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ANALYSIS OF SCHOOL TRAFFIC IN DHANMONDI RESIDENTIAL AREA

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ABSTRACT

Dhanmondi is one of the major residential areas in Dhaka City. It was planned and developed by the Public Works Development (PWD) in 1952. Although, primarily designed for residential use, non-residential uses have taken up to a percentage of 52.91 by the year 2006 (Ahmed, 2011)*. Often addressed as the 'School Parha'(Area scrammed with schools), Dhanmondi has 106 schools located in it* (Sharmin et al., 2004)*, withholding excessively more area than the permissible 0.34% set by Rajdhani Unnayan Kartripakkha (RAJUK). The surplus of schools is giving rise to traffic volume which is surpassing the carrying capacity of existing roads. Traffic during school opening and closing peak hours is creating an immense blockage within the area and obstructing car movement for up to 4 hours. To lessen this congestion, in this paper an extensive analysis of current scenario of the study area is represented and a suitable scheme of viable solutions is discussed. After conduction of three major surveys at Road no. 30 (Old), Road no. 31 (Old) and Road no. 27 (Old), the chief suggestible solutions are offered as compulsory school bus transportation, one-way movement during school hours, parking restriction during peak drop-off and pick-up hours, carpooling and cordon pricing; which could reduce overall residential traffic (inclusive of school traffic) by a significant amount.*

Keywords: *Residential area, school traffic, congestion*

1. INTRODUCTION

With the rapid rate of urbanization of Dhaka Metropolitan City, traffic congestion has become an acute problem of daily life. A clear reflection of this issue is seen in the day-to-day traffic routine of Dhaka's one of the most affluent residential areas, Dhanmondi. The main contributor of Dhanmondi's traffic congestion is the unplanned development of schools in the area. Dhanmondi was planned and developed by the Public Works Development (PWD) in 1952 according to the order Dhaka No. 11413 requ-.9th December 1952 (Mahabub-Un-Nabi and Hashem, 2007). Although, primarily designed for residential use, non-residential uses have taken up to a percentage of 52.91 by the year 2006 (Ahmed, 2011). Often addressed as the 'School Parha'(Area scrammed with schools), Dhanmondi has 106 schools located in it (Sharmin et al., 2004) withholding excessively more area than the permissible 0.34% set by Rajdhani Unnayan Kartripakkha (RAJUK). The surplus of schools is giving rise to traffic volume which is surpassing the carrying capacity of existing roads. Due to having a grid iron road network pattern, the roads are easily baffled with traffic during school opening(7:00AM-9:00AM) and closing(12:00PM-2:30PM) peak hours,creating an immense blockage within the area and obstructing car movement for up to 4 hours. The road network, originally developed for convenient use of the residents is facing a hard time coping with the ever increasing traffic volume resulting from school traffic with it's very limited aptitude. Dhanmondi is one of the most densely built up areas of Dhaka City, thus extension of road capacity is most likely an impossible consideration. Under the circumstances, a viable solution to this problem has to be originated.

2. METHODOLOGY

2.1 Selection of Study Area

Dhanmondi is one of the most affluent residential areas of Dhaka City. It spans over an area of 4.34 km² and it comprehends 33451 houses and 106 schools. Regarding the analysis of school traffic, three field surveys were conducted in the area as it is home to a great number of schools and therefore can be thoroughly investigated.

2.2 Data Collection and Analysis

Both primary and secondary data were attained for further analysis regarding the research. Primary data such as approximation of cars entering into the area during school peak hours and formation of multiple temporary car lanes during school peak hours were obtained from first-hand observations. Secondary data such as information taken from school authorities and security guards were collected through detailed interviewing. Other secondary data such as statistics and examples of feasible solutions to such congestion problems which are practiced around the world were also acquired through desktop studies. After completion of data collection, the data were analyzed in a quite simple and candid way. The significant points were noted, arranged and categorized from observations and interviews.

3. FINDINGS

According to the surveys conducted at Dhanmondi Road no.27 (old), Road no.30 (old) and Road no.31 (old) on June 2017,information about school traffic occurring at the mentioned roads which are the main access routes to the said schools(Sunbeams, Sunnydale and Mastermind respectively) have been collected and an analyzed representation of the data has been included in this section.

Table 1: Traffic Details of The Said Schools

Schools	Location	Students	Vehicle Usage	Situation, Morning	Situation, Noon	Vehicles Parked Around	Approximate Number of Vehicles
Sunbeams	Rd. 27, Dhanmondi	350	85%	Drop off for an hour; 300 vehicles (Approx)	Pick up for half an hour; 300 vehicles (Approx)	20 - 30	Car-153 Cycle Rickshaw-129 Motorcycle-18
Sunnydale	Rd. 30, Dhanmondi	300	70%	Drop off for an hour; 210 vehicles (Approx)	Pick up for half an hour; 210 vehicles (Approx)	20 - 30	Car-87 Cycle Rickshaw-92 Motorcycle-31
Master Mind	Rd. 31, Dhanmondi	1300	80%	Drop off for an hour; 1000 vehicles (Approx)	Pick up for half an hour; 1000 vehicles (Approx)	30 - 40	Car-728 Cycle Rickshaw-178 Motorcycle-94
Master Mind	Rd. 30, Dhanmondi	550	85%	Drop off for an hour; 450 vehicles (Approx)	Pick up for half an hour; 450 vehicles (Approx)	20 - 30	Car-213 Cycle Rickshaw-167 Motorcycle-70

Source: Field Survey,2017

The data represented in the above table were collected through interviews with the school authorities of each stated school and the daily approximate number of cars was estimated from first-hand observation and partially collected from the information given out by the school security guards . From the table, it was concluded that on an average 80% of the school students use vehicles for travelling to and from their schools.

Figure 1: School Traffic Scenario During Peak Closing Hour of Sunbeams(Rd. No.27)

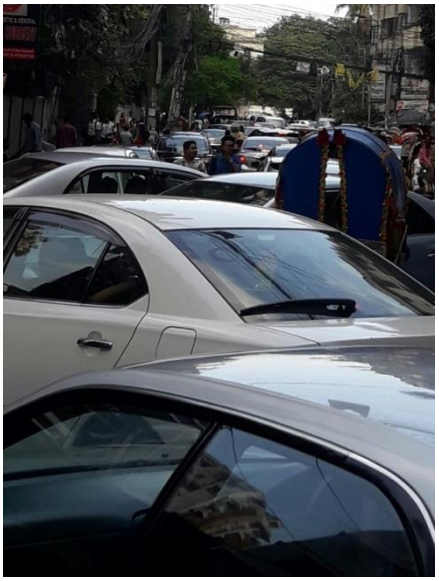

Figure 2: School Traffic Scenario During Peak Closing Hour of Sunnydale(Rd. No.30)

Figure 3: School Traffic Scenario During Peak Closing Hour of Mastermind(Rd. No.31)

From 'Approximate Number of Vehicles' section of Table 1, calculation of Peak Hour Maximum Passenger Car Units (PCU) was executed by using the following formula of Simple Method,

$$PCU = \sum(PCU\ Value * Number\ of\ Vehicles) \quad (1)$$

PCUs were calculated as per the PCU values/factors given in Geometric Design Standards Manual of RHD (Revised) 2005 and have been presented below,

Table 2: PCU Value for Different Types of Vehicle

Vehicle Type	PCU Value
Truck	3.0
Bus	3.0
Minibus	3.0
Utility	1.0
Car	1.0
Baby Taxi	0.75
Motor Cycle	0.75
Bicycle	0.5
Cycle Rickshaw	2.0
Bullock Cart	4.0

Source: (Geometric Design Standards Manual of RHD (Revised),2005)

Table 3: Calculated PCU of The Roads Beside The Mentioned Schools

Name of School	Peak Hour Maximum Passenger Car Units(PCU)
Sunbeams	424.5
Sunnydale	294.25
Master Mind (Road No.31)	1154.5
Master Mind (Road No.30)	599.5

From a desktop study on Road Design Standards (2004) prepared by the Planning Commission of Government of the People's Republic of Bangladesh, it was found that the

standard value of Peak Hour Maximum Passenger Car Units (PCU) for feeder road (carriageway width 3.7 m /12 ft) is 290.
It is known that feeder roads are those which feed traffic to main highway or freeway. All three of the selected roads of this research fall into the category of feeder road, as they set off from primary roads and their width varies within 3.5~4 meters. After comparing the standard value of PCU to the calculated values, it was seen that the calculated values deviate greatly from the standard one. The huge deviation indicates that an excess of vehicular flow is occurring on the roads and the capacity of the roads is insufficient for supporting such heavy flow.

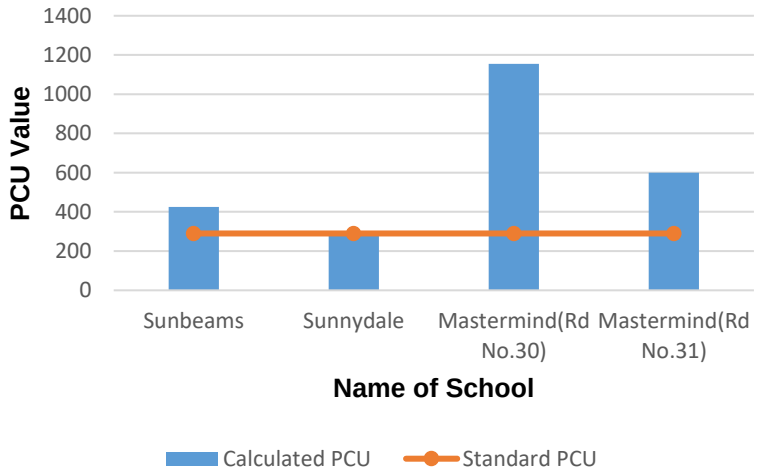

Figure 4: Graphical Representation of Standard and Calculated PCU Values

4. RECOMMENDATION

As private cars are the main contributors of the school traffic, measures have to be taken to control their number into the residential area. The probable solutions to such congestion problem whose applications are seen in many countries around the world have been mentioned and their suitability in the context of Bangladesh has been discussed in the following section.

4.1 Endorsing Compulsory School Bus Transportation

Endorsement of Compulsory School Bus Transportation will lessen the need for private transportation. It will lower the number of private vehicles and rickshaws entering into the area during school opening and closing peak hours. Also, it will save a significant amount of conveyance money of those who do not own any private vehicle.

Considering the socio-economic condition of Bangladesh,encouraging compulsory school bus transportation can save a handsome amount of money by the end of the month for all income groups of the society as school bus transportation service charges a nominal monthly fee. But in case of higher and upper-middle income groups, they rarely show interest in sending their children to school by school buses. The reason behind their disinterest is the unguaranteed safety of their children. Provision of high configured school buses with properly functional locks and air conditioning system can ensure both safety and convenience of the students and ultimately solve the safety issue.

If a bus with a capacity of 50 passengers is considered as a standard school bus then the number of total school buses required for each stated school can easily be calculated by the below simple method,
Number of School Buses=Number of Students÷Capacity of A Single School Bus

From the above formula the numbers were calculated to be 6 buses(Sunbeams), 5 buses(Sunnydale), 20 buses(Mastermind at Road No.31) and 9 buses(Mastermind at Road No.30). The PCU values for the newly attainted number of buses have been shown in the table below.

Table 4: Estimated PCU For Newly Obtained Number of Buses

Name of School	Peak Hour Maximum Passenger Car Units(PCU)
Sunbeams	18
Sunnydale	15
Master Mind (Road No.31)	60
Master Mind (Road No.30)	27

Comparing the actual PCU values with the estimated PCU values it can easily be concluded that PCU values of the roads connected to Sunbeams, Sunnydale, Mastermind(Road No.31) and Mastermind(Road No.30) will be lessened by 95.76%, 94.9%, 94.81% and 95.5% respectively. It goes without saying that the reduction of PCU values of the streets will definitely play a vital role in reducing school traffic congestion.
Thus, implementation of the idea of endorsing compulsory school bus transportation will be fruitfully sustained.

4.2 Compulsion of One-way Movement During School Hours

The road network of the study area is not capable of supporting heavy two-way traffic movements. The roads measure up to 3.5~4 meters in width and can only be used as two lanes when there is minimal traffic. During school hours, the roads are oppressed to hold cars in two lanes, thus creating congestion as vehicles cannot freely move. A probable solution to this problem can be the implementation of one-way traffic movement during school peak hours(7:00AM-9:00AM And 12:00AM-2:30AM). The vehicles will be entering through road no.31(13 new) and road no.30(14 new),then accessing Mirpur Road and finally setting off to road no.27(16 new).

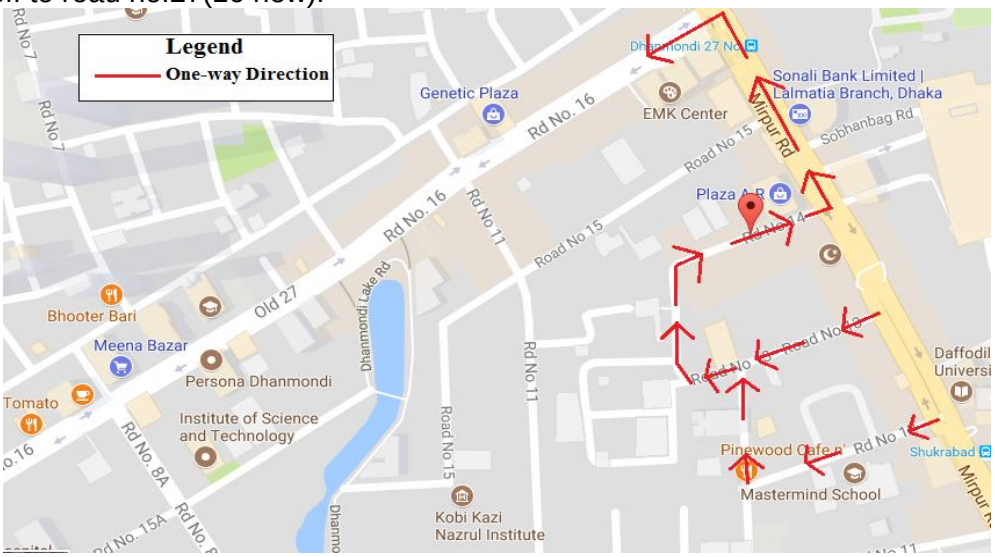

Figure 5: Proposed One-way Movement Direction

In context of the study area,the feeder roads are always scrammed with dense traffic during peak hours and free vehicular movement is close to impossible. Thus,channelizing one way traffic to primary roads will escalate free movement within a single lane. This is a moderately appropriate solution for school traffic, however, it may not always be found to be suitable as it will obstruct any residential traffic movement during peak hours because it will only permit movement in one-way.

4.3 Enforcing Parking Restriction During Peak Drop-off and Pick-up Hours

The roads of the study area are simultaneously used as parking spaces anytime during the day and most recurrently during school peak hours. There are signs currently present on the road sides which read “No Parking”, yet they are disregarded and not paid heed to. Hence, enforcement of parking restriction (e.g. Parking Fine) during peak drop-off and pick-up hours can be a way out of this problem. Parking restriction will free up space within the roads and promote free movement of vehicles and provide more accessibility.

Bearing in mind the societal and socio-economic condition of Bangladesh, implementation of such parking restrictions is only workable with proper law enforcement. Continuous surveillance of traffic polices at the important nodes of the area will create awareness among the vehicular users to abide by the parking restrictions. This idea of solving school traffic can be deviced if and only if the Government issues traffic polices at the respective points.

If the average number of vehicles parked around the schools during peak hours is omitted from PCU value calculation then the values will be lessened to 399.5, 269.25, 1119.5 and 574.5 for Sunbeams, Sunnydale, Mastermind(Road No.31) and Mastermind(Road No.30) respectively. The decreased values of PCU indicate that there is a good chance of traffic being reduced if parking restriction is enforced.

4.4 Promoting Carpooling

Carpooling refers to the sharing of car journeys, so that more than one person travels in a single car. It’s aim is to decrease the number of single car users and increase the number of multiusers of the same car. Although a safety issue arises with the implementation of carpooling, still it can be considered as an escalating solution to the congestion problem.

In recent time, carpooling has gained some popularity in Dhaka City. ‘Uber’ is the most known carpooling service which is trending at present. The students travelling from the same area can share a single car provided by ‘Uber’ or other carpooling services(DhakaRides, Taxiwala etc.). This will not only reduce the number of cars entering into the study area, but also it will significantly reduce conveyance money as the service fee will be equally divided and imposed on the passengers and no passenger will have to solely pay the fee himself. But considering the safety issue that arises, carpooling should not be considered as the prime solution to the existing problem, rather it may be considered as an optional resolution for when other options are malfunctioning.

Assuming that 3 students will travel in a single car from the same area, the total number of cars travelling to Sunbeams, Sunnydale, Mastermind(Road No.31) and Mastermind(Road No.30) will be 100, 70, 333 and 150 respectively. The calculated PCU Values considering these number of cars are found to be 100, 70, 333 and 150 respectively. It can be said without any doubt that these PCU values indicate much less school traffic than the school traffic that is already occurring in the study area everyday.

4.5 Implementing Cordon Pricing

4.5.1 Charging Area

The residential area surrounded by Road No. 27(old)(16 new),30(old)(14 new) and 31(old)(13 new) were taken as Charging Areas and they were bounded by the red line given in Figure 6.

Figure 6 : Proposed Cordon Pricing Zones

Vehicles will be charged each time they enter into the zone. Only the private vehicles will be charged (e.g. Private Car, Motorcycle). Other vehicles such as Taxis, CNGs, public transport modes, school buses, police cars, government automobiles and emergency vehicles will be discharged. No charge will be implied on the exit of the vehicles.

4.5.2 Charging Hour

There are definite peak hours within which traffic volume is the highest within the selected part of the residential area. It is when school traffic bursts out. The peak school hour at morning is 7:00AM-9:00AM and at midday it is 12:00PM-2:30PM.

4.5.3 Congestion Charge

Congestion charge was estimated on the basis of the annual per capita GDP of Bangladesh. As following the idea of London Congestion charge, comparing their charge of BDT1192.66 and annual per capita GDP (Purchasing Power Parity, PPP) of BDT30,58,333 with per capita GDP of Bangladesh of BDT1,66,666 (PPP), congestion charge was estimated to be BDT 65. Cars owned by the residents will enjoy 90% exemption, i.e. they have to pay BDT6.5 every time they enter into the area. But to enjoy this benefit, residents' cars will have to register first with a minimal cost of BDT 100 (Hasnat and Hoque, 2014).

4.5.4 Technology/ Charging Mechanism

Most common charging mechanisms are: (JICA, 2010)

1. Area Licensing Schemes (ALS): Need to buy and display coupon or license.
2. Electronic Road Pricing (ERP): Based on in-vehicle transponder units (IUs) that accept stored-valued smart cards for payment, each time vehicles pass through a gantry when the system is in operation, the ERP charges will be automatically deducted.

3. Electronic Toll Collection (ETC): Based on microwave technology and in-vehicle tags. When a car passes tolled booths the system reads data about the car taking into account the time and place of the passing.
4. Initial Electronic Security Systems (IESS): Cameras record images of traffic and send them to a central processor to have their number plates read and checked against the list of vehicles that have been paid for.
5. Tag and Beacon Technology: Tag and beacon involves cars having an electronic tag on the windscreen, which emits radio signals when it passes a roadside beacon, automatically paying the congestion charge.
6. Global Positioning Systems (GPS): Motor vehicles have a tracking device which constantly records the time and location of the vehicle through satellite.
7. Among the above mentioned methods tag and beacon with ANPR (Automatic Number Plate Recognition) camera could be considered as most effective according to the cases around the world as shown in Table 5.

Table 5: Technology Considered for Congestion Charging Around The World (Ahmed, 2012)

	ANPR	**Tag and Beacon**	**GPRS Type**
Local Scheme			
London	✓	✓	
Geona	✓	✓	
Copenhagen	✓	✓	
Prague	✓	✓	✓
Helsinki			✓
Stockholm	✓		✓
San Francisco	✓	✓	✓
Seattle	✓	✓	✓
Auckland	✓	✓	✓
Shanghai	✓	✓	
Hong Kong			✓
National Scheme			
England			✓
Netherlands			✓

Considering the local condition in Bangladesh, a tag and beacon system may seem to be too costly. Thereby the ANRP (Automatic Number Plate Recognition) usage should be enough. There are several ways by which Automatic charge can be collected such as, using cell phones or a simple procedure of sending a text message while a vehicle drives into the charging zone. GPRS is also a popular type of congestion charging in many countries but unfortunately it is too costly for Bangladesh. In GPRS system all the vehicles of the city have to be equipped with an in-vehicle unit costing, BDT12,500 each unit (Hasnat and Hoque, 2014).This procedure does not prove to be feasible as it will require a large amount of capital. Charge can also be collected online, by text messaging, by post services. The users are permitted to pay in advance or the day on which they enter into the charging zone. A penalty is to be imposed on the late payers. Charge collection by mobile phone or by text message may prove to be most convenient for the users (Hasnat and Hoque, 2014).

4.5.5 Enforcement

Available most common enforcement techniques are: (JICA, 2010)
X-Wave Camera: Analogue, colour and is used to give an image of the vehicle in the context of it's surroundings.
CCTV Camera: Analogue, monochrome and provide images for reading number plates.
Automatic Number Plate Recognition (ANPR) Technology: All images are sent to the ANPR via a telecommunications system. This system is based on dedicated DWDM (dense wave division multiplexing) technology which links the central data hub with each of the network

cameras over analogue video circuits. The ANPR creates a data block for each recognized number plate showing the time and date that the images were taken. These are then checked against a database to verify payment or eligibility for discounts and exemptions.

5. CONCLUSIONS

To keep under control the ever increasing school traffic of Dhanmondi Residential Area, it is necessary to increase the capacity of the existing roads. But increasing road capacity of an already developed urban area such as Dhanmondi is not only idealistic but also impossible, thus certain alternative way of traffic management must be applied to reduce congestion resulting from school traffic in the residential area. Cordon pricing has proven it's feasibility in many developed urban areas all around the world. Although considering it's high technological value, it comes with high installation cost which is a little less optimistic for Bangladesh, but bearing in mind the benefits it provides, it holds a good chance of resolving the congestion problem in Dhanmondi residential area by a significant amount. Other alternative ways of resolving the problem were also mentioned in the 'Recommendation' section, among which endorsement of mandatory school bus transportation and enforcement of parking restriction during peak drop-off and pick-up hours are very pragmatic and optimistic ideas which can bring a quick solution to the congestion problem.

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