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Traffic Flow Interruptions in Dhaka City: Is Smooth Traffic Flow Possible?

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ABSTRACT

Deficiencies in present roadway network of Dhaka city have reached to such an alarming state where scopes of traffic improvement are getting confined day after day. Weak infrastructure has provoked the heterogeneous mixing of vehicle along with non-lane based movement and no access control. Taking advantage of existing poor monitoring system, number of non-registered and road unworthy vehicles is on a rise. Recent studies showed that in developed countries, between 2 to 8.5 percent of accidents are directly caused by faulty vehicles. Situation gets worsen for developing countries like Bangladesh. Due to lack of proper implementation of transport planning and effective management, streets of Dhaka have become over numbered with vehicles and remain motionless for hours in both peak and off-peak periods. Frequent application of brake is a regular scene in congested roads, which directly stimulates accelerated depreciation of vehicle brake system. Identification of inherent weakness of interrupted traffic flow like total number of interruptions during a vehicle trip is prerequisite to confirm the smooth flow of vehicle and minimize the undesirable time killing of road users. As there is a direct relationship between road accident and vehicle brake system performance, an attempt is made to quantify the number of interruptions of vehicles of different categories. In this regard a comprehensive study has been carried out to count number of brake applied during vehicle flow from Malibagh level crossing to Bashundhara residential area for a week. The striking features of the research will be discussed in the paper with a view to understand the root causes of disruptions obstructing smooth vehicular flow and necessary engineering countermeasures will be provided to improve vehicle performance.

***Keywords*:** Interrupted traffic movement, Traffic congestion, Road safety, Smooth traffic flow.

1. INTRODUCTION

Dhaka city experiences the rise of scattered development without appropriate monitoring within a glimpse of last few decades which resulted in huge urban transport system difficulties. Weak transportation system has noticeably affecting the physical form and functional performance of the city. Only 9% of roadways and 6% of pavement area are available, in which 62 km functional primary, 108 km secondary and 221 km connector road serve the city road network (Mahmud et. al., 2008). Meanwhile road is 16% of total city area in Tokyo and 25% of total area in majority of other developed cities. Therefore, in Dhaka, poor infrastructure is progressively worsening the roadway environment, reducing mobility

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and deteriorating performance of overall traffic system. Dhaka, being the hub of political, commercial and cultural activities of Bangladesh and the nation's gateway, has now been announced as 26th Mega City and 10th most populous city of the world (Habib et. al., 2005). The population is expected to further grow to about 20 million by 2020 and to 25 million by 2025 (STP, 2005). With ever increasing travel demand, it is now an uphill task to balance the present travel demand and make the transport network sustainable. Vehicles plying on the road are one of the worst sufferers of current situation. Prevailing hostile roadway environment is a consequence of recent surprising growth rate of fragmented ownership of vehicle. Public transport system has failed to offer most of its lucrative features for presence of higher volumetric share of small vehicles. In the year 2012, according to statistical report of Bangladesh Road Transport Authority (BRTA), 73.33% of the total number of registered vehicle in Dhaka is small private vehicles (private car and motor cycle), while public vehicle (bus, minibus) is only 1.65% of the total newly registered vehicle. Undoubtedly, due to the excess presence of small vehicle and serious scarcity of resources, traffic stop-and-go situation dominates in Dhaka city. Here traffic phenomena are far complex with excessive interruptions than other developed or developing cities. The objective of this research was to glean information on the causes of interruption of traffic flow during peak hours in Dhaka city. This research also includes specified quantification of total number of interruptions. Based on the research outcome, justification of the possibility of attaining traffic smooth flow in Dhaka city is performed later.

2. SMOOTH TRAFFIC FLOW: WHY IS IT DESIRABLE?

Smooth traffic flow is that uninterrupted flow condition when drivers do not require stopping the vehicle due to traffic signal, factors external to traffic stream etc. In an ideal road network, uninterrupted flow condition can be found in mid-section of the road except critical locations like, near or at junction. In Dhaka, historically roadway is the most favored and dominant form of transport. But unplanned road network and imbalanced vehicle composition have resulted in a complex road system where vehicles face all ill-effects of frequent bottlenecks near junction. Sudden rear-end collisions is a common scene as a result of shockwave of vehicle. Passenger travel time is stretching to such limit where national economy is suffering due to losses of hours on the congested road. In Dhaka, the traffic congestion cost is US$3 billion a year and the city losses over 8 million work hours daily (Osman, 2011). Like many other cities in developing countries, Dhaka is struggling with the serious problem of existing traffic stop-and-go situation. In order to upgrade and improve existing transport network to a sustainable system, serious issues like traffic congestion, traffic stop-and-go situations, accelerated vehicle depreciation etc. have to be focused as primary concerns. Smoothening of traffic flow does not necessarily mean speeding of vehicle. This will ensure the optimum use of prevailing road capacity in Dhaka and thus inherent defects of city transport system will be overcome to a significant extent.

3. RESEARCH METHODOLOGY

In order to perform spot recording of interruptions, observation methodology was followed to detail the number of interruptions of vehicle flow. Any reduction in speed of vehicle or change in direction of vehicle movement was noted by surveyor present in the vehicle as an interruption during vehicle flow. Data had been taken for one whole week (including

holidays). The survey was conducted in the morning off-peak lean period to enlist numbers of interruption in uninterrupted flow condition. According to STP (Strategic Transport Plan, 2005) study, 31% trips in Dhaka are made by transit modes (bus or rail) while 18% by non-transit modes (private cars). Therefore, along the study route (from Malibag Level Crossing to Bashundhara Residential Zone Gate), three major types of vehicles were preferred for the research: non-counter based local bus (Turag Paribahan), non-counter based human hauler (Bondhu Paribahan) and private car. As human hauler takes left turn near Natun Bazaar junction, so number of interruption was counted from Malibag Level Crossing to Natun Bazaar junction. Also detailed questionnaire was prepared to collect data related to response attitude of drivers during frequent numbers of interruption in a specific route. In total, 45 experienced vehicle drivers participated in the face-to-face interview based on that questionnaire.

4. DATA COLLECTION AND ANALYSIS

4.1 Number of Interruptions during Traffic Flow

In Dhaka, traffic stop-and-go situation predominates on road. The research was conducted mainly to investigate the possibility of achieving smooth flow in Dhaka city. Hence, number of interruption along the study routes was quantified to verify the extent of traffic stop-and-go situation. To make the estimates consistent for a particular vehicle during one week, studies were commenced at both week-days and week-ends. Thus the number of interruption data are collected for three categories of vehicle and presented in Table 1.

Table 1: Total number of interruptions of vehicle flow for study route

Vehicle Category	***Travel Distance***	***Free Flow***	***Peak Hour Flow Condition***						
			Typical Working Day					***Typical off-day***	
			Sunday	***Monday***	***Tuesday***	***Wednesday***	***Thursday***	***Friday***	***Satur day***
Local bus	7.2 km (4.47 mile)	24	113	110	121	88	118	55	73
Human hauler	5.6 km (3.49 mile)	33	201	101	139	113	143	86	106
Passenger car	7.2 km (4.47 mile)	10	110	99	67	138	65	33	49

From the above Table 1, weekly pattern of the total number of interruptions for three different number of vehicle categories can be viewed explicitly. It is observed that day by day variations of interruption number do not follow any linear or regular pattern throughout the week. It depends on the complex variables of both geometric and operational conditions

prevailing on road, driver behaviour, road side non-motor activities, random pedestrian movements etc. During morning free flow condition, minimum number of interruption was observed. For personalized passenger car, brake application was lowest among three vehicle categories for almost every day. Disruption of flow was only 10 during free flow for private car. Significant increase of application of brake for car was enlisted during weekly peak hour flow, up to 13 times of interruptions during free flow condition. Wednesday is the closing day for local shopping malls; hence number of interruption was relatively lower for local bus and human haulers. Significant observation in the study is the noticeable number of interruptions during off-days. Moreover among the two off days, interruption occurred higher in Saturday. This signifies the increase of road user activity in Saturday than Friday.

4.2 Causes of Interruptions during Traffic Flow

The average number of interruptions along a week was documented and summary of the factors responsible for the number of interruption are tabulated in following Table 2. Only factors causing minimum 2% of total average interruptions of vehicular flow along a week was considered.

Table 2: Summary of the average number of interruptions for vehicle category for a week

Factors of Vehicular Flow Interruptions	***Vehicle Category***					
	Local bus		***Human hauler***		***Passenger car***	
	No.	***%***	***No.***	***%***	***No.***	***%***
Traffic Congestion	***66***	***68.75***	***89***	***70.08***	***53***	***66.25***
Lane Changing Maneuver	***5***	***5.21***	***13***	***10.24***	***3***	***3.75***
Non-Station Based Boarding	***15***	***15.63***	***9***	***7.09***	***0***	***0***
Slow Leader (Motorized)	***7***	***7.29***	***9***	***7.09***	***11***	***13.75***
Slow Leader (Non-motorized)	***0***	***0***	***0***	***0***	***4***	***5***
Pedestrian Passing at Mid-section	***3***	***3.13***	***0***	***0***	***3***	***3.75***
Uneven Road Surface (Pothole)	***0***	***0***	***3***	***2.36***	***0***	***0***
Other	***0***	***0***	***4***	***3.15***	***6***	***7.5***
Total	***96***	***100***	***127***	***100***	***80***	***100***

A close observation of Table 2 reveals that, for local bus, three main factors for average number of daily interruptions are traffic congestion (68.75%), non-station based boarding (15.63%) and motorized slow leader (7.29%) respectively. While for human haulers, lane changing maneuver caused significant number (10.24%) of average total interruptions. Though random pedestrian passing caused sudden interruptions, some permanent causes of interruptions also insisted drivers to apply sudden brake. Mainly geometric configurations or

layout of the road system hinders significantly smooth flow of every category of vehicle. Uneven road surface or potholes caused 2.36% of the total number of average interruptions along a week for human haulers.

4.2.1 Traffic Congestion: Inevitably Dhaka faces unbearable traffic jam. With present vehicular growth (over 10%), unplanned development, non-compliance and a poor mix of land uses the city traffic flow is headed towards an ever halted situation. In a congested road, drivers generally compete with aggressive attitude to occupy limited front space within a glimpse. This will lead to dreadful situation that is prevailing in Mexico city, where 20% of workers spend more than 3 hours traveling to and from work place every day, and 10% people has that over 5 hours (Habib, 2002).

4.2.2 Lane Changing Maneuver: In Dhaka, as there is non-lane based concept prevailing on road, repeated interruptions are observed due to abrupt lane changing of vehicles. As a result, in mixed condition, mainly smaller vehicles show a tendency to immediately occupy any available open space in road. From Table 2, it is observed that, human haulers caused 10.24% of the total number of average interruptions, which is the highest percentage among three types of vehicle. Even non-motorized vehicles often come and block the rightmost lane with its slowest vehicle speed. For larger vehicles, here situation can be best described as 'might is right'. When heavy vehicles perform lane changing maneuver, smaller vehicles are the worst victims due to the strong hydraulic horn and gigantic modified size of the heavy vehicles with additional features like angles of the truck carrier.

4.2.3 Non-station Based Boarding: According to a survey conducted under Strategic Transport Plan (STP, 2005), almost 73% people say bus journey is cheaper, 31% say it is more or less reliable, 21% say of saving time and 26% say it is convenient and comfortable too. But public transport is not popular in Dhaka, particularly to women, children or elderly people for poor accessibility and non-integrated transport network. Local buses have no defined stoppage facility along its route and they use total road width to board passenger. Such practice causes multiple numbers of obstacles in flow path, 15.63% of the total number of average interruptions in case of local bus.

4.2.4 Slow Leader (Motorized and Non-motorized): Temporary bottleneck is mainly localized disruption of vehicular traffic flow which can be caused by wide variants. In Dhaka, slow and fast moving vehicles ply along same route competing for the same space. Such slow moving leaders cause significant number of interruptions leading to complicated bottleneck, especially near junctions. Heavy passenger carrier buses are allotted the most right lane though, because of their operational nature, they should have been allotted the left lane as in practice in advanced cities like London, Singapore etc. Non-motorized vehicles, like rickshaws in particular, occupy 73% of road space and carry only 19.2% of total passengers (Bari and Efroymson, 2005). Rickshaws or other NMVs contribute to fair share of interruptions of smooth traffic flow while lane changing or boarding passengers or goods.

4.2.5 Random Pedestrian Crossing: According to a research, pedestrian share in road accident in Bangladesh is 54%, which is the highest; while in Philippines, Japan, China and India it is 51, 32, 26 and 13% respectively (Leather et. al., 2011). Pedestrians in Dhaka intentionally cross the road ignoring the consequence of possibility of fatal accidents. Over-bridges are occasionally used by the pedestrians and they simply cross the road walking through any available narrow space between two following vehicles. Also in busy roads they

are observed to simply cross the high hurdles placed in the middle of the road. Thus the main purpose of the hurdles which is to make the pedestrian to use refuge or grade separated crossing facilities remains unfulfilled. This phenomenon suddenly interrupts vehicle flow, resulting in hard braking situation. Also, presence of roadside vendors and other non-motor activities drastically limit the available effective right of way allotted for pedestrian to a noticeable extent.

4.2.6 Uneven Road Surface: Road surface in Dhaka city is deteriorating due to excessive pressure of vehicle population and absence of periodic maintenance. Countless amount of pothole exists on the surface of the roads. Situation worsens when rain water is stored in these potholes which lead to further damage. Travel on such uneven rough road surface is also very much risky and uncomfortable.

Among the other types of interruptions, factors like overtaking of side vehicles, vehicle merging maneuver, speed breakers etc. were observed with minimum number of interruptions.

4.3 Interruptions in Traffic Flow: Does It Affect Road Safety?

According to research conducted on heavy vehicle drivers in Bangladesh, it is observed that, 25.6% drivers show competitive attitude sometimes and 80.4% drivers never follow slow leader (Hoque et. al., 2007). In an accident prone country like Bangladesh, there is an urgent need for more systemic behavioral studies on vehicle drivers. Summary of the drivers' interview in enlisted in the following Table 3.

Table 3: Summary of the face-to-face interview of vehicle drivers

Vehicle Category	*Drivers disturbed by frequent interruptions*						*Increase competitive behavior*					
	Always		*Sometimes*		*Never*		*Always*		*Sometimes*		*Never*	
	No.	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*	*No.*	*%*
Local Bus	*10*	*66.7*	*4*	*27*	*1*	*6.7*	*12*	*80*	*3*	*20*	*0*	*0*
Human Hauler	*11*	*73.3*	*3*	*20*	*1*	*6.7*	*14*	*93.3*	*1*	*6.7*	*0*	*0*
Passenger Car	*5*	*33.3*	*8*	*53*	*2*	*13.3*	*9*	*60*	*6*	*40*	*0*	*0*

Maximum drivers from public vehicles found it really annoying to drive facing multiple interruptions. Obstructed visions in congested road, frequent obstacles on road led the competitive behaviour among 80% local bus drivers and 93.3% drivers from human haulers. In order to quickly recover the travel time loss occurred by traffic stop-and-go situation, drivers increase vehicle speed immediately and thus threatens road safety. Aggressive attitude of drivers like frequent lane changing, overtaking, over speeding, hard breaking etc. accelerate vehicle depreciation.

1. FUNDAMENTAL CAUSES OF DHAKA CITY INTERRUPTED TRAFFIC FLOW

In light of the conducted analysis of selected corridor, critical deficiencies in overall transport system in Dhaka city can be highlighted which specifically influence the interrupted vehicle flow.

5.1 Faulty Transport Planning: Planning is directly related to forecasted generated volume of traffic. Haphazard urbanization in Dhaka does not reflect any sign of appropriate city planning. Also delay and irregularities in implementation of plan is one of the main reasons for which Dhaka city is facing so many difficulties with the rapid rise in population along with increased travel demand. In this regard, failure of in time implementation of various planning under Strategic Transport Plan (STP, 2005) can be mentioned.

5.2 Peculiar Land Use Pattern: In the past few decades, massive privatized land development has occurred in Dhaka city. But lack of integration between land-use planning and transportation system has resulted in uncontrolled road network. Close observation showed that haphazard road connection with main road and side road maintained no width hierarchy. During survey it was observed that width of side road in Aftabnagar (two lane two way side roads) is not well proportioned in accordance with the main road towards Badda. According to Dhaka Metropolitan Development Plan (DMDP), the road proportions in Dhaka are - primary road 6.7%, secondary road 3.7%, feeder 5.21% and other narrow roads 84.6% (Bhuiyan, 2007). But no specific road width proportion is followed while developing main road to narrow side roads in Dhaka city road network. Rajdhani Unnayan Kartripakkha (RAJUK) is solely responsible for such irreversible problem of inconsistent development planning which causes lack of accessible road. Hence with the increase in motor vehicle ownership along with this unplanned land use practice in Dhaka, multiple interruptions in vehicular flow is observed.

5.3 Irregular Road Pattern: Most of the Dhaka city transport developments have been driven by ad hoc considerations. It lacks specific focus on analysis of present travel demand or future requirements. Hence, city road network is not organized or integrated considering connectivity or mobility. City Transport system is based on weak skeleton of irregular road pattern with less productive junctions. In the following Figure 1, grid pattern in Baghdad is shown while in Figure 2 radial road pattern in New Delhi is given. In grid pattern, signal coordination by linked signal is possible. Also one way traffic operation or tidal flow can be introduced in grid pattern which ensures smooth traffic flow. But most efficient road pattern is the radial one (hub and spoke pattern) which exists in developed cities like New Delhi, Paris etc. Such patterns act as catalysts of achieving smooth traffic flow in those cities.

Fig. 1: Grid road pattern in Baghdad, Iraq

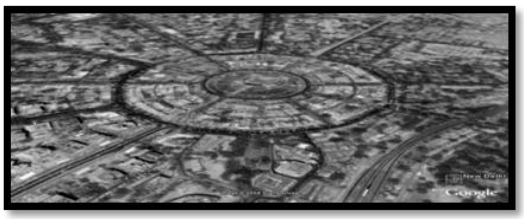

Fig. 2: Radial road pattern in New Delhi, India

5.4 Mixed Operation of Traffic and Random Pedestrian Movement on Road: Because of the characteristic of mixed traffic on road, serious congestion occurs in peak hours causing serious interruption of vehicular flow. Public transport is currently not given any priority over other vehicle types and road users. If such situation prevails, the goal of attaining smooth traffic flow will be unfulfilled. Only by introducing bus priority measures in an integrated road network, people can get rid of the unwanted side effects of prevailing traffic stop and go condition. In addition to that, pedestrian movement is significant in Dhaka as 14% of the total number of trip is done by walking in Dhaka (STP, 2005). Pedestrian awareness by social campaign can help to make them understand the necessity of uninterrupted flow.

6. CONCLUDING REMARKS

Transport network development has been carried out in Dhaka mostly by improvised concerns without any distinct focus on upcoming requirements. High growth of vehicular population, backdated transportation policies, mixed vehicle composition, improper implementation of transport planning: all these have promoted Dhaka as a prominent example of traffic stop-and-go situation. Some other serious deficiencies resulting from ad-hoc planning are: improper modal mix, un-integrated system etc. Serious institutional weakness of BRTC (Bangladesh Road Transport Corporation) and limited role of the private sector have caused the deterioration of public transport. With all these, there lies the answer of possibility of achieving smooth traffic flow in Dhaka city. The fragile road network and unplanned land-use pattern are to be considered as prominent irreversible obstacles standing on the way of achieving smooth flow in Dhaka city. Without hesitation it can be said that the existing transport network will not sustain any more burden on it in the name of further development project. Decentralization of the capital city, if possible, can be considered as one of the best possible ways to make this mega city livable in near future. As Dhaka is expanding outwards, the new areas are to be brought under strict provision of systematic development and proper planning. From the analysis, it is observed that maximum number of interruption occurred due to traffic congestion (68.8% of the total recorded interruptions for local bus, 70.1% for human hauler and 66.3% for private car). In order to efficiently overcome this congestion problem, upcoming projects of Metro Rail should be prioritized. Though Metro Rail is expensive venture while construction phase, it has a long term sustainable impact. Furthermore, the temporary causes of interruptions have to be overcome immediately to keep alive the remaining hope of transforming the transport system in Dhaka to a sustainable one. Therefore, success in attaining smooth traffic flow in Dhaka city will only bring to light, if government together with the people in Dhaka can overcome the upcoming hurdles. Only strong ambition and dedication to modify city transport network to a sustainable one, can help the future generation to escape from the upcoming unavoidable future of confining in concrete jungle of Dhaka city.

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