

## INVENTORYING OF BAHADDARHAT FLYOVER AND ITS IMPACT ON TRAFFIC SYSTEM

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### ABSTRACT

A flyover is a bridge that crosses over another road or railway for the purpose of making traffic less, which is generally constructed on road intersections to prevent congestion, accident etc. and to provide a more convenient way to navigate over the traffic. Bahaddarhat intersection is the only access which connects Chattogram city with the South-Eastern part of the country. Also roads from some in demand tourist spots such as Cox's Bazar, Kaptai, Bandarban etc. are connected with this intersection. The efficiency, safety, speed, cost of operation and capacity of road system very much depend on the intersection design. So a Grade separated intersection helps traffic to move with less interruption. Moreover, the intersecting roads are separated by different in level, thus eliminating the crossing manoeuvre. As Chattogram is the commercial capital of Bangladesh, Bahaddarhat flyover intersection plays an important role as a transporting agent among Kaptai, Coxs Bazar, Bandarban, Rangamati and Chattogram city. In order to inventory the Bahaddarhat Flyover and its traffic system, the existing geometric elements of the flyover have been measured so as to compare with the standard dimensions. The study also includes the counting traffic volume for a couple of consecutive days of the flyover intersection for all directions, from which design volume has been found out. Moreover, the nature of the traffic flow have been observed for determining conflict points. While inventorying, it has been found that carriageway width of Kaptai approach leg is narrow (5m) for two way trafficking. Two right turnings for the vehicles have also been observed on the flyover at same level which create two conflict points. Moreover, a left turning facility has no turning radius leaves a sharp angular left diversion. The presence of two right turnings, speed breakers at the approach road and a narrow width of the road at kaptai approach leg are the main reasons for the traffic congestion over the flyover intersection. Finally some remedial measures have been proposed for mitigating congestion and conflict points based on the various observed values.

**Keywords:** Flyover, Geometric elements, Traffic congestion, Traffic flow, Conflict points.

## 1. INTRODUCTION

A flyover is a type of grade separated intersection that allows uninterrupted vehicles movement that were previously in conflict at grade intersection, interchanges are made up of several overpasses (Maji, 2015). Sometimes flyovers can't fulfill its purposes due to some lacking of planning perspectives. A heterogeneous mixture of vehicles from different parts of the country including Chattogram, especially bus, truck, lorry, car, motor bike, mini bus, pick-up, three-wheeler along with some non-motorized vehicles shift through this intersection. Surrounding of this intersection has generally residential and commercial installations. So, traffic volume at this intersection sometimes crossed its capacity which leads to create congestion during peak hour. In general, traffic congestion on transport networks is a state that happens due to the increase in use and is measured by speed drops, increase in travel times and vehicular queuing. The Highway Capacity Manual (HCM) has introduced the standard of a road under different operating characteristics and traffic volume. When capacity gives a quantitative measure of traffic, it tries to give a qualitative measure. As a solution of this problems, Bahaddarhat flyover was constructed by Chittagong Development Authority (CDA). In line with strategic transport plan, flyovers have been constructed around Chattogram city with the aim of improving traffic jam conditions. The huge number of vehicles along with the non-motorized vehicles make the traffic system poor in different roads of Chattogram city. Due to mitigate these problems, government has built four flyovers to enhance the mobility and ensure the trustable transportation solution according to them. Among them, Bahaddarhat flyover is one and it was inaugurated in October 12, 2013. The operating condition of existing flyover has been shown in Fig 1.



Figure 1: Bahaddarhat Flyover Intersection, Chattogram

Eight years after the construction, still the mobility and accessibility of vehicles which were taken in consideration while constructing this flyover couldn't attain its goal in some contents. Specified the generality of flyovers in Chattogram city, unfortunately very few studies have been spoken to this subject orderly. Hossain (2018) had showed traffic congestion at different intersections in Chattogram city. Without considering the variation during different times of a day, Anwari (2016) evaluated circumstances of partially grade separated flyovers in Dhaka city. Again Anwari (2016) found the causes of poor traffic behavior and the clash of rail-road at Shaheed Ahsanullah Master Flyover. Rahman (2020) showed that flyovers were not effectively attained the motive of reducing congestion in Chattogram city area and they recommended to build low-cost traffic engineering measures to control conflicts between pedestrian-vehicle, vehicle-vehicle. They skipped investigating the Level of Service

(LOS) there. Again Anwari (2018) stated the impacts of Mohakhali flyover on the adjoining roads along with the flyover corridor integrating temporal variation. Rasel (2018) asserted the traffic characteristics on Moghbazar-Mouchak flyover rather than they didn't investigate the congestion over it. Zubayer (2020) blamed the faulty design and short-sighted planning as the cause of increased traffic congestion and non-functionality of the flyover. Previously in Chattogram region research have been done like evaluating lateral strength and safety evaluation of piers of Kadamtali Flyover (Mukhlis, 2017). Also, there is a study of traffic congestion of Chattogram metropolitan city (Robaka, 2013). However, the aforesaid literatures neither dealt thoroughly with the traffic characteristics of the certain flyover intersection accompanying its degree of congestion nor the specified problems in it. So, this paper addresses both the traffic characteristics of Bahaddarhat flyover in Chattogram city and the impacts over it.

Thus, from the above discussion, the following objectives have been undertaken for the present study.

1. To investigate of the existing geometric elements of the flyover intersection.
2. To study the traffic volume at present condition for the verification of geometric elements.
3. To investigate the traffic maneuvering on Bahaddarhat flyover.
4. To find out the causes of traffic congestion over it.

## 2. METHODOLOGY

The present study has been conducted according to the following steps which are presented in the Fig-2 as flow diagram.

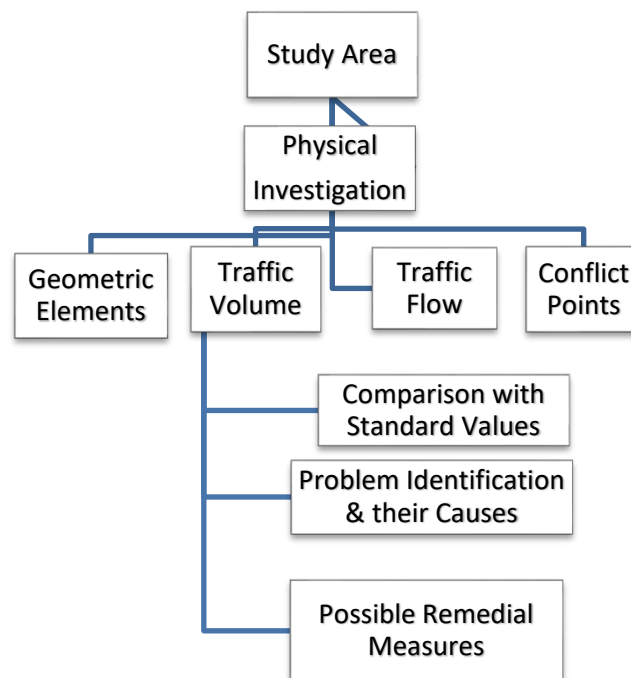


Figure 2: Work Flow Diagram of the Present Investigation

### 2.1 Study Area

Among different intersections of Chattogram city, Bahaddarhat flyover intersection plays a major role for the transportation sector inside the city. It is to be mentioned that no significant works were done at this site in both past and recent years. This intersection has three legs. One western leg goes towards (Muradpur) the interior part of Chattogram city, North-Eastern leg connects Kaptai-Rastar Matha and

the Eastern leg goes towards the tourist district Cox’s Bazar. The location of the study area is also shown in Fig 1.

## 2.2 Physical Observation

The site was physically observed for investigating the existing geometric elements, traffic flow, traffic volume, conflict points, possible causes of traffic congestion at the intersection.

### 2.2.1 Geometric elements

The existing geometric elements of the intersection have been measured physically by a measuring tape and phone apps. It is to assess the adequacy of the total traffic volume which is moving at the intersection. The road width, curve radius, median width, U turn gaps etc various geometric dimensions were taken carefully and accurately.

### 2.2.2 Traffic volume and Traffic flow

For counting the traffic volume on the existing flyover intersection a video camera has been used. Manual traffic counting was done to find out the hourly traffic flow at the selected intersection with left, right turning and straight movement. Traffic data were taken at the peak hours in a whole week. The selected peak hours are 8.30 AM to 10.30 AM and 5.00 PM to 8.00 PM. For different kind of vehicles, counting of traffic has been done separately and then converted into Passenger Car Unit (PCU) to get a detail idea about the traffic flow in all the directions.

### 2.2.3 Conflict point

Among the problem identifications, conflict points play a significant role to understand the traffic congestion and accident over the intersection. According to AASHTO (2001), there shouldn’t be any right turning traffic flow over the flyover. But there are consecutively two right turnings which create conflict there and hamper the traffic flow manoeuvring in all directions. This may cause fatal accident over the flyover.

### 2.2.4 Traffic control device

For proper regulation of traffic on the flyover, it needs a required number of traffic control devices like; pavement marking, direction sign, prohibitory sign, speed limit sign etc.

## 3. PHYSICAL INVESTIGATION

The flyover have been observed physically and perceived components that are described in the subsequent paragraph.

### 3.1 Existing Geometric Elements

The geometric elements of the flyover intersection have been measured physically which is shown in Fig.3 and these elements have been compared with IRC (1976) standard, shown in Table 1.

Table 1: Comparison of carriageway width

IRC,1976		Existing	
Class of road	Width of carriageway	Direction	Existing width of carriageway
Two lanes without raised kerbs	7 m	Towards Muradpur (one way)	6.5 m
		From Muradpur (one way)	6.5 m
Intermediate carriageway	5.5 m	Towards Kaptai (both way)	5.0 m

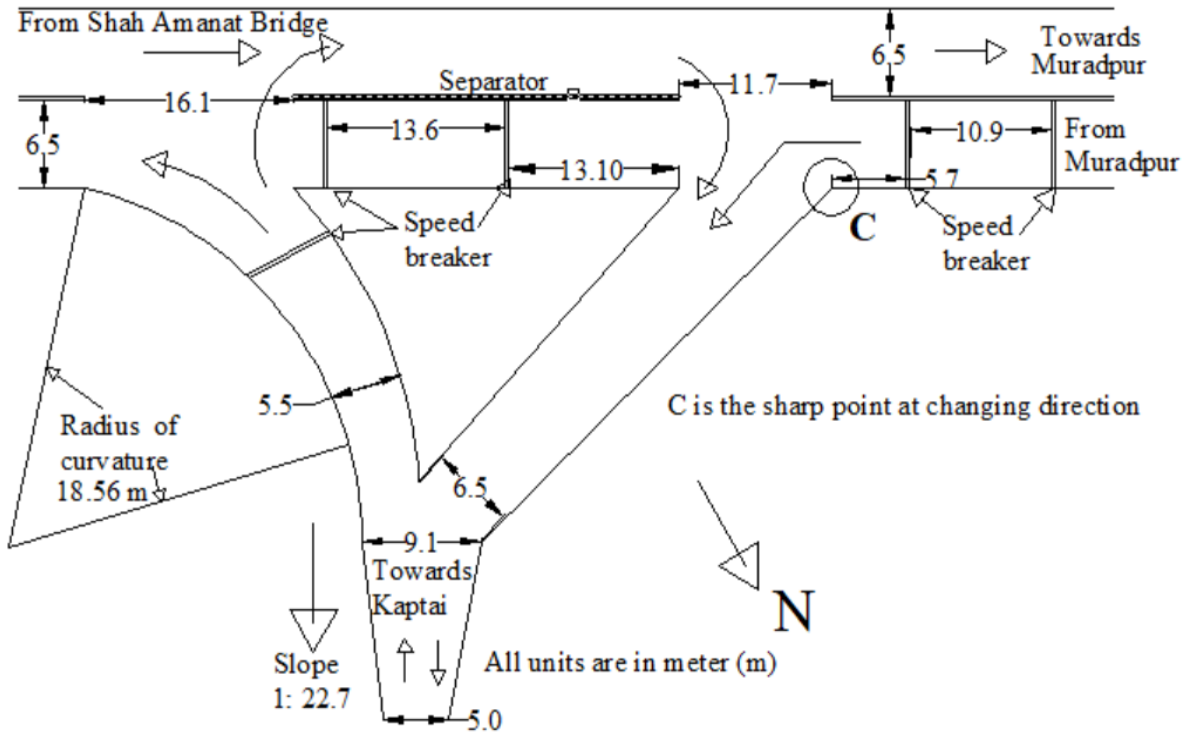


Figure 3: Existing Geometric Elements of Bahaddarhat Flyover

From Table 1, it is seen that the width of the various flyover legs are less than that of the standard width of carriageway and hence eventually congestion occurs over the flyover. Moreover, from Fig 3, it can be observed that (point C) there is a sharp point that can not be desirable at changing direction. It must include a horizontal curve at this C point. Since there is no curve, it may occur any type of accident.

### 3.2 Traffic volume

For the present traffic volume, a video camera has been provided at the top of the intersection during the peak hours consecutively for 7 days. Average traffic volume in PCU per hour alongwith traffic flow composition for different type of vehicles have been provided in Table 2 which are also depicted in Fig 4. Total PCU values also PCU factors as per RHD (2005) have been shown in Table 2.

Table 2: Existing Total Traffic Flow in all Directions

Approach Road ↓	Direction ↓	Average Vehicle/hour at peak									Total Traffic Flow (PCU/hour)
		Truck	Bus	Utility vehicle	Micro bus	Car	CNG	Motor cycle	Cycle Rickshaw	Bullock Cart	
PCU value (RHD, 2005)		3.0	3.0	3.0	1.0	1.0	0.75	0.75	2.0	4.0	✘
From Muradpur Road	Straight	48	05	80	18	125	226	100	00	00	627
	Left	20	02	64	44	106	360	188	00	00	691
From Kaptai Road	Left	03	08	45	06	30	58	25	00	00	176
	Right	10	08	66	40	190	470	220	00	00	868
From Shah Amanat bridge	Straight	35	18	142	30	92	324	200	00	00	816
	Right	8	00	34	00	14	54	46	00	00	147



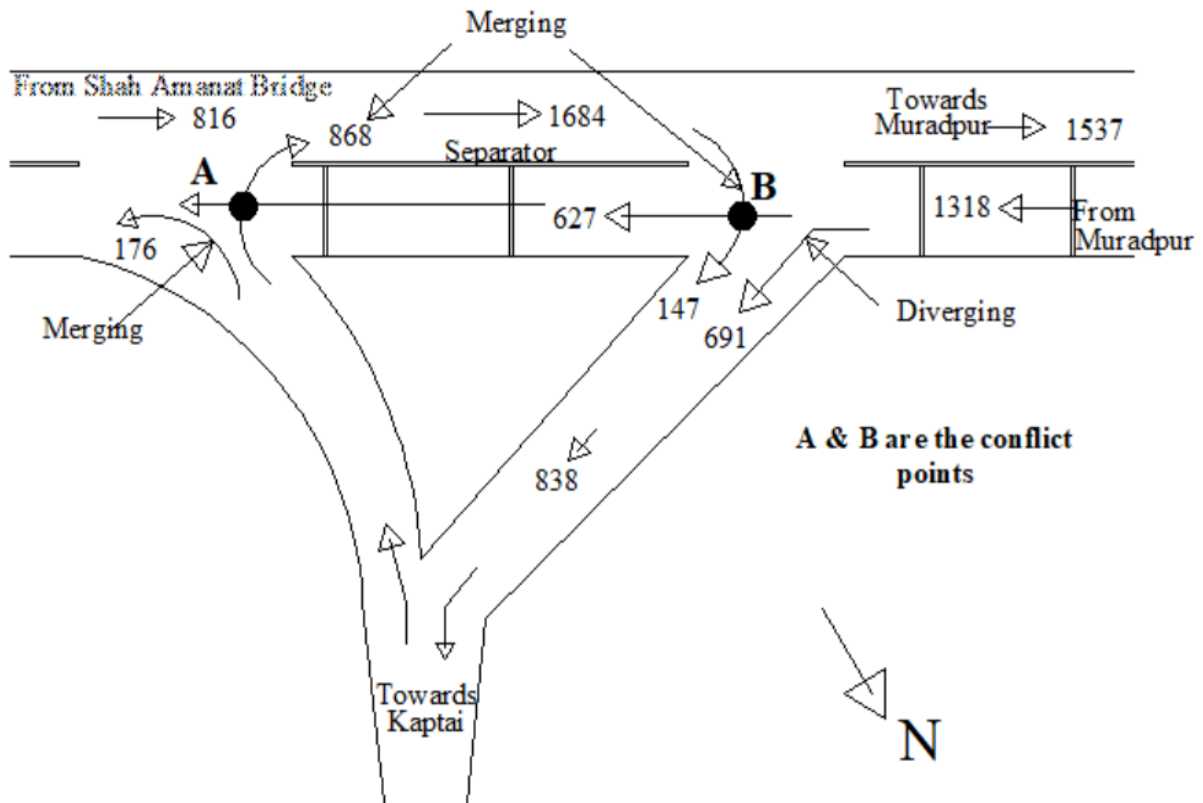


Figure 4: Traffic Volume Distribution at peak

The existing traffic capacities have been compared with the traffic capacities recommended by the U.K Standards which are shown in Table 3.

Table 3: Comparison of the practical capacities recommended by the U.K Standards for Urban roads( H.M.S.O., 1966) with observed values:

Width of the carriageway (m) (H.M.S.O., 1966) →		2-Lane			
		6.0 m	6.75m	7.30m	
Description		PCU/hr (Both directions of flow)			
H.M.S.O., 1966	All-purpose roads with no frontage access, no standing vehicles permitted and negligible cross traffic	1200	1350	1500	
Observed	Towards Muradpur	Dimension	-	6.5m	-
		Traffic	-	1684	-
H.M.S.O., 1966	All-purpose street with high capacity junctions and no waiting restrictions	800	1000	1200	
Observed	Towards Kaptai	Dimension	5.0m	-	-
		Traffic	1882	-	-

From Table 3, comparing existing traffic capacity with the standard values (H.M.S.O., 1966), it has been found that existing capacity exceeds the standard capacity. So the different heavy vehicles like truck, bus when they move together side by side, they can't move easily. That's why frequently traffic jam and head to head collision may occur on the intersection. Such type of example at peak hour can be seen from Fig 5.



Figure 5: Frequent traffic jam on the flyover

### 3.3 Traffic flow and Conflict points

From Fig 4, it can be seen that two conflict points A and B have been observed on the flyover intersection. Which are not desirable. Traffic volume from Muradpur to Shah Amanat bridge i.e. 627 pcu/hr conflicts with the volume 147 pcu/hr coming from Shah Amanat bridge direction to the right turning towards Kaptai. So for this reason, a conflict point B is created there. Similarly, Traffic volume 627 pcu/hr from Muradpur to Shah Amanat Bridge creates another conflict point A with the volume 868 pcu/hr coming from Kaptai direction.

These two conflict points are not desirable according to AASHTO, because of accident may occur at any time while traffic manoeuvring and it will be dangerous not only for vehicles on the flyover but also vehicles and pedestrians at ground level.

### 3.4 Traffic control device

While observing traffic control devices over the flyover, direction signs, some pavement markings are observed but they may not be clearly visible specially after evening. Also there is no prohibitory sign, speed limit sign etc. over the flyover which are very essential for smooth traffic regulation. Direction signs & some pavements markings on the flyover are shown in Fig 6.



Figure 6: Direction signs on the flyover

#### 4. RESULTS & DISCUSSIONS

After visiting the Bahaddarhat flyover intersection physically, all the required traffic data, measurements and some significant photographs have been collected. The measured geometric elements have been compared with the standard values and it has been found that they are significantly less than that of standard values. Also the traffic volume towards various directions are collected to justify the impact of traffic system on the intersection. The conflict points, due to two right turnings, hampered the traffic flow coming from all directions and increased travel time. Heavy vehicles cannot move freely side by side due to low flyover width, especially on the Kaptai direction leg. That's why congestion occurs at the flyover intersection which results a long queue of vehicle in the direction of flow. Also speed breakers have been provided to allow traffic for right turning at the intersection which are not desirable. These speed breakers lower the traffic velocity and traffic capacity, thus, it causes congestion over it. Calculated traffic flow has been further compared with the standard values from H.M.S.O. (1966) and found observed traffic flow are way more from given standards. So, some noteworthy controlling measures have been provided based on the field investigation.

#### 5. REMEDIAL MEASURES

For overcoming the traffic jam & other difficulties created on the flyover intersection following some remedial measures have been provided

1. Right turning traffic flow must be prohibited by providing continuous separator on the Shah Amanat to Muradpur approach leg & all speed breakers must be eliminated from the approach of intersection. Also, a loop can be constructed for single right turning traffic flow purpose.
2. Geometric elements should also be rectified. Only the lighter vehicles can permit for manoeuvring on the Kaptai approach leg before rectification.
3. Traffic control devices that are absent over the flyover should have been introduced properly for traffic movement.

#### 6. CONCLUSIONS

Chattogram is the second largest city of Bangladesh and Bahaddarhat intersection plays an important role for thorough movement of traffic within the city as well as for the . As, this intersection is the three faced junction in Chattogram city, so there is heavy traffic flow from three directions like Cox's Bazar, Kaptai/Bandarban, Chattogram city etc. Bahaddarhat is somewhat densely populated and congested area, that's why this flyover (Grade Separated Intersection) was built to mitigate the congestion. The geometric elements are evaluated and compared with standard dimensions. Existing traffic flow capacity is also compared with standards. Right turnings traffic flow on the flyover intersection must be stopped by providing continuous separator as these can create dangerous conflict points which may result fatal accidents & frequent traffic jam. Otherwise, the aim of constructing flyover at the Bahaddarhat intersection will be failed.

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