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Planning For An Instruction Program Related to Highway Safety Technology Transfer In The Americas

prepared for the

Federal Highway Administration
U.S. Department of Transportation

FHWA Order Number: DTFH61-94-P-01703

by

The University of North Carolina
Highway Safety Research Center

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PLANNING FOR AN INSTRUCTION PROGRAM RELATED TO HIGHWAY SAFETY TECHNOLOGY TRANSFER IN THE AMERICAS

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CHAPTER ONE: INTRODUCTION AND STATEMENT OF THE PROBLEM

A. Introduction

This report addresses several topics necessary for consideration if a decision is made to establish a comprehensive and continuing training program intended to foster Technology Transfer on the subject of highway safety. The discussion includes:

1. A description of the road accident problem in the Americas, including some road accident statistics.

2. Discussion of options for establishing a highway safety technology transfer program for the Americas.

3. Presentation of ideas concerning implementation of the plan through the Pan American Institute of Highways (PIH).

4. Summary of topics that might be included in highway safety "courses" from which an initial program of instruction could be constructed.

B. Traffic Safety as a Global Concern

1. RAPID MOTORIZATION IS UNDER WAY ALL OVER THE WORLD

The extensive mobility afforded by an highway transport system is a central mechanism by which societies worldwide pursue their economic and social goals. This steady trend toward motorization has been underway for decades in the Americas, and is paralleled all over the world. Motor vehicles in large numbers, plus a useful roadway system, allow unique individual freedom of movement and a means for seeking work and leisure goals with maximum flexibility. The desire for individual transport seems virtually universal, and the trend toward motorization is seen in most countries world wide despite wide variation in degree of economic development.

Not only is motorization under way on every part of the globe, but the rates of growth are very high in some countries. For comparison, consider the USA as a reference point. In the USA, highly motorized for decades, increases in vehicle population during recent years have been in the range of 2 to 4 percent annually. This modest and manageable vehicle growth rate contrasts sharply with the very large rate in some other countries where vehicle registration may increase as much as 20 to 25% per year -- as in China and South Korea [5,12]. Some countries in South America show growth that is quite consistent with that of the USA. During the nine years spanning 1982 through 1991, Brazil, Argentina, and Peru all showed growth in registration (excluding motorcycles and motor scooters) averaging about 2.6% per year. Columbia showed a gain of nearly 9% per year during the same span [1]. Thus, some South American countries do not have the same sort of explosive growth in motor vehicles that both blesses and plagues certain Pacific Rim nations.

The dramatic social and economic gains from such rapid motorization are evident. However, highway transportation involves another central issue and that is safety. (In more recent times, environmental issues such as air pollution, noise, land use, etc. have been added to the list.) Mobility is valued for what it permits a society to obtain -- rapid and relatively inexpensive distribution of goods and services, increased economic development, wider choice of work and living place, and freedom of movement that seems highly valued everywhere. Safety is valued for what it permits a society to avoid -- the terror of crashes, the pain, suffering, and bereavement among those affected, and the large negative economic consequences of traffic crashes.

Figure 1: In some rural areas, narrow roads are abutted closely by large and beautiful trees thus posing the dilemma of choosing between safety and the environment.

2. TRAFFIC INJURIES AND DEATH INCREASE WITH MOTORIZATION

Often, though not always, safety and mobility are in direct conflict. The very rapid vehicle growth rate occurring in many countries may overwhelm emerging, fragile safety efforts with the result that a great increase in the number of traffic deaths may occur. Already, worldwide road accidents result in the death of about 500,000 persons per year and produce injuries among 15,000,000 more people. This estimate is extrapolated from a compilation of national road accident statistics from more than 140 countries [10].

The absolute number of fatalities is relatively low in many small countries, and even in more populous countries having little motorization as yet. The

Bahamas with about 30 deaths per year illustrates the former, and Afghanistan's 450 per year, the latter [10]. At the other extreme, five countries may now endure traffic deaths in the range of 40,000 - 50,000 per year -- Brazil, China, India, Russia, and the USA. Although official figures do not confirm deaths of this magnitude in all five countries, it is felt by some in those countries that under-reporting probably accounts for the differences.

Figure 2: Some urban freeways in South America are built to high standards and comparable to freeways anywhere in the world.

Though these five nations are similar in their large roadway death totals, nevertheless there are significant differences in the factors that produce the similar end-results. This is shown when one considers two commonly used traffic death rates -- deaths per 100,000 population and deaths per 10,000 registered vehicles. Note the contrast between India, the United States, and Brazil in the table below.

Because of its high level of motorization, deaths per unit population in the USA are about 4.5 times higher than in India, though about the same as in Brazil. However, deaths per motor vehicle in India and Brazil are much higher than in the USA -- a forty fold difference in the case of India and about eight fold in the case of Brazil. The size of the population death rate in the USA is one indication that road deaths constitute a significant public health problem. The fact that the population death rate is still rather low in India is scant comfort there because India's growth in motorization combined with its high death rate per motor vehicle is an ominous sign that traffic deaths will become more numerous in the future. Brazil is already more motorized than India.

Traffic Death Rates	deaths per 100,000 Population	deaths per 10,000 registered vehicles
India	4.2	108.8
United States	19.1	2.7
Brazil	18.9	20.9

[references 1, 7, 17, 19]

It seems likely that traffic fatalities per 100 million kilometers of travel are 10 or more times higher in some motorizing nations than in highly motorized nations, even if the annual kilometers per motor vehicle is considerably greater than in the USA.

3. HEALTH AND ECONOMIC IMPLICATION OF ROAD DEATHS

Traffic injuries are well recognized as a significant health problem in highly motorized nations. In the USA, for example, motor vehicle crashes have been the leading cause of death for the youngest half of the population for some decades [2, 4]. Likewise, for many years, traffic crashes have been the third leading cause of deaths for the entire USA population, ranking behind only cancer and cardiovascular diseases [11]. Among children in the USA, motor vehicle deaths rank far ahead of all communicable diseases [2]. (It is said that, for the 25-44 age group, USA deaths from AIDS may have exceeded that from motor vehicle accidents for the first time in 1994.)

The somber public health implications of traffic deaths are widely quoted and widely recognized in highly motorized countries, but it is important to emphasize that motor vehicle deaths likewise constitute a major health problem in many nations in earlier stages of motorization. This may seem unlikely at first glance. After all, the question is asked, considering the other health problems facing such nations, is the traffic injury problem really so important by comparison?

However, as the great scourges of contagious disease come under control, and with improved water and food supplies and sanitation, some of the major causes of death from former times have come under increasing control. As such country-wide health problems decline, the counter trend is that traffic injuries are on the increase. One example is Dominica, a Caribbean island republic with a population of about 100,000, about 10,000 motor vehicles and about 10 fatalities per year. Traffic injuries and death are already a considerable burden on that nation's health care system and budget, and the years of life lost due to motor vehicle crashes exceed that of cancer and heart disease [13].

As indicated, traffic accidents constitute an economic burden on any country, requiring that resources be allocated to the results of injury and death, rather than other purposes more preferable to the people and their governments. In the USA it is estimated that motor vehicle crashes cost nearly 50 billion dollars per year [15]. This amount of money is required to pay for medical care, disabilities, property loss and other economic consequences of accidents. In the absence of accidents, such sums of money would be available for other, presumably more desirable, societal uses. The long term nature of some of the cost is suggested by the fact that motor vehicle crashes cause about half of the 18,000 accidental brain injuries each year -- trauma that produces long-term disability [15]. It is estimated that the annual total cost of motor vehicle crashes in the USA exceeds that of cardiovascular disease and is nearly as much as the cost of cancer [9]. Although many countries now in the process of motorization do not as yet sustain costs of this relative magnitude, traffic injuries still constitute a significant burden on their health care systems.

4. THE ROAD CRASH PROBLEM IN MOTORIZING COUNTRIES

Several of the basic characteristics of road accidents in motorizing nations are quite different from those in fully motorized nations. For comparison, consider the USA as a point of departure. In the USA, passenger vehicle occupants constitute the largest single category of traffic deaths. In response to that fact the USA has, during the past 25 years, devoted much attention to making the interior of passenger cars safer through occupant restraints, energy absorbing structures, etc.

Figure 3: Pedestrian risk is often a matter of unlawful and dangerous pedestrian behavior.

In many motorizing countries, however, passenger car occupant deaths are trivial compared to other categories. In India, passenger car occupant deaths constitute less than two percent of the total. In China, it is less than five percent. The largest categories of victims in both those countries are pedestrians or bicyclists who are struck by motor vehicles. Truck and bus riders also rank among the casualties. Thus, in many countries the exteriors of motor vehicles inflict more casualties than the interior. One may tend to regard the crash of a motor vehicle against a pedestrian as being too hopelessly severe to deal with except by prevention, but note that in the USA, 90 percent of pedestrian crashes are not fatal, in considerable degree because so many pedestrian accidents occur in urban areas where vehicle speeds are lower, and pedestrian survivability is possible. Many lives could be saved if that survival rate were improved even to 93%. Thus, the exterior of the motor vehicle could be the subject of crashworthiness engineering in like manner to the car's interior.

The size of the pedestrian accident problem also calls for enforcement and road user education. Efforts to make pedestrian behavior more orderly and to achieve better compliance with rules of the road would likely be as effective in motorizing nations as they were when introduced in the USA decades ago. Likewise, in some motorizing countries, the lack of a suitable traffic police presence and the lack of data processing systems to record cumulative traffic offenses of individual drivers, make it possible for some drivers to drive recklessly over extended periods of time without having to face the consequences of their actions.

Figure 4: Poor lane keeping behavior can reduce the ability of arterial streets to move large traffic volumes.

Another feature of traffic in many rapidly motorizing countries, in contrast to the USA and other highly motorized nations, is the wide diversity of users that share the road. In the USA, about 70% of the traffic stream consists of passenger cars, and most of the remainder is trucks, with a few motorcycles and buses. By contrast, in many rapidly motorizing countries, there are considerably fewer passenger cars, and an enormous number of pedestrians, bicyclists, and motorcycle or motor scooter riders. Add to this trucks and buses (in greater proportion than in the USA) plus animal drawn and human drawn conveyances, and one is reminded of the high proportion of "vulnerable road users" in the traffic stream (the theme of a recent international conference in New Delhi). This extensive variation within the mix of vehicles produces great variation in vehicle conspicuity, acceleration and turning ability, speed capability, and other characteristics that work against safe and smooth traffic flow.

Figure 5: Vehicle mix is a particular problem when a substantial variety of vehicles must share the road facility.

Another characteristic of many early-motorizing countries is that the role of the roadway in injury reduction tends to be ignored. Too seldom will one see guardrails built with attention to energy absorption, treatment of ditch slopes (by shaping them to avoid vehicle overturn), nor other roadside safety appurtenances commonly seen in motorized countries. Lack of resources and perhaps awareness contributes to this. Certainly there is great variation in Central and South American countries, and while the characterization above is not fully applicable in some places, it does apply in other places.

Figure 6: A wide range of vehicles, using a relatively high grade facility, poses special problems for road users.

5. BARRIERS TO INCREASED ROAD SAFETY

One barrier to improvements in road safety may be something as basic as the very way in which a government views and understands the nature of traffic crashes in their country. As is obvious, the measures that will be taken to control road accidents in a given country will be based on the prevailing view of the phenomenon in the first place. Here are a few examples of extreme points of view, presented as a way of laying groundwork for further discussions.

A. One point of view is that motor vehicle crashes are more or less inevitable, and therefore, that it is somewhat futile to seek remedies for the problem. Such a fatalistic attitude is not surprising. A common view of traffic fatalities in the USA during early decades of this century, when motor vehicles were beginning to be a prominent source of death, was that accidents were unforeseeable random events, and, as such, were substantially beyond society's control [8]. In fact, Haddon, et al. argued that the very use of the term <u>accident</u> implies the belief that crashes are a chance occurrence and that remedial measures are more or less futile [8]. To the extent that such a fatalistic view is prevalent, a government may not implement programs with a level of commitment that could otherwise exist.

B. A second viewpoint is that traffic accidents are largely the product of illegal or reprehensible behavior on the part of drivers or other road users, and therefore road safety is viewed almost exclusively in terms of crime and punishment. Thus, the

Figure 7: On this high grade facility, the bicyclist <u>and</u> the pedestrians are in the roadway, moving against traffic!

point of view may be that, "it is the driver who causes the problem, therefore most of our programs should be aimed at the driver -- to suppress improper behavior on the road". Such a view unnecessarily restricts the range of societal initiatives likely to be successful in addressing the problem. It is quite true that road users cause most of the crashes, but it does <u>not</u> necessarily follow that countermeasures should be exclusively aimed at driver behavior.

C. A third viewpoint that may limit initiatives to reduce traffic injuries and death is one in which traffic injuries are viewed almost exclusively as a transport problem. Because the road transport system is an extremely valuable and necessary societal endeavor to bring about the economic and social goals of the government and the people, some decision makers may concede that the necessary massive enterprise of moving people and goods will result in inevitable but acceptable "system failures" which produce injuries and loss of life and sustaining of injuries.

Inevitably, some safety initiatives <u>are</u> a matter of compromising between safety and mobility. Almost any government will resist large scale reductions in mobility that may be advocated in the name of safety. That is partly because reductions in mobility are readily perceived by the road users while decreases in safety are not. Nevertheless, unless a balanced view is taken, one in which the goal is to optimize both mobility <u>and</u> safety, then traffic injury reduction cannot be accomplished at a level that is otherwise feasible.

D. There is a fourth point for consideration, and that is to view traffic injuries, in part, as a public health problem. Obviously, traffic accidents are a transport problem, but it is useful to point out some of the characteristics of approaching a problem from a public health perspective.

In the public health approach, it is assumed that the problem is multidimensional. It is assumed that no single intervention will assuredly solve the problem, and it is assumed that skills should be employed from the several professional disciplines relevant to the problem. In a research and technology transfer sense, this means drawing on many different professional backgrounds including engineering, epidemiology, psychology, statistics, economics, medicine, safety education, enforcement, law, and public administration. From the standpoint of government, this means that road safety should be handled on a multi-ministerial and inter-ministerial basis. Ministries that should be involved on a coordinated basis certainly include: public roads, public works, public health, police, education, and trade. The public health approach also involves establishing a data and research capability for purposes of problem identification and program evaluation.

It is obvious that dealing with problems from a multiple-professional and multiple-agency perspective is nothing new and certainly is not the exclusive province of public health. The public health analogy is used here merely to make the point that, even in the nations earliest in the process of motorizing, an inter-ministerial commitment must be considered in order to address and control the problem of traffic injury and death. (Some of the foregoing text was adapted from a paper presented at an OECD conference in Seville, Spain. [Campbell, 1991, Reference 6])

C. Assessment of the Highway Safety Problem in the Americas

The degree of highway safety that prevails in a given country depends, of course, on a number of factors. Some large scale factors operate throughout the country, such as population urban/rural distribution, wealth, etc. Other factors are much more localized and, in fact, are specific to individual road users and highway locations. One of these more global factors is related to the degree of motorization found in a given country. In the Americas, the degree of motorization varies greatly from one country to another. In the USA, for example, there are about 76 motor vehicles per 100 persons. At the other end of the motorization scale, several nations have only about three motor vehicles per person. This includes the small country of Belize (population under 100,000) and also Peru, with a population of 21 million (1,7).

Table 1 shows population and motor vehicle registration figures for several countries in the Americas. Data were not available for all. The motor vehicle registration figures are confined to cars, trucks, and buses, and do not include the very widespread use of motorcycles and motor scooters in many countries in the Americas. It proved not to be possible to obtain reliable registration figures for these latter vehicles in all countries. Therefore, the figures presented here fall short of a comprehensive portrayal of mobility in some of the countries. Motor vehicle

Figure 8: In mountain terrain, severe horizontal curves require adequate signing, delineation, and guardrail placement to help avoid run-off-road accidents.

registration figures are taken from AAMA Motor Vehicle Facts and Figures, 1993 [1], reporting registration figures as of 1991. Population figures (as of 1989) are taken from Goode's Rand McNally World Atlas, 18th Edition, [7].

The degree of motorization in a country is a strong indicator of its wealth. Countries with greater personal wealth have higher levels of motorization, unless some government policy prevents such from occurring. The wealth factor is most relevant since highway safety expenditures are likely related to the wealth of nations. Countries that are very poor have many needs that may be regarded as more pressing than highway safety, as is seen in several countries in Africa and Asia.

In more wealthy countries, motor vehicle ownership and usage are high, and a great deal of travel occurs. In the USA there are about seven motor vehicles for every ten persons, and the average travel per year per vehicle is about 18,000 kilometers. As a result, road accidents rank high as a health problem in those countries.

Another relevant point about degree of motorization is the impact it has on the use of various rate indicators commonly used in highway safety. The rate most often used by transportation officials is the number of accidents (usually fatal accidents) per 100 million kilometers of travel. However, public health advocates like to use the rate of fatal accidents per 100,000 population because that population rate is used to characterize the magnitude of diseases and other public health indicators.

Table 1: Population, registered motor vehicles and rates per capita for some countries in the Americas

Country	Population	Registered motor vehicles	Motor vehicles per 1000 population
Antigua	84 000	17 200	205
Argentina	32 205 000	5 841 600	181
Bahamas	243 000	85 000	350
Barbados	255 000	50 695	199
Belize	184 000	4 800	26
Bermuda	56 000	22 711	406
Bolivia	7 184 000	325 000	45
Brazil	145 930 000	13 204 925	90
Canada	25 895 000	16 805 096	649
Cayman Islands	25 000	10 000	400
Chile	12 925 000	1 030 000	80
Columbia	30 465 000	1 468 606	48
Costa Rica	2 990 000	263 880	88
Dominica	100 000	10 172	102
Dominican Republic	7 069 000	242 038	34
Ecuador	10 345 000	245 000	24
El Salvador	5 122 000	160 000	31
Falkland Islands	2 000	1 600	800
Guatemala	8 818 000	250 000	28
Guyana	765 000	33 000	43
Haiti	6 346 000	55 000	9
Honduras	5 047 000	137 000	29
Jamaica	2 470 000	115 500	47
Mexico	85 300 000	10 700 000	125
Netherlands Antilles	194 000	71 251	367
Nicaragua	3 689 000	70 000	19
Panama	2 346 000	196 000	84
Paraguay	4 210 000	110 000	26
Peru	21 535 000	635 544	30
Puerto Rico	3 301 000	1 562 171	473
St. Lucia	148 000	11 000	74
St. Vincent	125 000	6 500	52
Suriname	398 000	50 000	126
Trinidad	1 295 000	210 202	162
USA	247 410 000	188 371 935	761
Uruguay	3 184 000	300 000	94
Venezuela	19 010 000	1 909 000	100
Virgin Islands, USA	106 000	63 188	596

Note the relationship of these two rate measures. In countries with a low number of motor vehicles per unit population, the population death rate from road accidents is necessarily low. However, the death rate per registered vehicle may be quite high. In countries with a high motorization rate -- like the USA -- the death rate per 100,000 population is rather high simply because so many people use motor vehicles so much. The death rate per motor vehicle or per kilometer is low, however.

As shown in a preceding section of this report, if one considers only deaths per unit population, Brazil and the USA are about the same, and both fare much worse than India. But if one considers the death rate per unit kilometers travelled, then the USA fares much better then Brazil, and Brazil much better than India.

Another item correlated to degree of motorization is the nature of the prevailing motor vehicle mix. In the USA, for example, the number of motor vehicles per capita is very high, and moreover, the motor vehicle mix is quite homogeneous compared to much of the rest of the world. In the USA, passenger cars account for a rather high percentage of total registration -- about 70% [1]. In countries with a lower level of motorization per capita (i.e. lower wealth per capita), the road user mix is likely to be much more heterogeneous. In such countries there will be relatively fewer passenger cars, and relatively greater numbers of vulnerable road users such as pedestrians, bicyclists, and those using animal or human drawn conveyances.

Figure 9: Animal drawn conveyances sometimes are part of the vehicle mix problem in urban as well as rural places.

This vehicle mix is quite relevant to highway safety in that accidents are more likely when there is a wider range of vehicles sharing the road, with their grossly different operating speeds, and differing acceleration and braking capabilities. Further, the high percentage of traffic that falls in the most vulnerable category of road users -- pedestrians, bicyclists, and the like -- make for a particularly high likelihood of death once an accident occurs. Safety priorities are justifiably different in countries with high versus low numbers of vehicles per capita.

What is the actual safety record in various countries of the Americas?

Unfortunately, it is not possible to obtain reliable traffic fatality data for all countries in the Americas. Table 2 below is based on fatality data from several sources:

* T.P. Hutchinson, Road Accident Statistics, 1987 [6].
* United Nations Yearbook, 1991 [16].
* World Health Statistics Annual, 1992 [17].
* Accidents Facts, 1994 [3].

Table 2 shows deaths per 10,000 registered motor vehicles with regard to American countries for which such data were available from the sources mentioned above. Where several fatality numbers are available, the one closest to 1991 (the date of the registrations) is used and is shown in bold face type.

Two comments can be made about data in Table 2. First, different sources of fatality data, from different years, are reasonably consistent for some countries, but not for others. Second, some of the countries show data which, according to information from some relevant officials in the country, reflect incomplete reporting (substantially incomplete in some cases, it is said).

Some rates are so high as to raise suspicion that the data may be so inaccurate as not to be usable. For example, the fatality rate in Haiti (291 per 10,000 vehicles) is more than 100 times greater than the USA value of 2.5. But even if figures from some of the individual countries are disregarded, Table 2 shows persuasively that deaths per 10,000 vehicles are much higher in many countries of the Americas than in the USA and Canada.

It should be said that the fatality rates shown in Table 2 are likely quite crude and are therefore of only limited use in making comparisons of one country to the other. For the sake of comparing on a common basis, it would be preferable to compare deaths per 100 million kilometers of motor vehicle travel in the various countries. However, information is simply not available from most countries that would permit estimating the annual kilometers travelled per motor vehicle.

In the USA, annual travel per vehicle is about 18,000 kilometers per year. In countries with much lower numbers of motor vehicles per capita, it is almost certain that the annual kilometers of use per vehicle is higher than in the USA. Partly that is because a much greater proportion of motor vehicles are buses and trucks in the other countries than in the USA and Canada and such vehicles generate greater annual mileage because of their commercial use. Therefore, using deaths per 10,000 vehicles probably exaggerates somewhat this difference between the USA and countries with much lower degree of motorization.

Another factor that should be mentioned is the inability to use motorcycle and motor scooter registrations in the estimate of the vehicle registration. If that data were available, than that too would reduce the calculated difference between Canada-USA and other countries in the Americas. Thus, the rates in such countries are surely much higher than in the USA, but perhaps not by the margins indicated by taking Table 2 at face value.

Table 2: Traffic deaths per 10,000 registered motor vehicles for some countries in the Americas

Country	Registered motor vehicles	Deaths: sources listed below with year Hutchinson reference 10	NSC ref. 2,3	UN ref. 17	WHO ref. 18	fatals per 10,000 mvs
Antigua	17 200	**9 (83)***				5.2
Argentina	5 841 600	3,750 (81)	**2,942 (90)****	3,054 (87)	3,085 (89)	5.0
Bahamas	85 000	42 (83)		**47 (87)**		5.5
Barbados	50 695			**28 (88)**		5.5
Belize	4 800	**12 (82)**				25.0
Bolivia	325 000	**629 (82)**				19.4
Brazil	13 204 925	19,835 (80)	**22,100 (89)**	29,551 (86)	27,611 (87)	16.7
Canada	16 805 096	3,973 (84)	**3,463 (91)**	4,210 (89)	3,645 (90)	2.1
Cayman Islands	10 000	**19 (79)**				19.0
Chile	1 030 000	972 (83)	941 (89)	879 (87)	**941 (89)**	9.1
Columbia	1 468 606	2,383 (81)			**4,111 (86)**	28.0
Costa Rica	263 880	200 (83)	**415 (91)**	352 (89)	389 (89)	15.7
Dominica	10 172	**10 (83)**				9.8
Dominican Republic	242 038	**541 (82)**				22.4
Ecuador	245 000	2,123 (80)	2,037 (88)	2,037 (88)	**2,049 (90)**	83.6
El Salvador	160 000	713 (84)		713 (84)	**1,088 (90)**	68.0
Falkland Islands	1 600	**1 (78)**				6.2
Haiti	55 000	**1,600 (80)**				290.9
Honduras	137 000	16 (78)			**37 (85)**	2.7
Mexico	10 700 000	15,722 (82)	**14,126 (91)**	12,288 (86)	13,662 (89)	13.2
Netherlands Antilles	71 251	**13 (81)**				1.8
Nicaragua	70 000	168 (78)			**337 (90)**	48.1
Panama	196 000	346 (84)		388 (87)	**320 (89)**	16.3
Paraguay	110 000	201 (84)		241 (86)	**225 (87)**	20.5
Peru	635 544	889 (78)		1,253 (83)	**809 (89)**	12.7
Puerto Rico	1 562 171		**581 (91)**	548 (90)	548 (90)	3.7
St. Lucia	11 000	**17 (81)**				15.5
St. Vincent	6 500	**10 (82)**				15.4
Suriname	50 000	71 (83)		68 (85)	**35 (87)**	7.0
Trinidad	210 202	224 (83)		124 (88)	**130 (89)**	6.2
USA	188 371 935	43,795 (85)	**45,827 (90)**	48,024 (88)	46,586 (89)	2.4
Uruguay	300 000	269 (84)	**375 (90)**	477 (89)	375 (90)	12.5
Venezuela	1 909 000	4,801 (83)	**3,905 (89)**	4,371 (87)	3,905 (89)	20.5
Virgin Islands, USA	63 188	**19 (9/77)**				3.0

* number in parentheses is the year of the fatalities

** numbers in bold face are used to calculate fatalities/10,000 vehicles

Nevertheless, even taking all of the above into account, it seems clear that the road accident and traffic death situation in the Americas is such that many countries have highway safety environments that are more dangerous than in Canada and the USA by the order of 10 fold -- more in some places and less in others.

It is this large difference that justifies increased Technology Transfer of highway safety information to help countries in the Americas to accelerate the pace of improvement in their accident rates that is already underway in most places.

D. Examples of Safety Problems in Central and South America

Though it is easy to cite large scale trends that differentiate countries and regions in terms of accident experience, the source of such differences is a multitude of specifics, as illustrated by examples below.

* Aggressive drivers who disregard speed limits, stop signs, etc., but for a variety of reasons often avoid any consequences for their reckless driving.

* In the face of sharing the road with many vulnerable road users, drivers of large vehicles pay too little attention to the safety of these vulnerable road users.

* Dense fog and other climatic factors, combined with low-grade roads, make for special problems in the mountainous part of several South American countries.

Figure 10: Narrow bridges abound in some rural areas and the hazard may be reduced only slightly by warning signs.

* Pedestrian deaths are a special problem in large cities, where pedestrians cross busy multi-lane thoroughfares, bus stops are located along high-speed freeways, and drivers may fail to slow down for pedestrians.

* Bicyclists commonly ride after dark without lights or reflectors.

* Overworked and aggressive bus and taxi operators cause problems in urban areas.

* Narrow bridges represent a serious problem on rural two lane roads.

* Roadside hazards abound such as steep side slopes, culvert head walls, and unprotected guard rail ends.

* At urban intersections it appears that some drivers do not understand right-of-way conventions (or ignore them).

* Lane-keeping by drivers on some multi-lane facilities leaves something to be desired.

* On the Pan American highway network, there are many at-grade intersections with little or no traffic control.

* Old and poorly maintained vehicles remain a problem.

* Adequate regulations and enforcement are needed for truck drivers in terms of hours of operation, rest intervals, etc.

* Drinking and driving is felt to be a problem in many areas.

* Some officials believe that the requirements for obtaining a driver license are too lenient.

* Several countries do not have an effective program for identification of high accident locations, and the correction of same.

Of course, to a greater or lesser extent these same observations can be made for highly motorized countries, including the USA. The point of these examples is to be reminded that action is required on many fronts to achieve an effective highway safety program, and therefore technology transfer in highway safety must take multiple avenues.

Chapter Two: Expanding the Highway Safety Technology Transfer Program for the Americas.

A. Introduction

Progress in highway safety is underway all over the Americas. Even though improvements have been seen in most countries, there is still a wide disparity in accident rates among the various countries on the North and South American continent, and the Caribbean nations, as has been shown in the previous chapter.

The challenge is to speed up the process of highway safety improvement in countries which now experience high accident rates. One approach to this problem is to increase the amount of highway safety technology transfer relative to that presently taking place.

Expanding this process and making it more regular has much to offer, but at the same time, many barriers to success are in evidence. This chapter presents some ideas as to approaches that might be taken to improve the process.

Naturally, the planning process begins with what exists at the present time. The situation that exists now, in terms of training as a part of highway safety technology transfer, is a sort of ad hoc effort in which safety-related short courses or lectures are given as requests arise, and as funds are available. In this report, ideas for establishing more formalized highway safety training activities are described in three stages. The three stages are arbitrary, since the actual process is mostly a continuous one. Events probably will unfold quite differently from that described here. The point, however, is to is to describe elements that must be present in order to "regularize" highway safety technology transfer through increased training. The stages are:

Stage 1: Formalizing the Ongoing Ad Hoc Efforts: In the first stage, a series of courses are developed and presented. The Secretariat of the Pan American Institute of Highways (PIH) acts as a broker in identifying the need and desire for courses and the faculty to teach. The Secretariat should also receive course materials that are used, and should retain these for future use and adaptation.

Stage 2: Increasing Highway Safety Expertise Among Technology Transfer Center Faculty: The second stage could feature increasing involvement of faculty of selected Technology Transfer Centers (TTC) of the Americas. Initially, the goal would be to assist TTC faculty at certain centers to attend safety courses and acquire expertise in a broad range of highway safety topics. As this is accomplished, TTC faculty would increasingly accept responsibility for teaching the courses, perhaps with diminishing participation from external faculty.

Stage 3: Sustaining a Regular Highway Safety Teaching Program Provided by TTC Faculty: The third stage could aim at attaining self-sufficiency of the TTCs in identifying highway safety instructional needs, and providing courses of instruction.

External faculty expertise would still be available to handle subject matter for which expertise is not readily available among the faculty of a given TTC, as a supplement to regular faculty.

In describing each of these three development stages, several points should be considered:

1. Identification of needed courses, and development of course content.
2. Identification of students who would benefit from the specific courses.
3. Identification of faculty.
4. Assembly of course materials and resources.
5. Liaison among parties with an interest in the effort.
6. Administration.
7. Financing.

The stages of program development and the seven categories are summarized in the table immediately below and then each is discussed thereafter.

	Stage 1	**Stage 2**	**Stage 3**
Course Content	defined by "experts", with input by country officials	increased role of TTC, plus international advisory panel	TTC defines, in coord. with advisory panel
Who attends the course?	officials from multiple govt. ministries, and TTC faculty	officials from multiple govt. ministries and TTC faculty	university students, ministry officials and employees with safety duties
Faculty	external experts	TTC staff plus experts	TTC staff with limited external input
Materials/ Resources	survey what is available and assemble it (translate?)	adapt and translate	develop new materials in local language
Liaison	informal via PIH	TTC and country staffs	TTC and country staffs
Administration	Pan American Institute of Highways	PIH plus internat. board	International Board via PIH
Financing	one time grant from sources such as World Bank, 3M, auto industry, road industry	regular FHWA funds plus fund raising in other countries	regular international funds, declining FHWA role

Since the process begins with an extension of the ad hoc efforts now underway, consider a brief summary of what has happened during the last few years. During that period, several highway safety courses (or lectures) have been presented in Central and South America. They were presented in Argentina, Brazil, Chile, Costa Rica, and

Uruguay. Through the coordinating efforts of the FHWA Highway Institute and the PIH, the desire to receive such courses was noted, and faculty were identified who possessed the expertise and willingness to participate. Most faculty were from the USA. Funds were secured and faculty travel expenses were covered. Funds were not sufficient, however, to cover faculty preparation time, or to cover expenses for students. All of these are items that should be considered for future programs.

Experience with these lectures and courses confirmed existence of a substantial eagerness for such information on the part of transport professionals from the several countries represented. It is also evident that there are highway safety experts with both the requisite subject matter knowledge and willingness to participate as faculty, assuming that appropriate funds were available.

How then, will it be possible to begin the process of providing this kind of instruction on a more regular basis? On following pages, let us consider the several categories summarized in the preceding table.

Figure 11: Some heavy volume facilities are beset with problems of left turn opportunities, and hazardous placement of roadside objects.

B. Course Content

At the outset, in stage 1, selection of topics and the definition of course content will probably be decided by the expert faculty and PIH officials. (Chapter three of this report describes 14 sample courses that might be appropriate.) The assumption is that, early on, students should be exposed to a broad array of highway safety topics, especially including those outside the usual responsibility of transport officials. This broad approach is recommended because of the need for viewing the accident problem as requiring a multi-ministerial and interministerial response. As this is done, course recipients will begin to see what is relevant to their situation and what is not, and will provide feedback leading to modification of the courses to suit the local need.

It is particularly important that any faculty from the USA or Canada be experts who well understand the crucial differences between the highway safety problems in highly motorized countries like USA and Canada in contrast to many nations in Central and South America. Clearly, course content must address those local needs and characteristics. In fact, this is one of the serious problems in undertaking the effort. Outside faculty will have difficulty in understanding details of the local situation. In the worst case, they may assume that certain things operate in a given country as they do in the USA or Canada, and may proceed on that basis in their lectures. This may result in the course being of quite limited utility. On the other hand, those receiving the courses may be unaware of the breadth and scope of highway safety information available, and may fail to ask for information that would, in fact, be quite useful to them.

As an example of local fact-finding, the Global Traffic Safety Trust presented a two day seminar in Montevideo, Uruguay, a few years ago, with six faculty participating. During the full week prior to the seminar, these faculty, separately, spend the week in fact-finding visits with officials in the various ministries both in Montevideo and elsewhere. They then spent the week end adapting the course topics to the information learned. It goes without saying that such visiting faculty, with only a week to learn, could know only a little of the local situation and the local constraints. However, their unfamiliarity with the local situation would have been greater without the fact-finding period. It is likely that visiting faculty will encounter time and cost barriers that will hamper this sort of fact-finding, but a lack of local knowledge imposes a limit to the effectiveness of courses given.

The course series would need to reflect several realities that characterize the highway accident situation in many countries in Central and South America:

<u>Need for a multi-ministerial approach</u> There is a need for interministerial coordination among ministry officials who work in areas pertaining to highways, police, health, education, vehicle regulation, insurance, driver licensing, etc.

<u>Need for better data and records</u> Lack of accident and driver records hamper any efforts to set up a process of identifying and correcting high accident locations on the highways, and also identifying and dealing with unusually dangerous drivers.

More diverse enforcement strategies Police may assign relatively low priority to traffic enforcement, and assignment of police on the basis of high accident locations may be impossible due to lack of data.

Better driver control programs With increasing mobility comes the need to identify dangerous drivers who commit serious infractions in various parts of the country.

Ability to identify high accident locations and need for a spot improvement program It is usually cost-effective to identify particularly dangerous locations on the roadway net, and to make changes to improve those spot locations. However, this cannot be done in the absence of a data process to identify the locations, or in the absence of a commitment to earmark a portion of road funds for correction of high accident locations.

Awareness of the influence of a different vehicle mix on the accident situation A special difficulty in most Central and South American countries is the great variety of road user types. With all kinds of vehicles and a particular preponderance of vulnerable road users such as pedestrians and bicyclists, the accident problem is even more formidable than in highly motorized countries where the vehicle mix is more homogeneous.

Figure 12: The need for access to their destinations sometimes forces pedestrians and bicyclists to share high speed facilities with motorized vehicles.

As the process moves from Stage One to Stage Two, it is imperative that TTC faculty begin to attend the courses, so that they may build up a detailed familiarity with any aspects of highway safety in which they happen to lack expertise. The most critical element of Stage Two is the development of TTC faculty so that they will have a good grounding in a wide array of highway safety topics.

Another important consideration is the relationship between TTC faculty and government officials. There should be good coordination of efforts so that the faculty expertise will be "in-step" with the desires and priorities of the government officials. A sure-fire route to failure is seen when government officials come to regard the University offerings as too theoretical and insufficiently practical to benefit those who actually do the safety work.

C. Who Attends the Course?

Interested officials will be invited to attend. Often the courses will be held at the same time and place as international meetings, capitalizing on the obvious advantage of saving on travel costs. The disadvantage is that the persons authorized for travel to such meetings may not actually be the most suitable persons to attend the courses. Eventually the more comprehensive courses will need to be held in government capital cities so that relevant officials can attend. In that way, attendance can be greater and travel costs can largely be confined to that of the visiting faculty.

A critical question is that of language. Initially, most of the "experts" will speak English. Because of the educational practices in the USA and Canada, few highway safety experts in those countries will be able to lecture in Spanish and virtually none in Portuguese. Many high level transport officials from the rest of the Americas will be able to understand lectures in English. This is a great credit to them! However, many of the lower level officials attending the courses will <u>not</u> be able to understand English. As a long term process, technology transfer in highway safety cannot really succeed until materials and lectures are available in the local language.

There is, of course, progress in addressing the language barrier. Border state transportation departments in Texas, New Mexico, Arizona, and California increasingly find it useful to develop training materials in Spanish. At Texas A & M University the Texas Engineering Extension Service has developed several courses and videos in Spanish. For examples, more than 20 video tapes have been developed with Spanish language commentary, and while most of these do not deal directly with safety topics, three address the matter of Work Zone Safety. A & M is currently developing a four week course on Highway Safety Management Systems and that would seem to be a prime candidate for translation into Spanish.

However safety is not <u>central</u> to most of these efforts, and safety needs to be made an integral part of efforts to develop materials in the Spanish language. Further, all of these efforts tend to fall more or less exclusively in the area of the roadway itself, whereas the need for highway safety training cuts across areas of human behavior, medicine, law, vehicles, licensing, etc. The mechanisms that have been developed for technology transfer into the Spanish language regarding the roadway should be opened up as well to broader areas of highway safety.

At the early stage, those who attend the courses will tend to be transport officials with higher level positions. A challenge, as the process develops into Stages Two and Three, will be to reach lower into the official hierarchy and to bring in some of the "working level" officials, as well as to expand laterally so that officials are brought in from ministries with responsibilities in education, public health, police, etc. -- non-transport agencies that have a role (or <u>should</u> have a role) in highway safety.

Figure 13: Pedestrian overpasses are expensive but provide safer means to cross busy freeways. Unfortunately, some pedestrians choose to cross at street level even where an overpass is present.

D. Faculty

Faculty could be drawn initially from several highway safety organizations in the USA and Canada, and other American countries. Once an initial candidate list of courses is selected, then senior experts in each subject area could be contacted to ascertain interest. It is already known that interest exists among senior staff from major University highway safety programs, such as the University of North Carolina, Texas A & M University, and the University of Michigan. An early task will be the identification of potential faculty to teach the basic courses selected. The Secretariat of PIH can consult with persons who have taught previous courses and can thereby identify many candidate faculty in addition to the candidates identified herein. In Chapter Three of this report, dealing with specific courses, potential faculty are identified for each course. (It is, however, beyond the scope of this effort to ascertain the willingness of each to participate.)

Faculty should definitely include FHWA and NHTSA staff, if agency policy permits such staff to undertake this kind of activity, entailing foreign travel as it does. If agency policy does not lean in this direction, then it would be hoped that a review of said policy could be made so that the desirability of involving this groups of experts could be considered.

It should also be pointed out that, in order to evolve to Stage Three, there should be a great deal of effort in "training the trainer". The TTC faculty may need to have extensive training in highway safety. It would be desirable to have among the faculty those who could address not only the several topics related to the roads and transport system, but those who could address the behavioral aspects of licensing and driver control, as well as those with expertise in enforcement, computer systems, medicine, and law. It is not enough that faculty include persons whose expertise is confined to these academic specialties. Faculty must also be acquainted with the extensive knowledge, writings, and techniques that have been accumulated in the "science" of highway safety over the decades. Thus, merely having an engineering professor on the faculty for one of the highway safety courses, or a psychology professor, is insufficient if those professors do not have a thorough acquaintance with the research and doctrines of the safety field.

In addition to the subject matter of the various topics of highway safety, the faculty needs to have expertise in research and evaluation techniques and results, such as have been applied to matters of highway safety. Motorizing countries should establish the capability and adopt the practice of evaluating the actual benefits of safety initiatives using well-established scientific research techniques. This will not merely help to identify initiatives which constitute the best use of funds, but will also help to establish a general scientific framework within which to view road accidents.

Rationalization of the understanding of road accidents, and establishment of a scientific approach is much to be desired in a field in which so much undocumented "theory" prevails and so many questionable statistics and questionable doctrines exist. Establishment of this kind of capability will quickly point out the need for appropriate accident data to support the evaluation function. One of the most critical roles of faculty is to bring scientific knowledge into all aspects of highway safety.

All this leads to the thought that there is need for a series of "long courses" perhaps taught in the USA. I can imagine that officials, designated as the highway safety person for a given TTC, should spend a year in the USA. It would probably be possible to arrange visits of, say two weeks at a time at various universities, state transportation departments, federal offices, private safety groups, etc. At these places the persons could be given training in various topics. Of course, the overall effort would require a central coordination function. The receiving organizations need time for preparation so as to be able to set up a program that is of value to the visitors.

The necessity for such an arrangement to teach highway safety underlines a serious deficiency that exists now and has existed throughout the history of highway safety in the USA. That is the lack of any place in the world where officials of motorizing nations may undertake a comprehensive program of study in traffic safety. Such a program would need to cover roadway, driver, vehicle, health, and economic aspects of safety. It is needed, but does not exist. It would be inherently international in nature. An international road safety training program, housed at a University, would seem to be a worthy topic for consideration by appropriate international bodies, with an invitation to multi-national corporations that they help in providing initial funds for such an undertaking. Note a recent discussion of the concept of a unified traffic safety science [14].

E. Materials and Resources

Initially, course materials and handouts will be assembled, presumably, by the individual faculty who presents the course. That means that most will be in English since most of the instructors will be English-speaking, at least in Stage One and much of Stage Two. An example of this is the compilation of materials used in a recent series of lectures and entitled "Seguridad Vial: Material de Referencia", FHWA PIH, 1992. [16] This notebook contains several documents (all in English, it should be noted) and these were prepared and distributed to those in attendance. This is an illustration of the process that should be repeated as a set of reference material is assembled.

A copy of materials developed or adapted should be retained by the PIH Secretariat for re-use or update, and thereby an archive will be initiated, consisting of materials expressly found useful in the technology transfer process. Materials retained should include written text and reports, and audio-visuals such as copies of slides, films and videotapes. There may be utility in videotaping the actual lectures by the faculty so that a videotape lecture series might be assembled over a period of time and thus be available for "home study courses".

A great deal of resource material is available in the form of reports and documents mostly financed by NHTSA or FHWA. These could be used in whole or in part. In addition to reports from these sources, materials have been developed in the course of activities performed by other motorized countries as <u>they</u> engage in their own process of Technology Transfer in traffic safety. Notable in this regard are the activities of the Overseas Branch of the Transport Research Laboratories (TRL) in England.

Discovering and compiling such material is no small task, however. As this process moves into Stages Two and Three, it is hoped that a specific project would be undertaken to assemble and compile materials from various nations that provide highway safety training in motorizing countries. Perhaps it would be possible to create a shared data base listing relevant reports that have been used or could be used in this sort of technology transfer activity.

This would imply, however, a funded activity to conduct the initial compilation of this resource data. Perhaps in the long run it would be possible for the FHWA to collaborate in a unified project of relatively large scale which would result in assembling information about safety initiatives that are relatively low cost and high benefit. Drawn from the vast literature in the US, Europe, Australia, Japan and elsewhere, the end-product would be a large compendium of information covering a full array of road safety initiatives and including such diverse topics as licensing procedures, accident records, roadside improvement, alcohol enforcement, vehicle standards, etc. Such an effort would result in a library of materials concentrated specifically on information of specific relevance to motorizing nations. Attesting to the hard work necessary in compiling such a "library" is the fact that few reports will be usable "as is". Rather, parts of various reports will have to be assembled, modified, and compiled.

As the TTCs become more engaged in safety teaching efforts, it is assumed that they will accumulate materials in their own libraries. Even if this is done, it would be useful to maintain a shared computer data base of report titles.

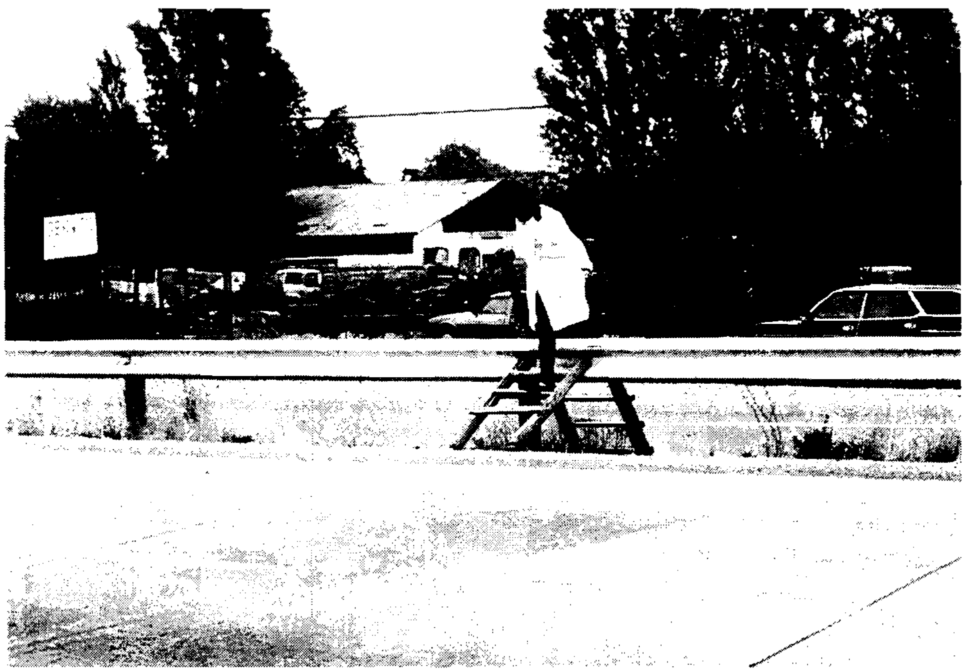

Figure 14: Pedestrians need access in even in the face of freeway development, and sometimes dangerous crossing methods are the only recourse.

F. Liaison

Success of highway safety courses will depend on avoiding conflicts among the interests of faculties of the TTCs, government officials in several ministries, and the international participants in the courses. Highway safety is a matter that logically cuts across several government ministries. Cooperation between police and highway departments is important. Involvement by the education and health ministries is important as well. However, in too many countries, the coordination among ministries is minimal, and in some cases, ministries with a potential role are hardly involved at all.

Further, since the TTCs are within the Universities, there is the question of the coordination between university and government. Does such exist? Is there a willingness on the part of government to have the Universities involved in highway safety training? Are the Universities interested in anything of such a "practical" nature, or do they see their role as being more "theoretical" than highway safety? Further, since the TTC faculties tend to be trained in the road and transport area, what is the likelihood of being able to engage faculty from other areas such as medicine, public health, psychology, education? There the task would be to "train" the faculty first so that they could usefully teach traffic safety courses.

In the beginning, there should perhaps be a single, multi-national liaison committee with government, university, PIH, etc. represented to get this effort underway. If the effort develops as one might wish, then in later stages, there probably should be a liaison committee associated with each of the selected TTCs in which university officials, government officials, and private interests in highway safety should have a coordinating function related to these teaching efforts.

Obviously, if such liaison activities were to be established around the traffic safety teaching efforts, that same function could probably be usefully be directed toward other tasks as well -- such as legislation, public information, financing, etc.

Finally, there is the important matter of establishing liaison with other TT activities around the world. Technology Transfer activities in highway safety training in motorizing countries is sometimes conducted by experts from Australia, England, Germany, Japan, perhaps France, Sweden, and the United States, and perhaps others. It would be most useful if the proposed venture in the Americas were to include liaison with appropriate persons from these other countries, so that course materials already developed elsewhere could be shared. Future materials might even be jointly developed. Liaison with efforts in other parts of the world is discussed in more detail later in this chapter.

Figure 15: When an adequate clear zone is available on the roadside, there is a good chance that a motor vehicle can recover if it leaves the road.

G. Administration

Initially, administration might be handled by the Secretariat of PIH. It would consist of: (a) identifying the need and desire for a highway safety course on a particular topic, (b) confirming local arrangements at the place where the course is to be given, (c) contacting potential faculty to secure the services of instructional personnel, and (d) handling the budget accounts for payment of necessary travel and related costs. To assist the Secretariat (and in particular to assist with fund raising) a Coordinating Committee of key officials from several nations may be useful.

If Stage One is successful, the Secretariat will find itself with multiple additional tasks. This will require staff at an early stage. If the effort were to move into Stages Two and Three, then administration would move from PIH to the TTCs presumably, and the PIH would evolve to a role of international coordination among TTCs.

Figure 16: In urban settings pedestrians malls are feasible ways of separating traffic elements for access and safety.

H. Financing

Since Stage One is an extension of the present ad hoc arrangement, it might be feasible to carry out the initial phase with one-time grant funding from one or more sources. Early in the Stage One effort there would be a need to acquire some funds -- otherwise the whole effort is destined to remain a "once in a while" ad hoc effort. As always in matters of highway safety, the very limited potential funding sources are easy to identify but difficult to tap.

At the USA national level, the FHWA and NHTSA are the most obvious sources, but this will require top-level policy decisions, and time to get such activities into the funding cycle. Unfortunately, large-scale funding reductions seem certain in coming fiscal years.

At the International level, it may be that the World Bank could be persuaded to grant initial funding to get the effort started. On the positive side, the African Development Bank funded a significant highway safety effort in Malawi. On the negative side, the Asian Development Bank recently declined to fund a highway safety training effort for Pacific Rim nations on the grounds that officials are moved around so much within the bureaucracy that such training is wasted because the trained official is likely to move on to a new, unrelated assignment.

If the World Bank is approached, perhaps it would be useful for several countries to make a joint proposal to address their own needs, stressing the necessity to cooperate across national boundaries to establish such a training program. It might be useful to consider whether several of the major nations of South America might be willing to submit a joint proposal to the World Bank in which highway safety training might be included as part of a larger proposal. Almost certainly the budget for such a highway safety training program would be trivial compared to the funding level for some of the large programs.

In the private sector, one can think of multinational corporations with a stake in transport in all of the Americas. This would include 3M, GM, the motorcycle industry, and large national corporations in some of the larger member states. One wonders whether large multi-national companies such as Coca-Cola, or the tobacco companies, who have a strong presence in Central and South America (but with no history of interest in highway safety) might find it useful to be recognized as a benefactor of highway safety.

But such considerations are probably only for stage one. It may be possible to obtain a one-time start-up grant from a private source, but if highway safety training activities are to become a standard and routine operation over the years, then they must be financed by government.

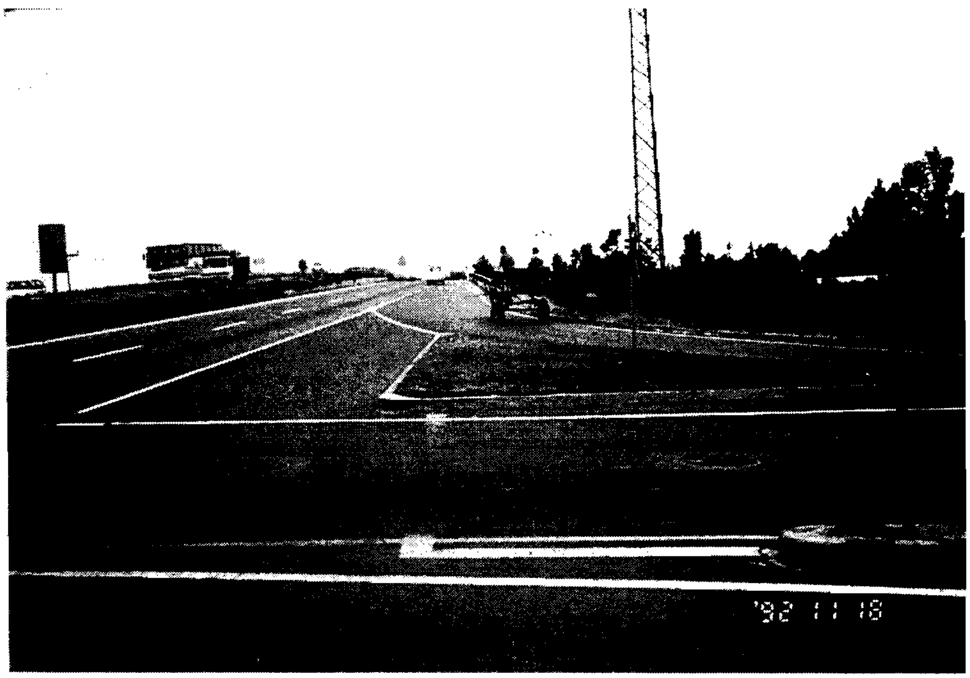

Figure 17: This animal drawn vehicle in the merge lane can disrupt traffic flow when vehicle speeds vary greatly.

I. Coordination With Other International Efforts in Highway Safety Technology Transfer

1. INTRODUCTION

Technology transfer in highway safety, while not an extensive global activity is, occurring in a number of countries. Persons from several countries have journeyed to "developing" countries in the interests of highway safety in those latter countries, and have carried out studies, and have performed consulting and teaching. Such services have been provided by representatives from England, Norway, Sweden, Germany, USA, Japan, and Australia at least.

In some instances the persons rendering the in-country service is a private contractor, and in some instances a government official. In some cases the funding as well as the staff are provided by the "donor" country. In at least one case the financing was provided, as mentioned, by the African Development Bank.

The writer of this report is presently unable to characterize the worldwide extent of highway safety technology transfer. Therefore, it is not presently possible to name the countries who offer such services, nor all the countries who have received such services, nor the full range of the financing mechanisms that have been employed.

2. BENEFITS OF COORDINATION AMONG PROVIDER COUNTRIES

The benefits that might accrue from liaison and coordination among provider agencies are speculative but obvious. If there were good information on "who does what, for whom, and where", then it would be easier to identify special expertise among the various providers, communicate experiences of success and failure, share existing resource materials, identify resource materials needed, and perhaps to cooperate in the development of future capabilities.

Perhaps if a given recipient country were to desire training or advisory services in a specific topic area, then officials in that country might be referred to the providers in best position to provide the specific sort of training or assistance in question.

Or if a given provider were to undertake the task of providing assistance on a given topic, coordination might enable them to know which <u>other</u> provider to ask for help in identifying resource materials, rather than to try to develop it from the very beginning.

3. BARRIERS TO COORDINATION

<u>a. Language</u>

Language is an obvious barrier to cooperation and sharing of resources. Just as language was cited earlier in this chapter as a barrier between faculty and student, so language is a barrier separating provider and provider. For example, even though the French may have developed a very good text for pedestrian education in a developing country, it may be just as expensive to adapt and translate that French text into English as it would be to develop new materials from the beginning.

Language is a natural force in channeling aid from certain provider countries to specific recipient countries. For example, countries that were under the influence of France in former colonial days may be the natural "territory" for France to provide highway safety assistance because officials in such recipient countries may well have been schooled in the French language in their younger years, and may well have pursued their University education in France.

Likewise, the Overseas Branch of the Transport Research Laboratory in England may tend to carry out their projects in countries that were part of Colonial England for the same reasons of language.

This does not always hold true though. For example, this writer recently spent several weeks consulting on highway safety in Malawi, Africa. Malawi was called (by the English) Nyasaland while that land was under English Colonial Rule. Malawi has a cadre of officials schooled in English, and that made consulting and teaching much easier for the English speaking experts who were there. However, at the same time I was in Malawi, consultants from Germany were also there, carrying out a separate project in the areas of accident records and data. There was no coordination between that group and the group I represented, even though our mission also included tasks in the area of accident records and data. One might suppose that coordination would have helped. We only by chance learned the Germans were present in the country.

Figure 18: Even in instances where a pedestrian refuge is provided, hazards may be "built in". In this case the tree grows in a hole and can cause pedestrian injury.

b. Other barriers to coordination

Other barriers to cooperation may exist. There may be competition for clients among provider countries and agencies. There might even be matters of poor international relations between certain provider nations that might prevent such coordination.

It is also not beyond possibility that some of the recipient countries themselves might not necessarily favor such coordination among providers. The recipient country may desire to avoid coordination on the basis that more aid funds and services might come to that country if there were multiple provider services, even if there were some overlap.

On balance, however, it would be useful to explore the matter of communication and possible coordination among providers, and to learn whether such coordination is viewed as useful by the several provider nations.

Figure 19: Narrow bridges pose a particular danger since oncoming traffic may have difficulty detecting the hazard.

4. WORKING TOWARD INTERNATIONAL COORDINATION

a. Identifying providers of highway safety technology transfer

The task of identifying providers of highway safety technology transfer is not simple, but probably is not inordinately difficult. It seems reasonable to assume that the main providers would come from among the highly developed nations -- larger countries of Western Europe, USA, Japan, and Australia. It also seems likely that international organizations such as the World Bank, the UN and the World Health Organization (WHO) would be good sources to tap in the interest of an inventory of active countries.

The process would be simply to survey as many likely sources as possible, and to ask each about their own activities and also what they know of others who are active. Transport officials in OECD would also be contacted, as would World Bank officials and the Director of the Global Accident Prevention Program of the WHO (Geneva). The latter also has a series of Coordinating Centers for Injury Prevention around the world. In the USA, the Centers for Disease Control is the Coordinating Center. In Australia one is the University of Adelaide.

Initial sources for inquiry would include:

Australia:

Australian Road Research Board (Melbourne)
Accident Prevention Center of Monash University(Melbourne)
Road Safety Unit, University of Adelaide
Australian International Aid Agency.

Japan:

The Takata Corporation
The Japanese Embassy to the USA
The International Association of Traffic and Safety Sciences, Tokyo
The Japanese International Aid Organization

England

Dr. Andrew Downey, Transport Research Laboratory, Crowthorne

Sweden

Dr. Kare Rumar, National Swedish Road Administration, Borlange

Germany

Dr. Bernard Friedlander, Ministry of Transport, Cologne

France

Dr. Dominique Cesari, INRETS (National Institute for Research on Transport Safety), Lyon, France

World Health Organization

Dr. Claude Romer, Global Program in Accident Prevention, Geneva

World Bank

Road Transport Division

From a survey of these organizations, and by following up leads from those initially contacted, it should be possible to expand the inquiry and therefore identify most of the (probably) small group of people and organizations worldwide, who are engaged in this kind of activity.

b. Find out what the provider nations are doing in highway safety TT.

Once the identity of a core number of persons is ascertained, the next step would be a survey to learn the elements of their program. Items of desirable information include the following:

Who are the recipient countries? It would be of interest to compile a list of recipient countries in which projects have been carried out, the nature of the project, and the identity of the agency with whom the work was done. Was it a police agency or a transport agency?

What is the subject matter specialty of each provider agency? The survey could seek to learn the highway safety "specialty" of each provider. In what topic areas do they consider themselves expert, and what, if any, areas do they avoid?

How is the recipient selected and served? When these services are rendered, how is it done? Is there a "house staff" of experts who travel to the country and provide the service and training, or does the provider agency contract with private firms who are presumed to have that expertise? What is the process by which recipient countries come to the attention of the provider agencies and how is the selection made to determine where and what services are to be provided?

Consider two examples. First, the country of Malawi, Africa secured funds from the African Development Bank for an overall transportation activity including a assessment of highway safety. Malawi hired the company of DeLeuw Cather (with whom the Malawi government had done business previously). DLC lacked highway safety expertise in-house, and hired some persons from the USA and elsewhere to carry out the safety analysis in-country. On the other hand, when the Transport Research Laboratory, England, provided highway safety assistance to Papua, New Guinea, the primary staff were employees of the safety group of the Overseas Division of TRL.

How are finances handled? How are the efforts financed? Is it provided via a loan from the World Bank or a Regional Development Bank? Does the providing country finance the effort themselves via their foreign aid to the client country? Are there other mechanisms? Do recipient countries themselves pay for services?

c. Steps toward coordination once the participants are identified

If there seems to be any interest in coordination, it might be useful to hold a meeting of some of the key providers of highway safety technology transfer, so as to get acquainted, share information, and identify areas where cooperation might be useful. This assumes such a process is not already underway. That would be part of the search. Is there some coordination of these activities already in place? If not, here are some coordinating activities that might be considered.

An E-mail newsletter: One example of a coordination mechanism would be an E-mail newsletter in which ongoing activities of the various providers would be summarized and reported to the network of providers (and recipient countries too).

A data bank of on-going projects: It might be useful to establish and maintain a data bank of ongoing projects so that if similar efforts were mounted in other countries, it would be possible to obtain information on parallel efforts in another country for comparison and ideas.

A data bank of resource material used or developed: It would be useful to have a data bank of project descriptions and actual materials developed for use in such projects. In that way, some existing materials could be used or adapted for further projects.

Share final reports: It would be useful to share final reports and/or annual reports among providor agencies and recipient countries for project evaluation and to help in developing new projects.

J. Conclusion

It is apparent that there is a need for highway safety training in developing or motorizing countries, and it is equally apparent that there is a lively appetite for such training on the part of potential recipients. Efforts are going forward in a variety of places around the world. The effort is modest, and barriers to expansion and success are considerable. However, an effort to expand these services is appropriate.

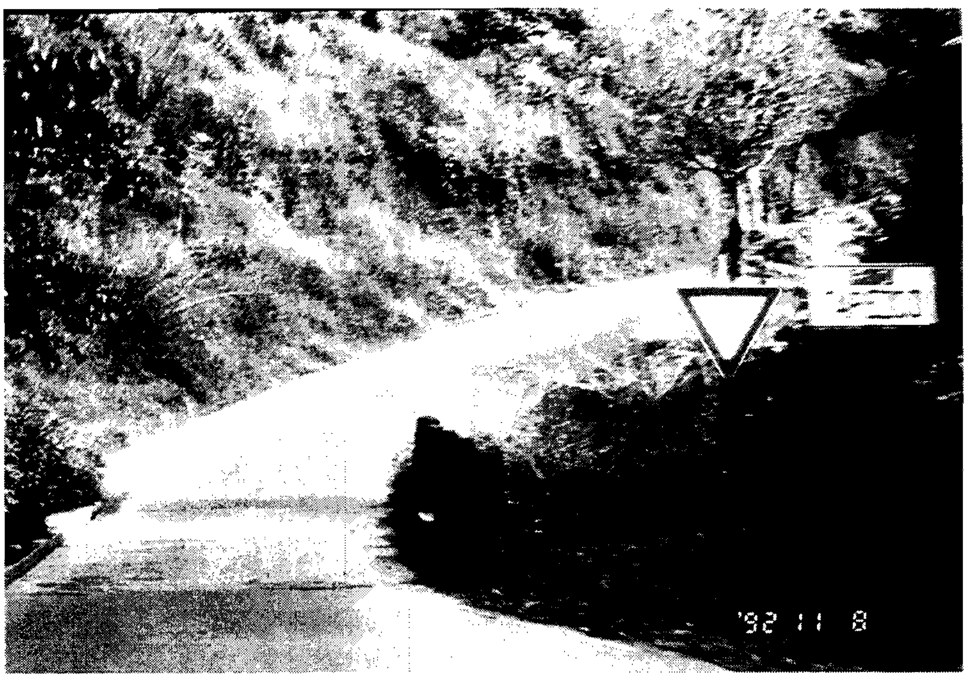

Figure 20: Danger is compounded by curve plus narrow bridge.

Chapter Three: Highway Safety Courses

This chapter presents a brief outline for each of 14 possible courses in highway safety. The courses are illustrative of the sort that might usefully be presented as a component of highway safety technology transfer to nations in the process of motorization. Additional courses can readily be envisioned, or elements from several courses could be combined.

Because the training requirements in a given situation cannot be fully anticipated, the term "course" is intentionally vague here. The topics presented below could be covered in lectures of only a few hours duration, or could be presented in longer courses, in some cases involving many hours of lecture and classroom participation.

Planning for a given course will proceed more effectively if the faculty has some knowledge of local conditions in the countries represented by those attending the course. Otherwise, the course may address problems and solutions that are substantially irrelevant to those attending. That caution is easy to state but difficult to follow. Indeed, aside from language, the greatest difficulty visiting faculty may have is the incomplete picture of the road safety situation confronted by the officials attending.

The course contents can only be indicated very briefly here. The detailed content of any course as it is finally presented must necessarily be developed by the faculty expert doing the instruction.

In discussing each of the 14 illustrative courses below, four aspects of the course will be addressed:

A. Importance of the course: A few sentences are presented giving reasons why the course is included.

B. Elements of the course: This section is a consideration of topics that would be covered. This ideas presented here are not presented at the level of detail of a complete curriculum. However, some key elements of the course are mentioned.

C. Examples of Possible Faculty: For purposes of illustration, persons are listed who possess the expertise to teach the course. It is not known whether each such person would be available to teach.

D. Resource materials: Where possible, this section names illustrative reports that might provide part of the course technical content. It seems likely that no single report would wholly suffice. Adaptations would be necessary, involving relevant parts of several reference sources (as would be true in establishing the contents of any course).

Course example 1. Safety on low volume roads

A. IMPORTANCE OF THE COURSE

It will be useful to include a course based on knowledge that might be classified under "low volume roads" in the USA. This is relevant because many roads in the less motorized countries may be built to standards reminiscent of low volume roads in the USA, but nevertheless may carry considerable traffic volume.

In the USA it is necessary to control the cost of low volume roads simply because they carry low volume. In other countries the need for low cost may stem from overall economic conditions throughout the country. Thus, low cost safety designs incorporated into low volume roads in the USA may also have applicability in less motorized countries.

For example, in Malawi, the main North-South highway has very low volume. Thus, there is the seeming contradiction of a road built to rather high standards (in terms of horizontal and vertical alignment), but with low volume, and a high accident rate. In contrast, many rural roads in China carry very high volume (and a wide array of road user types), but are built to standards like a low volume road in the USA.

B. ELEMENTS OF THE COURSE

1. Physical and environmental safety factors: This includes factors such as weather; road factors such as roughness and drainage; geometric features such as shoulder edges; roadside features such as ditch slope and culvert heads.

2. Problem identification: This includes location-based identification -- where the accidents occur, and process-based identification -- what kinds of accidents occur (which may lead to inferences as to what are the precipitating mechanisms).

3. Assigning priorities to safety improvements: What is the magnitude of the problem? How severe are the crashes? Is there a countermeasure readily available? Is the cost acceptable? Can the countermeasure be easily implemented?

4. The search for "low-cost" safety improvement: Here the search is for a redesign that is a significant improvement, does not increase safety for some road users at the expense of reduced safety for others, and there are no other proven designs of equal or better cost-effectiveness.

5. Roadside retrofits: Concrete culvert headwalls can be lowered to be flush with the road. Guardrails and bridge rail transitions can be installed. In some cases guard rails can be removed if ditch treatment is or can be made adequate.

C EXAMPLES OF POSSIBLE FACULTY

Lindsay Griffin, Texas Transportation Institute (TTI), Texas A & M University
Hayes Ross, Don Ivey, TTI
Charles Zegeer, UNC Highway Safety Research Center (HSRC)

D. RESOURCE MATERIALS

"Safety Improvements for Low Volume Roads", D.L. Ivey and L. I. Griffin, Texas Transportation Institute, Texas A & M University, College Station, Texas, presented at the 74th Annual Kansas Transportation Engineering Conference, March, 1992.

"Effect of Lane Width, Shoulder Width, and Shoulder Type on Highway Safety", C.V. Zegeer and J.A. Deacon in Relationship Between Safety and Key Highway Features, Transportation Research Board, 1988.

"Safety Improvements on Horizontal Curves for Two-Lane Rural Roads: Information Guide", C.V. Zegeer, D.W. Reinfurt, T. Neuman, and F.M. Council, Federal Highway Administration, 1990.

"Safety Cost-Effectiveness of Incremental Changes in Cross-Section Design: Information Guide" C.V. Zegeer, J. Hummer, L. Herf, D.W. Reinfurt, and W.W. Hunter, Federal Highway Administration, 1987.

"Economics of Design Standards for Low Volume roads", C.H. Oglesby and M.J. Altenhofen, Transportation Research Board Record, 1968.

Figure 21: Roadside clear zone may be compromised by sign placement.

Course Example 2. Formal road safety improvement program.

A. IMPORTANCE OF THE COURSE

When all but the lowest volumes prevail, it is usual that accidents tend to cluster at certain locations on the road net, rather than being distributed randomly or evenly. It is believed to be cost-effective to have a road safety improvement program to address such high accident locations. Sometimes it is possible to make substantial safety improvements at high-accident locations for relatively modest expenditures. Such programs are a valuable supplement to safety design standards for new construction because some roads were built before such safety considerations were paramount, and in other cases, post-construction experience reveals unanticipated accident clusters.

B. ELEMENTS OF THE COURSE

1. Identifying high accident locations: There are multiple ways to accomplish this, from the simple approach of a spot map, to sophisticated, computer-based accident location systems, and related software to help with the selection process.

2. Developing a priority scheme for selecting places to make improvements: For large jurisdictions with extensive spot improvement programs, the selection procedure can involve sophisticated statistics. However, for smaller areas, or those just getting started with the program, a simpler selection procedure can be used. Such can be based on number and severity of crashes, estimated cost of improvement, and feasibility of implementing the improvement scheme.

3. Identifying the range of improvement that can be made: The site itself dictates the changes that might be undertaken. Sometimes the improvement can be as simple as painting lines defining a holding lane for left turning traffic. In other cases, something as expensive as a pedestrian bridge might be necessary.

4. Selection and implementation of the improvement: This course segment would include discussion of factors involved in the final decision for a given, specific set of circumstances.

5. Evaluation of the effectiveness of the improvement: It is important to gather accident data in such a way as to be able to evaluate the effectiveness of site modifications designed to reduce crashes. In the process of carrying out such evaluations it is important to avoid the procedural error called regression to the mean.

C. EXAMPLES OF POSSIBLE FACULTY

Charles Zegeer, HSRC
Martin Parker, Martin Parker Associates, Wayne, Michigan
Forrest M. Council, HSRC
Jack Zogby, DunCannon, Pennsylvania
Lindsay Griffin, TTI
Val Pezoldt, TTI

D. RESOURCE MATERIALS

"Development of a plan for identifying highway locations that may be over-represented in accident frequency and/or severity", R.J. Flowers and L.I. Griffin, Texas Transportation Institute, Texas A & M University, College Station, Texas, September, 1992.

"Use of empirical Bayes procedures to identify locations on the Texas highway system that may be over represented in ran-off-roadway accidents", L.I. Griffin, R.J. Flowers, and G E. Miller, Texas Transportation Institute, Texas A & M University, College Station, Texas, September, 1993.

"Local Highway Safety Improvement Program", Federal Highway Administration, 1986.

"Evaluation of the high accident location, spot improvement program in Kentucky", K.R. Agent, Kentucky Department of Highways Research Division, Report 357, 1973.

Course example 3. Means for identifying high accident locations.

A. IMPORTANCE OF THE COURSE

As described in course 2 above, a spot improvement program is important. However, such a program to improve safety at high-accidents locations cannot proceed until a system is in place to identify said high accident locations.

B. ELEMENTS OF THE COURSE

Several elements are necessary for a program to identify high accident locations, and these include: (a) a system to identify specific locations where accidents accumulate, and (b) cooperation between police and highway departments. At the simplest level this could be a map whereby police literally place pins on maps corresponding to locations of accidents. In the small island nation of Dominica with about 10 fatalities per year, the police literally are aware of the hazardous locations based on their own personal, on-scene knowledge, though they do keep a log of such fatalities and their locations. But in a larger region, with more fatalities, some record keeping device is necessary.

It should also be pointed out that hospital Emergency Room (ER) staff can be important here. It is not unusual for victims to be taken to the ERs without the police knowing about the accident. ER personnel could maintain a spot map based on questions to the victims or the persons who brought the victims to the ER. Then the ER personnel could see that police and highway officials get the information. The importance of the ER spot map (according to Dr. P. Waller who brought this point to the writer's attention) is that some victim classes may be especially unlikely to come to police attention. Examples would be bicyclists, motorcyclists, riders of motor scooters, or (in some cases) pedestrians.

A part of this process would involve emphasis on collision diagrams prepared by police who report the accidents.

At a more sophisticated level, where the system is computer-dependent, a mileposting system is required. This would imply that road segments are identified and labeled in a computer representation of the roadway system. Means must be provided in the reporting system whereby accidents are described in terms of physical location in such a manner as to allow them to be tied-in with the computer milepost system.

In terms of a computer mapping program, some accident investigators could be provided with a Global Positioning Satellite (GPS) receiver, and therefore could precisely specify the ground location of each accident. The mileposting system could actually be created through these measurements. As more and more accidents sites are located precisely, those "anchor points" could be used as a tie-in to the entire link-node system of mileposts.

C EXAMPLES OF POSSIBLE FACULTY

Donald Reinfurt, HSRC
Forrest Council, HSRC
Charles Zegeer, HSRC
Martin Parker, Martin Parker Associates, Wayne, Michigan
William Baker, Federal Highway Administration (FHWA)

D. RESOURCE MATERIALS

"Accident research manual", F.M. Council, D.W. Reinfurt, and B.J. Campbell, University of North Carolina Highway Safety Research Center, Chapel Hill, 1980.

"Methods for Identifying Hazardous Highway Elements", C.V. Zegeer, National Cooperative Highway Research Program, Synthesis of HIghway Practice, Transportation Research Board, 1986.

"Identification and surveillance of high accident locations", Institute for Traffic and Transportation Engineering, Univeristy of California, Berkely.

Course example 4. Geometrics: Design standards related to safety.

A. IMPORTANCE OF THE COURSE

Safety should be an essential ingredient in road design. However, that is not always the case in motorizing nations. When a country is very oriented to rapid economic development, the practice may be to build the greatest amount of road mileage for the least amount of money, with little consideration for safety. That is understandable since safety design costs money, and safety benefits are less "visible" than additional miles of roadway. Built-in safety design is very important, however, because the safety errors of omission or commission, built into the road at the time of construction, will remain in place for decades thereafter, exacting their toll every day and every year.

It is especially important to review design standards in light of the country in question, and to alter the design wherever feasible to protect safety in view of the travel growth that is likely to occur. Sometimes this poses a dilemma. In Malawi, Africa, for example, the main north-south highway was laid out to such a high standard of vertical alignment that much cut and fill had to be introduced. The result is that, along a goodly portion of this road, a truck that runs off the road must traverse down a steep slope to the flat unobstructed ground alongside. The trucks frequently overturn because the fills and roadside ditches are not shaped to prevent overturn. A lower standard of vertical alignment, one that more nearly followed the contour of the land, might have been safer and still just as useful in terms of the low traffic volume.

B. ELEMENTS OF THE COURSE

1. Alignment: Course instruction will address such matters as sight distance, superelevation, spiral transitions, curves, curve combinations, and traffic controls.

2. Cross sections: This section includes lanes and shoulders, roadway condition, bridges, median design, and multi-lane treatment alternatives.

3. Intersections: This will include intersection type, channelization, and traffic control devices.

4. Alternatives: Often, there is simply nothing one can do about geometrics, and the question is what safety alternatives exist in these circumstances. Here attention will be paid to roadside safety features, signs and markings.

C EXAMPLES OF POSSIBLE FACULTY

Charles Zegeer, HSRC
William Hunter, HSRC
Dan Turner, University of Alabama
Jerome Hall, University of New Mexico
Tim Newman, Northwestern University
Douglas Harwood, Midwest Research Institute
John Mason, Penn State University

D. RESOURCE MATERIALS

"Policy on Geometric Design of Highways and Streets", American Association of State Highway and Transportation Officials, Washington, D.C., 1984.

"Compendium of Safety Design Effectiveness of Highway Design Features", Federal Highway Administration, Washington, D.C., 1991.

"The Association of Median Width and Highway Accident Rates", M. Knuiman, F.M. Council, D.W. Reinfurt, Transportation Research Board Record No. 1401, 1993.

"Analysis of Vehicle Operations on Horizontal Curves", D.W. Reinfurt, C.V. Zegeer, B.J. Shelton, and T.R. Neuman, Transportation Research Board Record No. 1318, 1991.

"Cross Sections. Volume III", C.V. Zegeer and F.M. Council, in Compendium of Safety Design Effectiveness of Highway Design Features, Federal Highway Administration, Washington, D.C., 1991.

"Alignment. Volume II", C.V. Zegeer, J.M. Twomey, M.L. Heckman, J.C. Hayward, in Compendium of Safety Design Effectiveness of Highway Design Features, Federal Highway Administration, Washington, D.C., 1991.

Course example 5. Alcohol programs.

A. IMPORTANCE OF THE COURSE

It would seem that few countries are "immune" to the problems of road use by persons under the influence of alcohol. However, in some countries with high accident rates, there is perhaps not sufficient recognition of the size of the problem of alcohol or drug-impaired road users. Sometimes this is because programs of post-mortem examinations have not been sufficiently comprehensive to document the portion of deceased drivers who were under the influence of alcohol.

In other instances political barriers may stand in the way of a full examination of this issue because of a preference not to admit that such a problem might exist. That might occur in places where there is a strong prohibition against alcohol or where there are strong reasons why post-mortem examinations are not permitted.

In this course the intention would be to raise issues as to the extent to which drinking drivers and other road users may be a problem in the countries in question, and the kinds of programs that might address the problem.

B. ELEMENTS OF THE COURSE

1. Size of the problem: As to the size of the problem, one can ask whether post-mortem data are available to make a judgement as to whether alcohol is a problem in road accidents. This can be done by describing procedures and findings from highly motorized countries in which post-mortem examinations have shown a large percent of deceased drivers to have high blood alcohol concentrations. This can be contrasted to the results of population surveys of alcohol levels in order to characterize the risk-increasing nature of alcohol. The size of the problem in highly motorized countries can be discussed.

2. Role of alcohol in accident causation: The role of alcohol in producing crashes will be discussed. Included will be material concerning the effects of alcohol on performance. Also relevant is the special vulnerability of (1) the young (inexperienced with both alcohol and driving), (2) the old (general decline in faculties complicated by alcohol and heightened vulnerability to death when they suffer crash injuries), and (3) women (alcohol has greater negative effects on women of a given body weight, more so than men, because of women's faster metabolism [alcohol gets more quickly into the bloodstream] and their lower ratio of muscle-to-total-body-weight, [hence their lower fluid volume per unit weight]).

3. Countermeasures: Enforcement and educational countermeasure programs will be described along with results of various effectiveness evaluations. Approaches that appear not to be effective should also be discussed.

C EXAMPLES OF POSSIBLE FACULTY

Robert Foss, HSRC
H. Laurence Ross, University of New Mexico, Albuquerque
Robert Voas, National Public Service Research Center
Douglas Beirness, Traffic Injury Research Foundation (TIRF), Canada
Herbert Simpson, TIRF
Ralph Hingson, Boston University
Alex Wagenaar, University of Minnesota

D. RESOURCE MATERIALS

"Background Papers for Surgeon Generals Workshop on Drunken Driving", Department of Health and Human Services, 1988

"Confronting drunk driving: social policy for saving lives", Yale University Press, 1992.

"Drinking and driving: advances in research and prevention", edited by R.J. Wilson and R. Mann, Guillford Press, New York, 1990.

"Substance Abuse Assessment of North Carolina Drivers Convicted of DWI Since January 1990", R.D. Foss, J.R. Stewart, and C.A. Martell, University of North Carolina Highway Safety Research Center, 1993.

"Alcohol and Other Drugs in Transportation: Research Needs for the Next Decade", Transportation Research Board Circular Number 408, 1993.

"Alcohol, Drugs, and Traffic Safety", Proceedings, 12th International Conference, Cologne, Germany, October, 1992.

"Assessment of Changes in DWI Enforcement Level", J.H. Lacey, R.K. Jones, University of North Carolina Highway Safety Research Center, 1991.

Course example 6. Driver licensing.

A. IMPORTANCE OF THE COURSE

Almost all countries recognize the advisability of a government license to drive motorized vehicles on the public roads. To have an effective driver control program , a safety-oriented license system is an important program element. In some countries, driver licensing is handled on a regional basis. In Uruguay, licenses are issued in each of the 17 Departmentes' (counties), with all that implies for standardization (or lack of it), and communication among issuing agencies (or lack).

B. ELEMENTS OF THE COURSE

1. Performance-based license: There is a need for a licensing program in which licenses are issued on the basis of competence (knowledge of the rules of the road and safety materials), rather than just a revenue collecting procedure in which a person, in effect, purchases a license.

2. Standardized tests: If knowledge of safe driving is the main basis for licensing, and if drivers are to be tested, then it is important that the test be prepared in an appropriate manner -- the correct reading level, a test based on standardized test construction procedures, and a pictorial test for those who cannot read or write.

3. In-vehicle road test: Covered would be the elements of a road test, in which a driver examiner rides with an applicant and approves or disapproves the performance on the basis of skills displayed during the standard driving test. In both the knowledge test and the driving test, a standardized procedure is required to achieve objectivity -- the concept that all applicants deserve an equal chance to pass, and to avoid examiner bias -- whether intentional or unintentional.

4. Eye test: At least a minimal eye test of visual acuity should be given. Eye tests are especially important for detecting age-related vision changes in older drivers.

5. Overall medical status: Some discussion would be appropriate regarding medical conditions relevant to the licensing decision, and how to screen for such conditions. Note that in some countries with a relatively low number of licensed drivers per unit population, there is a heavy emphasis on detailed medical certification as a licensing requirement. This comprehensive requirement is not in evidence in countries where the number of licenses per unit population is high.

6. Renewal exams: Is a renewal examination process warranted, and if so, should it be aimed at only old drivers, bad drivers, or across the board?

7. Age of licensure: What is the minimum age at which a license can be issued, and what rules should be in place for withdrawing a license from the elderly -- a discussion of policy options. This would include concepts such as a graduated license

program, limited licenses, etc. Graduated licenses for the young imply a longer training period and practice period in which driving is confined to trips with an adult, or trips during the day time, etc. Limited licenses imply that the license is only valid for certain kinds of driving at certain times and/or places.

8. Different classes of licenses: Also to be covered is the desirability of a classified license system recognizing the desirability of licensing procedures that are specific to the vehicles involved. Drivers of large trucks or buses should be licensed on a different basis from drivers of motor cars -- the same should be true for motorcyclists and riders of motor scooters.

C EXAMPLES OF POSSIBLE FACULTY

Jane Stutts, B.J. Campbell, HSRC
Patricia Waller, University of Michigan Transportation Research Institute
John Eberhard, Jerry Tannehill, NHTSA
Ronald Coppin, California Department of Motor Vehicles, retired
Raymond Peck, California Department of Motor Vehicles
Herbert Simpson, Don Mayhew, TIRF, Canada

D. RESOURCE MATERIALS

"Graduated licensing: Prescription for motor vehicle injury prevention", P.F. Waller, University of Michigan Transportation Research Institute, June 1990.

"The who and when of accident risk: Can driver license programs provide countermeasures?", P.F. Waller, D.W. Reinfurt, University of North Carolina Highway Safety Research Center, Chapel Hill, 1973.

"Driver performance tests: Their role and potential", P.F. Waller, L.K. Li, R.G. Hall, and J.C. Stutts, University of North Carolina Highway Safety Research Center, Chapel Hill, 1978.

"Functional Aspects of Driver Improvement: A Guide to State Medical Advisory Boards", in press 1994. Source: American Association of Automotive Medicine or the American Association of Motor Vehicle Administrators.

"Summary of Proceedings of the Conference on Driver Competency Assessment", California Department of Motor Vehicles and Transportation Research Board, 1990.

"Screening for Driver Limitation", National HIghway Traffic Safety Administration, 1976.

"Guidelines for Knowledge and Skill Testing", American Association of Motor Vehicle Administrators, Washington, D.C., 1995.

Course example 7. Central driver records.

A. IMPORTANCE OF THE COURSE

A key element in any safety program is the ability to discipline drivers with bad records by withdrawing the driver license or by imposing other penalties, based on the cumulative infraction record of drivers. While courts can impose penalties for individual infractions, the courts may not have a way to know the cumulative record of a driver (perhaps accumulated in another part of the country). In some places, infractions are recorded on the license document itself in order to address this problem.

Most jurisdictions in highly motorized nations base their driver control program on a central file of all licensed drivers, along with the capability for updating this file each time an infraction or accident report is received. When a bad driving record is accumulated, the file is reviewed by relevant officials and the driver is dealt with appropriately. In the absence of such a system, and with the high mobility implicit in a motorized society, it is quite possible for a motorist to accumulate a very bad driving record through individual infractions committed in various parts of the country, but that accumulation would not be known.

This is an example of the need to tailor the course to local needs and local law. It may be that in some nations, the courts are the sole adjudicator of license matters, and it may be that a central file is not seen as being of particular importance.

B. ELEMENTS OF THE COURSE

1. The need for a central file: In an increasingly mobile society, an individual driver can commit traffic infractions anywhere in the country, and the cumulative record of infractions can escape detection unless there is some kind of central file where records are assembled and held.

2. Programs of license sanctions: If a central file is available, then programs become feasible to impose driver sanctions if the cumulative driving record warrants. This implies that a pattern of infractions may occur in which no single violation warrants loss of license, but the situation is more serious when the pattern and frequency of multiple infractions is considered.

3. Computers: The level of computer power necessary depends on the size of the country. In Uruguay, for example, with only about three million citizens, only a portion of whom are licensed to drive, it is probable that a rather small computer would be sufficient to contain all of the files, assuming, of course, that a means were available to assemble and centrally record all the infractions adjudicated on a country wide basis.

4. Reporting requirements: There must be a dependable system in place such that if the officer charges the driver with an infraction, and if the driver is found guilty, then a record is made and forwarded to the central facility.

5. Available hardware-software systems: This would be a discussion of computer systems that might be available for smaller central data systems.

6. Need for a uniform traffic violation form, and an accounting system so that traffic violations will not "disappear" from the system: The system will only work if there is an accounting system to assure the integrity of the system, such that citations issued will reliably find their way into the system. Without that, driver accountability cannot be assured.

C EXAMPLES OF POSSIBLE FACULTY

B.J. Campbell, HSRC
Jane Stutts, HSRC
Patricia Waller, UMTRI
Raymond Peck, California Department of Motor Vehicles
John Eberhard, NHTSA

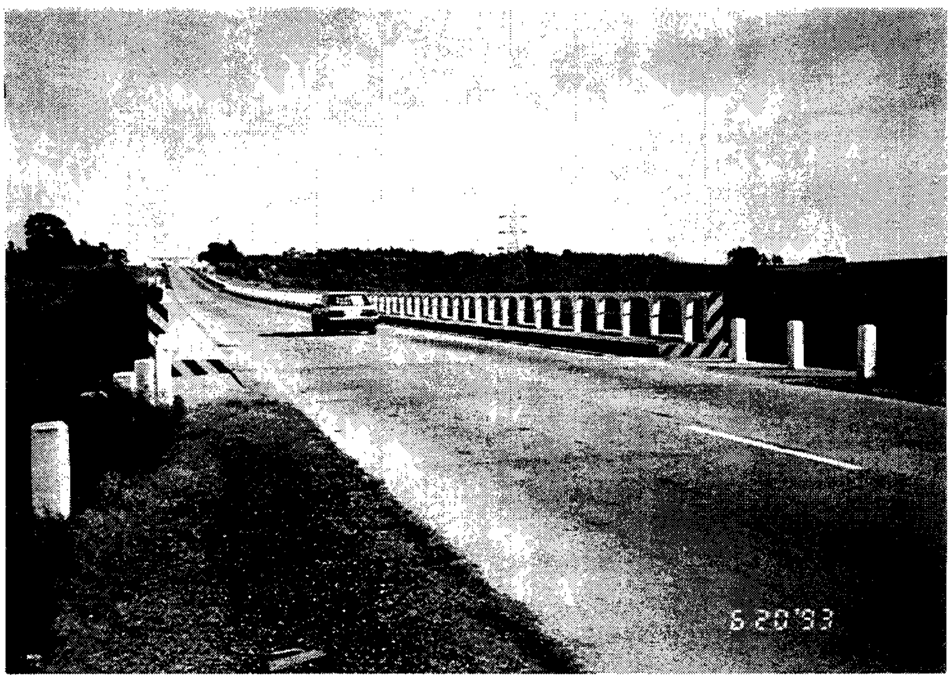

Figure 22: Even when a bridge is not narrow, the transition into the bridge rail is important. Pylons supply a visual transition, but do not provide safety if struck.

Course example 8. "Other" vehicles (bicycles, trucks, motorcycles, motor scooters, animal drawn vehicles, and buses).

A. IMPORTANCE OF THE COURSE

This particular course lumps together several classes of "other" vehicles, including trucks, buses, motorcycles, motor scooters, etc. These vehicles do represent an "other" category in the USA because the dominant vehicle type in the USA is the passenger automobile which accounts for about 70% of motor vehicles. For this reason, USA vehicle safety efforts have traditionally been more concentrated on passenger cars than on other vehicles.

However, almost everywhere else in the Americas, the "other" categories dominate the traffic stream. It is the very heterogeniety of the traffic stream in motorizing countries that is one of the defining features of accidents in such places. There are proportionally fewer passenger cars than in the USA, with the result that these "other" categories dominate. Because of this it would seem that several separate courses might very well be necessary, so as to provide detailed instructional coverage for (1) motorcycles and motor scooters, (2) trucks, (3) buses, and (4) non-motorized vehicles. Therefore the course elements below are in the form of a generalized outline of the sort that could be used in greater or lesser degree for any of the vehicle specific courses.

B. ELEMENTS OF THE COURSE

Instruction regarding each the several vehicle classes would include such elements as:

1. define the size of the problem.
2. operator training
3. public information
4. enforcement
5. vehicle condition and visibility
6. separation of traffic elements
7. licensing requirements for each major vehicle class

C EXAMPLES OF POSSIBLE FACULTY

Trucks: Dr. Forrest Council, HSRC
Dr. Ken Campbell, UMTRI
Buses: Mr. Charles Zegeer, HSRC
Motorcycles and motor scooters: Ron Engels, NHTSA
Non-motorized vehicles: Dr. V. Setty Pandakur, University of British Columbia

D. RESOURCE MATERIALS

"The Association of Helmet Use with the Outcome of Motorcycle Crash Injury When Controlling for Crash and Injury Severity", R. Rutledge and J. Stutts, Accident Analysis and Prevention, 25: 347-353, 1993.

"Characteristics and Solutions Related to Bus Transit Accidents", C.V. Zegeer, H.F. Huang, J.C. Stutts, E.A. Rodgman, J.E. Hummer, and J. Fruin, University of North Carolina Highway Safety Research Center, 1993.

"An Examination of Motorcyclist Injuries and Costs Using North Carolina Motor Vehicle Crash and Trauma Registry Data", J.C. Stutts and C. Martell, University of North Carolina Highway Safety Research Center, 1992.

"Operational Impacts of Wider Trucks on Narrow Roadways", D.L. Harkey, C.V. Zegeer, J.R. Stewart, and D.W. Reinfurt, University of North Carolina Highway Safety Research Center, 1991.

"Large Truck Safety: An Analysis of North Carolina Accident Data", F.M. Council and W. L. Hall, 33rd Proceedings of the Association for the Advancement of Automotive Medicine, Des Plaines, Illinois, 1989.

"A guide to the use of truck accident data at the Highway Safety Research Institute", R.E. Scott and J. O'Day, University of Michigan Transportation Research Institute, 1974.

"Safety research: heavy vehicles, information systems, and crash studies and methods", Transportation Research Record Number 1376, Transportation Research Board, Washington, D.C., 1992.

"Large vehicle study: Transit and trucks", Transportation Research Record Number 1322, Transportation Research Board, Washington, D.C., 1991.

Course example 9. Regional safety standards

A. IMPORTANCE OF THE COURSE

This topic perhaps does not so much warrant a course as it does a lecture, followed up by a working group in the country if there is interest and political feasibility.

By far the majority of countries are not producers of automobiles, but rather are importers. Small countries have limited power to control the nature of cars produced or the equipment that comes with them.

It is said that, in some cases, the version of vehicles imported into some of the smaller countries does not have certain safety equipment that is installed as standard equipment on that same vehicle when it is sold in larger countries (having vehicle safety standards).

An example will illustrate, though the particular example chosen deals with two highly motorized countries, Australia and the USA. There is a particular Ford production facility in Australia that manufactures cars both for sale in Australia and for shipment to the USA. The cars built in Australia for sale in the USA are equipped with air bags. The identical cars, produced in the same factory and designated for sale in Australia, do not have the air bags available.

The reason for such practices is obvious. By omitting certain safety equipment from the vehicles, they can be imported and sold for less, and price is a great concern. Individual countries may feel powerless to impose vehicle safety standards since they are not vehicle producers nations nor do they import on a massive basis. Importers, often involved in a highly profitable venture, may have little interest in safety.

In response to all of this, it might be feasible to consider regional safety standards in which several countries agree on certain minimum vehicle safety standards and impose these requirements in their import regulations.

B. ELEMENTS OF THE COURSE

1. Vehicle safety standards in the USA, Australia, Japan, and Western Europe: The introduction would be a brief statement of some of the comprehensive vehicles safety standards of Europe and the USA, including what vehicles are covered and to what degree.

2. Vehicle safety standards in developing nations: This would include a review of vehicle safety standards, if they exist, in such places as India and China.

3. Is "down-building" a problem: This would cover policy of manufacturers, if they will reveal them, as to provision of safety features even in markets where such is not required.

4. Minimum safety standards in smaller countries: This would be a review of a few minimal standards that even the smallest countries might consider requiring.

5. Politics of a regional agreement on minimum standards: This would be a discussion of whether it is politically desirable and feasible for a few smaller countries to invoke regional safety standards that would cover import regulations in all participating countries.

C EXAMPLES OF POSSIBLE FACULTY

B.J. Campbell, HSRC

D. RESOURCE MATERIALS

The materials here would consist largely of the vehicle safety standards of the USA, Europe, Australia, and any such standards from India and China, or other motorizing nations if such standards exist. Also, it would be well to learn the policies, if possible, of the international automobile manufacturers community with regard to the provision of safety features in imports to developing countries.

Course example 10. Roadway/roadside safety hardware.

A. IMPORTANCE OF THE COURSE

One of the most important areas in which highway safety technology transfer can take place concerns the "forgiving roadside philosophy", in which the roadside is either kept clear of obstacles or road features are introduced for the purpose of reducing the severity (injury and death potential) of crashes which will inevitably occur on the roadways or roadsides. A great deal on this subject has been learned through research. The results of such research have been widely implemented in the USA and Canada. Such practice is less in evidence in other American countries.

B. ELEMENTS OF THE COURSE

1. The clear zone or recovery area: Covered here would be clear zone concepts and criteria for recommended clear zones as related to roadway type.

2. Guidelines for the roadside: Guidelines would be discussed as they pertain to roadside conditions for which specific roadside safety features are recommended.

3. Safety Features: This covers widely used as well as innovative safety features such as guardrails and guardrail end treatments; breakaway supports for signs, light poles, and mailboxes; crash cushions for use at bridge piers; safety treated drainage structures; and safe side slopes, ditches, and driveways. Discussion would include how these features function, their cost, and maintenance considerations.

4. Recommended test and evaluation procedures for safety features: This would cover current procedures as laid out by the National Cooperative Highway Research Program. This report includes recommended procedures for evaluating the safety performance of highway features.

5. Benefit-cost and cost effectiveness procedures: This includes procedures that can be used to evaluate safety alternatives and to select those alternatives that provide the greatest safety return for limited budgets.

C EXAMPLES OF POSSIBLE FACULTY

King Mak, Lindsay Griffin, Hayes Ross, Roger Bligh, TTI
John Viner, Richard Powers, FHWA
William Hunter, HSRC
John Carney, Vanderbilt University

D. RESOURCE MATERIALS

"Roadside Design Guide", American Association of State Highway and Transportation Officials, Washington, D.C., 1989.

"Frequency and Severity of Crashes Involving Roadside Safety Hardware by Vehicle Type", J.G. Viner, F.M. Council, and J.R. Stewart, Transportation Research Board, 1994.

"A Comparative Performance Study of Longitudinal Roadside Barriers and End Treatments", W.W. Hunter, J.R. Stewart, and F.M. Council, International Conference on Strategic Highway Research Programs and Traffic Safety on Two Continents, 1993.

"Accident Effects of Sideslope and Other Roadside Features or Rural Two-Lane Roads", C.V. Zegeer, D.W. Reinfurt, W.W. Hunter, J. Hummer, L. Herf, and J.R. Stewart, Transportation Research Board Record 1195, 1988.

"Recommended Procedures for the Safety Performance Evaluation of Highway Features", Report 350, National Cooperative Highway Research Program, Washington, D.C.

"Development and evaluation of roadside safety features". Transportation Research Board Research Record 1367, Washington, D.C., 1992.

"Roadside safety features", Transportation Research Record Number 1302, Transportation Research Board, Washington, D.C., 1991.

"Fixed roadside hazards", Australian Road Research Board, Melbourne, 1977.

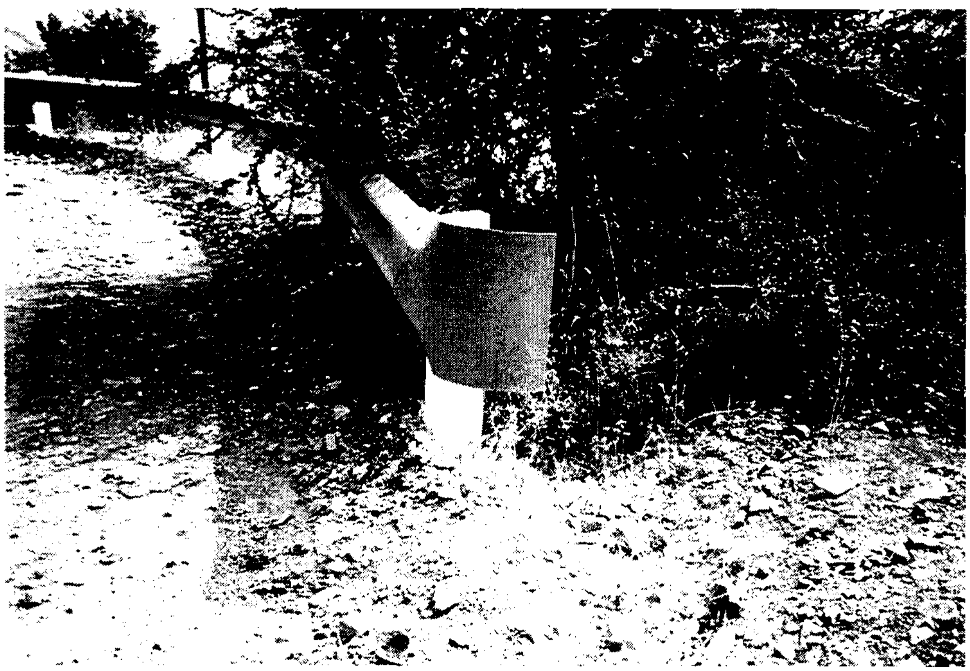

Figure 23: Non-breakaway end treatment does little to reduce hazard of a motor vehicle impact with the guard rail.

Course example 11. Traffic accident data and reporting.

A. IMPORTANCE OF THE COURSE

A usable accident data base is a requirement for accident problem identification and for evaluation of accident countermeasure efforts. Such a data base is essential for identifying high accident locations on which a spot improvement program depends. It is also an essential ingredient for placing highway safety onto a scientifically respectable basis involving valid countermeasure evaluation.

B. ELEMENTS OF THE COURSE

Achieving a usable system requires attention to the proper accident report form, training of police, correct electronic processing of information on the forms, ability to store and retrieve, and ability to carry out analysis.

1. Reporting: Such a course would address problems stemming from overlapping police jurisdictions (the need for a common accident report form on a country or jurisdiction-wide basis). The course would address the need for a form that goes beyond the mere police responsibility for defining fault in a legal or criminal sense. Roadway and milepost information is necessary on the form. Information is also needed about the vehicle, the driver, the environment, and injuries and death, etc.

2. Encoding: Also covered would be recommended practices as to data encoding of factors recorded on the accident report form. Unless the data from the form are coded into a computer system, meaningful analysis is not possible.

3. Analysis: Another course element would be data analysis. Some simple uses of data could be covered, with attention to repetitive tabulations for monitoring long-term trends, including trend analysis, data plots, etc. Any discussion of detailed accident data analysis for purposes of problem identification or program evaluation probably should be presented as a separate course on scientific evaluation.

C EXAMPLES OF POSSIBLE FACULTY

Donald Reinfurt, HSRC
B.J. Campbell, HSRC
Lindsay Griffin, TTI
Ray Peck, California Department of Motor Vehicles

D. RESOURCE MATERIALS

"Highway Accident Analysis Systems", C.V. Zegeer, National Cooperative Highway Research Program, Report 91, Transportation Research Board, Washington, D.C., 1982.

"Accident research manual", F.M. Council, D.W. Reinfurt, and B.J. Campbell, University of North Carolina Highway Safety Research Center, Chapel Hill, 1980.

"The Highway Safety Information System: Applications and Future Directions", F.M. Council and J.F. Paniati, Public Roads, 54: 271-278, 1991.

"Traffic Conflict Techniques for Safety and Operations: Engineer's Guide, Observer's Guide, and Instructor's Guide", M.R. Parker and C.V. Zegeer, Federal Highway Administration, 1988.

"Introduction to Comprehensive Computerized Safety Recordkeeping Systems", D.W. Reinfurt and B.V. Chatfield, Transportation Research Board Circular Number 293, 1985.

"Safety research: heavy vehicles, information systems, and crash studies and methods", Transportation Research Record Number 1376, Transportation Research Board, Washington, D.C., 1992.

"National summary report on the findings and recommendations of the accident data improvement plan", National Highway Traffic Safety Administration, HS 806 033, Washington, D.C., 1981.

"Traffic accident reconstruction from coded information", G.W. Schreyer, H.D. Dixon et al., Proceedings 17th conference, Association for the Advancement of Automotive Medicine, Des Plaines, Illinois, 1973.

Course example 12. Selective enforcement concepts.

A. IMPORTANCE OF THE COURSE

Effective enforcement of traffic laws are central to an appropriate program of traffic safety in any country. Without such enforcement, driver license laws have little meaning, and driver control programs (license suspensions) have even less. Enforcement is critical to the control of drunk driving and the enforcement of seat belt laws in addition to speed, reckless driving, etc.

B. ELEMENTS OF THE COURSE

1. Public relations: An effective enforcement program depends upon public support and pubic information, as well as upon specific enforcement techniques.

One specific element for presentation is elements of a public information campaign to gain public acceptance and public support for traffic enforcement.

Another aspect is <u>internal</u> public relations to persuade officers that traffic enforcement is a truly important part of their work.

A most important element is discussion of the futility of just "slogans" as a public relations approach, but the relatively greater effectiveness of public information when coupled with visible enforcement activities.

2. Tactics: The course could go into detail as to selective enforcement tactics of placing patrol emphasis at the times and places and toward the behaviors that are overrepresented in the accident problem. Assigning police on an equal basis to all roads and all times of the day does not take advantage of the way accidents are distributed by time and place. There is an advantage to deploying officers in a manner that reflects the places and times of maximum accident occurrence. (This, of course, implies availability of an accident data system that can produce such information -- another justification for a computerized accident records system.)

C EXAMPLES OF POSSIBLE FACULTY

Northwestern University Traffic Institute Staff
International Association of Chiefs of Police Staff
Mike Sheehan, NHTSA

D. RESOURCE MATERIALS

Much in the way of materials and resources exist in the USA and Canada, but an early task would be to find out what relevance it has. It may be that the role and function of the police is so different in some Central and South American countries, that there is little transfer from USA and Canadian experience. If so, then reliance will need to be made solely on faculty from the localities.

"An Evaluation of Non-Sanction Community Seat Belt Law Enforcement Programs", W.W. Hunter, L.M. Marchetti, J.C. Stutts, C. Little, J.R. Stewart, and D.W. Reinfurt, University of North Carolina Highway Safety Research Center, 1991.

"Combining Enforcement and Public Information to Deter DWI: The Experience in Three Communities", J.H. Lacey, L.M. Marchetti, J.R. Stewart, P.V. Murphy, and R.K. Jones, University of North Carolina Highway Safety Research Center, 1990.

"Safety research: Enforcement, speed, older drivers, and pedestrians", Transportation Research Record Number 1375, Transportation Research Board, Washington, D.C., 1992.

"How to make selective enforcement work: Lessons from completed evaluations", J.D. Jernigan, Virginia Highway and Transportation Research, Charlottesville, 1986.

"Impact assessment of alternative selective traffic enforcement activities", Transportation Studies Center, University of Maryland, College Park, 1983.

Course example 13. Occupant restraint laws.

A. IMPORTANCE OF THE COURSE

A law requiring use of seat belts, suitably enforced so as to attain reasonable compliance, is one of the most cost-effective ways to bring about reduced traffic deaths and injuries. Belts are readily available, they are effective, programs to increase belt use have been successful, and the topic is worth attention in virtually any country of the Americas. This course would be given in response to the fact that seat belt use is not widespread in all countries in the Americas, despite laws requiring belt use in some countries.

B. ELEMENTS OF THE COURSE

1. The course would include some information on dynamics of the crash explaining the way that seat belts help to reduce injury.

2. It would deal with studies of the effectiveness of belts in actual crashes.

3. It would describe the favorable changes in belt use and casualty reduction noted in many countries upon passage of laws mandating use of belts and in the face of reasonable enforcement of said laws.

4. The course would also include an introduction to elements of a successful belt use program including:

a. public information: relative crash risk, how belts work, dispelling myths about belts

b. incentive programs: various inexpensive "contests" to help people get into the habit of wearing seat belts.

c. enforcement programs: issuing citations to those who do not wear belts, warning programs.

d. elements of legislation: who is to be covered, what exceptions.

e. vehicle standards to require appropriate belt equipment: the necessity for comprehensive and fair standards requiring new cars (at least) to be equipped with safety belts.

5. Included in this course would be a section on child safety:

a. role of traffic crashes as a threat to child health: in many motorized nations, road accidents kill more children than communicable diseases.

b. advisability of requiring children to ride in the back seat: statistics showing that, generally, children are safer in the back seats.

c. hence the need for seat belts in the back seat: however, some cars have belts in the front but not back seats. Children should be belted.

d. role and benefit of child safety seats: for young children, protection is greater if a child safety seat is used. But these are relatively expensive.

e. publicity: there is usually a readiness among parents to protect children, and this general trend can be used in the context of child passenger protection through use of belts or child safety seats.

f. child safety laws: USA experience in requiring children to be belted.

g. enforcement considerations: warning tickets and full enforcement.

C EXAMPLES OF POSSIBLE FACULTY

Campbell, Council, Reinfurt, Hall and others from HSRC
Griffin, TTI
Waller, K. Campbell, UMTRI
Nichols, Scott, Hedlund, Eberhard and others from NHTSA.

D. RESOURCE MATERIALS

"Comprehensive Program for Increasing Use of Safety Seats and Seat Belts for Children and Young Adults", W.L. Hall, W.G. Tolbert, C.L. Cox, and J.C. Lowrance, University of North Carolina Highway Safety Research Center, 1993.

"Community Safety Belt Programs: A Guidebook for Law Enforcement Agencies", W.W. Hunter, J.C. Lowrance, and L.M. Marchetti, University of North Carolina Highway Safety Research Center, 1991.

"Evaluating the North Carolina Safety Belt Wearing Law", D.W. Reinfurt, B.J. Campbell, J.R. Stewart, and J.C. Stutts, Accident Analysis and Prevention, 22:197-210, 1990.

"North Carolina's Seat Belt Law: Public Safety and Public Policy", B.J. Campbell, Popular Government, 53: 27-35, 1988.

"Seat Belts Pay Off: The Evaluation of a Community-Wide Incentive Program", W.W. Hunter, B.J. Campbell, and J.R. Stewart, Journal of Safety Research, 17: 23-31, 1986.

Course example 14. Pedestrians and Bicyclists:

A. IMPORTANCE OF THE COURSE

Bicycling and walking are even more important as a traffic accident problem in most other countries of the Americas rather than in the USA and Canada. This is because pedestrian casualties account for a higher proportion of the traffic toll in those countries -- of the order of 40% or more in some countries as opposed to about 20% in the USA.

B. ELEMENTS OF THE COURSE

Pedestrians 1. Age: Information will be provided on the over representation in pedestrian accidents by the young pedestrians and the special vulnerability of elderly pedestrians to death and injury when they are struck.

2. Contributing circumstances: These will be covered such as the greater risk of pedestrian accidents at night, the failure of motor vehicle drivers to yield to pedestrians, and the lack of compliance with traffic regulations by pedestrians. The problem of drunk pedestrians will also be addressed.

3. Education and enforcement: These topics will be addressed, particularly as education efforts applied to the youngest pedestrians.

4. Engineering: The course will focus on the engineering issues that pertain to pedestrian safety, including crosswalks, school crossings, parking regulations, sidewalks or other pedestrian pathways, barriers to prevent pedestrian crossings at dangerous locations, far side bus stops, one way streets, special problems of handicapped pedestrians, pedestrian signs and signals, neighborhood traffic calming measures, turn restrictions, grade separation, and lighting,

5. Warrants for action: With so many facets of the problem, the solutions must consider political and social issues as well as technical countermeasures.

Bicyclists 1. The problem: As unprotected and relatively slow moving users of the roadway transportation system, human-powered cyclists are especially vulnerable to injuries and fatalities from collisions with motor vehicles. The increasing motorization of Central and South American countries will undoubtedly exacerbate this cyclist crash problem unless countermeasures are introduced.

2. Usage: Bicycles are often the primary mode of transportation and cargo hauling for a significant number of people in less developed countries, and thus play a vital role in individual and local economies.

3. Age groups: Bicycles can be expected to be used by virtually everyone, from children to adults and the elderly. Each age group generally has its own characteristic

set of crash problems that can be addressed through appropriate age-specific educational and enforcement interventions.

4. Design considerations: A vast body of knowledge has been compiled regarding bicycle transportation, and a variety of facilities and engineering interventions have been introduced in the USA and other nations, and some of these have shown to accommodate bicyclists with safety.

C EXAMPLES OF POSSIBLE FACULTY

Charles Zegeer, HSRC
Richard Knoblauch, Center for Applied Research, Great Falls, Virginia
Richard Blomberg, Dunlop and Associates, Stamford, Connecticut
William Wilkinson, Bicycle Federation of America, Washington, D.C.
Andy Clark, Bicycle Federation of America, Washington, D.C.

D. RESOURCE MATERIALS

"The National Bicycling and Walking Study", Federal Highway Administration, PD 94 023, Washington, D.C., 1994. (FHWA and HSRC).

"FHWA Study Tour for Pedestrian and Bicyclist Safety in England, Germany, and the Netherlands", Federal Highway Administration, Washington, D.C., 1994.

"Guidelines for Development of the North Carolina Pedestrian Program", J.C. Stutts, W.W. Hunter, and W.E. Pein, University of North Carolina Highway Safety Research Center, 1994.

"Pedestrian and Bicyclist Safety: A Review of Key Program and Countermeasure Development During the 1980's", J.C. Stutts, W.W. Hunter, L. Tracy, and W.C. Wilkinson, University of North Carolina Highway Safety Research Center, 1992.

"Engineering: Designing a Safer Walking Environment", C.V. Zegeer and S. Zegeer, Traffic Safety, 88: 16-19, 1988.

"Pedestrians and traffic Control Measures", C.V. Zegeer and S. Zegeer, National Cooperative Highway Research Program, Synthesis of HIghway Practice Number 139, 1988.

"An Analysis of Bicycle Accident Data From Ten North Carolina Hospital Emergency Rooms", J.C. Stutts, University of North Carolina Highway Safety Research Center, 1986.

D. References

1. AAMA Motor Vehicle Facts and Figures 1993, American Automobile Manufacturers Association, Washington D.C.

2. Accident Facts. 1990 edition, Chicago, National Safety Council, 1990.

3. Accidents Facts, 1994, National Safety Council, Chicago, Illinois, 1994.

4. Baker, S.P., O'Neill, B., Karpf, R.S.: The injury fact book, Lexington, D.C. Heath and Company, 1984.

5. Campbell, B.J.: Trinca, G.W.: Prevention and control of road traffic accidents, Manila, Regional Office for the Western Pacific of the World Health Organization, 1989.

6. Campbell, B.J., Barriers to the Transfer of Highway Safety Technology, OECD Conference on Technology Transfer, Seville, Spain, 1991.

7. Goode's Rand McNally World Atlas, 18th Edition, Rand McNally, New York.

8. Haddon, W., Suchman, E.A., Klein, D.: Accident research: Methods and approaches, New York, Harper and Row Publishers, 1964.

9. Hartunian, N.S., Smart, C.N., Thompson, M.S.: The incidence and economic costs of major health impairments: A comparative analysis of cancer, motor vehicle injuries, coronary heart disease and stroke, Lexington, Lexington Books, 1981.

10. Hutchinson, T.P.: Road accident statistics, Adelaide, Rumsby Scientific Publishing, 1987.

11. Injury in America: A continuing public health problem, Washington, DC, National Academy Press, 1985.

12. Journal, People to People Highway Safety Delegation to the People's Republic of China, June 17-July 8, 1987, People to People Inc., Seattle.

13. Knight, P., Campbell, B.J.: The impact of the motor vehicle: The challenge of the 90's. Report to the Prime Minister, Chapel Hill, UNC Highway Safety Research Center, 1989.

14. Mackay, M.: Towards a unified traffic science. Communication to the International Scientific Initiatives on Road Traffic, The Netherlands, 1989.

15. Rice, D.P., Mackenzie, E.J.: Cost of injury in the United States - A report to Congress, San Francisco, Institute for Health and Aging, University of California and Injury Prevention Center, The Johns Hopkins University, 1989.

16. "Seguridad Vial: Material de Referencia", Federal Highway Administration and PanAmerican Institute of Highways, Washington, D.C., 1992.

17. Trinca, G.W., Johnston, I., Campbell, B.J., Haight, F.A., Knight, P., Mackay, M., McLean, A.J., Petrucelli, E.: Reducing traffic injury - A global challenge, Melbourne, Royal Australasian College of Surgeons, 1988.

18. United Nations Yearbook (1991), Volume 1, 43rd Issue, United Nations, New York, NY, 1992.

19. World Health Statistics Annual, 1992, World Health Organization, Geneva, 1993.