A Brief Study on Capacity Loss at Major Rajshahi City Roads, Bangladesh

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Abstract

Rajshahi, the 4*th* largest metropolitan city of Bangladesh have such roadway networks which were designed decades ago and nowadays they are facing problems in housing the increasing amount of traffic. As a result, the mobility of the traffic system has been hampered causing congestion and slower movement of vehicles. For this, inability to use the full capacity of roads is considered to be the main matter of concern. The study investigated the main reasons behind capacity loss on major city roads. To do, seven busiest roads of Rajshahi city were chosen. Then, a survey was carried out to identify the key factors which play lead role in reducing overall capacity. Through the survey some reasons like; on-street parking(37.23%), parking near intersections(30.5%), existence of shops on roads(3.61%), periodic maintenance(16.2%), lack of facilities of waste disposal(2.8%) were mostly found prominent. Overall, the study has shown some potential findings regarding major city road capacity conditions.
Keywords: *Congestion, Capacity loss, Reduction in road width, Parking, Transport condition in Rajshahi*

1 Introduction

According to Wikipedia (Rajshahi District), there are 96 metal roads with a total length about 1270 km, 108 semi metaled of 546 km around Rajshahi city. As per requirement, the authority of Rajshahi City Corporation has constructed numerous road throughout the city. Design dimension of most of the road in Rajshahi City Corporation was enough to accommodate the traffic volume. As per a survey run on traffic situation in Rajshahi (Haque, 2017), among the total number of vehicles running around the city, the percentage of commercial vehicles is 63% and non-commercial vehicles is 37%. Moreover, the average annual growth rate for both categories is 6.1%. So, it's quite challenging for the existing road network as due to various reason these roads are not working up-to their full capacity. One of these problems is capacity loss of roads occurred by various factors. Experts have found that lane and shoulder widths have substantial impact on traffic flow (Chandra and Kumar, 2003). And, in Rajshahi city, the major cause of this capacity loss is reduction of the width of road. It's causing congestion in the road which is the main cause of delay on road, harassment of passengers and pedestrian, pollution of environment and economical losses. On the basis of those problems this study sorted out the factors that are accountable for these problems. According to a survey observed in Dhaka, the key factors which are responsible for capacity reduction of roads are on street parking, on street shops and markets, on/off street construction, roadside dustbins, poor maintenance of roads, water logging etc.(Mahmud *et al.*, 2008). Being quite similar to Dhaka, Rajshahi is also facing capacity loss in it's roads by becoming affected with same factors. To dive deep inside in search of the major causes regarding the availability of less amount of usable capacity of existing roads, those factors were taken into account. The main theme was to investigate the main reasons behind the loss and therefore to determine each responsible factor's contribution.

2 Literature Review

Heavy traffic volume is a common scenario at some parts of this city (Shaheb Bazar, Alupotti, Mintuchattar etc.). And the reason behind this is lack of road width to accommodate both of vehicular traffic and the pedestrian traffic that come into the road due to lack of proper footpath. These are the main reasons behind the capacity loss in this

city. The main factors that affect the free circulation of traffic by reducing effective road width are briefly discussed below.

Figure 1. Satellite image of the study area.

2.1 On Street Parking

On street parking is the most vulnerable problem in almost all cities in Bangladesh. In case of some specific road of Rajshahi city it's terrible. It is the main cause of congestion of traffic in this city. It is hindering the normal function of road and harassing all types of road users as well as reducing the capacity of roads. It may be categorized in two types-Parking beside road and Parking at intersections. The later one is more problematic. Here in Rajshahi there are a numerous number of reason of on street parking. The reasons are as follows: lack of parking space, insufficient shoulder in some road, no parking space for most of the corporate office and the govt. office, no parking space for most of the hospital, no service road for hospitals and educational institutions, waste dumping on the shoulder space aside road, parking spaces acquired by the street shopkeeper, no specific stoppage for Easy bikes, insufficient place for loading unloading goods in grocery markets, improper traffic maintenance in intersection, parking space for non-motorized vehicles has been grabbed etc.

According to a survey, illegal shops on footpath are grabbing considerable percentages of road width in Shaheb Bazar, New market, Laxmipur by 86%, 77% & 73% respectively. (Rahman and Hasnat, 2018) Due to footpath grabbing, the pedestrian comes down to the road and shoulder which forces the drivers to park on the street to let the passengers and goods get in or out. For controlling traffic, signal light is a must for intersection but it was evident that in this city traffic signal lights got wasted. Signal light is missing at 6.2% of intersections and 46% of traffic signal lights are placed wrongly (Rahman and Hasnat, 2018).

2.2 Parking at Intersections

One of the major reasons behind effective road width loss is the abundance of parking at intersections. Experts have classified two different scenarios; one is by blocking the upstream and another is by starving of flow in the downstream. Both can have impact over the discharge rate of intersection and hence result in congestion traffic flow (Chao *et al.*, 2015). A study discussed about the present condition of hazardous road intersections in Rajshahi and concluded that intersection near Rajshahi Rail Station is the busiest and most dangerous intersection in Rajshahi City Corporation (RCC) area (Miah, 2017).

2.3 On/Off Street Construction

On/Off street construction also results capacity loss of roads. At Court-Bheripara road some on street construction is going on for development and that reduced about 2 lanes of the total 4 lane width. At some points, lagged construction process have turned the road into permanent on street dustbin. At RC- Alupotti road construction material is found scattered here and there resulting in temporary capacity loss. Expert have investigated about temporary losses of highway capacity and impacts on performance which showcases the transient losses of highway capacity due to on/off street construction (Goodwin, 2005).

2.4 Poor Maintenance and Management of Roads

Poor maintenance and management of city roads play a vital role in the reduction process of effective width of roads. A study showed that in Rajshahi, 13% roads were in primary broken condition, 28% roads were in intermediate broken condition and 8% roads were in tertiary broken condition in every 10 km road length (Rahman and Hasnat, 2018). The Talaimari- Vodra road has 4 lanes and some points only 2 lanes are active. This road is severely damaged and authority took over a project to fix it about two years ago. The project is still incomplete and flow of traffic is badly hampered. The Vodra- Railgate road had also the same scenario near the Rajshahi Railway Station. Several accidents took place in the past two years causing death of passengers, pedestrians and damage to vehicles.

Fig 2. Congestion at Mintu Chattar

Fig 3. Parking at intersection

Figure 4. On street construction

Figure 5. Water logging

2.5 Faulty Waste Management and Drainage System

In Rajshahi city, it generates approximately 350 tonnes of solid waste everyday while the amount increases to 400 tonnes during summer. Of the total, only 210 tonnes are collected and dumped into the open dumping ground at Nawdapara. Over 40% solid wastes of Rajshahi city are dumped into drains, open spaces and water bodies; causing environmental pollution, health hazards (Ali A., 2010). The rest amount of wastes remain at street side dustbins and some places those ate up some width of road for miss-management. The drain sometimes especially after rain get over-flooded causing temporary water logging as the solid waste get stuck in drains on their way to be dumped in the river Padma.

3 Methodologies

To find the percentage of usable capacity of a road, the capacity loss of that particular road has been analyzed firstly. For that purpose, a group of parameters and their set of representative measures have been taken into consideration.

3.1 Calculation of % of Reduction of Road Width

Using various corresponding factors, the Percentage of Reduction of Road Width has been calculated. Before that, the types of obstruction has been figured out and classified accordingly. To find the best results, a group of data has been collected at selected locations at Peak Time when the vehicle movement was highest in number. The whole process used here is dependent on some parameters such as, Width of Road & Width of Obstruction.
The equation used for calculating reduction of road width is [3]-

$$\%\ Reduction\ of\ Road\ Width = \frac{Width\ of\ Obstruction(ft.)}{Width\ of\ Road\ (ft.)} \times 100\% \quad \dots\ \dots\ \dots\ \dots\ \dots\ (1)$$

3.2 Calculation of % Capacity loss

In the next step the percentage of the capacity loss of the total road have been determined. To find this for the selected roads by a specific factor the following equation has been used [10].

$$Capacity\ Loss = \frac{Lengthof\ Obstruction\ (ft.) \times \%\ Reduction}{Length\ of\ Road\ (ft.)} \times 100\% \quad \dots\ \dots\ \dots\ \dots\ \dots\ (2)$$

3.3 Calculation of % Usable Capacity

Up next, we can find the percentage of usable capacity by subtracting the value obtained from the capacity loss from 100. So, the equation stands,

$$Usable\ Capacity\ (\%) = 100 - \text{Capacity Loss} \quad \dots\ \dots\ \dots\ \dots\ \dots\ (3)$$

4 Result Analysis

To analyze the roadway capacity of different major Rajshahi city roads, seven *(7)* major roads across the city have been chosen as stated before. Percentage of capacity loss in major Rajshahi city roads are shown in the bar chart shown in Fig. 8. From the chart it's clear that the Court-Bheripara road tops the list having a capacity loss of 59.37%. On the other hand, the Railgate-Aamchattar road has faced the least amount of capacity loss numbering 11.6% having the Vodra-Station road of 12.88% capacity loss accompanied. The Mintuchattar-Jhautola road is in the second position having a capacity loss of 53.9%. The RC-Alupotti road has a capacity loss of 32% which is said to be one of busiest roads in the city.

The Talaimari-Vodra road and the C&B-City Bypass road have also considerable capacity loss of 37.4% and 20.1% respectively. From the chart, it is quite prominent that the Court-Bheripara road has the least usable capacity followed by the Mintuchattar-Jhautola road. On the contrary, the Railgate-Aamchattar and the Vodra- Railgate road have a better circulation of traffic flow. On street parking is a major cause of traffic hindrance which can result in effective road width loss. From Table-1, it is evident that, most of the on street parking is seen at the Mintuchattar-Jhautola road having a reduction of road width of 31%. This leaves an amount of 69% of road width open to vehicle movement which is causing a major level of congestion. Though there is an alarming amount of lack of flow capacity, the Court-Bheripara road has no on street parking. This is because of the effectiveness of only 1.5 lane width out of the 4 lanes. The other parameters like poor maintenance, dustbins, on street construction etc. have made it impossible to park on this road.

Table 1. Road Width Reduction due to On Street Parking

Road no. (Fig1.)	Road Id.	Road Name	Reduction of road width due to On street parking
1	R1	RC-Alupotti	15
2	R2	Talaimari-Vodra	15
3	R3	Vodra-Rail Gate	16
4	R4	Rail Gate-Aamchattar	14
5	R5	CNB-City bypass	26
6	R6	Mintuchattar -Jhautola	31
7	R7	Court-Bheripara	0

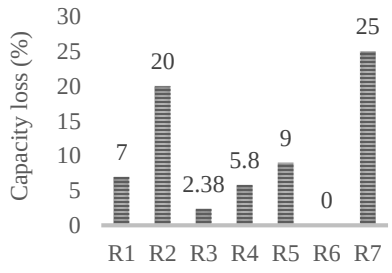

Figure 6. Capacity Loss Due to Parking at Intersection

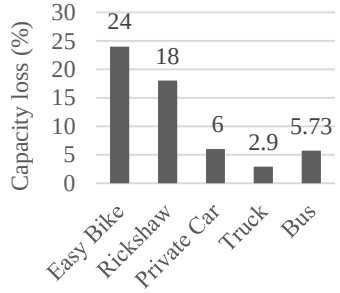

Figure 7. Capacity Loss by Different Vehicles

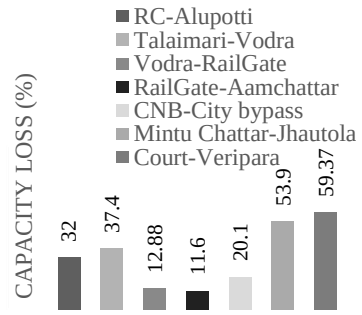

Figure 8. Capacity Loss in Major Rajshahi City Roads

From the survey, it is found that parking at intersections is the most common issue liable for effective road width loss of Rajshahi city roads. From Fig. 6 it is clear that there is a considerable amount of intersection parking in most of the major city roads causing loss in road width among which the Court-Bheripara road highest of about 53%.

As no inter-city bus service has not been introduced here in at Rajshahi yet, people rely on the easy bikes and rickshaws completely as mode of transportation. So, on street parking and parking at intersection which are being the culprit behind most of the road width loss. Easy bike causes a capacity loss of 24% and rickshaw causes 18%, of total capacity loss. Motorized vehicles as private cars causes 6% of capacity loss. Other vehicles as bus and trucks reduce capacity of 5.73% and 2.9% respectively. (Fig. 7) Also, an average amount of 16.2% capacity loss in roadway has been observed in the surveyed roads due to poor maintenance. As a result, the vehicles move slowly on the road facing congestion and number of accidents have also been increased alarmingly. Besides, on street shops have been liable for causing reduction in width at some important points including hawkers, products, food shop and sitting arrangements, extended portions of existing shops etc. These sum an overall loss of 3.61% across the city. On and of street construction works also hampers expected flow of vehicles. Scattering of construction materials was also observed across the city. A detailed survey result is presented in Appendix- A. shows contribution of each parameter which have taken into account for this survey of capacity loss.

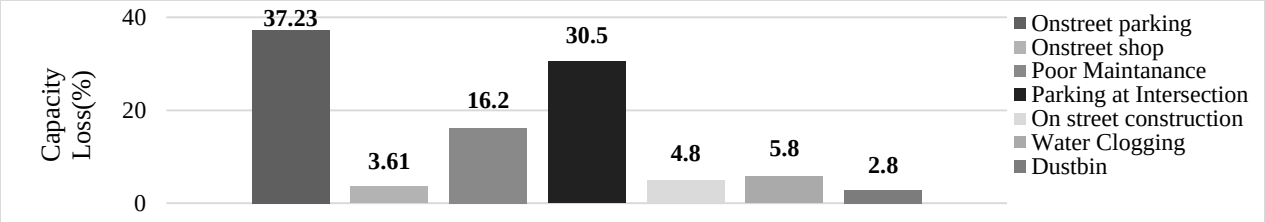

Figure 9. Overall Capacity Loss

Figure 9 represents that, on street parking has a percentage of 37.23% on overall capacity loss around the city. After that, parking at the intersection contributes 30.2% to the overall capacity loss because the overall road width provided at the intersections are greater than that of roadways as a provision for parking and changing direction. So, it is prominent that the above two parameters are the main culprits behind capacity loss in the roads of Rajshahi city. Water logging and on street dustbins cause a loss of 5.8% and 2.8% respectively on total loss. On street shops causes a loss of 3.61% and on street construction causes about 4.8% loss and they are increasing day by day. Poor maintenance of the existing roads feeds 16.2% to overall capacity loss in major roads in the city.

Appendix- A

Road ID.	Road Width (ft.)	Road Length (ft.)	Type of Loss	Reduction (%)	Capacity loss (%)	Total Loss (%)	Usable Capacity (%)
			On street parking	15	8		
			On street shop	21	2		
			Poor Maintenance	17	15		
R1	48	3280	Parking at Intersection	21	7	32	68
			On street construction	0	0		
			Water Clogging	0	0		
			Dustbin	0	0		
			On street parking	15	4		
			On street shop	0	0		
			Poor Maintenance	25	2.3		
R2	48	5249	Parking at Intersection	23	20	37.4	62.6
			On street construction	11	0.1		
			Water Clogging	23	11		
			Dustbin	0	0		
			On street parking	16	5.5		
			On street shop	0	0		
			Poor Maintenance	33	2.5		
R3	48	6562	Parking at Intersection	21	2.38	12.88	87.12
			On street construction	0	0		
			Water Clogging	27	2.1		
			Dustbin	13	0.4		
			On street parking	14	4.6		
			On street shop	0	0		
			Poor Maintenance	0	0		
R4	24	13123	Parking at Intersection	39	5.8	11.6	88.4
			On street construction	0	0		
			Water Clogging	0	0		
			Dustbin	0	0		
			On street parking	26	10.4		
	48	3773	On street shop	0	0	20.1	79.9
			Poor Maintenance	0	0		
			Parking at Intersection	24	9		

			On street construction	0	0		
			Water Clogging	0	0		
			Dustbin	12.5	0.7		
			On street parking	31	48.5		
			On street shop	21	2.8		
			Poor Maintenance	13	2.6		
R6	24	1476	Parking at Intersection	0	0	53.9	46.1
			On street construction	0	0		
			Water Clogging	0	0		
			Dustbin	0	0		
			On street parking	0	0		
			On street shop	12	3.4		
			Poor Maintenance	63	14.3		
R7	36	1805	Parking at Intersection	28	25	59.37	40.63
			On street construction	40	10.75		
			Water Clogging	0	0		
			Dustbin	12	5.91		

5 Conclusion

- The study and the total survey is performed by a simplified method of finding capacity loss in major roads across the city of Rajshahi.
- It represents a realistic scenario of the present traffic condition in association with the reduction of width in the selected roads.
- It is also helpful for finding out the best possible solution for minimizing the capacity loss as it comes with real time quantitative results. Besides, the liable factors are marked out clearly for each roads concerned and this will also assist to sort out fields of improvement.
- Thereafter, the study recommends the total eradication of the factors liable for capacity losses as early as possible. Otherwise, the overall situation may get worse and affect the others roads existing around the city.
- This method can be adopted for evaluating capacity condition in other roads of Rajshahi city for future investigations as the future studies might improve the reasons which are feeding the present parametric factors in various extents.

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