

Study of Traffic Congestion Impacts

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Abstract—Traffic congestion is one of main problems that is found in urban roads traffic and now a days it is very common with increasing road traffic, population etc. Traffic congestion is said to exist if the vehicles are travelling below free flow speed, longer trip times and increased vehicle queuing and can lead to even traffic jams if the free flow speed reaches to zero. The causes of traffic congestions are inadequate road capacity, lack of pedestrian facilities, presence of heavy vehicles and lack of parking facilities near road etc.

There are various negative impacts of traffic congestion in urban areas. The major impacts of traffic congestion includes accidents, air pollution, noise pollution, health effects, stress on motorists, loss in economic growth, delay movements, excess fuel consumption etc. Due to these negative impacts of traffic congestion all over the world in urban areas have attracted many researchers and transport planner to find ways to prevent traffic congestions.

This paper focus on study of impacts of traffic congestion in above mentioned factors by considering main focus on environmental factors. Awareness and knowledge of these impacts among the people is considered to be an effective medium to prevent the people and environment from its ill effects.

1. INTRODUCTION

Traffic congestion or traffic jam is a condition on road that occurs as use the no of vehicle increases, and has characteristics of slower speeds, longer trip times, and increased vehicular queuing. When traffic existing on road is great enough that vehicle interaction slows the speed of the traffic stream, this results in some congestion. As demand approaches the capacity of a road (or of the intersections along the road), extreme traffic congestion sets in. When vehicles are fully jammed for periods of time, this is known as a traffic jam or traffic snarls up.

Traffic congestion occurs when a volume of traffic or modal split demands for more space than the available road capacity; This point is commonly termed saturation capacity. There are a number of specific circumstances which cause or increases congestion; Most of them reduce the capacity of a road at a given point or over a certain length, or increase the number of vehicles required for a given volume of people or goods. Qualitative classification of traffic is often done in the form of a six letter A to F level of service (LOS) scale defined in the Highway Capacity Manual (HCM). LOS A represents best riding conditions on road with attainment of free flow speed for vehicles and LOS F represents worst riding quality. HCM

recommends at least LOS B to be provided for national highways. These levels are used by transportation engineers as shorthand and to describe traffic levels to the lay public. While this system generally uses delay as the basis for its measurements, the particular measurements and statistical methods vary depending on the facility being described. For instance, while the percent time spent following a slower moving vehicle figures into the LOS for a rural two lane road, the LOS at an urban intersection incorporates such measurements as the number of drivers forced to wait through more than one signal cycle.

Traffic congestion has a number of negative effects: Wasting time of motorists and passengers and it is nonproductive activity for most people, congestion reduces regional economic health, delays which results into late arrival at business places and others personal losses, wasted fuel increasing air pollution and carbon dioxide emissions, congested vehicles more frequents blow horn leading to noise pollutions, wear and tear on vehicles as a result of frequent acceleration and braking leading to more frequent repairs and replacements, stressed and frustrated motorists encouraging road rage and reduced health of motorists, higher chance of accidents due to tight spacing and constant stopping and going of vehicles.

International Commission on the Biological Effects of Noise (ICBEN) has recommended guidelines for investigating the community response, noise survey, and its effects on community. This includes the overall survey design, social survey samples, social survey data collection, and nominal acoustical conditions (Fields, J.M., Jong, R.G., Gjestland T., Flindell, I.H., Job, R.F., Kurra, S., *et al.*)

2. IMPACTS OF TRAFFIC CONGESTIONS

The impacts refer to impacts of traffic congestions on environmental and other factors which are direct effects. The impacts primarily refers to impacts on lives, health, ecosystem, society, infrastructures etc. some of the impacts are given below

a. Effect on air pollution

The transportation sector is a major source of greenhouse gas emissions (GHGs) in the United States. An estimated 30 percent of national GHGs are directly attributable to transportation—and in some regions the proportion is even higher. Transportation methods are the greatest contributing source of GHGs in the U.S., accounting for 47 percent of the net increase in total U.S. emissions since 1990.

Slower moving traffic emits more pollution than when cars move at freeway speeds. The relationship between driving speed and pollution isn't perfectly linear. Study suggests that emissions start to go up when average freeway speed dips below 45 miles per hour (mph). They also start to go up dramatically as the average speed goes above 65 mph. So, the "golden zone" for fuel consumption and emissions from your vehicle may be somewhere between 45 and 65 mph.

Whenever congestion brings the average vehicle speed below 45 mph (for freeway scenario), there is a negative net impact on CO₂ emissions. Vehicles spend more time on the road, which results in higher CO₂ emissions. Therefore, in this scenario, reducing congestion will reduce CO₂ emissions. If moderate congestion brings average speeds down from a free-flow speed of about 65mph to a slower speed of 45 to 50 mph, this moderate congestion can actually lower CO emissions. If relieving congestion increases average traffic speed to the free-flow level, CO₂ emissions levels will go up. Extremely high speeds beyond 65 mph can cause adverse impact on CO₂ emissions. If these excessive speeds can be controlled, there will not only be direct safety benefits but also indirect benefits of CO₂ reduction. (Barth, M. et. al, 2008)

b. Effect on noise pollution

Traffic noise has become a serious problem nowadays because of inadequate urban planning of the city in the past.. The problem has been compounded by increases in traffic volumes (two wheelers, heavy motor vehicles, and other vehicles) far beyond the expectations of our early urban planners. From the survey and findings it is evident that road traffic noise affects human work efficiency at Government Offices, Private Organizations, and Commercial Business Centers beside the busy main roads (Pal, D., Bhattacharya, D., 2012)

By means of questionnaire it was found that among all noise generating sources, road traffic was the major source of noise followed by factory/machines. A health survey reported about 52% of population was suffering by frequent irritation. 46% respondent felt hypertension, and 48.6% observed loss of sleep due to noise pollution. As the noise levels increases the level of annoyance also increases (Aggarwal, S., Swami, B.L., 2011)

Long term noise related health hazards can cause permanent hearing loss among exposed individuals. Furthermore,

exposure of high level noise can cause severe stress on auditory and nervous system of human beings. (Zannin *et al.*, 2006)

c. Impacts on health of living beings

Constant exposure to loud levels of noise can result in loss of hearing, occurrence of aggressive behavior, disturbance of sleep, constant stress, fatigue and hypertension, sleeping disorders (Babisch, 2002), cardiovascular disease (Vienneau *et. al.*, 2015) and stress related heart problems, effect on wildlife etc.

Annoyance, sleep disturbance and other health effects of road traffic noise exposure may be related to both level and number of noise events caused by traffic, not just to energy equivalent measures of exposure. Dynamic traffic noise prediction models that include instantaneous vehicle noise emissions can be used to estimate either of these measures (Coensel, B.D. *et. al.*, 2015)

Children with acute leukemia had higher odds of exposure to traffic-related air pollution at birth compared to controls. The exposure to the fourth quartile of NO₂ (11.19–19.89 ppb) were stronger among children with acute myeloid leukemia (AML) than acute lymphoid leukemia, with a positive association observed among urban children with AML. (Janitz, E.A. *et. al.*, 2016)

d. Impacts on accidents

Hourly accident rates and volume capacity (V/C) ratio follows Ushaped pattern and accidents involving injury and fatalities tend to decrease while the V/C ratio increases. (Zhou and Sisipiku, 1997). Another study on freeways found that with an increase in the V/C ratio fatal and single vehicle crashes decreases and crash rates (all crashes) follow a Ushaped relationship with V/C ratio. (Lord *et al.*, 2005)

Aarts *et al.* (2006) reviewed the literature on vehicle speed and road accident relationship and showed that road incidents increase significantly with an increase in speed on minor roads than on major roads. In order to relate the speed limit and fatal crash found that in Washington (USA) speed limit and fatal crash occurrence have positive relationship, the higher is the speed, more number of fatal accidents occurs (Ossaianer, Cummings, 2002)

Dickerson *et al.* (1998) revealed significant differences in accident - traffic flow relationship by road class and geography. Their outcomes are based on all types of accidents regardless of severity level. The empirical evidence by comparing fatality rates throughout day and found that during peak hours the fatality rate is obviously lower than at other times in the day (Shefer and Rietveld, 1997)

e. Impacts on economic growth

Downie (2008) also opines that traffic congestion occurs when the volume of vehicular traffic is greater than the available

road capacity, a point commonly referred to as saturation. He describes a number of specific circumstances which cause or aggravate congestion. Most of such circumstances are concerned with reduction in the capacity of road at a given point or over a certain length, or increase in the number of vehicles required for the movement of people and goods. Downie (2008) further argues that economic surge in various economies has resulted in a massive increase in the number of vehicles that overwhelms transport infrastructure, thus causing congestion on roads in cities.

May and Marsden (2007), however argue that congestion impairs us from moving freely and that it disrupts business activities in cities and reduces productivity. Congestion affects speed and smooth traffic flow. This affects a wide range of activities, services, goods, markets opportunities in the cities which can best be delivered through transport mobility. The report continues that congestion also reduces productivity through increased inventory holding by manufacturers and retailers as a result of unreliable travel conditions within cities. congestion on roads in cities.

Lewis (2008) and Downie, (2008) further delineate that although the digital revolution enables twenty 21st Century industries to adopt just-in-time production, distribution and inventory management system, the challenges in the transportation system such as congestion, makes it difficult for them to be up to the task of ensuring reliable just-in-time deliveries for enhanced productivity and competitiveness

f. Impacts on fuel consumptions

The presence of acceleration noise would be expected to increase the fuel consumption experiment shows the effect of different levels of acceleration noise on passenger car fuel consumption at different speeds. The model is based on the thesis that there is an increase in accelerations with increasing congestion (Greenwood, I.D.; Bennett, C.R.,1995)

The more microscopic approach based on the instantaneous fuel consumption in terms of liters per km or per time unit as a function of velocity and acceleration of the corresponding vehicle as fuel consumption depends strongly on the velocity profile. (Thiemann, c.; Treiber, M.; Kesting, A., 2007)

Fuel consumption, and therefore carbon dioxide emissions, increased by an average of 30% for the two vehicles when travelling in congested conditions compared to daytime traffic. Inbound peak-hour journey times increased by an average of 85% over daytime trips for the two routes.

Small increases in traffic starting from free flow conditions are positive in terms of fuel economy, but the general trend is that congestion increases fuel consumption. (Garcia-Castro, A.; Monzon, A.,2014)

g. Impacts on delay movements

Due to traffic congestion on roads travel time to the destination varies and travel Time Variability has several distinct components, including differences in travel time from day-to-day, over the course of the day, and even from vehicle-to-vehicle (Noland and Polak, 2002).

Based on the findings of this study, it was concluded that traffic congestion affect freight movement in the following ways; increased travel times decreased in fuel efficiency, increasing cost of fleet operation, shrink in market coverage, higher cost of shipment and drivers stress. (Fadare, S.O., Ayantoyinbo, B.B,2010)

3. AWARENESS REGARDING ILL EFFECTS OF CONGESTION

If the real-world, stop-and-go velocity pattern of vehicles could somehow be smoothed out so an average speed could be maintained, significant CO₂ emissions reductions could be achieved (Barth, M.; Boriboonsomsin, K.; 2008)

While progress in vehicle efficiency improvements and carbon-neutral fuels are underway, innovative traffic operations improvements (i.e. mitigating congestion, reducing excessive speeds, and smoothing traffic flow) can have a significant impact on vehicle CO₂ emissions.

To avoid the traffic congestion the steps can be enlarging the width of the road, construction of proper drainage, provision of parking space, rehabilitate all roads needing attention, public enlightenment/traffic education, hacking down all illegal buildings/shops built on the right of way (ROW), provision of road furniture, create a separate/alternative route for trucks and heavy vehicles, provision of pedestrian facilities, in-depth training of transport/traffic personnel, create special commercial transport coordinator and banning all form of road side trading/hawking are among the major remedies suggested from this study. (Popoola M.O., Abiola S.O.,Adeniji,W.A.)

4. CONCLUSIONS

The effect of traffic congestion on the various factors is very serious and with increasing traffic at such fast rate the effects are further increasing and need to properly investigated and some awareness program also need to be held to tell the impacts of traffic congestion to the common people. The effects of traffic congestion on environment also need to give special attention as its effects the health of surrounding people and long term effect on ecosystem.

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