VULNERABLE ROAD USERS (VRUS) SAFETY IN BANGLADESH

Dr. Md. Mazharul Hoque
Professor, Department of Civil Engineering and
Founding Director, Accident Research Institute (ARI),
Bangladesh University of Engineering and Technology (BUET)

Mohammad Faizus Salehin
Lecturer, Department of Civil Engineering,
Bangladesh University of Engineering and Technology (BUET)

ABSTRACT
Traffic crashes in Bangladesh result in an unacceptably high socio-economic toll that has been growing due to inadequate attention and under-investment in safety. According to World health Organization (WHO), more than 20,000 deaths from road traffic crashes are estimated to occur annually in Bangladesh, while around 4000 deaths are officially reported. Nearly 70 percent of road traffic fatalities are attributed to Vulnerable Road Users (VRUs) - pedestrians, bicyclists, motorcyclists, and users of informal and unsafe motorized and non-motorized transport. It has been observed from the studies that around 50 percent road deaths are pedestrians alone and in Dhaka city, they represented around 75 percent. Pedestrian-vehicle conflicts are therefore clearly the greatest problem with significant involvement of trucks and busses. Heavy vehicles, especially buses and trucks, are mostly involved in fatal accidents. They are particularly prevalent in crashes involving VRUs.

The road environment factors are particularly prevalent and unregulated private/business access to inter-urban highways leads to endless linear settlements resulting in high risks for pedestrians and other vulnerable road users. Several road environmental and behavioral factors force the VRUs to be exposed in high risk situation which eventually results in high number of road deaths. Highways are particularly hazardous for VRUs - rated as 2-stars or less (out of possible 5-stars) for vehicle occupants, pedestrians, motorcyclists and bicyclists as revealed from the results of the iRAP assessment of two busiest highways in Bangladesh. This paper argues that road infrastructure safety improvement is the priority issue for protecting the VRUs in Bangladesh and most importantly, for achieving the goals and targets of the Decade of Action. The paper emphasizes on the systematic implementation of a range of affordable cost-effective countermeasures related to road infrastructure within the principles of the Safe System Approach for protecting the legitimacy and safety of VRUs.

1 INTRODUCTION
Road safety is a serious public health issue worldwide, particularly so in the developing countries. Recent figures estimate conservatively that some 1.3 million people are killed each year in road crashes and further 50 million people are injured (WHO, 2009). More than 9 out of 10 of these road deaths occur in low- and middle income countries (LMICs), despite the fact that only half of the World’s vehicles are in these countries. The safety situation is predicted to be worse in the coming years unless this critical problem of epidemic nature is seriously addressed with significant improvements in the relevant sectors in a sustainable
manner. Concerningly, half of the World’s road death victims are the Vulnerable Road Users (VRUs) and they are most prevalent in such LMICs. The nature and the scale of the VRU safety problems in some developing countries in the Asia Pacific region could be seen in ADB (1997).

Bangladesh being one of the LMICs with rapidly growing motorization has a serious and worsening road safety problem. World health Organization (WHO) estimates that about 20,000 deaths occur annually in Bangladesh from road traffic crashes, while around 4000 deaths are officially reported. Analysis of reported crash data shows that nearly 70 percent of road traffic fatalities are attributed to the VRUs. This paper presents an overview of road safety issues of VRUs in Bangladesh by presenting some striking characteristics of their involvement in road crashes. The paper illustrates some behavioral and road infrastructural features that are contributing to the over involvement of VRUs in road crashes. Selective promising actions and measures to mitigate the problem are also discussed in the paper. Particular emphasis has been placed on the issues of road infrastructural safety improvements for VRUs.

2 VULNERABLE ROAD USERS IN BANGLADESH

2.1 The Context
Bangladesh is a very densely populated country in South Asia with nearly 160 million inhabitants living in an area of about 0.15 million square kilometer. The transportation system in this country is predominately road based with different types of motor vehicles viz. motorcars, jeeps, micro buses, taxis, buses, minibuses, trucks, 3-wheelers, motorcycles and non motorized vehicles like pedal bicycles, cycle-rickshaws, vans etc. Despite rapid growth rate of motorized vehicles, around 11% (BRTA 2012), the motorization level remains very low, around 10 vehicles per 1000 inhabitants. Of the total 1.7 million motorized vehicles, motorcycle alone constitutes nearly 50 percent of the total fleet. Apart from these motorized vehicles, there are approximately 4 million bicycles and 1.5 million rickshaws in the country and numerous push carts and animal drawn carts. Therefore the VRUs which include pedestrians, bicyclists, motorcyclists and users of informal and unsafe motorized and non-motorized transport still remain the major road users of this country. These VRUs are the inseparable part of the country’s transport system. Most of the population is dependable on such mode of transport. The NMTs are remarkably efficient in comparison with other modes of transport in this country and benefits the less well off in society either as users, or as suppliers of services (Habib and Iman, 2003). Despite their socio-economic and environmental advantages they are given very little consideration in country’s transportation planning.

These VRUs are in general slow-moving and exposed and at higher risk of injury when their travel path conflicts with those for the high speed motorized vehicles. The lack of external protection is the most fundamental features of VRUs which cause them to be fatally injured even when the collision speed is not that high. The irony is that most of the VRUs of this country have little choice but to travel along roads in close proximity to fast vehicles. As a consequence, they found themselves in a high risk situation, which inevitably leads to large numbers of crashes. Due to absence of proper regulation and dedicated facilities for this vast group of road users they consequently become the worst sufferer of road crashes in this country. Therefore, it is crucially important to realize that facilitating VRUs and ensuring
their safety are the key to ensure a sustainable transportation system under mixed traffic condition in the foreseeable future.

2.2 VRUs’ Mobility in Urban Areas
A significant part of the urban population is very poor and cannot afford to have any form of motorized or non-motorized transport of their own. They mostly depend on walking for their daily trips to work, school and shopping. About 65 percent of urban short trips up to one mile are made by the pedestrians walking on foot and in medium sized cities it constitutes about 40 percent short trips. Due to lack of walking facilities, channelization and fencing devices and encroachment of existing footpaths, huge pedestrians are found in scattered form all over the urban streets either travelling along with the motorized vehicles or crossing the streets randomly. Sometimes there are no dedicated pedestrian facilities at critical junctions even. Figure 1 shows the level of exposure of the VRUs in the mixed traffic features of urban streets.

Figure 1: Typical Urban Streets of Bangladesh

Cycle rickshaws too cater quite significant proportion of trips (25 to 40 percent) in cities. About 40 per cent of the metropolitan populations are directly or indirectly dependent upon rickshaws. For medium sized cities, almost 60 percent of trips are attributed to cycle rickshaws. Although this mode of transport has some advantage from environmental point of view but their indiscriminate plying in the urban mixed traffic condition often led them to collisions among themselves and with motorized traffic. Since they have very less momentum (mass times velocity) while in motion and have no protective shell for the driver and
passenger, the travelers often have minor to serious injuries in the event of a collision with a motorized vehicle.

The usage of bicycle as travel mode in urban areas is quite less, accounting for between 2 and 5 percent in metropolitan Dhaka. The bicycle share is however more in medium sized cities, nearly 5 percent. Its usage is discouraged because it is very much unsafe to ride a bicycle in urban mixed traffic condition with no dedicated facility for bicycle. On the other hand, usage of motorcycle is very rapidly increasing. Aggressive driving, non-wearing of helmets especially by the younger drivers, driving at a very high speed and overloading the motorcycle with three or more passengers are making this mode very unsafe and resulting increased numbers of motorcycle related accidents.

2.3 VRUs’ Mobility in Rural Areas
The income level of rural population is even less compared to those in the urban areas. Hence their dependence on walking mode of travel is much more prominent than urban people. They are exposed to serious risk particularly on rural highways along unregulated roadside markets, schools and workplaces. There is virtually no protection for them except their self cautiousness. Industrial workers and school going children tend to walk along the highways or cross them in groups posing them to serious risk of traffic crashes.

Apart from walking, informal motorized vehicles cater quite significant proportion of trips. These informal motorized vehicles are locally made three wheel auto rickshaws that use shallow irrigation engine. They have no system of applying brake properly and thus very much prone to accidents. Besides these vehicles have no fitness for driving in the road, the local drivers have no driving training and knowledge on road safety. Yet, they are the predominant mode of transportation in the rural areas because people hardly have any alternative choices and therefore, the users are being exposed to significant safety hazards. Figure 2 gives an idea about the characteristic situations and the traffic operational hazards on rural roads.
The usage of bicycles and motorcycles is quite high in the rural areas in comparison with their usage in the urban areas. Their risk of being involved in a multi-vehicle crash is very much severe in the rural highways.

3 ACCIDENTS INVOLVING VRUS IN BANGLADESH

Analysis of reported crash data reveals that nearly 70 percent of road fatalities in urban areas of Bangladesh are attributed to VRUs with pedestrian being by far the largest group. The VRUs are also the dominant group in rural fatalities, accounting for around 50 percent of the fatalities. Table 1 shows the share of different road user groups in the total road casualties.

Table 1: Road Casualties by User Groups in Urban and Rural Areas of Bangladesh (2008)

<table>
<thead>
<tr>
<th>User Groups</th>
<th>Urban</th>
<th>Percent</th>
<th>Rural</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedestrian</td>
<td>818</td>
<td>46.8%</td>
<td>1270</td>
<td>31.6%</td>
</tr>
<tr>
<td>Bicycles and Rickshaws</td>
<td>203</td>
<td>11.6%</td>
<td>396</td>
<td>9.8%</td>
</tr>
<tr>
<td>Motorcycles</td>
<td>123</td>
<td>7%</td>
<td>233</td>
<td>5.8%</td>
</tr>
<tr>
<td>Baby Taxi/Tempo/Microbus</td>
<td>128</td>
<td>7.3%</td>
<td>489</td>
<td>12.2%</td>
</tr>
<tr>
<td>Car/Jeep/Pickup</td>
<td>60</td>
<td>3.4%</td>
<td>220</td>
<td>5.5%</td>
</tr>
<tr>
<td>Buses</td>
<td>264</td>
<td>15.1%</td>
<td>1023</td>
<td>25.4%</td>
</tr>
<tr>
<td>Trucks</td>
<td>78</td>
<td>4.5%</td>
<td>348</td>
<td>8.7%</td>
</tr>
<tr>
<td>Others</td>
<td>73</td>
<td>4.2%</td>
<td>43</td>
<td>1.1%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>1747</td>
<td>100%</td>
<td>4022</td>
<td>100%</td>
</tr>
</tbody>
</table>

3.1 Pedestrian Accidents

- Pedestrian had always been the worst sufferer of road accidents in this country. Of the total fatalities their share varies around 50 percent (Table 2), although in the recent years there is slight improvement in this regard. However, the share of pedestrian
fatalities in Dhaka city is much higher, around 80 percent, as revealed in the following data:

- In 1986-87 - pedestrians 43 percent
- In 1991-92 - pedestrians 67 percent
- In 1998-99 - pedestrians 69 percent
- In 2002-03 - pedestrians 76 percent
- In 2005-06 - pedestrians 80 percent
- In 2009-10 - pedestrians 75 percent

Table 2: Share of Pedestrians in Road Accidents and Fatalities (2001-2010)

<table>
<thead>
<tr>
<th>Year</th>
<th>No. of Accidents</th>
<th>No. of fatalities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Pedestrian</td>
</tr>
<tr>
<td>2001</td>
<td>2925</td>
<td>1438(49)</td>
</tr>
<tr>
<td>2002</td>
<td>3941</td>
<td>1927(49)</td>
</tr>
<tr>
<td>2003</td>
<td>4114</td>
<td>1942(47)</td>
</tr>
<tr>
<td>2004</td>
<td>3566</td>
<td>1817(51)</td>
</tr>
<tr>
<td>2005</td>
<td>3322</td>
<td>1771(53)</td>
</tr>
<tr>
<td>2006</td>
<td>3566</td>
<td>1891(53)</td>
</tr>
<tr>
<td>2007</td>
<td>3954</td>
<td>2157(55)</td>
</tr>
<tr>
<td>2008</td>
<td>3800</td>
<td>1951(51)</td>
</tr>
<tr>
<td>2009</td>
<td>2815</td>
<td>1392(49)</td>
</tr>
<tr>
<td>2010</td>
<td>2437</td>
<td>1224(50)</td>
</tr>
<tr>
<td>Total</td>
<td>34440</td>
<td>17510 (51)</td>
</tr>
</tbody>
</table>

Note: Figures in brackets represent pedestrian percentage.

- Most of pedestrian fatalities occur at roadsides, 45 percent which is followed by on road 38 percent and at pedestrian crossing points, 12 percent.
- Most of the pedestrian fatalities occur while crossing the road (41%) and is closely followed by walking on the road (39%), and standing on road (14%).
- Heavy vehicles such as trucks and buses including minibuses are major contributors to road accidents and are particularly over involved in pedestrian accidents accounting for about 72 percent of urban pedestrian fatalities.

3.2 Involvement of Children in Road Accidents

- Child involvement in road fatalities in Bangladesh is found to be very high, about 21% of all fatalities are children below the age of 16 years.
- Of the total child fatalities, nearly 82 percent involved as pedestrians with the dominant age group of 5-10 years. About one- third of total pedestrian fatalities are children under the age of 15 years. They are the dominant age group of pedestrian fatalities.
- Of the total child fatalities in road accidents, nearly 80% are involved as pedestrians with the dominant age group of 5-10 years. About 18% are as passengers and 2% are
as cyclist. Figure 3 shows the distribution of child fatalities in three age groups as different road users.
- Children account for 16% of all cyclist fatalities.
- Children fatalities in rural areas are 3 times higher than that of urban areas.

![Figure 3: Child fatalities by age groups as respective road users (Source: Hoque & Mahmud 2012)](image)

### 3.3 Involvement of Bicycles and Cycle Rickshaws in Accidents
- Around 800 fatalities have been attributed to cycle rickshaws and bicycles in urban areas of Bangladesh during 1998-2006, which represented nearly 12 percent of total urban road deaths.
- On average 30 bicycle deaths and 60 cycle rickshaw deaths each year are reported by the police.
- The predominant types of bicycle accidents are rear end (58%) and head on (21%) and for cycle rickshaw the predominant type of accidents are rear end (70%) and head on (15%), indicating a serious problem of being hit from behind in the traffic streams and thus merits separating them by traffic segregation.
- Most of the accidents take place during day time, 6 am to 6 pm, (83% bicycle and 71% cycle rickshaw).
- Nearly 70 percent of such fatalities occur on mid block sections while the rest 30 percent occur at intersections. This again demonstrates the need for separate facilities for their protection.
3.4 Involvement of Motorcycles in Accidents

- Over the last twelve years motorcycle accident has increased from 5.6% in 1999 to 8.9% in 2010.
- Motorcycle accidents are predominantly rural problems (around 70% of all motorcycle accidents) which indicate the effects of speeding.
- The predominant type of motorcycle accidents is head-on collision (29%), followed by hit pedestrian (28%) and rear-ends (24%).
- Around 64% of motorcycle accidents occur in link or mid-block of carriageway, followed by 13% at T-junctions and 10% at cross junctions.
- Nearly three quarters of motorcyclist fatalities are attributed to non wearing of safety helmets.
- The majority of the victims (around 70%) are aged around 21 to 40 yrs.

4 FACTORS IN VULNERABLE ROAD USERS’ SAFETY

The prevalence of some factors and circumstances attributed to crashes involving VRUs are briefly discussed in this section.

4.1 iRAP Infrastructure Risk Assessment

In terms of crash severity, road condition is regarded as the single most lethal contributing factor in road crashes (World Bank 2009). Likewise, the local safety practitioners believe that the road safety problems especially for the VRUs’ are greatly compounded by the serious incompatibility of the existing roadway conditions. The International Road Assessment Program (iRAP) - Bangladesh Pilot Project (iRAP 2010) provided the first comprehensive infrastructure risk assessment of the N2 and N3 highways. More details about the iRAP Project and the potential and applicability of iRAP in road infrastructure safety assessment in Bangladesh can be found in Hoque et al. (2010) and iRAP (2011).

The iRAP assessment showed that despite recent large-scale upgrades to one of the busiest highways (N2: Dhaka-Sylhet highway) road users still face a high level of risk. Another busy highway (N3: Dhaka-Mymensingh highway) is also categorized as high risk for all road users. Table 3 provides a summary of the Star Ratings for each of the roads by road user type. Concerningly, the majority of the N2 and N3 are rated 2-stars or less (out of possible 5-stars) for all road users which is indicative of high level of risk of deaths and injuries and are attributable to serious road infrastructure deficiencies and uncontrolled linear developments fronting the highways. The hazardous situation of the VRUs viz. pedestrians, bicyclists and motorcyclists are particularly alarming. Currently iRAP has taken another initiative to assess further 1300 km of the national highway network which will provide strong basis to develop strategies and intervention programs for protecting the VRUs on a firmer basis.
Table 3: Overall Star Ratings for the N2 and N3

<table>
<thead>
<tr>
<th>Star Rating</th>
<th>Vehicle occupants</th>
<th>Motorcyclists</th>
<th>Bicyclists</th>
<th>Pedestrians</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length (km)</td>
<td>%</td>
<td>Length (km)</td>
<td>%</td>
</tr>
<tr>
<td>Highway N2 (Dhaka-Sylhet highway)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Star</td>
<td>2</td>
<td>1%</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td>4 Star</td>
<td>14</td>
<td>6%</td>
<td>11</td>
<td>5%</td>
</tr>
<tr>
<td>3 Star</td>
<td>45</td>
<td>20%</td>
<td>7</td>
<td>3%</td>
</tr>
<tr>
<td>2 Star</td>
<td>160</td>
<td>70%</td>
<td>147</td>
<td>64%</td>
</tr>
<tr>
<td>1 Star</td>
<td>8</td>
<td>3%</td>
<td>63</td>
<td>28%</td>
</tr>
<tr>
<td>Not rated</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>229</td>
<td>100%</td>
<td>229</td>
<td>100%</td>
</tr>
<tr>
<td>Highway N3 (Dhaka-Mymensingh highway)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Star</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>4 Star</td>
<td>6</td>
<td>7%</td>
<td>6</td>
<td>6%</td>
</tr>
<tr>
<td>3 Star</td>
<td>13</td>
<td>15%</td>
<td>1</td>
<td>1%</td>
</tr>
<tr>
<td>2 Star</td>
<td>60</td>
<td>67%</td>
<td>47</td>
<td>53%</td>
</tr>
<tr>
<td>1 Star</td>
<td>10</td>
<td>12%</td>
<td>36</td>
<td>41%</td>
</tr>
<tr>
<td>Not rated</td>
<td>0</td>
<td>0%</td>
<td>0</td>
<td>0%</td>
</tr>
<tr>
<td>Total</td>
<td>90</td>
<td>100%</td>
<td>90</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: numbers might not add due to rounding

Some of the factors driving the relatively poor Star Ratings are:

- High pedestrian flows along and across the roads and poor provision of footpaths and crossings mean the risk of serious pedestrian crashes occurring is high (see Figure 4 below). More than 90 percent of the N2 and N3 do not have footpaths in place, and the average distance between zebra crossings is 9km (it may also be argued that zebra crossings are inappropriate for roads carrying this volume of traffic)
• High overtaking demand (caused by large speed differentials between vehicles) and very little median separation (96 percent of the N2 is undivided and 98 percent of the N3 is undivided) contributes to a high risk of serious head-on crashes.
• Some 97 percent roadsides on the N2 and all roadsides on the N3 are coded as severe, having fixed objects or steep embankments within 10 meters of the pavement. This increases the risk that a run-off road crash will result in severe injuries.
• Poor quality, at-grade intersections are frequent (on average 1 every 1.6km). This increases the likelihood of severe intersection crashes occurring.

4.2 Observed Risk Factors and Issues of Concern
Observational studies of accidents in the context of Bangladesh have documented many varied factors. Typically the principal contributory factors of accidents of vulnerable road users are (Binnie partners 1994; Haworth 1995; Hoque 2006):
• Mix traffic with a variety of vehicle characteristics and speeds,
• Failure to obey mandatory traffic regulations,
• Conflicting use of roads
• Illegal and inconsiderate driving practices
• Adverse roadway and roadside environment
• Pedestrian and vehicle conflicts
• Failure to enforce traffic safety laws
• Inadequate and unsatisfactory of education of road users
• Poor detailed design of junctions and road sections
• Failure to give way and non-compliance of traffic rules
• Lack of lane disciplines
• Non-wearing of motorcycle helmets
• Failure to slow down when approaching intersections
• Excessive speeding, overloading, dangerous overtaking,
• Hazardous front ends of motor vehicles
The other major issues of concern for accidents of VRUs in Bangladesh are defective and road unworthy motor vehicles, drivers’ incompetency, low level awareness of the safety problems, absence of safety policies to protect poor people and inadequacy of safety research and investigation. Countermeasures and pragmatic policies need to be developed taking cognizance of the above factors and issues in mitigating the safety problem of vulnerable road user groups.

5 SOME SAFETY IMPROVEMENT OPTIONS

5.1 The Safe System Approach
One of the most recent advances in tackling road safety is the introduction of the concept of the Safe System approach. It aims to reduce the likelihood that crashes occur, and minimize the severity of those that do happen (World Bank, 2009). This approach puts particular emphasis on safe roads along with the mutual importance of safe road users, safe vehicles and safe speeds. The Safe System approach is very effective in preventing road deaths and serious injuries on large scale and its potential in less motorized countries like Bangladesh is enormous. Given the road environmental situation and hazards associated with VRUs, as discussed in the preceding sections, the systematic implementation of safe system approach can enhance the safety of the VRUs significantly. Recognizing the importance of adopting Safe System approach for the safety of the VRUs, this paper in particular highlights some of the safety options related to road infrastructural improvements. Indeed safer roads have the capacity to address key crash types and play an important role in addressing behavioral issues and makes travel safer for all road users (World Bank, 2009). Evidence (TRL 1991) suggested that excessive speed and driver inattention are a common occurrence at accident blackspots. This characteristic is fairly prevalent in Bangladesh as well. Therefore, countermeasures designed to alert drivers to the conditions and to encourage or force them to reduce speed is of paramount importance for the VRUs.

5.2 Some Priority Road Improvement Options

5.2.1 Facilities for Pedestrians
Given that ‘hit-pedestrian’ is the most dominant type of accident in Bangladesh, providing pedestrian footpaths and adequate pedestrian crossings including grade separated pedestrian crossing facilities are two very effective measures to reduce pedestrian deaths and deserve urgent attention. Implementation of innovative traffic calming measures as a part of urban safety management is urgently needed to improving pedestrian safety substantially. Indeed traffic calming is meant to benefit a wider group by reducing speeds and volumes and can also provide self enforcing speed reductions. Installing pedestrian safety barriers can play a vital role to channel the pedestrians away from the main traffic stream. Apart from these, pavement width can be slightly narrowed down by increasing median width or installing medians if they are missing at high pedestrian zones to encourage lower speed. Safety barriers and fences should be installed and maintained wherever warranted to prevent the pedestrians to cross the carriageways randomly and indiscriminately. Raised crossings and speed humps have to be installed on high risk sites. Pedestrianisation of some streets and areas are also a priority in Bangladesh.
5.2.2 Traffic Separation and NMV

Physical separation of non-motorized vehicles can be ensured by providing adequate and paved shoulders for NMV to ply on. From the country’s economical perspectives, completely removing NMVs from the main fast moving traffic stream is perhaps not feasible which demands intelligent design and innovative principles and separation methods in providing dedicated lanes and spaces for them. Raised and segregated kerb separated lanes at limited locations are found to be highly beneficial in Dhaka. Separation of two- and three wheeled motor cycles from large, high speed vehicles merits attention for increased motorcycle safety. Standard and policy frameworks have to be developed through studies and research to help road engineers in tackling VRUs’ safety in significantly mixed traffic situation in Bangladesh.

5.2.3 Improvement of Junctions

The potential for conflicts between non motorized and motorized vehicles is greatest at junctions. Therefore, a significant portion of VRU crashes occur at junctions which very often become accident blackspots. At present lack of channelization and proper signal controlling are causing many confusion and conflicts at the critical junctions. Presently, there is no practice of pedestrian only signal phase in this country and sometimes there is no pedestrian facility like overpass or underpass at many intersections. At times, buses stopping at or near the junction for boarding and alighting of passengers are aggravating the situation. Improving junctions by proper channelization, installing refuge islands for pedestrians, providing bus lay by away from the junctions and enforcing proper safety practices can effectively improve the overall road safety.

5.2.4 Treatment of Shoulders and Medians

In the absence of adequate shoulders pedestrians, cyclists, rickshaw and other animal drawn traffics are forced to share the carriageway with fast moving motorized traffic. Providing suitable shoulder will not only minimize side friction for the fast moving vehicle but also will provide greater recovery and maneuvering space.

Median barriers can be very effective on the high speed roads of this country and will have safety implications on both motorists and pedestrians. Providing median barriers will prevent undesirable, dangerous and risky overtakings and thereby eliminate ‘head-on’ crashes. Installation of central refuges and islands where appropriate will be highly beneficial. Refuges are indeed considered to be the simplest and cheapest method of protecting pedestrians.

5.2.5 Effectiveness of Priority Countermeasures

Most recently iRAP launched a project in Bangladesh with the purpose of providing Safer Road Investment Plans (SRIP) which suggested several countermeasures that can affordably and economically reduce risks and prevent deaths and serious injuries. Some of the selected engineering countermeasures from the iRAP proposed countermeasures list that would yield greater safety benefits and deserve urgent attention are (for example)- pedestrian fencing, upgrade pedestrian facility quality, bicycle lane (on road & off road), signalized intersections, shoulder sealing etc. shown to have benefit cost ratios between 15 and 105 (iRAP Bangladesh Technical Report, 2013).
6 CONCLUSIONS AND DISCUSSIONS

Addressing VRUs’ safety is crucial for achieving the goals and targets of the Road Safety Decade of Action in Bangladesh. This paper has made an attempt to highlight some of the striking problem characteristics and challenges of VRUs’ safety in Bangladesh. Nearly 70 percent of road fatalities in urban areas of Bangladesh are attributed to VRUs with pedestrians being involved in around 50 percent of all fatalities. Motorcycle occupant deaths are increasing alarmingly along with its increased rate of registration. A combination of increasing volume of vehicles on the road, complexity of heterogeneous mix of vehicles, poor road infrastructure, unsafe vehicles, risk taking behavior of general public, poor enforcement of traffic laws and lack of proper regulation and dedicated facilities for the VRUs force the VRUs to be exposed in the high risk situation which eventually results in high number of road deaths. Highways are particularly hazardous for VRUs- rated as 2-stars or less (out of possible 5-stars) for vehicle occupants, pedestrians, motorcyclists and bicyclists as revealed from the results of the iRAP assessment of two busiest highways in Bangladesh. Road infrastructure safety improvement is clearly a priority issue for protecting the legitimacy and safety of the VRUs in Bangladesh. The paper argued that the systematic implementation of a range of affordable cost-effective countermeasures related to road infrastructure within the principles of the Safe System Approach is an urgent necessity. It also identified some of the engineering measures that would yield greater safety benefits for VRUs.

REFERENCES

Asian Development Bank (ADB) (1997), Vulnerable Road Users in Asia-Pacific Region, Regional Technical Assistance in Road Safety (RETA 5620), ADB.

Bangladesh Road Transport Authority (BRTA) (2012), Statistics on Registered Motorized Vehicles in Bangladesh.

Binnie partners (1994), Preparation of Structure plan, Master plan and Detailed Area plan for Chittagong, Component 2C: present situation report, traffic and transportation in Chittagong, Project BGD/88/052, UNDP/UNCHS (Habitat), Govt. of Bangladesh.


International Road Assessment Program (2010), Bangladesh Technical Report.

International Road Assessment Program (2013), Bangladesh Technical Report.
International Road Assessment Program (2011), *iRAP Assessment of Risk on National Highways in Bangladesh*, iRAP Pilot Project in Bangladesh.

MAAP5, *Accident Database*, maintained by Accident Research Institute, Bangladesh University of Engineering and Technology, Dhaka, Bangladesh.
