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## Road Accident Analysis and Prevention Measures of Rajshahi - Sirajganj Highway in Bangladesh

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### ABSTRACT

In this study an attempt is made to investigate the characteristics of road traffic accidents on the Rajshahi-Sirajganj Highway in Bangladesh. For detail investigation, the highway was divided into three major sections as Section-I: Bonpara intersection to Parkol, Section-II: Parkol to Nayabazar and Section-III: Nayabazar to Toll Plaza. Road accident related data on selected highway for different years were collected from Bonpara Highway police station, Jholmoliya Highway Police Station and Fire Service and Civil Defense Station at Natore from year 2008 to 2015. From the investigation, it is found that the total numbers of accidents in Rajshahi - Sirajganj highway (Bonpara intersection to Atrai toll plaza) were 210 within year 2008 to year 2015; the number of fatalities, grievous injury and minor injury were 246, 231 & 265 respectively. It is also found that the maximum numbers of accidents (22%) occurred within 12 AM to 15 PM. Truck was the most involved vehicle in the road accident which is 39% of the total number of vehicles whereas, bus involved is 21% road accidents. From the year 2014 to 2015 there were 30% head on collisions, 34% rear end collisions, 29% hit pedestrians and 7% overturning occurred. A 3D model of Bonpara-Hatikumrul highway is proposed in this study, where the selected highway is developed into four lanes and the movements of fast moving vehicles are kept uninterrupted by providing a grade separated intersection.

**Keywords:** Rajshahi - Sirajganj highway, Accident study, speed study

## **1. INTRODUCTION**

Road accident is an accident in which at least one person is killed or injured by involving one road vehicle. In the developing world, around 88% of the 1.2 million deaths occur from road accident injuries [1]. Accident Research Institute (ARI) reported that 12000 people die as a result of road accident every year in Bangladesh. The BHIS estimated over 3,400 children were killed in 2002, most of them were pedestrians and by-cyclist. Due to the high levels of trauma incurred, it was the 4th leading cause of permanent disability from injury, responsible for over 1,360 children being permanently disabled or almost 4 children each day. For all these reasons, road traffic injuries are an important obstacle to development and national economy of a country [2-3]. In Bangladesh, the safety situation is very severe by international standards and has been rapidly deteriorating with increasing number of road accident deaths. National Road Traffic Report, 2007 reported that more than 3000 individuals-including our family, our friends and our co-workers loss their lives in road traffic accident and many more sustain disabling injuries. That figures clearly demonstrate that the road safety is a serious issue as it affects each and every one of us.

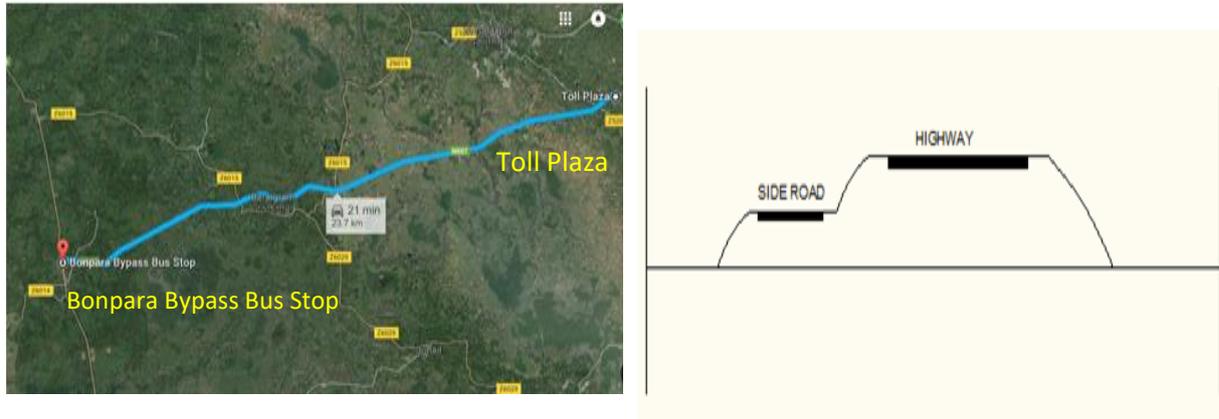
Rajshahi - Sirajganj highway is one of the most costly roads & which plays a very important role in connecting the northern part of Bangladesh with Dhaka. This Highway is directly connecting Pabna and Natore with Sirajgong. People living in the districts of the northern part of Bangladesh such as Natore, Pabna, Chapai-Nobabganj, Naogaon, Rajshahi use this road for office work, for business, for treatment and for other purposes. After completion of Jamuna Bridge, the importance of this highway got a new life. Communication between Rajshahi and Dhaka has become easy and time saving. Due to invention of fast moving vehicles, the problem of accidents is becoming more and more complex on highway [4]. It is more acute in case of mixed traffic. The increase of first moving vehicles on the road of Rajshahi - Sirajganj highway created a major social problem- the loss of lives through road accidents. Total length of roads including National highway, Regional highway & Feeder road is 21,571 km & fatality rate per km is 0.16 in (2003). In Rajshahi - Sirajganj highway, the fatality rate is 2.19 (2014) which is almost 14 times of the average rate of accident. These statistics prove the importance of studying the road accident situations in Rajshahi - Sirajganj highway. With the above requirement, the present study has been taken in order to identify the causes of the road accidents and to establish the possible suggestion for the reduction of accident rate.

## **2. INVESTIGATION**

The usefulness of recording and collection of accident data cannot be ignored, which is the only source of problem identification. Actual alignment of the highway and cross section of selected highway viewed from East to West is shown in Figure 1.

### **2. 1. Traffic Volume**

Traffic volume is the number of vehicles crossing a section of road per unit time at any selected period and represented as vehicles per day or vehicles per hour [5-10]. Traffic volume data is used for the following purposes: To measure the relative importance of road, traffic operation and pedestrian signals.



(a) Alingment of Rajshahi - Sirajgang highway (b) Cross section of Rajshahi - Sirajgang

**Figure 1(a,b).** Rajshahi - Sirajgang highway.

In developing countries like Bangladesh different classes of vehicles are found in the roadway without segregation. Mixed traffic flow is very complex compared to homogeneous traffic flow. In mixed traffic flow, traffic capacity and volume calculation is difficult, unless the different vehicle classes are converted to one standard vehicle unit [11-12]. Traffic volumes are counted for (12 PM to 1 PM) in a day at three sections of selected highway are summarized in Table 1.

**Table 1.** Traffic volume for one hour on selected highway

Highway section	Section-I	Section-II	Section-III
Traffic Volume, PCU/hr	926	1000	632

## 2. 2. Speed study

**Table 2.** Maximum speed on selected road of different vehicles

Serial No.	Vehicles type	Maximum speed (Km/hr)
1	Car	125
2	Microbus/ Jeep	115
3	Bus	110
4	Truck	90

The actual speed of vehicles over a particular highway may fluctuate widely depending on several factors such as geometric features, traffic conditions, time, place, environment and driver. Spot speed is the instantaneous speed of a vehicle at a specified section or location. Spot speed study is useful to use in planning traffic control & to use in traffic regulations and also to use in accident studies. The results of speed and delay studies are useful in detecting the spots of congestion, the causes and in arriving at a suitable remedial measure. The maximum speeds on some spots are collected from the interviews of the drivers of different vehicles and results are given in Table 2.

### **2. 3. Accident study**

Accidents are rarely caused because of one single factor [13-15]. Usually the interaction of a diverse set of factors causes the accident. A car driver may drive recklessly, he might be even under the influence of liquor, geometric condition of the road may be deficient, thick film of water on the road makes the road slippery, brake failure, resulting ultimately in the unfortunate accident. Complex as the problem is, yet it cannot be denied that study of the various causes of accidents is very vital for traffic safety. Broadly, the factors that cause accidents can be considered under the following headings: The road, the vehicle, the driver, the road users other than the motorist and Environmental factor.

#### **2. 3. 1. Road**

A road is a way on land between two places that has been paved or otherwise improved to allow travel by foot or some form of conveyance, including a motor vehicle, cart, bicycle, or horse. Different elements of road are affecting the road accidents. The brief descriptions of different elements are given below: Road surface hampers the normal movement of vehicles due to (i) Width of pavement and shoulder, (ii) Very smooth or very rough surface condition, (iii) Improper design of speed breaker, (iv) Uneven face of joint between road and bridge, (v) Spreading of straw cross on the road surface, (vi) Defective road surface.

Investigated results indicate that there are various defects on road surface within study zone. Sometimes road accident occurs due to this defective surface. Two defective road surfaces are shown in Figure 2 (a and b).



**(a) Pothole**

**(b) Slippage**

**Figure 2(a,b). Road surface condition.**

Roadside conditions are the cause of the accident due to (i) Road side trees, advertisement board and attractive building at the roadside, (ii) Unauthorized parking at the roadside, (iii) Hat – bazaar, mobs and stacking of materials at the road side and (iv) Stray animals on the roadside. Features on the roadside of study zone are shown in Figure 3.



(a) Attractive billboard

(b) Unauthorized parking



(c) Stack of construction materials

(d) Stray animals

**Figure 3(a-d).** Roadside condition.



(a) Sharp horizontal curve

(b) Derailed bus

**Figure 4(a,b)** Road geometry.

Road geometries increase the road accident due to (i) Improper road alignment, curve and super elevation, (ii) Insufficient extra width, clear sight distance and paved area at intersection. Derailment of vehicles at sharp horizontal curve during the rainy season are the cause of the accident within the study zone. Sharp horizontal curve and derailed bus are shown in Figure 4.

Improper traffic control increase the road accident due to Improper medians, road marking and road signs, Lack of street lighting and light reflector at night and Damaged signal post. Features of traffic control for study zone are shown in Figure 5.



**(a)** No lane separated marking

**(b)** Lack of street light

**Figure 5(a,b).** Road marking and lighting condition.

### 2. 3. 2. The vehicle



**(a)** Overloaded truck

**(b)** Defective vehicles

**Figure 6(a,b).** Overloaded and defective vehicles.

It is being increasingly realized-thanks to consumer protection pioneers like Ralph Nadar-that vehicles play a dominant role in road safety. One estimate puts that mechanical deficiencies

cause about 5% of all traffic accidents. Various aspects of vehicle design and maintenance are involved in making (i) Accidents fewer in number, (ii) Accidents less serious to another road user. (iii) Accident less severe to vehicle occupants. Bus, truck and micro hamper the normal movement due to: (i) Over dimensions, overweight and over speed and (ii) Defective brake, headlight, steering, tire condition, horn, rear view mirrors. Features of vehicles for study zone are shown in Figure 6.

### 2. 3. 3. The driver

The driver is the key factor in most of the accidents. He is the human element in charge of the machine [7]. From investigation it is found that motorcycle & scooter drivers are frequently violating traffic rules and using the highway instead of using the side road in Figure 7.



Figure 7. Violation of traffic rules by driver.

### 2. 3. 4. Road user



(a) Mounting & hanging on the vehicle

(b) Pedestrian running on the road carelessly

Figure 8(a,b). Violation of traffic rules by Road user.

Pedestrian, passengers, driver, cyclist, motorcyclists etc. is the road users. Many accidents occur for the road users. Road accident occurs due to passengers for the following reasons: (i) Alighting from or getting into moving vehicles, (ii) Mounting and hanging on the vehicle, (iii) Pushing or walking on bus roof, (iv) Keeping the head and hand at outside, (v) Talking with driver, (vi) Beauty queen passengers.

Pedestrian also responsible for the road accident due to Carelessness, Violating regulations, Gossiping and playing on the road, Violating of rules to cross the road. From investigation careless movement and road crossing of pedestrians are found which is shown in Figure 8.

### **2. 3. 5. Environmental factors**

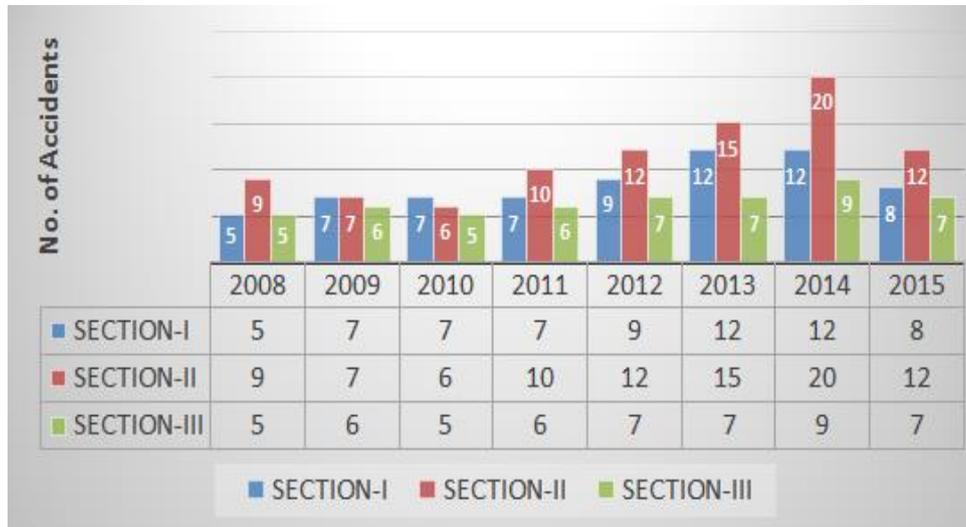
Environmental factors increase the road accident due to Snow, ice, rain water makes roads slippery; Mist, fog (thick mist), dust, smoke, heavy rainfall restrict normal visibility; Road below the rain or flood water. From investigation, environmental factors are found, which is shown in Figure 9.



**Figure 9.** Foggy weather restricts normal visibility.

## **3. RESULTS AND DISCUSSION**

It can be seen from Fig. 10, the total number of accidents in Rajshahi - Sirajgang highway is 19 in the year 2008, while it is 41 in the year of 2014. The rate of accidents is increasing in different sections of the highway. The yearly traffic volume is also increasing every year. Annual Average Daily Traffic (AADT) on Rajshahi - Sirajgang highway for 9 years were collected from Roads and Highways Department, Natore & Atrai Toll Plaza on selected highways and presented in Figure 11. The overall number of vehicles in Bangladesh is increasing day by day which is the main cause of the traffic volume increase in this road section. Political crisis were very severe in the year 2015. About three months of this year were under continuous stroke. Due to this political unrest the natural flow of traffic was hampered in this road section, so, the traffic volume was decreased in 2015.



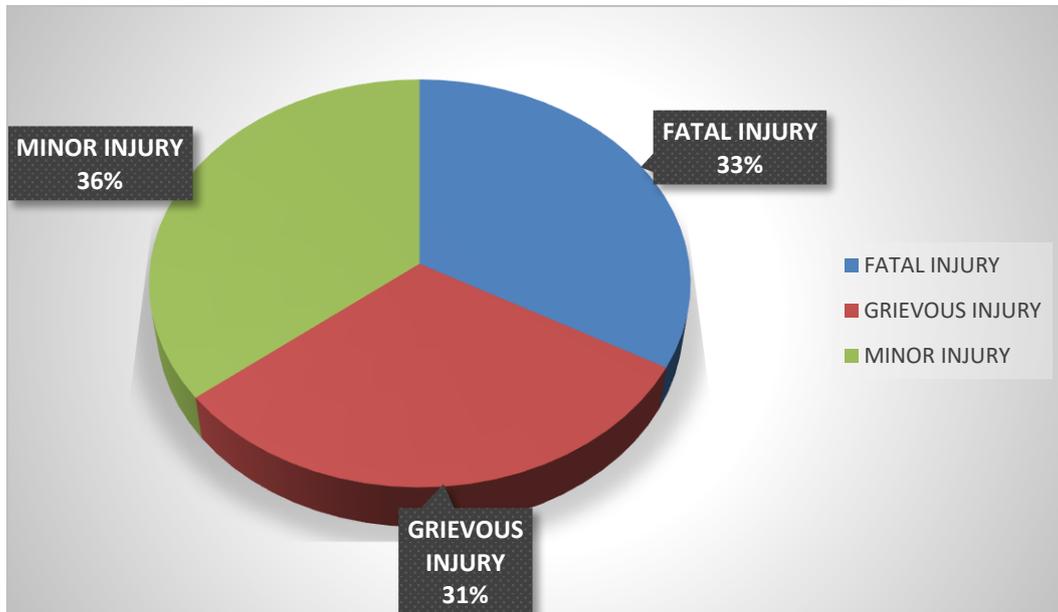
**Figure 10.** No. of accidents in different sections from year 2008 to 2015.



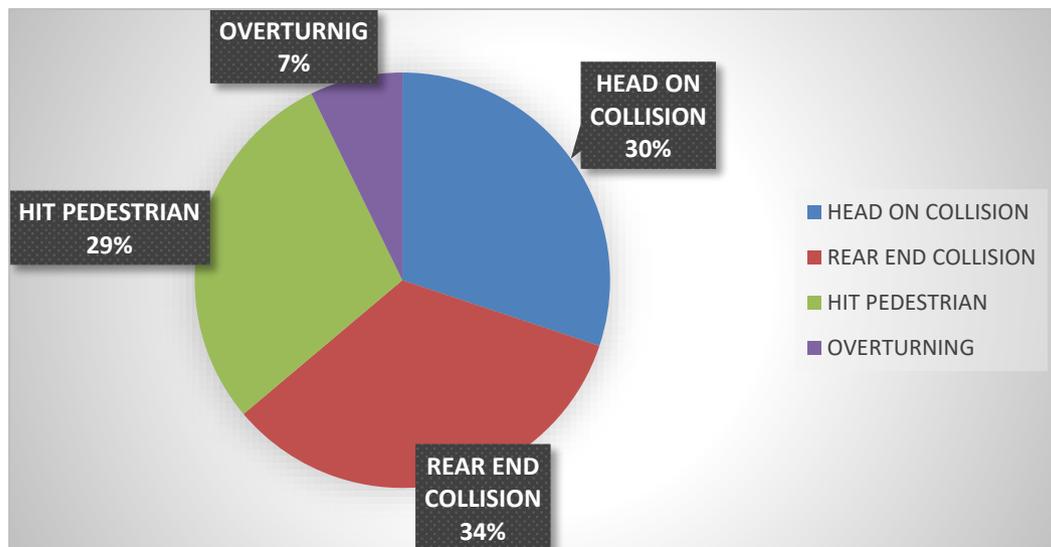
**Figure 11.** Yearly variation of AADT on Rajshahi - Sirajgang highway.

From the year 2008 to 2015 in Rajshahi - Sirajgang highway highway 16 persons were killed, grievously injured 28 and minor injured persons were 38. The percentage of different types of injury are presented in Figure 12.

From the year 2014 to 2015 there were 30% head on collisions, 34% rear end collisions, 29% hit pedestrians and 7% overturning occurred as shown in Figure 13. The reason of the higher percentage of head on collision is the mixed traffic and the absence of elevated lane separator. By providing elevated road lane separator and developing the highway into four lanes these problems can be eradicated.

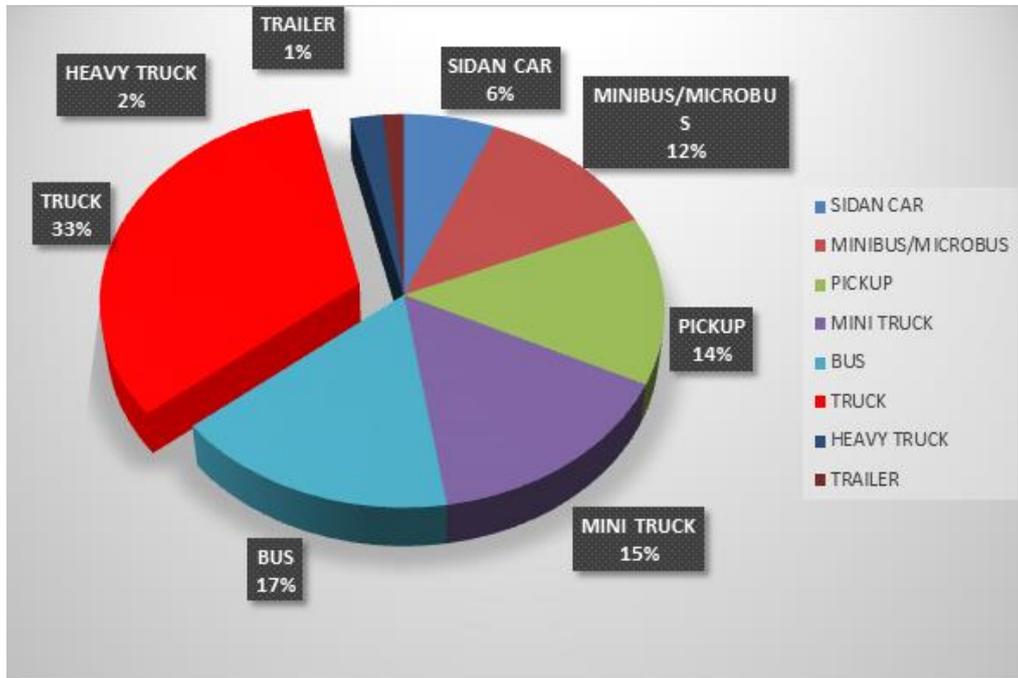


**Figure 12.** Percentage of different types of injury on Rajshahi - Sirajgang highway (2008 to 2015).



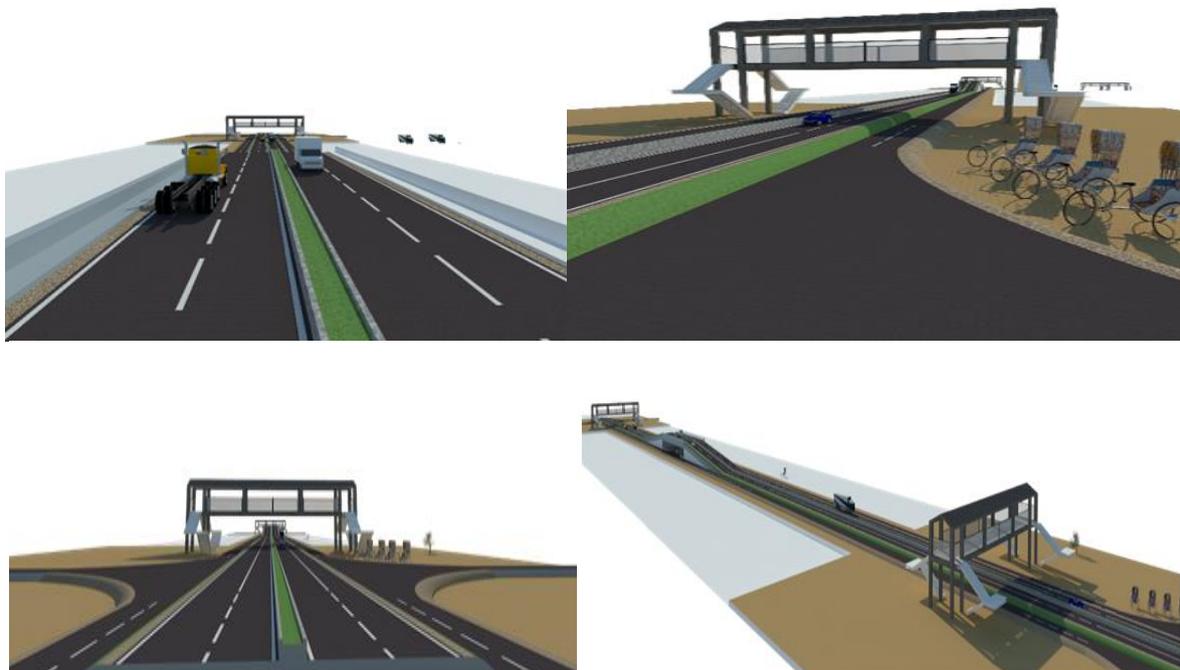
**Figure 13:** Different types of accidents on Rajshahi - Sirajgang highway (2014 to 2015).

It is notable that the percentage of truck, heavy truck & mini truck are collectively 50% which is half of the total vehicle. In Figure 14, it can be seen that truck is the vehicle which is involved in road accidents in most of the cases. To solve this problem, developing the highway into four lanes with an elevated road separator will be very useful. These may decrease head on collision. In some cases it is seen that truck is slower than other vehicle types in case of average speed. So, overtaking zones should be provided for smooth overtaking operation.



**Figure 14.** Percentage number of vehicles of different types of Rajshahi - Sirajgang highway (2014 to 2015).

#### 4. KEY PROPOSALS FOR RAJSHAHI - SIRAJGANG HIGHWAY



**Figure 15.** Proposed 3D model of Rajshahi - Sirajgang highway.

From the investigation and analysis of all the traffic accident data of the selected highway, it can be concluded that by implementing following proposals, traffic accident and corresponding losses can be reduced significantly.

- Conversion of the highway to four lanes with elevated lane separator.
- Grade separated intersections for crossing of vehicle from uncontrolled access and foot over bridge for pedestrian crossing.
- Widening of pavement width of sharp curves with elevated separators.
- Providing side road in the both sides of the highway.
- Strict application of traffic rules and regulations

Enlightening these proposals pictures of the proposed 3D model are given in Figure 15.

## **5. CONCLUSIONS**

It is clear that on Rajshahi - Sirajgang highway the trend of the accident is an uncertain motion. So after analyzing the data it can be said that the accident rate in Rajshahi - Sirajgang highway is worsening day by day. For safe crossing of the slow moving vehicle from the side road an overpass bridge can be constructed for heavy vehicles to avoid conflict. Such a solution is provided in the proposed 3D model. From the investigated result, it is observed that there are a lot of problems. To better investigate the following topics in this field can be studied:

- Identification of road accident with details throughout the year.
- Development of responsibility for every person for road safety.
- Study of the role of highway traffic to control the road accident in this region.
- To find out the new technology that can implement in this highway to overcome the existing problems.

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