Evaluation Of Traffic Speed Study In Dhaka City, Bangladesh

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Abstract: Bangladesh is a very populated country and its population is increasing day by day. As Dhaka is the capital city of Bangladesh it is the center of all governmental, financial and social activities. The main focus of this research is to understand the present status of traffic flow at the junction. The current work studies traffic speed characteristics in the city of Dhaka at one selected priority junction. In this work emphasis was given on traffic speed data collection and the analysis was carried out through primary traffic flow surveys at Tejgaon-Flyover junction to Shatrasta roundabout in Dhaka city which is done by manual method. This study is an attempt to understand the traffic patterns during different time periods for the safe and time efficient movement of the people and goods. The study involves both spot speed and travel speed of vehicles. The results from the present study will be helpful in controlling the traffic at the intersection and also in suggesting some of the remedial measures to improve the traffic safety in the region.

Keywords: Speed Characteristics, Spot Speed, Traffic Flow, Travel speed.

1. Introduction

Traffic engineering is the branch of engineering which involves traffic studies, scientific analysis and engineering applications [6]. Traffic flow is an important element of traffic engineering which is influenced by the speed of the traffic on existing roads. Speed is a function of several factors such as the geometric design features, traffic conditions like the presence of other vehicles, time and place, the environment, and the driver, and the traffic system in general [4]. Speed is an important transportation consideration because it relates to safety, time, comfort, convenience, and economics [3]. In this study, two types of speed studies will be discussed and they are spot speed and travel speed. Spot speed is the instantaneous speed of a vehicle as it passes a specified point along a road. It can be done by stop watch, radar meter and pneumatic methods. Travel speed is the effective speed of the vehicle on a journey between two points. Uniformity between travel and running speeds denotes comfortable travel condition [1]. Spot speed studies are used to determine the speed distribution of a traffic stream at a specific location [3].

98th Percentile Speed/Design speed: The speed at or below which 98 percent of a sample of free-flowing vehicles is traveling (based on a spot speed study) [5].

85th Percentile Speed/Safe speed: The speed at or below which 85 percent of a sample of free -flowing vehicles is traveling; this is typically used as a baseline for establishing the speed (based on a spot speed study) [5].

50th Percentile Speed/Median speed: The speed that equally divides the distribution of spot speeds, 50 percent of observed speeds are higher than the median, 50 percent of observed speeds are lower than the median (based on a spot speed study) [5].

The Travel Speed Surveys collect time and position data along specified routes. Data is collected using the "Number plate" method. Surveys are not undertaken during school holidays. Holiday periods significantly reduce the amount of traffic and these periods do not reflect average travel conditions. Travel times can vary from day to day [2].

2. Methodology

The main purpose of this study is to determine traffic parameter, specially speed. Spot Speed measurements are most often taken at a point of road way under conditions of free flow. The intent is to determine the speeds that drivers select, unaffected by the existence of congestion. This information is used to determine general speed trends, to help determine reasonable speed limits and to assess safety.

Observation: Classified vehicle (Private car) counts.
Method: Manual (Strip Method) **[Spot Speed]**
Number Plate Method **[Travel Speed]**
Equipment: Measuring tap, stopwatch, data sheet **(Spot Speed)**, 2 video cameras **(Travel Speed)**
Location: Shaheed Tajuddin Ahmed Avenue,Dhaka
Duration: 30 minutes for spot speed study and 30 minutes for travel speed study.
For Spot Speed: 26.83 meter (88 feet),
For Travel Speed: 750 meters (2,460 feet).
No of lanes: 3 Lanes (both side)

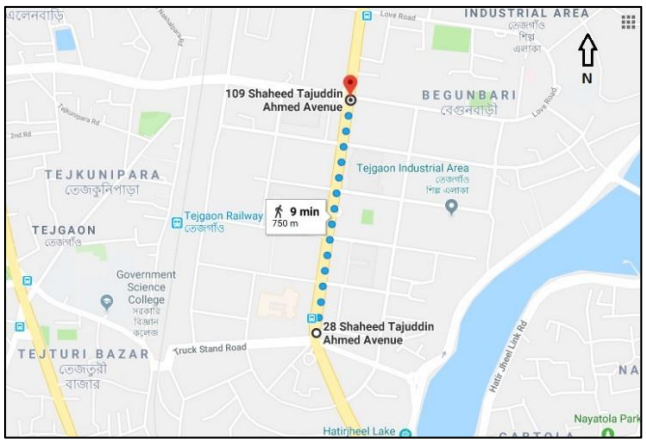

Figure 1: *Location Map for Spot and Travel Speed Study*

3. Data Collection and Analysis

The data collection is done only for private cars.

3.1 Spot Speed Study

Table 1: *Data Collection for Spot Speed Study*

Vehicle No	Distance (m)	Time (s)	Speed (ft/s)	Vehicle No	Distance (m)	Time (s)	Speed (ft/s)
1	26.83	2.6	33.85	16	26.83	1.8	48.89
2	26.83	2.8	31.43	17	26.83	1.8	48.89
3	26.83	1.9	46.32	18	26.83	1.7	51.76
4	26.83	1.8	48.89	19	26.83	1.9	46.32
5	26.83	2.3	38.26	20	26.83	2.1	41.90
6	26.83	2	44.00	21	26.83	2.2	40.00
7	26.83	1.5	58.67	22	26.83	2	44.00
8	26.83	2.1	41.90	23	26.83	2.3	38.26
9	26.83	2.5	35.20	24	26.83	2.1	41.90
10	26.83	2.4	36.67	25	26.83	1.8	48.89
11	26.83	1.4	62.86	26	26.83	2.2	40.00
12	26.83	1.7	51.76	27	26.83	2.4	36.67
13	26.83	1.5	58.67	28	26.83	2.1	41.90
14	26.83	2.1	41.90	29	26.83	1.7	51.76
15	26.83	2.3	38.26	30	26.83	2.3	38.26

Total spot speed = 1328.04 ft/s

$= \frac{1328.04*3600}{3.28*1000} = 1457.61$ km/hr.

Average spot speed = $\frac{1457.61}{30} = 48.5870881$ km/hr.

Table 2: *Frequency Calculation for Spot Speed Study*

Class	Frequency	Mid Speed (X)	% Frequency(f)	Cumulative Frequency	Xf	Weighted Average
33-35	1	34	3.3	3.333	113.33	
35-37	0	36	0.0	3.333	0.00	
37-39	2	38	6.7	10.000	253.33	
39-41	2	40	6.7	16.667	266.67	
41-43	4	42	13.3	30.000	560.00	
43-45	2	44	6.7	36.667	293.33	
45-47	5	46	16.7	53.333	766.67	
47-49	2	48	6.7	60.000	320.00	
49-51	2	50	6.7	66.667	333.33	161.33
51-53	0	52	0.0	66.667	0.00	
53-55	4	54	13.3	80.000	720.00	
55-57	3	56	10.0	90.000	560.00	
57-59	0	58	0.0	90.000	0.00	
59-61	0	60	0.0	90.000	0.00	
61-63	0	62	0.0	90.000	0.00	
63-65	2	64	6.7	96.667	426.67	
65-67	0	66	0.0	96.667	0.00	
67-69	1	68	3.3	100.000	226.67	
Total	**30**		**100**		**4840.0**	

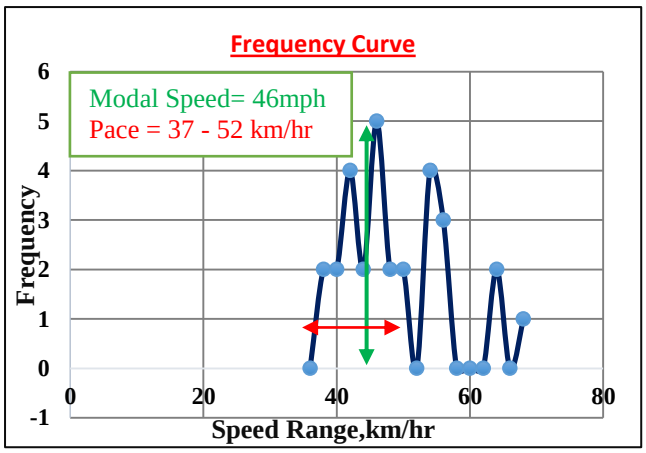

Figure 2: *Frequency Curve*

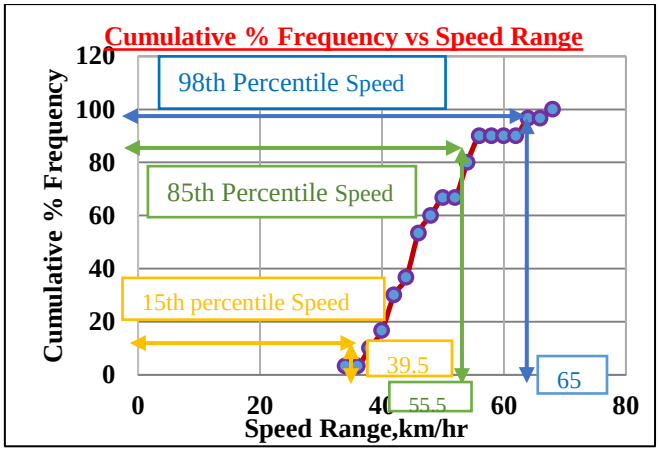

Figure 3: *Cumulative % Frequency vs Speed Range Curve*

3.2 Travel Speed Study

The data collection is done only for private cars.

Table 3: *Data Collection for Travel Speed Study*

Vehicle no.	Distance (m)	Time (sec)	Speed (km/h)	Vehicle no.	Distance (m)	Time (sec)	Speed (km/h)
1	750	53.131	50.82	11	750	82.631	32.68
2	750	64.957	41.57	12	750	99.16	27.23
3	750	65.54	41.19	13	750	97.145	27.79
4	750	61.543	43.87	14	750	79.254	34.07
5	750	60.093	44.93	15	750	55.064	49.03
6	750	63.618	42.44	16	750	62.892	42.93
7	750	68.9	39.19	17	750	72.235	37.38
8	750	76.25	35.41	18	750	69.469	38.87
9	750	94.85	28.47	19	750	57.894	46.64
10	750	82.563	32.70	20	750	65.2	41.41

Total Travel Speed = 778.61 km/hr.

Average Travel Speed = $\frac{778.61}{20}$ = 38.93 km/hr. = TMS or Arithmetic Mean Speed (v_t) (km/h)

Table 4: *Statistical Calculation for Travel Speed*

Vehicle no.	Speed (km/h) (v_i)	SMS or Harmonic Mean Speed (v_s) (km/h)	$(v_i-v_t)^2$	Vehicle no.	Speed (km/h) (v_i)	SMS or Harmonic Mean Speed (v_s) (km/h)	$(v_i-v_t)^2$
1	50.81	-11.88	141.30	11	32.67	6.25	39.12
2	41.56	-2.63	6.94	12	27.22	11.70	136.93
3	41.19	-2.26	5.13	13	27.79	11.13	124.04
4	43.87	-4.94	24.41	14	34.06	4.86	23.64
5	44.93	-5.99	35.88	15	49.03	-10.10	102.07
6	42.44	-3.51	12.32	16	42.93	-4.00	16.001
7	39.18	-0.25	0.065	17	37.37	1.55	2.410
8	35.40	3.52	12.39	18	38.86	0.06	0.004
9	28.46	10.46	109.50	19	46.63	-7.70	59.38
10	32.70	6.22	38.790	20	41.41	-2.48	6.15
SUM Σv_i= 778.62 Standard deviation= $\sqrt{\frac{\Sigma(vi-vt)^2}{n-1}} = \sqrt{\frac{896.056}{19}}$ = 6.86							

Time mean speed = 38.93 km/hr.

Space mean speed = $\frac{n}{\Sigma\frac{1}{Vt}}$ = 37.7 km/hr.

So, Space mean speed < Time mean speed

The Wardrop relation between Time Mean Speed & Space Mean Speed:

Standard deviation = 6.86

$$Vt = Vs + \frac{\delta\text{^}2}{Vs}$$

L.H.S: Vt =38.93 km/hr.

R.H.S: $Vs + \frac{\delta\text{^}2}{Vs}$=37.7 + $\frac{6.86\text{^}2}{37.7}$ = 38.95 km/hr.

So, it is quiet nearer to the value of time mean speed

So, L.H.S. = R.H.S.

4. Discussion on Result

4.1 Discussion on Spot Speed Study

Pace is calculated from the frequency curve which is obtained by scaling a 15 kmph range just keeping the modal speed in the middle. The lowest speed is found 37 kmph and

the highest speed is found 52 kmph. Pace is the indication of the speed range in which mostly drivers are driving. Frequency vs Spot speed curve was drawn from the spot speed data and the frequency. From this curve design speed is estimated. The design speed is a tool used to determine geometric features of a new road during road design. Contrary to the word's implication, a road's design speed is not necessarily its maximum safe speed; that can be higher or lower. Design speed is equal to the 98th percentile speed and this graph it is 65 kmph. That means 98 percent of the vehicles (private cars) are running at speed 65 kmph. So, this data can be used for further designs. Upper limit=85th percentile speed=55.5kmph. That means vehicles cannot cross this speed, this is the maximum limit. Lower Limit=Minimum speed=15th percentile speed=39.5kmph. That means vehicles should not travel at a speed less than this.

4.2 Discussion on Travel Speed Study

In travel speed study, travel time is taken for different vehicles from Pubali Bank to Satrasta Bus Stoppage. To proof Wardrop equation, CAR travel speed is taken. From the calculation, the Wardrop equation was satisfied. Congestion can be measured with the help of travel speed data. This data is very much effective in signal design or improvement of the traffic signal. It is also an important considerable factor in operational considerations, regarding the ongoing and future management of road networks, initiatives and planning, and associated funding submissions.

5. Recommendations

Automatic data collection process must be used for more realistic information. As this study is done by manual method, there will be some minor errors. Speed study must be done carefully for cost & benefit calculation of a project. Volume study must be done before speed study. The result of the study suggest that traffic control system have to improve for smooth flow. Bicycle should have specific lane of their own which typically is placed beside footpath. Side road access should be controlled. If necessary a number of side roads can be closed. Direct access to the structures should be made off and a rear entry road maybe provided for the buildings. Road side parking should be banned. A separate parking space should be provided. Laws should be enforced to prevent drivers from lane changing and overtaking. Roads should be constructed and maintained in a way that the road surface is smooth.

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