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STUDY ON HISTORICAL COMMUTER TRAFFIC PATTERN OF DHAKA-CHITTAGONG HIGHWAY (NH-1) OF BANGLADESH

Mohammad Ahad Ullah
Department of Civil Engineering, Curtin University,
Western Australia, Australia

Dr. Hamid Nikraz
Department of Civil Engineering, Curtin University,
Western Australia, Australia

Dr. Md. Shamsul Hoque
Department of Civil Engineering, Bangladesh University of Engineering and Technology (BUET), Dhaka, Bangladesh

ABSTRACT

Dhaka-Chittagong Highway, which is the main transportation artery for the economy of Bangladesh. Approximately 257 kilometers in length, the road links the country's two largest cities, Dhaka and Chittagong. The NH-1 is a top development priority and is the most demanding road in Bangladesh. Recent enormous congestion, long traffic queue and road accidents ascertains that the highway was built based on non-engineered way or else proper traffic study was not performed during the construction of that highways. Regrettably no extensive traffic studies have been completed on NH-1 by the Government of Bangladesh till now. However, an attempt is made through this research to establish daily, weekly and monthly traffic flow factors along NH-1. Usually traffic data collection and analysis follows varying trends and plays an important role in the evaluation and management of road network schemes. Traffic flow pattern is highly required for different purposes by different ministries and organizations in Bangladesh. The major areas for which this type of study is required are planning prioritization, project initiation, project design, planning maintenance, national transport statistics, road safety measures and traffic control. The daily, weekly and monthly traffic flow arrangements of Dhaka-Chittagong highway have been observed separately in this study. Some specific observation includes that Friday possess maximum traffic flow of 16.20% of weekly volume in NH-1 corridor, Sunday has the minimum traffic flow of 13.51% of the weekly volume and the average daily

flow pattern sags on midweek. Likewise, there is a trend of increasing traffic in the first three weeks of a month and decreasing traffic in the last week of a month. It is also detected that the average maximum monthly flow percentage occurs more frequently on November and December. On the contrary, February carries minimum flow more frequently.

Key words: Daily traffic flow variation, National Highway, Weekly traffic flow variation, Monthly bi-directional traffic flow variation, Maximum and minimum flow.

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1. INTRODUCTION

Dhaka and Chittagong are the two major metropolitan areas of Bangladesh. Dhaka is the main commercial and administrative center of the country; Chittagong is the primary seaport, accounting for about 90% of imports and exports. About a quarter of Bangladesh's population lives in the Dhaka–Chittagong corridor. The government's Seventh Five-Year Plan, 2016–2020 assigns the highest priority to increase the capacity of the existing National Highway No.1 (NH-1) [1]. Construction of a larger Dhaka-Chittagong expressway has been proposed already under Public Private Partnership (PPP) to decrease congested traffic on this highway. Besides, NH-1 will be a part of the Asian Highway that connects with neighboring countries. The detail daily, weekly and monthly traffic flow analysis is badly needed for future planning as with recent high-level intergovernmental consultations and agreements that will allow better access for Bhutan, India, and Nepal to Chittagong Port. The additional traffic of goods and passengers will use Dhaka–Chittagong corridor and has to be considered when planning the road capacity between Dhaka and Chittagong. It should be mentioned here that, specific time series analysis of traffic flow in any highway are considered as one of the most important parameter where those provides essential efforts for traffic model developments and calibration exercises that can be used for the planning of new road construction, existing road for widening, determination of roadway geometry, congestion management, pavement design, and many others [2]. During the planning, design, construction and maintenance period of any road network, traffic flow analyses becomes an essential element in decision-making, and therefore the format and the accuracy of data collection and analysis is as well critical.

2. OBJECTIVE AND SCOPE OF THE STUDY

The NH-1 highway is solely supervised and maintained by Roads and Highways department (RHD) of Bangladesh. No study has been done by the Government of Bangladesh (GoB) and RHD regarding historical commuter traffic pattern on NH-1 before. Hence, an attempt is taken through this study to explore the daily, weekly and monthly traffic flow variations of Dhaka-Chittagong Highway (NH-1) corridor of Bangladesh to comprehend the latest traffic flow characteristics of that highway. This study has been performed based on daily traffic data of Meghna and Gumuti Bridges, which are the entry point of Dhaka-Chittagong highway corridor. Gazaria upazlia in Narayanganj district is located between two channels of the Meghna River. On the eastern side is the Daudkandi channel and on the western side is the Meghna channel

of the Meghna River. The Gumti bridge over the Daudkandi channel and Meghna bridge over the Meghna channel.

3. LITERATURE REVIEW

Daily, weekly and monthly traffic flow indicators of Dhaka-Chittagong highway is essential for various engineering works on that corridor as well as other highways of Bangladesh from short term to long term, such as pavement design, plan for future investments, road widening, traffic impact assessment, feasibility studies, traffic forecasting and modelling, congestion reduction, traffic queue reduction, improved incident management, dynamic network traffic control, reducing fuel consumption (and thus lower CO2 emissions) and air emissions, shorten driving times thus reducing costs, improved vehicle fleet management, improved information services (e.g. traffic information, dynamic route guidance, road message signs, etc.). The improvements are expected to affect all the transportation actors at different degree, for example, government and public authorities, logistics and fleet operators, location based service providers, consultants, map providers, marketing, telecommunications, automotive manufactures, etc. The Roads and Highways Department of Bangladesh will have a cost-effective tool to obtain continuous and wide-covering data leading to better traffic monitoring in real time, better understanding of the traffic patterns and plans for future investments. The international donor agencies in Bangladesh can formulate different studies like congestion monitoring, journey time studies, planning studies, air pollution studies, OD matrices and planning local transport by using traffic flow indicators of N-1 corridor before investing money. Transport agencies of different developed countries widely record traffic data of various highways using automatic and manual method and at the same time they use those data for traffic analysis. Conversely, no studies has been done by Government of Bangladesh regarding extensive time series traffic analysis of NH-1 and no parameters has been set by the Roads and Highways Department, as a part of Development of Geometric Design Standards in 1994 and Pavement design guide in 2005, on some important highways [3][4]. However, only a few studies with very limited range of data has done for traffic study in Bangladesh. Muhibur Rahman performed studies on Vehicular Flow Pattern on Jamuna Multipurpose Bridge Access Road in 2002 [5]. Hamid-Uz-Zaman completed another study in Traffic Flow Characteristics and Modeling for Estimation of AADT in selected Rural Highways in 2006 [6]. Mohammad Ahad Ullah carried out research on Evaluation of Pavement Design Parameters for National Highways of Bangladesh [7]. In addition, guidelines are followed for investigation of traffic characteristics from Traffic Monitoring Guidelines 2001, published by Federal Highway Administration of U.S. Department of Transport, which have been helpful for this type of research [8].

4. DATA COLLECTION

The various types and methods are used to collect traffic data in different countries that provide a good and valuable coverage of the required traffic information for decision making and planning of both development and maintenance of the national road network. Unfortunately in Bangladesh there is no establishment of regular manual traffic counting program or spontaneous automatic counters along the public highway network. However, in recent years the government of Bangladesh has invited tender to bid an Operation and Management (O&M) contract for five years against a fee after building the major roads and bridges of some selected corridors. The O&M operators maintains the bridge and collects toll on behalf of the government.

Electronic toll collection system has not introduced yet in Bangladesh. Nevertheless, the traffic data that has been used in this study for the traffic flow characteristics analysis is primarily collected from the Operation and Management (O&M) Companies of Meghna and Gomoti Bridges. The daily traffic flow data from the year 2006 to 2014 have been collected from the toll operators called RCL (Reza Construction Limited) and MBEL (Mohiuddin Builders and Engineers Limited)-ATT (Asian Traffic Technologies Limited) JV (joint venture). The traffic data has been recorded by the operators by direct entry from the toll plaza and then have been electronically preserved at their main database. These flow data have then been collected from the operators with official permission from Roads and Highways Department of Bangladesh and have been used in this study to perform the required analysis.

5. DATA ANALYSIS AND FINDINGS

Detail traffic flow features of Dhaka-Chittagong Highway (N-1) is analyzed in this research. It is a matter of regret that, neither Roads and Highways Department of Bangladesh nor the concern O&M company of the contractors' are concern about the research value of the traffic data. Hence, they don't preserve it properly and it was not possible to collect data for inbound and outbound traffic separately.

The following sections discusses the detail traffic flow characteristics along this highway of Bangladesh.

5.1. Daily Traffic Flow Variation

Daily flow fluctuation on highways is an important parameter of flow characteristics where the variation of flow in days-of-week is observed. From the analyses of 9 years data collected from RCL and MBEL-ATT JV (2006 to 2014), distinct daily flow fluctuation pattern can be achieved. It is seen in figure 1 how each month of year affects this daily flow fluctuation. To make this observation, curves have been plotted showing daily flow variation for all months of a year during this study. Two of such charts are given in Figure 1 and Figure 2, where the average daily flow variation pattern are found to conform to those obtained from the previous analyses, but no definite relation can be established in terms of influence of individual month on these daily variations. This implies that, individual month has no significant effect on daily variation of traffic flow on Dhaka-Chittagong highway.

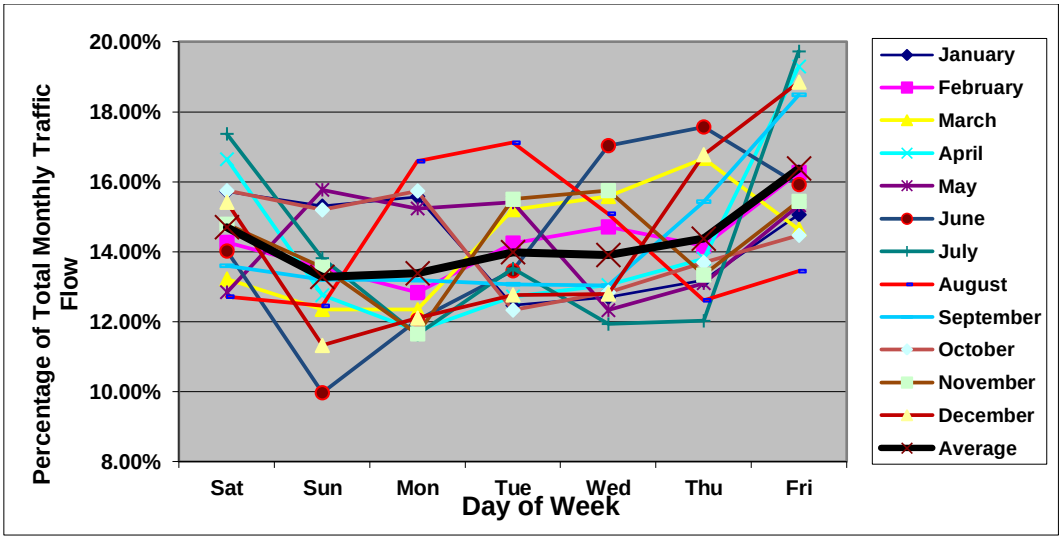

Figure 1 Month-wise Daily Traffic Flow Variation on Dhaka-Chittagong Highway, 2011 (Both Direction)

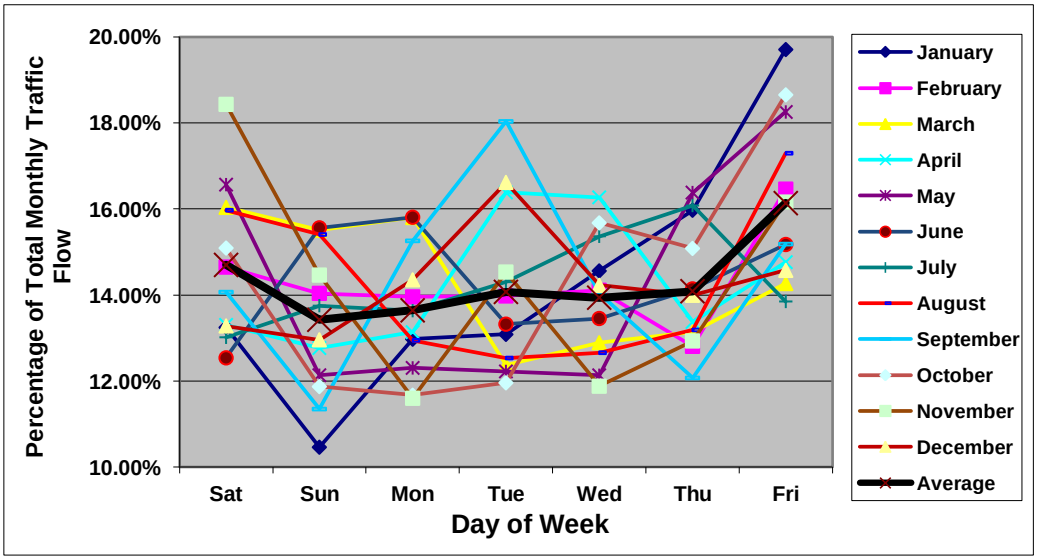

Figure 2 Month-wise Daily Traffic Flow Variation on Dhaka-Chittagong Highway, 2014 (Both Direction)

Summary of Findings

From the analyses, the following important flow characteristics parameters have been obtained, where it is obvious that Friday possess maximum traffic flow of 16.20% of weekly volume in NH-1 corridor. On the other hand, from Monday to Wednesday the daily traffic flow varies from 13.59% to 14.00% of weekly volume and Sunday has the minimum traffic flow of 13.51% of the weekly volume. Besides, Thursday has second highest traffic volume of 14.80% of weekly volume in N-1 corridor. This analysis indicates that the flow pattern sags on midweek.

Table 1 Summary Table - Daily Flow Variation

	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
Saturday	14.29%	13.59%	13.61%	13.62%	13.79%	14.70%	13.32%	15.06%	14.70%	14.08%
Sunday	13.51%	13.34%	13.64%	13.51%	13.30%	13.28%	13.84%	13.76%	13.42%	13.51%
Monday	13.64%	13.80%	13.51%	13.51%	13.75%	13.38%	13.34%	13.74%	13.64%	13.59%
Tuesday	13.52%	13.71%	13.95%	13.96%	13.89%	13.98%	14.04%	13.21%	14.07%	13.82%
Wednesday	13.50%	14.48%	14.33%	14.03%	14.10%	13.90%	14.60%	13.10%	13.94%	14.00%
Thursday	14.77%	14.92%	14.71%	15.03%	14.65%	14.37%	16.12%	14.56%	14.09%	14.80%
Friday	16.78%	16.15%	16.24%	16.32%	16.52%	16.38%	14.74%	16.56%	16.13%	16.20%

5.2. Weekly Traffic Flow Variation

Depending on the economic activities of highway corridors, traffic flow may exhibit weekly flow variation, i.e. considering four weeks in a month; the flow may vary from week to week. To find out these characteristics on NH-1 highway, weekly flow analyses have been done in this section.

Each month has been divided into four weeks. The first three weeks have seven days each and the fourth week, except February, has 9 to 10 days depending on the month. So, it is anticipated that the fourth week will naturally contain more traffic. To compensate this possible error, the model uses weekly ADT instead of weekly volume and then compares between the four weekly ADTs of each month from January 2006 to December 2014. A typical table of weekly flow variation analyses is shown in Table 2.

Table 2 Summary of Weekly Flow Variation (Both Direction)

Year	Weekly Flow Percentage			
	1st Week	2nd Week	3rd Week	4th Week
2006	24.81%	24.52%	25.17%	25.50%
2007	24.68%	24.89%	25.32%	25.11%
2008	25.30%	25.19%	24.13%	25.38%
2009	24.45%	25.10%	25.50%	24.95%
2010	24.56%	25.25%	25.60%	24.58%
2011	24.67%	24.72%	25.16%	25.45%
2012	24.55%	24.73%	25.45%	25.27%
2013	24.44%	24.62%	26.15%	24.80%
2014	23.47%	25.47%	25.55%	25.50%
Average	24.55%	24.94%	25.34%	25.17%

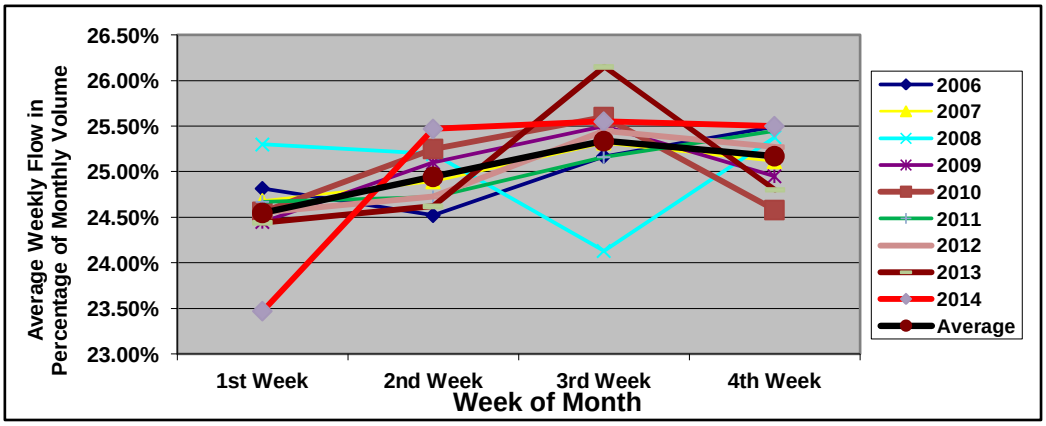

Figure 3 Weekly Flow Fluctuation on Dhaka-Chittagong Highway 2006-2014 (Both Direction)

From Figure 3, it implies that, in the NH-1 corridor, there exists specific weekly flow variation pattern. The average curve (for the year 2006 to 2014) shows that, the first three week of a month, there is a trend of increasing traffic and the last week of the month there is a trend of decreasing traffic .

5.3. Monthly Traffic Flow Variation

In the study of monthly flow variation, nine years of traffic flow data on Meghna-Gomoti Bridge collected from RCL and MBEL-ATT JV have been used for analyses, which will give a thorough understanding of nature of traffic flow variation in different months of a year. Characteristics curves showing monthly flow variation is shown in Figure 4. It can be seen that, monthly flow variation in every year shows very similar repetitive nature of flow fluctuation. The magnitude of flow has risen every year but the flow pattern remains same, which implies that month has influences over traffic flow along this corridor.

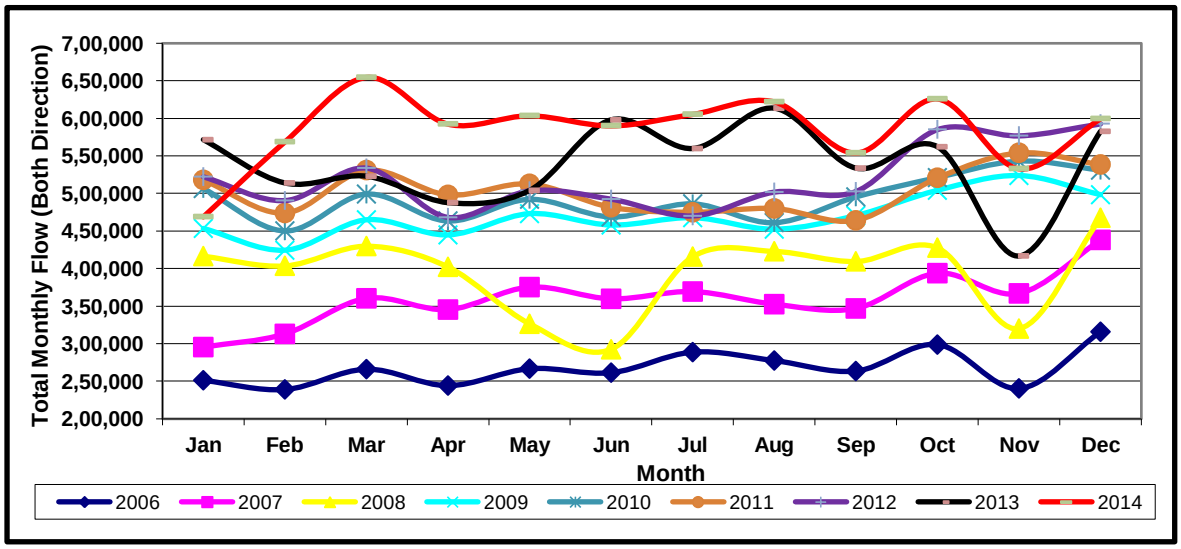

Figure 4 Monthly Flow Variation on Dhaka-Chittagong Highway (Bothway), 2006-2014

The following table (Table 3) shows the monthly flow variation on N-1 corridor from the year 2006 to 2014.

Table 3 Monthly Bi-directional Flow Variation on Meghna-Gomoti Bridge, 2006-2014

Month\Yr	2006	2007	2008	2009	2010	2011	2012	2013	2014
January	250,988	295,193	416,396	453,185	506,324	517,868	522,201	571,349	469,000
February	238,820	312,740	403,447	424,170	450,000	473,737	490,460	513,774	568,800
March	265,789	360,112	429,778	464,702	498,985	530,898	533,794	522,770	654,660
April	243,965	345,105	402,048	444,537	463,220	497,869	467,980	487,590	592,488
May	266,474	375,049	326,242	472,871	491,998	512,614	503,448	503,899	603,622
June	261,144	359,441	292,239	457,681	468,513	481,405	492,290	597,735	590,175
July	288,475	369,120	415,725	467,515	485,985	474,700	469,951	559,599	605,453
August	277,259	352,299	422,798	452,142	460,937	479,789	501,742	613,240	622,103
September	263,283	346,617	409,367	470,306	495,200	463,908	502,540	533,527	554,010
October	298,482	393,615	427,631	503,949	520,837	520,681	585,166	561,955	625,965
November	240,141	366,653	319,814	523,644	542,724	553,986	576,798	416,639	533,088
December	315,590	437,893	467,464	498,096	530,778	538,364	592,804	582,487	599,619
Yearly Volume	3,210,410	4,313,837	4,732,949	5,632,798	5,915,501	6,045,819	6,239,174	6,464,564	7,018,983

Source Data: RCL, MBEL-ATT JV.

Table 4 shows the maximum and minimum monthly flow percentage of NH-1. Maximum and minimum flow is marked in red and blue separately. It is found from the below table that, the average maximum monthly flow percentage occurs more frequently on November and December. On the contrary, February carries minimum flow more frequently. The graphical representations are shown below in Figure 5.

Table 4 Maximum & Minimum Monthly Flow

Month\Year	2006	2007	2008	2009	2010	2011	2012	2013	2014	Average
January	7.82%	6.84%	8.80%	8.05%	8.56%	8.57%	8.37%	8.84%	6.68%	8.06%
February	7.44%	7.25%	8.52%	7.53%	7.61%	7.84%	7.86%	7.95%	8.10%	7.79%
March	8.28%	8.35%	9.08%	8.25%	8.44%	8.78%	8.56%	8.09%	9.33%	8.57%
April	7.60%	8.00%	8.49%	7.89%	7.83%	8.23%	7.50%	7.54%	8.44%	7.95%
May	8.30%	8.69%	6.89%	8.39%	8.32%	8.48%	8.07%	7.79%	8.60%	8.17%
June	8.13%	8.33%	6.17%	8.13%	7.92%	7.96%	7.89%	9.25%	8.41%	8.02%
July	8.99%	8.56%	8.78%	8.30%	8.22%	7.85%	7.53%	8.66%	8.63%	8.39%
August	8.64%	8.17%	8.93%	8.03%	7.79%	7.94%	8.04%	9.49%	8.86%	8.43%
September	8.20%	8.04%	8.65%	8.35%	8.37%	7.67%	8.05%	8.25%	7.89%	8.16%
October	9.30%	9.12%	9.04%	8.95%	8.80%	8.61%	9.38%	8.69%	8.92%	8.98%
November	7.48%	8.50%	6.76%	9.30%	9.17%	9.16%	9.24%	6.44%	7.59%	8.18%
December	9.83%	10.15%	9.88%	8.84%	8.97%	8.90%	9.50%	9.01%	8.54%	9.29%
Total	100%	100%	100%	100%	100%	100%	100%	100%	100%	100.00%
Max.	9.83%	10.15%	9.88%	9.30%	9.17%	9.16%	9.50%	9.49%	9.33%	9.29%
Min.	7.44%	6.84%	6.17%	7.53%	7.61%	7.67%	7.50%	6.44%	6.68%	7.79%

Source Data: RCL, MBEL-ATT JV.

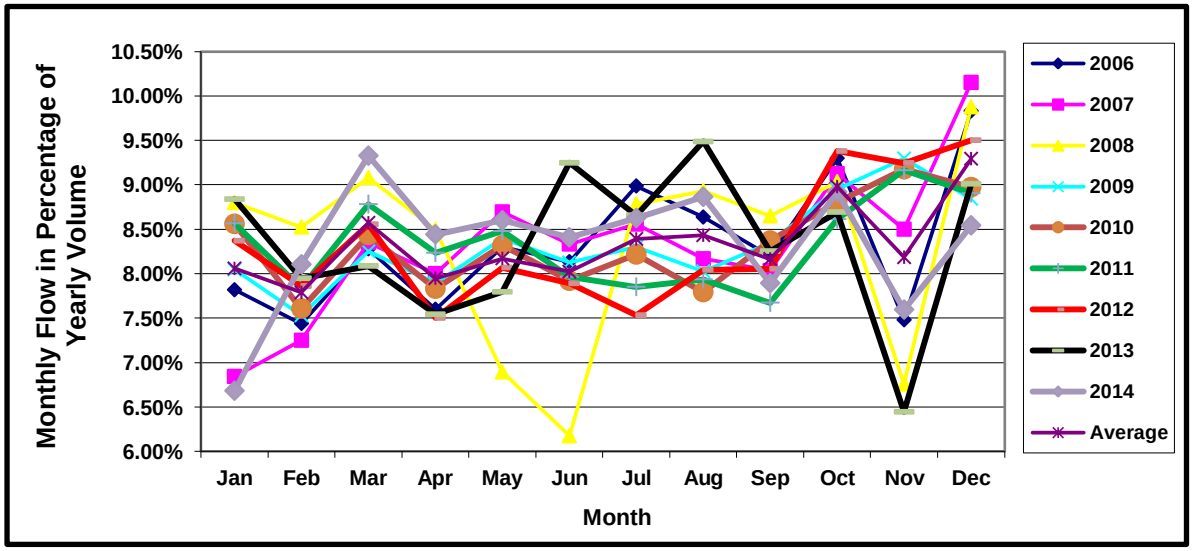

Figure 5 Monthly Flow Variation (in percentage of yearly volume for bi-directional traffic)

6. CONCLUSIONS AND RECOMMENDATIONS

An inclusive knowledge of daily, weekly and monthly traffic flow characteristics along Dhaka-Chittagong highway corridor have been discovered from this study. Though nine years of data is not adequate for in-depth traffic flow analyses. By proper preservation of round-the year traffic data and populating more years' of data within this present framework, a more generalized traffic flow pattern can be made possible along this highway.

Automatic Traffic Recorder (ATR) should be established in different locations of Dhaka-Chittagong highway to preserve uninterrupted traffic flow data; which is used to produce volume, classification, speed and weight data as well as traffic forecasts, vehicle miles traveled (VMT) figures, reports, maps and analysis. Traffic data products are used in safety evaluation, pavement design, funding decisions, forecasting, modeling, and much more. In addition, assessment of pavement performance through traffic survey and periodical monitoring is mandatory for road accident prone area of NH-1. Moreover, other indicators like hourly traffic data, accident data, Environmental Impact Assessment (EIA) report, Highway Development Management (HDM) report, axle load data, concurrent pavement distress data, etc. should be included in future in this research to formulate a real-time traffic flow model of NH-1 corridor.

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