

XXIInd WORLD ROAD CONGRESS

Durban, South Africa. October 2003

C13 Technical Committee on Road Safety Special Session on Innovations in Road Safety

Road Safety on Very Low Traffic Roads in Undeveloped Rural Areas

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Abstract

Rural roads in developing areas often carry very little motorised traffic. Justification for capital investments and maintenance of these roads is based more on social and economic benefits to local communities than savings in vehicle operating costs. But since these benefits are small and often difficult to measure, the cost of road works must be kept to a minimum.

Construction costs are reduced by accepting lower standards for the horizontal and vertical alignment and reducing the width of the road. The durability of roads is enhanced by providing steep camber in order to shed water off the road. Both of these measures result in lower maintenance costs, but may have a significant impact on the safety of road users.

Inter-vehicle collisions on very low traffic roads are rare despite short sight distances. But conflicts between motorised vehicles and non-motorised road users are more frequent due to the larger number of pedestrians and cyclists. Road improvements tend to encourage higher vehicle speeds, which can significantly increase road safety risks.

Where conflicts occur the non-motorised road users invariably emerge worse off. Cyclists and pedestrians have nowhere to go but off the road, often into a side drain or thick grass. Being forced off the road is an act of self-preservation for cyclists and pedestrians, who are aware that many drivers have little respect for non-motorised traffic.

Where collisions occur they often result in death or serious injury. Where collisions are avoided, but the cyclists or pedestrians must take evasive action, the consequences might be limited to minor injuries and damage to bicycles. But the full extent of these damages and the cost to poor rural communities is not known, and may not be fully appreciated.

It is apparent that the design of very low traffic roads should take into account the social and economic costs of traffic accidents. Roads should be designed to accommodate the expected mix and growth of all modes throughout the life of the road. But there are a number of areas where further research is required before design guidelines can be produced that enable planners and engineers to achieve an appropriate balance between the conflicting objectives of minimising construction costs, and yet adequately providing for the safety of road users.

Key Words: Safety, Standards, Accidents.

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Road Safety on Very Low Traffic Roads in Undeveloped Rural Areas

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Introduction

Studies have shown that speed is a major factor in road accidents¹. The upgrading of roads often leads to an increase in vehicle speeds and therefore increased risks of traffic accidents. On access roads in rural areas, there is an additional factor of motorised traffic moving at relatively fast speeds competing for use of the road with much slower non-motorised modes of transport and pedestrians. The upgrading of very low trafficked rural roads² often requires lower standards of road alignment and a narrow width designed to minimise construction and maintenance costs. This may further increase the risk of accidents, particularly for pedestrians and cyclists who are the predominant users of these roads.

The purpose of this paper is to raise awareness of the possible social and economic costs of traffic accidents on very low traffic roads and the need to ensure that these roads are designed to accommodate the expected mix and growth of all road users throughout the expected life of the road. This suggests that a whole-life approach that includes a road safety dimension might be more appropriate than designs based on minimising construction and maintenance costs alone. Information is required to determine the potential risk to all users of very low-volume roads and the associated costs. This would enable guidelines to be produced on the design of these roads based on a minimum whole-life cost approach that also takes into account the safety of all road users as is required for higher order roads.

Design Standards for Very Low Traffic Roads

Rural roads in developing areas often carry very little motorised traffic. Therefore, vehicle operating cost (VOC) savings are small and justification for capital investments and maintenance of these roads is based more on providing basic access and improved passability with associated social and economic benefits to local communities. With VOC's small and social benefits often difficult to measure, designs of these very low-volume roads are often based on the construction cost of road works and, less frequently, on expected maintenance inputs.

Construction costs are reduced by accepting lower standards for the horizontal and vertical alignment and reducing the width of the road. A reduction in width from 6 metres to 4.5 metres can significantly increase the durability of the road cross-sectional shape over the life of the road and reduces maintenance costs³.

The durability of gravel and earth roads is also enhanced by providing a steep camber (5%-7%) in order to shed water off the road. On single-carriageway roads this camber provides no difficulty to motorised vehicles, which tend to travel along the centre of the road.

The change from head loading to other forms of transport facilitated by basic road provision can result in significant increases in benefits to people in rural areas⁴. The potential of carrying greater loads to market as well as the reduction in travel time provides a substantial improvement in mobility to rural communities, as well opportunities for social and economic development. In most circumstances, the

¹ Taylor, M C, *et al.*

² Very low traffic: Less than 20 motorised vehicles per day.

³ This was the experience of the ANE/DFID Feeder Road Project in Zambezia Province, Mozambique.

⁴ See Hine, J L.

greatest increase in traffic following the construction or rehabilitation of earth or gravel roads is non-motorised, often bicycles. These cyclists often carry very large loads.

Vehicle Conflicts

Historically, on very low traffic roads the speed of motorised vehicles was constrained by the roughness of the surface, narrow road width and sharp curves. Inter-vehicle collisions were, and still are, rare despite short sight distances because traffic volumes are low and most vehicles travel relatively slowly. Conflicts between motorised vehicles and non-motorised road users are more frequent due to the larger number of pedestrians and cyclists. Furthermore, the increased awareness of the need for improved maintenance has led to improved running surfaces and higher vehicle speeds.

The steep camber, which is considered essential for reducing the rate of deterioration and maintenance requirements, can, quite literally, be lethal for cyclists. Motorised traffic which, relative to the cyclists, is travelling at high speed, tends to give other road users little time to adjust before arriving at the same point on the road. The alignment and reduced sight distances on these roads, which is also intended to reduce construction costs, also means that conflicts between different modes of road users occur with less warning than on other roads. The heavy and high loads carried by cyclists render them unstable and manoeuvring out of the way of fast approaching traffic often results in them falling off their bicycles damaging both themselves and the goods that they carry.

Thus, where these conflicts occur the non-motorised road users invariably emerge worse off. Cyclists and pedestrians have nowhere to go but off the road, often into a side drain or thick grass. Being forced off the road is an act of self-preservation for cyclists, who are aware that many drivers have little respect for non-motorised vehicles. Where collisions occur they often result in death or serious injury.

Where collisions are avoided, but the cyclists or pedestrians take evasive action, the consequences might be limited to minor injuries and damage to bicycles. But for many people in rural areas, the ability to acquire a bicycle represents a major improvement in providing opportunities for livelihood sustainability, and the cost of a bicycle represents a major investment for most families. The full extent of these damages and their costs to the poor living in rural communities is probably substantial, although this has not yet been quantified.

Estimating the Cost of Accidents

If road safety issues are to be considered as an input to the design of very low-volume roads, then the costs of traffic accidents on these roads needs to be quantified or estimated. Several methods of estimating the cost of traffic accidents have been developed. Perhaps the most commonly used is the "Gross Output Approach", which estimates the cost of an accident as the sum of costs due to loss or diversion of current resources plus the costs due to loss of future output. In most cases this calculation demonstrates that the cost of traffic accidents is high, and significant economic rates of return can be derived through expenditure on relatively low-cost measures to improve road safety.

It would appear that road safety risks on very low traffic roads are traditionally considered to be of little consequence. The economic cost of accidents on these roads is seldom, if ever, calculated. It is likely that many incidents resulting in damage to cycles or goods and even injury often go unreported. Only in the case of serious injury are incidents likely to be reported to the police. Less serious incidents are more likely to be reported at local community level, and in order to obtain information on these it may be necessary to consult village clinics, local councils, headmen etc.

A separate but related issue is one of security of the road reserve. Higher order roads in many countries are fenced. Alternatively, the whole width of the road reserve is clearly defined in a way that makes it relatively easy to preserve this area to prevent incursions. This is not the case on very-

low volume earth and gravel roads. The road outside the longitudinal drainage ditch is seldom cleared by more than a couple of metres and people often tend to build houses quite close to the road. In these situations there is potentially a considerably increased risk to pedestrians, particularly young children. There is little warning to motorised traffic when pedestrians or animals decide to cross the road.

Furthermore, households close to the road are affected when the road is upgraded, because on roads of minimum width, the upgrading process generally includes road widening. This is another reason for adopting a whole life approach when designing and costing roads that initially carry very low traffic volumes. For roads that are likely to provide only a basic level of access for a long period, a minimum width approach might be acceptable with little concern for the width of the road reserve, (notwithstanding the road safety issues). But for roads on which traffic (motorised and non-motorised) is likely to grow, or where the modal mix is likely to necessitate upgrading within a reasonable time period, it is important to secure the road reserve required for upgrading from the outset. Otherwise, it is likely that many households will require re-location when upgrading takes place.

Reducing Road Safety Risks

The traditional approach to reducing the road safety risk to pedestrians and cyclists focuses either on integration or separation. Integration includes making provision for pedestrians and cyclists in the roadway, traffic calming, pedestrian crossings etc. Separation seeks to remove them from the roadway through the construction of pedestrian walkways and bridges, by-passes around towns, fences and rails etc.

The traditional approach to road safety on very low traffic access roads relies on reduced vehicle speeds due to reduced geometric standards to enable pedestrians and cyclists to use the road safely without segregation⁵. This approach may be sufficient on roads with very low traffic, which even at the end of their design life will provide no greater level of service than basic access. But it is evident that on some roads, the rate at which conflicts occur and cyclists or pedestrians are forced off the road is high, even just a few years after construction or rehabilitation. Therefore, on these roads, it is clear that a longer-term approach may be necessary, and appropriate road designs adopted at the outset. These should be consistent with the road function and traffic, not just at the time of construction, but by all road users throughout the intended “life” of the road.

Research has shown that the provision of a separate footpath significantly reduces road accidents to pedestrians. First Year Rate of Return benefits of between 400% and 1,000% have been recorded⁶. The provision of footpaths should be considered even on very low traffic roads, particularly where the road passes through rural settlements. Other measures used to accommodate non-motorised traffic on higher order roads, such as the provision of wide shoulders or wide drainage ditches, may also encourage safer travel for users of very low traffic roads.

Key Issues

The purpose of this paper is to highlight issues of road safety on very low traffic roads in developing areas. It is evident that further research is required to establish guidelines for engineers and planners for the design of these roads, in order to achieve a balance between the conflicting objectives of minimising construction costs, and yet adequately providing for the safety of road users. Questions that need to be answered include:

1. What influence do the following factors have on traffic accident frequencies and the cost of accidents on very low traffic roads?

5 See Towards Safer Roads....page 81.

6 See Vulnerable Road Users...

- Road Design (width, camber, geometry)
 - Quality of road surfacing material (which may cause dust and skidding when wet)
 - Vehicle speed
 - Modal use
 - Pedestrians
 - Lack of maintenance of roads (particularly reduced sight distances due to uncut grass on the road shoulders)
 - Condition of vehicles (including bicycles)
 - Day light and darkness
 - Driver behaviour.
2. What is the policy of governments towards road safety for rural communities? Do governments monitor and report accidents occurring in remote areas?
 3. What is the normal response of local police towards accidents involving local residents in remote rural areas? What are the normal consequences for motorists involved in these accidents?
 4. Are the commonly used methods for calculating the cost of traffic accidents in developing countries appropriate to very low traffic roads?
 5. What are the costs of introducing measures to reduce accidents, and what are the associated benefits of improved road safety in whole life terms of roads carrying very low volumes of traffic.

Summary

There is substantial anecdotal and visual evidence that non-motorised users (particularly bicycles and pedestrians) of low-volume roads are at risk from accidents involving motorised traffic travelling at relatively much higher speeds. This situation is particularly acute on narrow roads with steep camber designed for basic access, but on which growth in non-motorised traffic is sufficient to pose road safety problems for all its users. This situation can occur relatively early in the “life” of the road. This paper highlights the need for further research to determine the extent of the problem, quantify the costs of accidents and identify the benefits of introducing various cost-effective measures for improvements in road safety. A whole-life cost approach for the provision of these roads is suggested that would include a road safety dimension. A guideline is required so that practitioners can provide cost-effective low-volume roads that are designed for safe use by all users (motorised, non-motorised and pedestrians) throughout the expected design life.

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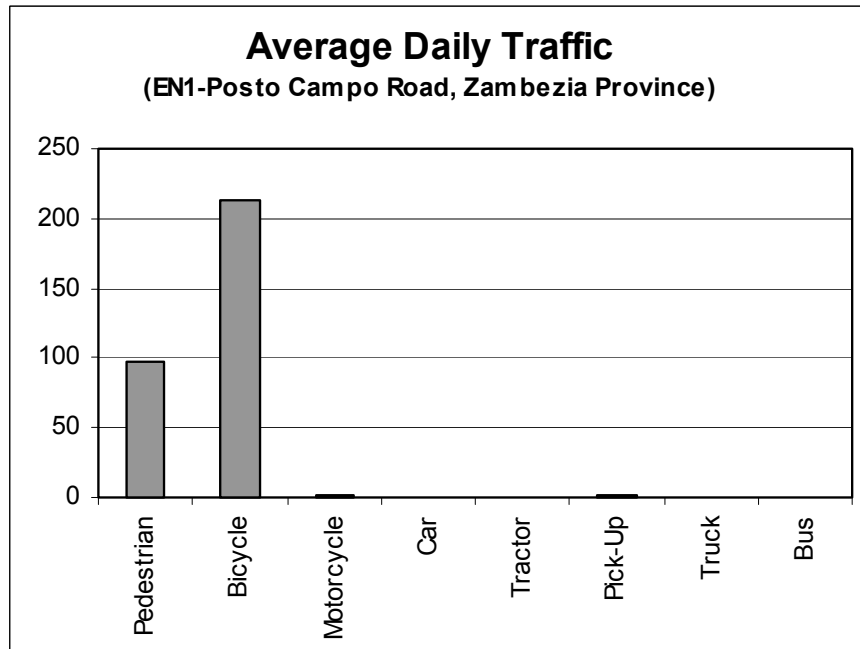
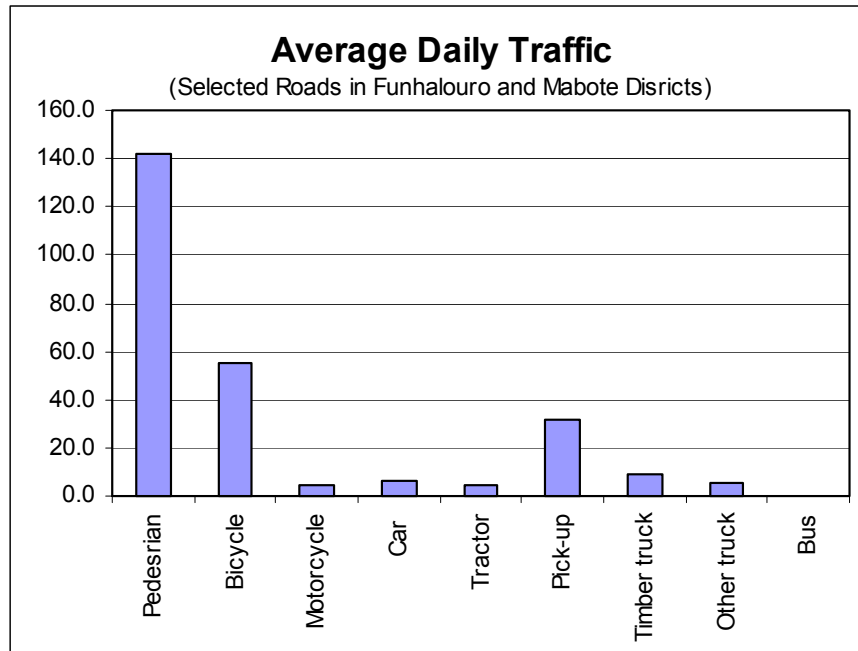
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Annex A: Modal Mix

Traffic counts in Inhambane Province in Mozambique indicated that pedestrians and cyclists make by far the majority of trips on rural tertiary roads (see figure below).⁷ The high proportion of pedestrians and cyclists is even more marked in remote areas of Zambézia Province⁸, where motorised vehicle ownership is very low and bicycle ownership increased significantly with improved rural livelihoods following the end of the Mozambique civil war (see figure below).



⁷ Directorate of Public Works and Housing / Ireland Aid. **Traffic Counts on Roads in Funhalouro and Mabote Districts of Inhambane Province**. Mozambique. Final Report. Scott Wilson. January 2003.

⁸ National Road Administration / DFID. Zambézia Feeder Road Project. Traffic count data. Scott Wilson. 2001.