

## **Investigation of highway geometric problems and remedial measures in Rajshahi City corporation area, Bangladesh**

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**Abstract:** The economic development of a country mostly depends on the good transportation system. Rajshahi, one of the six metropolitan cities in Bangladesh. So the development of Rajshahi city mostly depends on the transportation system. Road network system is the main mean of transportation system in Rajshahi city. But this system involves so many problems such as drainage problem, shoulder problem, horizontal clearance problem, environment pollution problem etc. Drainage problem hampers the normal life of road. It creates the dampness of road and decrease the salability of it. Shoulder problem reduce the width of road. It creates serious traffic jam and sometimes responsible for accident. Horizontal clearance problem creates inconvenience to the drivers when move on a curve. Insufficient horizontal clearance may create serious conflict at the place of curve. Environmental pollution occurs due to dumping of solid waste on the pavement because of absence of roadside dustbin. The purpose of this study is to investigate the problems associated with the road network system of Rajshahi City Corporation and suggest some remedial measures.

**Keywords:** *Geometric elements, Drainage, Shoulder, Horizontal clearance, Environmental pollution*

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### **1. Introduction:**

The geometric design of highways deals with the dimensions and layout of visible features of the highway. The importance of the geometric design is to address the requirement of the driver and the vehicle such as safety, comfort, efficiency etc. The features normally considered are the cross sectional elements, sight distance consideration, horizontal curvature, gradients and intersection [Khanna and Justo, 2001].

Road transport network is the most important mean of the communication system in Bangladesh as is elsewhere in the world. In fact, road transport in our country has come forward to be the most dominant mode in motorized surface transportation carrying in recent years over 70% of passenger and over 60% of freight traffic respectively [Roads and Highway Department, RHD].

Besides, GOV is implementing the Poverty Reduction Strategy Paper (PRSP) in all development sectors. RHD has since been making its investment program commensurate with the PRSP. In this program, district roads and government declared roads of public importance, which contribute more to the growth of rural economy and rural employment including women, are getting higher priorities. According to the latest RHD database report, there is the total length of about 21272 Km road of different categories under the control and management of Roads and Highways Department, of which about 18203 km is paved, while the remaining 3069 km is either partly paved or unpaved. Of this total road network under the department, 3538 km is national Highways, 4276 km Regional Highway and remaining 13458 km is the district road. Besides this, RHD has under its control about 4507 number of bridges with total length of 130 km and 13751 numbers of culverts with a total length of about 54

km as per 2011 data [Roads and Highway Department, RHD].

Rapid urbanization in Rajshahi is taking place since the partition of India in 1947. However, most of this urbanization is taking place in an unplanned way leading to unemployment, increase of urban poor, development of settlement in marginal lands and hazard prone areas, living in densely populated unstable buildings in slums and squatters, absence of basic services and facilities, etc. To cope with the changing situation in urban area due to rapid urbanization improvement of road network is essential [www.erajshahi.gov.bd].

#### **1.1 Study Area-**

Rajshahi is a city in the western part of Bangladesh. The city of Rajshahi is the divisional headquarters of Rajshahi division as well as the administrative district that bears its name and is one of the six metropolitan cities of Bangladesh. Rajshahi is often referred to as Silk City and Education City. Rajshahi is located at 24.40°N 88.50°E and is situated on the northern banks of the river Padma. It consists of nine Upazilas, fourteen Paurashavas and seventy one unions. Rajshahi was formerly known as Rampur Boalia. Though an epigraphic record engraved on the Dargah of the famous saint Hazrat Shah Makhdum (Rh.) indicates that the antiquity of Rajshahi goes back to at least 1634 A.D. The town was given importance in 1825, when the East India Company shifted the administrative headquarters of the district of Rajshahi from Natore to then Rampur Boalia, mainly for the ease of communication from Calcutta through the Hooghly River, Bhairab River and Padma River. Rajshahi Municipality, which was one of the first municipalities in Bangladesh, was established in 1876. Rajshahi Municipality was renamed as Rajshahi Paurashava, and finally,

Rajshahi Paurashava was declared Rajshahi City Corporation in 1987. There are three major roads connecting with other districts. With the development and rapid industrialization of the country various structures such as educational institutions, mills, factories and offices are established in this area. Every day people from other districts come into Rajshahi city for office works, for business, for

treatment and for other purposes. People from nearest towns and villages also come every day in Rajshahi city for job, educational purposes in colleges and University and many other activities. Existing city road network is not adequate for the increasing traffic volume. The road network map of Rajshahi zone is shown in figure 1.



Figure 1: Location of the study area (Rajshahi City)

## 2. Objectives of the study-

The objectives of this study are as follows:

- To investigate the existing geometric elements.
- To investigate the existing horizontal clearance of the road.
- To study the existing drainage facilities.
- To suggest the possible solution of the identified.

## 3. Problems exist on road networks-

Hazards associated with roads and roadsides were particularly predominant. Adverse roadway elements contributing to highway accidents were substandard road way alignment or geometry, lack of shoulders and shoulder defects, absent or inappropriate pedestrian facilities, narrow and defective lanes and bridges/bridge approaches, roadside hazards, undefined pavement center and edge lines, poor sight distances and visibility, unmarked and inappropriate design of intersections, serious allocation deficiencies along the route, haphazard bus shelters/stops, and others.

The problems that identified by this investigation in Rajshahi city corporation area are as follows:

- Drainage problems.
- Shoulder problems.
- Horizontal clearance problem.
- Environmental pollution problem.

## 3.1 Drainage Problems-

### i. Water logging:

When water from any source find no path to escape or drain out and create a hazardous situation is known as water logging. Excessive rainfall, inadequate drainage sections, conventional drainage system with low capacity and gravity, natural siltation, absence of inlets and outlets, indefinite drainage outlets, lack of proper maintenance of existing drainage system, and over and above disposal of solid waste into the drains and drainage paths are accounted for the prime causes of water logging. From the observation of road network in RCC it has been found that during rainy season many roads are affected by water logging. This is cause due to absence of any drainage system, improper maintenance of drainage facilities etc. A road with serious water logging problem was found beside the New Market which is shown in figure 2.



Figure 2: Water logging situation on New Market to Nagar Bhaban road due to absence of drainage system

**ii. Reduction of soil stability:**

Soil stability refers to the engineering properties of a soil specifically its resistance to failing when disturbed. Soil stability depends on its shear strength, its compressibility and its tendency to absorb water. The stability of a soil gradually decreases due to long term water logging situation. As soil stability decreases, the bearing capacity of soil also decreases and the soil is failed at slope. This type of situation was found at Naudapara Bazar which is shown in figure 3.



Figure 3: Soil stabilities gradually decrease due to long term water logging situation at Naudapara Bazar

**iii. Erosion of pavement:**

Water allowed to remain on top of a gravel or paved road weakens the surface and combined with traffic, causes potholes and cracking. If there is absence of drainage system, water wash out the particles and causes soil erosion and a breakdown of pavement edges. Due to continuous erosion of pavement, lessen the width of road and creates danger zone which is responsible for serious accident. So inadequate drainage facilities is the crucial reason for erosion of pavement. The serious erosion occurred at a point of Rajshahi to Natore road as shown in figure 4.



Figure 4: Inadequate drainage facilities cause serious deterioration of the pavement by continuous soil erosion at Katakhal

**iv. Blockage of drain by bushes and sharbs:**

Grass, weeds, brush etc. are responsible for blockage of drain. If they are not control regularly may block the road side drain and creates serious condition such as water logging on road surface, environment pollution etc. The drainage system in many places of Rajshahi city is suffered with this problem. Which is due to insufficient maintenance work. A drainage system running parallel with Talaimari to Saheb Bazar road is blocked by bushes and sharbs is shown in figure 5.



Figure 5: Road side drain blocked by bushes & sharbs near Hadir Mor

**v. Blockage of drain by dumping of soil:**

Sometimes the drainage may be block by dumping of soil into it. It is done by local people for walking purpose and for crossing goods from one side to other side of the drain. This problem hampers the drainage facilities and creates water logging situation. In Rajshahi city this problem was seen beside the Vodra to Meherchondi road which is shown in figure 6.



Figure 6: Drainage is blocked by dumping of soil beside Vodra to Meher Chandi road

### 3.2 Shoulder Problems:

#### i. Shoulder occupied by hawker:

Shoulders of different points of Rajshahi city corporation road occupied by illegal hat-bazar and hawkers. This hat-bazars are established by the local powerful influential people, slum people and low income people. For this reason following consequences also found-

- a) The width of the road is decreasing.
- b) Space for pedestrian and bicycle are reducing.
- c) Lateral clearance and sight distance are reducing.
- d) Traffic capacity of the road is decreasing.
- e) Traffic jam creating and the speed of vehicle reduces.
- f) Sometimes accident occurs due to narrow width of road.

It has seen that the shoulder of the road at Rajshahi railway station is occupied by hawkers which creates so many problem and shows in figure 7.



Figure 7: Shoulder on both side of the road is occupied by hawker at Rajshahi railway Station area

#### ii. Shoulder is occupied by illegal parking of vehicles:

Road in many places of Rajshahi city corporation it has been observed that shoulders are used as parking place of vehicles, ignoring the interdiction of RHD. This process is going on at the places like Vodra,

Rail station, Saheb Bazar, Rail gate etc. These public transports as a result use carriageway for stopping, parking, dropping, picking and waiting for passengers and goods. And the local drivers drive vehicles without any training. Most of the driver has no any idea about the traffic rules. So they parked their vehicles on shoulder, and creates traffic jam. It is often seen at the rail gate area, the easy bikes, CNGs etc. are parked on shoulder as shown in figure 8.



Figure 8: Illegal parked vehicles on shoulder at Rail gate area

Due to this illegal parked vehicle sometimes serious traffic jam creates, which is responsible for the inconvenience to the passengers. A traffic jam was found at Binodpur area which is shown in figure 9.



Figure 9: Serious traffic jam creates due to illegally parked vehicle on shoulder at Binodpur area

#### iii. Pavement used by local people:

Most of the hat-bazars, markets, shopping malls, schools, colleges and universities are situated beside the roads. For this reason the road pavement is used by local people for walking purpose. Thus the road width is reduced and accident occurs. People likes to use pavement surface for walking than unpaved surface. They do not care about the traffic rules or even don't know the rules. Similar type of feature was seen at Shaheb Bazar area which is shown in figure 10.



Figure 10: Local people use pavement for walking at Shaheb Bazar

iv. Shoulder is blocked by construction materials:

It has been observed that construction work is going on at many places of RCC, which is adjacent to the roads and the owner is use the shoulder for keeping the construction material such as bricks, sand, brick chips, stone chips etc. which creates inconvenience to the drivers and sometimes accident may happened. Due to this reason following consequences also found-

- The width of the road is decrease.
- Traffic capacity of the road is decrease.
- The speed of vehicle is reduce and traffic jam creates.
- Sometime accident occurs.

The shoulder is blocked by bricks, sand etc. which was found at Vodra area is shown in figure 11.



Figure 11: Shoulder is blocked by construction material both side of the road at Vodra

### 3.3 Horizontal Clearance Problem-

Planting of trees on the road side, or the road arboriculture is one of the important aspects in road side development. Trees on both sides of urban and rural road serves the following purposes:

- To provide attractive landscape of the road.
- To provide shade to the road users.
- To protect against moving sand in desert areas.
- To provide fruit bearing trees and timber.
- To intercept the annoying sound waves and fume from road vehicles.

To allow for adequate horizontal clearance and the transport of abnormal loads, 5.7m headroom should be provided when designing new roads and structures. The headroom must be available over the full width of the road formation. There may be special requirements on some roads and this should be checked with the RHD's field divisions. The lateral clearance, measured between the outer edge of the shoulder and roadside objects should be a minimum of 1m.

Collusion between vehicles have been occurred due to inadequate lateral space of emergency overtaking and the vehicle may run off the pavement. The road section passes beside the main gate of Rajshahi University are affected by this problem, which is shown in figure 12 and 13.



Figure 12: Inadequate horizontal clearance at the place of curve in front of Rajshahi University



Figure 13: Serious conflict may occur due to inadequate horizontal clearance at the place of curve

### 3.4 Environmental pollution problem-

The deposition of waste on the edge of the pavement may pollute the water source, particularly wells, tube wells, ponds etc. odor nuisance may also pollute air. This may create various problem. While planning development of roads and transportation facilities, apart from aiming at operational efficiency, it is also necessary to consider the quality of the environment due to the development. It is important to prepare the environmental impact statement at the planning stage itself. But in the case study of the Rajshahi city corporation road, it has been found that illegal dumping of solid and hazardous waste at Hadir Mor causing serious air and water pollution is shown in figure 14.



Figure 14: Illegal dumping of solid waste all most on the pavement causing environmental pollution at Hadir Mor.

## 4. Remedial measures:

### 4.1 Remedies for Drainage Problem:

In order to avoid the drainage problems following remedies should be consider-

- Depressing the subsurface water level by suitable drainage system.
- Raising the road level by constructing embankment.
- Providing a capillary cut-off to arrest the capillary rise of water.
- Providing sufficient pavement thickness.
- Proper camber should be provided.
- In order to avoid sever erosion problem stone pitching and soil stabilization techniques should be provided.
- In order to facilitate the flow of water from one side of the pavement to the other side, cross drainage should be provided.
- In order to remove surface water, longitudinal RCC drains should be provided maintaining proper shoulder at important bazaar places.

To avoid drainage problems some remedies such as surface drainage system, trapezoidal drainage system etc. may be used.

#### i. Surface drainage system:

In order to remove surface water, longitudinal RCC drains should be provided maintaining proper shoulder at important bazaar places, which is shown in figure 15.



Figure 15: Road with surface drainage

#### ii. Trapezoidal drainage system:

Trapezoidal drainage should be provided beside the road to remove rain water immediately from the pavement surface which is shown in figure 16.



Figure 16: Trapezoidal drainage system

### 4.2 Remedies for Shoulder Problem:

Following remedies should be considered in order to remove the shoulder problem-

- Illegal establishment should be removed from the pavement shoulders.
- Specific road side parking place should be provided to park the vehicles.
- Hawkers from shoulders should be removed.
- Overall law and order situation should be sound enough to take proper steps against the powerful local influential.
- Bushes should remove from shoulder.
- Sign-post and rules can apply.
- Traffic law enforcement is meant to achieve the safe and efficient movement of all road users.

An example feature that could be applied to avoid the shoulder problem is shown in figure 17.



Figure 17: A road with proper shoulder

**4.3 Remedies For Horizontal Clearance Problem-**

Following remedies should be considered in order to remove the horizontal clearance problem-

- a) RHD’s operational division should take proper steps to maintaining sufficient horizontal clearance.
- b) Plantation of trees on the road side is the job of local administration, they should aware about that.
- c) The drivers should move slowly at the place of curve.
- d) Adequate signs should be provided at the place of curve.
- e) Proper super elevation should be provide at curve.
- i. Adequate horizontal clearance at the place of curve:

An example of standard horizontal clearance that could be applied at place of curve is shown in figure 18.



Figure 18: Adequate horizontal clearance at the place of curve

- ii. Use of road safety mirror:
- The road safety mirror can be used at the place of curve which helps the drivers to see the vehicle come from the opposite direction and move their vehicle safely. An example is shown in figure 19.



Figure 19: Safety mirror can be used at the place of curve

**4.4 Remedies For Environment Pollution Problem:**

In order to avoid the environment pollution problems following remedies should be consider-

- a) RCC should take proper steps to keep clean the hat-bazar and both side of the pavement.
- b) Local administration should use the law to keep the pavement clean.
- c) Roadside dustbin should be provided by the authority.
- d) People should be aware about the environment pollution and not to through the dust on the pavement.

An example of roadside dustbin that should be suggested is shown in the figure 20.



Figure 20: Road side dustbin should be suggested

**5. Conclusion:**

With the development of transportation facilities in a city, there will develop fasters. Thus helping the balanced development of the country as a whole. So a well-developed, sound road network has been desired.

Rajshahi is a rising city consisting of major educational and industrial institution. As a result of recent population growth in this city, the existing road network of this city is not adequate for the increasing traffic volume and the existing road network is suffer from various problem. From the investigation of the road network of Rajshahi City Corporation following problems are found:

- a) Absence of drainage facilities causes water logging.
- b) Absence of drainage facilities causes decrease in soil stability.
- c) Inadequate drainage system causes soil erosion.
- d) Absence of drainage facilities causes stripping of the pavement.
- e) Improper maintenance of existing drainage system causes blockage of drain.
- f) Lack of horizontal clearance, thus creating serious accident hazard.
- g) Emergency overtaking problem due to inadequate shoulder width.
- h) Existing shoulder is occupied by bushes and shrubs many places of the road.
- i) Existing shoulder is occupied by illegal parking of vehicles, hawkers, construction materials and illegal hat/bazaar causes traffic jam.
- j) Existing shoulder is occupied by dumping of solid waste on the pavement causes environment pollution.

The problem given above should be solved immediately, otherwise the road network is unsuitable for use before its lifetime. Some remedial measures should be suggested to eliminate all the problems. Maintenance work should be done regularly by the authority. The people should be aware about the traffic rules and use the road properly.

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