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Traffic Impact Analysis of Re-Scheduling Educational Institutes: A Case Study of Dhanmondi Residential Area, Dhaka

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Abstract

Efficient operation of different modes of transport along every road in a locality is a key factor from planning perspective. Educational institutions generate significant number of trips in different periods of a day. Dhanmondi Residential Area is one of the first planned areas of Dhaka city. But huge number of educational institutes is disrupting its general purposes. Traffic generation in opening and closing period of educational institutes at Dhanmondi disrupts traffic flow in the whole area. In two selected roads for volume survey, traffic generation crosses 250 PCU in quarter-hourly interval at Dhanmondi area (Field Survey, 2012). A rescheduling was proposed based on two different scenarios to equally distribute increased number of vehicles throughout the day. In both roads, rescheduling brings quite positive result, but cannot completely remove the problem. This scenario clearly depicts the importance of controlling number of educational institutes at Dhanmondi. Rescheduling can reduce the problem of traffic jam in few aspects, but decreasing the number of educational institutes is the only solution at present scenario.

Key Words: *Traffic Volume, Peak Hour Factor, Passenger Car Unit.*

1. Introduction

Educational institutions within walking distance of children and efficient operation of different modes of transport throughout residential area are two key factors for residential area development. Unplanned location of educational institution and excessive student capacity can create huge pressure on roads, which may turn into a traffic jam in many cases. Dhanmondi Residential Area in Dhaka contains a long list of schools, colleges and universities, which are in excess of their requirement for a planned residential area. These have invited people and vehicular trips beyond expectations. On an average each school generates around 150 vehicles at the morning; among them 56% is car in Dhanmondi residential area (Chowdhury et al., 2008). These huge number of vehicles causes traffic congestion in peak hours at Dhanmondi Residential Area. According to a study, noise level in Dhanmondi Residential Area is 78 decibels, whereas acceptable limit of noise is 50 decibels in the morning for any residential areas (Dey et al., 2002). As walking environment deteriorates, people are forced to use cars even for short distances, especially when taking their children to schools. Re-scheduling of the school opening and closing period can be a possible solution in the present scenario. According to the research paper "Managing Urban Traffic Congestion" published in European Conference of Ministers of Transport "Targeting travel time variability in the most extreme congestion incidents can deliver rapid, tangible and cost-effective improvements" (Abraham, 2007). Rescheduling has been also proposed in case of

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passenger train and freight transport at Switzerland. An integrated real time rescheduling process has been utilized, which is based on system's current behavior and predicted behavior (Lüthi and Zürich, 2008). Rescheduling has been also proposed by means of traditional vehicle routing and scheduling (VRS) software, which is consist of algorithms that attempt to optimize the routing of vehicles so that deliveries (or collections) are made in the most efficiently. Night-time transport has been found most appropriate according to the study (Palmen and Piecyk, n.d.).

A suitable distribution of the school opening and closing time has been proposed in this study based on Peak Hour Factor (PHF) to mitigate negative impacts of uncontrolled traffic generation in fixed periods of time. Main objective of the study was to find out impact of educational institutes on traffic congestion in Dhanmondi Residential Area and proposing an appropriate solution of the problem.

This study would reveal some important outcome to find out contribution of educational institutions in traffic congestion of Dhaka city. In case of controlling traffic congestion in Dhanmondi, this study will help policy makers to take decisions from planning perspectives.

2. Materials and Methods of Research Methodology

A comprehensive volume survey was conducted in both roads of Dhanmondi Residential Area in different time period to find out the variation in traffic generation. To compare the variation in traffic generation Passenger Car Unit (PCU) value has been utilized to take different types of vehicles in a common unit. Rescheduling has been proposed based on PHF value.

2.1 Selection of Parameters and Calculation Method:

Peak Hour Factor (PHF):

Capacity and other traffic analyses focus on the peak hour of traffic volume, because it represents the most critical period for operations and has the highest capacity requirements. The peak hour volume, however, is not a constant value from day to day or from season to season.

The Peak Hour Factor (PHF) is the hourly volume of the day divided by the peak 15-minute flow rate; a measure of traffic demand fluctuations within the peak hour.

PHF = Hourly Average Volume/Peak Rate of Flow

If 15-min periods are used, the PHF may be computed as: PHF=V/(4xV15). Where, PHF=Peak-Hour Factor, V=hourly volume (vph), and V15=volume during the peak 15 min of the peak hour (veh/15 min).

PHF over 0.50 are indicative of traffic volumes with flatter peak, on the contrary PHF value below 0.50 indicates a steeper peak (Abraham, 1994).

Traffic Volume Survey:

Traffic volume survey is the counting of number of vehicles passes a fixed section of a road within a time interval. It can be conducted in different methods like manual method, combination of manual and mechanical method, automatic devices method, moving observer method, photographic method etc. In this study, manual method has been utilized.

Passenger Car Unit (PCU):

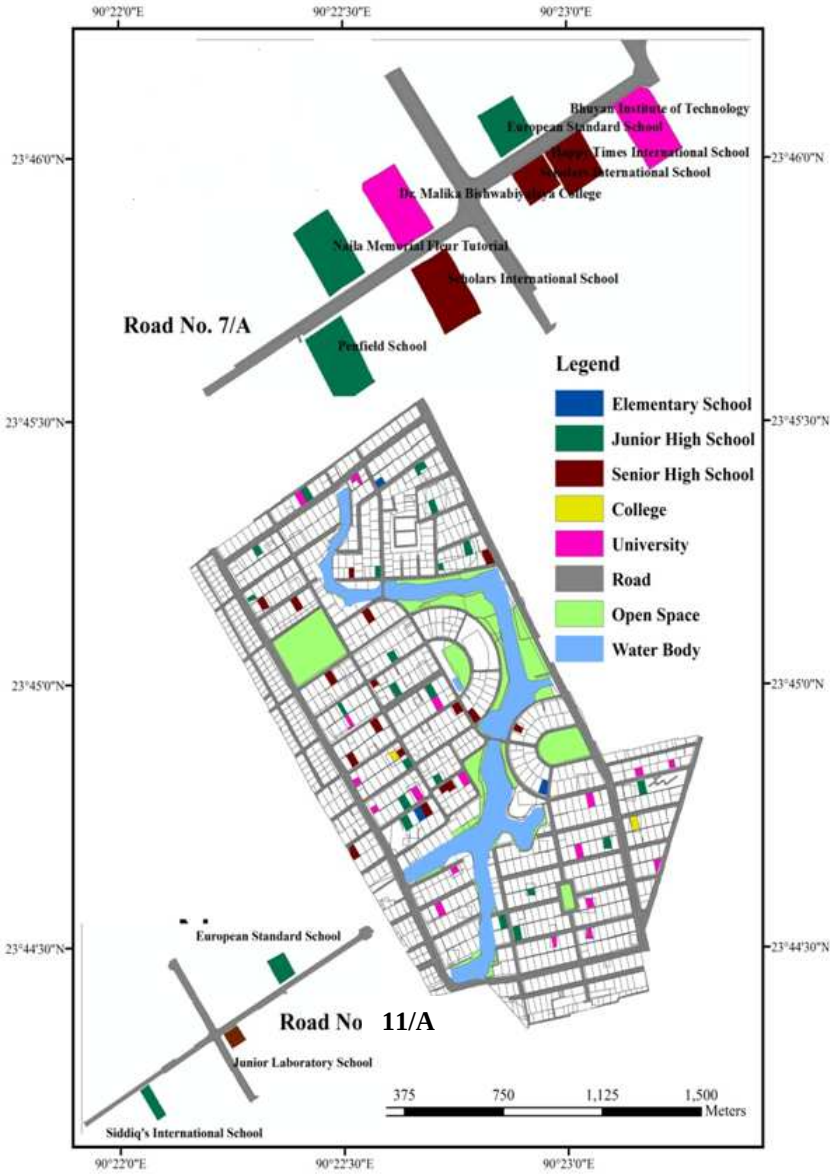
Different types of vehicles put forward different degrees of influence on road and it is necessary to bring all into a common unit. This common unit is termed as Passenger Car Unit (PCU). Value of PCU depends upon size and speed of the vehicle, as well as type and kind of road environment.

Vehicle Type	PCU	Vehicle Type	PCU
Passenger Car	1	Mini- Bus	2
Tempo/Human Hauler	0.5	Rickshaw	0.8
CNG	0.5	Bicycle	0.2
Truck	2	Pushcart	4
Bus	2.5	Motor Cycle	0.3

Knowledge of the vehicle volume using a road network is fundamental for understanding the effectiveness of the road and the general quality of service offered to the road users. The flow results are normally used to determine whether traffic flow of a particular section of the road below or above the capacity. Traffic congestion is the result of heavy flow of traffic with continuous loss of journey speed (Kadiyali, 2006).

2.2 Data Collection:

Location of educational institutes has been identified by visiting Dhanmondi several times. Map 1 clearly depicts present educational institutes of Road 7/A and Road 11/A. Traffic volume survey has been conducted between 7:30 am- 2:30 pm in front of schools, 8:30 am-4:30 pm in front of universities and 7:30 am- 4:30 pm in front of roads. Generally schools close after 2 pm and only a tiny number of vehicles come to schools after 2:30 pm. That why, volume survey has not been conducted in front of schools after 2:30 pm. Universities on Road no. 7/A starts at 9:00 am. For this reason, traffic generation data collection has been started from 8:30 am. A questionnaire survey has been conducted to find out opinion of officials of educational institutes regarding shifting of school time schedule. Counted total number of bus, rickshaw, car, CNG and motor cycle has been converted by means of PCU to find out the quarterly variation of traffic generation.



Map 1: Selected Schools for Volume Survey in Dhanmondi Residential Area; Source: Field Survey, 2012

Table 1

Proposed Time Schedule of School after 30 and 60 minutes shifting (Road 7/A)

Name of Educational Institutes	Existing Class		Schedule Time		30 min Schedule Time		60 min Schedule Time	
	From	To	From	To	From	To	From	To
Pen-Field School	6	12	8:00	2:00	8:00	2:00	8:00	2:00
Scholars International	1	2	8:00	1:00	8:00	1:00	8:00	1:00
Naila	0	5	8:00	11:30	8:30	12:00	9:00	12:30
	6	10	8:00	2:00	8:30	2:30	9:00	3:00
Scholars International	0	jr1	8:00	11:30	8:30	12:00	9:00	12:30
European Standard	0	8	8:00	1:00	9:00	2:00	10:00	3:00
Happy Times International	0	0	10:00	12:30	11:00	1:30	12:00	2:30
	1	5	8:00	11:30	9:00	12:30	10:00	1:30
	6	10	8:00	2:00	9:00	3:00	10:00	4:00

Source: Field Survey, 2012

Table 2

Proposed Time Schedule of School after 30 and 60 minutes shifting (Road 11/A)

Name of Educational Institutes	Existing Class		Schedule Time		30 min Schedule Time		60 min Schedule Time	
	From	to	From	to	From	To	From	To
European Standard School	0	12	8:00	1:30	8:00	1:30	8:00	1:30
Junior Laboratory School	0	10	8:00	2:00	8:30	2:30	9:00	3:00
Siddiq's International School	0	12	8:00	2:00	9:00	3:00	10:00	4:00

Source: Field Survey, 2012

3. Results

According to the residents of Dhanmondi area excessive number of traffic generation from schools are responsible for unauthorized parking, noise pollution, air pollution, traffic collusion etc problems.

Unauthorized parking in both sides of streets besides educational institutes reduces the effective widths of street making it difficult for cars and other vehicles to pass through. As result the street becomes blocked and congested. Roads in Dhanmondi Residential Area are less than 30 ft in most of the area, but the width is sufficient for use in a residential area (Field Survey, 2012).

Respondents alleged that traffic generated by the educational institutes contribute to noise pollution in Dhanmondi. Presence of huge number of short length access roads and low width of roads force vehicles to control speed within a range. For this reason most of the collisions are not that acute/ severe. Two alternative time schedule for both roads (Road no. 7/A and 11/A) of the study area have been proposed based on the questionnaire survey of officials at educational institutes. According to them, opening time of the educational institutes can be shifted highest one-hour from the existing time. If educational institutes are shifted more than one-hour, traffic volume may increase at peak-hour. Proposed time schedule for educational institutes has been shown within Tables 1-2.

PHF value has been calculated based on changed scenario of traffic generation from educational institutes.

Table 3

Contribution of Schools in Total Road Volume (Road 7/A)

Time	Pen-Field School	Scholars International (senior section)	Naila Memorials School	Scholars International (Kids Section)	European Standard School	Happy Times International	Total (PCU)	Total Road Volume (PCU)	Contribution of Schools in Road Volume (%)	Volume not Generated by Schools (PCU)
7:30-7:45	42.6	34.8	41.1	39.5	32.9	41.1	232	272.5	85.14	40.5
7:45-8:00	36.4	49.8	42.2	42.6	39.8	42.2	253	290.8	87.00	37.8
8:00-8:15	32.9	40.7	30.1	34.1	29.1	30.1	197	250.3	78.71	53.3
8:15-8:30	18.7	26.8	18.3	19.9	19.5	18.3	121.5	165	73.64	43.5
8:30-8:45	5.5	6.9	3.5	3.5	3.5	3.5	26.4	70.8	37.29	44.4
8:45-9:00	4	2	1	1	1	1	10	50.5	19.80	40.5
9:00-9:15	2	3.8	0	0	0	0	5.8	70.3	8.25	64.5
9:15-9:30	1	2	0	0	0	0	3	66	4.55	63
9:30-9:45	0	0	0	0	0	6	6	55.5	10.81	49.5
9:45-10:00	0	0.8	0	0	0	22.9	23.7	80.3	29.51	56.6
10:00-10:15	1	0.8	0	0	0	11.8	13.6	90.8	14.98	77.2
10:15-10:30	1	0	0	0	0	3.1	4.1	55.8	7.35	51.7
10:30-10:45	0	0	0	0	0	0	0	60.8	0.00	60.8
10:45-11:00	1	1	0	0	0	0	2	53.5	3.74	51.5
11:00-11:15	0	0	1	43.2	1	1	46.2	90.8	50.88	44.6
11:15-11:30	2.3	2.8	22	38.2	5.8	5.8	76.9	120.8	63.66	43.9
11;30-11:45	1	25	25.3	38.3	0.5	22.1	112.2	193.5	57.98	81.3
11:45-12:00	0.8	19	22.4	13.4	1	13.4	70	130.8	53.52	60.8
12:00-12:15	1.1	2.8	0.8	0.8	1.6	12.2	19.3	60	32.17	40.7
12:15-12:30	1	2	0	0	0	22.2	25.2	60.5	41.65	35.3
12:30-12:45	0	30.7	1.6	2.6	12.6	32.6	80.1	110.8	72.29	30.7
12:45-1:00	0	36.3	2.7	0	44.9	34.9	118.8	142	83.66	23.2
1:00-1:15	1	39.5	3.6	0	29.9	29.9	103.9	130.3	79.74	26.4
1:15-1:30	1	23.9	2.3	0	19.7	13.7	60.6	80	75.75	19.4
1:30-1:45	27.7	1	27.7	0	4.4	32.2	93	127.8	72.77	34.8
1:45-2:00	32.3	0.8	32.3	0	0.8	31.4	97.6	125.5	77.77	27.9
2:00-2:15	41.3	1.1	41.3	0	0	39.2	122.9	164.3	74.80	41.4
2:15-2:30	21.9	1	21.9	0	0	18.5	63.3	83.3	75.99	20
2:30-2:45	0	0	0	0	0	0	0	35.5	0.00	35.5
2:45-3:00	0	0	0	0	0	0	0	22.8	0.00	42.8
3:00-3:15	0	0	0	0	0	0	0	25.5	0.00	25.5
3:15-3:30	0	0	0	0	0	0	0	32.5	0.00	32.5
3:30-3:45	0	0	0	0	0	0	0	33.3	0.00	33.3
3:45-4:00	0	0	0	0	0	0	0	40.5	0.00	40.5
4:00-4:15	0	0	0	0	0	0	0	50.3	0.00	50.3
4:15-4:30	0	0	0	0	0	0	0	47.8	0.00	47.8

Source: Field Survey, 2012

Table 4

Contribution of Schools in Total Road Volume after 30 minutes shifting (Road 7/A)

Time	Pen-Field School	Scholars International (senior section)	Naila Memorials School	Scholars International (Kids Section)	European Standard School	Happy Times International	Total (PCU)	Volume not Generated by Schools (PCU)	Total Volume after Reschedule	Contribution of Schools in Road Volume (%)
7:30-7:45	42.6	34.8	0	0	0	0	77.4	40.5	117.9	65.65
7:45-8:00	36.4	49.8	0	0	0	0	86.2	37.8	124	69.52
8:00-8:15	32.9	40.7	41.1	39.5	0	0	154.2	53.3	207.5	74.31
8:15-8:30	18.7	26.8	42.2	42.6	0	0	130.3	43.5	173.8	74.97
8:30-8:45	5.5	6.9	30.1	34.1	32.9	41.1	150.6	44.4	195	77.23
8:45-9:00	4	2	18.3	19.9	39.8	42.2	126.2	40.5	166.7	75.70
9:00-9:15	2	3.8	3.5	3.5	29.1	30.1	72	64.5	136.5	52.75
9:15-9:30	1	2	1	1	19.5	18.3	42.8	63	105.8	40.45
9:30-9:45	0	0	0	0	3.5	3.5	7	49.5	56.5	12.39
9:45-10:00	0	0.8	0	0	1	1	2.8	56.6	59.4	4.71
10:00-10:15	1	0.8	0	0	0	0	1.8	77.2	79	2.28
10:15-10:30	1	0	0	0	0	0	1	51.7	52.7	1.90
10:30-10:45	0	0	0	0	0	6	6	60.8	66.8	8.98
10:45-11:00	1	1	0	0	0	22.9	24.9	51.5	76.4	32.59
11:00-11:15	0	0	0	0	0	11.8	11.8	44.6	56.4	20.92
11:15-11:30	2.3	2.8	0	0	0	3.1	8.2	43.9	52.1	15.74
11;30-11:45	1	25	1	43.2	0	0	70.2	81.3	151.5	46.34
11:45-12:00	0.8	19	22	38.2	0	0	80	60.8	140.8	56.82
12:00-12:15	1.1	2.8	25.3	38.3	1	1	69.5	40.7	110.2	63.07
12:15-12:30	1	2	22.4	13.4	5.8	5.8	50.4	35.3	85.7	58.81
12:30-12:45	0	30.7	0.8	0.8	0.5	22.1	54.9	30.7	85.6	64.14
12:45-1:00	0	36.3	0	0	1	13.4	50.7	23.2	73.9	68.61
1:00-1:15	1	39.5	1.6	2.6	1.6	12.2	58.5	26.4	84.9	68.90
1:15-1:30	1	23.9	2.7	0	0	22.2	49.8	19.4	69.2	71.97
1:30-1:45	27.7	1	3.6	0	12.6	32.6	77.5	34.8	112.3	69.01
1:45-2:00	32.3	0.8	2.3	0	44.9	34.9	115.2	27.9	143.1	80.50
2:00-2:15	41.3	1.1	27.7	0	29.9	29.9	129.9	41.4	171.3	75.83
2:15-2:30	21.9	1	32.3	0	19.7	13.7	88.6	20	108.6	81.58
2:30-2:45	0	0	41.3	0	4.4	32.2	77.9	35.5	113.4	68.69
2:45-3:00	0	0	21.9	0	0.8	31.4	54.1	42.8	96.9	55.83
3:00-3:15	0	0	0	0	0	39.2	39.2	25.5	64.7	60.59
3:15-3:30	0	0	0	0	0	18.5	18.5	32.5	51	36.27
3:30-3:45	0	0	0	0	0	0	0	33.3	33.3	0.00
3:45-4:00	0	0	0	0	0	0	0	40.5	40.5	0.00
4:00-4:15	0	0	0	0	0	0	0	50.3	50.3	0.00
4:15-4:30	0	0	0	0	0	0	0	47.8	47.8	0.00

Source: Field Survey, 2012

Table 5

Contribution of Schools in Total Road Volume after 60 minutes shifting (Road 7/A)

Time	Pen-Field School	Scholars International (senior section)	Naila Memorials School	Scholars International(Kids Section)	European Standard School	Happy Times International	Total (PCU)	Volume not Generated by Schools (PCU)	Total Volume after Reschedule	Contribution of Schools in Road Volume (%)
7:30-7:45	42.6	34.8	0	0	0	0	77.4	40.5	117.9	65.65
7:45-8:00	36.4	49.8	0	0	0	0	86.2	37.8	124	69.52
8:00-8:15	32.9	40.7	0	0	0	0	73.6	53.3	126.9	58.00
8:15-8:30	18.7	26.8	0	0	0	0	45.5	43.5	89	51.12
8:30-8:45	5.5	6.9	41.1	39.5	0	0	93	44.4	137.4	67.69
8:45-9:00	4	2	42.2	42.6	0	0	90.8	40.5	131.3	69.15
9:00-9:15	2	3.8	30.1	34.1	0	0	70	64.5	134.5	52.04
9:15-9:30	1	2	18.3	19.9	0	0	41.2	63	104.2	39.54
9:30-9:45	0	0	3.5	3.5	32.9	41.1	81	49.5	130.5	62.07
9:45-10:00	0	0.8	1	1	39.8	42.2	84.8	56.6	141.4	59.97
10:00-10:15	1	0.8	0	0	29.1	30.1	61	77.2	138.2	44.14
10:15-10:30	1	0	0	0	19.5	18.3	38.8	51.7	90.5	42.87
10:30-10:45	0	0	0	0	3.5	3.5	7	60.8	67.8	10.32
10:45-11:00	1	1	0	0	1	1	4	51.5	55.5	7.21
11:00-11:15	0	0	0	0	0	0	0	44.6	44.6	0.00
11:15-11:30	2.3	2.8	0	0	0	0	5.1	43.9	49	10.41
11;30-11:45	1	25	0	0	0	6	32	81.3	113.3	28.24
11:45-12:00	0.8	19	0	0	0	22.9	42.7	60.8	103.5	41.26
12:00-12:15	1.1	2.8	1	43.2	0	11.8	59.9	40.7	100.6	59.54
12:15-12:30	1	2	22	38.2	0	3.1	66.3	35.3	101.6	65.26
12:30-12:45	0	30.7	25.3	38.3	0	0	94.3	30.7	125	75.44
12:45-1:00	0	36.3	22.4	13.4	0	0	72.1	23.2	95.3	75.66
1:00-1:15	1	39.5	0.8	0.8	1	1	44.1	26.4	70.5	62.55
1:15-1:30	1	23.9	0	0	5.8	5.8	36.5	19.4	55.9	65.30
1:30-1:45	27.7	1	1.6	2.6	0.5	22.1	55.5	34.8	90.3	61.46
1:45-2:00	32.3	0.8	2.7	0	1	13.4	50.2	27.9	78.1	64.28
2:00-2:15	41.3	1.1	3.6	0	1.6	12.2	59.8	41.4	101.2	59.09
2:15-2:30	21.9	1	2.3	0	0	22.2	47.4	20	67.4	70.33
2:30-2:45	0	0	27.7	0	12.6	32.6	72.9	35.5	108.4	67.25
2:45-3:00	0	0	32.3	0	44.9	34.9	112.1	42.8	154.9	72.37
3:00-3:15	0	0	41.3	0	29.9	29.9	101.1	25.5	126.6	79.86
3:15-3:30	0	0	21.9	0	19.7	13.7	55.3	32.5	87.8	62.98
3:30-3:45	0	0	0	0	4.4	32.2	36.6	33.3	69.9	52.36
3:45-4:00	0	0	0	0	0.8	31.4	32.2	40.5	72.7	44.29
4:00-4:15	0	0	0	0	0	39.2	39.2	50.3	89.5	43.80
4:15-4:30	0	0	0	0	0	18.5	18.5	47.8	66.3	27.90

Source: Field Survey, 2012

Table 6:

Contribution of Schools in Total Road Volume (Road 11/A)

Name of School	European Standard School	Junior Laboratory School	Siddiq's International School	Total Traffic Generation	Total Road Volume	Contribution of Schools in Road Volume (%)	Volume not Generated by Schools (PCU)
7:30-7:45	30.1	38.4	24.2	92.7	291.5	32	198.8
7:45-8:00	42	39.3	35.4	116.7	296.3	39	179.6
8:00-8:15	27.20	28.10	34.70	90.00	207.10	43	117.10
8:15-8:30	20.4	24.9	15.9	61.2	185.4	33	124.2
8:30-8:45	4.9	6.9	10.4	22.2	85.9	26	63.7
8:45-9:00	2	8.9	5.4	16.3	94.6	17	78.3
9:00-9:15	0	3.8	3.8	7.6	71.6	11	64
9:15-9:30	2.5	2	4.5	9	73.5	12	64.5
9:30-9:45	0	2.6	0	2.6	62.6	4	60
9:45-10:00	0	1.8	0	1.8	94.6	2	92.8
10:00-10:15	0	1.3	0	1.3	98	1	96.7
10:15-10:30	0	0	0	0	74.3	0	74.3
10:30-10:45	0.00	0.00	0.00	0.00	74.50	0	74.50
10:45-11:00	1.80	2.00	3.30	7.10	66.70	11	59.60
11:00-11:15	2.50	1.80	3.10	7.40	99.80	7	92.40
11:15-11:30	6.40	3.10	7.40	16.90	131.50	13	114.60
11;30-11:45	1.8	2.5	3.6	7.9	176.9	4	169
11:45-12:00	1.3	2.9	3.4	7.6	166.2	5	158.6
12:00-12:15	2.9	1.4	3.9	8.2	104.6	8	96.4
12:15-12:30	0.8	2.1	0.8	3.7	84.8	4	81.1
12:30-12:45	12.1	0	13.5	25.6	135.4	19	109.8
12:45-1:00	43.7	0	36.2	79.9	149.5	53	69.6
1:00-1:15	31	1	29.8	61.8	129	48	67.2
1:15-1:30	18.2	3.6	17.4	39.2	87.1	45	47.9
1:30-1:45	5.9	33.4	25.8	65.1	136.9	48	71.8
1:45-2:00	2.60	32.80	14.90	50.30	130.00	39	79.70
2:00-2:15	0	47.1	1	48.1	164	29	115.9
2:15-2:30	0	32.9	0	32.9	114.8	29	81.9
2:30-2:45	0	0	0	0	52.7	0	52.7
2:45-3:00	0	0	0	0	39.9	0	39.9
3:00-3:15	0	0	0	0	32.7	0	32.7
3:15-3:30	0	0	0	0	53.5	0	53.5
3:30-3:45	0	0	0	0	48.6	0	48.6
3:45-4:00	0	0	0	0	47.2	0	47.2
4:00-4:15	0	0	0	0	65.2	0	65.2
4:15-4:30	0	0	0	0	67.5	0	67.5

Source: Field Survey, 2012

Table 7

Contribution of Schools in Total Road Volume after 30 minutes shifting (Road 11/A)

Name of School	European Standard School	Junior Laboratory School	Siddiq's International School	Sum	Volume not Generated by Schools (PCU)	Total Volume after Reschedule	Contribution of Schools in Road Volume (%)
7:30-7:45	30.1	0	0	30.1	198.8	228.9	13
7:45-8:00	42	0	0	42	179.6	221.6	19
8:00-8:15	27.20	38.40	0.00	65.60	117.10	182.7	36
8:15-8:30	20.4	39.3	0	59.7	124.2	183.9	32
8:30-8:45	4.9	28.1	24.2	57.2	63.7	120.9	47
8:45-9:00	2	24.9	35.4	62.3	78.3	140.6	44
9:00-9:15	0	6.9	34.7	41.6	64	105.6	39
9:15-9:30	2.5	8.9	15.9	27.3	64.5	91.8	30
9:30-9:45	0	3.8	10.4	14.2	60	74.2	19
9:45-10:00	0	2	5.4	7.4	92.8	100.2	7
10:00-10:15	0	2.6	3.8	6.4	96.7	103.1	6
10:15-10:30	0	1.8	4.5	6.3	74.3	80.6	8
10:30-10:45	0.00	1.30	0.00	1.30	74.50	75.8	2
10:45-11:00	1.80	0.00	0.00	1.80	59.60	61.4	3
11:00-11:15	2.50	0.00	0.00	2.50	92.40	94.9	3
11:15-11:30	6.40	2.00	0.00	8.40	114.60	123	7
11;30-11:45	1.8	1.8	0	3.6	169	172.6	2
11:45-12:00	1.3	3.1	3.3	7.7	158.6	166.3	5
12:00-12:15	2.9	2.5	3.1	8.5	96.4	104.9	8
12:15-12:30	0.8	2.9	7.4	11.1	81.1	92.2	12
12:30-12:45	12.1	1.4	3.6	17.1	109.8	126.9	13
12:45-1:00	43.7	2.1	3.4	49.2	69.6	118.8	41
1:00-1:15	31	0	3.9	34.9	67.2	102.1	34
1:15-1:30	18.2	0	0.8	19	47.9	66.9	28
1:30-1:45	5.9	1	13.5	20.4	71.8	92.2	22
1:45-2:00	2.60	3.60	36.20	42.40	79.70	122.1	35
2:00-2:15	0	33.4	29.8	63.2	115.9	179.1	35
2:15-2:30	0	32.8	17.4	50.2	81.9	132.1	38
2:30-2:45	0	47.1	25.8	72.9	52.7	125.6	58
2:45-3:00	0	32.9	14.9	47.8	39.9	87.7	55
3:00-3:15	0	0	1	1	32.7	33.7	3
3:15-3:30	0	0	0	0	53.5	53.5	0
3:30-3:45	0	0	0	0	48.6	48.6	0
3:45-4:00	0	0	0	0	47.2	47.2	0
4:00-4:15	0	0	0	0	65.2	65.2	0
4:15-4:30	0	0	0	0	67.5	67.5	0

Source: Field Survey, 2012

Table 8

Contribution of Schools in Total Road Volume after 60 minutes shifting (Road 11/A)

Name of School	European Standard School	Junior Laboratory School	Siddiq's International School	Sum	Volume not Generated by Schools (PCU)	Total Volume after Reschedule	Contribution of Schools in Road Volume (%)
7:30-7:45	30.1	0	0	30.1	198.8	228.9	13
7:45-8:00	42	0	0	42	179.6	221.6	19
8:00-8:15	27.20	0.00	0.00	27.20	117.10	144.3	19
8:15-8:30	20.4	0	0	20.4	124.2	144.6	14
8:30-8:45	4.9	38.4	0	43.3	63.7	107	40
8:45-9:00	2	39.3	0	41.3	78.3	119.6	35
9:00-9:15	0	28.1	0	28.1	64	92.1	31
9:15-9:30	2.5	24.9	0	27.4	64.5	91.9	30
9:30-9:45	0	6.9	24.2	31.1	60	91.1	34
9:45-10:00	0	8.9	35.4	44.3	92.8	137.1	32
10:00-10:15	0	3.8	34.7	38.5	96.7	135.2	28
10:15-10:30	0	2	15.9	17.9	74.3	92.2	19
10:30-10:45	0.00	2.60	10.40	13.00	74.50	87.5	15
10:45-11:00	1.80	1.80	5.40	9.00	59.60	68.6	13
11:00-11:15	2.50	1.30	3.80	7.60	92.40	100	8
11:15-11:30	6.40	0.00	4.50	10.90	114.60	125.5	9
11;30-11:45	1.8	0	0	1.8	169	170.8	1
11:45-12:00	1.3	2	0	3.3	158.6	161.9	2
12:00-12:15	2.9	1.8	0	4.7	96.4	101.1	5
12:15-12:30	0.8	3.1	0	3.9	81.1	85	5
12:30-12:45	12.1	2.5	0	14.6	109.8	124.4	12
12:45-1:00	43.7	2.9	3.3	49.9	69.6	119.5	42
1:00-1:15	31	1.4	3.1	35.5	67.2	102.7	35
1:15-1:30	18.2	2.1	7.4	27.7	47.9	75.6	37
1:30-1:45	5.9	0	3.6	9.5	71.8	81.3	12
1:45-2:00	2.60	0.00	3.40	6.00	79.70	85.7	7
2:00-2:15	0	1	3.9	4.9	115.9	120.8	4
2:15-2:30	0	3.6	0.8	4.4	81.9	86.3	5
2:30-2:45	0	33.4	13.5	46.9	52.7	99.6	47
2:45-3:00	0	32.8	36.2	69	39.9	108.9	63
3:00-3:15	0	47.1	29.8	76.9	32.7	109.6	70
3:15-3:30	0	32.9	17.4	50.3	53.5	103.8	48
3:30-3:45	0	0	25.8	25.8	48.6	74.4	35
3:45-4:00	0	0	14.9	14.9	47.2	62.1	24
4:00-4:15	0	0	1	1	65.2	66.2	2
4:15-4:30	0	0	0	0	67.5	67.5	0

Source: Field Survey, 2012

3.1 PHF value of Road 7/A:

Average Hourly Traffic Flow V (veh/hr)

=(272.5+290.8+250.3+165+70.8+50.5+70.3+66+55.5+80.3+90.8+55.8+60.8+53.5+90.8+120.8+193.5+130.8+60+60.5+110.8+142+130.3+80+127.8+125.5+164.3+83.3+35.5+22.8+25.5+32.5+33.3+40.5+50.3+47.8) / 10 PCU/hr; (Table 3)

= 354.15 PCU/hr

Scenario	Average Hourly Flow rate V (Veh/Hour)	Peak Period	Peak 15 Minutes Flow Rate V15 (veh/15 min)	PHF (V/(4*V15))
Existing School Schedule	354.15	7:45 am- 8:00 am	290.8	0.30446 ≈ 0.30
Staggered with 30 minutes/half-hour	354.15	8:00 am- 8:15 am	207.5	0.42668 ≈ 0.43
Staggered with 60 minutes/One hour	354.15	2:45 pm- 3:00 pm	154.9	0.57157 ≈ 0.51

So, PHF value increases with increase of shifting school time period. At, 60 min shifting period curve crosses the 0.5 limit of PHF value and becomes flatter. As a consequence of this result, it can be expected that vehicles should be more equally distributed throughout the day.

3.2 PHF Value of Road 11/A:

Average Hourly Traffic Flow V (veh/hr)

=(291.5+296.3+207.1+185.4+85.9+94.6+71.6+73.5+62.6+94.6+98+74.3+74.5+66.7+99.8+131.5+176.9+166.2+104.6+84.8+135.4+149.5+129+87.1+136.9+130+164+114.8+52.7+39.9+32.7+53.5+48.6+47.2+65.2+67.5)/10 PCU/hr; (Table 6)

= 399.44 PCU/hr

Scenario	Average Hourly Flow rate V (Veh/Hour)	Peak Period	Peak 15 Minutes Flow Rate V15 (veh/15 min)	PHF (V/(4*V15))
Existing School Schedule	399.44	7:45 am- 8:00 am	296.3	0.3370 ≈ 0.34
Staggered with 30 minutes/half-hour	399.44	7:45 am- 8:00 am	228.9	0.4362 ≈ 0.44
Staggered with 60 minutes/One hour	399.44	7:45 am- 8:00 am	228.9	0.4362 ≈ 0.44

So, PHF value also increases with shifting school time period at Road 11/A. But, PHF value in both 30 min and 60 min shifting are equal. So, traffic generation will give equal result in both cases.

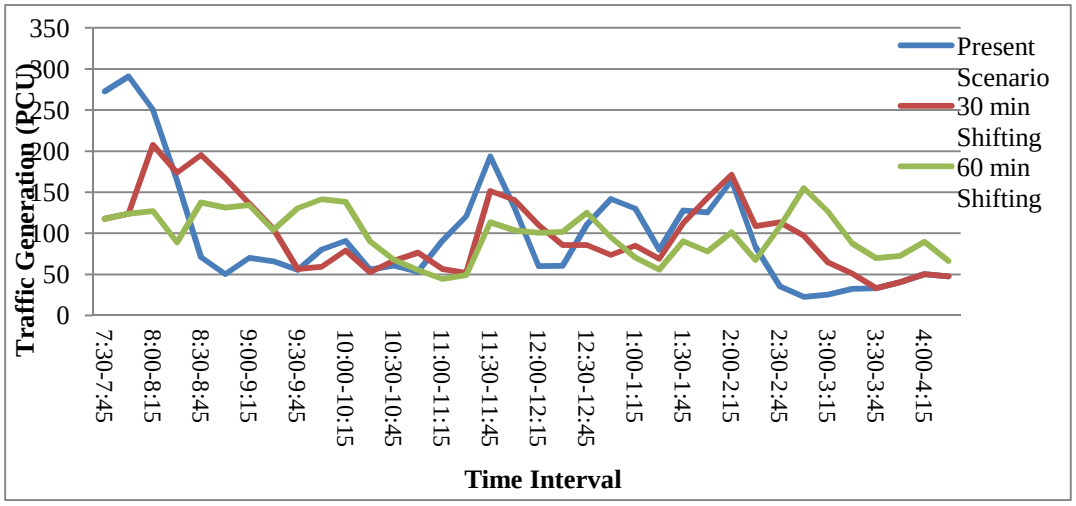


Figure 1: Variation of Traffic Generation in Road 7/A; Source: Field Survey, 2012

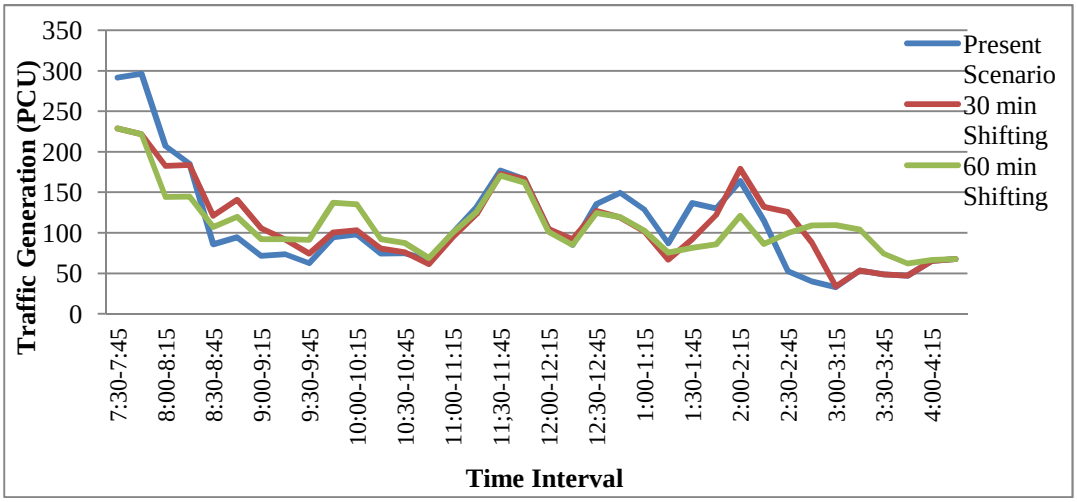


Figure 2: Variation of Traffic Generation in Road 11/A; Source: Field Survey, 2012

4. Discussions

Scattering of the time period of non-residential land use is a major process of controlling traffic jam in neighborhoods. An increase in the reliability and predictability of travel times can rapidly reduce the cost associated with excessive congestion levels. In case of Road no. 7/A and 11/A of Dhanmondi Residential Area, school pays the major role behind traffic jam problem. Most of the schools open at the same time and closes within a short period. Shifting of opening and closing time may play a key role in reducing traffic congestion. Shifting time can vary based on the peak and off-peak hour of adjacent areas.

In Dhaka city peak hour generally starts after 10:00 am. For this reason, two shifting period 30 minutes and 60 minutes have been considered for all the schools on Road 7/A and 11/A.

4.1 Changes in Traffic Volume and PHF value at Road 7/A:

Increase in PHF value indicates lower volume in peak hour traffic flow. In the context of Road 7/A in Dhanmondi Residential Area after 60 minutes shifting of school schedules, PHF value increases from 0.30 to 0.51. So, traffic volume will be equally distributed throughout the day in case on 60 minutes shifting. So, pressure on road in a particular time will be quite low. Occurrence of traffic jam will be decreased.

Traffic generation from Road 7/A increases at its highest peak within the interval of 7:30 am- 8:30 am. After 8:30 am it starts to decrease gradually, because most the schools in Road 7/A starts at 8:00 am and after 8:30 am they do not attract anymore traffic from outside and inside areas. From 11:00am-2:30pm it shows some significant increase because of the closing period of school. Traffic generated from school play the major role behind traffic volume in Road 7/A (Figure 1).

After 30 minutes shifting of schools time period at Road 7/A, contribution of schools in total volume of Road 7/A varies within 50-80% at 7:30 am-9:00 am. After 9:00 am, it starts to decrease sharply and it reaches close to 0 % in 10:00 am. In case of closing period 12:30 pm- 2:30 pm, contribution is quite similar. It varies within the range of 60-80%. After 3:00 pm, schools do not have any impact on total road volume (Figure 3).

In general scenario, student's arrival time to schools will shift 30 minutes, if opening time also shifts 30 minutes. Considering this scenario, number of students a school generates at 8:30 am has been considered same as 8:00 am, when its opening time shifts 30 minutes. In case of closing time and other opening time periods, calculation has been done in same procedure. In this changing scenario, figure of traffic generation of schools shows slight change compared to present scenario.

Traffic generation varies in the range of 50-200 PCU, compared to 25-290 PCU in present scenario. Result is similar traffic generation from schools throughout the period and less severe

impact in a fixed period, which is common in present scenario. In case of closing time of schools 12:30 pm-3:00 pm, quite similar scenario occurs. Traffic generation in Road 7/A is generally within range of 100-150 PCU in this period (Figure 1).

Contribution of schools in case 60 minutes shifting fluctuates close to 70%, except in the short period 10:30 am- 11:00 am. This picture represents the effectiveness of scattering. Instead of huge impact in a fixed period, traffic generation is equally distributed throughout the school period. Traffic jam must be reduced in Dhanmondi Residential Area, if schools opening and closing time is shifted 60 minutes (Figure 3).

Traffic generation scenario at Road 7/A in case of 60 minutes scattering is much positive, compared to 30 minutes shifting. Traffic generation varies within the range of 70-140 PCU throughout the period 7:30 am- 3:00 pm. It only shows sharp decrease within the short period 11:00 am-11:30 am. It reaches close to 40 PCU in this period, but situation is mush positive compared to present scenario or 30 minutes scattering (Figure 1).

4.2 Changes in Traffic Volume and PHF value at Road 11/A:

In case of road 11/A, PHF value increases after the school time schedule has been scattered. Interesting finding is that, after 30 minutes and 60 minutes shifting PHF value is same. So, the policy makers can choose any alternative decisions for Dhanmondi road 11/A to reduce the peak hour traffic

Total traffic generation from Road 11/A changes quite similarly to Road 7/A. Peak periods are found during opening and closing period of schools. This result reflects the impact of schools on total residential area (Figure 2).

30 minutes shifting in time schedule does not bring quite satisfactory result in Road 11/A. contribution is still close to 50%-60% in different periods. In case of existing scenario, situation is quite close (Figure 4).

Traffic generation varies withinthe range of 50-200 PCU in case of Road 11/A. after 30 minutes rescheduling. Traffic volume do not increase drastically in a fixed period to create traffic congestion in Dhanmondi Residential Area (Figure 2).

In case of Road 11/A, 60 minutes shifting bring positive scenario. Throughout the opening period contribution is lower than 40%. In existing scenario, it is close to 60%. In other intervals it increases slightly (Figure 4).

Traffic generation fluctuation is almost absent in case of 60 minutes rescheduling. Traffic generation in case of Road 11/A shows drastic changes during 60 minutes shifting. Except at 7:30 am-8:00 am period, it varies within the range of 100-150 PCU throughout the day. Probability of traffic congestion is quite low in these cases, because of the equal distribution of vehicles (Figure 2).

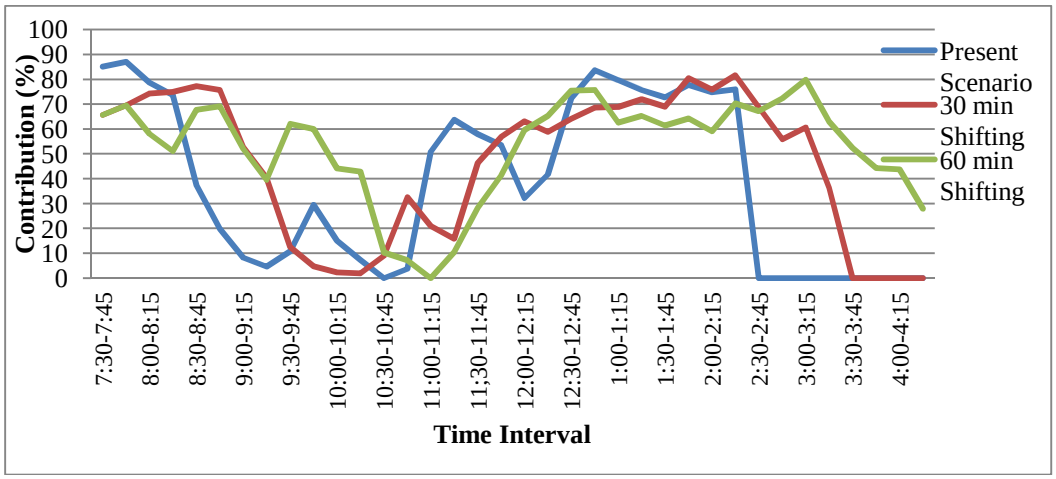


Figure 3: Contribution of Schools in Road Volume (Road 7/A); Source: Field Survey, 2012

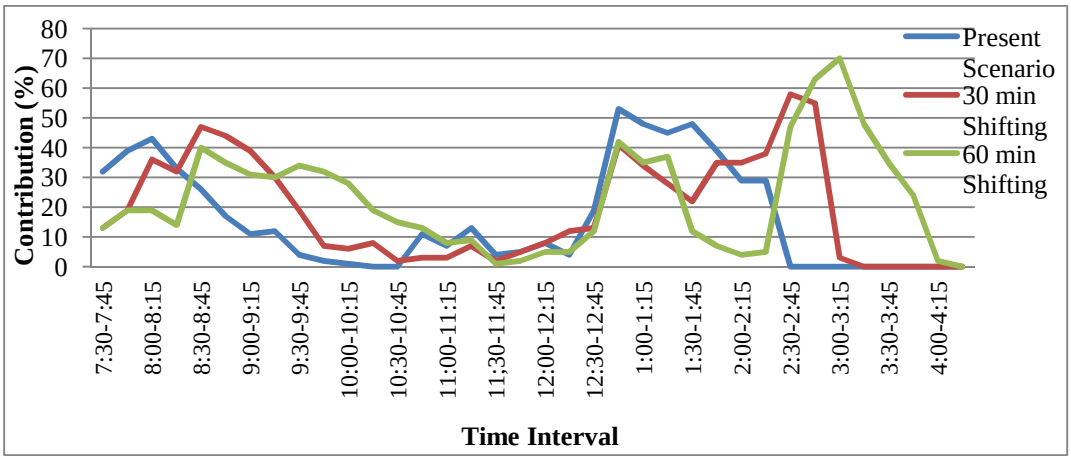


Figure 4: Contribution of Schools in Road Volume (Road 11/A); Source: Field Survey, 2012

5. Conclusions

Living condition in residential areas of Dhaka city is deteriorating day by day as result of immense pressure from educational institutes. Unauthorized permission of educational institutes in residential areas is making efficient planning practice impossible in many cases. Schools are attracting students from outside Dhanmondi. The numbers of private colleges and universities are also rising, because of the capacity of Dhanmondi to attract students from high income families in Dhaka, by violating all planning principles. As a combined effect of these entire violations, total living condition of whole area is deteriorating. Traffic jam has become an everyday scenario. Other areas of the neighborhood livelihood, like air quality, noise quality, security etc are also declining sharply. Proposed rescheduling in case of both Road 7/A and Road 11/A would bring PHF value within the range 0.4-0.6, which is not a complete satisfactory scenario. Controlling the increased number of educational institutes is the only solution at present. Traffic generation will decrease in case of lower number of educational institutes. So, rescheduling will be more effective and appropriate solution in case of changed scenario.

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