DETAIL ASSESSMENT ON THE DISTRIBUTION OF VEHICULAR TRAFFIC PATTERN ALONG NATIONAL HIGHWAY NO.1 (NH-1) OF BANGLADESH

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Abstract:

In recent years, road transport has become the dominant mode of surface transportation in Bangladesh, carrying more than 70% of passengers and 60% of freight. A primary concern of administrators of Bangladesh Roads & Highways Department (RHD) has moved from the construction of new roads to the management of existing road infrastructures. For this reason there is a growing need for pavement management systems and detail vehicular traffic flow information to evaluate pavements, including pavement use and the resulting deterioration. The National Highway No.1 (NH-1) is the busiest road in the country and a top development priority. An attempt is made through this research to discover the traffic composition along NH-1 as no detail traffic distribution patterns have been designed by RHD yet. Some particular outcomes includes Truck is the most predominant vehicular class with average volume of 32.29% of total traffic that indicates NH-1 is vulnerable to frequent pavement fatigue. Besides, except truck and bus (12.68%), the remaining vehicular class consist of small vehicles, which marks NH-1 very accident prone and congested highway. Though individual year varies significantly, the average growth factor of Truck and Bus is found 6.68% and 4.07% per annum respectively.

Key words: Growth Pattern, Traffic Composition, Truck Percentage, Bus Percentage.

1   INTRODUCTION

Road traffic scenario in Bangladesh is categorized by the presence of both motorized and non-motorized vehicles plying on roads. In other words, there is predominant traffic mix on all roads, even in highways, of the country. This is one of the serious problems for road network of Bangladesh in terms of traffic flow and road safety. The 462 kilometer long National Highway No.1 (NH-1) with average width of 8.35 meter is the busiest and second longest highway of Bangladesh [1]. However, negligence in traffic studies along NH-1 effects the highway with abnormal delay, heavy congestion, recurrent pavement fatigue and accident prone. As each road is unique in terms of its role in the network, catchment, traffic composition and determinate of future traffic growth; design parameters should ideally be assessed in order to make a road-specific traffic projection as a basis for road design and computation of economic returns [2]. Specific traffic flow parameters, i.e. traffic composition and individual class wise traffic growth pattern of NH-1 have been focused in this paper.

2   OBJECTIVE AND SCOPE OF THE STUDY

The main objective of this study is to explore daily traffic flow data on a selected highway to achieve accurate vehicular traffic composition pattern. Vehicle class wise growth pattern, truck and bus percentage are also to be determined in this research. No study has been done by the Government of Bangladesh (GoB) and RHD regarding traffic composition pattern and class wise growth pattern on NH-1 before.

This study has been performed based on daily traffic data of Meghna and Gumuti Bridges, which are the entry and exit 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 is situated over the Daudkandi channel and Meghna bridge over the Meghna channel.

3   LITERATURE REVIEW

Transportation system is a dynamic system. Information about traffic must be regularly updated to keep pace with ever-changing transportation system. Data must be collected and analyzed systematically to get representative information. Traffic surveys are the means of obtaining information about traffic. This is a systematic way of collecting data to be used for various traffic engineering purposes. Study of various characteristics of road traffic is immensely useful for planning and design of roadway systems and operation of road traffic [3].

The detail study on vehicular traffic composition along National Highway No.1 (NH-1) is indispensable for various engineering works 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 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 NH-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 class wise daily traffic composition 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 [4][5]. Haque has investigated traffic congestion and safety issues; and the accident problem in highways [6][7]. 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 [8]. Hamid-Uz-Zaman completed another study in Traffic Flow Characteristics and Modeling for Estimation of AADT in selected Rural Highways in 2006 [9]. Mohammad Ahad Ullah carried out research on Evaluation of Pavement Design Parameters for National Highways of Bangladesh [10]. 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 [11].

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

In Bangladesh there is no unified vehicle classification system until now. Hereafter, different road operators are using different vehicle classification system and thus making traffic composition analyses more complex. In Meghna and Gumuti bridges, since these are tolled bridges, it was necessary to define a vehicle classification system for setting toll amount for different classes of vehicles passing through the bridges. However, the total traffic is divided into eight classes considering vehicle size and capacity are: (1) Class 1: Motor Cycle, (2) Class

2: Scooter / Tampu, (3) Class 3: Car / Jeep, (4) Class 4: Micro / Pickup, (5) Class 5: Mini Bus / Coaster/ Mini Truck, (6) Class 6: Bus, (7) Class 7: Truck and (8) Class 8: Trailer. According to Government of Bangladesh order, some classified government vehicles are exempt from paying toll to these bridges and hence a new vehicle class is added as Class 9: Toll Free Vehicles.

5.1   Vehicle classwise yearly growth pattern and traffic composition

Figure 1 shows the classification wise yearly volume of traffic on National Highway Number-1 from 2006 to 2014. It can be seen from the figure that most predominant vehicle classes are truck. Total yearly flow of trucks ranges from 12,00,000 to 20,00,000 with average value of 1.75 million. Alternatively, the second highest traffic category is micro/pick-up, which produces 5,00,000 to 13,50,000 number of yearly trip with average value of 0.97 million that is nearly half times lesser then truck. The graph indicates that special consideration should be taken at the time of pavement design, construction and maintenance of this corridor as the probability of pavement damage may be highest due to maximum movement of truck.
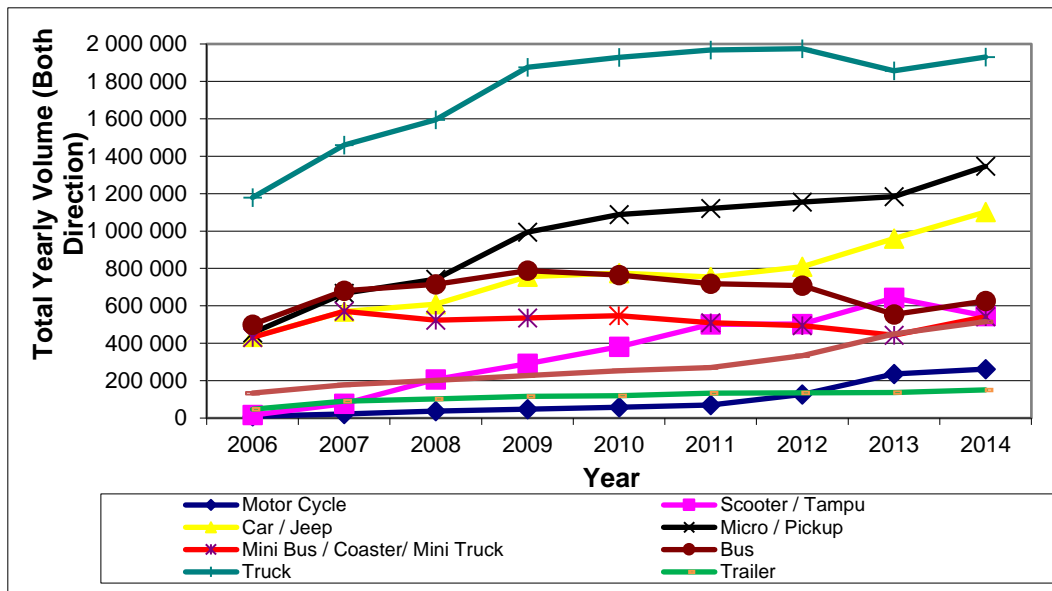

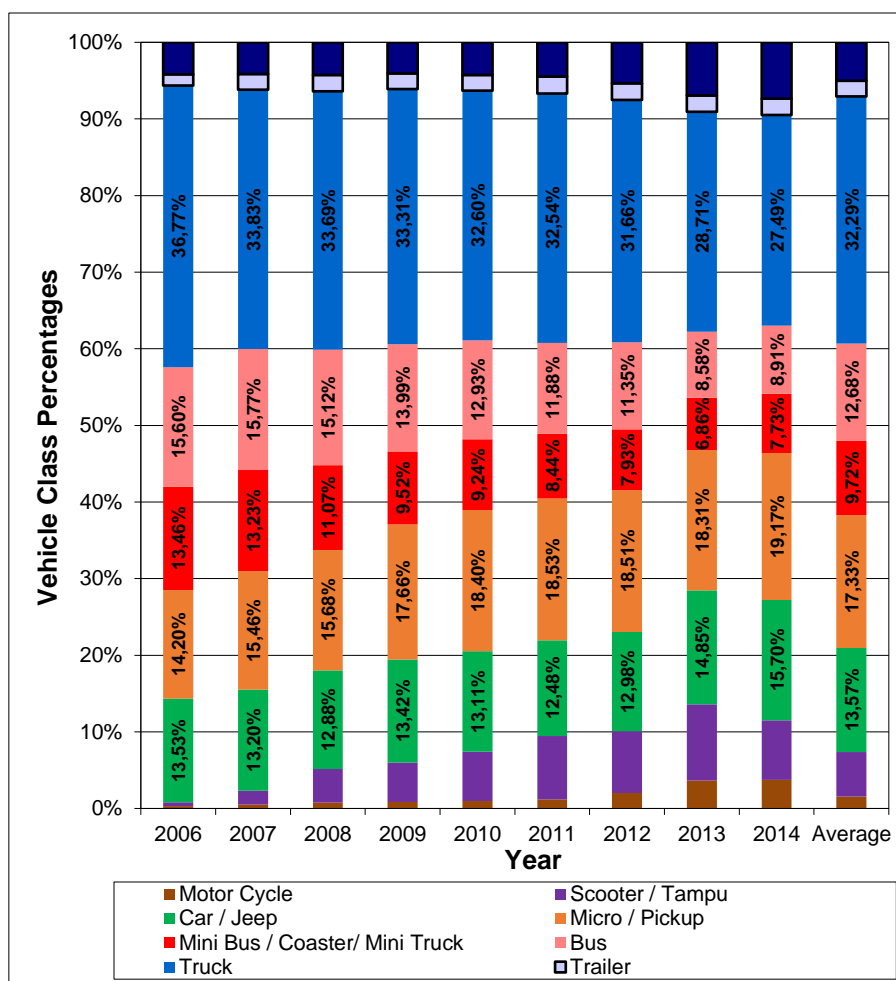***Fig. 1*** *Vehicle Classwise Yearly Growth Pattern of Traffic on NH-1*

Fig. 2 *Composition of Traffic Pattern on Dhaka-Chittagong Highway*
(in percentage of total traffic)

Also, the proportion of micro/ pick-up has increasing trend. The third largest trip producer is car/jeep, ranges from 4,00,000 to 11,00,000 with average value of 0.75 million and the trip quantity of this vehicle class is also have a rising trend, which could produce traffic congestion and accident at the same time due to mix traffic nature along NH-1. The fourth vehicle class is bus with average value of 0.67 million per year. In addition, the number of trailer on NH-1 corridor is relatively low but it has an increasing trend.

The detail traffic composition pattern is shown in figure 2 of NH-1 from the year 2006 to 2014. It is established in this study that, along this corridor vehicular class number 7 i.e. Truck has the topmost proportion in the traffic flow. In 2006, the percentage was 36.77% and during the next years the proportion is virtually same but the quantity has increased. The average percentage of truck from 2006 to 2014 is 32.29%. The subsequent highest percentage of vehicle class is Micro/Pick-up, the fraction of which was 14.20% in 2006 and 19.17% in 2014. The average proportion of Micro/Pick-up from 2006 to 2014 is 17.33%. The third highest contributing class to the total traffic flow is car/jeep. In 2006, its percentage was 13.53% and it became 15.70% in the year 2014, the average is found to be 13.57%. The fourth utmost vehicle class is bus, which has 15.60% in 2006 and 8.91% in 2014 making average from 2006 to 2014 is 12.68%. Analyzing the traffic flow data on Meghna-Gumuti bridges from 2006 to 2014, it is found that these four pre-dominant vehicle classes comprise of total 75.87% of total traffic flow. Rest 24.13% is shared between minibus/coaster/Mini Truck (9.72%), motorcycle

(1.56%), scooter/tampu (5.81%), trailer (2.05%) and toll free (5.00%). The study shows that individual class wise traffic composition along NH-1 are maintaining a stable pattern and hence should be incorporated in geometric design standards manual of Roads and Highways department, Bangladesh for accurate and durable pavement design. The graphical representation of the growth pattern on individual vehicle classes along Dhaka-Chittagong highway is shown in figure 3.
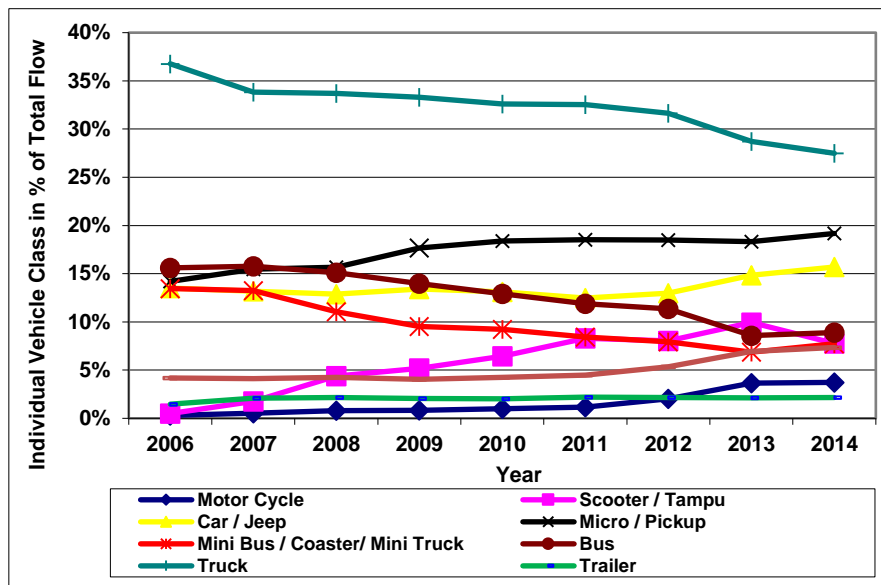

Fig. 3 *Growth Pattern of Individual Vehicle Classes on NH-1*

(in Percentage of Yearly Total Volume)

5.2 Heavy vehicle percentage along NH-1

Reliable estimates of heavy vehicle percentages are important in a number of transportation applications. Estimates of heavy vehicle percentages are necessary for pavement design and pavement management as well as bridge performance. Truck and bus volumes play a vital role for road safety operations. The number of bus and trucks on the road also influences roadway capacity. Heavy vehicles have more difficulty accelerating and maneuvering than passenger cars and have a lower deceleration in response to braking compared to passenger cars. Therefore, the number of heavy vehicles present in the traffic stream influences traffic operations especially in mix traffic conditions like NH-1. Attempts have been made with this study to establish the actual heavier vehicle percentage and their travel pattern along NH-1 based on field level data from the year 2006 to 2014.

5.2.1 Truck percentage

According to the vehicle classification system used by the toll operators in NH-1, vehicle having capacity of 5 ton to 8 ton are classed as trucks. This class is most common in Bangladesh and hence contributor of the highest percentage of traffic. Besides, some trucks capacity is more than 8 ton and usually possesses more than two rear axles. It is observed from field survey that the toll collectors are often confused about the classification between the trucks falling near to boundary conditions.

Nevertheless, from the analyses of traffic flow data from 2006 to 2014, taking the average of nine years, it is observed that the percentage of all classes of trucks 34.34% of total vehicle.

Among this, the percentages of trucks and trailers are 32.29% and 2.05% respectively as presented in Table 1 and Figure 4 (graphical form). The average growth factor of Truck is 6.68% per annum. Though separate year wise growth factor of truck differs considerably, such as from 2006 to 2014 the growth factor of truck is established 23.44%, 9.25%, 17.67%, 2.77%, 2.03%, 0.38%, -6.01%, and 3.95% respectively.

Tab. 1 *Truck Percentages on Dhaka-Chittagong Highway*

Year	Truck	Trailer	Total Trucks & Trailers
2006	36.77%	1.47%	38.24%
2007	33.83%	2.08%	35.91%
2008	33.69%	2.15%	35.84%
2009	33.31%	2.06%	35.37%
2010	32.60%	2.03%	34.63%
2011	32.54%	2.20%	34.74%
2012	31.66%	2.17%	33.82%
2013	28.71%	2.12%	30.84%
2014	27.49%	2.15%	29.64%
Average	**32.29%**	**2.05%**	**34.34%**

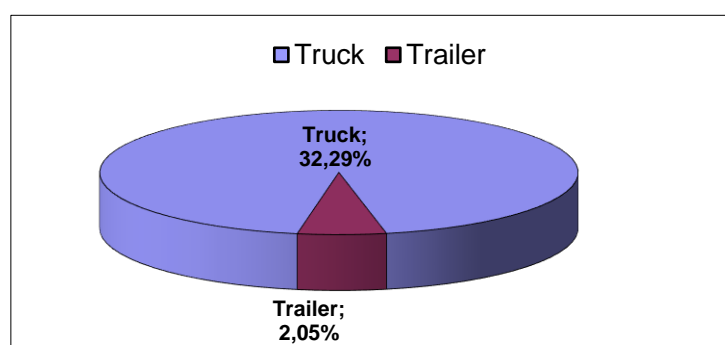*Source: RCL, MBEL-ATT JV.*

Fig. 4 *Annual Truck Percentage on Dhaka-Chittagong Highway (average from 2006 to 2014)*

5.2.2 Bus percentage

Passenger transport services in Bangladesh are provided by various modes and are characterized by high growth rates, its diversity and poor financial and operational performance. However, demand for passenger transport services is already enormous and growing at a rapid rate due to rapid rise of population in the country and the vast majority of the population is still be relying on road-based transport system. Hence, precise determination of bus percentage is crucial for structural and geometric design of pavement. The buses travelling through Meghna and Gumuti bridges are classified into two groups namely Mini Bus/ Coaster/ Mini Truck and large Bus are

called Bus. Buses having capacity of 30 seats of less are classed as mini bus and buses having more than 30 seats capacity are classed as Bus.
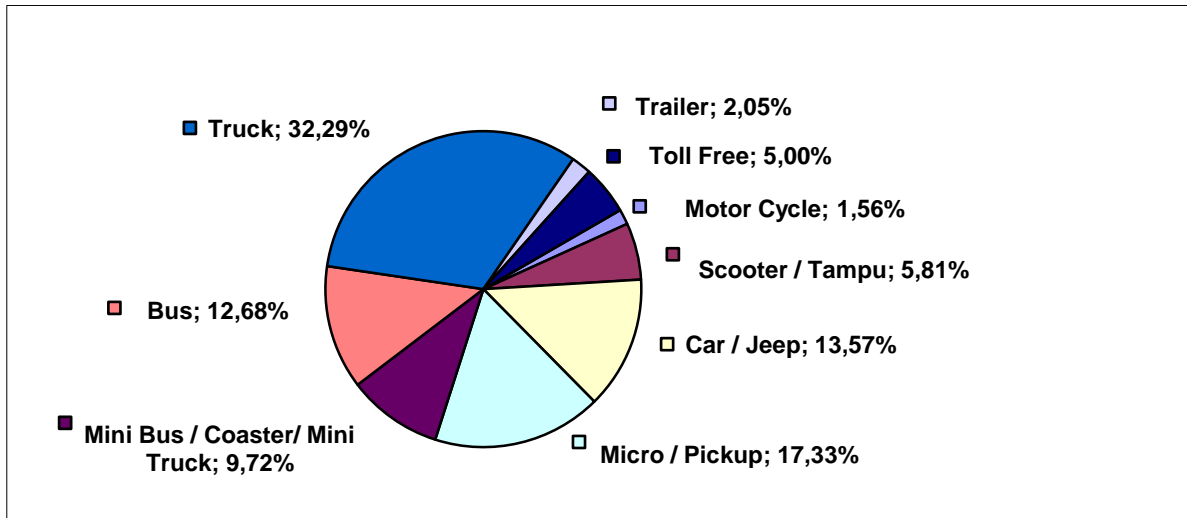

Fig. 5 *Annual Bus Percentage on Dhaka-Chittagong Highway (Averaged over 9 Years)*

It is found from figure 5 that bus percentage along NH-1 is 22.40% of total annual flow (taking average from 2006 to 2014) including 12.68% is bus and 9.72% is mini bus. From the nine years of daily traffic data, the growth factor of bus is established 4.07% per annum. However, growth factor of bus percentage along individual year varies significantly, such as from 2006 to 2014 the growth factor of bus percentage is found 36.65%, 5.17%, 10.14%, -2.95%, -6.13%, -1.42%, -21.63% and 12.77% respectively. More years of data is needed to reveal the misterious nature of growth factor of passenger transport services along NH-1. Furthermore, it is also calculated that the percentage of bus has decreased with respect to total traffic (15.60% in 2006 and 8.91% in 2014). The illustrative form of the growth pattern of buses along NH-1 is shown below in figure 6.
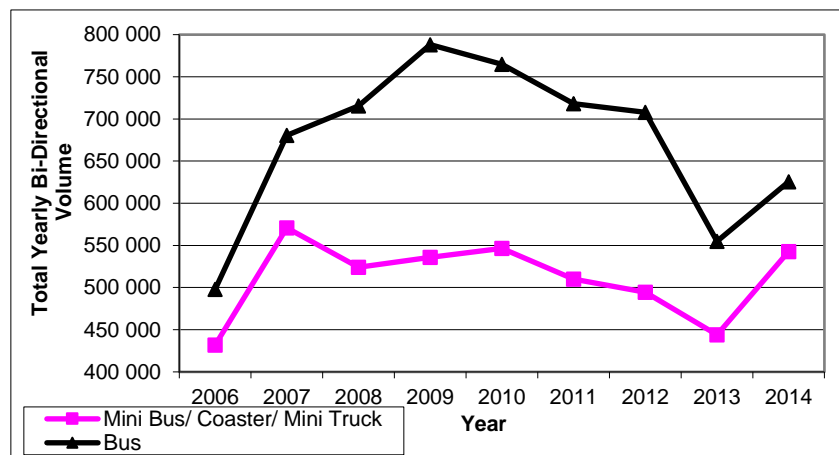

Fig. 6 *Growth Pattern of Buses on NH-1 (Both Direction)*

6   CONCLUSIONS

Traffic data is the foundation of highway transportation planning and is used in making numerous decisions. Since accurate traffic data is a very crucial element in the transportation planning process, understanding and implementing the process accurately can lead to better design and maintenance decisions. The geometric and structural design of any road facility greatly depends on traffic composition and growth pattern. Bangladesh road authority don't use updated traffic data to design and manage road and traffic system. A wide-ranging daily traffic data analysis have been performed in this research along Dhaka-Chittagong highway to get accurate traffic pattern and growth factor along the corridor. The detail analyses will be useful for planning and designing traffic facilities, selecting geometric standards, economic analysis, vehicle and pavement management.

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