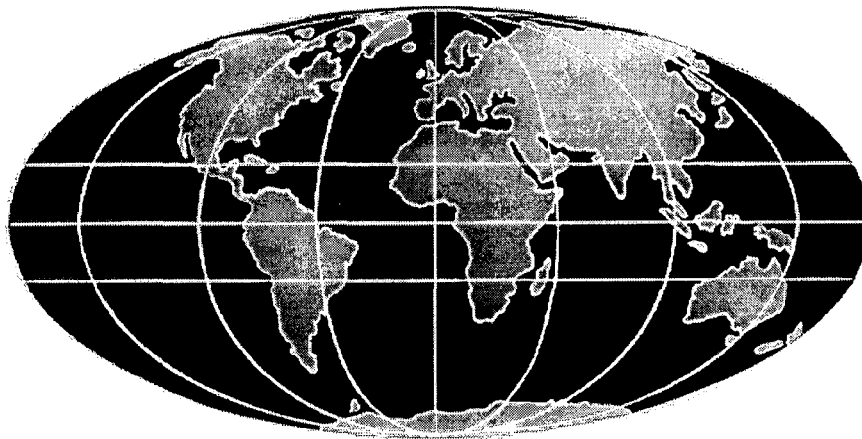


TITLE: Road safety for buses

by: T Pearce, D A C Maunder, T C Mbara and D M Babu



PA3382/98 PEARCE, T, D A C MAUNDER, T C MBARA and D M Babu.
Road safety for buses. *CODATU VIII Conference, Cape Town, September 1998*

Road Safety for Buses

Sécurité routière pour les autobus

T Pearce and DAC Maunder (*Transport Research Laboratory*), TC Mbara (*University of Zimbabwe*) and DM Babu (*Central Institute for Road Transport*)

ABSTRACT: Countries of the developing world are characterised by rapid urbanisation, high growth rates in traffic and congestion and decreasing regulation of public transport. Because a majority of the developing worlds' inhabitants are dependent on public transport services the need for efficient, safe and effective public transport is essential to ensure adequate and affordable accessibility and for sustainable urban development. The paper highlights the operational environment of the public transport sector in Nepal, India and Zimbabwe, the extent of bus accidents and their likely causes and makes recommendations to reduce both the severity and number of public transport accidents in the future.

RESUMÉ: Les pays en voie de développement sont caractérisés par une urbanisation rapide, des taux de croissance élevés de la circulation et d'embouteillages et un diminution de la réglementation des transports publics. La majorité des habitants de ces pays dépend des services du transports publics, donc il faut absolument que ceux-ci soient efficaces et sûrs, et qu'ils fonctionnent bien pour soutenir un accès adéquat et abordable dans le cadre d'un développement urbain durable. Cette communication met en relief l'environnement opérationnel du secteur de transports publics en Népal, en Inde et en Zimbabwe, l'importance des accidents d'autobus et leur causes probables. Elle offre des recommandations pour réduire la gravité et aussi le nombre des accidents dans ce secteur à l'avenir.

1 INTRODUCTION

Worldwide, there are estimated to be some half a million road accident fatalities each year. Almost 70 per cent of these occur in the developing or emerging world. Whilst there is a general decline in the number of fatalities in industrialised countries the opposite is true elsewhere. If account is taken of levels of motorisation by expressing accident statistics as rate per registered vehicle, then less developed countries (LDCs) have rates at least 10 to 20 times higher than the best industrialised countries. The worst countries in these terms have fatality rates 100 times higher (Ghee et al 1997).

Considerably higher proportions of those (reported as) injured in road accidents consequently die from their injuries in the developing world compared with industrialised countries. The fatality index defined as the percentage of fatalities out of the total number of road accident casualties is also 10 to 20 times higher than in industrialised countries. Thus, not only is the proportion of people injured per vehicle very high in developing countries, but also the death rate is higher.

Fouracre and Jacobs (1976) calculated that, for any country, the cost of road accidents is equivalent to approximately one percent of its Gross National Product (GNP) although currently it is thought to be between 1.5 and 2.0 percent. However, using the 1 percent figure gives an estimated annual global cost of

road accidents of the order of US\$230 billion, with the cost to LDCs being around US\$36 billion, a sum that they can ill afford. For example, in Mexico and India, road accidents may well be costing US\$2.5-3.2 billion per annum, in South Africa and Pakistan US\$0.5-1.0 billion and in Zimbabwe and Kenya US\$55-70 million per year.

Unfortunately, road safety is but one of the many problems demanding its share of funding and other resources in developing and emerging nations. Even within the boundaries of the transport and highway sector, difficult decisions have to be taken regarding the allocation of resources that any government can devote to road safety. In order to assist in this decision making process it is essential that a good road accident data base is established enabling the evaluation of both road accidents costs and the value of prevention.

Countries of the developing world are characterised by rapid urbanisation, high growth rates in traffic and, consequently, congestion and decreasing regulation of public transport. All of these factors point to the need for a clear assessment of the safety and environmental problems faced by vehicle operators in general and by urban public transport operators in particular. Because a majority of the developing world's inhabitants are dependent on public transport services the need for efficient, safe and effective public transport is essential to ensure adequate and affordable accessibility for urban residents and for sustainable urban development.

The Transport Research Laboratory (TRL), funded by the British Government's Department for International Development (DFID) Technology, Development and Research (TDR) Programme is currently evaluating the safety and roadworthiness of public transport vehicles by assessing the scale of the problem resulting from road accidents and the effect of varying maintenance practices on bus fleets' roadworthiness. The effects of accidents on passenger comfort and safety are also being investigated and recommendations developed for safer public transport services.

The 3 year study, which commenced in July 1997, is being undertaken in a number of countries which are assumed to be representative of the developing and emerging worlds. Studies have already been undertaken in Nepal, Zimbabwe and in a state (Maharashtra) of India and others will follow. As the newspaper montage illustrates (see Plate 1) the problems of accidents involving public transport vehicles are considerable and the carnage substantial. Consequently the costs, both economic and social, are a drain on a country's scarce resources hindering development both in the long and short term.

Despite having only recently started the project, this paper aims to establish the current operational environment of the public transport sector in each of the three countries, the extent of bus accidents, and the likely causes of such accidents in each of the countries. Accident data have been collected from official sources in the countries and interviews undertaken of police, bus owners, operators, drivers, conductors, passengers and associations to obtain opinions as to the causes of bus accidents and finally vehicle condition and driver behaviour were monitored. Initial general conclusions and recommendations will be refined at a later date to reduce both the severity and number of public transport accidents in the future.

2 NEPAL

2.1 Background

The first bus services operated in Nepal commenced in 1957 and since then the fleet has grown substantially, especially since 1992. By 1996 there were a total of 7800 conventional buses and 2752 minibuses operating public transport services throughout the Kingdom (Maunder et al 1998). Traffic Regulations were enacted in 1963 and the National Transport Management Act came into force in 1965 which provided legislation to licence drivers and vehicle operators. In 1992 the Vehicle and Transport Management Act was enacted which is currently the definitive legislation in terms of the provision of bus public transport services in Nepal. In terms of providing and operating bus services in the Kingdom

the aim of the Act was to ensure fair competition but the 'dial system' continues which ensures that Operator Associations or Syndicates manage routes so as equalise trip making and negate free and fair competition.

In order to operate a service a bus owner requires to have a:

- A certificate of registration
- A licence to operate a transport service
- Insurance of vehicle, driver conductor etc
- Vehicle fitness certificate
- Route permit

and, in addition, a driver must be in possession of a Heavy Vehicle Licence and a conductor a Conductor's Licence.

2.2 Accident rates

During the period July 1995-June 1996, a total of 3379 accidents were reported to the police nationwide (urban and long distance) with bus accidents representing 14% of the total. However these 479 serious bus accidents resulted in 365 fatalities and 1751 injured persons. The totals represented 39 percent of all road fatalities during the 12 month period and 60 percent of road casualties and therefore bus accidents represent a significant proportion of all road accidents and injuries in the Kingdom of Nepal. Table 1 illustrates the breakdown of such accidents by type of accident and time of day.

Table 1 Serious Bus Accidents July 1995 - June 1996

Accident Type	Accidents		Number injured		Number killed	
	No of Acc.	Percent at night	No of injured	Percent at night	Total	Percent at night
Bus only	180	25	1236	23	225	26
Bus/ Vehicle	139	24	371	35	50	40
Bus/ Pedestrian	160	23	144	27	90	27
TOTAL	479	Avg 24	1751	Avg 26	365	Av 28

All three types of accident identified in the Table are common, however bus only accidents, in which the driver lost control and the bus left the road or overturned, were the most frequent resulting in 71% of total injuries and 63% of fatalities. Of the remaining types of accident, bus/vehicle collisions resulted in 21% of injuries and 14% of fatalities and bus/pedestrian 8% and 24% respectively. Unsurprisingly, pedestrians are very much at risk and are more likely to die than be injured if hit by a bus.

It might be supposed that most of the accidents would happen at night when driving conditions are likely to

be more difficult but only a quarter of bus accidents happened at night and were no more severe in terms of casualties than daytime accidents.

2.3 Probable Causes

From comments made by the diverse groups interviewed, the likely causes of bus accidents can be categorised as follows:

- Drivers and driving habits
- Vehicle condition
- Road condition
- Other factors

Everyone agreed that one single factor was unlikely to cause an accident and that a combination of causes was the likely explanation. The factors raised in respect of drivers and their driving habits were:

- ease of obtaining an Heavy Vehicle licence
- lack of professional driver training
- lack of knowledge of the Highway Code and road
- driver fatigue due to long working hours
- overloading of vehicles to maximise revenue
- night drivers consuming alcohol or drugs
- speeding at night or for the road condition.

In terms of vehicle condition, factors included:

- lack of maintenance due to cost
- overworn tyres and duplicate parts used to minimise costs
- irrelevance of the Vehicle Fitness Test.

Surveys of vehicle condition noted that 65% of buses had one or more faults in terms of tyres, wheel fixings, front/rear lights. Yet all had passed a Vehicle Fitness Test and were legally fit to operate.

Road condition, a lack of road maintenance, poor alignment and a lack of traffic signs and safety features were all identified as possible accident causes along with weak enforcement of traffic regulations and a lack of road sense by pedestrians in rural areas when herding animals on the road.

3 ZIMBABWE

3.1 Operational Background

Urban public transport services are supplied by the Zimbabwe United Passenger Company (ZUPCO), now wholly owned by the government and which operates both conventional buses and minibuses (Maunder et al 1993), privately operated commuter omnibuses introduced in 1993, and consisting of various vehicle types and capacity (Maunder et al 1993,1995,1996), and emergency taxis which are estate cars operated on a shared taxi basis (currently being phased out). Long distance bus services (inter city and rural) are provided by ZUPCO and the private sector who operate mainly conventional single deck vehicles.

There are three main pieces of legislation controlling bus operations in Zimbabwe. These are The Road Traffic Act, The Road Motor Transportation Act and The Road Construction Equipment and Use Regulations. In addition, legislation can be enacted through Statutory Instruments. The Road Traffic Act, revised in 1996, defines a public passenger vehicle, licensing requirements and offences while the Road Motor Transportation Act, revised 1997, defines in detail operational requirements of services, documents required, eg operators licence, certificate of vehicle fitness, route permit, timetables, insurance, fare tables etc.

3.2 Accident Statistics

The police collect accident data in Zimbabwe and the Zimbabwe Traffic Safety Board analyses the data and organises safety education and training programmes on behalf of the government. In 1992 there were a total of 27,150 reported accidents leading to 1,066 fatalities and 13,458 injured persons and by 1996 the totals had increased to 38,777, 1,205 and 18,070 respectively. Table 2 shows the distribution of bus accidents by road category for the year 1996.

Table 2 Bus Accidents January - December 1996

Road Category	No bus accidents	Accidents reported	Bus accidents as % of total
State roads	801	4766	16.8
Municipal roads	4166	28888	14.4
Communal roads	782	5123	15.2
Total	5749	38777	14.8

The Table illustrates that 72% of bus accidents occurred on municipal, ie urban roads yet, most bus fatalities, which comprised 93 (or 7.7%) out of a total of 1205 road accident fatalities in 1996 occurred on roads outside urban areas ie on long distance bus services. Thus 74% of the reported 93 bus fatalities involved long distance buses. In contrast, the majority (78 %) of bus person injuries totalling 2074 or 11.4% of the 18070 injured in 1996 occurred on urban roads.

3.3 Probable causes of bus accidents

Extracting data from police statistics of bus accidents in 1996 and analysing the same led to the following findings:

- 58% of bus accidents were classified as blameworthy and
- blameworthy accidents led to 76% of bus fatalities and 75% of injuries

Grouping blameworthy causes as assessed by the police led to the following Table.

Clearly, driver misjudgement, including factors such as excessive and reckless speeding, following too closely, overtaking and reversing errors, failure to give way, etc, is the key element of blameworthy accidents as apportioned by the police in Zimbabwe.

Table 3 Causes of blameworthy accidents involving buses (1996)

Cause of accident	Percentage
Misjudgement of driver	82
Vehicle defect	7
Road condition	1
Drink/drugs	2
Other	8
Total	100

As in Nepal, a wide group of individuals and organisations involved in operating, regulating or using public transport services were interviewed as to their opinions of the causes of bus accidents. Three broad categories evolved from the discussions embracing:

- Driver behaviour
- External factors and
- Vehicle condition.

The most frequently quoted factors in respect of driver behaviour included reckless driving, inattention and a lack of judgement, speeding, driver fatigue and unqualified and inexperienced drivers. One long distance operator suggested that "speed is used as a marketing tool" whereas in urban areas "speed is used to maximise earnings".

External factors included road conditions, stray animals, weak enforcement of regulations and adverse weather such as during the rainy season. Observations of vehicles showed that vehicle condition is generally satisfactory and that genuine spare parts are utilised.

4 INDIA

4.1 Operational environment

The rate of growth of registered vehicles in India has consistently been in excess of 10% per annum and with its traffic mix of motorised and non-motorised vehicles competing for space has led to a burgeoning road accident crisis. Thus during 1995/6 the latest year for which data are available throughout India shows that there were 260,700 reported accidents leading to 60,400 fatalities and 261,500 injured persons. Thus in a year almost 1 person in 2500 is likely to suffer injury or death on India's roads and if it is assumed there is under reporting the situation is likely to be far worse.

4.2 Maharashtra State

The state of Maharashtra in the West of India has a mix of manufacturing industry, agriculture and the bustling financial centre of Bombay; it is one of the most prosperous states in India. During the period 1961-1996 the registered motor fleet has grown by over 40 times whilst the road network has increased by 3.5 times; thus the growth in vehicles has far outpaced the quantum of road network and other infrastructure. As a consequence over the last two decades the number of road accident fatalities has increased by 282% and injuries by 220% and so an average of 200 accidents are reported daily leading to 23 fatalities and 134 injured persons.

During 1991 (the latest detailed data available) 23% of accidents occurred on the State Highways which led to 38% of fatalities, State roads accounted for 14% and 27% respectively and other roads 63% and 35%. The police attributed 66% of accidents and 80% of fatalities to poor driver behaviour. During the same year the registered bus fleet in the State accounted for 1% of the total motor fleet yet buses were involved in 14% of reported accidents and 12% of fatalities (it should be remembered that buses from other States will be operational on Maharashtra's road network during the year).

Unfortunately the detailed data obtained during the study did not extend to the private sector, and so the detailed analysis that follows is for a publicly owned bus company namely the State owned Maharashtra State Road Transport Corporation (MSRTC) which operates bus services throughout the State in competition with privately owned and Municipal operated bus companies. Table 4 illustrates in the opinion of the bus management the primary causes of accidents involving its own buses. During the operational year 1996/7 there were 4149 accidents involving its bus fleet which culminated in 688 fatalities.

Table 4 Causes of MSRTC Bus Accidents 1996/97

Bus Driver error	49.0
Other Driver error	31.0
Pedestrians	6.0
Bus passengers	3.0
Cyclists	2.0
Mechanical fault	0.5
Unknown	8.5
Total	100

The MSRTC bus driver was at fault for almost 50% of accidents with stated causes including 'inaccurate judgement, speeding, following too closely, reckless overtaking and reversing'. Fifty seven per cent of all accidents happened on a straight road and in 70% of cases the road surface was described as 'good'. Sixty

nine per cent of accidents occurred in daylight and 78% in fine weather. From these figures it can be seen that in the majority of accidents, it is quite likely that there was no external, adverse factor relating to the road or driving conditions that specifically caused the accident.

Other significant statistics are that 20% of accidents occurred when passing through congested areas of urban centres. Head on and rear end collisions accounted for 50% of accidents and 30% involved a 'swipe/brush' with another vehicle. Driver inexperience appears to be a probable cause as 37% were aged between 24 and 32 and 46% had been driving for less than 4 years.

The age of vehicle is not clearly linked to accident frequency except that it is worth noting that new buses [<100,000 km] have a higher accident risk than those that have covered between 100 and 300,000 km, however after that distance the accident frequency returns to its initial level, very old buses [>700,000 km] have a much lower accident risk which is likely to be linked to their duty cycle, i.e. low usage and speed.

5 SUMMARY and CONCLUSIONS

In all three countries where studies have been undertaken by TRL road accidents are increasing over time. Public transport vehicles appear to be involved in a higher proportion of accidents than their numbers warrant. However, this is principally because buses cover a high annual mileage through their duty cycles. Considering the number of passengers transported a safety culture should be active and evident however, it does not seem to be the case at the present time.

The most frequent causal features of bus accidents identified by TRL so far comprise:

- Poor driver behaviour
- Pedestrian/other road user behaviour
- Mechanical condition of bus

The overriding factor which needs to be addressed is how to improve bus driver behaviour. Suggestions to improve bus driver behaviour are listed below. It is clear however that drivers need to be better educated and trained when initially learning to drive but in particular:

- they should be taught not just the technical skills to pass the driving test but also the social and psychological skills required to be a safe and responsible professional driver.
- bus drivers, like all HGV drivers, should also participate in refresher driver training courses so that the inevitable bad habits acquired can be eliminated at a relatively early stage.
- owners should be encouraged to provide financial incentives for drivers who have been 'accident free' during the previous 12 month period.

medical and health checks need to be provided for drivers especially ageing drivers.
owners and drivers should be encouraged to work within existing legal maximum hours.

These may increase costs but are likely to be less expensive in the longer term than the cost of human tragedy, vehicle replacement and other third party costs.

As well as improving the behaviour of the bus driver, road safety campaigns need to be funded and encouraged so that all road users are better educated as to how to behave when crossing and using the road and when herding animals on the rural road network.

Many owners and operators need to be encouraged to maintain their vehicles to a much higher standard than at present. Preventative maintenance can improve performance and productivity and extend the operational life of the vehicle. A safe, smart vehicle is also more likely to attract passengers than an unsafe and poorly maintained vehicle and also passengers might be encouraged to afford a slightly higher fare for such a vehicle/service. Owners/operators also need to understand that vehicle maintenance is a sound, effective business practice which can minimise vehicle downtime and costly, time consuming breakdowns whilst in service.

Finally, improvements in bus safety cannot be achieved by one individual or discipline, it is a collective responsibility and a collective spirit is required of all those involved including:

- Bus owners, drivers, conductors and mechanics
- Operator associations/unions
- Police and government departments
- Road Safety Associations/ driver training schools
- Manufacturers and repairers of vehicles, spare parts and tyres
- ALL road users

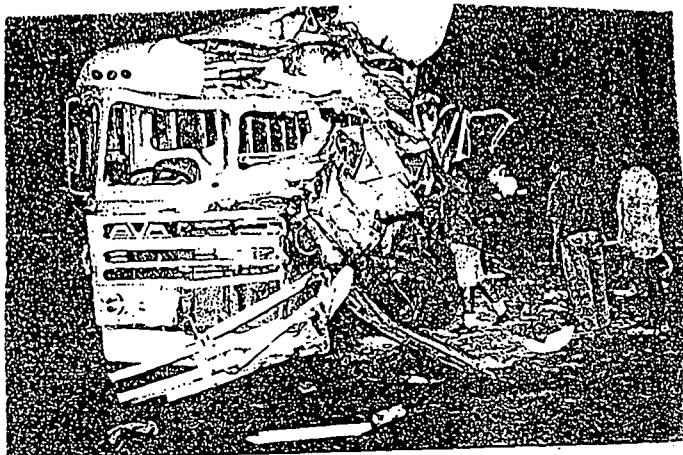
6 REFERENCES

- Ghee C, Silcock D, Astrop A, Jacobs GD (1997). Socio-economic aspects of road accidents in developing countries. TRL Report 247, TRL, Crowthorne, UK.
- Fouracre PR and Jacobs GD (1976). Comparative accident costs in developing countries. TRRL Supplementary Report 206. Crowthorne: Transport Research Laboratory
- Maunder DAC and Mbara TC (1995). The initial effects of introducing commuter omnibus services in Harare. TRL Report 123, TRL, Crowthorne, UK .
- Maunder DAC and Mbara TC (1993). The effect of ownership on the performance of stage bus services in Harare, Zimbabwe. PR25, TRL, Crowthorne, UK.
- Maunder DAC and Mbara TC (1996).

Liberalisation of urban public transport services: What are the implications? Indian Journal of Transport Management Vol.20 No 2 February 1996.

Maunder DAC and Pearce T (1998). Bus Safety in Nepal . Indian Journal of Transport. Management Vol 22 No3 March 1998.

MONTAGE OF RECENT NEWSPAPER HEADLINES



4 killed in bus accident

BHARATPUR, Jan 14 (RSS) - Four persons died and 43 others were injured when a passenger bus (Ga A Kha 608) heading from Narayanghat to Devgaha fell some 30 ft near Ramnagar at 09:30 pm January 14.

Of the deceased, two died on the spot and two others died at Bharatpur hospital while under treatment, the District Police Office said.

The dead are 22-year-old Bhoj Prasad Gurung of Bharatpur municipality-10, 17-year-old Gulshan Gurung of ward No. 2 of

the municipality, Simara Gurung, 17, of Kot VDC-6, Tarahm, and 60-year-old Padma Kumari Timilsina of Lekhnath VDC-1 Kaski.

Forty-one pilgrims injured in the accident were admitted to Bharatpur hospital for medical treatment on January 14.

Eight of them have since been brought to Kathmandu while 25 others returned home after general treatment, according to Dr Punja Bahadur Thapa of the hospital. A search is on for the driver who is at large, warren said.

3 die in bus mishap

DIPAYAL (RSS) - Three passengers were killed on the spot and 12 others injured when a passenger bus with registration number M Kha A 225 going from Mahendranagar to Doti overturned near the Ocroi Collection Post of Dipayal municipality at 6:30 pm the other day.

According to the police the accident took place when the bus started rolling backwards on a steep slope and the bus driver banged the bus to the roadside wall to save it from falling into the Setu river.

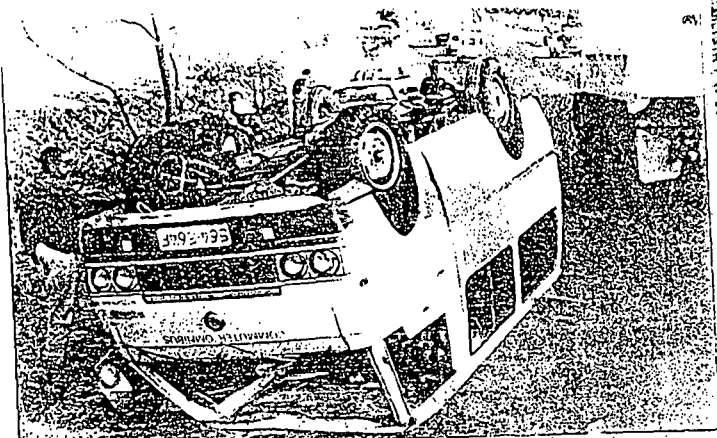
2 die in bus collision

JHAPA - Two persons died and three others were critically injured on Monday when a bus with plate no. Ba A Kha 721 collided with another vehicle with plate no. Me A Jha 49. Police said, the dead include Chandragadhi resident Sitaran Dahal and vehicle driver Gopal Khadka. Both of them succumbed on their way to the hospital. The injured are undergoing treatment at the Damak Hospital.

Horror crash



Crashed into tree parts is what remains of the Biratnagar bus which killed 10 people. It was the spot at the weekend.



The City Warren Park commuter omnibus after overturning along the Bulawayo flood yesterday morning.

9 killed in bus accident

KATHMANDU, July 30 (RSS) - Nine persons were killed and seven others injured, five of them seriously, when a bus (Na A Kha 7562) met with an accident between ward no 2 and 3, Gauribas VDC of Mahottari district on July 29.

19 killed, 84 injured in separate bus mishaps

TANSEN, Dec 19 (RSS) - Nineteen passengers were killed when a passenger bus with registration number L A Kha 161 heading from Pokhara to Bhairabi met with an accident at Sawa and Panchajanya village development committee, Palpa district this afternoon, it is learnt from the police.

Sixteen passengers were killed on the spot while two passengers died later at the District hospital and one at Palpa hospital.

Elsewhere, 11 of the 84 injured passengers are undergoing treatment at the District hospital. Some of these passengers are in serious condition, as reaching the District hospital. Of the 19 passengers killed in the accident, the death of Chakra Prasad, a resident of ward no 1 of Chakra Prasad village development committee, Sanyasi district and Sita Bhadrani, 24, a resident of Hange, Palpa district could be identified only in the evening.

One of the injured had RSS that the bus skidded off the road and fell about 150 feet below. The cause of the accident is not known.

The bus was carrying passengers more than its capacity, it is learnt.

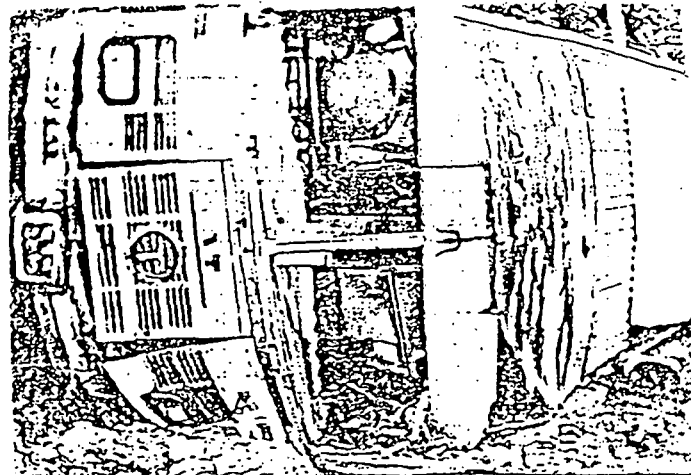
In a separate incident, forty six persons were injured when a bus (Ma A Kha 2791) plying from Bhairabi to Bhairabi met with an accident on the bank of the Sawa river bridge this afternoon.

Sixteen of the 46 injured passengers were hospitalized at the District hospital and another passenger who sustained serious injuries in the mishap are undergoing treatment at the District hospital.

Twenty six others with minor injuries have also been admitted to the hospital, while some others have returned home after necessary treatment.

26 killed as bus plunges into river

Kathmandu, July 8 (RSS) - Home Minister Khum Bahadur Khadka informed that 26 persons were killed when a passenger bus with registration number Lu. A. Kha. 889 heading for Butwal from Tansen met with an accident at 9:45 pm last night near Chidiya Khola bridge after falling 150 ft. into the Tinau river.



A passenger bus on its way to Kathmandu from Dhusikhel overturned near Suryavinayak, Bharatpur on Wednesday.