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TRAFFIC CONGESTION MONITORING IN THE SELECTED TRANSPORT AXIS OF CHITTAGONG CITY

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ABSTRACT
Over the last few years, the transportation problem of Chittagong City has visibly been deteriorating gradually. This study is dedicated to analyzing present traffic congestion in the selected major transport axis of Chittagong city. The traffic study has been conducted on the five most important intersections (Tigrepass, Agrabad, Barik Building, Nimtoli, and CEPZ) by taking into consideration their commercial value and the movement of traffics. Observation of operational conditions indicates that the road continuously suffers from unrestrained movements of pedestrians, motorized and non-motorized vehicles. Again, from the estimated Annual Average Daily Traffic (AADT) data, it is found that the maximum peak period traffic flow is above 4000 PCU/Hour at Agrabad intersection designating overcrowded road. From the journey speed study, it is found that the average travel speed on the selected roadway is about 10 to 15 K.P.H. throughout the day dropping below 10 K.P.H. during the peak hour indicating severest congestion. The traffic capacity study of the existing roadway showed that the traffic capacity of the roadway is less than the present demand at major survey locations and providing a level of service (LOS)-F with existing traffic flow.

Keywords: Chittagong City; traffic congestion; Annual Average Daily Traffic; travel speed; Passenger Car Unit; Level of Service.

1 INTRODUCTION

In general, traffic congestion on transport networks is a state that happens due to the increase in use and is measured by speed drops, increase in travel times and vehicular queuing. Congestion is mainly occurred due to the increased travel demand resulting in the vehicular interactions and fall of the travel speed of the traffic stream.

Traffic flow issues in urban areas are being studied by many researchers throughout the world and some of the studies are reported in the literature. The traffic jamming and travel delays at a rotary intersection in an Indian city were studied and suggested to redesign roundabout and traffic signal timing and to construct flyover, cloverleaf, underpass and uplifted roundabout (Patel, 2014). Muhammad Ali and Faraj measured congestion by evaluating the LOS of the road by determining the rate of traffic flow of the road as well as free flow rate (Muhammad Ali and Faraj, 2013). To minimize traffic congestion and travel delays at city road, intersections should be signalized and parking at road intersections should be strictly prohibited (Aderamo AJ, 2012). Habib evaluated some planning alternatives (rickshaw and auto-rickshaw elimination, improvement of bus service, minor improvement at bottlenecks of the road networks, introducing rail transit using the existing rail lines with suitable access modes) to relieve traffic jamming and resultant air pollution (Habib, 2002).

2 BACKGROUND

Chittagong is the major port city and the gateway of Bangladesh and is considered as a major economic hub of Bangladesh. For different reasons, many government officials and general people are continuously using Chittagong Airport for moving to the capital city and overseas countries. Moreover, the southern part of Chittagong city is also very important for many offices and amusement areas (Agrabad, CEPZ, Patenga). On the way to Chittagong Airport from the city, the presence of country's largest port, two export processing zones (CEPZ and KEPZ) and diversion of intercity through traffic (Tigerpass, Barik Building, Nimtoli) also deteriorated the traffic congestion at several intersections. But, due to traffic congestion on the roads, it is very hard to reach the areas on time.

According to a report ("Coastal Road Project of Chittagong - Assignment Point," n.d.), the road network in Chittagong city is not adequate compared to the traffic volume on the road, and there are traffic safety issues due to a lack of sidewalks in addition to chronic congestion. According to the JBIC Pilot Study for "Formation for Multi-sector Infrastructure Development in Chittagong" project, the Sheikh Mujib Road has the highest volume of traffic in Chittagong City. The road's 12-hour motorized traffic volume is as high as 44,000 vehicles. Travel speeds were surveyed by JICA in 2008 along the section extending from Patenga to the City Gate, via the M. A. Aziz road, Port Connecting Road, and Dhaka-Chittagong Highway. The degree of traffic congestion was highest during the evening peak hour with travel speeds of 10km/hour or slower. This study is aimed to investigate the current conditions of the selected road intersections of Chittagong city considering congestion point of view.

3 ROADWAY CONDITIONS ALONG THE STUDY AREA

The study is designed to analyze traffic performance on CDA Avenue Road to M. A. Aziz Road, particularly the transport axis starting from Lalkhan Bazar intersection and ended near Butterfly Park, Patenga. Among the 10 intersections available along the road axis, Tigerpass, Agrabad, Barik Building, Nimtoli, and CEPZ are selected for detail traffic engineering assessment. The study roadmap indicating five selected intersections is shown in Figure 3-1.

Figure 3-1: Map of the Selected Road Network of the Study Area (Source: Google Map)

Traffic composition of this roadway is dominated by various kinds of vehicles such as freight carrying lorry, buses, trucks, covered vans, private car, jeep, bike, taxi, rickshaw, etc.

4 TRAFFIC STUDY

A traffic survey is a detailed examination and analysis of a transportation system supported by traffic data survey. In order to identify the major causes of congestion and nature of the problem at the selected intersections (Tigerpass, Agrabad, Barik Building, Nimtoli, and CEPZ), extensive traffic survey was undertaken, including directional traffic count study and travel speed survey.

4.1 Traffic Count Study

There are two available methods for performing traffic volume counts; namely (1) manual count method and (2) automatic count method.

Manual Counts Method: Manual counts are recorded using one of three methods: tally sheets, mechanical counting boards or electronic counting boards. In this study, the tally sheets method is used.

In this method, recording data onto tally sheets is the simplest means of conducting manual counts. The data can be recorded with a tick mark on a pre-prepared field form.
Automatic Count Method: Automatic counts are recorded using one of three methods: portable counters, permanent counters, and videotape. In this study, the videotape method is used. In this method, observers can record count data by videotaping traffic. Traffic volumes can be counted by viewing videotapes recorded with a camera at a collection site.
Traffic Data Collection and Processing: The traffic counts were undertaken from August 4 to August 20, 2015. Different groups of surveyors were employed to strategically selected traffic count locations for manual counts at different hours of the day over the total network.

Seasonal Variation Factor: From Classified Traffic Count we can get the Average Daily Traffic (ADT) and the ADT is adjusted with the seasonal variation factors to get the AADT.

Table 4.1 shows the seasonal variation factor adopted by the Roads and Highway Department (RHD).

Table 4.1: Seasonal Variation Factor (RHD, 2005)

Vehicle Type	Adopted Value	Vehicle Type	Adopted Value	Vehicle Type	Adopted Value
Heavy Vehicle	1.103	Auto Rickshaw	0.952	Micro Bus	0.952
Truck	1.103	Motor Cycle	0.952	Car/taxi	0.952
Bus	0.952	Bicycle	0.952	Cycle/Rickshaw /Van	0.952

Passenger Car Unit (PCU) Values: In respect to passenger car unit, weightage to various types of vehicles is very important, because of their different operating characteristics and impact on the flow of traffic. As prescribed by geometric design standards of RHD following weightage were given to different vehicles in determining AADT for the studied road is given in Table 4.2.

Table 4.2: PCU Values of Different Vehicles (RHD, 2000)

Type of Vehicles	Weightage	Type of Vehicles	Weightage
Rickshaw	2.0	Mini bus/ Pick-up	2.0
Motor Cycles/ Cycle	0.75	Buses	3.0
Hand Drawn Vehicles	4.0	Trucks	3.0
Cars/ 3 wheelers	1.0	Trucks 3 axle	3.5
Micro Bus/ Vans/ Jeeps	1.25	Lorry/ Tailor units (more than 3 axels)	4.0

4.2 Travel Speed Survey
Journey time surveys were conducted to get the actual travel time through the study area in the base year 2015. Data was collected by Floating car method. Vehicle mounted GPS devices were used for this purpose.

5 RESULT AND DISCUSSION
This section presents the analysis of traffic study data performed at the selected intersections for all directions traffic. From the traffic count data, PCU/Hour and AADT were calculated and travel speed study data were tabulated in order to show journey time and speed at various locations of the roadway. Finally, PCUs and travel speeds observed on various road intersections were compared to traffic capacity as per UK guidelines and Highway Capacity Manual (HCM) to find out the level of service (LOS) and to understand existing traffic congestion on the selected roadway.

5.1 Assessment of Traffic Volume
The daily classified traffic data was processed for ADT considering PCU for different vehicles and then ADT is adjusted with the seasonal variation factor to get the AADT. A line graph is shown in Fig.5-1 is plotted to give an overview of the hourly variations of estimated AADT over the entire road network representing traffic flow in both directions of the road.

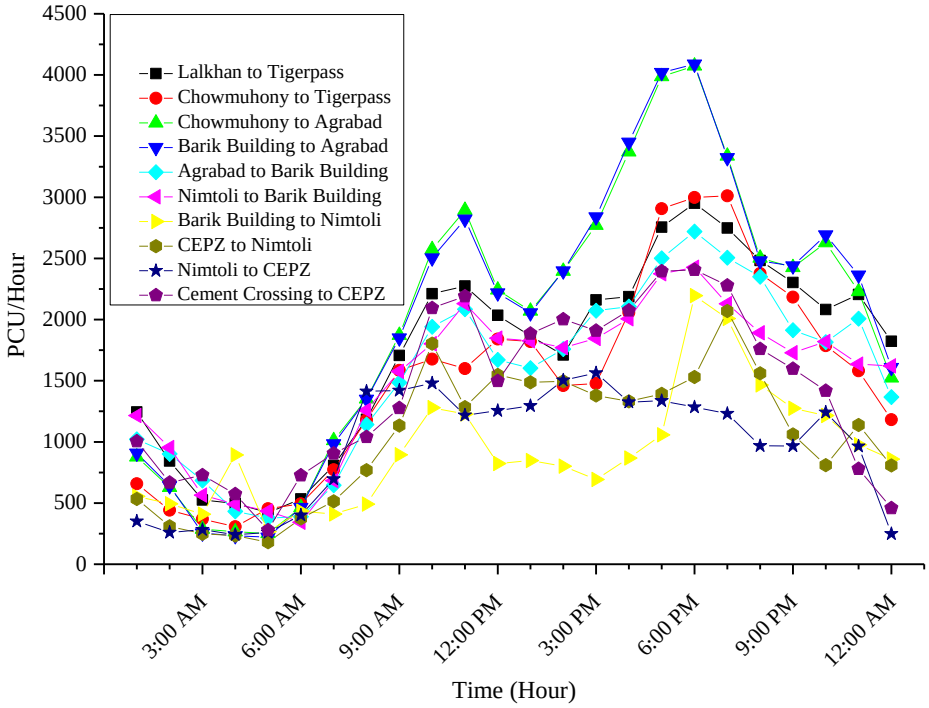

Fig.5-1: Estimated AADT on the study road (Both-ways)

From the above graph, it is seen that the morning peak mainly spans from 9 am to 12 pm and the evening peak extends from 4 pm to 7 pm at almost all the studied intersections. The most congested morning peak basically occurs at Agrabad intersection at 10 am; the most congested evening peak ensues at 6 pm which is also at Agrabad intersection. It is also seen that Agrabad intersection experienced the highest peak hour volume of traffic (over 4000 vehicles).

5.2 Assessment of Journey Time and Speed

Travel speed survey was carried out at the different time of the day (peak and off-peak) to measure the time consumed for traveling from WASA to Airport by using a private car in Table 5.1 describes the results of the journey time survey at the base year 2015.

Table 5.1: Journey Time Survey (Vehicle Type: Private Car)

Loop No	Survey Route		Survey Time			Travel Distance (km)	Travel Speed (K.P.H.)
	Starting Point	Finishing Point	Starting	Finishing	Travel Time		
1	WASA	WASA	8:04	11:08	3hr4 min	30.8	10.04
2	WASA	WASA	12:14	14:44	1 hr 40 min	30.8	18.48
3	WASA	WASA	16:07	18:37	2 hr 30 min	30.8	12.32
4	WASA	WASA	18:00	19:48	1 hr 48 min	30.8	17.11
				Avg. Time	2 hr13 min	Avg. Speed	14.49

5.3 Demand and Capacity of Roadway

The capacity of a facility is defined as the maximum hourly rate at which persons or vehicles can reasonably be expected to traverse a point or uniform section of a lane or roadway during a given time period under prevailing roadway, traffic and control conditions (Highway Capacity Manual, 1985). The Highway Capacity Manual (HCM) has introduced the concept of "Level of Services" to donate the level of facility one can derive from a road under different operating characteristics and traffic volume. When capacity gives a quantitative measure of traffic, LOS tries to give a qualitative measure. The intention of LOS is to relate the traffic service quality to a given rate of traffic. HCM divides the quality of traffic into six levels ranging from level A to level F. Considering the complex nature of traffic conditions and the lack of consistent data, the HCM recommends the following LOS for such streets as shown in Table 5.2.

Table 5.2: HCM Recommended Level of Service (LOS)

Level of service (LOS)	Operating Characteristics
A	Free flow relatively, with some stops likely to occur. Average overall speed is 40 K.P.H. or more.
B	Stable flow, with delay, not unreasonable. Average overall speed is 30 K.P.H. or more.
C	Stable flow, with significant delays which may be acceptable. Average overall speed is 25 K.P.H. or more.
D	Approaching unstable flow, with tolerable delays. Average overall speed is 15 K.P.H. or more.
E	Unstable flow, with average overall speed, is below 15 K.P.H. but moving.
F	Forced flow, jammed conditions. Stop-and-go movement.

From Table 5.1 and Table 5.2, it is found that the travel speed is around 10 to 15 K.P.H. throughout the day which drops below 10 K.P.H. during the peak hour indicating chronic congestion with LOS F quality service in the study area.

The practical capacities recommended by the U.K. Standards for Urban Roads are given in

Table 5.3. From the traffic count survey data, PCU per peak hour for the studied area has been determined and the calculated value with their traveled width of the road section has been depicted in Table 5.4.

Table 5.3: Practical Capacities Recommended by U.K. Standards (H. M. S. O., 1966)

Width of the carriageway	2-lane			3-lane		4-lane			6-lane
(m)	6.00	6.75	7.30	9.00	10.00	12.0	13.5	14.6	22.0
Description	PCU/Hour (Both directions of flow)					PCU/Hour (One direction of flow)			
All-purpose roads with no frontage access, no standing vehicles permitted and negligible cross traffic	1200	1350	1500	2000	2200	2000	2400	2200	3600
All-purpose street with high capacity junctions and 'no waiting' restrictions	800	1000	1200	1600	1800	1200	1500	1350	2500
All-purpose street and capacity restricted by waiting vehicles with junctions	300 to 500	450 to 600	600 to 750	900 to 1100	1100 to 1300	800 to 900	1000 to 1200	900 to 1000	1600 to 2200

Table 5.4: Peak PCU/hr. at Various Section

Road Section	Traveled width (m)	Peak PCU/Hour	Road Section	Traveled width (m)	Peak PCU/Hour
Lankhan Bazar to Tiger pass (4L2W)	7.50	2951	Agrabad to Tiger pass	7.0	3012
Tiger pass to Agrabad (6L2W)	9.85	4074	Barik Building to Agrabad	10.74	4088
Agrabad to Barik Building (6L2W)	10.74	2719	Nimtoli to Barik Building	7.43	2428
Barik Building. to Nimtoli (4L2W)	7.43	2196	CEPZ to Nimtoli	9.25	2070
Nimtoli to CEPZ (6L2W)	9.25	1336	Airport to CEPZ	11.34	2407

From
Table 5.3 and Table 5.4, it is clearly observed that most of the carriageway width of the selected intersections are not properly maintained as per the UK guidelines for urban streets. Almost all of the studied intersections are overloaded with present observed traffic capacity and reached in a state of forced movement and severely

congested area.

6 CONCLUSIONS

This study has brought into focus the issue of traffic congestion on the selected road intersections of Chittagong city. Along the selected streets, there are uncontrolled intersections at frequent intervals. These roadway sections allow two-way traffic providing a huge volume of mixed traffic allowing parking at the intersections. The morning peak primarily spans from 9 am to 12 pm and the evening peak mostly starts at 4 pm and ends at around 7 pm at almost all the studied intersections. Based on the limited number of scopes and variables studied, the following conclusions can be drawn;

- The PCU/Hour during the peak hour at the studied five intersections are twofold to threefold higher than the recommended value of PCU/Hour as per UK standards.
- The average journey speed on the roadway is about 10 to 15 K.P.H. throughout the day plummeting below 10 K.P.H. at the peak period expressing severest jamming.
- Traffic volume of the road is higher than the roadway intersection capacity and the road experiencing forced flow, packed conditions, and stop-and-go movement indicating LOS-F quality service.

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