SUSTAINABILITY OF NATIONAL HIGHWAY SYSTEM IN INDIA : LESSONS LEARNT

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ABSTRACT

India is going through a transitional phase of economic growth and development in recent years. The Government of India has invested a significant amount of fund for road development throughout India. A significant percentage of these roads are high speed roadways. While there is a false notion about the functional characteristics of these highways— classifying them as "uninterrupted flow facilities", often these highways are what is known as multilane highway elsewhere. Thus, the access controls of these highways are close to (or even worse than) multilane highways and in no way near to "true uninterrupted flow facilities". This has implications both on mobility and safety— the two very important indicators of sustainability. The situation is even more difficult since the needs of road users in *mixed* traffic are very different and often conflicting. The obvious result is that vulnerable road users (VRU) like bicycles and pedestrians are often at high risk due primarily to the absence of adequate facilities, or due to ill planning or design of such facilities. However, a recent case study conducted near Kharagpur, over a 100 km stretch of National Highway (NH) provided somewhat interesting insights to this problem. There are strong evidences that 3Es "engineering", "education" and "enforcement" have their distinct role in making the study stretch of NH to be unsafe and non-sustainable in its present form to such an extent that noble cause of road development is questioned. Some areas of improvements are identified with appropriate countermeasures so that concerned authorities adopt a plan for safe and sustainable NH.

Key words: Safety and sustainability, mixed traffic, vulnerable road users

1. INTRODUCTION AND BACKGROUND

India is going through a transitional phase of economic growth and development in recent years. The Government of India has allocated a significant amount of fund for road development throughout India through programs like National Highway Development Program (NHDP), Pradhan Mantri's Gram Sadak Yojona (PMGSY), which enhance connectivity with cities and villages. Ministry of Road Transport and Highways (MoRTH) is responsible for road development and maintenance in general and National Highway Authority of India (NHAI), an agency under the Government of India and an agency of MORTH, is responsible specifically for National Highway (NH) development and maintenance in India. The NHs are high speed facilities meant primarily for mobility and they connect major cities and states in India. India is building such high speed roads under NHDP since year 2000. While roads are being built for economic enhancement of the country, India is loosing more than 3% of National GDP each year from road traffic accidents (Sundar committee report, 2007). NHAI and MORTH recognize the importance of improving road safety along NHAI roads. A report by Asian Development Bank (World Bank, 1995) identified that the traffic accidents and deaths along National Highways in India have been high when compared to similar roads in the Asian countries. The numbers of traffic accidents and deaths have been growing in the recent years, with the increase in the number of vehicles on the roads. A report by MoRTH (Sundar Committee report, 2007) indicated a steady increase in road traffic accidents from 391449 in 2000 to 460920 in 2006. During the same time fatal accidents increased from 78911 in 2000 to 105749 in 2006. While the number of vehicle ownership has steadily increased during this time period, it is shocking to see a jump of total number of road accidents from 439255 in 2005 to 460920 in 2006, almost a 5% increase in a single year. During the same time, fatality increased by more than 11%, from 94968 in 2005 to 105749 in 2006. With many more new

NHs and four-laning of the major National roads, the number of traffic accidents and deaths are expected to further increase due to reasons such as lack of good engineering, improper enforcements and lack of education of road users. This has implication on sustainability of the NH since a sustainable transportation system must meet the mobility and accessibility needs by providing safe and environmentally friendly transportation. However, the elevated crash statistics on NHs question the sustainability of the system even though they are meant to enhance mobility of passenger and freight movement through road transportation throughout the country. A critical analysis of the current state of safety performance of NHs reveals some of the unique challenges that Indian National Highway transportation are facing and they need to be addressed before we expect any better safety performance. In the following sections these are described in detail with respect to a case study.

2. ROAD ENGINEERING

Under NHDP, India launched a massive program of highway upgrades, in which the main north-south (Kashmir to Kanyakumari) and east-west (Gujrat to Assam) connecting corridors and highways connecting the four metropolitan cities, i.e Delhi, Kolkata, Chennai, Mumbai have been fully paved and widened into 4-lane highways. Other NHs connecting major cities are mostly 2-lane highways. While a few busy stretches of NHs

are access controlled expressways, major portion of NHs can be classified as high speed multilane facilities with minimum or no control of access. These facilities often have intersections with state highways and other major roads. NHAI guidelines although specified the need for service lanes in built up areas and grade separated interchanges in urban areas for better management of access to NHs, most projects have often failed to include such facilities for reasons such as inadequate land acquisition and minimizing overall cost. Land acquisition for NHs in India would remain a major challenge since historically development of most built up areas were concentrated along the major highways and there was hardly any concept of clear zone in such areas. Consequently any lateral expansion at present day requires major political pressure and face opposition from stake holders. However, in a haste where the country is more interested in adding capacity and expanding its roadway network, the safety is often overlooked as it has been the case in almost all nations' history. Moreover, the problem is far more serious in India compared to other developed countries due to the mixed traffic condition with high percentage of vulnerable road users (VRUs) such as motorcycles, bicycles and pedestrians whose access must be controlled for safer operations.

2.1 Access management in mixed traffic

Access management/control is one of the critical elements of geometric design and is related to the management of the interference with through traffic (AASHTO). If access to a highway is managed, interference due to vehicles', pedestrians', bicyclists' entrance and exit could be minimized and they would get designated entrance and exit suitable for traffic and land use needs. As pointed out by AASHTO, the absence of access management encourages roadside businesses to develop haphazardly, which is happening in India in present time—thereby reducing capacity and increasing crash potential. Also, considerable portions of NHs traverse through suburban and rural locations, where a significant share of population is from low-income group. As a result, share of bicycle is very high since it is often an only form of private transportation other than walking a family can afford in rural and suburban regions. Rural population is also located in a scattered manner over a large geographical area. As a results bicycles are found not only on village roads (where motorized vehicles are not significant), but also on NHs, since they often provide the only direct connection between populated areas and there are no alternative roads connecting their origins and destination. Due to such reasons, infrastructure design that works for countries with homogeneous traffic mix may not be suitable for mixed traffic conditions with very large share of non-motorized traffic (NMT). Road design in India must meet the needs and requirements of motorized automobiles as well as NMTs for safer operations. This is undoubtedly a challenge since the needs of the two groups of users are very different and often conflicting. As rightly pointed out

by Tiwari (1999) for safer movements, the NMTs need to be provided with a safe infrastructure, either physically segregated road space from motorized traffic, or the speed of the motorized traffic must be reduced. Now the second option is meaningless in case of NHs since NHs are meant to provide mobility, the only option left in the context of NHs is to provide separate facility for NMTs. The question might rise as to why NMTs like bicyclists and pedestrians would be allowed in NHs since their entry is often prohibited in similar facilities elsewhere. In this context, it is important to remind what was mentioned before— that in India, rural population constitutes about 70% of the country's population and a significant share of rural population is from low-income group. Also, absence of alternative route between points with high demands for pedestrian and bicycle force them to use NHs. As a result, the designer must consider their effects on safety and act accordingly. As mentioned earlier that even though NHAI specification include that local traffic in built up area shall be separated with provision of service roads in all sections of the Project Highway, the provision is there ONLY WITHIN the limits of municipal towns having continuous length of 200 m or more in non-municipal areas where dwellings / shops have been built on one or both sides of the Project Highway on at least 50 percent of the total length of each such section (NHAI). However, this service roads are also missing in most locations where they qualify for and it is practically impossible to develop such continuous service roads alongside all national highways primarily due to lack of financial resources. It is also practically impossible to restrict the use of bicycles on NHs due to poor access management. It is therefore necessary to come up with innovative solution which is cost effective but will safeguard vulnerable road users like bicyclists and pedestrians and improve safety and sustainability of these high speed facilities.

3. FINDINGS AND RECOMMENDATIONS BASED ON A CASE STUDY

A case study was conducted on 120 km stretch of NH-6 between Dankuni (Located near Kolkata) and Kharagpur which is a part of Golden Quadrilateral (GQ) connecting two major cities— Kolkata and Chennai. The study stretch is currently a four lane divided facility with service lanes only at two suburban locations. A considerable part of this road goes through rural set up where there is no alternative roadway connecting the localities alongside of the NH-6. As a result the share of the non motorized traffic is very high along those stretches of NH-6. Also, there is only one interchange along this stretch and the rest of the intersections are at-grade with no traffic control devices except for channelization islands. As a result the numbers of potential conflicts are high at these locations. Increased number of incidents and accidents forced authorities to place traffic police on NH who designate right of way to oncoming traffic. While NHAI authority plan to convert all of these at-grade intersections to interchanges during its up gradation to 6-laning, the problem will remain for NMTs since grade separated facilities are not designed for NMTs. As a result the question still remains as to how these NMTs will be handled along the NH corridors where there is no alternative roadways. The problem is quite serious along those stretches where busy sections of SH were up graded to 4-lane NH with poorly managed access to businesses alongside the highway. In designing these new interchanges design of access also needs to be good, otherwise even after building expensive structures, little benefit will be achieved and over time access from nearby business may cause problem in traffic operation. The study area is a perfect example of a roadway, where anyone can get access almost anywhere especially the NMTs and highway parking to access roadside business is a common occurrence. While enforcement has a strong role to mitigate some of these issues, the planning and engineering for future NHs should consider the lessons learnt from NH6 on GQ and keep provisions for non-motorized traffic into country's expanding road network by providing designated space and with better access control. This is no doubt unique and challenging, but at the same time very essential for safety and sustainability of NH system. A preliminary survey of the study area indicate some of the obvious measures that NHAI can adopt as part of NH building, even though current specifications and code of practice has no provision for such measures. However, it is anticipated that sooner or later pertinent authorities would appreciate the need for adopting such inclusive and forgiving designs not only for safety but also from the view point of equity of access of various road users. Some of the plausible recommendations that could be worthwhile to consider are:

1. Service lanes will definitely be a good measure to alleviate unsafe interaction of bicyclists and

other non-motorized road users. However, it is practically impossible to develop such continuous service roads alongside all national highways due to lack of financial resources. Hence, the planning and construction of service roads will ONLY be governed by currently available NHAI specification. However, the justification of inclusion of such VRU friendly facilities should NOT be assesses only from the view point of improved mobility and travel time savings but also be based on the benefit of savings from VRU crash reductions.

2. An alternative to expensive service road will be construction of low cost service roads along the highway with subways or on street crossings at intersections. These service roadways will be separated by safety barrier and cut/fill slope will start from the outer edge as shown in Figure 1. Materials that may be used for such roadways include but not limited to compacted earth, water bound macadam (WBM), wet mix macadam (WMM) or other low cost materials suitable for the topography and weather conditions. These roads need to strong enough to carry NMT and they will also provide strength and stability to the motorized carriageway.

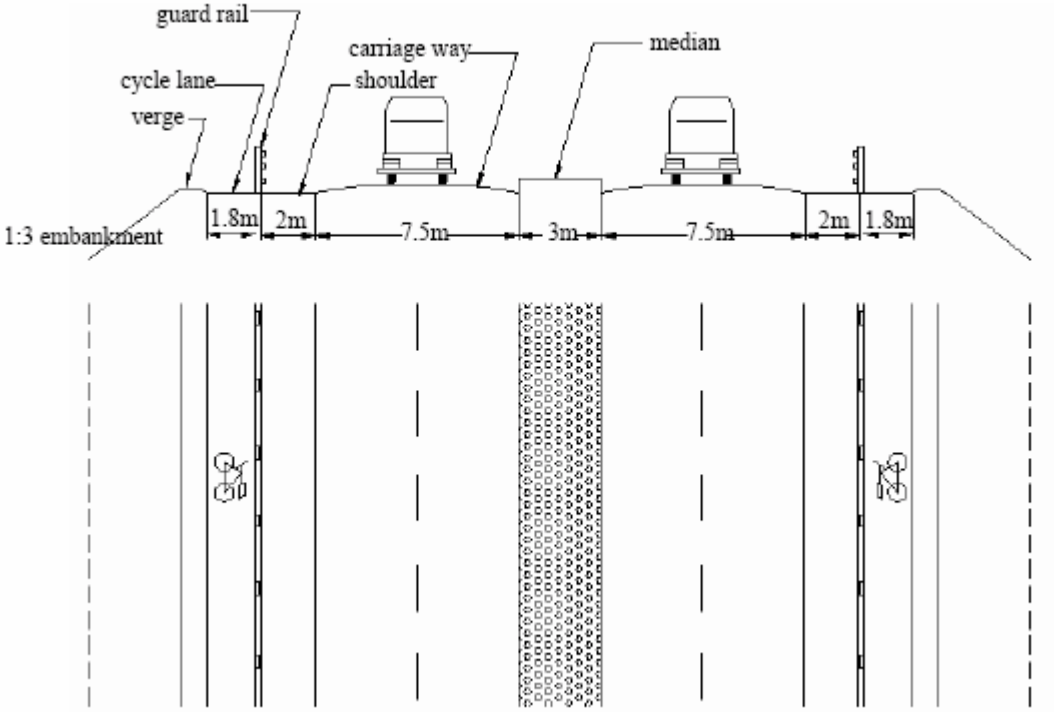

Figure 1. *Example of a 4-lane National Highway with cycle lane in both direction*

3. Another provision would be to construct wider shoulders with rumble strip separation (which will function very much like centerline rumble strip) between carriageway and shoulder. These rumble strips along the edge of the carriageway could be very effective in providing separation as well as cautioning inattentive drivers in case they shift towards outer shoulder. The design of these rumble strips can be very similar to center line rumble strip with a length between 10 and 12 inches (along the cross section) and a width of 6 inches along the direction of traveled way as shown in Figure 2. However, the only drawback this design may have is that it will not force NMT users outside the safety barrier thereby leaving some chance of their actually using the carriageway as they do presently due to lack of education and enforcement.

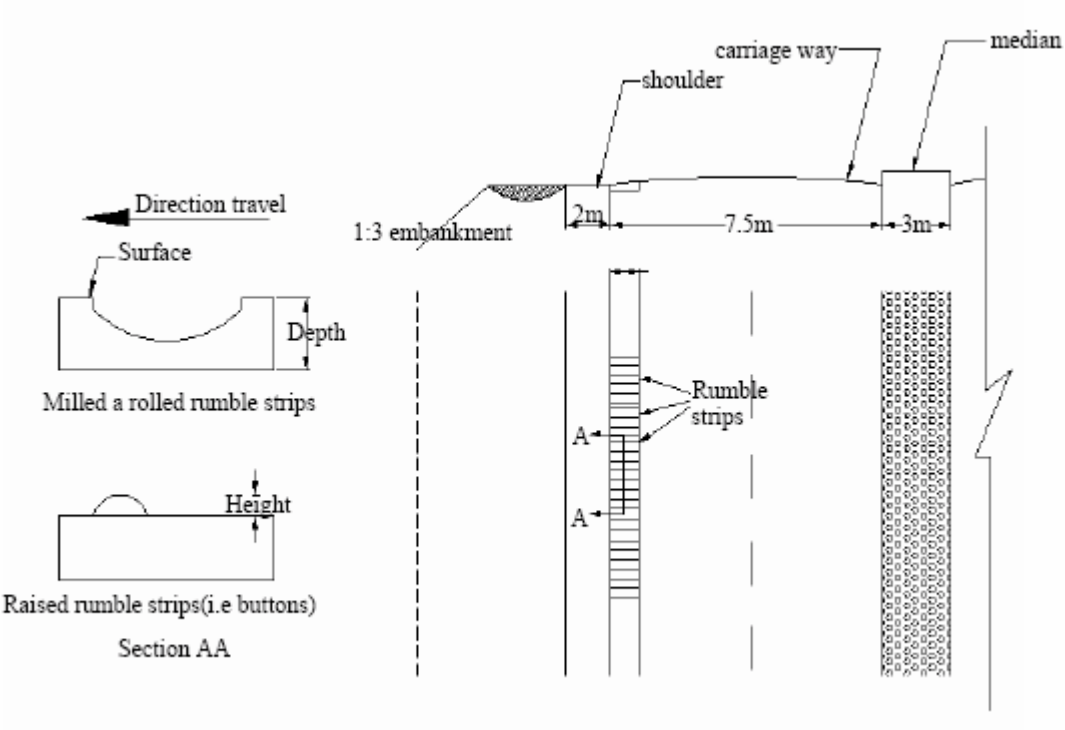

Figure 2. *Example of shoulder rumble strips along the border between carriageway and shoulder*

Finally the two other E's— "Education" and "Enforcement" need to be improved for the country. The current evidence from user survey done by students of IIT Kharagpur show that road users both drivers of motorized vehicles and NMT users are unaware of rules of roads primarily due to a lenient licensing process and lack of road safety education at school level. Also, a high percentage of rural populations have minimum or no literacy— making it even more difficult to educate them on road safety. There is also namesake presence of highway patrolling for NHs with little or no enforcement. There is no way to catch moving violators and standing on-spot enforcement is not always transparent. All these lacunas in the system add up to make road safety a serious challenge in India amidst its prosperous economic development.

4. CONCLUSION

Access management is one of the very important design elements for ensuring better mobility and safety. However, access management and control is often poor in National Highways leading to disproportionate number of deaths of vulnerable road users. In mixed traffic conditions where the share of bicycles and pedestrians are high, there needs to be provision for such users in general and particularly along stretches of NHs with no alternative road network. While high speed facilities like NHs do not provide access to NMTs elsewhere, situation is very different in India. Hence, it calls for revisiting the existing design norms for NHs and come up with innovative solutions to provide safety and mobility of NMTs on NHs. If such measures are not taken up in near future, NH system in India will be non-sustainable due to its poor safety performance and the noble cause of road development will not be fulfilled.

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