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RESEARCH ARTICLE

IMPACT OF SCHOOL INDUCED TRAFFIC ON URBAN INTERSECTION IN DHAKA CITY UNDER TRAFFIC CONDITION OF BANGLADESH.

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Abstract

The establishment of schools or other educational institutes near the intersection of an urban road is generally prohibited in developed, well planned cities. However, in developing countries like Bangladesh, there are many schools close to the intersections which contribute to considerable trip attraction during morning and evening peak. A questionnaire survey on school students reveal that 33% of the students use non-motorized transports and 28% of them use private car/taxi to make their school commuting trips. From video survey and manual counting method Maximum length of queue has been observed during 12:30 to 12:45 which is actually due to the school induced traffic and control delay at the approach near Wills Little Flower School is 51.492 sec/veh which is greater than delay of other time of the day. An effective school zoning policy including provisions for establishment of schools at a certain distance away from intersections can provide a long-term solution. Short-term solution can involve effective enforcement such as imposing case against illegal on street parking in front of school.

Introduction:-

Dhaka city which is the administrative, commercial and cultural capital of Bangladesh has been turned into 26th Mega City and 10th most populous city of the world (Habib et al., 2005). In last five years the population of the city has grown by about 50% to about 18.7 million, while for the same period the vehicle population has also grown by about 50% to more than 375,000 vehicles. Immense densification and mushrooming development of residential, commercial and other infrastructure, trim down the opportunity to construct new road infrastructure or introduce modern system for taming overall transportation system. Incomplete understanding of the inherent weakness of the city, the authority is providing piecemeal solution without a long term vision which is becoming an extra burden on the overall system of the city and the city is developing without a decent growth (Mahmud, S.M. Sohel, 2009). The road traffic system of Dhaka Metropolitan City is in the worst phase now. All major signalized intersections (presently controlled manually through responsive signal system in field condition) within this city have got severe traffic congestion producing long delay and untold sufferings of the road users (Signal Synchronization Study, 2013). Intersections are one of the important bottlenecks, which interrupt the smooth flow of traffic which cause delay (Alam, M.S., 1997).

The performance of an intersection is highly effected when school near it induces huge volume of traffic to the intersection which is responsible for creating more delay resulting congestion. School commuting trips or the trips

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made by students and/or guardians to reach school and return from school contribute to urban road congestion situation to a large extent. A study in the city of Kanpur reveals that most percentage of students use their family vehicles to reach school whereas most of the respondents using private vehicle are female. Bicycling is also gender biased as 25% of the respondents were male and only 9% were female (Singh et al., 2017). In Bangladesh, for example in Sylhet city majority of the students travelling to schools use rickshaw whereas 14% of them use motorcycle mainly driven by their guardians and followed by a share of 13% by private cars (Hoque et al. 2016). This indicates that students in developing cities tend to use different forms of transport instead of using public bus and school bus service. The heterogeneous mode involved school trips though originates from verities of places, these ultimately terminates in a single school. As a result, congestion arise at a particular section of road which eventually leads to problems for operation of urban intersections.

In this research study main focus is to show the impact of school induced traffic on the intersection. Different parameters are important to quantitatively analyze and show the impact of school on the near intersection. Mode choice, trip generation, vehicular flow variation, vehicle composition, vehicular speed, approach queue length, approach control delay are such parameters which indicate the impact of school on the intersection. The effect of school on the intersection can be quantitatively shown by the performance of the intersection with respect to control delay. If one approach is effected by increasing delay overall performance of the whole intersection will be deteriorated. The delay is defined as the difference in travel time when a vehicle is unaffected by the controlled intersection and when a vehicle is affected by the controlled intersection. This delay includes lost time due to deceleration and acceleration as well as stopped delay. Thus, intersection delay estimates are directed toward estimating total delay or simply stopped delay (Kadiyali, L.R., 2016). Different methods are available for estimation for control delay considering lane based homogeneous traffic condition. As in our country non-lane based heterogeneous condition exists, Modified Webster's formula (M.S. Hoque et al., 2007) for Bangladeshi traffic condition is very useful.

School induced traffic makes a considerable impact on urban intersections. As a result, the operational conditions of intersections profoundly affect the well-being of the surface transportation of goods and passengers in cities; whose social, economic, recreational, and other activities depend on an efficient road system. As the operational quality of urban road systems gradually deteriorates due to increase in traffic volume and a higher level of service (LOS) is required. Based on assessment results, the authorities can isolate those strategies and plans that make both the improvement measures and the allocation of limited funds more rationally (J. Li. et al., 2004).

Research Methodology: -

Methodology of this research has been divided into three parts: a) study area selection; b) data collection, c) data extraction and analysis.

Study Area Selection: -

At the beginning of this research a preliminary survey was conducted within the Dhaka city. The main purpose of this preliminary survey was for the selection of suitable intersections for research. There are about ninety-eight (98) major intersections in Dhaka Metropolitan city, out of which sixty-one (61) intersections were surveyed in this preliminary survey. After having done the preliminary survey of 61 major intersections of Dhaka Metropolitan City and analyzing the findings of preliminary survey, Kakrail Intersection with Wills Little Flower School at Kakrail Circle approach has been selected for this research study. Google map view of Kakrail Intersection has been shown in Fig. 1

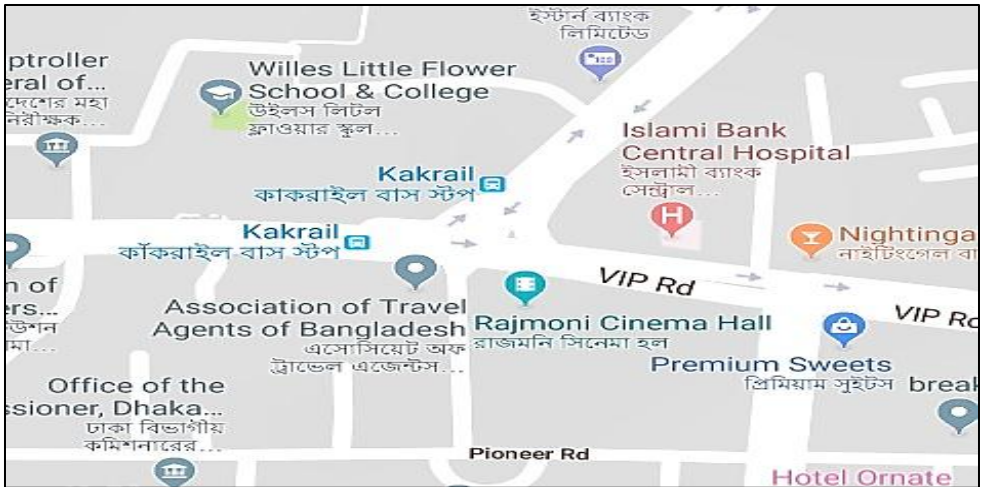

Figure 1:- Google map view of Kakrail Intersection with Wills Little Flower School

Data Collection: -

Data collection was done by two methods: a) video survey, b) questionnaire survey. Video camera was used to collect field data because it provides permanent record of data with minimum manpower and data collection is much more superior to manual data collection. Recorded film was replayed in the laboratory and required information for showing impact of school induced traffic on intersection. For Kakrail intersection data was collected from 8:00 am to 6:00 pm with 15 min interval on Sunday, 24 December, 2017 from 3rd floor of a multistoried building near the intersection. Questionnaire survey at Wills Little Flower School was done at 14 December, 2017.

Data Extraction and Analysis: -

Impact of school induced traffic on intersection has been identified by following parameters: a) mode choice, b) trip generation, c) approach traffic, d) vehicular speed, e) queue length, f) control delay.

Mode Choice: -

Mode choice data was extracted from questionnaire survey conducted at Wills Little Flower School.

Trip Generation: -

Trip generation data has been extracted from O-D (origin-destination) survey conducted with the students, guardians and drivers carrying the students by different mode of transport at Wills Little Flower School.

Approach Traffic: -

Approach traffic data has been extracted from video survey.

Vehicular Speed: -

Vehicular speed has been recorded by using strip length 88ft. When vehicle enters at the upstream of the strip timer was started and when it exits the strip's downstream timer was stopped. From time difference time was counted for various composition traffic and average speed was calculated.

Queue Length: -

To measure the queue length manually the approach was marked with color paint at a distance of 10 ft. interval starting from the intersection vehicle stop line initially. The observer was equipped with suitable clip board, watch, pencil and a supply of detailed forms. Detailed forms were designed to allow swift and accurate recording of all desired data.

Control Delay: -

Control delay was estimated using modified delay formula considering non-lane based heterogeneous traffic condition in Dhaka City.

Modified Webster's Formula:- Modified Webster's formula developed from classical Webster's delay formula by M.S. Hoque and M.A. Imran under Bangladesh condition.

$$d = \frac{1}{2} \times \frac{c \times (1-u)^2}{1-y} + \frac{x^2}{2q \times (1-x)} + 46.93 - 46.04 \times q - 37.32 \times x - 0.3608 \times pnmv$$

Here, d = average delay per vehicle in seconds; u = green time ratio; q = average arrival rate (flow) in pcu per seconds; s = saturation flow in pcu per seconds; nr = average overflow queue in pcu; c = cycle length in sec; g = Effective green time in sec; x = Degree of saturation; pnmv = percentage of non-motorized vehicles.

Results and Discussions: -

Mode Choice:-

A questionnaire survey revealed that 33% of the total students travel to school using rickshaw and 7% students use school van. So, a total of 40% of the students use Non-motorized vehicle (Fig. 2). However, the approach in question don't provide access to NMV's though some rickshaw and school vans were seen passing through the approach illegally. The rest 60% of the motorized vehicles are mainly attracted to the approach in question.

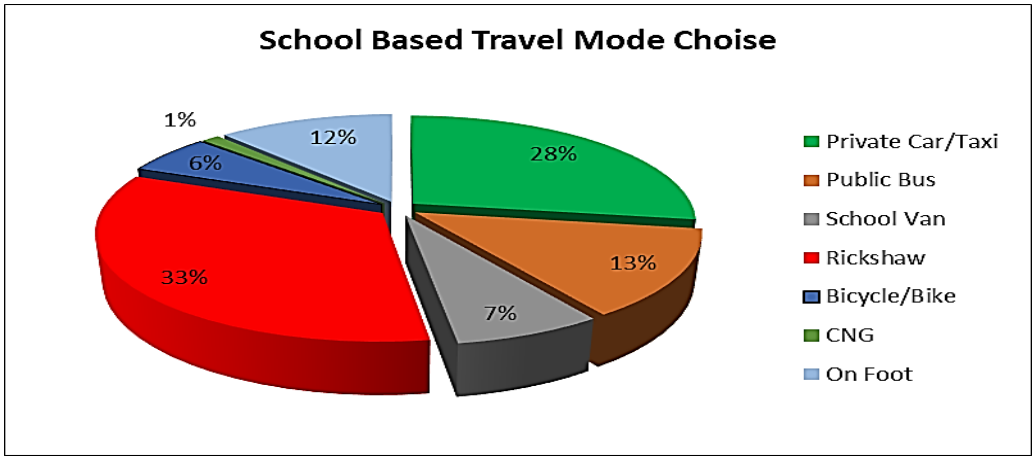

Figure 2:- School based travel mode choice

Trip Generation:-

Haphazard trip is generated from almost all parts of the city. As it has been seen earlier 60% of this trip are made using motorized vehicles, this contributes to operation difficulties at the intersection near the school. The trip attraction of the school can be seen in Fig. 3.

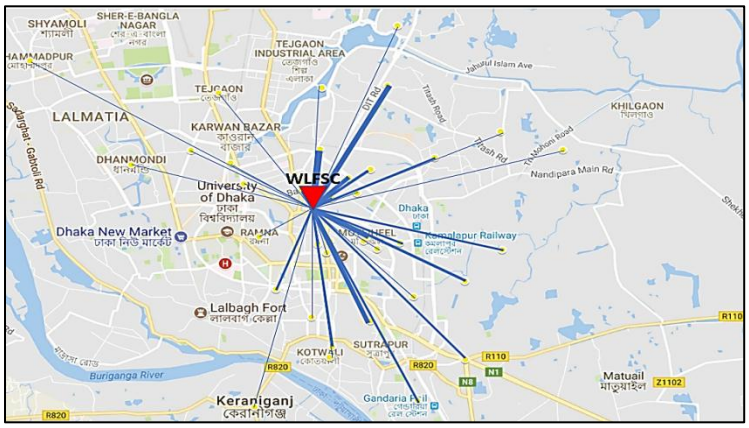

Figure 3:- Catchment area of trip generation of Wills Little Flower School

Approach Traffic: -

The selected approach of the intersection has three major peaks as can be seen in Fig. 4. The first peak of the day (9:00 to 9:45) clearly denotes the residence to work commuting trips and last peak (16:30 to 16:45) depicts work to residence commuting trip. The peak during afternoon is the time during when school trips both home to school and school to home are induced. This also is a validated by the increased traffic during school holiday at that time.

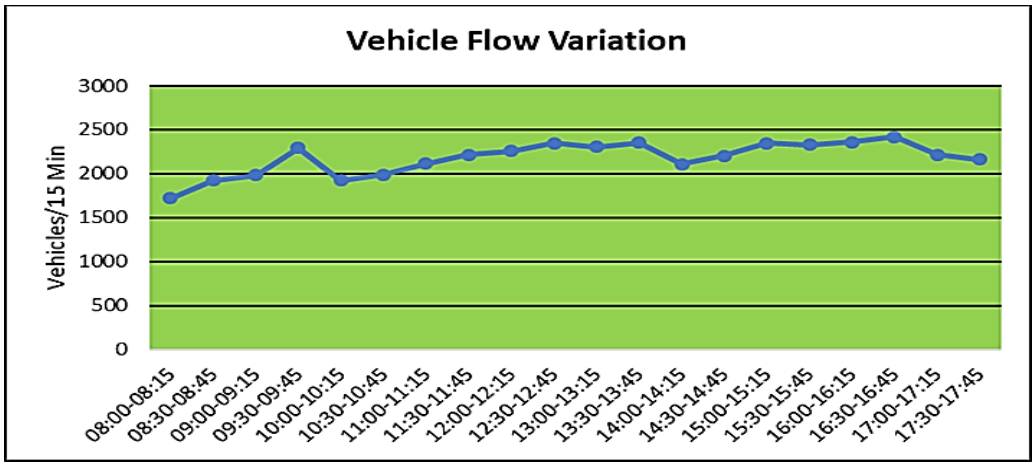

Figure 4:- Vehicular flow variation

A video survey conducted on the approach reveals that 76% of the vehicles are either private car or taxi. 13% bikes are also seen with very small proportions of CNG, public bus and non-motorized vehicles (Fig. 5). However, there is considerable amount of increase in the traffic volume on the school day while keeping the proportion of all vehicles almost same.

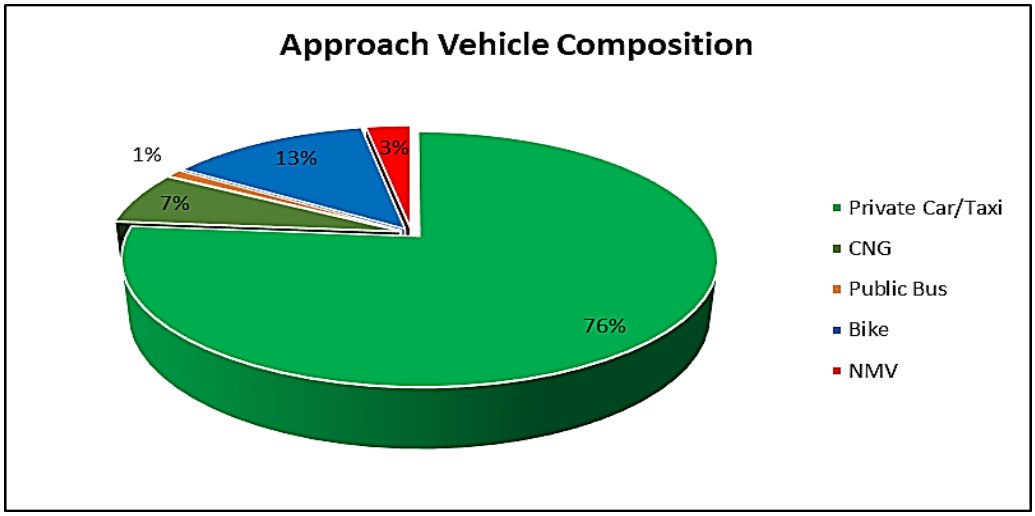

Figure 5:- Approach vehicle composition

Fig. 6 reveals that private car, bike and CNG Auto rickshaw volume is increased considerably during school days. This have considerable effect on the intersection operation in various aspects. One certain thing must be noted in this regards that the vehicle count that denotes school holiday is such a day when office and other institutes are open and only schools or other educational institutes are closed. This data can clearly depict the increase in traffic volume only due to school trips.

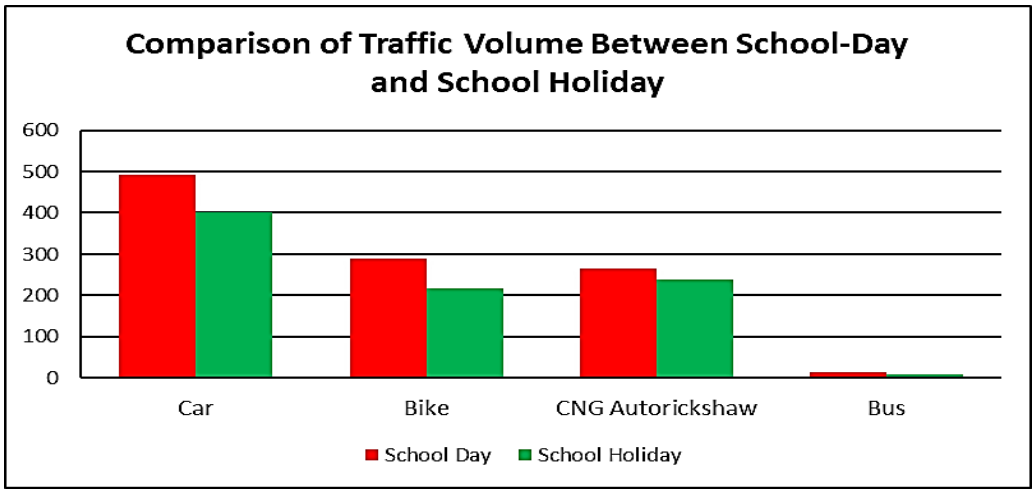

Figure 6:- Comparison of traffic volume between school-day and school holiday

Impact on Intersection:-

The increase in traffic volume surrounding the school campus have various detrimental effect on the roads adjacent to school and consequently on the intersections. Various things that ultimately lead to the inefficiency in intersection operation are: -

1. On-street parking
2. Drop-off and Pick-up activity
3. Gathering of NMV's in front of school gate

These phenomena ultimately lead to bottlenecks and creates problem for through traffic. The questionnaire survey reveals that 69% of the drop-off and pick-up operation takes place on the main road which seriously hampers through traffic and has impact on operating speed of the vehicles specially for private cars. As can be revealed in Fig. 7 that speeds of private cars, bikes, buses and CNG's are significantly reduced during school days. This eventually leads to accumulated delay in the intersection.

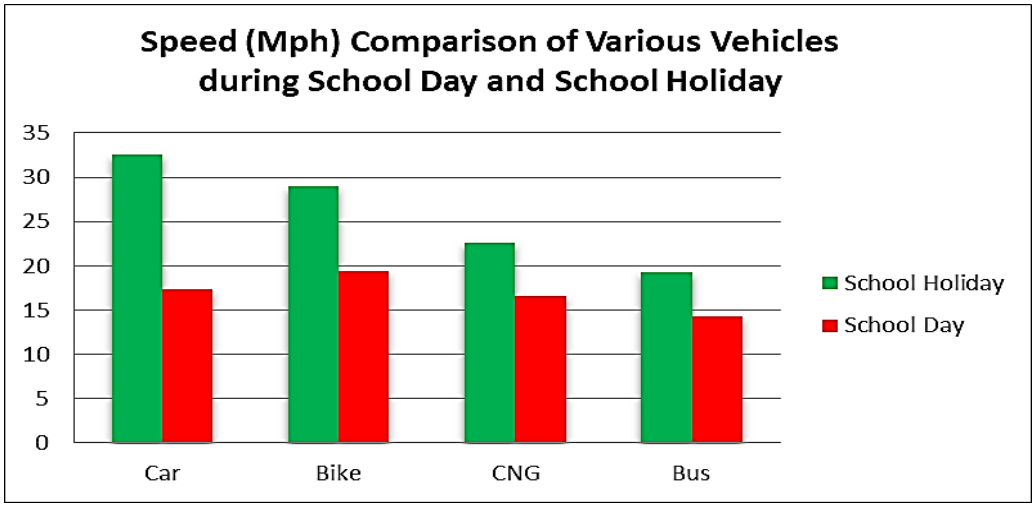

Figure 7:- Speed comparison of various vehicles during school day and school holiday

Another important thing is that the queue length for the approach is significantly increased during the evening peak when the morning shift of the school terminates and day shift stars (Fig. 8). Maximum length of queue is seen during 12:30 to 12:45 which is actually due to the school induced traffic as the general government and private sector working hour in Dhaka is 9:00 to 5:00. So, it clearly indicates that the increased queue length during the 12:30 to 12:45 cycle is only due to school traffic.

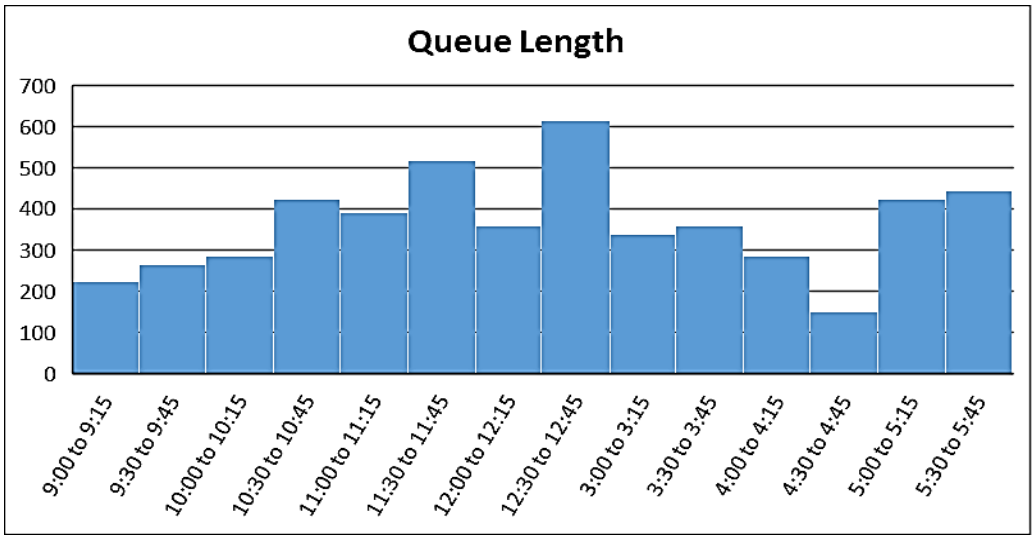

Figure 8:- Queue length

Control Delay:-

Table 1:- Determination of control delay

Approach	Arrival Flow q (PCU/s)	Arrival Flow q (PCU/s)	Saturation Flows (PCU/hr)	y (q/s)	Green Time g (sec)	Cycle Time c (sec)	Green Time Ratio u (g/c)	Degree of saturation x = y/u	Percentage of NMV (pnmv)	Delayd (sec/veh)
Kakrail Circle to Kakrail	426.63	0.11851	4643	0.092	58	130	0.446	0.206	11.79	51.492

From Table 1 it has been found that at peak hour (school hour) control delay at the approach near Wills Little Flower School is 51.492 sec/veh which is greater than delay of other time of the day. So it's a clear indication of having huge impact from school on urban intersection.

Concluding Remarks:-

The current congested roadway situation of urban areas of Bangladesh cannot be improved unless policy makers make some important decision based on research. In the analysis it is found that mainly long-distance education trips attract a large number of private automobiles. Thereby, increases travel demand unnecessarily and contribute to congestion significantly, particularly at peak periods.

Some recommendations are made for improving the current situations. These involve both long-term and short-term solution to the problem concerned. These recommendations are: -

1. An effective school zoning policy including provisions for establishment of schools at a certain distance away from intersections can provide a long-term solution.
2. Short-term solution can involve effective enforcement such as imposing case against illegal on street parking in front of school.

References: -

1. Alam, M.S. 1997. Performance Evaluation of Selected Intersections in Dhaka City. MSc Thesis, Department of Civil Engineering, BangladeshUniversity of Engineering and Technology, BD
2. Habib, M.A.; Armed M. and Siddique M.Z.H. 2005. Transportation Problems and System Deficiencies of Dhaka City an Integrated Approach for Solutions. BURP Thesis, Department of Urban and Regional Planning, Bangladesh University of Engineering and Technology, BD
3. Hoque, M.B.& Chayan, M.M.H. (2016). Transport mode choice model for school trips in Sylhet city. ICETCESD
4. Kadiyali, L.R. 2016. TRANSPORTATION ENGINEERING. Delhi, India: Khanna Publishers. pp. 250-256
5. Li, J.; Yue, Z.Q. and Wong, S.C. 2004. Signalized Urban Intersection under Mixed Traffic Conditions by Gray System Theory. ASCE Journal, pp. 113-121
6. Mahmud, S.M. Sohel. 2009. Identifying the Deficiencies of Land-use Transport Development in Dhaka City. MSc Thesis, Department of Civil Engineering, Bangladesh University of Engineering and Technology, BD
7. M.S., Hoque and M.A. Imran. 2007. Modification of Webster's delay formula under non-lane based heterogeneous road traffic condition. Journal of Civil Engineering(IEB), 35(2): 81-92
8. Signal Synchronization Study. Traffic Signal Synchronization Study in Dhaka Metropolitan City Area. World Bank Funded, CASE Project, 2013. IDA Credit No:4581, BD Report
9. Singh, N. & Vasudevan, (2017). Understanding school trip mode choice – The case of Kanpur (India). Available at: https://doi.org/10.1016/j.jtrangeo.2017.12.007 [Accessed 23 March 2018]