

CASE STUDY: AN AFFORDABLE SAFETY BARRIER FOR NEPAL

A. Jones (1999)

Objectives of the case study

Many developing countries are beginning to introduce wide-ranging road safety programmes, but it will take time to teach everyone the skills, habits, and attitudes needed to ensure road safety. In the short term, it may be quickest and easiest to reduce fatalities and injuries by road safety engineering, making roads safer by better design and traffic management. This case study draws on the example of Nepal, where the provision of safety barriers at hazardous road locations have been successful in preventing serious injuries following road accidents.

1. BACKGROUND

The safety barrier is a common feature of modern highways in the developed world and it has proved to be effective in reducing the severity of accidents. It has great potential for use in countries like Nepal that have many serious run-off-road accidents. However, the types of safety barrier that we are familiar with in Britain are not always appropriate for use in developing countries. Crucially, the typical run-off-road accident is often quite different. Cost is also a major consideration in these poorer countries as is ease of installation and maintenance. The Traffic Engineering and Safety Unit of the Department of Roads in Nepal has been testing a safety barrier made of gabions (stone-filled steel mesh cages) and this has performed well enough to be recommended for general use.

2. TRUCK AND BUS PLUNGES

Most of the vehicles on Nepal's main inter-urban roads are trucks and buses. They are generally worked quite hard and are poorly maintained. The towns are far apart, so drivers are at the wheel for many hours, and they tend to drive rather faster than is sensible given the limitations of the vehicle and the sometimes difficult road environment. It is not surprising then that all too frequently the driver loses control of his vehicle (often after swerving to avoid a person, animal or fallen rock) and goes off the road. Sometimes the vehicle will plunge down a mountainside, and when this happens to a crowded bus the death toll can be very high.

3. REQUIREMENTS FOR A SAFETY BARRIER

It has been the practice in Nepal to mark the road edge at steep drops with low blocks made of cement masonry. Road engineers call them 'confidence blocks', and yet they shear easily on impact. The Safety Unit recognised that at hazardous sites on the busier roads what was needed was a proper safety barrier, one which would be:

- Capable of containing a 16 tonne truck travelling at 40kph and impacting at an angle of 30°
- Affordable
- Able to 'give' on impact to reduce the risk of injury to the vehicle occupants
- Easy and cheap to repair
- Simple to design and install
- Suitable for installation on sharp bends

4. PROBLEMS WITH CONVENTIONAL SAFETY BARRIER

The steel beam safety fence is widely used in Britain, but is not suitable for Nepal, principally due to its cost as it would be necessary to have a double-beam fence to contain loaded trucks on sharp bends. Moreover, design and installation require specialist skills and equipment. Maintenance could be a problem too, as it might be difficult to keep a sufficient stock of fence components. Reinforced concrete structures are commonplace in Nepal, so the Safety Unit also looked at using a reinforced concrete wall. Once again, it proved to be too costly for general use. Furthermore, like all rigid barriers, it would be very unforgiving when hit by a vehicle.

5. GABION SAFETY BARRIER

The gabion safety barrier is simply a wall (one metre high by one metre wide) made out of gabions wired together. Its use in Nepal goes back some years, but nothing was known about how it performed until the Safety Unit decided to test it. Over the past three years the Unit has installed gabion safety barriers at many accident sites on the busiest road out of the Kathmandu Valley, and the barrier has been hit at least twenty times. In nearly all the reported impacts the vehicle involved was a truck or bus. Sometimes the vehicle broke through part of the barrier, or rode onto the top of it, but it was always brought to a halt. No serious injuries were reported, except in a few accidents where the vehicle overturned before hitting the barrier.

The way the barrier pushes back and absorbs some of the impact undoubtedly helps prevent serious injury. The consequences of a light vehicle hitting the barrier at high speed are likely to be much more severe, but there have been few accidents involving light vehicles and none have resulted in serious injury.

Gabion safety barriers are easy to build and there is generally plenty of stone available, so the price offered by local contractors is quite affordable. Repairing the barrier after it has been hit is a simple matter, though in practice there are often delays while the Department waits for there to be sufficient repair work to make the job of interest to contractors. In addition, the stone used in the gabions is light coloured, so the barrier shows up well even at night, and this helps drivers recognise where the road goes.

The Safety Unit has been modifying the design of the barrier in the light of experience. At first the gabions were anchored into the ground with steel reinforcing

rods, but people broke open the gabions to steal the rods, so these were omitted in later versions and performance has not been affected. Small gaps are now provided in the barrier at intervals of 18-24m. These enable road workers to push loose rock and earth (from landslides) off the road. A frequent criticism of the barriers is that they take up too much space, so a 750mm wide gabion barrier is now being tested.

6. CRITERIA FOR THE PROVISION OF SAFETY BARRIER

The success of the gabion safety barrier has been well noted by road engineers, and the Safety Unit is frequently asked for advice on where safety barriers should be installed. In response to this the Safety Unit has developed these guidelines:

- To protect vehicles from falling down a slope – this applies where there is a drop of three metres or more at or near the edge of the road, and the slope is steeper than one in four
- To protect vehicles from hitting a roadside object – this applies where there is a hazardous object close to the edge of the carriageway, such as a building or the end of a bridge parapet
- To prevent crossover accidents on dual carriageways

However, it is not economic to install safety barriers on every section of road that falls into these categories. There are a number of other factors that need to be taken into account in determining whether safety barriers will be cost effective:

- Whether there have been run-off-road or crossover accidents at the site
- Whether the site is on a sharp bend (where the design speed differs from the approach speed by more than 15kph)
- Whether it is a busy road – defined as a road with an AADT of more than 1,000
- Whether the 85th percentile speed of traffic approaching the site is greater than 50kph

If two or more of these factors apply there is probably a good case for installing a safety barrier.

7. CONCLUSION

The safety barrier experiment has demonstrated the potential for road safety engineering in Nepal. A safety feature on roads in the developed world has been adapted to meet the particular circumstances of Nepal, and seems to be working well.

Gabion safety barriers are now coming into general use and it is confidently expected that this will reduce the severity of many accidents. This outcome also shows the value of a Roads Department having a Safety Unit, which can look for cost-effective solutions to safety problems and then promote their use. The Unit is now turning its attention to the very big problem of pedestrian safety in Nepal.

Source: Jones, A. (1999). An Affordable Safety Barrier for Nepal. Highways and Transportation. Institution of Highways and Transportation, London. Vol 46, No. 3, March 1999.