TRAFFIC CONGESTION IN DEVELOPING COUNTRIES: LACK OF SPACE OR LACK OF MANAGEMENT

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ABSTRACT: Developing countries like India have been facing troubles related to traffic mainly in the urban areas. India adds about 20 million vehicles to its roads every year including passenger and commercial vehicles. Vehicle density in India and US are 17 and 641 per 1000 people respectively and population density of Singapore is more than 15 times compared to that of India (7987 and 382 people per square kilometers respectively). These two observations lead us to look for reasons for traffic congestion in India. We have identified that poor space management, poor policies at the micro level and virtually non-existent management of crossings and junctions are the main contributors to traffic congestions within cities.

KEYWORDS: Traffic congestion, Traffic management, City management.

INTRODUCTION

Developing countries like India have been facing troubles related to traffic mainly in the urban areas. The traffic congestion costs 20% additional consumption of fuel. In other words, one is paying 20% extra on a daily basis. Traffic congestion has been investigated for its prediction, detection and prevention (Jain, 2015), (Sen et al, 2002), (Steven, 2000). Population density and vehicle density in India is far less compared to Singapore (Table 1.1).
It is obvious that vehicle population and population density is not the reason for traffic congestion. Road available per person in Singapore and in India are 0.63m and 0.25m. These three observations led us to look for reasons for traffic congestion in India. A search through publications from central government agencies indicates that there is a lack of investigations for reasons at micro level. Our focus in this paper is to look at micro level reasons for traffic congestion.

Table 1. Comparative Statistics

Parameters	Singapore	India
Average Speed during peak hours on city roads	30km/hr	5km/hr
Number of cars per 1000 people	90	17
Number of buses per 1000 people (urban)	.8	.004
Rail length per 1000 people	30 m	.091 m
Road density	$5km/km^2$	$1.07/km^2$
Population density per km^2	7987	382
Number of traffic lights	2185	No data available

We have identified that poor space management, poor policies at the micro level and virtually non-existent management of crossings and junctions are the main contributors to traffic congestions within cities. We focus on the congestion at level rail line crossings where train has a right of the way. We have collected data in Kanpur, a major city in northern India that has a population of around 4.8 Million. Kanpur is a hub for many industries including the paper, soap, chemical products and leather refineries. Kanpur has 35% motorized vehicles and 65% non-motorized vehicles on its

roads (Naujoks and Ingo, 2014). We show through the data that we have collected in Kanpur, that a passing train should not add delay of more than 5 minutes to the traffic that needs to cross the rail track and no delay to other traffic. But due to poor or no management of these level crossings, a delay of up to one hour gets added to the traffic irrespective of direction of their travel. Rest of the paper explains the background of the study, case study prepared and conclusion.

BACKGROUND

Traffic congestion scenario differs from developing to developed nations (Gwiliam, 2003). The congestion pattern varies from one place to another in developing nations (Jain, 2012). Developing countries like India have been facing troubles related to traffic mainly in the urban areas. There are many reasons for traffic congestions. Some of them are as follows:

1. Obstacles in the road causing a blockage that leads to significant loss in the carrying capacity of the road.
2. Too many passenger vehicles due to non-availability of public transportation system
3. Traffic signals out of sync with the traffic
4. Too many pedestrians or cyclists preventing regular flow of the traffic
5. Too many goods carrier due to non-availability of goods trains
6. Inadequate road system

Investigations support the reasons listed above. For instance, rapid disproportional increase in number of vehicles compared to supporting infrastructure including roads and parking is one of the problems. India adds about 20 million vehicles to its roads every year including passenger and commercial vehicles (SIAM). Additional roads and highways are also built to accommodate the added traffic at the rate of 10 miles a day in India. The road density is much higher in India (142) compared to USA (66). Road density is the ratio of the length of the country's total road network to the country's land area. When one talks about road density, we have not been able to find any mention of the width of the road. If width of the road is not sufficient to carry the load, the traffic may experience congestion leading to further decrease in the carrying capacity of the road. The parameters that will determine the adequacy of the transportation system are widely studies by different agencies. We cannot increase the road density, width of the roads, lay railroads, construct fly over bridges quickly as these require planning, resources and money. Some studies show that it is a policy issue and suggest that a policy solution is possible for traffic congestion (Jain, 2015), (John, 2005). Macro level policies have been formed to solve the traffic congestion problem. It has been argued that micro level policies are also required to address local traffic congestion problem (Arnott, 2005). Several policy initiatives have been undertaken but not yielded desired outcomes. A common statement that people make is that increase in number of private cars is responsible for congestion in cities. If there is a traffic congestion, public transportation such as buses are impacted more leading to people becoming more inclined towards using cars (Kutzbach, 2009). The average speed of cars is 16 miles per hour compared to 10 miles per hour for buses. Buses are now getting reserved lanes for them to perform better. Share of the cars is 85% of the total vehicle kilometers travelled in India (Davis, 2005). The objective of a research study is to go beyond what people believe and establish what is supported by data. If increased number of vehicles was the reason for congestion then cities like Varanasi (oldest city of India) should not be congested at all that has only 7% vehicle population of what Delhi has.

In this paper, we investigate the first reason listed above in detail in Indian context. We show that due to lack of proper management of roads and traffic, we experience additional traffic congestion that can be avoided. We should make every effort to make best use of the resources available. We also point out solutions and the governing bodies that are responsible for implementing the solutions.

CASE STUDY, DATA COLLECTION AND DISCUSSION

We have taken Kanpur as our case study city that faces traffic congestion problem on a regular basis. The city has a railway track that runs parallel to Grand Trunk (G.T. Road) through the city. At road-rail level crossing, trains always have right-of-way. The crossings are manned and are gated. The gates are closed before the arrival of a train and are opened after the train departs. The road traffic has to wait for the train to pass and gate to be opened before resuming.

The length of this track is 15km and there are 14 level crossings. There are about 26 passenger trains and about 10 goods train daily that pass through the city (Figure 1).

Each time, the gate closes to let a train pass for about 5 minutes. A train should not add delay of more than 5 minutes to the traffic that needs to cross the rail track and some additional delay due to traffic wave and no delay to other traffic. A traffic wave occurs when cars slow down, and the slowing trend continues backward -- like a domino effect. As long as there are more vehicles approaching from behind, the traffic congestion travels in a wave. We collected data and found that at times, this delay is as much as one hour. We started looking at the reasons by asking people and by going through newspapers. The media and city administration every so often blame the rail line for the congestion. The latest one was reported by a leading newspaper on Feb 26, 2016 and we quote:

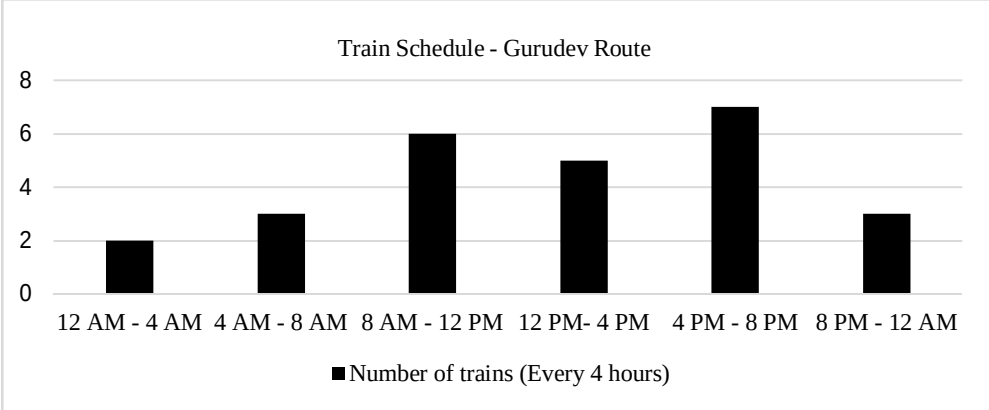

Figure.1. Number of trains passing every 4 hours

The problem of traffic jam due to the Anwarganj-Mandhana railway line extending upto Kasganj which also divides the industrial city into two halves has been addressed by Railway Minister Suresh Prabhu in his second rail budget presented in parliament on Thursday (TOI, 2016).

General belief was that people don't follow rules and are impatient as indicated by people that we talked to. We also started looking through the literature. We found some studies done the central government agency, Central road research institute (CRRI) of India that points out that insufficient number of traffic police for surveillance and negligible use of ITS technologies for traffic monitoring and law enforcement are problems in India (Verma et al, 2011). Ministry of Road Transport and Highways (MORTH) has made multiple attempts and continues to strive for increasing road safety and reducing accidents (Sundar, 2007). It is clear that simple measures that can reduce congestions have not been taken. We establish this point using our case study.

The traffic junction in our study is an X junction when the rail gate is open and T Junction when the rail gate is closed. An Arial view of the junction is shown in Figure 2 and its dimensions are shown in Figure 3.

The behavior of the junction changes from an X junction to T junction every time a train passes. This transition in Kanpur happens without much of a warning. In order to make sure that the traffic that doesn't want to cross the rail line continues to move smoothly, the drivers need to be informed well in advance so that they can position their vehicles properly.

Figure.2. Arial view of the level rail crossing (Source: http://www.bing.com/mapspreview)

The crossing that we studied has absolutely no traffic signals and no marking on the road. The gate at the crossing closes with less than 30 seconds of warning. As a result, drivers get caught in the middle of the junction with nowhere to go. In the absence of traffic signals and traffic police, people just don't know the order in which to proceed.

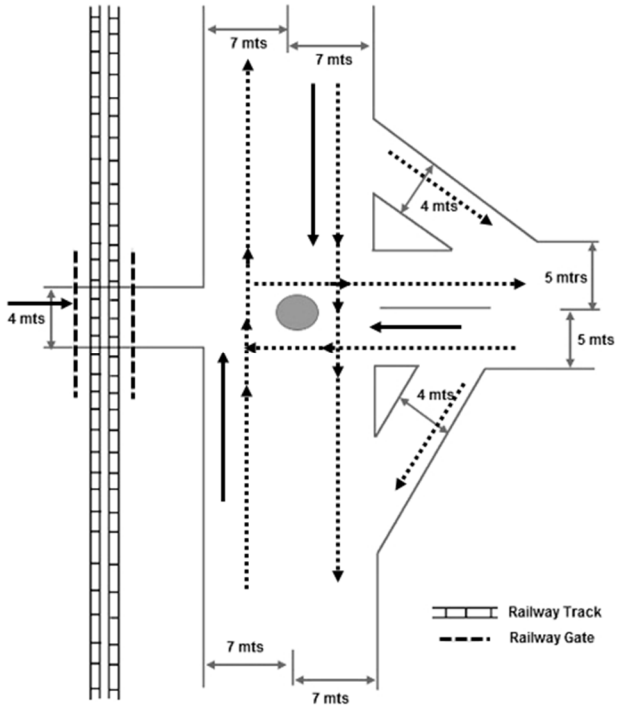

Figure.3. Level crossing design including the widths of the roads at the junction; traffic along dotted arrows will flow and only the traffic along bold arrows will be blocked when the level crossing gate is closed

Sooner than later, one can find a deadlock leading to a traffic jam that can take up to one hour to clear. This traffic jams can be avoided by informing the commuters in time before the gate closes so that vehicles can wait without blocking the roads. Each side of the road can hold about 30 to 35 vehicles that is more than the capacity required. Enough technical solutions are available for programming the traffic signals according to traffic conditions (Steven, 2000).

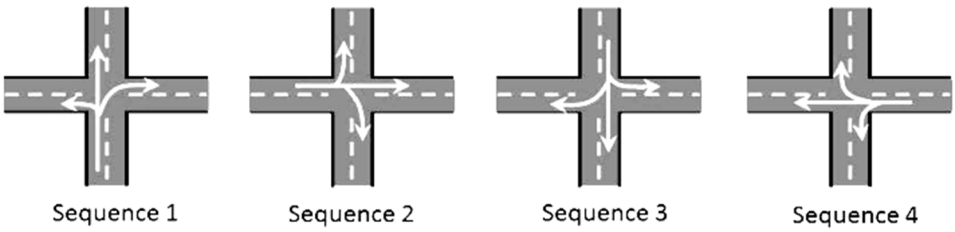

Figure.4. The junction functions as X joint when the level railroad crossing gate is open

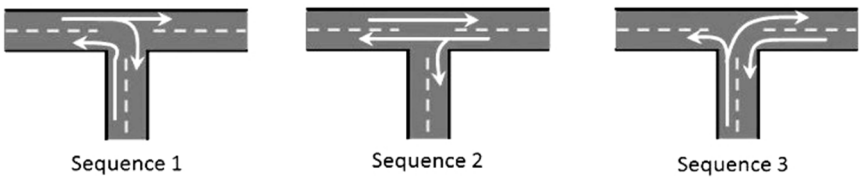

Figure.5. The junction functions as T joint when the level railroad crossing gate is closed

To deal with this situation without major changes, the administration needs to install warning system to inform the commuters ahead of time when the crossing gate is about to close. This will allow the commuters to place their vehicles properly to avoid blocking the road. There will be no traffic congestion if proper traffic management system is deployed, including traffic lights at junction with a separate warning system for the level crossing and marking on the road to facilitate proper placing of waiting vehicles. The traffic signals should work synchronously with railroad warning system

to help commuters to wait at the designated place on the road. Active warning devices consisting of flashing lights or bells that are activated 1-2 minutes before the gate closes will work fine.

But surprisingly the absence of traffic signals has never been identified as a cause. Installing a traffic signal costs about 10,000,00 INR. Internal roads, traffic signals and parking lots construction and their maintenance are the responsibilities of city administration that are called municipal corporations in India. It is not clear why the city administration has not been able to install traffic signals on all the crossings in the city. Our observations clearly suggest that traffic police will fail if there are no proper markings and signals to facilitate traffic movement.

CONCLUSION

Road traffic congestion is the main problems faced by every person in the urban areas of developing nations. The reasons for the congestion vary from place to place.

We went around looking for other reasons for traffic congestion in Kanpur and in the capital city of India. We found that schools are located on main roads and their entrances are also on the main traffic carrying roads. The vehicles are parked on the sides of main roads. In the morning, when schools open, teachers slow down their vehicles to park causing a traffic wave. Since they don't have designated parking places, they also have to search for parking places. A traffic wave occurs when cars slow down, and the slowing trend continues backward causing congestion. To make matter worse, the space utilization is also very poor. In front of one school, there is an open drain that is about two feet wide but the space wasted is more than two feet as the driver stops about two feet away from the drain to stay safe. If it is a big car, it extends into the road and blocks the road. The local administration can intervene and create proper vehicle parking system and reduce the congestion.

Through this study, we have made an attempt to show that lack of proper management at local level is one of the reasons for additional traffic congestion that can be avoided. Why these issues are not getting resolved, the local administration will know best and some enthusiast can also take up the study.

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