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Impact of Traffic Congestion in Roundabout: A study on Gazipur Chowrasta

Md Sifat Bin Siraj[1*], Most. Farjana[2], Motachim Billah[3], Mahadi Hasan[4], Md. Tahatul Azid[5]

[1]*Southwest Jiaotong University, Sichuan, China (sifatbinsiraj@gmail.com)*
[2]*Department of Urban and Regional Planning, RUET, Rajshahi, Bangladesh (farjanaalom384@gmail.com)*
[3] *Department of Civil Engineering, BSMRSTU, Gopalganj-8100, Bangladesh (motachim786@gmail.com)*
[4]*Department of Civil Engineering, DUET, Gazipur-1707, Bangladesh (mahadi.ce.duet@gmail.com)*
[5]*Department of Urban and Regional Planning, RUET, Rajshahi, Bangladesh (litunurp18@gmail.com)*

Abstract

Traffic congestion problems are increasing due to population growth and the production of a large number of vehicles. It is a major problem in most of the city areas of Bangladesh. Major causes of traffic congestion are inadequate mass transit, narrow roads, road blockages, continuous development work etc. This study explores the major causes, problems, and solutions to traffic congestion in Gazipur Chowrasta. Maximum traffic congestion was measured in the Chowrasta to Mymensingh approach and minimum in the Chowrasta to Joydebpur Approach both on weekdays and weekends. About 54% of people lose 4-to-5-hours time daily at this intersection due to traffic congestion. Analysis shows that road blockage is 39% and continuous development work is 35% responsible for traffic congestion in study area. About 55% respondents feel mild mental discomfort, and 49% feel uncomfortable based on their physical comfort due to congestion. Finally, the study presents specific implications for city planners.

Keywords: *Traffic congestion; Roundabout; Gazipur Chowrasta; Physical and Mental Effects; Industrial Zone.*

1 Introduction

Urbanization is a concept that is frequently used nowadays in both developed and developing countries. In developing countries like Bangladesh, where the population is growing rapidly and there are several infrastructure developments projects ongoing, traffic congestion is being given more attention on a national scale (Siraj et al., 2021a, Jianxin et al., 2021, Siraj et al., 2021b, Ahmed et al., 2023). Traffic congestion is a condition in vehicular transport that can be classified as slower speeds with longer travel times and increased vehicular queuing. In this century, many countries have faced traffic-related problems especially in developing countries. In Bangladesh, traffic congestion is a common phenomenon in almost all the cities (Hossain et al., 2021). Like other countries in the world, Bangladesh is experiencing traffic problems that are gradually increasing day by day. Every day thousands of people lose not only their valuable time but also their health. However, the current study aims to evaluate the traffic congestion and its causes and effects and propose solutions in the Gazipur Chowrasta. Gazipur city, the main study area, is situated in the centre of Bangladesh. This is the busiest and most significant route connecting Dhaka with north Bengal(Islam et al., 2022). The population of Gazipur City is constantly growing, resulting in an increasing volume of vehicular traffic, particularly in Gazipur Chowrasta (Hossain et al., 2020, Ahmed et al., 2020). Minimizing traffic congestion is essential for improving air quality, strengthening the economy, increasing fuel efficiency, saving time and money, enhancing safety, and lowering greenhouse gas emissions. Different types of vehicles, particularly motorized and non-motorized types, are used in the transportation sector (Siraj et al., 2023, Siraj et al., 2022) of the metropolitan area of Gazipur. From this study it is seen that inadequate manpower, poor traffic signals, overtaking, and many other factors are important causes of traffic congestion.

With an estimated population of almost 4 million in an area of about 329.23 square kilometers, this city is at risk of rapid population growth because of urbanization (Hossain et al., 2019). This atonement of population is making life repellent on the roads of Gazipur Chowrasta during the crowded hours due to traffic congestion. However, several investigators have been identified who have carried out various studies on traffic congestion. But very little research has been identified in the study area. As a result, the current investigation will assist in determining the primary causes, difficulties, and possible solutions to traffic congestion in Gazipur Chowrasta. The main objectives of the research are to evaluate the traffic contestation of roundabout. However, the secondary objectives are,

a) To find out the present condition of traffic congestion and mark down the reason behind traffic congestion.
b) To identify the physical and mental effect of traffic congestion.
c) To find out the possible solution for the problem.
A number of significant studies have been done on traffic congestion issues in developed and developing countries. But few studies have been conducted in developing countries, where most of them are in major cities and towns. The study aim is to find out suitable solution for Gazipur Chowrasta. Hence, this study will help to increase mobility in roundabouts, especially in Gazipur Chowrasta which is considered the industrial hub in Bangladesh.

2 Study Area and Methodology

The study was conducted in Gazipur Chowrasta, Bangladesh. Gazipur is considered the industrial hub of Bangladesh where several industries, government and non-government offices and several education institutions. Gazipur district is located between 23°53′ and 24°21′ north latitudes and between 90°09′ and 92°39′ east longitudes (Fig. 1) which is in the centre of Bangladesh (Hossain et al., 2019). The study roundabout is located at 25km distance form Dhaka city. The roundabout is essential for trying together Bangladesh's main regions. (North, North-East, North-West).

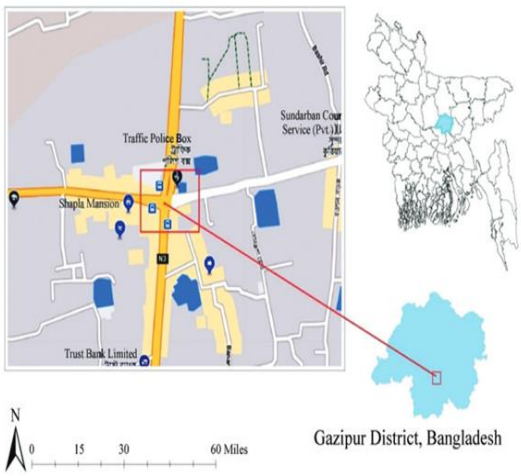


Fig (1): Topographical view of the study area.

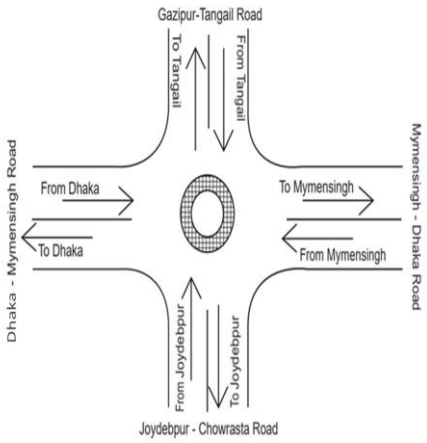


Fig (2): Gazipur Chowrasta roundabout.

First of all, the methodology of this study is based on previous literature. Secondly, the methodology starts with problem discovery and preparing research questions. Thirdly, defining an objective that is related to the traffic congestion problem. Fourthly, data collection included primary (field visits) and secondary surveys (data collection). The inventory survey includes important locations in the locality and some opinions of the local people about the study area which helps to make the final questionnaire survey form. All data were collected by employing 20 surveyors on weekdays and weekends from 6 am to 12 am. The survey was done by taking interviews with different vehicle drivers and travellers. Almost 375 data were collected which include the causes and problems of traffic congestion. The area is divided into four portions (1: Joydebpur Approach, 2: Tangail Approach, 3: Mymensingh Approach, 4: Dhaka Approach) for the betterment of the study. The data was collected from 6 am to 3 pm and 3 pm to 12 am respectively. Finally, the survey data is analysed and visualised. The final recommendation is based on the outcome of the study.

3 Data Analysis

3.1 Based on Demographic Characteristics

The demographic characteristics of the respondents for passenger profiles are shown in Table 1. The total number of respondents in this survey was 375, with approximately 44% being male and 56% being female. According to age categories, 54% of respondents are between 14-30 years old, and 22% are between 31-40 years old (Table 1). Based on occupation, 28% of respondents are found as students and 27% are found as service holders. Based on respondents' education level, higher-educated persons are found in 45%, secondary-educated persons are found in 20%, and 14% are found uneducated. Income level between 0-8000 BDT was 35%, between 8000-15000 BDT 31%, and more than 40000 BDT 5%. Travel frequency (week) 1-4 times 59% and 5+ times 41%.

Table 1: Demographic characteristics of respondents

Demographic classification	Passenger profile	%
Gender	Male	44
	Female	56
Age (Year)	14-30	54
	31-40	22
	41-50	14
	>50	10
Occupation	Student	28
	Service holder	27
	Business	15
	Daily labour	21
	Housewife	2
	Unemployed	3
	Other	5
Education	Primary education	13
	Secondary Education	20
	Higher Education	45
	Uneducated	14
	Higher secondary	8
Income level (BDT)	0-80000	35
	8000-15000	31
	16000-25000	17
	26000-40000	12
	>40000	5
Journey frequency (week)	1-4 times	59
	5+ times	41

3.2 Hourly Queue Length

In Table (2), it has been shown that, the maximum queue length in the C to D approach was 16769 feet at 8-9 am on weekdays, and the minimum queue length was found at 11-12 am. Again, the maximum queue length was 7679 feet at 5-9 pm and the minimum was 971 feet at 9-10 pm respectively in C to J approach. In the C to M approach, the maximum queue length was 20754 feet at 8-9 pm and the minimum was 971 feet at 9-10 pm. In C to T approach, the maximum queue length was found to be 9339 feet at 8-9 pm and the minimum was found in 1181 feet at 9-10 pm. However, overall traffic intensity exceeded roadway capacity and created huge congestion in all approaches.

Table 2: Weekdays hourly queue length in Gazipur Chowrasta.

Time	C to D	C to J	C to M	C to T
6-7 am	4242	1943	5250	2363
7-8 am	4666	2137	5775	2599
8-9 am	5133	2350	6353	2859
9-10 am	5646	2585	6988	3144
10-11 am	6211	2844	7687	3459
11-12 pm	6832	3128	8455	3805
12-1 pm	7515	3441	9301	4185
1-2 pm	8266	3785	10231	4604
2-3 pm	9093	4164	11254	5064
3-4 pm	10002	4580	12379	5571
4-5 pm	11453	5245	14175	6379
5-6 pm	12599	5769	15593	7017
6-7 pm	13859	6346	17152	7718
7-8 pm	15244	6981	18867	8490
8-9 pm	16769	7679	20754	9339
9-10 pm	2121	971	2625	1181
10-11 pm	2333	1068	2888	1299
11-12 am	2566	1175	3176	1429
*Queue length in feet				

C= Gazipur Chowrasta, D= Dhaka Approach, J= Joydebpur Approach, M= Mymensingh Approach, T= Tangail Approach.

From the analysis, the maximum queue length was measured at 8384 feet at 8-9 pm and the minimum was measured at 1061 feet at 9-10 pm in C to D approach in weekends. In the case of C to J approach, the maximum queue length was measured at 3839 feet at 8-9pm and minimum congestion length was measured 486 feet at 9-10pm in weekends. Queue length was maximum (10377ft) at 8-9pm and minimum (1313ft) at 9-10pm in D to M approach. From the analysis, it is found that the measured queue length was maximum (4670ft) at 8-9pm and minimum (591ft) at 9-10pm in C to T approach in weekends. Traffic volume is lower on weekends compared to weekdays, which is why traffic congestion is comparatively lower on weekends. However, the overall average queue length was maximum in C to M approach and minimum in the C to J approach on weekends (Table 3).

Table 3: Weekends hourly queue length in Gazipur Chowrasta.

Time	C to D	C to J	C to M	C to T
6-7 am	2121	971	2625	1181
7-8 am	2333	1068	2888	1299
8-9 am	2566	1175	3176	1429
9-10 am	2823	1293	3494	1572
10-11 am	3105	1422	3843	1729
11-12 pm	3416	1564	4228	1902
12-1 pm	3757	1721	4650	2093
1-2 pm	4133	1893	5115	2302
2-3 pm	4547	2082	5627	2532
3-4 pm	5001	2290	6190	2785
4-5 pm	5727	2622	7088	3189
5-6 pm	6299	2885	7796	3508
6-7 pm	6929	3173	8576	3859
7-8 pm	7622	3490	9433	4245
8-9 pm	8384	3839	10377	4670
9-10 pm	1061	486	1313	591
10-11 pm	1167	534	1444	650
11-12 am	1283	588	1588	715

*Queue length in feet
C= Gazipur Chowrasta, D=Dhaka Approach, J=Joydebpur Approach, M=Mymensingh Approach, T=Tangail Approach

3.2.1 Comparison of weekdays and weekends queue length

The comparison between weekdays and weekends traffic queue length is illustrated in Fig (3) and Fig (4) measured in kilometres. It shows that weekdays queue length is greater than weekends queue length. The maximum queue length was found from 7 to 9 pm both weekdays and weekends. Which means that all people try to leave Gazipur to Dhaka early in the morning but most of the office close time is between 7 to 9 pm which causes massive traffic congestion. The traffic flow at night is normal and congestion problem is comparatively low.

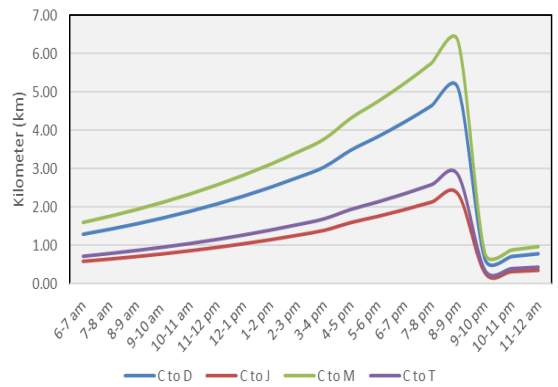


Fig (3): Weekdays traffic flow

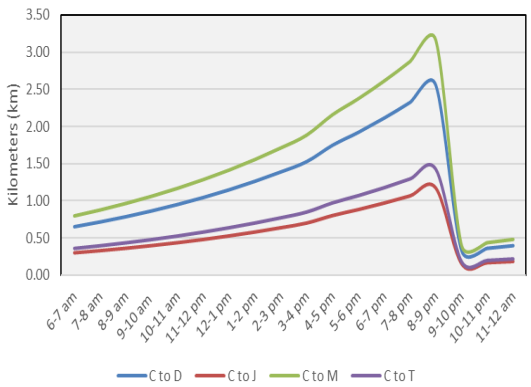


Fig (4): Weekends queue length.

3.3 Time Waste Due to Traffic Jam

Everyday 5 million working hours lost due to traffic congestion only in Dhaka city (Siraj et al., 2021b). Gazipur Chowrasta rises as the foremost affected area due to increasing rapid urbanization. The time waste distribution indicates that crossing the intersection can take several hours, with 64% are experiencing less than an hour of waste, 27% are facing 1-2 hours, and 9% enduring over 2 hours. The amount of waste hour is varied with different time. Like the waste is maximum in peak hours and minimum in off-peak hours.

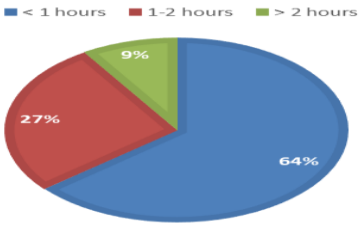
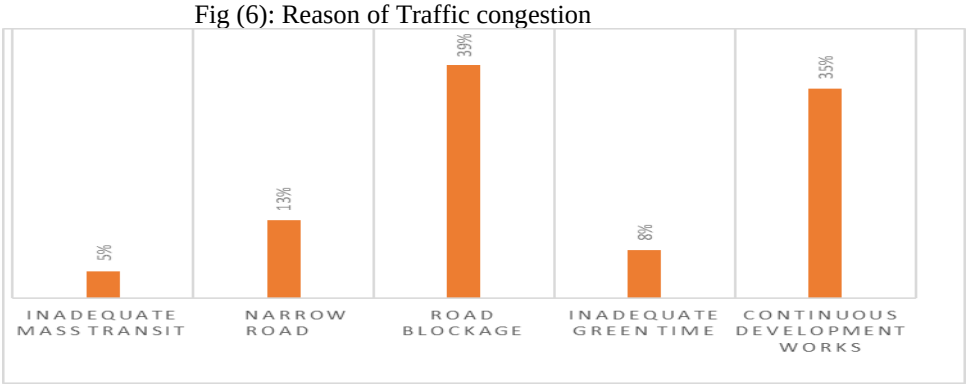


Fig (5): How many hours waste due to traffic jam

3.3.1 Reason of Traffic Jam

Analysis shows that, main reason for traffic congestion is road blockage which is about 39%, continuous development works are 35%. One of the main reason for traffic congestion in Bangladesh is continuous development work on road way. Narrow road is 13% responsible for traffic congestion (Fig. 6). It indicates that massive loss is occurred due to development projects and road blockage.

Fig (6): Reason of Traffic congestion



3.4 Physical and Mental Discomfort for Traffic Contestation

Travelers are found those are feeling physical and mental discomfort due to traffic jams. In the case of mental discomfort, 55% feel mild, 16% feel distressing, 15% feel uncomfortable,16% feel distressing and 10% feel severe. Based on the physical discomfort 49% feel uncomfortable, 20% mild, and 20% distressing. It indicates that passengers in vehicles suffer lots of problems due to traffic congestion (Fig. 7).

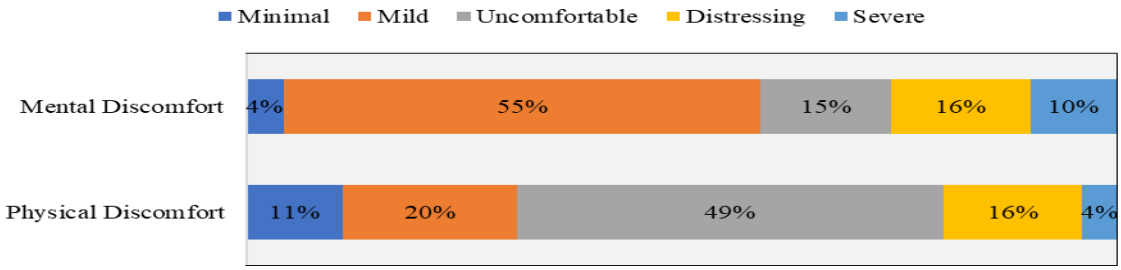


Fig (7): Physical and mental discomfort for traffic contestation

4 Conclusions

Gazipur is one of the major industrial hubs of Bangladesh. Basic employment has been increasing which acts as a push factor of migration. Non basic activities also have been increasing which attract huge number of people to this place for employment and investment. New facilities and land-use change generate a large number of trips. It has a direct impact on the intersection along the road. Negative impact like congestion causes both physical, social and economic loses. It is considered as the busiest interests. Some participants respond for general consideration like impact of congestion at chowrasta which is responded as negative impact on them by mainly

economically. They couldn't reach their workplace timely and most often need to pay for it. On weekdays the queue length is maximum from Gazipur Chowrasta to Mymensingh approach (20754 feet at 8-9 pm) and lowest from Gazipur Chowrasta to Joydebpur approach (971 feet at 9-10 pm). And for the weekend it has found maximum from Gazipur Chowrasta to Mymensingh approach (10377 ft at 8pm-9 pm) and minimum from Gazipur Chowrasta to Joydebpur approach (534 feet at 10pm-11 pm). At evening peak period maximum congestion has been noticed as all offices are closed. People and freight vehicle star to move and volume to capacity of intersection decreased. The main reason of traffic congestion at Gazipur Chowrasta are road blockage 39%, continuous development work, and the presence of narrow roads. This congestion leads to an impact on mental and physical condition. People lose their workability with proper concentration. Govt. authority along with NGO should come forward to make the traffic flow smoothly.

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