down the number of vehicles passing by you.

$$q = \frac{n}{t}$$

Where "***n***" is the number of vehicles that passed by a point during the time frame "**t**".The flow is equal to zero in two cases - either when there is no traffic (no cars present on the road) or when all vehicles are stuck in a traffic jam and cannot move forward. There are four important flow measurement applications:

i. Existing Traffic Demand
ii. Service Volume
iii. Capacity
iv. Saturation Flow Rate

2.2.2 DENSITY

It is also known as concentration, it is the number of vehicles present in a stated length of road at any instant. Density of vehicles can be measured by counting the number of vehicles in chosen length. The number of vehicles in this length is counted on each series of frames and the mean value of density can be found by averaging out the density in a number of frames. The density is generally averaged over certain duration of time. Density is denoted by "k".

Density tells us how significant the congestion of cars on the road is. If the density reaches its maximum, the flow drops to zero and a traffic jam is formed. Density is noted for every 10 second interval within the subjected region. The density is measured as the number of vehicles "***m***" that occupies a segment of a road of a length"L". To calculate it, simply divide these two values:

$$k = \frac{m}{L}$$

The reciprocal of the traffic density is the **headway** that is the distance between the front tips of two vehicles driving one after another.

2.2.3 SPEED

In traffic engineering language speed is the rate of movement of traffic or of specified components of traffic and is expressed in m/s. In actual practice it is not possible to calculate the speed of every individual vehicle. Due to this the average speed is taken into consideration. The average speed can be calculated in two ways:

i. Time mean speed
ii. Space mean speed

Time mean speed (v) is defined as the average speed measurements at one point in space over a period of time. It is the average number of spot speed measurements.

Space mean speed (u) is defined as the average speed of measurements at any instant of time over a space.

Following are the steps to calculate the travel speed:

i. Measure how many vehicles pass one point in a given time frame which will give us flow (q)
$$q = \frac{n}{t}$$

ii. Count how many vehicles occupy a segment of a road at once which will give us density (k)
$$k = \frac{m}{L}$$

iii. Now, we can calculate the headway between the cars as the reciprocal of the density. The last thing to do is to use the fundamental equation in order to find the average travel speed: Since the above three mentioned flow parameters are related to a basic equation
$$q = u \times k$$
Therefore, speed is calculated as:
$$u = \frac{q}{k}$$
Where, "q" is flow, "u" is speed and "k" is density

2.3 TRAFFIC DATA COLLECTION

The videos are recorded at all the selected stations and are then decoded by playing it in slow motion using VLC media player software on computer and noting down all the types of vehicles passing through each selected station. All the videos are recorded from each station and after playing each video in slow motion on computer the data is collected and is noted and represented in form of tables.

2.3.1 DATA COLLECTION AT STATION 1

At station 1 traffic volume has been collected on Thursday, 18th of April 2019 for a time period of 30 minutes during the peak hour that is between 1:00 PM to 1:30 PM because of the high traffic volume. Traffic volume data collected is shown in below given tables.

2.3.2 DATA COLLECTION AT STATION 2

At station 2 traffic volume has been collected on Thursday, 18th of April 2019 for a time period of 30 minutes during the peak hour that is between 2:00 PM to 2:30 PM because of the high traffic volume. Traffic volume data collected is shown in below given tables.

2.3.3 DATA COLLECTION AT STATION 3

At station 3 traffic volume has been collected on Thursday, 18th of April 2019 for a time period of 30 minutes during the peak hour that is between 3:00 PM to 3:30 PM because of the high traffic volume. Traffic volume data collected is shown in below given tables.

3. DATA ANALYSIS

3.1STATION WISE DATA ANALYSIS

3.1.1FOR STATION 1

On the basis of traffic data collected at location A1 and A2 of Station 1 Traffic Flow, Traffic Density and Speed is calculated .

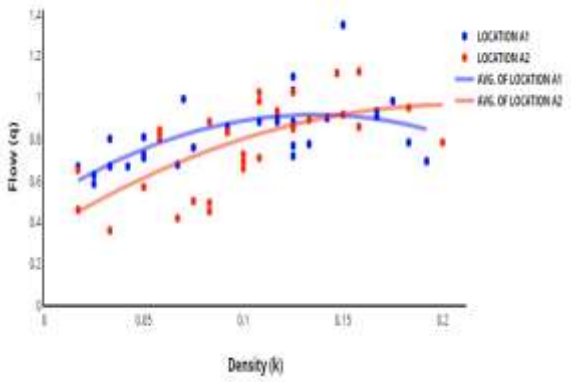

Fig. 3.1 Flow (q) vs. Density (k)

Here Fig. 3.1 is showing flow versus density graph for the data collected at location A1 and location A2 of Station 1. In this graph the curvature shape of the curve in each case reflects that initially the flow increases with increase in density up to a certain limit and there after the flow decreases with further increase in density.

3.2 COMPARISON OF TOTAL TRAFFIC VOLUME DATA COLLECTED OF ALL STATIONS WITH STANDARD TRAFFIC VOLUME

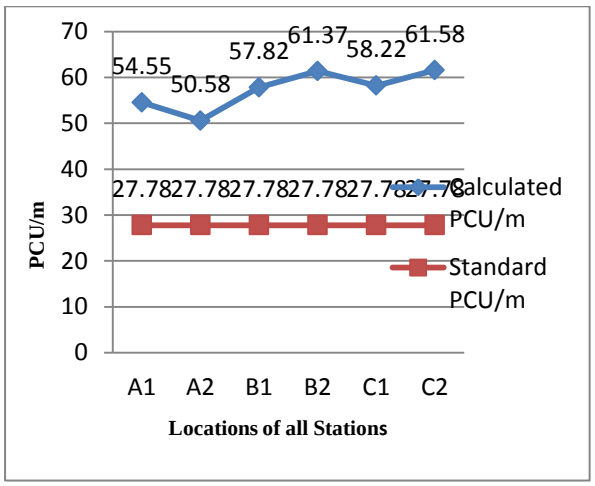

Fig. 3.2 Comparison of Total Traffic Volume Data Collected of all Stations with Standard Traffic Volume

From the graphical representation it is clear that the existing traffic volume on selected 9.0 Km's stretch of 4-lane divided highway i.e. between Dera-Bassi to Zirakpur is quite high when compared with the standard traffic volume for 4-lane divided highway as per IRC. So this stretch is likely causing congestion and it needs immediate action in order to remove or reduce congestion.

Similarly for Station 2 and Station 3.

4. CONCLUSIONS AND SCOPE OF FUTURE WORK

4.1 CONCLUSIONS

The conclusions that can be made on this study regarding Evaluating Traffic Congestion and its Remedial Measures are as under:

i. This study finds that congestion has been confined in terms of additional time taken to reach a destination as compared to when the road has been clear off traffic.
ii. Flow-density curve shows that with the increase in density, flow also increases up to a certain limit and with further increase in density results into decrease in the flow.
iii. From the graphical representation of comparison of total traffic volume data collected at all stations with standard traffic volume based on IRC, it can be seen that the traffic volume at all the stations is exceeding the standard traffic volume for 4-lane divided highway thereby causing congestion.

iv. In this study it has been seen that at various locations the traffic signals are available but malfunctioned which causes disturbed traffic movement thereby aiding congestion.
v. In this study it has been seen that bus lay bays on both L.H.S and R.H.S of highway is insufficient in length as well as in width and is not as per designed drawings w.r.t. number of buses/hr being operated because main bus stand of Derra-Bassi and Zirakpur towns are below flyovers. This all causing congestion.

4.1.1 REMEDIAL MEASURES

Following are the remedial measure which has to be adopted to reduce congestion:

i. When traffic demand is in excess of supply, capacity is increased. In roads, this means adding lanes to existing road width for smooth traffic flow.
ii. Road pricing is another technique to reduce traffic congestion. In this method people are charged for the use of roads, more when and where it is congested and less when and where it isn't congested. This will foremost reduce travel during congested times and thereby reduce congestion.
iii. Construction and maintaining roads is important. But closing entire roads for construction can't be the right strategy. It is recommended to do construction one lane at a time in order to reduce traffic congestion.
iv. Making all signs and signals fully functional at all the suitable locations in order to maintain proper traffic flow.
v. Fixing time and area of movement of certain types of vehicles.
vi. Providing and prohibiting parking for vehicles at all the suitable locations.

4.2 SCOPE OF FUTURE WORK

In this study, all the work is done in order to evaluate and reduce the traffic congestion. Following is the future scope of this work:

i. To carry out the traffic volume determination by some other methods.
ii. For reducing the traffic congestion the other remedial measures regarding geometric design modification of roadway may also be taken up.

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