

Determination of the Level of Service at Major Intersection: A Case Study on Traffic More Intersection Area, Pabna, Bangladesh

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Abstract

The performance of transportation system largely influences economic and social progress of any area. Pabna is one of the major developing city in Bangladesh which is not blessed enough in terms of transportation facilities. This study primarily focused on the peak hour factor and level of service of Traffic More road intersection in Pabna city. The data analysis result shows that the level of service of major intersection covering connected roads of Pabna city such as Hospital road, Abdul Hamid road and Pabna-Ishwardi highway road varies from A to C at different consecutive days of the week, where “A” represents the free flow of traffic and “C” represents the traffic flow with some delay. Lack of footpath, temporary street site shops and illegal parking is the main reasons for this situation. In this regard this situation can be controlled through improvement of existing road network and proper traffic management system.

Keywords: *Peak hour factor, Level of Service (LOS); Passenger Car Units (PCU); Volume Capacity Ratio.*

1 Introduction

In Bangladesh, the efficiency of road network is termed as a catalyst to solve all the transportation problems (Sharmeen, et al., 2012). Transportation system directs the urban development pattern (Saha, et al., 2013), therefore the improved transportation system is one of the major key of all kinds of development. With various structural and infrastructural improvement of the Pabna city, numerous industries, educational institutions, financial banks, offices, hotel and restaurants etc. are established. SQUARE is one of the top leading industry of Bangladesh which is situated in Pabna city. In this regard people from various parts of the northern Bangladesh are coming to Pabna for a job. As a result, the non-local population of Pabna is rising very rapidly, on the other hand to support increasing number of city people, the number of various types of vehicles such as auto rickshaw, rickshaw, CNG, motorbike is increasing day by day. Due to rapid population growth and the increasing number of various types of vehicles, in present times the traffic management system is becoming worse in Pabna city. As a result traffic congestion becomes a daily occurrence in this locality.

In Pabna city, the nature of traffic flow is heterogeneous. During the peak hours it is very common to see traffic congestions at major intersection area. In this regard the aim of this study is to find out the characteristics and the conditions of Level of Service (LOS) on Traffic More intersection area of Pabna city. Traffic More is one of the major intersections of Pabna city which connects three major roads named Abdul Hamid road, Hospital Road and Pabna-Ishwardi Highway. Level of service is used as a tool for evaluating the success and efficiency of Traffic More. Traffic volume survey and roadside interview survey method has been carried out to identify the level of service of Traffic More intersection. The determination of level of service is done on the basis of Highway Capacity Manual (HCM). It is a qualitative measure which generally describes the operational conditions within a traffic stream. The study shows that the level of service at the roads intersection varies in different consecutive days of the week. There is indispensable need of required level of service in major intersection connecting roads, as lower level of service leads to excessive delays and driver's frustrations. Efficiency of road network can be achieved through compatible transportation planning and impact assessment of existing transportation system. In this regard this study aims to provide some recommendations from the analyzed scenario of the study area to reduce the traffic congestion problem and to ensure proper traffic flow for urban dwellers, therefore this study can be helpful for concern authority for planning and designing new roads, accident analysis and future traffic demand forecasting for Pabna city.

2 Methodology

Transport is an essential part and parcel of our everyday lives and it is central to development. It enables access to employment, education, business, health services, and social interaction. Adequate and efficient transport system is a crying need for sustaining economic development. In order to fulfil the objectives, some steps such as selection of traffic congested road intersection area of Pabna city, literature review, determining peak hour traffic volume with peak hour factor, calculating level of service (LOS), data interpretation and report preparation has been performed.

2.1 Selection of the Study Area

Pabna is one of the major city in Rajshahi Division of Bangladesh which is located in between 23°48' and 24°21' north latitudes and in between 89°00' and 89°44' east longitudes. Pabna is characterized as an important trade and manufacturing center of Bangladesh. The district is dotted with many industrial units for its easy transportation linkages with other parts of the country (Saha, et al., 2013). Traffic More intersection area of Pabna city is selected as study area which is one of the major road intersections in Pabna, that connects three major roads of Pabna city named Abdul Hamid road, Hospital Road and Pabna-Ishwardi Highway, where peak hour traffic congestion has become a common issue for the city people. In this regard an effective research related to understanding about the level of service (LOS) of three major road containing intersection area of Pabna city is very necessary for the concern authority for planning and designing new roads, accident analysis and future traffic demand forecasting.

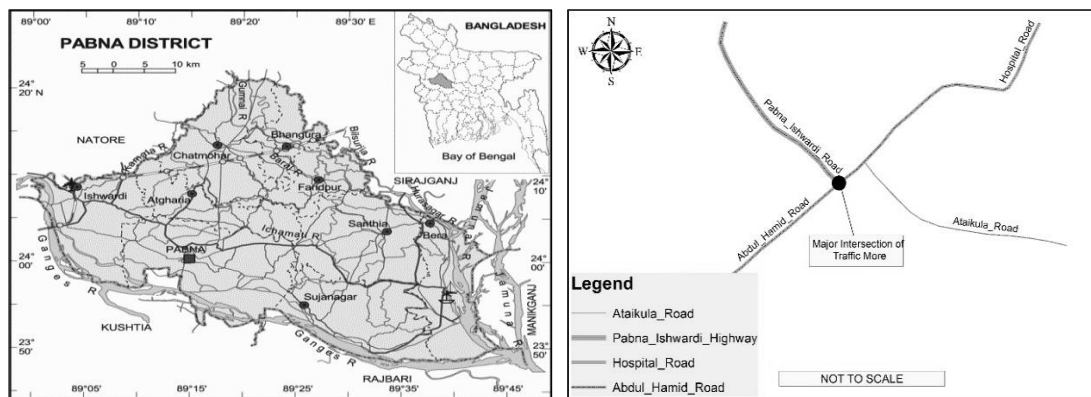


Figure 1. Location of the study area Pabna city and Traffic More intersection area

2.2 Literature Review

Various journals, conference papers, online articles has been studied to build up understanding about the calculation of level of service, passenger car unit and traffic volume survey method. LOS is the measurement of the level of facility one can get from any road which is measured by using volume capacity ratio (V/C) in terms of Passenger Car Units (PCU). According to Babit et al., (2016), peak hour factor of urban roads is mainly the ratio of the peak hour traffic volume and capacity of the road.

2.3 Determining Peak Hour Traffic Volume and Peak Hour Factor

Manual counting method has been used for the determination of traffic count. The peak hour factor can be defined as the ratio of the volume during the peak hour to the maximum rate flow during a given time period (Babit, et al., 2016).

2.4 Analysis of Data

The Highway Capacity Manual (HCM) has defined level of service (LOS) as a quantitative performance measurement that represents quality of service (Manual, 2010). It is measured by using volume capacity ratio (V/C) ratio in terms of Passenger Car Units (PCU). Capacity of any road is mainly depends on the usual speed, flow and density of vehicles. The calculation of LOS is done by following equations-

$$\text{Hourly PCU} = \sum \text{Total number of a type of vehicle passing in an hour} \times \text{PCU value basec on its type} \quad (1)$$

The highest hourly PCU value indicates the peak hour which is used to find LOS.

$$\text{Level of Service} = \frac{\text{PCU value in peak hour}}{\text{Capacity of roads based on its carriage width}} \quad (2)$$

3 Results and Discussions

3.1 Geometric Elements of Traffic More Intersection

Traffic impact analysis is the appropriate way to take transportation planning and land-use planning into account together. It has also been considered as efficient means to harmonize the relationship between land exploitation and development of transportation (Wang and Lu, 2003). Traffic More is one of the major intersections in Pabna city. Three roads are connected in this intersection named as Abdul Hamid Road, Hospital Road and Pabna-Ishwardi highway.

Table 1. Geometric elements of traffic More intersection area

Sl No.	Name of the routes	Road Width (in meter)
1	Hospital Road	9.5
2	Abdul Hamid Road	9
3	Pabna Ishwardy highway	15

3.2 Traffic Count

This study was conducted for the time span of one week. This study was conducted from 1st April, 2018 to 7th April, 2018. Calculation of traffic volume is done manually. Traffic volume contains heterogeneous vehicle types which consist of van, rickshaw, motor cycle, cycle, CNG/auto rickshaw, bus, truck etc. The survey results shows the highest number of vehicles is auto rickshaw or CNG and that possess 37% of total number of vehicle on the study area. Another vehicles such as rickshaw, bi-cycle, motor cycle, van, car, bus, truck and microbus possess 31%, 11%, 9%, 5%, 2%, 2%, 2% and 1% of the study area.

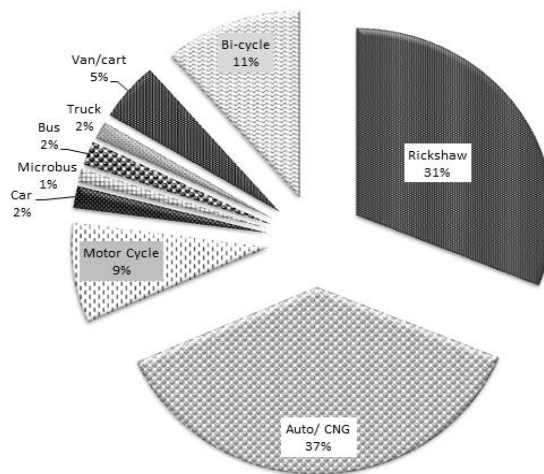


Figure 2. Heterogeneous traffic at traffic More intersection

3.3 PCU Value of Different Vehicles

Nature of traffic flow in Pabna is heterogeneous. This mixed traffic is simplified by using Passenger car unit (PCU) value. Passenger Car Unit (PCU) for different vehicles to calculate traffic volume:

Table 2. PCU value for different types of vehicles

Type of Vehicle	PCU Value	Type of Vehicle	PCU Value	Type of Vehicle	PCU Value
Truck	3.0	Utility	1.0	Motorcycle	0.75
Bus	3.0	Car	1.0	Bicycle	0.5
Minibus	3.0	Baby taxi	0.75	Cycle Rickshaw	2.0

(Source: RMSS, 2000)

3.4 Peak Hour Factor for Different LOS

Highway Capacity Manual (HCM, 2000) has defined LOS as the quality measurement operational conditions of a traffic stream. Generally level of service measures the speed of vehicles, freedom to maneuver, travel time, traffic interruptions, driving comfort, and convenience and. LOS has six categories from A to F where category “A” represents best operating condition on the other hand category “F” represents the worst quality of transportation services (HCM, 2000).

Table 3. Peak Hour Factor for Different Level of Service

LOS Level	V/C Ratio	Description	Control Delay per Vehicle for Signalized Intersections (Sec/Veh)
A	<0.60	Highest driver comfort; free flowing	≤10
B	0.60-0.70	High degree of driver comfort; little delay	>10 - 20
C	0.70-0.80	Acceptable level of driver comfort; some delay	>20 - 35
D	0.80-0.90	Some driver frustration; moderate delay	>35-55
E	0.90-1.00	High level of driver frustration; high levels of delay	>55-80
F	>1	Highest level of driver frustration; excessive delays	>80

(Source: HCM, 2006. Exhibit 16-2)

3.5 Peak Hour Factor of Hospital Road

Hospital road is an important and busy road in Pabna. There are a number of private clinics, diagnostic centers, police station, school and colleges located either side of the roads. The study shows that the level of service of this road varies from A to B in the peak hours.

Table 4. Level of Service at Hospital Road

Days	Peak Hour PCU	Peak Hour Factor	Level of Service
1 st April	2921	0.543239725	A
2 nd April	3471.25	0.64557374	B
3 rd April	2867	0.53319695	A
4 th April	3706	0.689231914	B
5 th April	3663.5	0.681327878	B
6 th April	3394.25	0.631253487	B
7 th April	1571.5	0.292263344	A

3.6 Peak Hour Factor of Abdul Hamid Road

Abdul Hamid road is another major road at Pabna town which contains the maximum traffic all day long. A number of financial banks, shops, markets, community centers, town hall, restaurants and so other public places are situated in this area. The level of service of this road varies from A to C as shown in the following table 5.

Table 5. Level of Service at Abdul Hamid Road

Days	Peak Hour PCU	Peak Hour Factor	Level of Service
1 st April	1869.25	0.366951315	A
2 nd April	3089.25	0.606448763	B
3 rd April	2362.25	0.463731841	A
4 th April	3644.25	0.715400471	C
5 th April	3345.25	0.656703965	B
6 th April	2383.5	0.467903416	A
7 th April	1154	0.226541029	A

3.7 Peak Hour Factor of Pabna-Ishwardi Highway

Pabna- Ishwardi Highway is also known as Edward College road. The width of this road is 15 meters. The level of service in this road is highly satisfactory. Usually the level of service of this road remains “A” which represents highest driver’s comfort and free flow of vehicles.

Table 6. Level of Service at Pabna- Ishwardi Highway

Days	Peak Hour PCU	Peak Hour Factor	Level of Service
1 st April	1363.75	0.160630153	A
2 nd April	2022.75	0.238250883	A
3 rd April	2546	0.299882214	A
4 th April	3620.5	0.426442874	A
5 th April	2353.25	0.277179034	A
6 th April	2138.5	0.25188457	A
7 th April	1675.75	0.19737927	A

3.8 Level of Service at Traffic More Intersection

Due to the location near commercial area, Traffic More is the busiest intersection in Pabna town which consists of three major roads. It is a non-signalized intersection. Traffic flow is higher in Abdul Hamid road and Hospital road. Different commercial activities, health facilities and educational activities around Abdul Hamid road and Hospital road attract people very much. As a result, traffic congestion becomes a common scenario in this intersection. Level of service is poor in these two roads. It is causing driver’s discomfort and time delays.

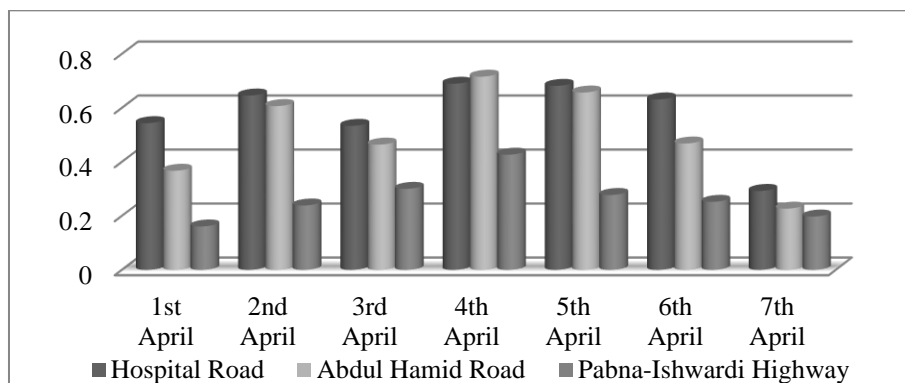


Figure 3. Variation in level of services of three roads at Traffic More intersection.

People usually parks their vehicles on the roadside as there is inadequate parking place for the vehicles. There is no specific footpath which is causing More trouble to the pedestrians. Also street side shops occupy most of the places of the roads.



Figure 4. Roadside shops and illegal parking at Traffic More intersection area.

4 Conclusions

Transportation system is part and parcel of a city. Pabna is one of the fastest growing city of Bangladesh where narrow road network is not sufficient enough to support huge number of growing vehicles, therefore traffic congestion has become a common issue for the city dwellers. The congestion at the intersection area is worse than the other parts of the road networks. Traffic More is a major non-signalized intersection area of Pabna city, where three major roads named Abdul Hamid road, Hospital road and Pabna-Ishwardi highway road connect among them. Abdul Hamid road and Hospital road is much narrower than the Pabna-Ishwardi road. In this regard peak hour level of service of the Abdul Hamid road and Hospital road varies from "A" to "C" where "A" represents free flow of traffic and "C" represents traffic flow with some delay. Several factors such as illegal parking, temporary shops on the road, narrow width of the road, and lack of foot path are major reasons behind the variation of the level of service at major intersection covering roads. Only a successful application of the proper traffic management plan in Pabna can reduce the traffic congestion problem. Widening of roads can't be done due to unavailable land on both sides of the road. Heavy vehicles should not be allowed to cross the intersection area during the day time. Temporary roadside shops need to be ousted and footpath should be built for pedestrian's safety. Illegal parking near the three routes should be strictly prohibited. Public carpooling facility can also reduce the traffic congestion at a high rate in peak hours. Overall proper traffic management system needs to be ensured by the concerned authority for the improvement of level of service at major intersection area.

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