

# A Case Study on Reduction of Traffic Congestion of Dhaka City: Banani Intersection

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**Abstract**— These Intersection is a composite region of a road section where vehicles can resolve to divergent directions. Traffic flow at any intersection of an urban road has always been an entangled nonlinear process. Aggregation at intersections is an enormous problem in Bangladesh for right evolution of economy and society. So upgrading to a medium income country from low income country will not be accomplished for Bangladesh unless we engage proper traffic management at intersection. But due to scantiness of funds and proper knack it's a light in the far sky. Ever growing traffic volume and manual system of controlling intersection kills a lot of working hours of the road users of the megacity Dhaka because flow from different locations share common spaces at a time and traffic budge like a stop and go situation. Government along with foreign expertise have tried to improve the scenario by constructing flyovers, implementing time controlled automated traffic signal lights, banning rickshaw movement in VIP roads but none has ensured direct access whole over Dhaka city. This paper points out on the fact of reduction of congestion through existing roadway conditions and features because intersections are an integrated element of traffic system and can bring effective contribution in reducing vehicular delay. We considered all major intersections of Dhaka city for our research purpose but will present our research findings of kakali/banani intersection. As banani intersection is the heart of Dhaka road network system, that's why for this study it is chosen. Like other intersections at Dhaka city it follows the all way stop control intersection resulting in a huge congestion of vehicles at peak hours which makes it almost impossible for the traffic police to control the vehicle flow in a nimble way. 12 feet width lane, every passenger car in traffic stream and stop of right and left turning are ideal condition for an intersection. According to this ideology right turn will be allowed only for few locations of our proposed area, so that through movement at mahakhali flyover and banani intersection never get interrupted. By the study, it is identified it will reduce waiting expectancy and increase travel length. As we considered existing road network it will save our country from huge amount of loan installment and will improve mental behavior of driver as we prefer to travel long distance without any stopping. This will ensure optimum use of resources and will improve the transportation system of Dhaka city.

**Keywords**— Existing roadway, intersection, traffic congestion, travel length.

## I. INTRODUCTION

Transportation system provides the way for movements and

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medium for reaching destinations, Deficient transportation system not only creates barriers to economical events but also obstruct the development. As the developing countries are facing overpopulation and poor economic condition, they also need to develop their economic activities to face the need of the extra population and for this reason they need to have good transportation facilities. Due to failure of the authority to cope up with the problems of the city area, they go for unplanned solution triggers traffic problems and environmental degradation. A part of our life, motor vehicles have placed their selves in a position that we cannot ignore their benefit in our daily life and nevertheless the consequences of using them. Inhabitant of urban areas spend their most of the time by roaming between workplace and home [1]. Although the invention of these motorized vehicles was to help us travel a long distance in a short period, with the passage of time they have become the reason for our delay in reaching our destined places. Planning and management of urban road networks is very important. In every cities of Bangladesh, traffic congestion is a common problem. Major metropolitan cities like Dhaka, Chittagong, Khulna and Rajshahi are facing this problem, especially in Dhaka it turns out as a great problem besides basic demand scarcity [17]. Traffic congestion or traffic jam is the byproduct of using motorized vehicles. Traffic jam is created when the vehicles do not move for a long time [2]. We kill most of our time stuck in the traffic jam. If we consider local and international traffic situation, we will observe that almost every county developed or under developed suffers a lot due to traffic congestion. Traffic jam has become the major global and commonly faced problem for both develop and under developed countries [3]. In the urban areas, traffic congestion is much common scenario than rural areas. For the people living close to the roads and for the travelers, traffic congestion is disturbing as well as potentially dangerous. Traffic congestion is the result of gap between transportation demand and supply [4]. We may say, traffic jam is killing our time only but that will be wrong. Traffic congestion can be held responsible not only for harming our health but also for not gaining full potential in our economic sector. Transportation system has now become the spider that is sitting in the center of a development web in which every web string controls almost every development process of a country. Traffic congestion is an obstacle for development of any country as it creates a huge amount of economic costs, discomfort cost and furthermore alike [5]. Because of traffic congestion, companies that are related with public transport system cannot achieve their targeted profit. From a survey on Ireland based company called

Bus Eireann, this company is losing €18 million annually just because they cannot adjust their timetables due to the increased traffic congestion [6]. A country can be judged by the condition of their transportation system. Because a country that has developed its economy has more improved transportation system than the country that is trying to improve itself economically. With the increasing demand and vehicle, any intersection meets its full capacity. Therefore, vehicles have slower speed and longer travel time that leads them forming queue. This is known as traffic snarl-up or traffic congestion. If we observe current situation of traffic congestion across the world, we will be alarmed by this fact that both developed & under developing urban countries around the world is suffering from this curse. For instance, traffic circumstances at Bangkok has been attaining inferior scenario since the government announced a policy to refund tax for first time car buyers. The policy which coupled with Thai aspiration to have own car and get some social value generates five million vehicles in a city which can only cope with less than two million cars. The people living in Jakarta, Indonesia have their own word for traffic jam the inevitable ‘‘macet’’. It takes about 90 minutes to two hours to cover twenty to twenty-five kilometres. Their insufficient bus lanes contribute to traffic congestion by bottlenecking intersections and reducing road space while moving comparatively small numbers of people [7]. Transportation Institutes 2011 mobility report, congestion in US has increased corporeally over last 25 years with elephantine amounts of losses pertaining to time, fuel and money. Sao Paulo, Brazil is known to endure the world’s worst traffic jams where people are perplexed for two or three hours every day in traffic jam [8]. It is so far seen that many critical congestion areas in developing region have poor traffic management systems that if any of these hits a congestion, the road network can result in a massive traffic jam for elongated time periods. Work organization faces problems from their workers due to frequent traveling between workstation to house include lateness, absenteeism, more turnover, less employee performance and added cost in the budget. In this economy based society, progress of any organization depends mostly on the performance of the employees. If they can work in their full potential level then that organization is bound to achieve its targeted progress, otherwise it is not possible. We can figure out the picture of relation between economy and employees. The confederation of British Industry of UK notified that 200 million days were wasted as a result of illness in 1998 costing \$10.2 million to industry [9]. A study on southern large cities of Sweden shows that noise pollution created by traffic congestion has become one of the major problems for the inhabitant of Sweden [10-11]. Therefore, if the employees have healthy condition in both physically and psychologically then it will be easier for the organization to reach to its success and in a way, it will help the country to progress. The swift and enduring development has triggered in extreme levels of traffic congestion and extraordinary hassles on infrastructure and service provision within the country’s urban areas. As for megacity like Dhaka, the 10th most populous & 26th mega city, has an annual growth rate of 8.2% for freight transport and

8.4% for passenger transport. Bangladesh has become one of the most densely populated countries occupied by 993 people per square kilometer [12]. As it is a developing country, usage of motorized and non-motorized vehicle is increasing day by day. Traffic problems have become far more dangerous as well as tormenting subject in the cities of Bangladesh. Let us have a look on the usage of vehicles mentioned in STP survey, 7% of householder access or can access to a car, 4% of them have motorcycle, 3% have access to cycle rickshaw, 5% have access to bicycle and 2% have access to auto rickshaw [13]. Both cycle rickshaw and auto rickshaws are used for commercial purposes. This survey also shows that 84% of household use public transportation as do not have their own transport vehicles and 16% use their own transport vehicles. From these usage values, we can understand how much people are dependent on and importance of the public transport system. So it is easy say that the capacity of the existing road is not enough to bear the increased amount of private and public transport. The cost of Dhaka traffic congestion is estimated as \$3.8 billion a year. According to DTCA, this city with more than 15 million people which makes around 25 million daily trips demands in the city [14]. Several steps have been undertaken to reduce the traffic congestion of Dhaka city like imposing restriction on the entrance of trucks in Dhaka during daytime, banning rickshaws in different roads, changing the time table of the trains, changing the lanes of public-private transport, rather than impose force to use zebra crossings, constructions of less number of flyovers, overpasses and so on. None of them have been proven fruitful for the city so far. A question may be asked if whether it is actually possible to decorate Banani as well treated zone and to make a free flow in between main Banani-Kakoli intersection. If we take a short look of Banani itself, we see that Dhaka cantonment area is a model of well-ordered community, sidewalks, road markings, traffic signs, and others. We cannot deny that Dhaka is one of the top ten worst cities of the world and traffic congestion is a big factor behind of this scene [15]. In this regard it is important to understand the reasons for ongoing congestion and the procedure to lessen it. Upgrading new transport routes for more efficient use of limited space is critical for ensuring people’s mobility, improving their quality of life and boosting economic growth. Traffic congestion is consuming our valuable time that later lessen our economic progress. Country wise annual economic loss had become USD 79 million for the year 1997 [16]. In Bangladesh, annually USD 3 billion and daily over 8 million work hour is wasted due to traffic congestion [17]. Bangladesh can neither afford the economic loss nor environmental loss because of traffic congestion as it is a developing country [3]. However, capacity of existing road can be folded and performances of the arterials can be augmented through proper traffic management. This paper will further discuss about the reasons for this habitual bad trend of congestion and suggesting some practical policies the authorities would have implemented to reduce the level of traffic at Banani-Kakoli section area as a pilot project. If it becomes fruitful then it can be implemented for other important intersections for a better traffic system within our limitations

and very low cost.

Although a modern city should have 25 percent road area of its total terrestrial, Dhaka has merely 7 percent [13]. But the crucial fact is that roads carry over 80 percentage of countrywide traveller who provide the backbone of the transport sector in this country of approximately 160 million people [18] and so far Dhaka is not independent of this curse. A 2009 World Bank analysis found sixty separate bus companies in Dhaka. Every year, Dhaka adds an extra 37000 cars to its already beleaguered road. At present Dhaka roads have been carrying 948883 registered different types of motor vehicles and the system has also danger number of amounts non-registered motor vehicles [19]. This city is facing deficiency of road alignment as it has no road network pattern, no through and by-pass road, no ring or distributor road, no principle arterial for inter district through traffic movements etc. Only 9 percent of roadways and 6 percent of pavement area is available, in which 62 km functional primary and 108 km secondary and 221 km connector road serve the city transport service [20]. So mentioning the circumstances the traffic congestion is a must curse for Dhaka city that hampering the economy, environment, health and society. Constructing new roads is not an option. Because if somehow traffic jams are reduced, soon the number of vehicles will increase and same problems will show up again at least as bad as they originally were. So different solution has to be considered. This paper contains the solution with improving the existing road network facilities only.

## II. TRAFFIC CONGESTION SCENARIO OF BANGLADESH

The present passenger transport scenario of metropolitan Dhaka shows existing facilities are inadequate to keep pace with running population. Moreover, the traffic system of the city is non-sustainable. The major share of road space remains occupied by the small capacity vehicles which subsequently has amplified traffic congestion, travel delay and accidents. The total road network is 3000km (with only 450km primary and secondary/collector roads). The non-existence of qualified traffic engineering professionals is also a great barrier in this city traffic management. It is observed that bus traffic in Dhaka is on a level of baby compared with other cities. Today's bus operation in Dhaka is characterized with the existence of 750 individual bus owners [21]. There is lack of coordinated control of buses and no route commitment resulting in time wasting, aggressive competition on roads, rough behaviour of bus crews, unsafe driving practice, dangerous boarding and alighting by passengers in the middle of roads, nosing of buses etc. are the daily happenings of Dhaka city. This is the true scenario of bus transport in Dhaka. Our drivers are not capable enough to understand traffic signs, warning signs, informatory signs etc. Most of the cars are driven by local drivers. So uneducated drivers are a big problem. The another common scenario causing traffic congestion is illegal car parking as the space a car takes in the roads which serve for only one passenger benefits. Road space is also wasted when drivers (cars or buses) drop people off, return home, then pick them up again; the distance travelled is twice that required. All these causes lead to

the traffic congestion. Moreover 70 percent of trips in Dhaka are short trips, most of them of less than two kilometres [22]. Another common fact is that roads are not designed and constructed through proper planning and engineering survey. Eventually when planners design, they have followed the optimal scale and pricing for picking the functional form used to describe the relationship concerning highway speed and roadway traffic volume. This congestion relationship is a crucial empirical fact for planning [27]. While past work has posited a variety of speed-volume models, no successful efforts have been made for comparing the specifications. Roads are wide enough in respect of its use but cannot use it properly due to proper planning and lack of coordination of engineering survey [23]. In Banani-Kakoli traffic condition varies with time. Illegal parking, pedestrian movements, high traffic volume lead to rush traffic in busy hours; wasting their precious hours and they have to do nothing. The traffic system of the city has already collapsed as the vehicles can't run on the main roads of the city due to congestion specifically school going students, old people faced trouble due to disorderly movement of vehicles. Despite initiatives taken by authorities, but the municipality are still blocked by traffic jams. The main factors involved with complex pattern of road network and heavy concentration of vehicles, absence of adequate public transport, insufficient road frame, out of order signing equipment and poor enforcement of traffic rules [30].

## III. STUDY AREA

In Dhaka, intersections have been constructed to reduce travel time at several locations. However, with the growing population, number of transportation mode has also increased. Increased mode of transportation is the main reason behind increased congestion. From the study, it has been observed that intersections are one of the most hazardous locations responsible for causing injury in the past nine years and becoming a common scenario for developing country like Bangladesh [24]. Therefore, it is a crying need to reduce the number of intersections for avoiding accidents and congestion problem at those points. When a traffic congestion is recognized then the travelers will try to a dig out a way where travelling time becomes shortest.

For our study, we have selected Banani-Kakoli intersection. This is one of the busiest intersection in Dhaka. It is the meeting place for vehicles that are coming from Mohakhali, Tongi, Gulshan and Banani DOHS. It acts as the common intersecting point among three commercial zones (Mohakhali, Tongi and Gulshan) and one residential zone (Banani DOHS). Congestion at this location occurs due to the vehicles that tend to travel to these commercial locations mainly. Left turning and right turning movements occurs more acutely in these locations, which is the seed of all congestion problems. Our study will further discuss about these problems and the way to reduce the traffic congestion at this point.

TABLE I: LOCATION OF STUDY AREA



Fig. 1: Congestion at the Banani- Kakoli Intersection (Source: bdnews24)



Fig. 2: Banani-Kakoli Intersection (Source: Google map)

IV. PROBLEM IDENTIFICATION

In any intersection, the usual scenario is that vehicles are coming from all direction. If we analyse intersectional congestion, we can determine the causes for the congestion. Vehicles, which are trying to make U-turn, are responsible for causing traffic congestion at the intersection. Again, vehicles making left or right turn can also be held responsible for causing congestion. For both cases, reason behind the congestion is slowing down of the vehicles. We can see that these are the two types of problem, which are directly responsible for causing congestion at the intersection. Depending on these two facts, we can divide the flow pattern into three groups. They are: Merging Flow, Diverging Flow & Intersecting Flow. Alongside with the vehicles movement, pedestrian also contribute for generating congestion. We can mark them as the indirect but very important fact for traffic jamming. Through the analyse of the study area, Banani-Kakoli intersection, we can identify the similar types of problem that are responsible for creating traffic jam at the intersection.

By studying vehicle movement at the Banani-Kakoli intersection, we can identify five points where vehicle flow merges. First one is at the Masjid road where vehicles arriving from Mohakhali route take left turn and enters Masjid road. Second one occurs where vehicles from Kamal Ataturk Avenue crosses Dhaka-Mymensingh Highway and takes right turn to enter Tongi route. At the third point, vehicles from Masjid road takes left turn and enters Tongi route. At merging point four, vehicles from Tongi route, Kamal Ataturk Avenue and

Mohakhali route meet. Vehicles moving towards Tongi route makes U-turn at the intersection to enter Mohakhali route. Again, vehicles from Kamal Ataturk Avenue takes left turn to enter Mohakhali route via Dhaka-Mymensingh Highway and merges with the incoming vehicle flow from Tongi route and vehicles moving straight towards Mohakhali route. At the last merging point, vehicle flow from Tongi route to Mohakhali route merges with the flow from Kamal Ataturk Avenue in which vehicles takes left turn to enter Mohakhali route.

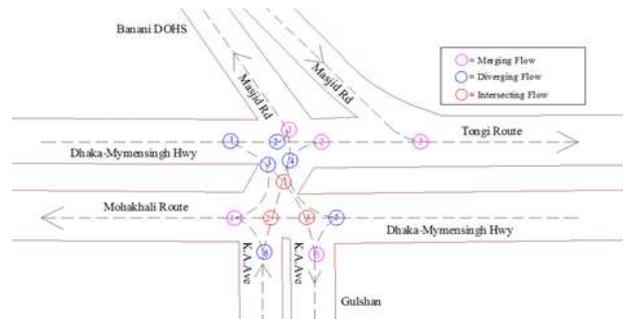


Fig. 3: Vehicle flow pattern at Banani - Kakoli Intersection

In case of diverging flow, we can locate six points where flow diverges. First one is located in the Tongi route where flow divides into two sections. One portion remains to move straight and other takes turn and enter Mohakhali route. Vehicle flow that enters Mohakhali route can be divided into two part. One part of the flow makes U-turn and move straight towards Mohakhali and the other part of the flow crosses the Dhaka-Mymensingh Highway to enter Kamal Ataturk Avenue. These two flows are the part of divergent flow positioned at point 3. As for the divergent flow at point 2, one portion of vehicle flow takes left turn and enters Masjid road. Other portion keeps moving in the straight direction. We can point out two divergent point, point 4 and point 6, for the vehicles that are coming out from Kamal Ataturk Avenue. For divergent point 6, vehicle flow divides into two portion. One portion takes left turn to enter Mohakhali route and the other portion crosses Mohakhali route to enter Tongi route. Vehicles entering Tongi route then gets divided into two portion. One portion enters Masjid road by crossing Dhaka-Mymensingh Highway. Other portion of flow takes right turn and enters Tongi route. This dividing point of flow is denoted as divergent point 4. As for the last divergent point, point 5, one portion of vehicles of Mohakhali route takes left turn to enter Kamal Ataturk Avenue, other portion makes U-turn to enter Tongi route and the rest keeps moving in the straight direction following Mohakhali route.

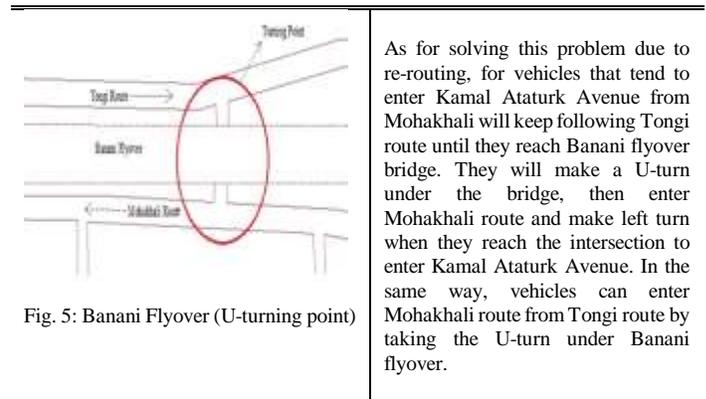
From the vehicle movement flow diagram, we can locate three points where flows intersect. First two intersecting point is created because of those vehicles which are crossing the Mohakhali route to enter Tongi route. Vehicles, which enter Tongi route by taking right turn from Kamal Ataturk Avenue and crossing the road, intersect with the vehicles that are tending to make right turn from Tongi route and cross Mohakhali route in order to entering Kamal Ataturk Avenue. This is the first intersecting flow point. For second intersecting

flow point, vehicles from Kamal Ataturk Avenue while crossing Dhaka-Mymensingh Highway to enter Tongi route intersects with the vehicles that are approaching from Mohakhali route. In case of last intersecting flow point, point 3, vehicles from Tongi route make right turn to enter Kamal Ataturk Avenue and cross Mohakhali route and so intersect with the vehicles of Mohakhali route that tend to move straight.

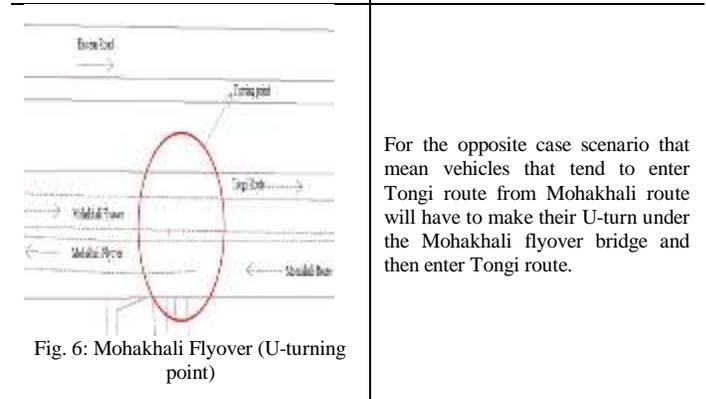
Let us consider one side of the Dhaka-Mymensingh Highway, suppose Tongi route, in which vehicles are moving from Mohakhali to Tongi, for showing the reasons behind congestion formation at the intersection. In Tongi route, from the vehicle flow diagram we can observe that one portion of vehicles that are making U-turn leads to making queue when the straight movement is allowed on the other side and U-turn is delayed for the time being. This queue formation hampers straight going flow as the vehicles that tends to make U-turn begin to occupy most of the portion of the road. This queue is formed not only due to the vehicles that tend to make U-turn but also for the vehicles that wants to make right turn for entering Kamal Ataturk Avenue. Vehicles that wants to make left turn also hampers straight movement as they form long queue when the train passes and crossing the railway is prohibited for that time. The vehicles that are making U-turn to enter Tongi route from Mohakhali route also hamper forward movement. The last but not least vehicles that are making right turn from Kamal Ataturk Avenue to enter Tongi route hamper straight movement in Tongi route. Therefore, we can conclude that, vehicles that are making U-turn, right turn and left turn are the main causes behind forming queue at the intersection which ultimately leads to forming congestion.

V. SOLUTION

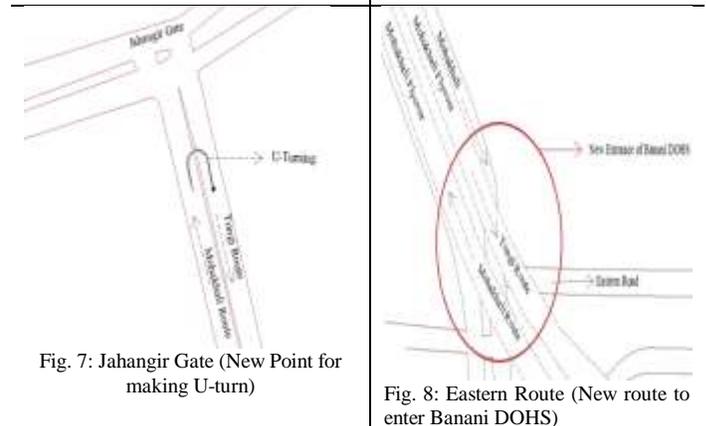
For lessening traffic congestion, there are two ways and they are: i) increasing road capacity and ii) lessen the traffic demand [25]. It is possible to increase road capacity by affixing more capacity along the route or at bottlenecks, making new routes and betterment of traffic management[30]. From these two statement, we are able to point out the solutions for reducing traffic congestion at Banani-Kakoli intersection.



As for solving this problem due to re-routing, for vehicles that tend to enter Kamal Ataturk Avenue from Mohakhali will keep following Tongi route until they reach Banani flyover bridge. They will make a U-turn under the bridge, then enter Mohakhali route and make left turn when they reach the intersection to enter Kamal Ataturk Avenue. In the same way, vehicles can enter Mohakhali route from Tongi route by taking the U-turn under Banani flyover.



For the opposite case scenario that mean vehicles that tend to enter Tongi route from Mohakhali route will have to make their U-turn under the Mohakhali flyover bridge and then enter Tongi route.



From analysing the vehicle flow at Masjid road route, which is used for entering Banani DOHS, we can observe that the reason behind increased congestion at this point is the railway crossing. At rush hour, while crossing the railway is restricted for some time, traffic congestion increases at Masjid road. Therefore, to reduce the traffic congestion in this route, we propose another route for entering Banani DOHS. The new route that will help to reduce the congestion is the Eastern road. It will save both time and decrease the pressure at Masjid road. Vehicles that are coming from Mohakhali to Banani-Kakoli intersection in order to enter Masjid road they can simply take a left turn at the intersection to enter Banani DOHS via Masjid road. As for the vehicles that are coming from Tongi and from Gulshan via Kamal Ataturk Avenue road for entering Masjid road, they will have to keep heading towards Jahangir Gate using Mohakhali flyover. Before reaching Jahangir Gate, they will take U-turn in the proposed location shown in the figure and head back towards Tongi route. This time they will use the road beside the Mohakhali Flyover. Vehicles that tend to enter Banani DOHS will enter Eastern Road by taking left turn. This route will help them to enter Banani DOHS. This way they can reach their destination without further hassle caused by rail crossing at the intersection. Therefore, waiting time will be less and free flow will remain constant.

TABLE II: EXPLANATION OF MODIFIED JUNCTION

Figures of Different Intersection (After Application of Solution)	Explanation
<p>Fig. 4: Kakoli-Banani Intersection</p>	<p>For solving the problem, our first step will be changing the intersection into one-way route. These will prevent vehicles from crossing the Dhaka-Mymensingh Highway, which is the main culprit behind creating traffic congestion at the intersection. If we restrict crossing movement, then we can get free flow in the intersection. However, the vehicles that tend to enter Kamal Ataturk Avenue from Tongi route or Masjid road and the vehicles that tend to make a U-turn to enter Mohakhali route will have to be re-routed.</p>

For solving the congestion problem, we are proposing to make U-turn under Banani and Mohakhali flyover bridge

because traffic considerably less there. Therefore, we can divert the flow into new routes without increasing any more traffic congestion. Although travel time will increase but in the end, it will save times that we used to lose due to congestion. Therefore, if we diverse the old flow to new proposed route, we can be able to reduce waiting time and doing so, we can expect less traffic congestion at the intersection.

Though private vehicle travel has conferred enormous benefits on many millions of drivers but these costs social and environment of the society. This has caused a profound incongruity among many planners over the proper role for automobiles in society, particularly in cities. But price hike at a marginal social cost, could improve traffic flow, reduce emissions, and increase walking, biking, carpooling, and transit use in cities [28].

The proposed route plan is expected to work if BRTA should maintain transparency of their activity such as Issuing driving license and transport fitness license. Elsmore, Numerical driving permit should have to be familiarized to control the fake driving license holding drivers. Strict lane management Lanes for versatile types of vehicles should be marked on the roads and law i.e. financial penalty should be imposed to follow the lane. Somewhat than that considering the importance of this major arterial rickshaw and all others non-motorized traffic should be restricted to move on. In addition, Government can take such stringent action suppose imposing financial penalty on the law disobeying drivers. This trend is available in Dhaka. All Policies should be made to dissuade the drivers from certain congestion-causing habit such as wrong overtaking, one-way driving, disobey of traffic signals Mobile court should be introduced to fine the truck drivers for disobeying traffic law and driving unfit truck. This kind of implication of law can mitigate the traffic jam in short run, but in long run all the people should be involved to create awareness and responsible to the society. Otherwise traffic jam solution is impossible. Congestion can be condensed by either growing road capacity (supply) or by reducing traffic (demand) [29] revealed that road capacity can be increased in a number of ways such as adding more capacity over the whole of a route or at bottlenecks, creating new routes, and improvements for traffic management.

## VI. CONCLUSION

Traffic congestion is a worldwide as well as native delinquent. All over the world, the prime cause of traffic congestion is on street parking [3]. In Bangladesh, traffic congestion is a common issue in the big cities like Dhaka, Chittagong and Khulna and in Dhaka it is severe where Banani - Kakoli intersection being one of the important and busiest intersection, the solution we have proposed for reducing traffic congestion can be applied to other intersection with few modification depending on the existing road network. Although this solution will increase the travel path, if we look at the bright side we can assure that travel time will take much less time than before. Establishing free flow in the intersection is the main target of this solution. Traveling a long path than waiting in the traffic jam will not only save time but also save

fuel consumption. Therefore, it can be said that this solution is applicable in present circumstance. Saving time will improve our economy and ourselves. By implementation of appropriate traffic rules, it can be possible to mitigate the problems of traffic congestion.

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