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Summary

The objectives are to examine rural road accident data in order to develop a method by which high accident rate locations and accident causes can be identified, and also to develop proposals for improvements at such locations and to identify measures which will improve road safety throughout the country.

The problem of road safety in Iran is an important issue, because of the tragic and unnecessary loss of life, and the enormous cost of accidents in the country. The resources available to deal with the problems are limited and must be allocated on priority basis. This study represents an initial effort to identify the extent of the problem in order to take remedial measures.

A study was made of all the available road accident data collected by agencies related to road safety in Iran, and the major organisations responsible for road safety development were visited. The Vice Minister of Roads and Transportation selected for this study a 280 Km rural road in South West Iran. Mainly because of the lack of suitable maps and plans of the roads, it was not possible to accurately identify the location of accidents. Accident scene data was subsequently collected by the highway police and personally by the author. The data for the study road was then analysed to identify 'high accident rate' locations, and also to determine, as far as was possible, the reasons for the accidents.

The study suggests specific improvements for each of the high accident rate locations examined (eg. the building of dual carriageways with central guard rails to reduce the risk of collision with oncoming vehicles, pedestrian facilities to allow pedestrians to cross dangerous roads). In addition recommendations are made to guide and assist the major organisations responsible for road safety in Iran. These recommendations are:

- (a) for improving accident data collection and storage
- (b) for subsequent analysis for taking remedial measures with a view to accident prevention

KEYWORDS

IRAN  
RURAL ROAD  
ACCIDENT LOCATION  
ACCIDENT PREVENTION  
ROAD SAFETY

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CHAPTER ONE

INTRODUCTION

## 1.1. THE JUSTIFICATION OF THIS STUDY

One of the biggest and major public health problems which most developed and developing countries have since the invention of the motor vehicle is the problem of road traffic accidents. It seems that almost every driver at sometime in his life has at least one road traffic accident. In addition, every driver is acquainted with someone who has died or been seriously injured in a road accident <sup>(1)</sup>.

Although figures are not readily available from most of the largest countries (e.g. Argentina, China, Egypt, India and the U.S.S.R) it is clear that world annual road deaths probably approach 300,000 and total casualties perhaps 10 million per year <sup>(2)</sup>.

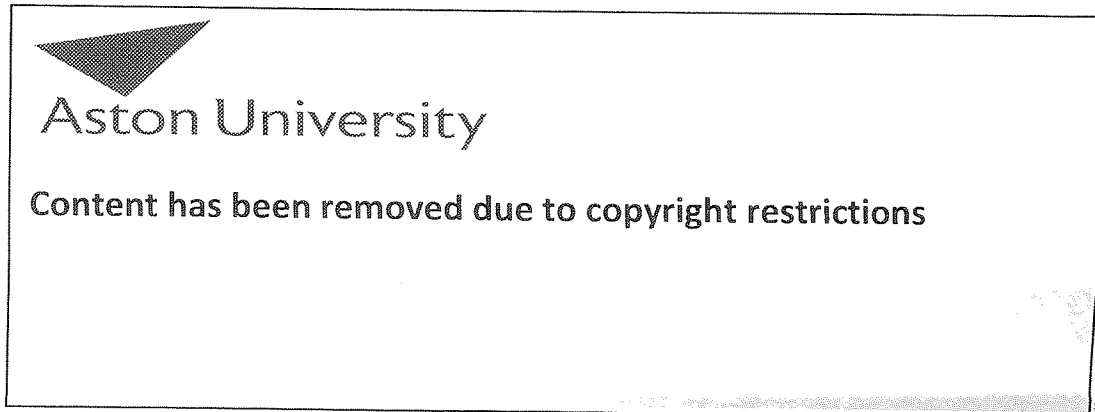
The most recent statistics (Table 1.1) are by geographical regions, but the values are underestimated since only certain countries regularly furnish such statistics.

On Britain's roads, each year nearly 360,000 people are killed or injured as a result of road traffic accidents. It is known that injuries are underestimated by probably 30 percent. In addition, there are estimated to be at least another 1½ million non-injury accidents reported to insurance companies and an unknown number of accidents not appearing in any statistics <sup>(3)</sup>.



TABLE 1.1

Annual Road Deaths by Geographical Region (2)



Also (Table 1.2) shows the deaths due to road traffic accidents for various countries (4), (5).

In Iran, the vehicle ownership rate in general is rising fast. It is not uncommon for ownership levels to treble in a five year period (6), (7). As a result, road traffic accidents in Iran are becoming a major health and economic problem, with some distinct differences from accidents in developed countries.

TABLE 1.2

Deaths due to road traffic accidents (4), (5)



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The human agony of thousands of Iranian families women and children suddenly widowed or orphaned is immeasurable. Yet their cries are not heard. The issue of traffic accidents, therefore, is a matter of survival in Iranian society, and is something that we cannot afford not to take remedial measures.

In developing countries with the still low levels of vehicle ownership, the consequences of road traffic accident are severe. The reasons for these are believed to be (2):

1. Large numbers of pedestrians sharing the roadway with vehicles, many pedestrians having little appreciation of the limitations of road vehicles in their ability to stop and turn. Physical segregation of pedestrians from wheeled traffic hardly exists.
2. Large numbers of old, poorly maintained vehicles. As a corrolary to high growth rates of vehicle ownership, mechanical knowledge and aptitude are absent from the population. Economic restrictions also mean than maintenance standards are low. The proportion of accidents caused by vehicle defects in developing countries is probably several orders of magnitude higher than in the industrialised world.
3. Low levels of driving performance. In many developing countries unlicenced drivers are a major difficulty, and driving standards are low. Some countries have no aptitude tests at all for a driving licence.

4. Large numbers of motorcycles in the vehicle population. Because of their cheapness and utility, motorcycles represent the first step in individual, powered transport in many areas. The vulnerability of their riders, particularly if they are untrained and self-taught is very high.
5. Large numbers of buses and trucks carrying many people, often in an overloaded condition. In developing countries it is not uncommon to receive reports of single accidents involving fifty or more casualties. In 1977, one accident in Colombia for example caused the death of 128 people.
6. A widespread disregard of traffic rules. Particularly in remote regions of developing countries, there is little appreciation of the need for traffic law and enforcement levels are minimal. Educational programmes in traffic matters are usually non-existent.
7. In some oil rich countries the vehicle population contains large numbers of new cars, often with high performance characteristics being used on road system which are quite inadequate for such vehicles.
8. The people most at risk as car occupants in some developing countries are the very people most valuable to the community. Such casualties include professional men, senior civil servants, doctors and technicians; those people most useful to the economic development of the country.

9. In some developing countries special vehicles have evolved, not seen elsewhere. For example, in Asia, scooter-based taxis are common, whilst in South America truck chassis are used as the basis for locally constructed buses. The bodies of such vehicles are often wooden and are extremely vulnerable in collisions. In general, these special vehicles, although often cheap and functional, have been built with no regard to crash performance.
10. A lack of information as to what the scale and nature of the traffic accident problem actually is. Data collection systems are often rudimentary or non-existent. Often data collection systems exist in theory, but in practice gross under-reporting and inaccurate reporting is commonplace.
11. A lack of understanding of the problem on the part of local, regional and national government authorities. Being a relatively new problem in many areas, government agencies do not have the knowledge or abilities to introduce remedial measures. This problem is compounded by confusions over areas of responsibility between health and transport authorities and police, and in some countries the military who may be in operational charge of many civil policing functions.

The justification of this research is that the true extent of the road traffic accident problem in Iran is unknown, and due to lack of understanding of the problem among the

official authorities, they imagine that nothing can be done towards road safety development with the existing situation, or if it is possible how it should be approached.

This study will examine the problem in depth and will be submitted as a Ph.D. thesis based on factual data, discussion with officials and people related to the problem, how the problem is approached in other countries, and 'at-scene-study' of some accidents on a selected road.

It would be far beyond the scope of the author to study all the road traffic accident problems for the whole country.

Therefore, this study is mostly concentrated on rural roads (as the author is an official engineer of the Ministry of Road and Transportation and has better access to this data), but include some urban and populated areas which the study road goes through.


## 1.2. INTERNATIONAL STATISTICS OF TRAFFIC ACCIDENTS

Using the data in (Table 1.2) it can be shown that crude statistics such as these can not be satisfactorily used to compare the accident records of different countries. There are a number of other factors to consider such as vehicle density, population density, annual vehicle kilometerage and road kilometerage. There are unquantifiable factors, such as the degree of urbanization and the nature of society in the country, that can be considered relevant. In addition, there is no internationally accepted definition of what constitutes a traffic accident fatality, with variation extending from the Belgium definition of a death occurring at the scene of the accident <sup>(9)</sup> up to the more widely used definition of death occurring within 30 days <sup>(9)</sup>.

(Table 1.3) shows the international differences in car ownership rates, the fatality rates per million persons and the vehicle density in terms of vehicles per road kilometer. It should be remembered that exact comparisons of the relationship between vehicles and road kilometer in different countries are complicated by local variations in the definition of what constitute a road. However, this table shows that Great Britain has a good road safety record in terms of numbers killed per head of the population despite having the highest vehicle per mile figure. Conversely, the U.S.A. has a high

TABLE 1.3

Some international vehicle ownership and road accident fatality rates (11), (12)

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NOTE : Data of vehicle ownership in (Table 1.3) and in (Table 7 of (13)) do not match, because in (Table 1.3) vehicle ownership of G. Britain for 1970 is 0.21 but in (Table 7 of (13)) is 0.26.



fatality rate with only a moderately low vehicles per mile figure. But such comparisons make no true allowance for exposure. For example, the annual kilometerage for similar types of vehicles may be substantially different and the mean speeds in accidents are probably higher <sup>(10)</sup> in the U.S.A. than Great Britain, resulting in the higher fatality rate.

In the U.S.A. in 1971, 67.8% of fatal accidents occurred in rural areas while the corresponding figure for Great Britain was 45.4%. Further, only 19.4% of U.S.A. fatalities were pedestrians compared with 39% in Great Britain <sup>(5)</sup>, <sup>(10)</sup>.

Much of the variation in road deaths between different countries and at different times in the same country, can be explained in terms of population size (P) and the number of vehicles (V). Smeed <sup>(12)</sup> found the best fit for annual road death was :-

$$\text{Annual road deaths} = 0.0003 (V \cdot P^2)^{\frac{1}{3}} = \frac{V}{P}$$

and it is remarkable how widely this formula is applicable. An important concept is the degree of motorisation or vehicles per head of population  $(\frac{V}{P})$  with increasing vehicle ownership, road deaths rise less than might be expected, so that deaths per vehicle fall as  $(\frac{V}{P})$  rises. Presumably, this is an overall measure of many changes, such as improved roads, better vehicles, changes in driving behaviour and levels of medical care of casualties.

In the industrialised countries these adaptations to road transport have been spread over 70 years or more. However, in many developing countries changes have been much more rapid, and the statistical relationship of Smeed does not apply to them for certain periods of time. With a very rapid development of modernisation it is possible for the death rate per vehicle to rise with an increasing level of vehicle ownership.

One consequence is that the risks of involvement may become so high in some developing countries over a short period of time that road deaths per head of population may exceed the levels experienced in industrialised countries, even though the levels of vehicle ownership are still relatively low. This is illustrated in the case of Zambia in (Figure 1.1), (2).

### 1.3. IRAN'S STATISTICS OF TRAFFIC ACCIDENTS

In general, basic traffic accident statistics in Iran are fragmentary, and unlike most developed countries there is not a central organization which records all the accidents.

FIGURE 1.1

Fatalities per million population by year  
(2), (13)

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Year

statistic for the whole country. The urban traffic police, who are part of the national police, collect and record urban road traffic accident data and the highway police, who are part of the military, collect and record rural road traffic accidents. These two official organizations work independently and rarely know about each other's accident data.

Accident statistics are not usually published or given out to any organizations by either the urban traffic police or the highway police unless a permission is given by one of the very high government officials such as the Minister of Roads and Transportation.

In 1973, there were 2079 fatalities\* as a result of road traffic accidents on urban roads in Iran (6) and 1341 fatalities on rural roads in the same year according to the highway police. Also 8,700 people were seriously injured as a result of road traffic accidents on rural roads (17).

A report by Atkins International in 1977 (6) states in general for some developed countries (Sweden and the U. S. A.) inter urban casualties rate as a result of road traffic accidents is more than that for urban roads. But 'Chapter Two' of this thesis will show that it is different in Iran,

\* Refer to page 34

and that more people are killed and seriously injured on urban roads than rural roads. In 1975 there were a total 3650 people killed and over 25,550 seriously injured <sup>(7)</sup> (usually requiring detention in hospital) on Iranian roads .

Table 1.4 shows the number of injury accidents on rural roads in Iran by year <sup>(7)</sup> (Source :- highway police 1980).

TABLE 1.4

Number of injury accidents on rural roads in Iran by year (7).



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NOTE : See Section 2.2 for definitions.

It can be shown that

In 1977 there were 21,400 serious damage accidents on rural roads involving 65,710 light and heavy vehicles (17). However, many accidents are not reported to the police because of the legal procedures involved for drivers. This is especially true for the guilty drivers because the parties have to spend a lot of time running about to attend many legal procedures. Usually, the parties agree between each other to sort out the matter between themselves, unless one of the parties requires the police attendance. According to the road police there are at least 10 times more road accidents happen which are not reported. In many cases, according to the highway police, even many fatal accidents are not reported. This is especially true in cases where a freeway goes through a populated area. If pedestrians are killed as a result of a road traffic accident, and vehicle involved does not stop, often the victim's family, because they do not know about the legal procedure, merely bury the victim and forget about prosecuting the vehicle driver.

However, Faulkner 1970 (20) when dealing with developed countries suggested the method of collecting glass fragments from the road would help to do a rough estimate of unreported accidents, which is about 10 times more than reported ones.


This was only for underestimation of minor damage accidents, but in Iran many serious accidents go unreported.

Using the data in Table 1.4, it can be shown that the number of injury accidents and the number of fatalities and serious injury accidents have been increasing from 1975 every year except for 1979. This was due to Iran's revolution which altered many things and is studied in more details in 'Chapter 8'.

#### 1.4. ROAD ACCIDENTS AS A CAUSE OF DEATHS IN DEVELOPING AND DEVELOPED COUNTRIES

To illustrate the extent of the road accident problem in developing countries, comparisons have been made between road accident fatalities and the number of deaths resulting from diseases. This has been shown by a world organization survey to be of particular concern to developing countries. This analysis was first carried out for the year 1968 and results were given in the paper at the PTRC Summer Meeting in 1975 (14). For the ten countries for which data was available, it was found that road accidents ranked third as a cause of deaths, accounting for 13% of the total number of deaths studied. The analysis was repeated for the year 1972 using data from 15 countries :-

- |                |              |                       |
|----------------|--------------|-----------------------|
| 1. Barbados    | 6. Jamaica   | 11. Mauritius         |
| 2. Cyprus      | 7. Jordan    | 12. Singapore         |
| 3. Hong Kong   | 8. Kenya     | 13. Sri - Lanka       |
| 4. India       | 9. Malawi    | 14. Trinidad & Tobago |
| 5. Ivory Coast | 10. Malaysia | 15. Zambia            |

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1 5

FIGURE 1.2 - PERCENTAGE OF DEATHS BY VARIOUS CAUSES IN 15 DEVELOPING COUNTRIES (14)



TABLE 1.5

Accidents Statistics for Several Main Rural Roads in Iran 1974 (19)



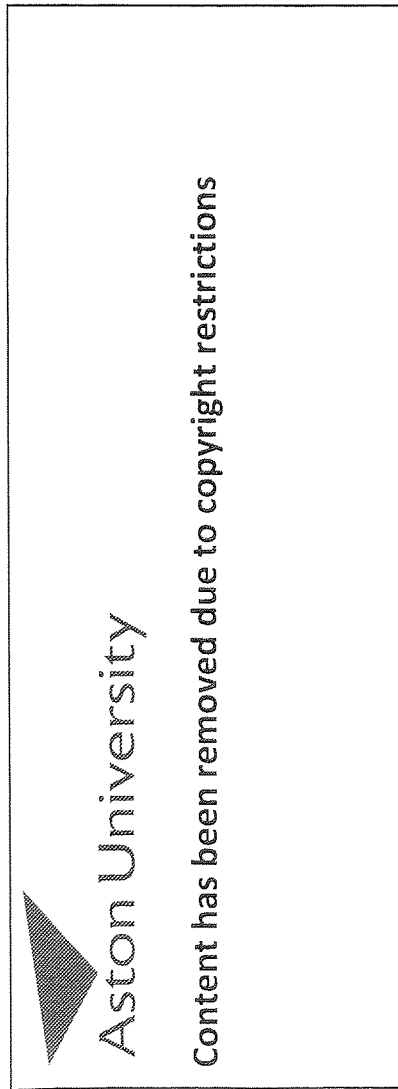
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TABLE 1.6

(19)

Accident Statistics for the Tehran Khoramshahr Road, 1974



the number of accidents could be decreased or kept constant as the number of vehicles increase if road safety is improved and better road side facilities and regulation is provided for the road users. The current estimate for Iran is that the annual average increase in vehicle kilometers will be 12 to 13 percent, so that by 2002 the figure will be 280 billion. Potentially the number of accidents, injuries and deaths could also rise at the same rate, although the rate of increase in the number of accidents as previously stated will also depend upon the effectiveness of new safety measures. However, if the same rate does continue this will mean that deaths due to road traffic accidents in the year 2002 will be of the order of 40,000 per year in rural roads, as well as approximately 10 times that number seriously injured.

Some of these people will die unnecessarily or will be disabled permanently and require continuing institutional support because they do not receive adequate emergency medical care sufficiently quickly. Consequently, when road traffic accidents occur available resources should be activated in order that lives can be saved and the severity of injuries and permanent disability resulting from them be reduced. This same effort should of course also be applied for other accidents and in emergency medical situations such as heart disease.

## 1.6. THE COST OF ROAD ACCIDENTS

The author has been unable to find any research that has been carried out to estimate the cost due to road traffic accidents in Iran up to the present time, but a Consultant suggested that the cost is so large that road safety investment in Iran would be one of the most profitable investments that the Ministry of Roads and Transportation of Iran could carry out.

However, to put a meaningful cost to a road accident is a difficult procedure. Some of the constituent costs of each accident can be calculated, and as repair bills, running costs of emergency services, legal fees, etc., but there are other intangible items such as traffic delay, lost production and, in particular, pain, suffering, and grief upon which a sensible cost is difficult to place.

Dawson (1967, 1971) (21), (22) has developed costings for road accidents upon which the official figures for the United Kingdom are based. Using his figures, the total economic cost of accidents in 1970 was £346M. In his later paper, Dawson changed his method of calculating the effective loss of output of those killed in accidents so that their future consumption was no longer deducted from their future output, thus increasing considerably the cost of a fatality from £13,000 to £19,000.

The author's calculations suggest that the cost to Iran of road accidents is extremely high, and one of the justifications for this research is to try and reduce the cost by reducing the number of accidents. The detailed calculations of the cost are discussed in 'Section 2.13'.

#### 1.7. TRAFFIC COUNTS AND TRAFFIC FLOW IN IRAN

National Traffic counts have only been made for the year 1971-1972. The agency responsible was the Ministry of Roads, and two kinds of count were made :

(a) Mechanical

(b) Manual

(a) Mechanical counters were supposed to operate all the year round, and were therefore referred to as permanent stations. There were 24 permanent stations in operation which worked mechanically by means of tubes across the road, which recorded each axle as one half of a vehicle. A car was thus recorded as one. Totals were recorded each quarter of an hour for 24 hours a day, 365 days a year. The problem with this method was that tubes were broken after sometime and even stolen by natives at different stations.

(b) Manual counts were also made at the location of the mechanical counts, to establish the breakdown of traffic by vehicle type and in particular the number of axles; this made it possible to connect the daily axle-count registered mechanically into a daily vehicle count.

Two kinds of manual count station were employed :-

( i) Control Station

24 hour counts were taken during three days of one week, once in the first six months and once in the second six months of the year. Of the three days, one would always be on a weekend (Friday). There were 42 of these manual control stations.

(ii) Covering station

A one day, 24-hour count was taken in the first six months and once again in the second six months of the year. There were 318 of these manual covering stations.

In the manual counts, traffic was divided into eleven categories :-

- (1) Private cars
- (2) Minibuses All classified as cars
- (3) Vans
- (4) Truck with 2 axles
- (5) Truck with 3 axles
- (6) Truck-traillers with 4 axles All classified as trucks
- (7) Truck-traillers with 5 axles
- (8) Truck-traillers with 6 axles
- (9) Tanker-trucks with 2 axles
- (10) Tanker-trucks with 3 axles
- (11) Buses

The usefulness of the counts for calculating a reliable annual average is severely impaired by the fact that from one year to the next, or from the first half-year to the second, the counts have not been made on the same day of the week or even the same month. The evidence accumulated so far indicates considerable daily variation within the week and monthly variation within the year.

#### 1.8. NUMBER OF VEHICLES IN IRAN

There are no official sources in Iran that could give the number of vehicles existing in the country. The only official source which could give the actual number of vehicles registered in the country for different years is the vehicle registration office which is part of national police. This office gives the figures to the Ministry of Economy, Bureau of Statistics, but these figures were not available to the author. Even if they had been, it would be difficult to find out the number of existing vehicles in Iran as they would not give data on how many vehicles are off the road. Therefore, it would be extremely difficult to obtain any exact figure of the existing vehicles even with the government figures.

However, in most towns vehicle number plates are issued by the Police Department. There are different coloured plates for private vehicles, public service vehicles, and government vehicles. The police, gindarmani and armed forces have their own distinctive plates. The police know, of course, exactly

how many vehicles are given plates, but when a vehicle is scrapped they are rarely informed. Therefore, there is no reliable data showing the size, age, and composition of vehicles. The earliest record of vehicles registered in Iran is from 1949.

However, there are two different sets of data for the number of vehicles in Iran (6), (7), and these are given in Table 1.7 and 1.8.



TABLE 1.7

Number of Vehicles Registered in Iran by Year 1954 - 71 <sup>(7)</sup>



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Also according to B.C.O.E.M. in 1976 there were 200 vehicles registered everyday. Therefore in 1976 the total number of vehicles were : (7)



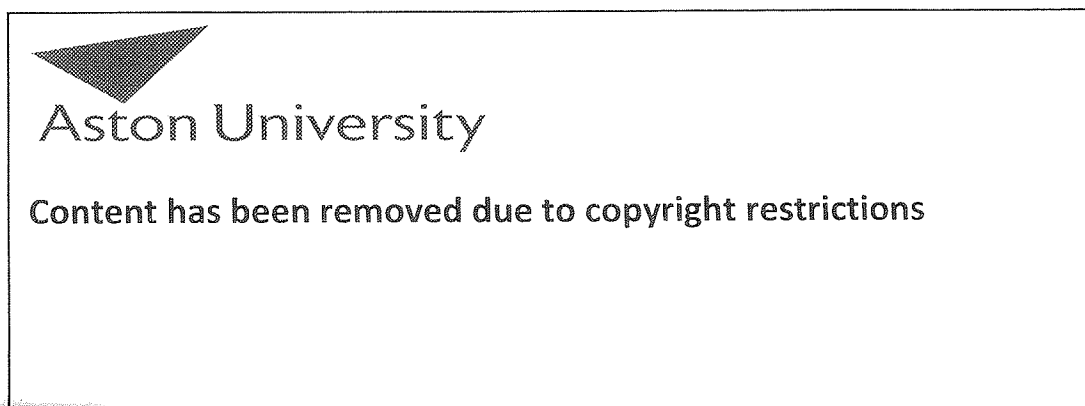
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However, according to Atkins, the number of vehicles is different and the figures are given in Table 1.8

TABLE 1.8

Number of Vehicles in Iran for the years 1949, 1963 and 1974<sup>(6)</sup>



NOTE : The above data does not include the number of military and agriculture vehicles.

In 1974 Atkin's predicted the number of motor vehicles in Iran as about 2,000,000 for the year of 1976, but B.C.E.O.M. gave a number of 513,000

However, comparing data in Tables 1.7 and 1.8 it can be shown that the number of vehicles for 1963 in both tables do not match each other, although both Atkin's and B.C.E.O.M. obtained their figures from one source, The National Police of Iran.

This shows that published figures are most unreliable.

### 1.9. IRAN ROAD SYSTEM

In 1973, for a total area of 1,650,000 Km<sup>2</sup> Iran possessed only 42,000 Km of roads of national or regional significance, of which some 12,500 Km, or 30 percent, were paved. This represents one kilometer of paved road per 135 Km<sup>2</sup> of territory or 2,600 head of population. Much of the network, paved and unpaved, is poorly constructed and inadequately maintained (7).

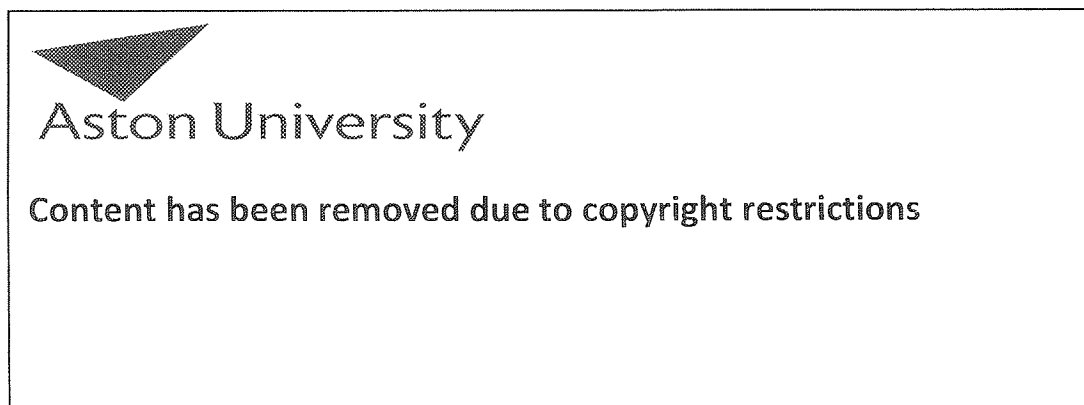
When looked at historically, (See Table 1.9) this total represents rapid progress. In 1963, at the end of the second plan period, Iran possessed only 3,660 Kms. of paved roads, 17,500 Kms of gravel roads, and 13,000 Kms. of earth roads. During the third plan, the development of motor transport proceeded at a fairly rapid pace. Work on main roads started under the second plan was completed while a further 4,000 Kms of main roads were constructed. In addition 3,000 Kms of feeder roads were built. During the fourth plan period, 2,600 Kms of main roads, and nearly 8,000 Kms. of feeder roads were constructed.

All this information is shown in Table 1.9, but more recent information is unavailable and once again demonstrates the lack of available data and knowledge concerning the road network and accident problems of Iran.

Source : B.C.E.O.M. (7)

TABLE 1.9

Length of Road in Iran, 1949 - 1973 (7)  
(in kms)



CHAPTER TWO

A REVIEW OF THE LITERATURE

## 2.1. INTRODUCTION

Responsibility for road safety does not rest in any one academic field but is spread over a truly multi disciplinary area. Civil and highway engineers are responsible for the design and construction of the road system, mechanical engineers design, build and maintain the vehicles using the road system, lighting engineers ensure that we are able to see at night by providing road and vehicle lighting, electronics engineers are responsible for many control systems on the road and to an increasing extent in the vehicle. On the human side psychologists study human behaviour, ergonomists examine the immediate environment of the vehicle operator, education services provide the population with road safety training. Support services are provided by the medical profession not only in the field of accident surgery but also in the question of fitness to drive by statisticians whose experimental design can give the information needed to evaluate changes in the system and who provide in cooperation with the computer programmers the tools to enable data storage and analysis to be performed.

However, these disciplines cannot work in isolation as the findings of their research can affect other areas. Thus, the published work in this field is diversified in subject and, as the study of road safety expands due to social pressures created by the size of the problem becomes more extensive.

The longer that a subject is studied, the deeper and more specialised the work tends to become, but compared with the classical scientific disciplines research into road safety is still moving from general topics into specific areas.

The effect of the many disciplines involved in gathering data which may be ultimately used in traffic accident countermeasures, is that any review of the literature cannot hope to cover the entire field of safety in depth due to the limitations in the understanding of one person.

This review will be no exception. Since the theme of this thesis is to study the prevention of road traffic accidents in Iran, all that will be attempted in this review will be a presentation of some of the work related to accidents and traffic research of the prevention of road traffic accidents in Iran.

## 2.2. SOME DEFINITIONS FOR THIS STUDY

For the purpose of this study the following definitions were used :-

### (A) Developing Countries

Originally, a developing country was taken to be one with a vehicle ownership level of less than 1,000 vehicles per 10,000 population but Cyprus, Kuwait, Singapore and South Africa were later added to the list. The division between developed and developing countries is by no means clear and many different definitions have been used. In this thesis countries similar to Iran are classed as developing countries, with a maximum gross national products of \$600 per year (13) and (7).

### (B) A fatal road traffic accident

This is a road accident in which one or more vehicles either collides with each other, or an obstacle, or a pedestrian, or an animal, and which as a result of that accident one or more people lose their lives at the scene of the accident.

### (C) A serious injury road traffic accident

This is a road accident in which one or more vehicles collide with each other, or an obstacle or a pedestrian, or an animal and which as a result of that accident one or more people need detention in hospital.



(D) A slight injury road traffic accident

This is a road accident in which one or more vehicles collides with each other, or an obstacle, or a pedestrian, or an animal, and which as a result of that accident one or more people are injured which only requires first aid treatment.

(E) A serious damage road accident

This is a road accident in which one or more vehicles collides with each other, or an obstacle, or a pedestrian, or an animal, and which as a result of that accident property is damaged which requires at least £250 for repairing.

(F) Fatalities

Care must be taken because different definitions vary from country to country (see Table 2.5). Some countries considered that death occurred as a result of a road accident if the victim died on the spot (e.g. Belgium), some, if the victim died within 24 hours (e.g. Spain), and some if the victim died within 3 days (e.g. Austria), and some if the victim died within one year (e.g. U.S.A.). But in this thesis a fatality is considered to be death at the scene of the accident.

(G) Personal Injury

Slight injury does not require detention in hospital, but serious injury does require detention in hospital.

(H) Vehicles

Vehicles are defined in this study as cars, trucks, mini-buses, vans, motor cycles and others e.g. tractors, carriages pulled by animals, bicycles etc.,

Definitions used describing accident collisions are explained in (Table 2.1). Vehicle collision sectors and different types of vehicle collisions are shown in figure 2.1.

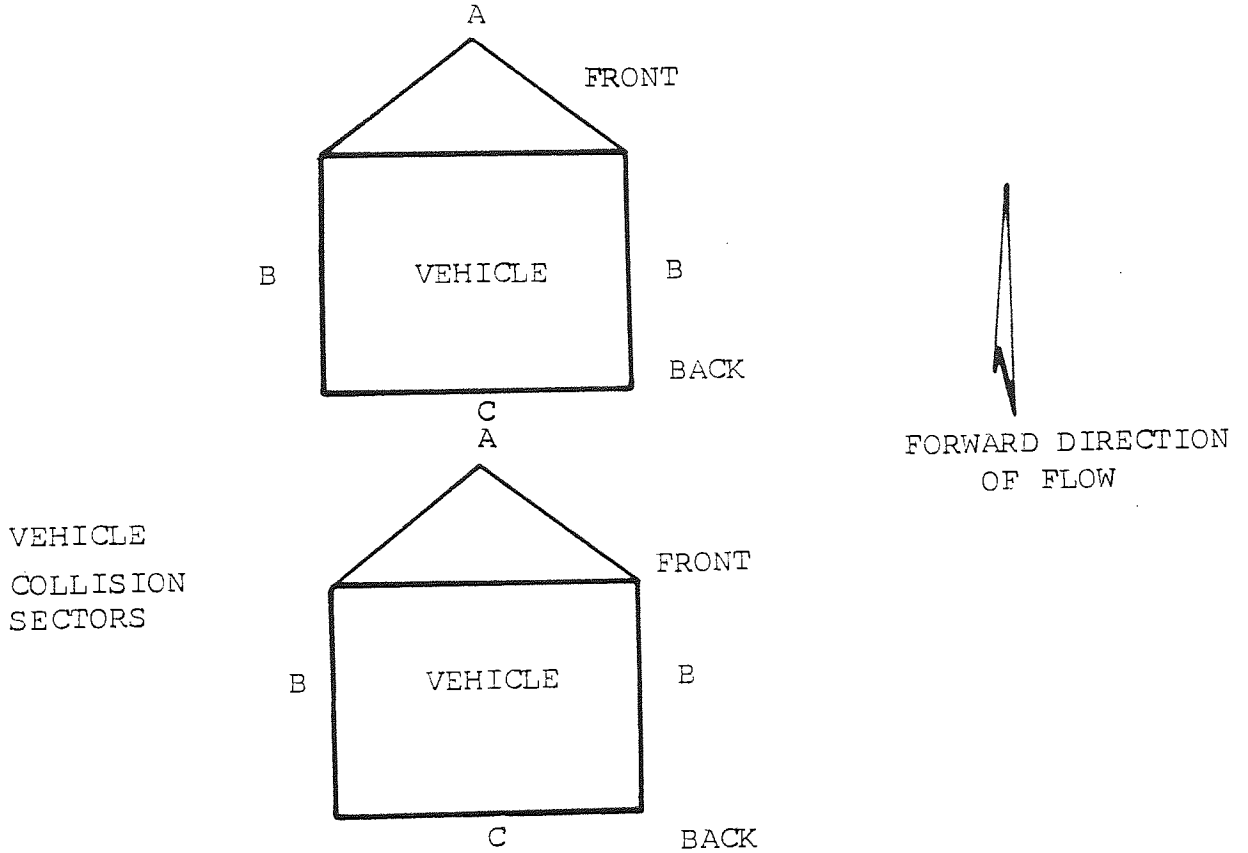
TABLE 2.1

Definitions used describing accident collisions

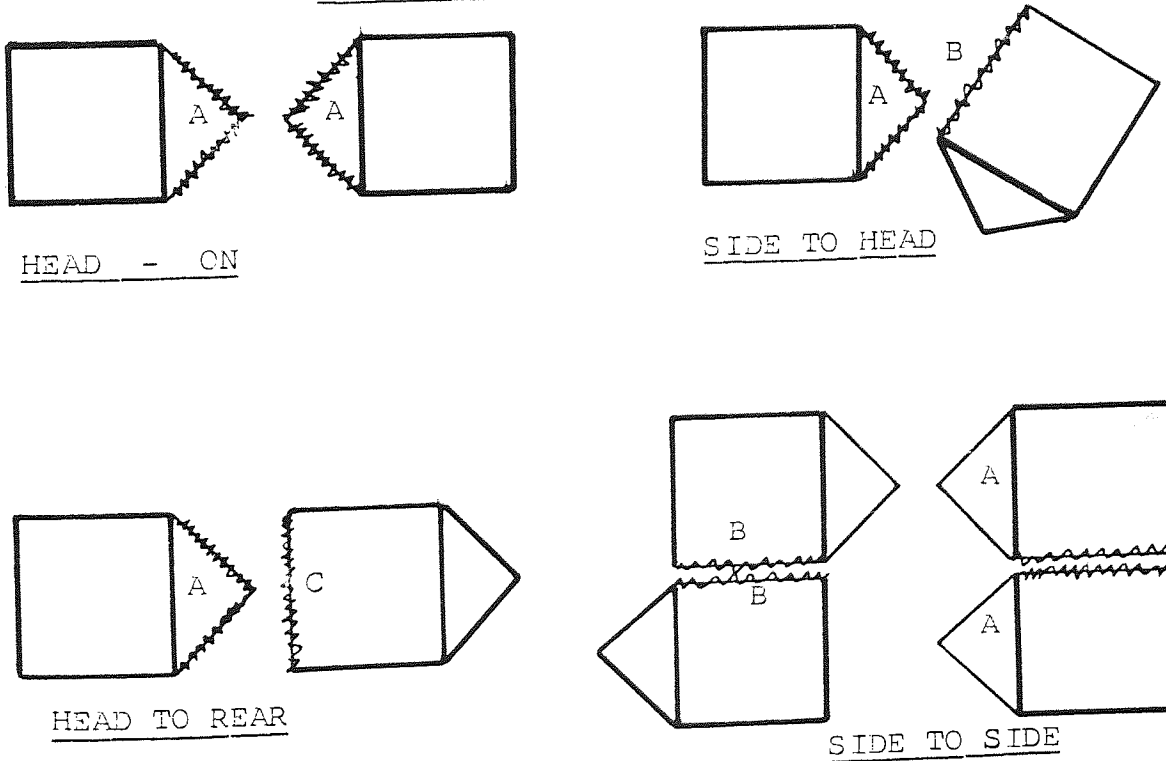
Code	Description	Definition of Accident
1	Single vehicle	Only one vehicle involved colliding with road furniture, or premises, or rolling over.
2	Vehicle/Vehicle Head On	Two vehicles impacting within the sectors A to A show in Fig. 2.1.
3	Vehicle/Vehicle Side to Head	Two vehicles impacting within sector A to B in Fig. 2.1
4	Vehicle/Vehicle Head to Rear	Two vehicles impacting within the sector A to C.
5	Vehicle/Vehicle Side to Side	Two vehicles impacting within the sector B to B.
6	Multi - Vehicle	Three or more vehicles colliding.
7	Vehicle/parked vehicle (s)	Collision involving parked vehicle(s) and one moving, vehicle.
8	Vehicle/Pedestrian	A collision between a single vehicle and one or more pedestrian on or off roading.
9	Multi Vehicle/Pedestrian	Two or more vehicles colliding and one or more pedestrian being impacted.
10	Other	A category embracing any other collision conditions encountered.

FIGURE 2.1

Vehicle collision sectors and different types of vehicle/vehicle collision.



EXAMPLES OF VEHICLE/VEHICLE COLLISIONS



### 2.3. ROAD ACCIDENT PROBLEMS IN DEVELOPING COUNTRIES

In developing countries there were over 100,000 people killed and over 1,500,000 seriously injured as a result of road traffic accidents in 1974 (14), and the situation is worsening, unlike that in the western European and North American countries. Up to 1972 very little research had been carried out on the problem of road accidents in developing countries but in 1972, following requests for aid and guidance in this field, a small team was formed within the Transport and Research Laboratory (T.R.R.L.) overseas unit to carry out some work on developing countries' road safety problems.

In those developing countries which are rich in oil, for instance in NIGERIA, road casualties have increased spectacularly. Although gross under-reporting probably occurs, road deaths have doubled in the past six years (2), but in other developing countries without oil the increase has been less abrupt. In general it is likely that most of the developing countries are now entering a rapid and very sustained growth of vehicle ownership and hence road accidents. Experience from the industrialised countries shows that vehicle ownership with time follows a classical 'S' curve. Although there is uncertainty over the final asymptotic level of stable ownership, it appears that many countries are reaching the point on the lower part of the 'S' curve where

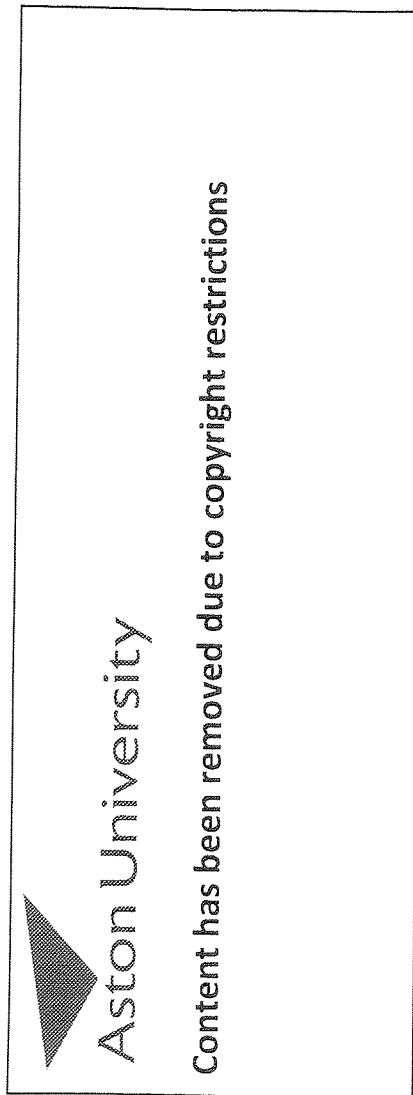
the growth rates take off from very low levels and increase linearly for a number of years. Particularly if oil is available, it is likely that the growth rates will be very much faster than has been the case in the industrialised world.

In order to investigate the changing pattern of fatality and injury rates over time, fatality and casualty rates per licenced vehicle were obtained for the years 1961 to 1971 (Table 2.2). It was found that there was a tendency for most of the rates related to licenced vehicles to decrease with time. Of the 22 countries studied, 16 showed a decrease with time, 16 showed a decrease in fatalities per vehicle and 18 countries showed a decrease in injuries per vehicle. This analysis agreed with that carried out by Smeed (16), (15), in 1953 and again in 1968 (in mainly developed countries) which showed decreases in 15 out of 16 countries studied.

ZAMBIA, JAMAICA and KENYA were among the countries which had considerable increases in the number of fatalities per licenced vehicle and in such countries unusual factors may be operating. Thus by examining trends over a period of time, it is possible to identify countries where the road accident situation is worsening. From the above analysis KENYA, MALAWI, ZAMBIA, BOTSWANA, JAMAICA AND NIGERIA fall in to this category (Table 2.2).

TABLE 2.2

Percentage change in vehicle ownership fatality and injury rates in different countries over a 10-year period (1961 was used as the base year) (13)



\* 1961 and 1971 figures not available. 1958 and 1968 used.

Having studied changes in fatality rates over ten year period, the analysis was repeated for both longer and shorter time periods. The analysis was first repeated for as long period as possible (up to 20 years) and then for the four year time period 1968 - 1972. Results are given in (Tables 2.3 and 2.4). Over the longer period of time (mainly 1952 - 1972) the results are similar to those obtained in the earlier analysis of 22 countries over the ten years period (1961 - 1971).

Thus of the 26 countries for which data was available (15 developing, Table 2.3 and 11 developed, Table 2.4) 22 showed a decrease in fatality rates. Those showing an increase were all developing countries namely; KENYA, ZAMBIA, JORDAN and SRI - LANKA (Table 2.3).

Over the 4-year period, all 11 developed countries again showed a decrease in fatality rates. Of the 15 developing countries, 9 showed an increase. Thus over this shorter period, approximately two thirds of the developing countries in the group of countries considered showed increases in fatality rates, indicating that the accident situation has worsened considerably over this short time. Over this period, although vehicle ownership has increased substantially (approximately 40 per cent on average) it is possible that measures necessary to reduce accident rates,



TABLE 2.3

Percentage change in fatality rate per 10,000 vehicles in different developing countries over the period 1968 - 1972 and 1952 - 1972 (14).



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TABLE 2.4

Percentage change in fatality rate per 10,000 vehicles in different developed countries over the period of 1968 - 1972 and 1952 - 1972 (14)

---

Changes in Fatalities



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such as improved road geometry, driver training, enforcement of regulation and improvement in vehicle safety standards, have not kept pace with the rise in vehicle ownership.

#### 2.4. TRENDS IN FATALITY RATES

Using data for road fatalities, vehicles and population for the year 1938 from 20 European countries, U.S.A. Canada, Australia and New Zealand, Smeed <sup>(12)</sup>, derived the relationship expressed by the formula :

$$\frac{F}{V} = 0.0003 (V/P)^{-2/3}$$

where F = road fatalities

V = number of vehicles

P = population

Using methods similar to those used by Smeed, an analysis of fatality rates in 32 developing countries was carried out, firstly for the year 1968 and again for the year 1971 <sup>(13)</sup>. Statistically significant relationships were derived which are illustrated in Figure 2.2 <sup>(14)</sup>. It can be seen that as vehicle ownership increases, the fatality rate decreases, i.e. the less developed countries (with lower vehicle ownership) were those with the higher fatality rates.

But in the case of Zambia for the period 1964 - 74 a doubling of vehicle ownership level was accompanied by a 181% increase in fatalities per person and a 40% increase in fatalities per vehicle <sup>(23)</sup>.

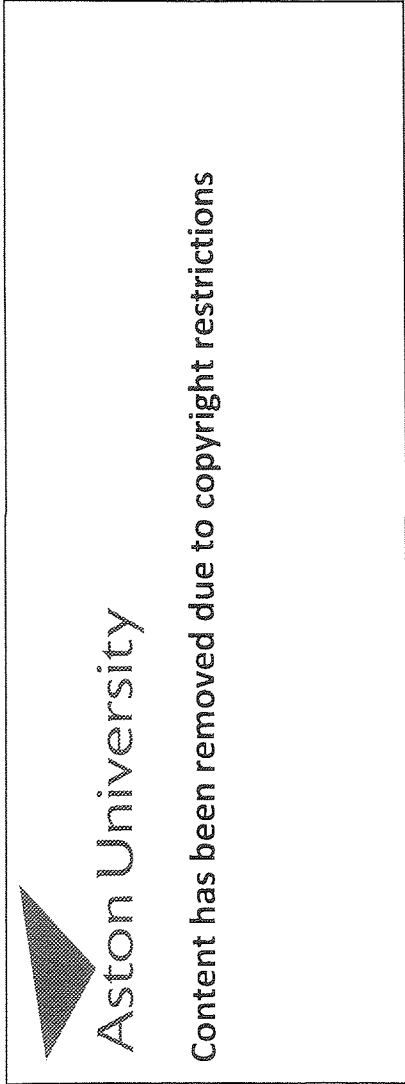


FIGURE 2.2 – RELATIONSHIPS BETWEEN FATALITY RATES AND LEVELS OF VEHICLE OWNERSHIP (1.4)

## 2.5. FACTORS AFFECTING ACCIDENT FATALITY RATES

It might at first appear reasonable to assume that as the number of vehicles increases in a country, the fatality and injury rates will also increase, since more vehicles imply that vehicle-vehicle, or even vehicle-pedestrian conflicts become more likely. However, it was shown in Figure 2.2 <sup>(14)</sup> that there is a tendency for the number of fatalities and injuries per vehicle to fall with increasing ownership. Reasons for this tendency were put forward by Garwood and Munden <sup>(18)</sup>, in 1968. They showed that in GREAT BRITAIN, whereas the total number of casualties per vehicle-mile travelled fell over time, the rate per vehicle-mile for drivers of cars, other four-wheeled vehicles, motor cyclists and pedal cyclists actually rose. The reasons suggested for these were :-

- (A) Riders and passengers of two-wheeled vehicles have much the highest casualty rates per mile travelled, but over time they become a decreasing proportion of the total traffic.
- (B) Pedal cyclists and pedestrians travel are not included in the assessment of casualties per motor vehicle mile, but their casualties are not increasing at as fast a rate as the total of casualties.
- (C) The number of pedestrian casualties per motor vehicle mile for the different classes of vehicle is falling.

Thus, the decreased rates per vehicle over time in most countries could be due to the fact that vehicles with the highest accident rates are decreasing in numbers, and that pedestrian accident rates per vehicle of various kinds are also decreasing possibly because of pedestrianisation of central shopping areas, and also better pedestrian-crossing facilities. Using data from a number of developed countries, Professor Smeed <sup>(15)</sup>, was able to confirm that the above points suggested by Garwood do have a significant effect on changes in fatality and casualty rates over time.

As was seen earlier in (Table 2.2) KENYA, JAMAICA, ZAMBIA and NIGERIA showed an upward trend in fatality rates per vehicle over time, as opposed to the downward trend exhibited by most other developed and developing countries. Applying the reasons suggested by Garwood above to these countries, it is possible for example that the increases in fatality rates are due to rapid increases in motor-cycle ownership, or to the fact that pedestrian fatality rates are not falling as is the case in most countries.

## 2.6. HISTORY OF ROAD TRANSPORTATION ROUTES IN IRAN

The framework of the present highway system was laid down during the 1930's when government implemented a series of road development programmes. The first objective was to build roads linking the centres of the provinces to the

capital city. The fulfilment of this objective facilitated greater governmental control over the various parts of the country. Hence, Tehran became the hub of the transportation system, within easy reach of all sections of the state. Aside from this, nothing was done to develop the intra-regional road systems <sup>(24)</sup> .

World war II had a great impact upon the road and railroad systems of Iran. The allied powers paid for the damages to the government instead of repairing them. Consequently they were left in worse condition after the war than they had been before. In 1949 a group of engineers and economists under the Overseas Consultant Inc., made a complete survey of the economy of the country including the transportation and communication systems. Suggestions were proposed for the development of the transportation system, but the government, due to economic difficulties, curtailed the entire development programme.

In 1955, the programme was resumed and the development of roads and highways became one of the objectives of a seven year plan. In that year a total of 110 million dollars, 32% of the entire government expenditure, was set aside for the purpose of transport and communication development.

The economic history of Iran is largely the story of the opening of its vast area by various forms of transport, resulting in economic growth, which, in turn, stimulated the demand for transport.

Iranian transport did not evolve through the stage of animal-drawn carts, partly because of the great distances over uninhabitable terrain involved. This meant that the country had the advantage of jumping the stage of technology between animal loading and the modern motor vehicle. Thus roads were not developed until the advent of motor vehicles in the 1920's and 1930's. Actually, only since World War II has the country been served by an adequate, network of all season roads for truck and passenger traffic. By the end of the first plan period (1955) Iran had 34,060 Kms of road, or one kilometer per 48 square kilometers, but of this only 116 kms were paved with asphalt. At the present time, the total road system covers 42,775 kms of which 12,060 are hard surfaced. Practically all parts of the country are now linked by roads to the capital, although the concentration of roads is much heavier in the north and west than in the south and east.

#### 2.7. ROAD SAFETY AND ROAD SAFETY PROBLEMS IN IRAN

The rate of road accidents in Iran is quite high by world standards, the average number of fatalities (people instantly killed at the scene of accident) in Iran in 1974



having been 10 per day and injuries well over 70 a day, in a vehicle population of half a million (25). Although the standard of drivers conduct leaves much to be desired, it may be recognised that highway driving in Iran is still in its infancy. Almost all asphalt roads having been built in the past decade.

The great majority of drivers have only a few years driving experience behind them. According to the director of the division, road accidents are being tackled on the following fronts :-

(1) Signs and road marking improvements

From about 1973 the Ministry of Roads and Transportation of Iran decided to switch from the American AASHO system of road signs to the European/International system laid down in the U.N. Convention on Road Traffic Signs and Signalization, Vienna 1968. The new signs were introduced first on main roads, and now they are moving on to the secondary roads as well.

Road construction contractors were required to install road signs themselves, whereas until 1974 this was left to the Ministry of Roads people, making for delays and poor implementation. The Ministry of Road district officers are sometimes entrusted with reviewing and maintaining the signs on secondary

roads, but in general the director prefers to have his own teams install the signs whenever there is any question of skill or judgement involved.

(2) Better road construction standards

(3) Enforcement of traffic regulations

This depends primarily on the availability of qualified manpower in the police and Gendarmerie. More road-side police check-points are being built on main roads. Tachographs (speed-recording devices) have been installed in buses by order of the Ministry of Roads traffic and transport supervision division, and will soon be compulsory for trucks as well.

(4) Driving tests to obtain a first licence

The police organize a three stage test;

- (a) Medical
- (b) Written, and
- (c) Practical

It appears that enforcement and control of licences is entirely the responsibility of the police.

(5) Analysis of accident statistic

General accident statistics are available from 1972 but in detail from 1977 only. To obtain any of this information involves a lot of digging into old police files and progress has been very slow. There is, therefore no systematic feedback as yet that could provide guidance for strengthening weak points in either sign posting, enforcement or the driving test.

(6) Lack of certain traffic regulations produce a serious safety hazard.

An example are the bus companies in passenger road transport as several bus companies can vie with each other for the same route and schedule. They actually race to arrive first and pick up waiting passengers at the next stop. This practice has persisted despite the introduction, by government order, of speed-recording devices in every bus, which the highway police are supposed to check at every weighing station check point. The licencing of routes to bus operators would overcome this problem.

Another extremely serious danger is that drivers stay at the wheel for excessively long periods at a stretch with very inadequate rest in between. A regulation covering the number of hours a driver is allowed to drive would prevent this.

Many other safety problems remain unsolved or are settled in an unsatisfactory way due to lack of adequate regulation governing the technical condition of vehicles or providing for the systematic elimination of unfair practices.

## 2.8. SOURCES OF ACCIDENT DATA

Reliable data is required in order to gain an accurate picture of the situation.

There are different sources of accident data for different types of study, but there are four main sources.

### (a) Road traffic police

(i) Urban road traffic police who are part of the national police but deal only with a given urban area.

(ii) Highway road police who are part of the military special division of the Gendarmerie. But deal only with inter-urban roads.

### (b) Insurance companies

Although third party insurance is compulsory, many people drive uninsured so information here are underestimated. Also one would have to collect information from all the companies that is extremely time consuming.

### (c) Emergency hospitals

Again each hospital keeps its own records so to obtain any accurate data of accident casualties would be extremely hard and time consuming.

### (d) Garages

There are so many private and company garages that it is not feasible to collect information (there is no centralised accident information).

In addition, data may be collected by an experimenter in the laboratory or at the scene of accident.

Unlike most developed countries, Iran does not have any centralised accident records and this makes data collection on large scale extremely difficult and time consuming.

In some countries the records are held by the Ministry of Roads and Transportation, or the Road Police or a National Statistical Bureau. For example, Great Britain, all the official road traffic accident statistics are compiled from informatory collected by the road police and forwarded to the D.O.E. 'STATS 19' form. Only accidents involving injuries are collected as the law only requires drivers to report these accidents. Thus large scale data collection is automatically carried out using this system in Great Britain. But a similar system does not operate in Iran.

Table 2.5 shows fatal and serious injuries rate per 100,000 population by class of road users and age group of Great Britain 1971.

In Great Britain, to obtain any damage accident information one must look in insurance companies file. The most reliable sources of information would be the urban traffic police, or the highway police, depending on the type of data required. Unfortunately, in Iran up to present

TABLE 2.5

Fatal and serious injuries rate per 100,000 population by class of road users and age of GREAT BRITAIN 1971. D.O.E. 1973 (10) .

CLASS OF ROAD USERS



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much of this data is kept confidential and comparatively little analysis has been carried out either by the police or other organizations.

In order to obtain any data from the police, there are a large number of stages and 'official channels' involving giving detailed explanations at each stage, which is both arduous and time consuming. A more direct route is via the Minister (or Deputy Minister) of Roads and Transportation who have access to data, although this is usually in a crude, general form, not the actual detailed accident report sheets.

The author had to bear the expenses and time of this type of delay going to the Ministry, then the police, then back to the Ministry. The result of this was the acquisition of some very rough statistics on accidents on the stretch of highway between km100 and km300 on the road from AHWAZ TO KHORAMSHAHR, with no indications of the actual accident locations. For this reason, it was necessary to design a method of study to more accurately locate accidents and to collect more usable data.

## 2.9. ACCIDENT DATA COLLECTION

Road accidents are defined as the interaction of one or more vehicles with other people, animals, vehicles, or fixed objects as to cause injury and/or damage to property (37). Three elements are essential for road accidents are shown in Diagram 2.1.

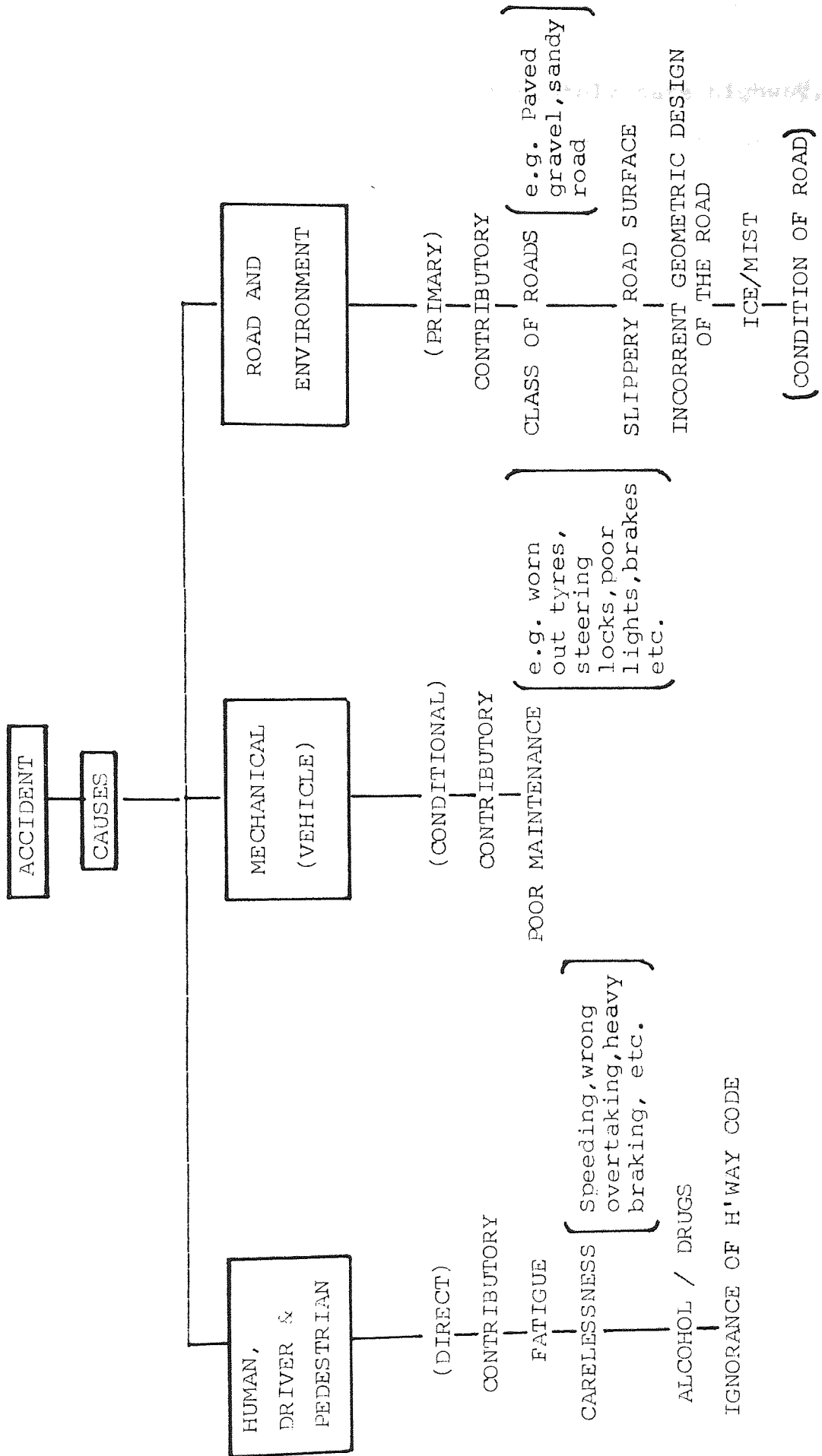
Using this diagram, it can be seen that road accidents are a complex phenomenon and to identify the causes of any one accident many experts from different academic fields, and a lot of time and facilities are needed. The highway police and the highway authorities are likely to have different attitudes to accidents, since the police will always try to isolate the human element, yet the human element is only one factor, and passing a deterrent sentence on a driver will not solve the problem. We must take the driver as he is, not as we would like him to be. The driver is one element as far as the accident is concerned. He is full of physical, emotional, moral limitations and imperfection and we must weed out those drivers whose ability to drive in a proper and safe manner is not up to standard.

The highway authorities usually try to isolate the road element.



DIAGRAM 2.1

The three contributory causes of road accidents.



There is no such thing as an absolutely safe highway, any more than there is an absolutely safe vehicle or entirely safe human behaviour.

Reduction of accident losses can be sought in modifications to the environment, to the vehicle and to human behaviour.

However, in most developed countries information which is collected by their road police takes the form below :

- (1) Time and date of accidents are recorded.
- (2) Environmental situation, such as lightness, darkness, slippery road, etc.,
- (3) Types of collision;
  - (a) vehicle/vehicle
  - (b) vehicle/pedestrian
  - (c) multi vehicle
  - (d) vehicle/stationary obstacle
- (4) Casualties of road traffic accidents;
  - (a) number
  - (b) sex
  - (c) severity
  - (d) age
- (5) Road conditions;
  - (a) road marking and signing
  - (b) geometric design of the road, junction, main road, dual carriageway, condition of pavement, and road side facilities.

One of the most important facts of all is that in most developed countries, accident locations are recorded although this method depends on the country's road numbering system. For example :-

- A. In countries which have one type of road numbering system, and all the roads have fixed distance signs for identification of the location of accidents, first the number of the road is recorded and then the distance of the accident location to the nearest distance sign, such as A34, 83.3 mile.

This method is also used for studying the conditions of a road at different points for recording on a computer system.

This is one of the most advanced methods for identifying accident locations with a view to long term solution.

- B. The second system of accident location recording is to use maps of the road with a scale of 1 : 100,000 or 1 : 150,000 and using a co-ordinate system for accident location recording.

This system is used in Ireland and gives about 87% accuracy, according to the B.C.E.O.M. research team (26). Therefore, accident locations could be identified with less than 200 metre error.

## 2.10. ROAD ACCIDENTS ON RURAL ROADS IN IRAN

According to 'Atkins' report (6), it was stated that usually there are more casualties as a result of road accidents on rural roads than urban roads (e.g. in Sweden in 1973 there were 1093 deaths as a result of road accidents of which 732 occurred on rural roads).

But the situation for the same year, 1973, was different in Iran. There were more deaths on urban roads than rural roads (e.g. there were 3420 fatalities as a result of road accidents on which 2079 were on urban roads).

However, the overall balance between urban and rural areas in a country will affect the percentage of accidents in each.

Therefore, one conclusion that can be drawn out of the above information is that in developed countries there are more casualties as a result of road accidents on rural roads than urban roads, while in developing countries the opposite is true.

This is possibly because in urban areas, pedestrianisation of central shopping centres, and better pedestrian crossing facilities, mean that people are less exposed to road accidents in developed countries than those in developing countries. Consequently, less people are killed on their urban roads in developed countries.

## 2.11. THE IDEA OF AN 'ACCIDENT'

The common meaning of 'accident' is 'an event without apparent cause; unexpected event; unintentional act; chance mishap.....' (Oxford Dictionary).

In IRAN, accidents are defined as an 'Act of God'. If for example in accident somebody dies as a result of that accident, it would be classified as an act of God, and by accepting this definition, the relatives of the victim would suffer less pain and grief. This probably is a very good excuse for the government officials to sit and do little towards road safety in the country.

## 2.12. MEASUREMENT OF EXPOSURE

It is important to take exposure to the hazard into account for comparisons of traffic hazard in different areas or at different times or to different classes of road users.

Instead of using simply themselves of casualties or accidents, a number of different measures of exposure are currently used and are described by the Institute of Traffic Engineers (1965), Department of Scientific Research (1963) and Johnson and Garwood (1971) <sup>(27)</sup>. The rates most commonly used are :-

- (a) Casualties or accidents per head of population
- (b) Casualties or accidents per mile (or kilometer) of road
- (c) Casualties or accidents per vehicle-mile (or vehicle-Km)
- (d) Casualties or accidents per vehicle.

The amount of exposure differs for each measure mentioned above. Casualties per head of population is the measure usually used to describe pedestrian casualty rates although it does not take into account possible differences in vehicle numbers or kilometers driven <sup>(10)</sup>.

Casualties or accidents per unit road length can only be validly used for comparative purposes when traffic flows on the lengths being compared are similar. The composition of the flow should also be similar. The most widely used basis for comparison is the rate per vehicle-kilometer.

Accidents or casualties per vehicle-kilometer takes into account traffic volume and the kilometers driven. They are used for comparison of different road types and vehicle classes and also for comparisons between countries, although caution is needed when making such comparisons for reasons below. At intersections, it is meaningless to consider accidents per vehicle-kilometer, since the distance over which such a rate is being calculated is virtually zero. Thus, a better description of the accident rate is obtained by simply accidents per vehicle entering the junction.

Accepting the exposure measure currently used, Hadden (1964) <sup>(28)</sup> pointed out two important aspects in their use. Firstly, the kilometers driven by each class of vehicle were calculated from fuel usage and the average consumption rate by the different types of vehicle. It is thus inappropriate to apply rates calculated on such a gross scale to local conditions where the quality of the exposure may differ considerably from the average. Secondly, vehicle occupancy rates differ for different types of road, at different times of day and for different classes of vehicle. These variations make casualty rate comparison more liable to error.

A serious difficulty encountered in making comparisons between countries arises from the different definitions of traffic accident fatalities employed. Table 2.6 shows some definitions used.

TABLE 2.6

Traffic accident fatality definitions for various countries (5),  
(10).

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Using the data in Table 2.6, it can be seen that the definition of a traffic accident fatality used in U.S.A. is death within 1 year of the accident, while in Belgium it is defined as death at the scene of accident. Therefore, comparison of traffic accident fatality rates of these two countries is difficult.

Iran defines a traffic accident fatality as death occurring at the scene of accident (people instantly killed). Therefore, it is difficult to compare Iran with the U.S.A., U.K. or Australia, as Atkin's (19), attempted.

Further more, people within Iran are differently exposed to road traffic accidents. Some people live as tribes and do not have anything to do with vehicles or roads, but others live in populated areas through which highways pass and therefore these people are more exposed to road accidents than the people in other parts of the country. Also lack of central shopping area in urban also make even more people exposed in urbans to road accidents than rural areas. Since there are no records kept of this differential exposure to accidents in Iran, it is difficult to make a comparison of road traffic accident rates in Iran with other countries where there is a more even distribution of likelihood of exposure across the whole population.

## 2.13. COST OF ROADS ACCIDENTS

Before studying any road accident cost in Iran let us look at some work that has been carried out in developed countries.

In 1971 in the U.S.A. the estimated cost of motor vehicle accidents was over  $\$1.5 \times 10^{10}$  (National Safety Council) <sup>(29)</sup> and in 1970 in U.K. was over  $\pounds 3.4 \times 10^8$ . In the calculations of accident costs, there are a number of aspects which must be considered, including :

- (a) Loss of output of the victims
- (b) Cost of medical treatment
- (c) Cost of vehicle and property damage
- (d) Administrative costs
- (e) Subjective costs

There has been almost no cost analysis of accident data carried out in Iran up to the present date, but in the U.K. four studies have been made to calculate the cost of road accidents. The earliest one was by Jones (1946) <sup>(30)</sup> using data for 1938. This was followed by Reynolds (1956) <sup>(31)</sup> and by Damson (1967 ; 1971) <sup>(22)</sup>. The absolute costs placed on accidents by different authors are of little interests since comparisons are made difficult by the conversions needed due to price and wage rises. It is the methods which each used in arriving at this final cost which are more useful.



Jones (1946) <sup>(30)</sup> did not break his calculation down into the sections listed above but considered only compensation for personal injury, damage to and repair of property and administration costs. The figures included for compensation for injury were based upon court awards. The effect of this method is to consider only the more serious injuries and then to use a non-representative value for these since court awards tend to be skewed in their distribution. He tried not to include any contribution for pains and suffering as this can be difficult since damages are often intended to include such factors.

Reynolds (1956) <sup>(31)</sup> used basically the same system as that of the government but used 1952 costs.

Dawson (1967) was the first of the British authors to make any allowance for the non-pecuniary losses resulting from an accident. Thedie and Abraham (1961) <sup>(32)</sup>, in a French study, added in about £2,000 per fatality for effective losses including pain and suffering, compensation and other factors. Dawson considered in 1963 values of £5,000 per fatality and £200 per serious injury accident.

Thorpe (1963) <sup>(33)</sup> reports that, based on insurance claims and on minor accidents not involving claims, the cost of accidents in the state of Victoria, Australia was about £25 x 10<sup>6</sup>. The true cost would be considerably higher if subjective costs were included.

Furthermore, the latest work carried out on the costs of road accidents in Great Britain was in 1980 for the year 1977 by Barbara E. Sabey and H. Taylor <sup>(34)</sup>. They found out that in Great Britain in 1977 there were 6,600 deaths, 81,700 serious injuries (usually requiring detention in hospital), and 259,770 lesser injuries reported in the police statistics. It is known that injuries are underestimated by probably 30 percent. In addition, it is estimated that at least another 1½ million non-injury accidents were reported to insurance companies and an unknown number of accidents do not appear in any statistics. The cost of these accidents to the community has been fairly reliably assessed at £946 million in resource costs, damage to vehicles and property (Over half the total), and costs of the police, and administration of accident insurance. (See Table 2.7).

Over and above these costs are the costs of pain, grief, and suffering to the involved person, to relatives and friends. These are very real costs to society but are by their nature not directly quantifiable in monetary terms. In recognition of the relevance of these losses, current practice in Great Britain is to include what can only be regarded as a notional minimum allowance for subjective costs, which total £347 million, and averages £25,880 per fatal accident. However, a recent appraisal of these figures <sup>(35)</sup> suggests that they are not in line with general principles of costs

benefit analysis. A survey of studies where researchers have attempted to evaluate how an individual values risk has revealed figures for value of life between  $2\frac{1}{2}$  and 10 times this average. It is also true that U.K. accident values are consistently lower than those of other countries.

TABLE 2.7

Costs of road accidents in Great Britain in 1977 (35).



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Furthermore, it is difficult to calculate the lost output of a person in developed countries, because of the way computers and robots are doing people's work in different industries. In some ways, it is possibly less costly for some developed countries to lose these people - unemployment is high so these deaths allow other people to take their places - whatever happens it means that the state has one less person to support.

The cost of road accidents in Iran is extremely high, because the majority of people at risk as car occupants in Iran are the very people most valuable to the community. Such casualties include professional men, senior civil servants, doctors and technical men; these people most useful to the economic development of the country. In 1978 in one fatal accident on the road from Abadan to Mahshahr the only professor of heart surgery in the country and 3 other doctors specialising in heart and brain surgery died instantly. These were professional people who were desperately needed by this country and even the world. However, how much value could be put on these people's life? £1000, £5000, £100,000, or a million pounds?. Most senior professional Iranians have been trained and qualified in different developed countries and the cost of this is paid by the person's family. The time taken for a medical doctor to qualify after finishing his high school would be about 10 years in language school and university.

If the family's investment is £5,000 per year then after 10 years the total would be about £50,000.

For the family to benefit from this outlay, the person who has been educated needs to be paid a high salary on commencing work, and this happens because there are so few qualified people produced in this way on private finance. Consequently if one of these people is killed in a road accident, the cost is very high because of the investment during training and the loss of future output.

When considering damage to vehicles only it must be remembered that vehicles are very expensive in Iran. For those imported from abroad, the import duty is about 300% of their original value. For example, if a vehicle is worth £5,000 from its factory (such as Mercedes - Benz) another £15,000 would be paid for its import duty and import tax. Therefore a car would cost about £20,000 and H.G.V.'s range from about £30,000 to £60,000.

These are some indications of the extent of damage from road traffic accidents in Iran. However, due to lack of detailed data about casualties and damage to properties, therefore, it is very difficult to estimate the total cost of road accidents in Iran. Furthermore, according to the National Insurance Co. of Iran, there is a loss of 300% per year due to vast number of road accidents.

## 2.14. CONCLUSION

The review of the literature shows that lack of detailed data about road accidents in developing countries make it very difficult to find out about the true picture of the accident problems in those countries. However, on the basis of the available information some of the main differences between road accident problems in developed and developing countries are listed below :-

- (a) In many developed countries it was shown that over the years, as vehicle ownership increased, fatalities as a result of road accidents decreased. However, in many developing countries, as the vehicle ownership increased, the number of fatalities as a result of road accidents also increased. (See Section 2.3)
- (b) Fatalities - various countries have different definitions of death as a result of road accidents. Some consider it as the result of an accident if the victim died on the spot, (e.g. Belgium); some if the victim died within 24 hours (e.g. Spain), some if the victim dies within 3 days or 7 days of the accident (such as Austria and Italy respectively), and some if the victim dies after one year of the accident (e.g. U.S.A.) (See Table 2.6)



- (c) In most developed countries, the number of fatalities resulting from road accidents is less than for rural roads. However, in developing countries, there are more fatalities as a result of road accidents on urban roads than on rural roads. This could be because developed countries have pedestrianisation of central shopping areas, and also there are better pedestrian crossing facilities. Therefore, less people are exposed to the possibility of road accidents in urban areas, whereas in developing countries there is a lack of pedestrian crossing facilities in urban areas and there are very few large pedestrianised shopping centres (See section 2.5)
- (d) In most developed countries accident data collection on a large scale is automatically carried out, as there is a central organization collecting all the information about accidents (e.g. T.R.R.L. in G.B.) However, in developing countries, road accidents are a relatively new problem as there is a lack of such an organisation. This makes it very difficult to obtain all the data relevant to a road accident (e.g. police records, hospital records, etc.)
- (e) Lack of data about road accidents makes it very difficult to carry out any cost analysis about the time extent of the road accident problem in developing countries. However, it was shown that most developed countries have fairly reliably estimated the total cost of road accidents for the whole country (e.g. Great Britain - £946 million) <sup>(35)</sup>.

## 2.15. STRUCTURE OF THIS THESIS

The structure of this thesis is based on a general study of road accident analysis and prevention in different developed and developing countries in the world, and in depth analysis and study of the road accident problems on rural roads in Iran, with specific reference to the selected study road of ANDIMESHK - AHVAZ - KHORAMSHAHR, which is 280 kilometers long.

The thesis is presented in 8 Chapters as below :-

1. Introduction
2. A Review of the Literature
3. Selection and Description of the Study Road
4. Accident Data Collection and High Accident Rate  
Location Identification
5. Accident Data Analysis of AHVAZ - KHORAMSHAHR  
road
6. Accident Data Analysis of AHVAZ - ANDIMESHK  
road
7. A Comparison of Accident Data Analysis of  
AHVAZ - KHORAMSHAHR and AHVAZ - ANDIMESHK road
8. Discussions and Recommendations.

CHAPTER THREE

SELECTION AND DESCRIPTIONS OF THE STUDY ROADS

### 3.1. SUMMARY

This chapter explains briefly about the difficulties and reasons for choosing of the roads selected in this study. It then gives a general description, construction history, facilities for road users and some photographs of the roads. Also included is traffic volume, types of vehicles using the road and their accident rates.

Finally, the conclusion is a comparison of the two roads which were selected for this research.

### 3.2. INTRODUCTION

For better understanding of the rural road accident problem a typical Iranian rural road was needed to carry out in detail investigation of accidents and high accident locations. To obtain such a road and to have access to the area and all the relative data the Minister or his Vice Minister agreed to provide the road, all the necessary facilities and permission to have access to it.

Unfortunately, confusion and lack of understanding of the road safety problem among the ministry's officials caused a lot of trouble and inconvenience for the author and spending many weeks in argument with the officials in an attempt to convince them of the importance of the research. It was

finally decided to study the road (described later in this chapter) but no necessary facilities were provided at all, such as transportation to the study area which was 1200 kms away from the author's home in Tehran.

### 3.3. SELECTION OF ROADS FOR STUDY

To carry out the research a typical section of a main rural road, which has most of the features that many rural roads of Iran have, had to be selected. Features such as main roads going through populated areas with high numbers of accidents, light and heavy duty vehicles using the road, etc., were selected, in order to study in detail the problems which cause accidents. A road for which all possible accident data had been collected previously by the highway police and a road with easy access for field observations.

Iran is a very large country and roads stretch about 2000 kms to the south and 1500 kms to the north - east and north - west from Tehran.

Therefore, the author had either to stay in the district or travel to the study road every time field observations were needed. Staying in the district was not possible because data about rural road traffic accidents

are kept in the Head Office of the Tehran Highway Police. Office facilities and most importantly, accommodation was in Tehran. The study area had to be close enough to Tehran for external supervisor to supervise the research.

Finally, the road chosen by the vice minister was ANDIMESHK - KHORAMSHAHR road about 1200 kms from Tehran.

#### 3.4. DESCRIPTION AND LOCATION OF THE STUDY ROADS

The study road is located in the South - West of Iran and is divided into two sections :

- (a) Northern Section  
AHVAZ - ANDIMESHK, and
- (b) Southern Section  
AHVAZ - KHORAMSHAHR

It was felt that this road was a good choice for a number of reasons :

- (a) The two sections are similar in length
- (b) Both sections are single carriageway
- (c) Both sections carry almost the same numbers and type of vehicles
- (d) For comparative reasons one section of the road has recently been repaved and its signs and marking improved.

The total length of the road is 280 kms and it links the port of Khoramshahr to most other parts of the country. About 40 - 50% of Iran's trade is handled at this port, and most of the goods are transported along the study road alone. Consequently, it is an important major road linking the port of Khoramshahr to its hinterland. Figure 3.1 shows the location of the study road.

### 3.5. DESCRIPTION AND FEATURES OF AHVAZ - ANDIMESHK ROAD

Very little information about this road existed in Tehran, even in the Ministry of Roads Head Office. After an exhaustive search through the old files of the Ministry and after a visit to the road, the following description was compiled.

AHVAZ - ANDIMESHK is supposed to be a single carriage-way of 7.3m width, but in many sections it is less than 6m wide. For example, at 80 km from Ahvaz. The total length is about 150 kms. This road was designed and built by the Italian firm SAOTI about 30 years ago and very few improvements and changes have been made since. The pavement condition is very poor and there is a lack of road-signs and road markings. Those road signs which exist are either incorrectly positioned or too dirty to show their meanings (See photograph 3.1.).

FIGURE 3.1

Location of the study road in Iran



Not to scale



PHOTOGRAPH 3.1

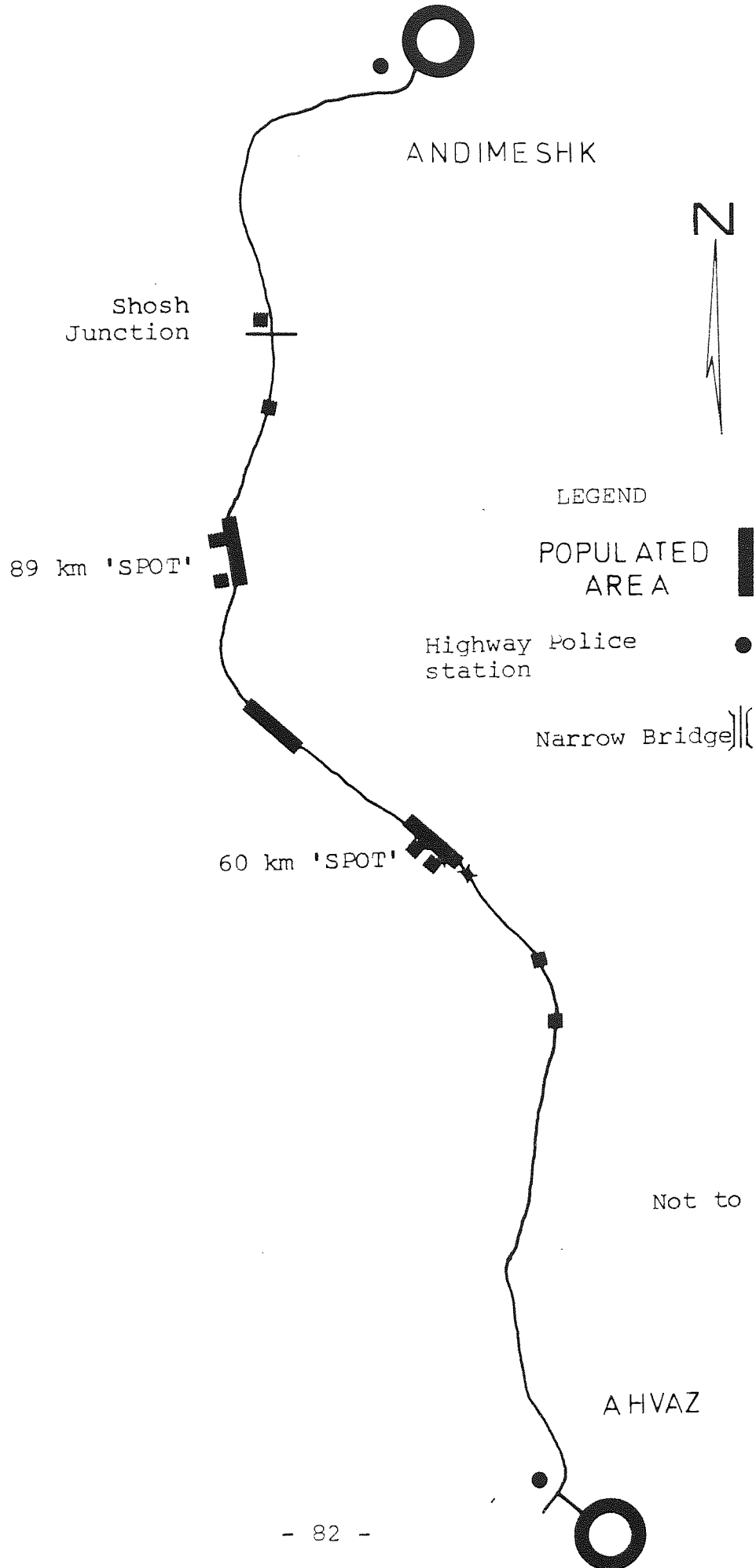
Shows part of the AHVAZ - ANDIMESHK road to illustrate the pavement conditions, road markings and road signings.



The study road goes through many populated areas for which no pedestrian crossing facilities exist. Large numbers of pedestrians share the main road with high-speed vehicles of all types. Road-side facilities for vehicles do not exist; for example strong crash barriers and entry and exit lanes. Many buildings are too close to the main roads. Plan 3.1 illustrates the AHVAZ - ANDIMESHK road.

PLAN 3.1

AHVAZ - ANDIMESHK road features



### 3.5.1. TRAFFIC FLOW AND ACCIDENTS RATE

Detailed traffic account were made between 1960 and 1962, but were given up thereafter, only to be resumed in 1971 - 1972. The agency responsible was the Ministry of Roads and Transportation.

Average daily traffic flow varies on this road and all depends on the import and export of goods through Khoramshahr port. The variation of the daily traffic flow was between 3000 to 8000 light and heavy vehicles per day in 1974. To be more accurate in 1974, the average traffic was 1,398 light vehicles and 2,335 heavy goods vehicles (trucks), a total of 3,733 vehicles per day and an annual traffic in millions of vehicles/kms of 204. (See Table 1.6 Chapter I).

In 1974 there were 104 fatal and serious injury accidents recorded and as a result 33 fatalities and 171 serious injuries (serious injured means required detention in the hospital). This gives a rate per 100 million vehicle/kms of 16.17 fatalities, 83.82 serious injuries and 50.98 fatal and serious injury accidents (See Table 1.6 Chapter 1). According to the Ahvaz emergency hospital, about 50% of injured die on the way to hospital or afterwards in the ward. If a record was kept of these later deaths it would put the fatality rate up to about 30 to 40 fatalities per 100 million vehicle/kms.

Comparing with the U.K. rate of fatalities per 100 million vehicle/kms of 3.81, the U.S.A. rate of 3.38 and the Australian rate of 6.06, the Iranian rate is almost 10 times more than for those countries. Therefore this is another of the justifications of this study.

### 3.6. DESCRIPTION AND FEATURES OF THE AHVAZ - KHORAMSHAHR ROAD

The only way to obtain useful information about this road was the same as for the AHVAZ - ANDIMESHK road, by making field investigation and observation during a few visits to the road.

This road is a single carriageway of 7.3m in width. The total length of the road is about 120 kms. This road was also designed and built by the Italian firm, SAOTI, about 30 years ago. Few alterations to its design or construction have been made since it was built, except recently its road pavement, signs and road markings have been improved by the Ministry of Road and Transportation. The pavement condition is generally in good condition except not much maintenance has been carried out on this road since it has been repaved. As in some locations where the road surface is covered with mud from vehicles arriving from dirt side roads onto the main road making its surface very slippery, especially when it is raining. In many laybys trucks waiting to enter the

port change their oil on the road side. This oil covers the road surface, and results in a slippery surface.

However, although there is adequate road signings and road markings, there is lack of care about their positioning. For example, as shown on photograph 3.2 the road sign stops drivers overtaking, whilst the road mark in the centre of the road contradicts this sign.

PHOTOGRAPH 3.2

Shows contradiction between road-signs and road markings.



AHVAZ - KHORAMSHAHR is a particularly straight road with only a few bends. Along some straights there is a 50 kms stretch between bends. This is very dangerous for a single carriageway.

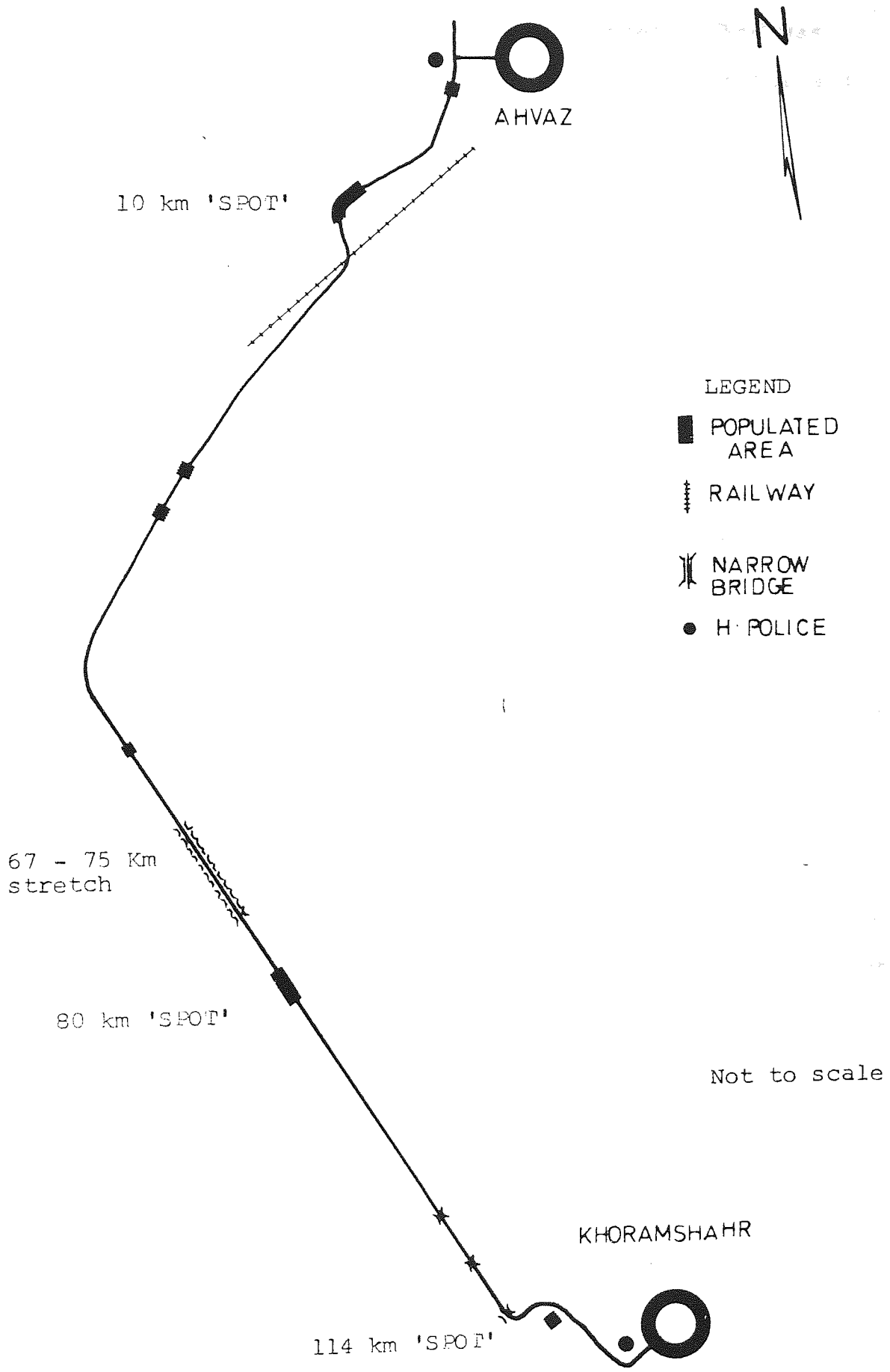
This road passes through 5 populated areas. In one of them a large number of pedestrians share the road with vehicles using the main road, because there are inadequate pedestrian facilities (See Plan 3.2 for illustration).

### 3.6.1. TRAFFIC FLOW AND ACCIDENT RATE

As it was explained in the previous section, the amount of traffic using this road varies according to the movement of goods in and out of Khoramshahr's port, because there is no organised system for the handling of goods. This is because sometime too much goods arrives to the port and must be distributed to the country in a short time, because if not the goods would go off or for other reasons. Therefore, many trucks are needed for the movement of the goods, and AHVAZ - KHORAMSHAHR road being the only road links the port to the rest of the country, the traffic flow rises suddenly. The traffic flow varies between 3000 to 8000 per day.

In 1974 the average daily traffic was 1,904 for light vehicles and 1,981 for trucks. The annual traffic in millions of vehicle/kms was 184 (See Table 1.6 in Chapter 1).

AHVAZ - KHORAMSHAHR road features



The accident rate per 100 million vehicle/kms was 7.6 fatalities, 70.65 serious injuries and 35.86 fatal and serious injury accidents. According to the Ahvaz emergency hospital, most of the injured die on the way to hospital or die later, whilst the above figures are only for fatalities at the scene of the accident.

By including the numbers of people who die later in hospital (about 50%) of the injured, this would increase the fatalities per 100 million vehicle/kms to about 20, which is almost 6 times more than fatality rate in Great Britain (19).

### 3.7. ACCIDENT DATA COLLECTION BY THE DISTRICT HIGHWAY POLICE

Up until 1977 most accident data collected by the highway police was crude and basic and covered the national accident rates only (e.g. the number of accidents and their classifications). In 1977 the highway police purchased some computer equipment and since then they have tried to collect more data about accidents.

It was thought that this additional data when analysed by computer would help solve many road accidents. As a result too much unnecessary data has been collected for a country such as Iran, where accident prevention is at an early stage of development, whilst the collection of basic data has been neglected. For example, data about the

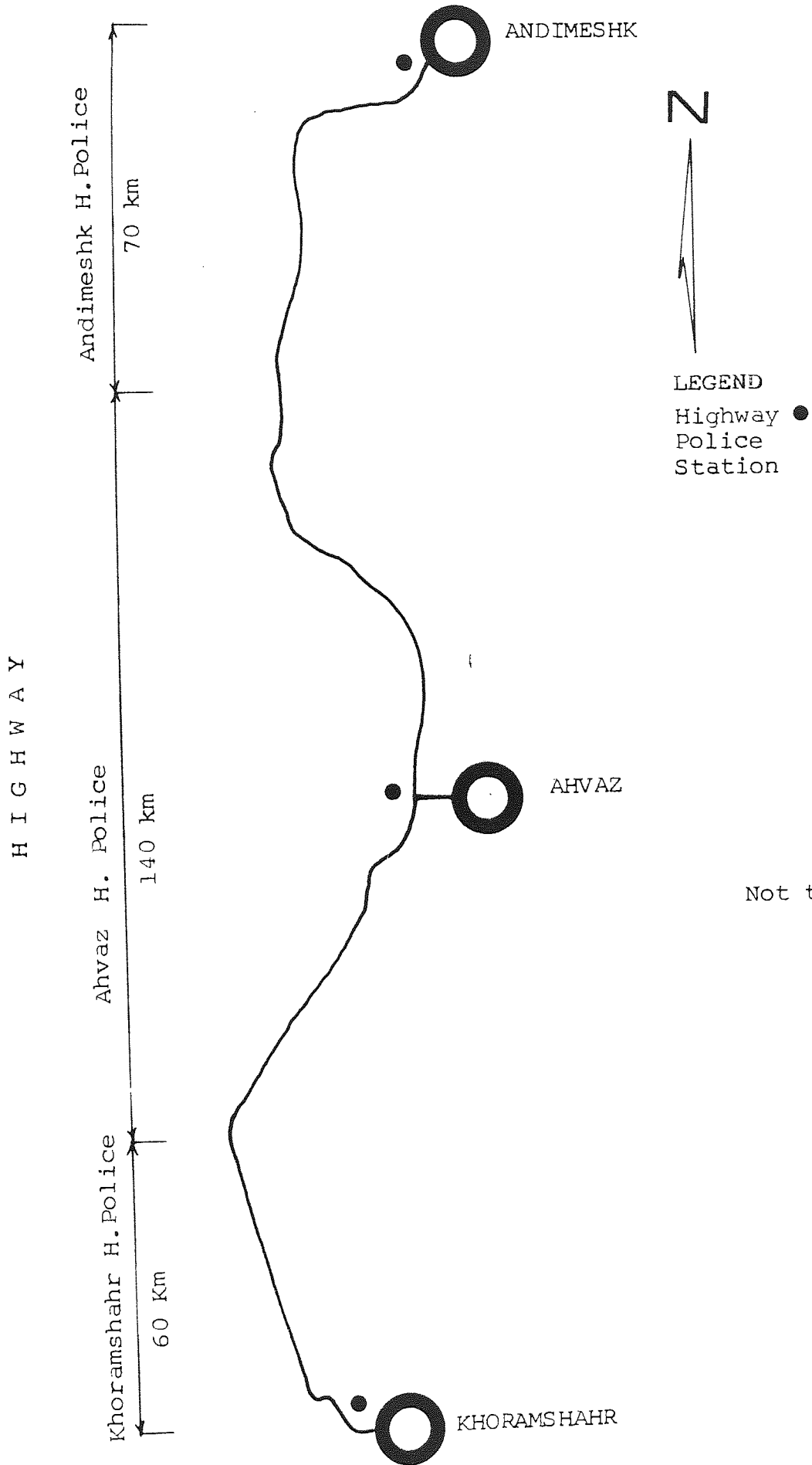


location of the accidents, the severity, sex, age of injuries incurred and mechanical cause of accidents have been neglected. In addition, although the data requirements of present accident record forms are important, the amount of detail required is too advanced for recording by one young police officers. It would require a team to collect this amount of information. In many cases, this leads to unreliable recording of accident data. For these reasons, only a sample of these data has been used for analysis in this study (See Chapter 4 for data collection). However, there are three highway police stations incharge of this study roads of AHVAZ - ANDIMESHK and AHVAZ - KHORAMSHAHR as below :

- (a) Andimeshk Station - from Andimeshk to Ahvaz up to 70 kms 'SPOT'.
- (b) Ahvaz station - from Ahvaz to Andimeshk up to 80 kms 'SPOT' and from Ahvaz to Khoramshahr up to 60 kms 'SPOT'.
- (c) Khoramshahr Station - from Khoramshahr to Ahvaz up to 60 kms 'SPOT'.

plan 3 illustrates the territory covered by these 3 stations.

Khozestan Highway Police Territory



### 3.8. CONCLUSION

Although it was very difficult and inconvenient for the author being 1200 kms away from the study area, but the roads were very good examples of road accidents, as many of the justifications could be varified. Comparisons could be made between the two sections of the study road. This is because both roads are very similar in many aspects e.g. traffic flow, types of vehicles, environmental conditions, etc., But one section of the road from AHVAZ to KHORAMSHAHR has been improved in its road pavement, signs, marking and hard shoulders. The other section from AHVAZ to ANDIMESHK has been hardly improved since it was designed and built about 30 years ago .

Given only a rough comparison for road traffic accident results between these two sections of the study road, it is apparent that the accident rate on the AHVAZ-ANDIMESHK road is almost double the number of accidents on the other section (Section 3.5.1 and 3.6.1.)

Consequently, the immediate conclusion and recommendation for any road safety development is that by improving road surface, signs, marking and hard shoulder widening almost 50% reduction in the number of accidents can be expected.

However, this will be discussed after the data analysis of the accidents in details in Chapter 5, 6 and 7.

CHAPTER FOUR

ACCIDENT DATA COLLECTION HIGH ACCIDENT RATE LOCATIONS IDENTIFICATION

#### 4.1 SUMMARY

This chapter describes some legal aspects of accident reporting, and the highway police system for reporting and recording of road accident data. It then explains the accident data collection by the author and accident data to be analysed to verify the justification of the study. Definitions and methods of identifying high accident rate locations on the study employed by the author is then explained.

#### 4.2 SOME LEGAL ASPECTS OF ACCIDENT REPORTING

The Road Traffic Act and Highway Code of Iran requires that a person driving or riding a vehicle involved in an accident which causes damage or injury to any other person, vehicle or any animal (horse, cattle, mule, sheep, goat) not in his vehicle, that person must:

- (a) Stop
- (b) Give his and the vehicle owner's name and the registration mark of vehicle to anyone having reasonable grounds for requiring them
- (c) If the driver or rider does not give name and address to any such person at this time, report the accident to the highway police as soon as reasonably practicable, and in any case within 24 hours
- (d) If anyone is injured and the injured person(s) needs hospital treatment, the driver or rider should ask for help from vehicles passing by, to report the accident to the highway police and/or emergency hospital
- (e) The vehicles and casualties should not be moved until the highway police arrives at the scene of the accident

However, in practice it is very much different as was found by the author during fieldwork (See Section 4.4).

#### 4.3 THE HIGHWAY POLICE SYSTEM FOR REPORTING AND RECORDING OF ROAD ACCIDENT DATA

Information collected by the highway police of Iran up to 1977 was mostly a crude and descriptive explanation of fatal and serious injury accidents but ignored the many other types. Also it was generally from too wide an area to give the necessary details for searching analysis.

However, Iranian highway police started to collect more detailed information (see accident form details) from 1977 with a view to computerization of data. This was hampered due to the fact that the Iranian road system did not have identification numbers, or distance markings. This meant that it was virtually impossible to give an adequate location in accident reports, and description of the location was only given for serious/fatal accidents. This rendered it difficult to identify high risk locations.

##### ACCIDENT FORM DETAILS

The form records the details of the accident as below:

- (a) Reference number
- (b) Type of accident (eg. fatal/injury/damage)
- (c) His police station number
- (d) Date and time of the accident
- (e) The vehicle which caused the accident
- (f) Collision type
- (g) Definition of the accident (eg vehicle/vehicle, vehicle/pedestrian etc)
- (h) Number and types of casualties (eg Driver, Pedestrian, Passenger etc)
- (i) Age and sex of the guilty driver only
- (j) Type of road (eg oneway, single carriage way, main road, bend etc)

- (k) Environmental conditions (eg. dry, wet, icy, etc)      *eg. of accidents*
- (l) The factor(s) which caused the accident (eg speeding, crossing the centre line, not keeping an adequate distance from the vehicle in front etc)

The above details should be accompanied by a sketch of the accident and a descriptive explanation of the accident.

However, the problem is compounded by the illegible handwriting of some of the traffic officers, and the different colloquialisms used for any given spot (people from different towns or villages may describe the same spot in different ways, and not be able to recognise the place from the other descriptions).

In order to overcome this problem, the author had to prepare an up-to-date plan of the road under study, including all the different local names for each point, bridges, villages, roadside facilities etc., any clues which aid more precise location of accidents (see section 4.5 for more details).

However, in the event of an injury accident, highway police officers are required to attend the accident at once and record the necessary information, and nothing must be touched or moved until he reports the accident to the district doctor and he comes to check the casualties before giving permission for their removal. Also he is required to inform the district ministry of roads so that they can repair any damage caused. He is further required to inform his head office about any injury accident within 24 hours. However, as the author found during the course of field work, in practice the situation is very much different and not all the above duties are carried out. Due to lack of

experts attending accident investigations, the precise cause of accidents cannot be determined - the police tend to concentrate on the human element in causation (even so, a lack of equipment means that such things as breathalyzer tests are seldom carried out). (See data collection for more information).

#### 4.4 COLLECTION AND SELECTION OF ACCIDENT DATA

In order to build up a complete and accurate picture of any accident, whether at a rural high accident rate location or elsewhere, a comprehensive study of the human, environmental, vehicular and medical factors resulting in and from the accident is necessary with such a study ideally being initiated at the scene of the accident and being followed up by interviews, medical examinations and the like. Such a study is lengthy and very expensive and was beyond the scope of this research.

All the available accident forms (about the nature and extent of the accidents) were studied in the head office of the highway police. It was found as stated previously that up to 1977 most data was not detailed enough for research purposes. From 1977 until 1979 more details were recorded from accidents but the accident forms were still not always completed. This was because the highway police were trying out a variety of different types of accident forms with different data to be collected each type only being used for a few months or so.

Consequently the author had no choice except to use the crude but more reliable data from the 1974-79 period, and to revise the data collection for the 1979-80 period with the co-operation of the Khozestan highway (eg. data such as accident locations on the study road, etc.)



Before selecting accident data for analysis, about a year of field investigation and observation was carried out with the KHOZESTAN highway police, and the major organisations responsible for road safety in the country were visited concentrating on organisations such as:

- (a) KHOZESTAN county hospitals (eg. AHVAZ hospitals, emergency J hospital etc)
- (b) AHVAZ Ministry of Roads and Transportation
- (c) Truck terminals and commercial vehicle driver union
- (d) GENDARMERI of KHOZESTAN
- (e) Insurance companies
- (f) KHOZESTAN local councillors

During "at-the-scene" studies of some of the fatal and serious injury accidents on the study road, it was found that the fatalities are underestimated due to lack of adequate road police officers and facilities (eg. vehicles to attend all the accidents, etc), also many of the injured will die unnecessarily due to lack of quick and reliable medical treatment, for example the author and the only highway police officer in charge were attending and investigating an injury accident at about 70 Km "spot" of AHVAZ-ANDIMESHK Road when they were informed by a passing vehicle about a fatal accident on the AHVAZ-KHORAMSHAHR Road. This was about two hours after the accident had happened. On the way to attend the accident there were two other serious injury accidents which the highway police had to stop and deal with. They finally reached the fatal accident about five hours after the event of the accident and this was fairly quick considering the road situation etc.

At the site of the accident, the scene was tragic, just like a nightmare. Bodies and pieces of human flesh were everywhere, mostly women and young people. This was a result of a single head-on collision between a mini-

bus and a truck with an estimated impact velocity of about 260 km ph.

Some of the casualties had been taken to the AHVAZ hospital by passing vehicles and what was left of the victims was fifteen bodies lying on the road waiting for the doctor in charge of the county and the highway police to come and give permission for their removal. (See photographs 4.1, 4.2 and 4.3)

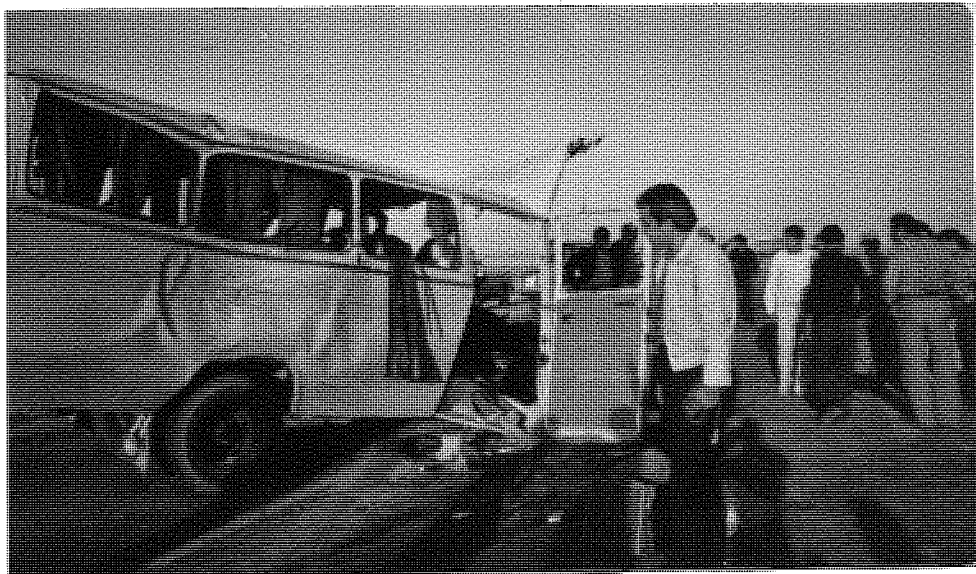
The highway police recorded the number of fatalities as those who were killed at the scene of the accident. To find out about the rest of the casualties the author visited AHVAZ emergency hospital. According to the doctor in charge of the hospital most of the seriously injured died on the way to hospital due to lack of doctors and medical facilities (eg. ambulances etc) and the rest of the casualties were so badly injured and badly handled on the way to hospital, that they would soon die, or be permanently paralysed. He also said that no record was made of these casualties and that nobody had even asked them to do so.

After 36 hours the author went to the scene of the accident and the bodies were still lying on the roadside and the doctor who was supposed to come immediately to the scene of the accident was not available since he was the only doctor and was busy with other work.

It was also found that doctors and medical facilities were not located where they are most needed (eg. near Tehran the capital too many doctors and medical facilities are provided, but in KHOZESTON there are not enough doctors so that in a serious accident such as this no doctors are available even two days after the accident). As a result many people have already or will die unnecessarily or be permanently crippled. Therefore the ministry

PHOTOGRAPH 4.1, 4.2 & 4.3

Show a typical fatal and serious injury accident investigated during this study.



of health should carry out a survey about what facilities and how many doctors are needed in each part of the country. However the author was not able to attend all the accidents therefore the data to be analysed are the highway police data, and the authors method of identifying the high accident rate location is employed. (See Section 4.6).

The accident data to be analysed are as below:

- (a) Accident and casualties statistics for the study roads.
- (b) Distribution of fatal and serious injury accidents along the study road
- (c) Vehicle/Casualties relationship
- (d) Casualties classification
- (e) The vehicle which caused the accidents and the types of accident collision
- (f) Causation factors of the accidents
- (g) Time of the accidents

#### 4.5 METHOD OF IDENTIFYING HIGH ACCIDENT RATE LOCATION ON THE STUDY ROAD.

##### 4.5.1 GENERAL DEFINITION OF HIGH ACCIDENT RATE LOCATIONS

At a "spot" or a section of a road, if the number of accidents is higher than the average number of accidents on the whole section, it is known as a high accident rate "Spot" or high accident rate section of a road.

One stretch of road can have one or more high accident rate "Spots" and/or one or more high accident rate sections. These locations change with changing conditions of the road (better or worse). However in general, there are two methods of identifying high accident rate location:

- (a) Numerical method
- (b) Statistical method

(a) Numerical method

This method only considers the number of injury accidents. This is because damage accidents are not estimated accurately and to use fatalities would be difficult because an injured person could die sometime after the accident, also to use severity of injuries as a measure would be difficult.

Therefore, if the number of injury accidents on a section or a "Spot" between two junctions on a road that have similar situations and conditions, is higher than the average number of accidents on the rest of the road, these locations are classed as high accident rate locations. (See section 2.12 for unit used).

(b) Statistical method

The statistical method of identifying high accident rate location is a better method because causes of accidents are taken into consideration.

On any one section of road between two junctions accidents are related to Poissons theory. For example if a section of road with no junction is considered from A to B the number of accidents which occur would be:

$$d \times L = d.L$$

d = Number of accidents in one km

L = Length of A to B in km

In practice the actual number of accidents would be different, because of the parameters related to Poissons theory ( $m_1, m_2$ ). Substituting the actual number of accidents would give about 90% of accuracy.

However, if  $d.L$  is less than  $m_2$  this location is a high accident rate and should be investigated in detail. (26)

#### 4.5.2 Identification of high accident rate locations on the study road

As explained in Chapter 3 and the previous section, there were little and inaccurate records of accident locations for the study road. However, the locations of some of the fatal and serious injury accidents were roughly described in the descriptive section of the accident forms.

This was not a failing on the part of the highway police, but was due to lack of recording facilities, and the road system in Iran not having adequate identification and referencing (eg. numbers etc) or distance signs on the roads.

Consequently, when the accident locations are not recorded, high accident rate locations cannot be identified, but for the purpose of this study the author must identify these locations.

Therefore with very little help and facilities (eg. lack of large scaled maps and plans of the roads, aerial photographs, manpower, transport facilities, financial support, surveying equipment and many many others), the author in two stages identified the high accident rate locations on the study road as follows:

##### (a) Stage One

In this stage the author prepared a simple plan of the study roads, at a scale of  $\frac{1}{50,000}$ . Then in the Head Office of the highway police in Tehran he studied all the fatal and serious injury accident forms related to the study road. (The author could only study the

forms in this office as no-one was allowed to take the file out).

Then all the details of the locations of the accidents were researched and checked and then recorded on the plan. For example, one of the accident locations was recorded as 40 km from Ahvaz to Khoramshahr next to a petrol station, but as it was found later by the author, the only petrol station on this road was located at 60 km "spot".

(b) Stage Two

After preparation of the new plan of the study road, in conjunction with the accident forms, the author was now able to understand the terms used by different police officers describing accident locations. Meanwhile a copy of the plan was left with the highway police of Ahvaz for the purpose of recording the location of subsequent accidents.

After about 6 months the locations of all the fatal and serious injury accidents were recorded on this plan of the study road (see Plan 3.1, 3.2). After this second stage it was clear which location had high rates of accidents. Consequently the author selected those locations for detailed analysis of accident data to find the causes of accidents.

CHAPTER FIVE

ACCIDENTS DATA ANALYSIS OF AHVAZ-KHORAMSHAHR ROAD



## 5.1. SUMMARY

This chapter analyses fatal and serious injury accident data for the AHVAZ - KHORAMSHAHR road for the year 1979 and identifies the high accident rate locations. It then analyses, investigates and discusses accident data for each high accident location, and suggests appropriate improvements to reduce the number of accidents. The maximum percentage reduction possible in the annual number of accidents is then estimated.

## 5.2. INTRODUCTION

It was explained in Chapter 4 that obtaining accident data from the highway police was not an easy task. This was because they did not appreciate that an analyses of this data would help to improve road safety. The first accurate details of accidents were not collected until the beginning of this research in 1978.

The author had to sift through data on accidents in a number of different offices of the highway police in Tehran, and different district highway police stations in Khozestan county. The author had to produce a plan of the study road since none was available. This was an extremely difficult task since the study road is 280 kms long, and no aerial photographs, large scale maps, or advanced equipment

were available. The road plan was researched as accurately as possible by the author walking and driving all along the road from Ahvaz to Andimesh (150 kms) and from Ahvaz to Khoramshahr (130 kms).

The plan shows all the up to date roadside facilities, populated areas, bridges, factories, cafes, lay-bys, etc., and all the visible factors which could be related to road safety (Plan 3.1 & 3.2). The use of this plan facilitated identification of accident locations for further analysis.

The next step required spending several weeks in the head office of the highway police in Tehran studying individual accident reports, finding their locations, (as previously stated most accident locations were descriptively explained with the local name of the location), and assessing the accuracy of the police report itself.

### 5.3. ACCIDENT AND CASUALTY STATISTICS FOR AHVAZ - KHORAMSHAHR ROAD FOR 1979

The results of the search of accident data at the head office of the highway police in Tehran, and of the AHVAZ - KHORAMSHAHR highway police records showed that a total of 255 road traffic accidents were recorded, of which 24 were fatal accidents, 14 were serious injury accidents

and 90 were serious damage accidents. Also there were 44 fatalities and 238 serious injuries as a result of road traffic accidents. (See Table 5.1).

TABLE 5.1

Accident and casualty statistics for AHVAZ-KHORAMSHAHR road in 1979,

Length In (kms)	Number of				
	Fatal Acci- dents	Fata- lities	Serious Injury Acci- dents	Serious Injuries	Serious Damage Acci- dents
120	24	44	141	238	90

NOTE : The figure for fatalities as a result of road accidents is that for immediate deaths. The serious injuries figure may include an indeterminate number of resultant, though not immediate deaths (e.g. en-route to hospital or in hospital). These are unaccountable from the statistics; as most casualties are immediately taken to hospital by passing vehicles and are not on the scene when the highway police arrive. Thus the police simply record them as injured.

The distribution of accident locations and casualties is described and illustrated as below :

### 5.3.1. DISTRIBUTION OF FATAL AND SERIOUS INJURY ACCIDENTS AND CASUALTIES

Using the same sources as before <sup>(17)</sup>, and illustration of the distribution of fatal and serious injury accidents and casualties was produced as follows.

Table 5.2 shows the number of fatal accidents and fatalities, at different locations on the AHVAZ-KHORAMSHAHR road for 1979.

Table 5.3 shows the number of serious injury accidents and number of serious injuries at different locations on the same road for the same year.

Figure 5.1 shows the distribution of fatal and serious injury accidents, diagrammatically along the AHVAZ-KHORAMSHAHR road for the year 1979.

Figure 5.2 shows the distribution of fatalities and serious injuries, diagrammatically, along the same road for the same year.

TABLE 5.2

Number of fatal accidents and fatalities on AHVAZ-KHORAMSHAHR road 1979.



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TABLE 5.3

Number of serious injury accidents and serious injuries on  
AHVAZ - KHORAMSHAHR road (1979).



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### 5.3.2. STUDY OF THE ACCIDENT LOCATIONS

Figure 5.1 highlights three precise 'SPOTS' (10kms, 80kms, and 114kms), and two general lengths of the road (68 - 75kms and 89 - 103kms), where accident frequency is high. All these locations needed to be closely investigated and their data analysed, but the only detailed data that could be obtained was for the 10kms and 114kms 'SPOTS' and the 68 - 75km stretch, for the 1979. However, the data from these locations were analysed in detail and discussed with a view to deriving the causes of the accidents in order to be able to suggest any improvements.

### 5.3.3. A COMPARISON STUDY OF DISTRIBUTION OF ACCIDENTS WITH DISTRIBUTION OF CASUALTIES

One would expect a comparison of Figure 5.1 and 5.2 to yield a positive relationship between number of accidents and number of casualties. This is generally true for 'SPOTS' 10km, 80km, and 114km, and stretches 68 - 75km and 89 - 103km, but there is one anomaly. At 'SPOT' 45km, there was only one accident, (in this case, the figures were for a high speed head-on collision between a mini-bus and a truck), but as a result, 13 people were killed and 7 were seriously injured.

This latter suggests that as well as looking at high accident locations, there are more factors to be taken into account. This type of accident can not really be explained

by a 'high accident location' hypothesis, no geographic/situation variable made this a particularly likely location for an accident.

For the purposes of this thesis only high accident locations with high frequencies of accident occurrence (NOT as in the SPOT at 45km, high injury/fatality) will be studied further.

#### 5.4. ANALYSIS OF THE FATAL AND SERIOUS INJURY ACCIDENT DATA FOR 10KM 'SPOT'

Data for the first six months of 1979 was obtained from the highway police in Tehran. After much sifting and weeks of search, the remainder was obtained from KHOZESTAN county highway police, since detailed accident records were not kept by the road police in Tehran. Using the data in Tables 5.2 and 5.3 it can be shown that a total of 47 fatal and serious injury accidents at the 10km 'SPOT' resulted in 10 fatalities and 58 serious injuries. The analyses of the accident data from this location for the year 1979 are as below :

##### 5.4.1. CLASSIFICATION OF VEHICLES AND THEIR ASSOCIATED CASUALTIES

Using the data in Table 5.4 it can be shown that, the 47 fatal and serious injury accidents involved 76 vehicles.

FIGURE 5.1

ASTON UNIVERSITY ROAD (1979)

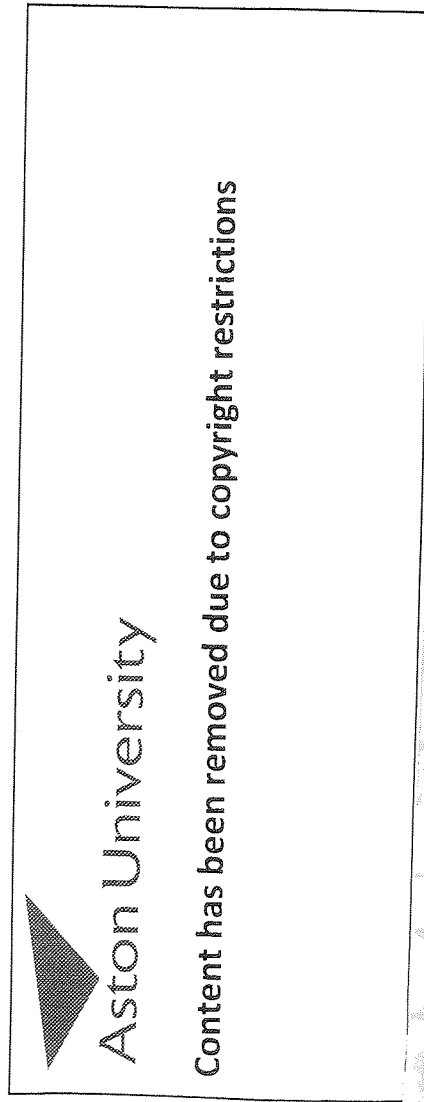


FIGURE 5.2

FATALITIES\* AND SERIOUS INJURIES\* ON AHVAZ-KHORAMSHAHR ROAD (1979)

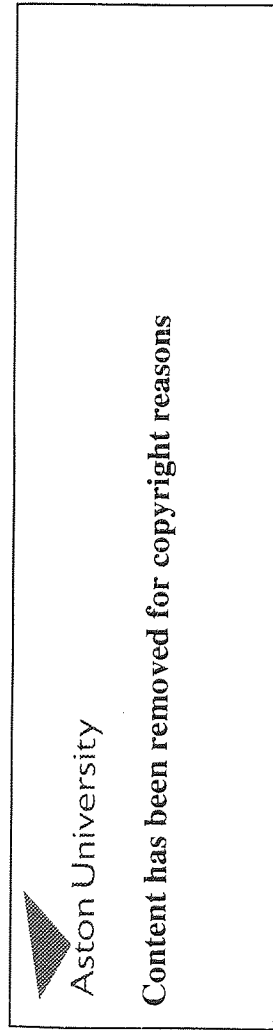




TABLE 5.4

Vehicle/Casualties relationship at 10km 'SPOT' of AHVAZ - KHORAMSHAHR road for 1979



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The percentage of cars is the highest, 40%, motorcycles 30%, vans 11%, trucks 9%, Mini-buses 5% and others 5%. There are no buses involved in accidents at this section. The highest casualty rate is 43% and is associated with cars. The next highest is 35% and is associated with motorcycles. 12% and 6% are associated with vans and mini-buses respectively. Strangely enough no casualties were associated with trucks.

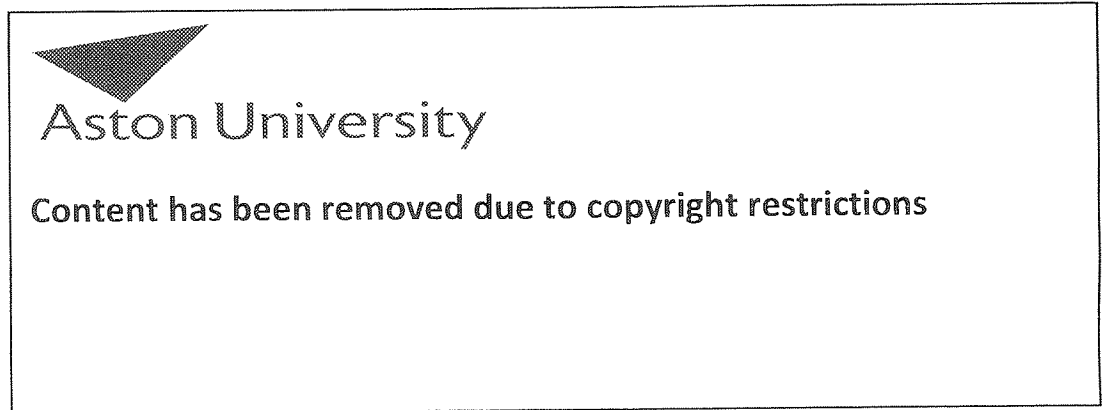
Using data in Table 5.4.1, it can be shown that 90% of the fatalities were pedestrians and 10% were vehicle passengers. 67% of the serious injuries were vehicle drivers (two and four wheeled vehicles), 26% pedestrians and 7% vehicle passengers.

#### 5.4.2. TYPES OF VEHICLES CAUSING THE ACCIDENTS AND THE COLLISION TYPES

Using the data in Table 5.5 it can be shown that cars and vans in that order had the highest incidence of accident collisions, 49% and 17% respectively. Motorcycles, trucks, mini-buses and others caused the accidents in 11%, 8.5%, 8.5% and 6% of the cases respectively. Further investigation of the data is necessary to determine why the majority of accidents at this location are caused by cars.

TABLE 5.4.1

Casualties Classification of 10km 'SPOT'



Using data in the same table it can be seen that 62% of the accident collisions were vehicle/vehicle (for definition see Table 2.1. Chapter 2), and the next highest category is vehicle/pedestrian 32%. vehicle/Vehicle accident collisions are classified into four types. The most frequent vehicle/vehicle accident collision type is the side to head collision 28%, head-on is 17%, head to rear and side to side are both 8.5%.6% of accident collisions are not specified on the accident forms.

TABLE 5.5

The vehicles which caused the accidents, and collisions types at the 10km 'SPOT'



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There were no reports of single vehicle (overturning sliding etc.,) accidents, or of multiple pile-ups.


#### 5.4.3. CAUSATION FACTORS OF THE ACCIDENTS


Table 5.6 shows the causation factors of the accidents at 10km 'SPOT'. Using the data in Table 5.6, it can be seen that only four factors out of thirteen factors listed caused all the accidents. The highest causation factor is crossing the centre line of the road (44%) and the next highest are, not looking ahead (33%), pedestrians (16%) and U-turning (7%) respectively. It is strange that only four factors are contributing and not more, for example none of the accidents are caused by overtaking or speeding or reversing. This would give an indication that either the road police did not understand about the factors which caused the accident or that it is difficult to distinguish between crossing the centre line and overtaking. This could be a good reason to reduce the number of causation factors that the road police have to take into account on the accident form, e.g. four or five instead of thirteen.

To clarify 'crossing the centre line', on single carriageway roads such as the roads of this research, a vehicle must cross the centre line onto the opposite side of the road in order to overtake or avoid hazards. If in doing so it becomes involved in an accident, this then re-

TABLE 5.6

The causation factors of the accidents of 10 km 'SPOT'

Line change
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Note : Total number of causation factors do not hatch the total no of accidents because in most cases more than one factor is recorded (e.g. crossing centre line and U-trun-

corded as the factor causing the accident. 'Not looking ahead' - this is really synonymous with not being able to see ahead, if for example the road is too narrow vehicles 'edging out' to see ahead may hit oncoming vehicles, or vehicles may be too close together to brake safely.

#### 5.4.4. TIMES OF THE ACCIDENTS

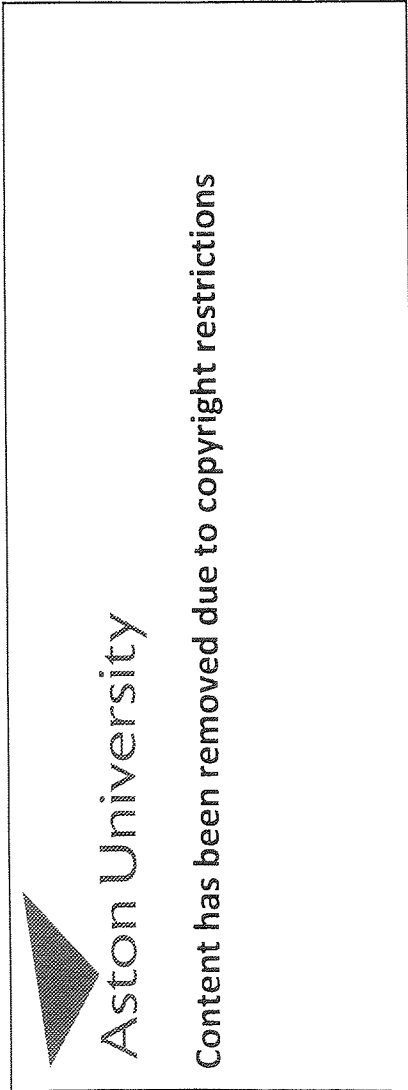
Using the data in Table 5.7, it can be shown that 62% of the accidents occurred around the hours of seven and eight a.m. This being the time that most people go to work in Iran. Pedestrians are most vulnerable going to the main road for transport facilities, buses, lifts etc. The rest of the accidents occurred at different times 11 - 12 11%, 17 - 18 11%, 20 - 21 8% and 23 - 24 8%.

#### 5.4.5. AGES OF THE CASUALTIES

There is little recorded data about the ages of casualties and little more about age of drivers involved in the accidents, except the guilty drivers, (This is because the driving licence of the guilty driver is usually taken by the police for further investigation.) The author therefore made enquiries of the local people, the emergency hospital at Ahvaz, and the highway police during his field studies in Khozestan county, in order to assess the impact of these deaths on families and country.

TABLE 5.7

Time of the accidents of the 10km 'SPOT'





According to Ahvaz emergency hospital about 80% of the pedestrian casualties are around 20 - 30 years old, often married with children, many also support their parents (there is no social security in Iran and families thus afflicted home to try to stretch a living - children having to give up school, etc.).

In addition most of these people are skilled workers, technicians etc., and developing countries cannot afford to sustain such losses especially when already short of such workers to such an extent that it has to employ people from other countries.

#### 5.4.6. FINAL FIELD OBSERVATION AND DISCUSSION

After a brief study and analysis of the accident data gathered in Tehran, the author realised that a final and more detailed observation and investigation of this location was needed before any improvement suggestions could be made. Obviously, to carry out such an investigation, an expert team from different academic fields was needed to help the author (See Introduction of Chapter 2). This final study had to be carried out with only the help of the highway police, district ministry of roads and the external supervisor.on

The first observation of the 10km 'SPOT' was at about 8 a.m. - there were many pedestrians walking along both sides of the road, and numerous vehicles, some from the

the village, generally heading for Ahvaz.

The author stopped and asked a number of the pedestrians either waiting at the roadside or crossing the road, such questions as, origin, destination etc. Most of them worked in Ahvaz or in factories near Ahvaz, and came to the road to hitch lifts or await friends or neighbours with vehicles. Some motorcyclists were interviewed, their circumstances were similar to the pedestrians, their ages were mostly around 20 - 35 years.

The photographs 5.1 and 5.2 show people waiting on the side of the road to get lifts to Ahvaz to go to work or to go shopping. For many people this is the only means of getting to work and they may continue to do this for a number of years.

Vehicles crossing the centre line in order to avoid pedestrians, who are too close to a major high-speed road, expose themselves to the risk of a collision with oncoming vehicles. When asked, the pedestrians said that if they were denied access to this road they would be unable to get to work to support their families, or even get to Ahvaz at all to shop etc. There are no alternative provisions made for these people. This would explain why so many pedestrians (Table 5.4.1) are killed or seriously injured as a result of road accidents at this location. The next part of the investigation involved a study of the general design and construction of the road.

PHOTOGRAPHS 5.1 & 5.2

Show the hectic situation at 10 km 'SPOT' due to lack of pedestrian facilities.

5.1



5.2



This 'SPOT' is on an embankment (on average 3-5metres high), this does not enable the driver of a vehicle to see that he is, in fact, approaching a populated area, (See Photograph 5.3). Drivers who were not familiar with this section of the road, who were stopped and interviewed said that they were unaware that they were in a populated area. Truck drivers more often familiar with this road said that they generally slowed down when approaching the area, and that they could see hazards from further away since they are in higher vehicles than car drivers. Therefore this would explain why so many cars are involved in accidents and not trucks (See Table 5.4).

The above indicates some casualties for the high number of pedestrian fatalities - why most accidents are caused by cars, why so many motorcycles are involved in accidents, and why actions such as 'Crossing the Centre Line' are major factors in accident causation (44% - See Table 5.6). Suggestions for accident reduction at this 'SPOT' can be found in the next section.

#### 5.4.7. SUGGESTION FOR IMPROVEMENT

As it was stated in the previous section, to be able to suggest any proposals for future improvement, experts from different academic fields would be needed, to carry out a full and deep observation and investigation of locations and causes of accidents.

PHOTOGRAPH 5.3

Shows the situation of 10 km 'SPOT'




There is considerable evidence to indicate that lack of pedestrian facilities, and lack of mass transport facilities for the villagers, caused many fatal and serious injury accidents. Using the data in Table 5.5 it can be shown that 32% of the accidents were vehicle/pedestrian. Also there is evidence to indicate that pedestrians standing either side of the road to catch lifts, or get off vehicles, caused up to 44% of the accidents (See Table 5.6), by forcing vehicles to cross the centre line of the road. Obviously, one could say that even if there were no pedestrians standing either side of the road, vehicles may still overtake and cross the centre line, and still cause accidents. Also 62% of the accident collisions were vehicle/vehicle, (Single vehicle colliding with another vehicle) (See Table 5.5) of which 28% were side to head, 17% head on, and 8.5% head to rear. This is very strange since one would expect that head to rear accidents would be more frequent than side to head, since if a pedestrian suddenly crosses the road, drivers will brake heavily. In this case, however, it appears that most drivers try to swerve round pedestrians instead of braking heavily. Providing pedestrian facilities in this area would eliminate 90% of the fatalities (See Table 5.4.1), 32% of vehicle/pedestrian and a large proportion of vehicle/vehicle accident collisions (See Table 5.5). It would also reduce the number of accidents caused by pedestrians standing either side of the roads to catch lifts etc., Also mass transportation facilities would reduce

up to 35% of the casualties associated with motorcycles (see Table 5.4). Providing dual carriageways with central guard rails would reduce 45 to 53.5% of the vehicle/vehicle collisions (Table 5.5), head-on, side to side and side to head. Also 44% of accidents caused by crossing the centre line of the road and 7% by u-turning would be eliminated (See Table 5.6). However, providing a dual carriageway with central guard rails, pedestrian facilities and mass transportation would theoretically reduce the accident rate (See Table 5.8).

Table 5.8 tabulates and summarises suggestions for improvement of the 10km 'SPOT' . Further recommendations for road safety development - See Chapter 8.

TABLE 5.8

SUGGESTION FOR IMPROVEMENT FOR 10KM · S P O T ·

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## 5.5. ANALYSIS OF THE ACCIDENT DATA FOR STRETCH 68 - 75KM

Using the data in Tables 5.2 and 5.3 it can be shown that a total of 26 fatal and serious injury accidents occurred on this stretch of road, resulting in 1 fatality and 37 serious injuries. The analyses of the accident data for the year 1979 is as follows.

### 5.5.1. CLASSIFICATION OF VEHICLES AND THEIR ASSOCIATED CASUALTIES

Using the data in Table 5.9, it can be seen that the 26 accidents involved 48 vehicles. There were only two types of vehicles involved in the accidents, cars and trucks, of which 84% were trucks and 16% were cars. It is strange that there were no other vehicles involved at all, therefore a final site investigation and observation was needed.

Using the data in Table 5.9.1, it can be shown that 100% of the fatalities were passengers of vehicles (cars - See Table 5.9). 59% of serious injuries were passengers of vehicles and 41% were drivers of vehicles.

### 5.5.2. THE VEHICLE WHICH CAUSED THE ACCIDENTS AND THE TYPES OF ACCIDENT COLLISIONS

Using the data in Table 5.10, it is shown that trucks are responsible for all the accidents. Types of accident

TABLE 5.9

vehicle/casualties relationship of 68 - 75 Km Stretch

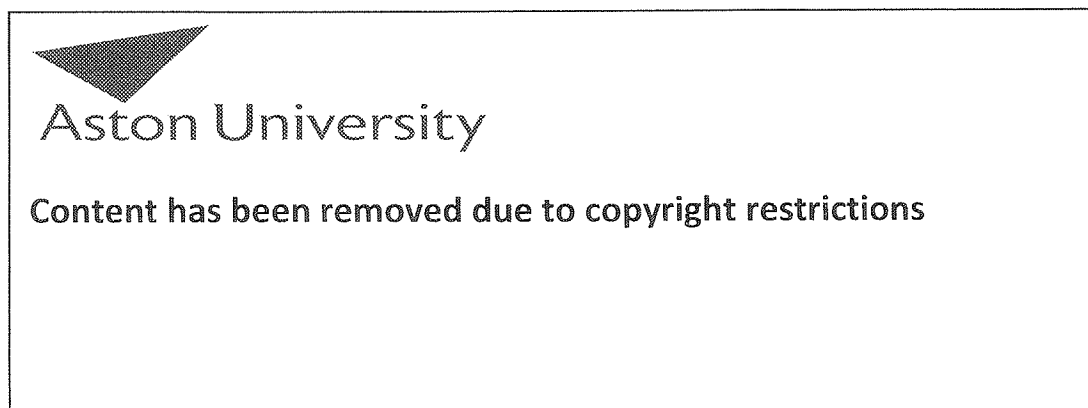


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TABLE 5.9.1

Casualties classification of 68 - 75 km stretch



collisions are only vehicle/vehicle, of which 54% are side to side, 23% side to head and 23% head to rear. There are no multiple pile-ups or vehicle/pedestrian collisions recorded at all.

5.5.3. CAUSATION FACTORS OF THE ACCIDENTS

Using the data in Table 5.11, it can be shown that only three out of thirteen factors listed in the accident report sheets caused all the accidents. Crossing

TABLE 5.10

The vehicles which caused the accidents and collision type of 68 - 75km stretch

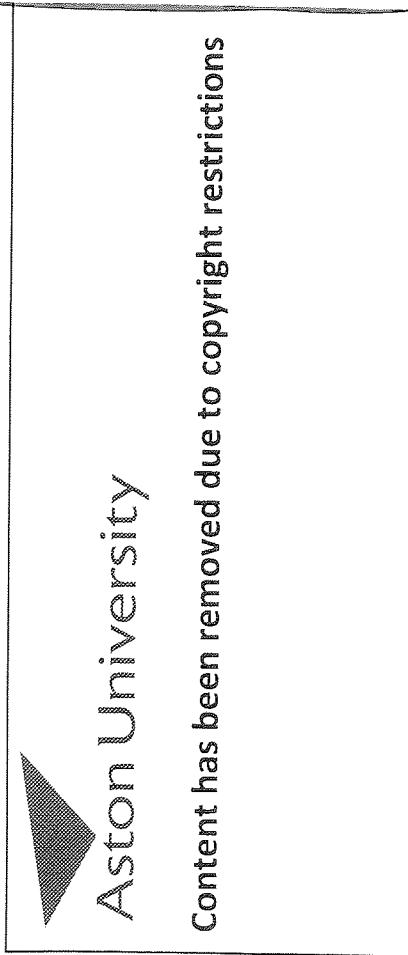


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TABLE 5.11

Causation factors of the accidents on the 68 - 75 km Stretch



the centre line of the road is the highest cause of accidents (48%), driving too close to the vehicle in front (41%) speeding is the lowest of all (11%). There are no other causes recorded, such as reversing or overtaking etc.,

#### 5.5.4. TIMES OF THE ACCIDENTS

Using the data in Table 5.12, it can be shown that most accidents occurred during the hours of darkness, 21 to 23, 64%, 1 - 2 a.m. 12% and 4 - 5 a.m. 4%. Also 9 - 10 a.m. 12%, 13 - 14 4% and 15 - 16 4%. This would indicate that there must be some factors which cause accidents in the night.

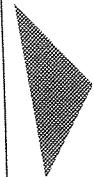
#### 5.5.5. FINAL FIELD OBSERVATION AND DISCUSSION

After a brief study and analyses of the accident data gathered in Tehran, a final trip was made before suggesting any improvements. Referring to Tables 5.2 and 5.3 and Figures 5.1 and 5.2, it can be shown that there was a spread of accidents rather than a clearly defined 'SPOT', though it is still possible to highlight some of the causation factors of these accidents.

There are eleven bridges on this section, close to each other, with good signing and marking. There also reflective signs to indicate narrow bridges, but these seem to

TABLE 5.12

Time of the accidents at the 68 - 75 Km Stretch



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have little effect (See Photograph 5.4). There are also five lay-bys on this section often used by trucks. These are incorrectly designed, not providing adequate slip roads. Vehicles pulling out of these may be hit by approaching high speed vehicles (See Photograph 5.5).

The highway police believes that all 26 fatal and serious injury accidents at this location were caused by trucks (Table 5.10). The collisions were basically all vehicle/vehicle, mainly side to side, with side to head and head to rear occurring to a lesser extent in equal numbers. The explanation for this is probably that, since the bridges are narrow, the trucks would try to avoid hitting the guard rail of bridges by either breaking heavily, (if there is an oncoming vehicle at the same time), or 'crossing the centre line' of the road, resulting in head to rear, side to side, or head to side collisions. This would not be so prevalent among smaller vehicles, since they are narrower and the guardrail would not constitute a hazard to them.

Using the data in Table 5.9 , it can be shown that trucks\* are most often involved in accidents, with cars being the only other types of vehicle involved. Equal numbers of truck drivers and car passengers were injured. Truck passengers were injured but the only fatality was a car passenger. The most probable explanation for the incidence of truck accidents being so high is, as has already been stated, that

\* This will vary with the percentage of trucks in the traffic flow.



PHOTOGRAPHS 5.4 & 5.5

Show the situation of 67 - 78 km 'stretch'

5.4



5.5



in order to avoid hitting the guard rails on these narrow bridges, they take up a central position in the road. Hence crossing the centre line, or brake heavily. It was also found that sudden descent of fog occurs at this location. This causes a sudden and drastic reduction of visibility. As a further note, if the fog occurs during darkness the traffic tends to move towards the middle of the road to avoid the sides of bridges. Thus increasing the incidence of 'crossing the centre line', with the resultant increase in likelihood of accidents (See Photograph 5.6).

PHOTOGRAPH 5.6

Shows fog on 68 - 75 km stretch



Accidents tended to occur at night (See Table 5.12) or in the fog which happen very often (especially at night). In conditions of limited visibility such as these, the vehicles try to keep well clear of guard rails either side of the bridges, but this means driving in the middle of the road, hence, increasing the likelihood of side to side accidents.

#### 5.5.6. SUGGESTION FOR IMPROVEMENT

As was stated previously, to be able to suggest any improvements, experts from different academic fields would be needed, as road accidents are complex phenomena. There is a considerable evidence to indicate that existence of these bridges and the incorrect design of the lay-bys created most of the accidents. Also sudden descents of fogs reduce the visibility, hence increasing the likelihood of accidents. Using the data in Table 5.9, it can be shown that 84% of vehicles involved in the accidents were trucks, and the only other vehicles were cars. Due to the width of trucks it is obvious that such narrow bridges constitute a serious hazard, as do the badly sited lay-bys. This would indicate that, by physical improvement of the layby to somewhere more suitable, the number of accidents could be reduced dramatically (up to 77% - See Table 5.10). Using the data in Table 5.9.1 it can be shown that 100% of the fatalities were

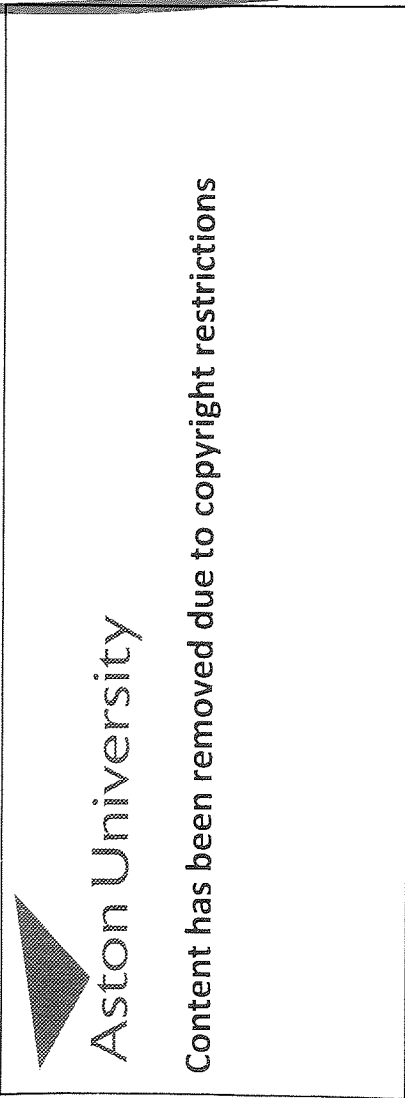
passengers in vehicles. Also 59% of the serious injuries were vehicle passengers, with vehicle drivers comprising the other 41%. This could indicate that drivers, who hold the steering wheel, are more protected than passengers, who have nothing to brace themselves against, therefore in the event of accidents, passengers may hit the windscreen in more cases than, and harder than drivers.


Referring to Table 5.10, it can be seen that 77% of the accident collisions were side to head and side to side. Dual carriageways with central guard rails would eliminate these types of collisions and the 48% of accidents whose causation can be directly attributed to 'Crossing the Centre Line' of the road (See Table 5.11).

Using the data in Table 5.12 it can be shown that 80% of the accidents occurred during darkness and sudden descent of fogs. This would suggest that improving existing road signs and markings, and extending their use where necessary to give drivers more advance warning of such hazards as fog and narrow bridges, together with an improvement in street lighting and the impositions of speed restrictions, would reduce the number of accidents in low visibility situations dramatically. Table 5.13 is a tabulated proposal for the improvement of this location. See Chapter 8 for more recommendations.

TABLE 5.13

Suggestion for improvement of 68 - 75km Stretch



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## 5.6. ANALYSIS OF THE ACCIDENT DATA FOR 114 KM'SPOT'

Using the data in Tables 5.2 and 5.3, it can be shown that a total of 18 fatal and serious injury accidents at 114 km 'SPOT' resulted in 6 fatalities and 32 serious injuries. The analyses of the accident data for this 'SPOT' for the year 1979 are as below :

### 5.6.1. CLASSIFICATION OF VEHICLES AND THEIR ASSOCIATED CASUALTIES

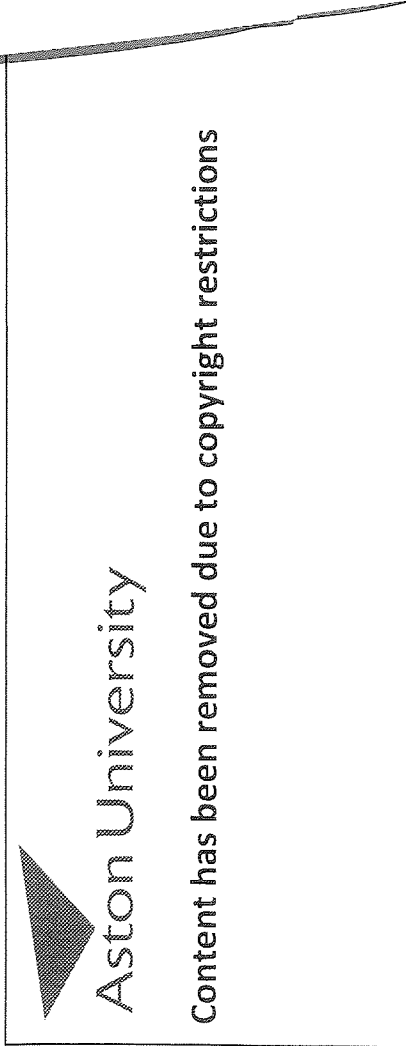
Using the data in Table 5.14 it can be shown that the 18 fatal and serious injury accidents involved 36 vehicles, of which 83% were trucks, 8% were cars, 6% were vans and 3% were motorcycles. There were no buses or mini-buses involved in accidents here in 1979. The highest casualty rate is 58%, associated with trucks and the next highest is 29%, associated with cars, 8% with motorcycles and 5% with vans. Using the data in Table 5.14.1, it is shown that 67% of the fatalities were vehicle passengers and the rest (33%) were vehicle drivers. 54% of the serious injuries were vehicle drivers and the rest (46%) were vehicle passengers. There are no pedestrian casualties recorded for this location.

### 5.6.2. THE VEHICLES WHICH CAUSED THE ACCIDENTS AND THE COLLISION TYPES

Using the data in Table 5.15, it is shown that trucks had the highest incidence of accident collisions (61.5%). Cars, vans, motorcycles and mini-buses caused the accidents in 16%, 11.5%, 5.5% and 5.5% of the incidents respectively. There were no buses involved in accidents. Most accident collisions

TABLE 5.14

vehicle/casualties relationship of 114 km 'SPOT'



were vehicle/vehicle, 50% side to head, 33% head to rear and 11.5% side to side. There is only one single vehicle accident recorded and no multi-vehicle or other type. Therefore the author made a final trip to the location for further observation and investigation in order to discover why trucks caused the majority of accidents.

TABLE 5.14.1

Casualty classification of 114 km 'SPOT'



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TABLE 5. 15

The vehicles which caused the accidents and collisions type of 114 km  
'SPOTS'



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### 5.6.3. CAUSATION FACTORS OF THE ACCIDENTS

Using the data in Table 5.16 , it can be shown that four factors caused the accidents, the most frequent being crossing the centre line of the road (54%) the others were driving too close to the vehicle in front (28%) speeding (14%), and abrupt change of direction (6%). There are no other factors recorded.

### 5.6.4. TIMES OF THE ACCIDENTS

Using the data in Table 5.17 it can be shown that 28.5% of the accidents occurred between 5 - 6 a.m. and the rest appear to be randomly distributed throughout the day and night.

### 5.6.5. FINAL FIELD OBSERVATION AND DISCUSSION OF 114km 'SPOT'

After a brief study and analysis of the accident data gathered in Tehran, it was decided that a final trip to the site was needed before any suggestion for improvement could be made. As stated earlier, in order to carry out this investigation an expert team from different academic fields would be needed to help the author. (See Chapter 2 Introduction).

It is important to note that this is a fairly straight well paved road but it is only 7.3m wide. The condition of

TABLE 5.16

Causation factors of the accidents of 114 km 'SPOT'

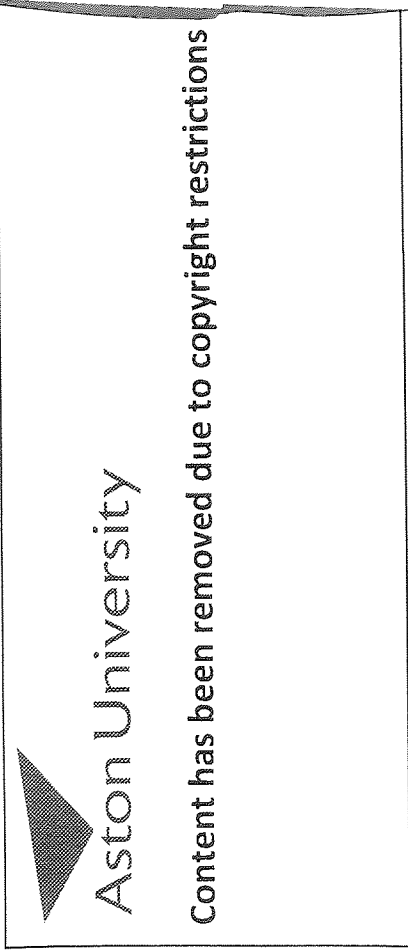
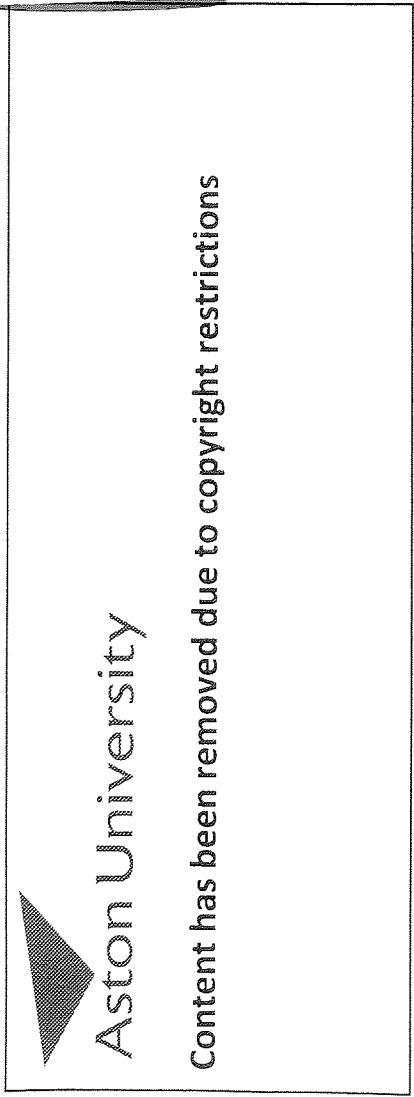



TABLE 5.17

Time of the accidents at 114 Km 'SPOT'



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the road means that traffic, especially trucks, travels at a very high speed, often well over 100km per hour, to reach the port for loading and once loaded to drive to destinations. A head-on collision would have a collosing velocity of over 200 km per hour. A fact which explains the number of fatalities and serious injuries in an impact e.g. the 45 km 'SPOT'.

Photograph 5.7 was taken about 88 km along the road from Ahvaz, it shows trucks racing to get to the 114 km 'SPOT'. (this is where the truck station is located) to obtain their queueing number for entry to the port, if the vehicle overtaken does not give way (and the driver is not motivated to do so since he will then be displaced in the queue), both lanes will be occupied, and oncoming vehicles will have little chance to get out of the way.

PHOTOGRAPH 5.7  
Shows trucks racing to get to 114km "SPOT"



The situation in Photograph 5.7 arises since most of the trucks are privately owned, and in order to make enough money to hire and to pay off his overheads, the owner/driver must make as many trips as possible. Delays such as queueing cost them money. This racing to get to the 114 km 'SPOT' no doubt explains the number of accidents on the 88 - 103 km stretch (See Figures 5.1 and 5.2).

The author would suggest that if trucks were in the hands of larger and reputable companies such as N.I.O.C. (National Iranian Oil Company), who pay at a standard rate, not on a time for trip basis, then the practice of racing and risking many road users lives would die out.

A further factor, according to the highway police, is that many truck drivers service their vehicles on laybys (particularly private owners/drivers). This causes the road surface to become slippery due to the desposition of oil, diesel and grease. When a vehicle pulls slowly out of a layby (since there is no adequate slip road to allow them to reach a high enough speed to merge safely with the traffic stream) oncoming vehicles often have to brake quite heavily to avoid them, or by-pass them, this coupled with the slippery nature of the road surface can cause head to rear, side to side, or head to side collisions. This could highlight the reason for many of this type of collisions (See Table 5,5). At the 114 km 'SPOT' itself, the situation was hectic,

trucks were parked all over the road and laybys, and high numbers of trucks were going in and out of the truck station; which is built at this location to sort out truck drivers' documentation . This explains why 83% of the vehicles involved in the accidents were trucks (Table 5.14). Using the same table, it can be shown that 58% of the casualties are also associated with trucks.

Photographs 5.8 and 5.9 show general features of 114 km 'SPOT' from Ahvaz and from Khoramshahr respectively. There is a lack of road markings and this could cause many vehicles to cross the centre of the carriageway without realising it.

Photograph 5.10 shows that even the hazard warning sign has itself been the victim of an accident. According to the post officials, due to the frequency of accidents, the sign has to be replaced every few weeks.

PHOTOGRAPHS 5.8 & 5.9

Show general features of 114 km 'SPOT'

5.8



5.9





PHOTOGRAPH 5.10

Shows even the hazard warning sign has itself been the victim of an accident.



The road is covered in mud/clay , this is due to the fact that truck drivers have to pull onto a muddy layby before going into the office, and on leaving clay is carried onto the road on truck tyres. In rainy conditions, fairly frequent in these parts, or simply in the ambient humidity, this clay is moist and slippery, and this could also explain why 33% of the accident collisions were head to rear (Table 5.15), and why 28% of accidents were reported as being due to driving too close, probably the vehicles kept adequate spacing for normal conditions, but slippery the conditions led to most of the accidents.

Using the data in Table 5.17, it can be shown that the times of the accidents were almost evenly distributed over the day and night, except 5 - 6 a.m. at which 28.5% of the accidents occurred. This is when the truck station starts to open and trucks rush to get their queueing numbers etc.,

#### 5.6.6. SUGGESTIONS FOR IMPROVEMENT

The evidence suggests that it is the location of this truck station at this point which is the main factor that causes accidents here. A first point to make is that organisation of the truck station is very poor. Many truck drivers have to wait days in the queue, losing time (during the peak hours) they cannot afford and which they try to make up by speeding on their delivery run. Sometime they drive constantly up to 36 hours without a break. This is hazardous both to themselves and other road users.

The physical situation of the station is perhaps the major factor in the causation of a number of accidents. The station is located on a sharp double bend just after a narrow bridge 114 km from Ahvaz towards Khoramshahr (See Figure 5.3).

To improve the situation for accident reduction at this location, two ways are suggested as follows :

(A) Administrative and the highway police control improvement.

(B) Physical improvement.

(A) Using the data in Table 5.16 , it can be shown that 68% of the causation factors of the accidents were 'Crossing the Centre Line' and 'Speeding' (54% and 14% respectively). Improvement of the highway police control and additional highway police officers would help the situation dramatically. Better management of the truck station, would help the situation by sorting out the drivers documentation quicker. Obviously, this has to be in cooperation with the dock workers, because if the drivers have to wait at the dock for loading instead of waiting at the truck station it does not help the situation.

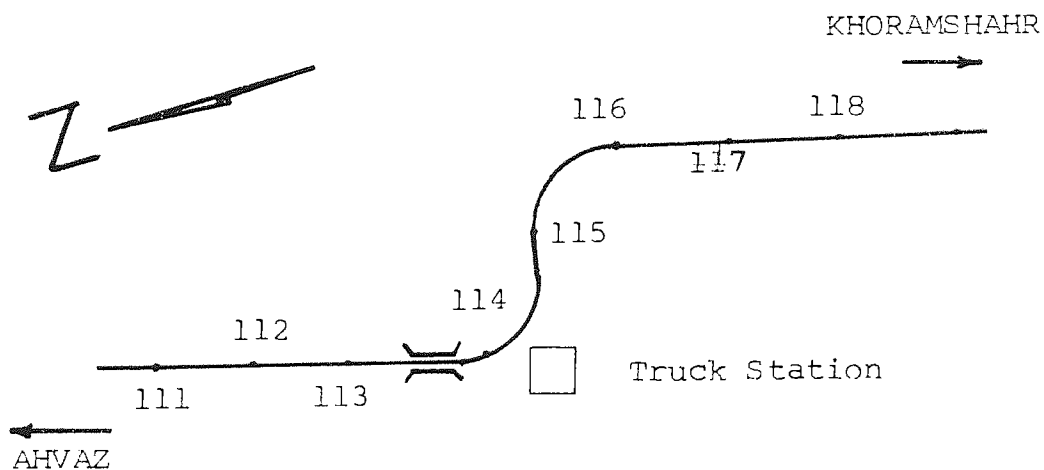
(B) Physical improvement of the situation could help accident reduction in the short and medium term to a greater extent than (A). Using the data in Table 5.17, it can be shown that 54% of the accidents were caused by vehicles which 'crossed the centre line', therefore providing dual carriageways with central guardrails would reduce the accidents dramatically. Movement of the truck station to somewhere more suitable e.g. about 3 km towards Ahavz where there is more space, and providing adequate paved slip roads, would cut down on the number of accidents by 33% head to rear, and a large proportion of head to side (See Table 5.15).

Furthermore, using the data in Table 5.17 it can be shown that 61.5% of the accidents occurred during the dark hours. Therefore, providing street lighting would reduce the number of accidents dramatically.

Table 5.18 is a tabulated proposal for the improvement of this location. See Chapter 8 for more recommendations.

FIGURE 5.3

Improvement of location of the truck station at 114 km 'SPOT'




#### 5.7. STUDY OF 80 KM 'SPOT'

Using the data in Tables 5.2 and 5.3, it can be shown that a total of 10 fatal and serious injury accidents in 1979 at this location resulted in 5 fatalities and 14 serious injuries. The study of this location was carried out as follows :

TABLE 5.18

Suggestion for improvement of 114 Km 'SPOT'



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#### 5.7.1. DATA AVAILABILITY

Little data could be found to carry out further analyses relating to this 'SPOT' in the head office of the highway police in Tehran, except the total number of fatal and serious injury accidents as stated above. Therefore, the author bases this study on his field investigation and observation only.

#### 5.7.2. FINAL FIELD OBSERVATION AND DISCUSSION

During the field investigation, it was found out that, most of the casualties were local pedestrians, and the accidents were mainly caused by trucks, generally on their delivery run from the port, usually speeding.

People living here do not commute to the larger town of Khoramshahr (c.f. 10 km 'SPOT') which is 40 km away. But go there only to purchase items not available in the village or for medical treatment etc., which cannot be regarded as regular events.

Photograph 5.11 shows a family leaving a taxi which has stopped on the road side. This causes traffic to cross the centre line, which is a major factor in many accidents.

#### 5.7.3. SUGGESTIONS FOR IMPROVEMENT

This location is similar to 10 km 'SPOT' of the same road, therefore similar suggestions

should solve the problem. However, it is suggested that adequate provision of mass transport (one bus a day would probably be enough for the existing situation), and pedestrian facilities for crossing the road, would reduce accidents. Building of a dual carriageway with guard rails would stop vehicle/vehicle head-on collisions. Advance road signs and markings, warning vehicles that they are approaching a populated area would dramatically improve the situation, but creating a free flow traffic system should totally solve the problem.

PHOTOGRAPH 5.11

Shows features of 80 km 'SPOT'



5.8. COMPARISON OF HIGH ACCIDENT LOCATIONS 10KM, 68-75 KM  
AND 114 KM SECTION OF AHVAZ - KHORAMSHAHR ROAD

Studies of these sections reveal a number of differences, but there are also a number of common factors in the causation of the accidents.

Comparing data in Tables 5.6, 5.10 and 5.13, it is seen that crossing the centre line and hence collision with on-coming vehicles is a major causation factor in all cases studied. Vehicle/vehicle collisions are generally head on, side to head and side to side. In most cases the accident is a direct result of vehicles avoiding obstacles (such as slow moving vehicles merging from laybys, guard rails on narrow bridges, parked vehicles, or pedestrians on the road) or over taking.

It is suggested that the greater number of accidents, would be prevented by providing dual carriageways with central guard rails, and providing adequate pedestrian facilities in urban areas.

On the 68 - 75 km stretch and 114 km 'SPOT', most accidents are caused by trucks. In order to facilitate queueing at the port, trucks are allocated a number, therefore drivers race to get to the traffic control office hence increasing the accident risk. Those leaving the port will rush in order to make up time lost by queueing. Although in theory speed and travel



times are controlled by legislation, private drivers who need to make the maximum number of trips in the minimum time to be able to meet their overheads, rarely adhere to regulations, again causing hazards.

#### 5.9. CONCLUSION

Analyzing data for each high accident location shows an almost forgone conclusion that when the road passes through populated areas, pedestrians make up the bulk of fatalities and serious injuries. Especially, it is noted that adequate pedestrian facilities, mass transport systems and thoughtfully positioned bus terminals are lacking, causing the pedestrians to walk along the road or wait in the hope of getting a lift, even to have to cross the main road just to get from one part of the village to another (See Analysis for 10 and 80 km 'SPOTS'). Also it is noted that accidents occurring around a truck station dealing with a large volume of trucks entering and leaving a busy congested port, would generally involve a large number of trucks especially if there are not adequate facilities to deal with them properly.

This latter points to the need for improvement of port loading and unloading facilities, for stream lining the queueing system which is shown to cause delays, and drivers to rush in order to make up for lost time, and for a better physical position for the station itself which is on a fairly hazardous

stretch of road, compounding the risk of accidents.

Looking at the analysis for the 68 - 75 km stretch shows that constrictions in the road caused by narrow bridges led to drivers adopting a central position to avoid guard rails of the bridges and vehicles pulling out of the laybys. This leads to increased incidences of crossing the centre line with the concomitant increase in risk of colliding with on-coming vehicles or having to brake heavily to avoid doing so, and then being hit by a vehicle following closely behind (this holds true mainly for trucks, which are wider than cars and do not have as much margin for clearance).

The main factor noticed in accidents on the road from AHVAZ to KHORAMSHAHR was this type of collision between opposing vehicles. This seems to be a common factor in accidents on single carriageways all over the world, in fact, it is probably the single most frequent accident type.

This study would tend to lay the blame for most accidents on lack of foresight by official bodies, by not providing adequate facilities for vehicles and pedestrians alike, and failing to notice these fairly obvious risks.

Some factors could have been so easily recognised such as the tendency for truck drivers (particularly private drivers) to race to gain priority of entry into the port. The lack of

management of the priority allocation office should be looked into with a view to reducing turnaround time, and hence release some of the time pressure on commercial drivers.

See Chapter 8 for more recommendations

CHAPTER SIX

ACCIDENTS DATA ANALYSIS OF AHVAZ-ANDIMESHK ROAD

### 6.1. SUMMARY

This chapter analyses fatal and serious injury accident data for the AHVAZ - ANDIMESHK road for the year 1979, and then identifies the high accident locations. It then analyses, investigates and discusses accident data for each high accident location selected, and suggests improvements to reduce the number of accidents. The maximum percentage reduction possible in the annual number of accidents is then estimated.

### 6.2. INTRODUCTION

In order to carry out the data analysis for each high accident location, the author had to dig out the raw, sketchy data from several different offices of the Highway Police. This was sifted and refined and the resultant data yielded several useful tables and comparisons (e.g. vehicle/casualties relationship, classification of vehicles and their associated casualties, causation factors of accidents, times of accidents etc.) which formed the basis of this study.

### 6.3. ACCIDENT AND CASUALTY STATISTICS FOR AHVAZ-ANDIMESHK ROAD FOR 1979

The results of the study of accident data in the head office of the Highway Police Tehran, and at AHVAZ-ANDIMESHK Highway Police headquarters show that a total of 531 road

traffic accidents were recorded, of which 57 were fatal accidents, 190 were serious injury accidents and 284 were serious damage accidents. As a result there were 74 fatalities, and 354 serious injury (see Table 6.1).

TABLE 6.1

Accident and casualty statistics for AHVAZ - ANDIMESHK road for 1979.



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Distribution of fatal and serious injury accident locations and casualties along the road is described and illustrated as follows :

6.3.1. DISTRIBUTION OF FATAL AND SERIOUS INJURY ACCIDENT LOCATION AND CASUALTIES

Using the same sources as before <sup>(17)</sup>, an illustration of the distribution of fatal and serious injury accidents and casualties was produced as follows :

Table 6.2 shows the number of fatal accidents and fatalities at different locations on the AHVAZ-ANDIMESHK road for 1979.

Table 6.3 shows the number of serious injury accidents and number of serious injuries at different locations on the same road for the same year.

Figure 6.1 shows the distribution of fatal and serious injury accidents, diagrammatically, along the road for 1979.

Figure 6.2 shows the distribution of fatalities and serious injuries, diagrammatically, along the road for 1979.

TABLE 6.2

Number of fatal accidents and fatalities on AHVAZ-ANDIMESHK road for 1979.



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TABLE 6.3

Number of serious injury accidents and serious injuries  
on AHVAZ - ANDIMESHK road for 1979



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### 6.3.2. STUDY OF THE ACCIDENT LOCATION

Figure 6.1 highlights three precise high accident rate 'SPOTS' (60 km, 89 km and 105 km) where accident frequency is high. The 60 km and 89 km 'SPOTS' were selected for further deep analysis.

### 6.3.3. A COMPARISON STUDY OF DISTRIBUTION OF ACCIDENTS WITH DISTRIBUTION OF CASUALTIES

Comparison of figure 6.1 and 6.2 shows a positive relationship between number of accidents and number of injuries/fatalities. This is generally true for SPOTS' 60 km, 89 km and 105 km. These three 'SPOTS' all require further investigation, but for the purpose of this thesis, only the 60 km and 89 km 'SPOTS' are considered, because of their greater frequency of accident occurrence and because of availability of their data.

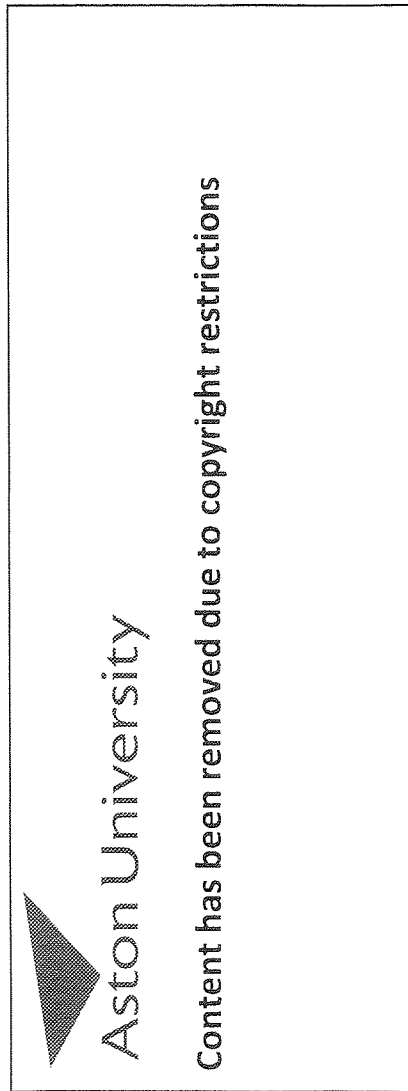
### 6.4. ANALYSIS OF THE FATAL AND SERIOUS INJURY ACCIDENT DATA FOR THE 60 KM'SPOT'

Using the data in Tables 6.2 and 6.3 it can be shown that a total of 53 fatal and serious injury accidents at this 'SPOT' resulted in 28 fatalities and 77 serious injuries. The analysis of the accident data from this 'SPOT' for the year 1979 is as follows :

FIGURE 6.1

FATAL AND SERIOUS INJURY ACCIDENTS ON AHVAZ — ANDIMESHK ROAD (1979)

80  
70



#### 6.4.1. CLASSIFICATION OF VEHICLES AND THEIR ASSOCIATED CASUALTIES

Using the data in Table 6.4 it can be shown that the 53 fatal and serious injury accidents involved 96 vehicles. The percentage of trucks is highest (50%), and the next highest are cars (21%), motorcycles are 11% of the total and vans 10%. The highest casualty rate is 28% and is associated with cars, the next highest is 20% associated with vans. Although the most frequent type of vehicles involved in accidents is the truck, only 18% of the casualties are associated with them (only the third highest casualty rate). Therefore, there is a need for a further field investigation and observation.

#### 6.4.2. THE VEHICLE WHICH CAUSED THE ACCIDENTS AND THE COLLISION TYPES

Using the data in Table 6.5 it can be shown that trucks and cars, in that order, had the highest incidence of accident collisions (44% and 30% respectively). Motorcycles, vans and mini buses caused the accidents in 11%, 11% and 4% of the cases respectively.

The most frequent type of accident was vehicle/vehicle (79%) of which 24% were head on, 23% were head to rear, 21% were side to head and 11% were side to side. The next most

TABLE 6.4

vehicle/casualties relationship of 60 km 'SPOT'



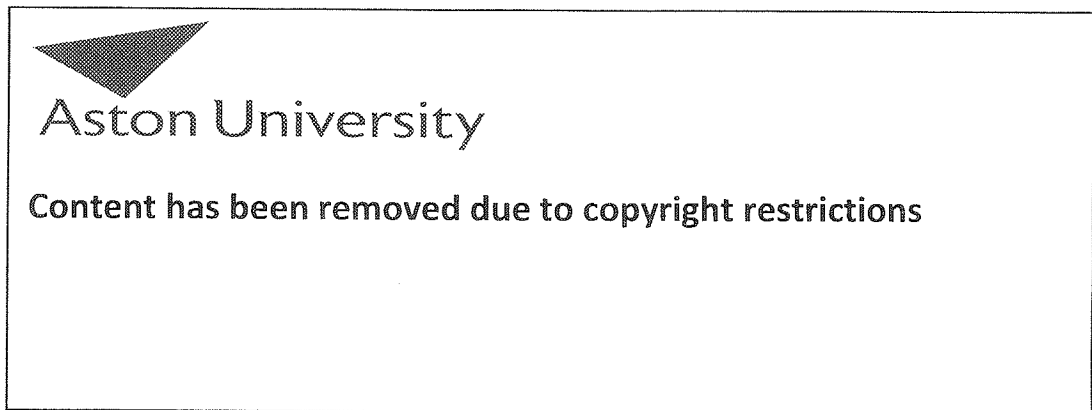
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frequent type of accident was vehicle/pedestrian (17% of the total) and the least frequent was for multi vehicle/parked vehicle or multi vehicle/pedestrian collisions recorded in 1979 at this location.

TABLE 6.4.1

Casualties classification of 60 km 'SPOT'



---

### 6.4.3. CAUSATION FACTORS OF THE ACCIDENTS

Table 5.6 shows that 47% of the accidents were caused by vehicles which crossed the centre line of the road, 33% were caused by drivers not looking ahead (or having inadequate braking time) , 8% were caused by pedestrians, 5% were caused by overtaking, 3.5% were caused by right/way and 3.5% were caused by vehicles being too close to each other.

TABLE 6.5

The vehicle which caused the accidents and the types of accidents  
collisions at the 60 km 'SPOT'



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TABLE 6.6

Causation factors of the accidents at 60 km 'SPOT'



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#### 6.4.4. TIMES OF THE ACCIDENTS

Using the data in Table 5.7 it can be shown that 35.5% of the accidents occurred around the hours of 6 and 8 a.m. This being the time that most people go to work, pedestrians are most vulnerable going to the main road for transport facilities. The rest of the accidents occurred in a fairly random distribution throughout the rest of the day.

#### 6.4.5. FINAL FIELD OBSERVATIONS AND DISCUSSIONS

After a brief study and analysis of the accident data gathered in Tehran, the author realised that a final closer observation and investigation of this (60 km) 'SPOT' was needed before making any suggestions for improvements.

This location is in a populated area, the observation was at about 7.a.m. - there were many pedestrians walking along both sides of the road, and numerous vehicles and motor-cycles (most of them from the village) generally heading for nearby farms or factories, etc., to go to work. There were no pedestrian facilities at all, not even a zebra crossing. This could indicate why 17% of the accident collisions were vehicle/pedestrians (Table 6.5) and 8% of the accidents were caused by pedestrians (Table 6.6). The general condition of the pavement is very poor, and there is a lack of road signs and markings.



TABLE 6.7

Time of the accidents at the 60 km 'SPOT'



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On one side of the road there is a school and the children who live on the other side of the road have to cross it in order to get to the school and back, and no pedestrian facilities are provided for them. At this 'SPOT' there is a bridge, 8m wide which connects the north part of the village to the south part. This bridge is used by vehicles, pedestrians and animals, and according to the highway police most accidents occur at this 'SPOT'. Many of the houses are built too close to the main road, and this combined with the fact that pedestrians stand either side of the road to catch lifts in the mornings etc., has meant that vehicles tend to drive closer to the middle of the road to avoid such obstacles, and this accounts for the high percentage of vehicle/vehicle accident collisions (79%). This also explains why trucks (which are much wider than cars) are involved in such a higher percentage of accidents (44%). The situation is worsened since there are no central road markings. See Photographs 6.1 and 6.2.

Photographs 6.1. and 6.2 show the condition of the pavement, the bridge and some of the pedestrian's who have to share this bridge with vehicles in order to get from the north part of the village to the south part.

Using the data in Table 6.4 it can be shown that most casualties are associated with cars, not trucks which comprise 52% of the total number of vehicles involved in

PHOTOGRAPHS 6.1 & 6.2

Show general features of 60 km 'SPOT'

6.1



6.2



accidents. This is because cars are generally weaker than, and do not offer so much protection to occupants as trucks. 20% of the casualties are associated with vans. This is because vans are used to carry passengers, and passengers in the back of these vans are not protected at all. In a single accident between a truck and a van which was taking 13 people to work, all the 13 people were killed instantly. This is the reason why the percentage of vehicle passenger casualties is higher than the percentage of casualties amongst vehicle drivers. Table 6.4.1 shows that 18% of the fatalities and 11% of the serious injuries are pedestrians, this is due to a lack of pedestrian facilities. Using the data in Table 6.6, it is shown that 33% of the accidents caused by 'not looking ahead'. This is due to a lack of road signs and markings, which means that high speed vehicles approaching the village are not warned that this is a populated area. The accidents which happened at night, are also due to a lack of road markings, drivers cross the centre of the road without realising it.

#### 6.4.6. SUGGESTION FOR IMPROVEMENT

As stated in Chapter 2, road accidents are a complex phenomenon, and in order to be able to suggest improvements, a multi-disciplinary team of experts would be required for a period of several months - a very expensive undertaking - to participate in the study.

From an analysis of the data produced by this study it is, however, possible to show that certain physical improvements to the situation, could dramatically reduce the accident rate. There is considerable evidence to indicate that lack of pedestrian facilities, and lack of mass transport facilities for the villagers caused many of the accidents (Tables 6.4, 6.4.1 and 6.6) as did lack of good pavement surface, signs and markings and the existence of narrow bridge. Providing pedestrian facilities and mass transportation would therefore, reduce the fatality rate by 18% and the serious injury rate by 11% (Table 6.4.1) it would also reduce accident collisions by 17% (Table 6.5 vehicle/pedestrian) and also remove a causation factor accounting for 8% of the accidents, Table 6.6. Providing a dual carriageway with central guard rail, improvement of signs and road markings, and widening of the existing bridges would reduce the annual accident figure by a theoretical maximum of 56% by elimination of head on collisions (24%) side to head collisions (21%) and side to side collision (11%) (See Table 6.5) and eliminate 'Crossing the Centre Line' which causes 47% of the accidents.

Providing pedestrian facilities, mass transportation and a dual carriageway as described above would reduce the accident rate by up to 73% (See Table 6.8).

See Chapter 8 for more recommendations.

TABLE 6.8

Suggestion for improvement for 60 km 'SPOT'



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#### 6.5. ANALYSIS OF THE ACCIDENT DATA FOR 89 KM 'SPOT'

Using the data in Tables 6.2 and 6.3 it can be shown that a total of 35 fatal and serious injury accidents at this 'SPOT' resulted in 3 deaths and 60 serious injuries. Therefore, this 'SPOT' was picked for more detailed investigation as below.

##### 6.5.1. CLASSIFICATION OF VEHICLES AND THEIR ASSOCIATED CASUALTIES

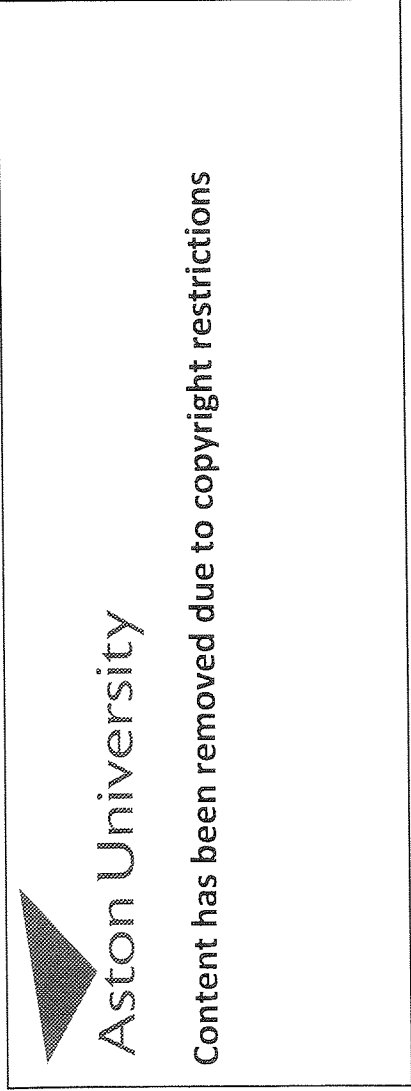
Table 6.9 illustrates classes of vehicles involved in the accidents and their associated casualties. Using the data in this table, it can be shown that 35 fatal and serious injury accidents involved 57 vehicles, of which 67% were trucks (the highest rate), 19% were cars, 9% were vans, and 5% were motorcycles. 44% of the casualties were associated with trucks, 36% with cars, 14% with vans and 6% were associated with motorcycles.

Using the data in Table 6.9.1, it can be shown that 33% of the fatalities were pedestrians and 67% were vehicle drivers. There were no vehicle passenger fatalities. 22% of the serious injuries were pedestrians, 28% were vehicle drivers and 50% were vehicle passengers. It was necessary for the author to carry out a final site investigation and observation.

TABLE 6.9

Vehicle/casualties relationship of 89 Km

'SPOT'





Using the data in Table 6,9, it can be shown that the 35 injury accidents involved 57 vehicles of which 67% are trucks.

Further investigation is necessary to find out why so many trucks are involved in accidents.

TABLE 6.9.1

Casualties classification in 89 km 'SPOT'



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6.5.2. THE VEHICLES WHICH CAUSED THE ACCIDENTS AND  
TYPES OF ACCIDENT COLLISIONS

Table 6.10 illustrates the types of vehicles which caused the accidents and types of accident collisions at the 89 km 'SPOT'.

Using the data in Table 6.10 it can be shown that 68.5% of the accidents were caused by trucks, 23% by cars, 5.5% by motorcycles and 3% by vans.

43% of the accident collisions were single vehicle, 48.5% were vehicle/vehicle of which 23% were head to rear 17% were side to head and 8.5% were head on. Also 8.5% of the collisions were vehicle/pedestrian.

#### 6.5.3. CAUSATION FACTORS OF THE ACCIDENTS

Table 6.11 shows the causation factors of the accidents. Using the data in Table 6.11 it can be shown that 42% of the accidents were caused by crossing the centre line of the road (the highest percentage) 23% by not looking ahead, 23% by pedestrians, 4% by driving too close, 4% by right/away and 4% by other factors. No other factors, such as speeding, overtaking, ignoring police signs etc., were recorded.

#### 6.5.4. TIMES OF THE ACCIDENTS

Using the data in Table 6.12, it can be shown that 65% of the accidents occurred during darkness, between 19

TABLE 6.10

The vehicles which caused the accidents and the types  
of accident collisions at 89 km 'SPOT'

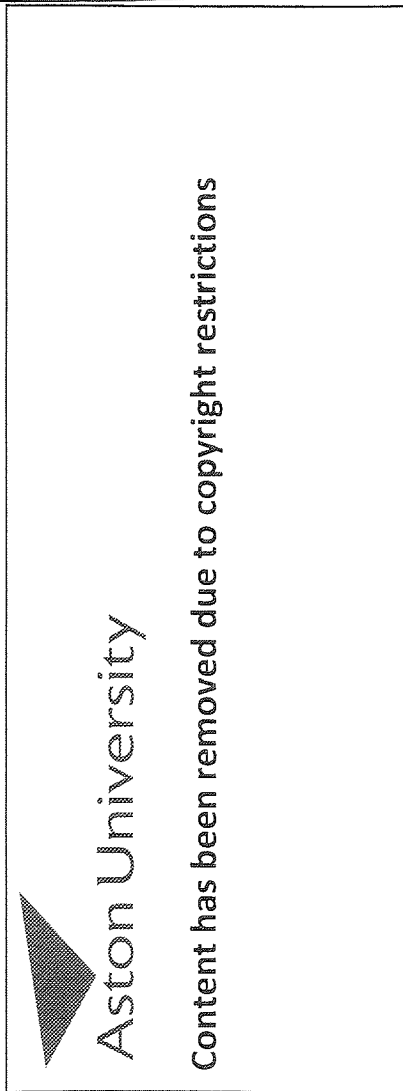


TABLE 6.11

Causation factors of the accidents at 'SPOT' 89 km


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TABLE 6.12

Time of the accidents at 89 km 'S P O T'



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and 3.a.m. and 26% of the accidents occurred around the hours of 8 and 9 a.m. The latter being the time that most people go to work in Iran, and pedestrians going to the main road for transport facilities, buses, lifts etc. are most vulnerable at this time.

#### 6.5.5. FINAL FIELD OBSERVATION AND DISCUSSION

Data gathered were studied in Tehran before commencing the final field observation studies. This section of the road is a populated area. The first observation was at 7 a.m. There were many pedestrians walking along both sides of the road and a number of vehicles, some from the village, generally heading for nearby factories, farms etc., to work.

The chief of the village, explained that most of the people of the village work either in nearby factories about 20 km away from this location, or on nearby farms. Due to the lack of mass transportation, the workers have to come to the main road to hitch lifts or wait for friends or neighbours with vans or lorries etc. This could explain why in one single accident between a van and a truck, 13 passengers of the van were killed at the scene of the accident. (at 60 km 'SPOT'). There is a lack of pedestrian facilities not even a simple zebra crossing or a pedestrian sign.

Therefore, it is clear why 33% of the fatalities and 22% of the serious injuries were pedestrians (Table 6.9.1). Also why 8% of the accident collisions were vehicle/pedestrian (Table 6.10) why 23% of the accidents were caused by pedestrians, and finally why 26% of the accidents occurred around 7 - 9 a.m. (Table 6.12), this being the time that most people go to work.

The general features of the road were very poor, there was a total lack of road signs and road markings. The surface of the pavement was 200 to 300 mm higher than the surface of the hard shoulder. This could easily explain why so many single vehicles overturned at night. At this location (Tables 6.10 and 6.12) lack of road markings during the night time would make it difficult for drivers to distinguish between the edge of the pavement and the hard shoulder, and if one or more wheels of a vehicle goes over the edge, especially at speed the vehicle would easily go off the road and overturn. Photographs 6.3

Photograph 6.3 shows the general feature of the road and that pedestrians are close to the main road.

Photograph 6.4 shows how the above situation caused a car go off the road and overturn.

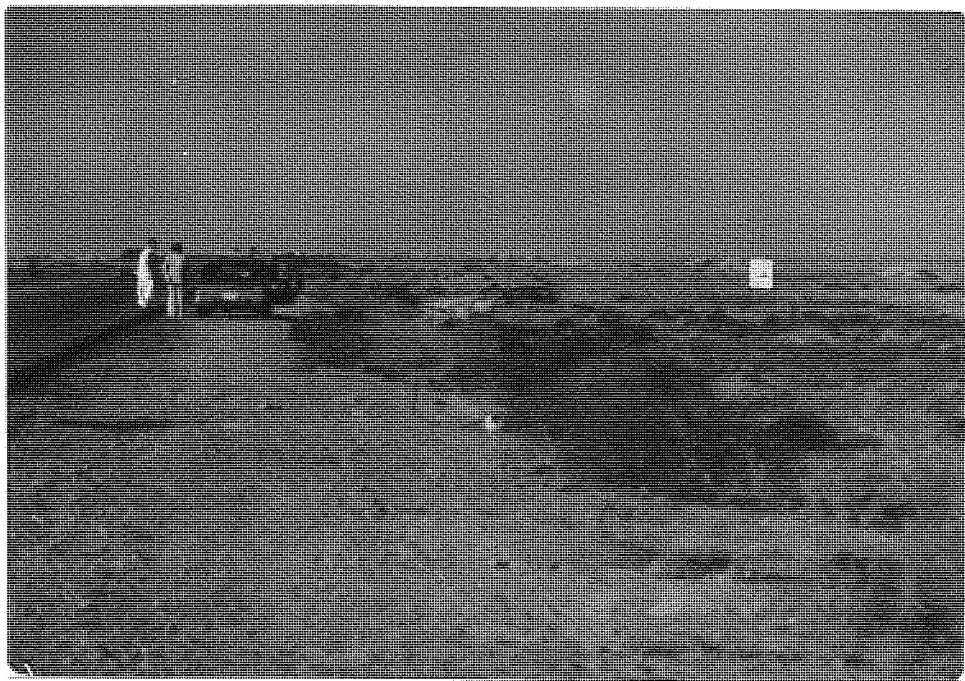
PHOTOGRAPHS 6.3 & 6.4

Show the general features of 89 km 'SPOT'

6.3



6.4





#### 6.5.6. SUGGESTION FOR IMPROVEMENT

There is a considerable evidence to indicate that lack of pedestrian facilities and lack of mass transportation facilities for the villagers caused many of the accidents. Therefore providing pedestrian facilities and mass transport, would reduce the accident collisions by 8.5% (Table 6.10), fatalities by 33%, serious injuries by 22% (Table 6.9.1), a factor accounting for 23% of accident causation (Table 6.12) and 26% of the accidents which occur between 7 and 9 a.m.

Poor construction of the road and lack of road signs and markings, also caused many of the accidents. Using the data in Table 6.10 it can be shown that poor construction of the road surface and the hard shoulder caused 43% of the accident collisions, involving single vehicles going off the road and overturning. Lack of road facilities to separate the carriageways e.g. central guard rails, caused 42% of the accidents 'crossing the centre line' (Table 6.11) and 25.5% of the accident collisions of which 8.5% were head on and 17% side to head (Table 6.9). N.B. If the figure 42% and 25.5% do not match, it is because more than one factor could have caused the accidents e.g. pedestrians and crossing the centre line.

However, improvement of the pavement condition and the hard shoulder would reduce the number of the accidents dramatically.

Using the data in Table 6.12 it can be shown that 68% of the accidents occurred during the dark hours. Therefore, improvement of the road signs and markings, especially using reflectors and street lighting would reduce the number of accidents by a great percentage.

Table 6.13 is a tabulated suggestion for improvement of 89 km 'SPOT' of AHVAZ - ANDIMESHK road.

#### 6.6. STUDY OF 105 KM 'SPOT'

Using the data in Tables 6.2 and 6.3 it can be shown that a total of 36 fatal and serious injury accidents in 1979 at this location resulted in 9 fatalities and 58 serious injuries. The study of this location was carried out as follows :

##### 6.6.1. DATA AVAILABILITY

Very little detailed data could be found in the head office of the highway police to carry out any further analysis. This location is a major junction and due to the difficulties of recording, only the accident classification (fatal and serious etc) and the numbers of fatalities/serious injuries were recorded for accidents at this 'SPOT'. The author, therefore, has made suggestions for improvement at this 'SPOT', based solely on his field investigations.

TABLE 6.13

Suggestion for improvement for 89 km 'S P O T'



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#### 6.6.2. FINAL FIELD OBSERVATION AND DISCUSSION

This 'SPOT' is a major junction connecting two roads together;

- (a) AHVAZ - ANDIMESHK main road, and
- (b) SHOSH road, minor road

There is a lack of adequate road signs and road markings at this 'SPOT'. The situation looked very hectic and there was no free flow for traffic on the main road of AHVAZ - ANDIMESHK. There was an entrance to a cafe very close to the junction which caused many accidents. Photograph 6.5 shows the situation at 105 km 'SPOT', the Shosh junction.

#### PHOTOGRAPH 6.5

Shows the genral features at Shosh Junction

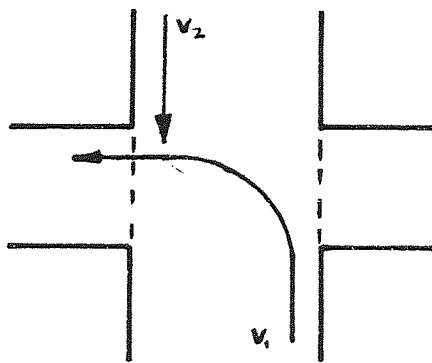


6.6.3. SUGGESTION FOR IMPROVEMENT

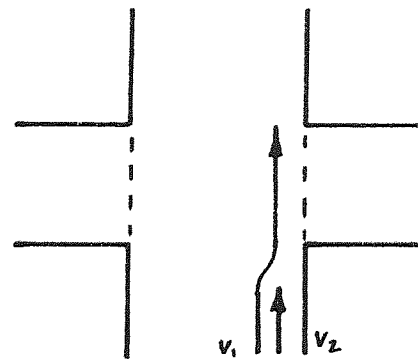
Before any suggestion for improvements are made, detailed data of the conflicts at this junction should be recorded by the road police. See Figure 6.3 below.

FIGURE 6.3

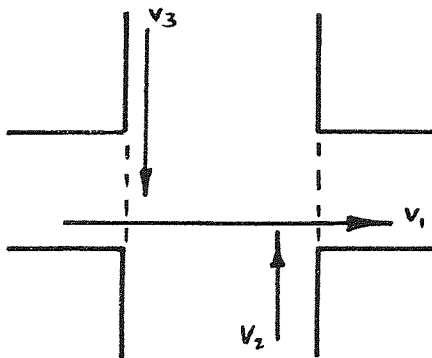
Some examples of vehicle interaction at rural junction.



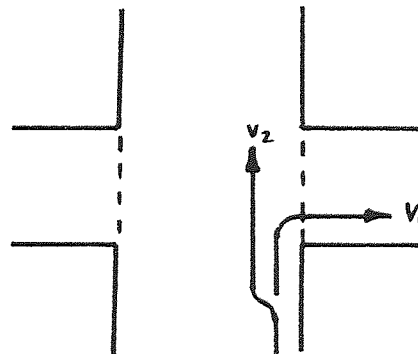
Left turn conflict



Weave conflict



Cross traffic conflict



Rear end conflict

However, improvements such as providing street lighting for the junction, improvement of the signs and road marking would reduce the number of accidents dramatically. See junction improvement in Chapter 8 for more details.

6.7. A COMPARISON STUDY OF HIGH ACCIDENT RATE LOCATION OF 60 KM AND 89 KM 'SPOTS' OF AHVAZ - ANDIMESHK ROAD

Studies of these locations reveal a number of differences, but there are also a number of common factors in the causation of the accidents.

Comparing the data in Tables 6.4 and 6.9, it can be shown that in both cases trucks are most frequently involved in accidents, also in both cases pedestrians are involved in fatal and serious injury accidents, and so are motorcycles.

Comparing data in Tables 6.5 and 6.10 it can be seen that trucks are the major cause of accidents in both cases, and vehicle/vehicle collisions are the most frequent type, mainly head-on, head to side, side to side and head to rear, vehicle/pedestrian collisions are also high on the list of accident type in both cases. One of the differences however, between these two 'SPOTS' is (using the data in Table 6.10) that at the 89 km 'SPOT' 43% of the accidents

were due to single vehicles going off the road and/or overturning (it was found out this was due to bad condition of the pavement and hardshoulder, also due to lack of road signs and road markings), whilst at the 60 km 'SPOT' there were no single vehicle accidents recorded at all. This proves that by only improving and widening the hard shoulder at the 89 km 'SPOT' accidents may be reduced by up to 43%.

Comparing data in Tables 6.6 and 6.11 it can be shown that pedestrians caused 8% and 23% of the accidents respectively, and that the highest causation factors of the accidents were vehicles crossing the centre line of the road, 47% and 42% respectively. Therefore, separating the carriageways by using a central guard rail would reduce the accidents dramatically and save many lives.

Comparing data in Tables 6.7 and 6.12, it can be shown that in both cases the highest percentage of accidents occurred around 8 a.m. (34.5% and 26% respectively. This being the time that most people go to work, school etc., and pedestrians are most vulnerable at this time going to the main road for transport facilities or crossing the road etc. Therefore simply providing pedestrian facilities and mass transportation for the villagers would improve the situation greatly. Using the same tables, it can be shown that 25% and 65% respectively of the accidents occurred in the night time, therefore, providing street lighting reflector signs and road markings would help the situation greatly.

## 6.8. CONCLUSION

Accident data analysis and the final site investigation proved that the bulk of the accidents were due to lack of adequate facilities for the road users and pedestrians. Although there were incomplete data about the three factors causing accidents (i.e. human, vehicle and the road) it was found that the most obvious factor causing most of the accidents was that the road (e.g. 60 and 89 km 'SPOT') with no pedestrian facilities caused 17% of the accident collisions vehicle/pedestrian, and lack of central guard rails for separation of vehicles with oncoming vehicles caused 56% of the accident collisions (Table 6.5).

Also 43% of the accidents at 89 km 'SPOT' occurred due to lack of road markings and poor hard shouldering of the road (Table 6.10). Therefore, it can be seen that one of the first measures that the Ministry of Roads should adopt is the physical improvement of the roads. Simply by sending the engineers of each district's Ministry of Roads to go along the roads and make a record of their condition, a programme of remedial work could be suggested, (e.g. improvement of hard shoulders), the cost would be very low but the benefit would be very great.

Also at 89km 'SPOT' the people of the village should be provided with a pedestrian crossing for the school children who have to cross the highway twice every day to go to school and back.



CHAPTER SEVEN

A COMPARISON STUDY OF ACCIDENT DATA ANALYSIS OF  
AHVAZ-ANDIMESHK AND AHVAZ-KHORAMSHAHR ROADS

### 7.1. SUMMARY

This chapter compares and studies the conditions, features, traffic flow, types of vehicle, high accident rate locations, accident rates and types of accident on the study roads from AHVAZ to ANDIMESHK and from AHVAZ to KHORAMSHAHR. In conclusion, it shows that accident and casualty rates can be reduced dramatically (about 50%) by simply improving the road pavement, signs and markings of the study road.

### 7.2. A COMPARISON OF FEATURES AND CONDITION OF THE ROADS

As described in Chapter 3, the two study roads have many similar aspects and these similarities are as below :

- 1 - Both roads are located in almost the same environmental situation and condition.
- 2 - Both roads were designed and built by the same firm, and their ages are the same, about 30 years old.
- 3 - Both roads are single carriageways.
- 4 - Both roads are classed as first class paved road.
- 5 - Both roads are classed as main roads.
- 6 - Both roads are almost the same length.
- 7 - Both roads are in the same Ministry of Roads and Transportation district for their maintenance.
- 8 - Both roads are controlled by the same highway police district through the three police stations of ANDIMESHK, AHVAZ and KHORAMSHAHR stations.

- 9 - Both roads have almost the same geometric designs and are built on almost level ground.
- 10 - Both roads go through some populated areas and these areas are similar in types of people with similar attitude and characters.

But the only difference between these two roads is that, the road from AHVAZ to KHORAMSHAHR recently been re-conditioned and paved, also its road signings and markings have been improved, and its hard shoulders have been widened but AHVAZ - ANDIMESHK road is still in a bad condition (see field study of high accident locations on this road).

### 7.3. A COMPARISON STUDY OF TRAFFIC FLOW AND TYPES OF VEHICLE USING THESE ROADS

Using the data in Table 1.6, it can be shown that in 1974 the average daily traffic flow on AHVAZ to ANDIMESHK was 1,398 light vehicles and 2,335 heavy vehicles, a total of 3,733. The annual traffic in millions of vehicle/kms for the same year was 204.

Using the data in the same table, it can be shown that the average daily traffic flow for the same year on the AHVAZ - KHORAMSHAHR road was 1,904 light vehicles and 1,981 heavy vehicles, a total of 3,885. The annual traffic in million of vehicle/Kms for 1974 was 184.

However, the most recent traffic counting was carried out by the Ministry of Roads and Transportation in 1979, and this stated that the types and the numbers of vehicles using these two roads are almost the same. But this has not been published yet.

#### 7.4. A COMPARISON STUDY OF THE HIGH ACCIDENT LOCATIONS ON THE ROADS

Using the data in Figure 5.1, it can be shown that, there are three precise 'SPOTS' and two general lengths of the road where accident frequency is high (See Section 5.3.2.). These five accident locations were two populated areas, as it was found out in Chapter 5 and the rest were due to lack of road facilities for the road users.

Using the data in Figure 6.1, it can be shown that, there are three 'SPOTS' where accident frequency is high (See section 6.3.2.). These three high accident locations were two populated areas and a major junction as it was found out in Chapter 6.

However, it is clear that populated areas have relatively high frequency of accident occurrence (See Conclusion in this Chapter.

7.5. A COMPARISON STUDY OF THE ACCIDENT AND CASUALTY  
RATE ON THE ROADS

Using the data in Table 6.1, it can be shown that on AHVAZ - ANDIMESHK road, there were 104 fatal and serious injury accidents and as a result 33 fatalities and 171 serious injuries. The occurrence rate of fatal and serious injury accidents per 100 million vehicle/kms was 50.98, occurrence rate of fatalities 16.17 and occurrence rate of serious injuries 83.82. (Table 1.6)

Using the data in the same table, it can be shown that on AHVAZ - KHORAMSHAHR road in 1974, there were 66 fatal and serious injury accidents and as a result 14 fatalities and 130 serious injuries. The occurrence rate of fatal and serious injury accidents per 100 million vehicle/kms was 35.86, occurrence rate of fatalities was 7.60 and occurrence rate of serious injuries were 70.65.

Comparing the above data with each other, it can be shown that road accidents and casualties on AHVAZ - ANDIMESHK road are far more than those on AHVAZ - KHORAMSHAHR road.

Using the data in Tables 5.1 and 6.1, Table 7.1 can be produced as follows :

TABLE 7.1

Comparison of accidents and casualties of AHVAZ-KHORAMSHAHR and AHVAZ - ANDIMESHK road and their (%) differences for 1979.



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Using the data in Table 7.1 it can be shown that in all cases of accidents and casualties rate on AHVAZ-ANDIMESHK road is far greater than on AHVAZ-KHORAMSHAH road. Fatal accidents by 137%, fatalities 68%, serious injuries by 48% and serious damage accidents by 215%.

## 7.6. CONCLUSION

This chapter shows that although these two roads have an almost 90% similarity in their features, design, traffic flow, types of vehicle, environmental condition, maintenance managements and road police control, the 10% difference between these two roads due to reconditioning of AHVAZ - KHORAMSHAHR road (e.g. better pavement, signs and markings and hard shoulders improvement) has made a dramatic difference in the accident and casualty rates. Using the data in Table 7.1 it can be shown that the figure for fatalities as a result of road accidents on AHVAZ - ANDIMESHK is 68% higher than the figure for the AHVAZ - KHORAMSHAHR road. Consequently, these results speak for themselves, by improving the road pavement, hard shoulders, roand signs and markings AHVAZ - ANDIMESHK fatal accidents could be reduced by about 137%, serious inury accidents by 35%. Furthermore, improvement of high accident locations at the same time would reduce the accident and casualty rates even more (see Chapter 5 and 6 for suggestions for improvement).

Also it was found out that the high accident rate (the 10 km 'SPOT' from AHVAZ towards KHORAMSHAHR and the 89 km 'SPOT' from AHVAZ towards ANDIMESHK) were very similar to each other since they are populated areas without adequate provision of pedestrian facilities and hence pedestrians cause the bulk of accidents.

Thus in Iran, fatalities as a result of road accident are higher on urban roads than on rural roads ( sections 1.3 and 2.10) whilst in some developed countries the opposite is true due to provision of better pedestrian facilities etc. fewer people are at risk from road accidents on urban roads.

Therefore, the Ministry of Roads should provide pedestrian facilities wherever the highway goes through the populated areas.



CHAPTER EIGHT

DISCUSSION AND RECOMMENDATIONS

## 8.1 SUMMARY

This chapter discusses the problems of accidents in Iran, the accident/casualty relationship on rural roads of Iran; methods of accident data collection for the immediate and short term (eg. up to a year) and the medium term, to suit the existing situation of the country. It then goes on to discuss and recommend methods for identifying and recording accident locations.

In the conclusion and the recommendations, the justification of the research is verified and some recommendations are made for the agencies related to the road safety development in Iran to take the remedial measures. These agencies include the highway police, ministry of roads and transportation and the ministry of health.

## 8.2 INTRODUCTION

The size of the road accident problem in Iran is such that it requires considerable attention in order to obtain an understanding of the problem and to be able to take the remedial measures and prove to the official authorities that there are ways to approach the problem.

The literature survey indicated an absence of detailed studies of road accidents in Iran or similar countries, and of any satisfactory method of determining and recording accident locations in order to identify the high accident locations of the existing situation.

Lack of understanding of the accident problem by the government official bodies created so many problems for the author that a lot of time, money and effort was wasted in obtaining permission to have access to the road

of study and to the accident data of the highway police.

Lack of facilities (eg. plan of the study roads, large scale map of the country and the accident road, transportation, surveying equipment, camera, aerial photographs of the area, help from the ministry of roads, accommodation, drawing equipment, financial support, etc) made it very difficult for the author to prepare a plan of the study road for identifying high accident locations.

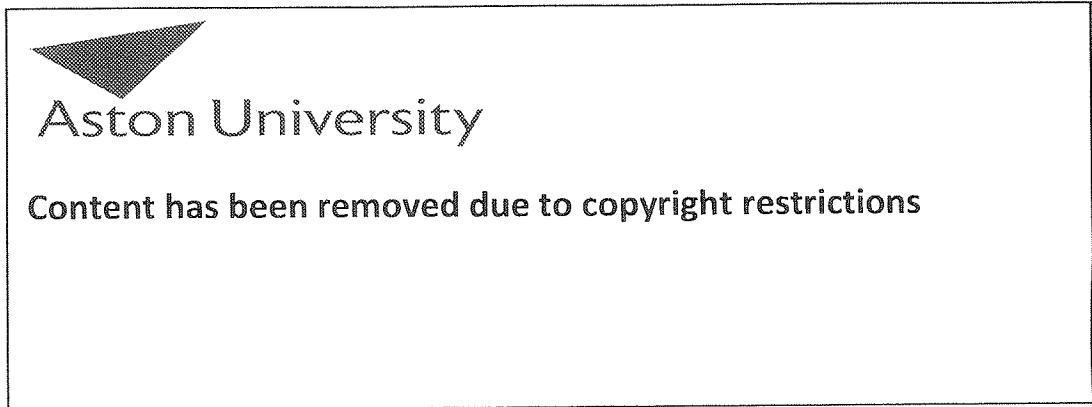
Police accident data was not an ideal source of research data because of the low proportion of accident data reported, due to lack of facilities (eg. equipment to identify the mechanical cause of accidents, an inadequate number of police officers, shortage of police cars etc). However no better source of large quantities were available.

Analysis of the high accident locations showed that the most obvious places created the most accidents, such as populated areas, narrow bridges, poor road surface conditions, lack of road markings and signing etc. However in the later sections there are recommendations for accident data collection and identification and recording of accident locations to enable high accident locations to be identified for remedial measures.

### 8.3 ACCIDENT/CASUALTY RELATIONSHIP ON RURAL ROADS IN IRAN

Using the data in Table 1.4, Figure 8.1 can be drawn from which it can be seen that the number of fatal and serious injury accidents on rural roads in Iran dropped from 7,721 to 6,781 between 1974 and 1975, but that the number of fatalities and the number of serious injuries for the same year went up from 1,341 to 1,593 and 8,700 to 11,340 respectively. After investigation and discussion with government officials, it was found out

FIGURE 8.1 ACCIDENT/CASUALTIES RELATIONSHIP ON RURAL ROADS IN IRAN  
BETWEEN THE YEARS 1974-1980



that prior to 1974, when a person imported a vehicle, the amount of import duty tax payable was directly related to age and condition of the vehicle.

In 1974 the law was changed and required any imported vehicle irrespective of its age or condition, to pay the same import duty as a new vehicle. The effect of this was that after 1974 almost all the vehicles imported to the country were new vehicles with high performance characteristics, and these were used on a road system which was quite inadequate for such vehicles. Consequently with new vehicles the number of accidents dropped, because of their improved performance but the severity of accidents and the number of casualties increased.

From 1975 to 1978 as the number of vehicles increased in the country (according to the highway police) so the number of accidents increased, and casualties also increased, but there was a drop from 1978 to 1979 in the number of accidents and the number of casualties (see Figure 8.1). This was due to Iran's revolution which began in 1978 with workers' strikes. (eg. National Iranian Oil Company). Most work stopped and shortages of fuel caused the majority of vehicles to remain idle.

As the number of kilometers covered by vehicles dropped, so the number of road accidents dropped.

After the changes of the government the situation began to return to normal and the highway police (which is part of the military) began to change their personnel and administration staff. During this time the highway police had very little power to enforce any laws on rural roads. Consequently, many road users broke the highway laws and ignored many highway codes and as a result the number of accidents and casualties almost

doubled in the year from 1979 to 1980. Furthermore, from 1979 no vehicles were imported into the country at all, and therefore the increase in accidents occurred with a constant vehicle ownership.

The above case illustrates that the road police can be effective, as the reducing number of road accidents. Therefore more attention should be paid to the road police by governments as well as other organisations related to road safety in order to reduce road accidents.

#### 8.4 ACCIDENT DATA

Accident data recorded by the highway police of Iran is far from an ideal source for research data, but the only alternative is to collect data "at-scene-study" of the accident. However this is costly, time-consuming, and a lot of facilities are needed. Therefore for the short-term the only source that could be used was the data collected by the highway police and some "at-scene-study", even though this was incomplete, not through any failing on the part of the highway police or the author, but due to the lack of facilities (eg. mechanical equipment to find out about mechanical causes of accidents, highway police officers, transportation, large scaled maps, plan of the roads, breathalizer test equipment etc).

Unfortunately incomplete data does not give a true picture of the scale of the accident problem. The highway police should realise that the traffic accident problem is a complex phenomena and should be approached from a joint national effort. They are the only people who can show other national agencies about the true extent of the problem, as they are directly involved with the problem, by providing them with correct, accurate and reliable accident data. For example, for many years the road maintenance department of the ministry of roads has been spending

a lot of money, time and effort on the improvement of what it thought was "the high accident locations" of the roads. But it has wasted money by improving many locations which did not need any improvement (eg. providing pedestrian facilities, where no-one needed any pedestrian facilities) - this was due to lack of recording of accident locations or recording them inaccurately. Therefore it can be seen that one of the most important parts of accident data that has to be recorded as accurately as possible is the identification of the accident locations. However, accident data collection by the highway police can be improved very much, by reducing the number of items to be recorded on the accident record sheets. Items which are not necessary for road safety planning can be eliminated, but items which are important can be included eg. the cause of the accident, whether it was:-

- (a) Mechanical fault
- (b) Human error        or
- (c) Road defects

Means of improving accident location recording could also be added.

Referring to the data analysis of chapters 5 and 6 it can be shown that some important accident data was not recorded. One example of this is mechanical faults not being recorded as a contributory cause of an accident (eg. brake failure, slack steering, poor maintenance of the vehicle, worn-out tyres, vehicle body rusted and weak, etc.) Another example is that details of the road have not been recorded (eg. the number and type of road signs and road markings, the geometrics design of the road etc.) Data about the casualties is also very inadequate, for example there is no record of how many of the serious injuries as a result of road accidents live or die after the accident (at least 30 days) nor the age and sex of the casualties.

Not recording this information about casualties, makes it impossible to find out about road accidents as a cause of death in the country.

Furthermore, intoxication has not been recorded at all. This makes the calculation of the number of drunk or drugged drivers which cause accidents virtually impossible.

It should be noted that in many cases accidents are so severe that it would be very difficult, time consuming and costly to record all the accident data. For example, when a vehicle is burnt after an accident, or the driver is burnt, it would be extremely difficult to find out if the driver was drunk or on drugs etc. In cases such as this it simply can be recorded as "not possible".

However, there are two ways recommended by the autor for accident data collection:

- (a) short term
- (b) medium term

(a) Short term

This method is suggested for the immediate solution. It consists of collecting data that has been left out of the existing accident form. In addition to the original sheet, information would be collected on:

- i. the accurate accident location
- ii. the type of injuries sustained by the casualties, and their ages and sex. Information is also required as to what happens to the casualties within 30 days of the accident
- iii. any mechanical cause of the accident if possible (eg. brake failure, worn out tyres, poor maintenance of vehicle, age of vehicle etc)



- iv. the intoxication of the drivers involved in the accidents
- v. the road side facilities (eg road signs and road markings, geometric design of the road if possible)
- vi. the type of collision and the associated casualties

Although all the six additional pieces of data to be collected are very important, probably the most important of all is to record the accident location as accurately as possible. In addition some photographs of the scene of the accident from different directions would be extremely useful for further investigation.

(b) Medium term

The data needed to be collected for the medium term is basically the same as for the short term in that more information is required than from the original accident form, but this information is required in more detail as outlined below:

- (1) The reference number of the person completing the accident report form ie police station number and officers number.
- (2) The type of accident ie fatal, personal injury, or damage.
- (3) The date and time of the accident (ie year, month, week, day hour and minute).
- (4) The location ie to the nearest metre.
- (5) The casualties and the total number of vehicle occupants.

Information on the casualties should include:

- i. their age, sex and details of their condition for at least 30 days after the accident
- ii. the severity of the injuries and what part of the body was affected (eg legs, chest, head etc)
- iii. whether a seat belt was used

- iv. the number of casualties associated with each type of accident collision
- (6) The age, sex, nationality, and driving licence details of the guilty driver.
  - (7) The participants in the collision (eg. vehicle/vehicle, vehicle/pedestrian, vehicle/obstacle (eg tree, an embankment, etc)).
  - (8) The type of accident collision (eg. head-on, side-to-side, side-to-head, head to near etc)
  - (9) The types of vehicle involved, age of vehicle, and the severity of damage caused (eg with trucks how many axles, loaded or empty etc)
  - (10) Details of the vehicle(s) (eg private, government, army, agriculture, etc).
  - (11) The cause of the accident
    - (a) Mechanical fault in a vehicle (eg brake failure, worn-out tyres, metal fatigue, poor maintenance, etc).
    - (b) Human error (eg pedestrian, intoxication, fatigue, physical disability etc)
    - (c) Road conditions (pavement condition, road classification, environmental condition (eg. dry, wet, etc), road signs and markings, narrow bridges, pedestrian facilities, geometric design of the road, built up area etc.
  - (12) Any other relevant information about the accident.
  - (13) Photographs of the scene of the accident
  - (14) A descriptive explanation of the accident with sketches by the officer in charge.

Obviously a lot more detail about the accidents can be recorded, but for a country such as Iran that is only just beginning to develop road safety, the above details would be a lot to ask for in the medium term.

Referring to Chapter 2, it was shown that the road accident problem is a complex phenomena. Therefore to be able to tackle the problem, a lot more data has to be collected from an accident for investigation, and analysis. For example in the U.S.A. there are 222 variables used to report a fatal accident and there are up to 10 accident forms to be completed. Also detailed records of the casualties up to one year after the accident have to be recorded. The forms that have to be completed by the National Crash Severity Study of the Department of Transportation of the U.S.A. are as follows:

1. Accident form
2. Occupation form
3. Vehicle form supplement special study check off
4. Occupant form up-date record
5. Special studies occupant form up-date record
6. Truck underside form, vehicle supplement
7. Side intrusion form
8. Roof intrusion form
9. Steering column form
10. Pedestrian and non-motorist form

Therefore it can be seen that to approach the road accident problem, a great deal of data needs to be collected from an accident. However, in Iran more detailed accident data collection would depend on the result of the short and medium term collection and analysis, the situation of the country's road system, the administration of the country, the types of vehicles involved in accidents (eg. class of vehicle, country of manufacture, performance of vehicle etc), the highway police and road safety regulations, etc. Thus any extra data that may be required will be decided after a period of time using the medium term recommendations.

## 8.5 METHODOLOGY OF IDENTIFYING AND RECORDING ACCIDENT LOCATIONS

It was shown in Chapter four that lack of recording or inaccurate recording of the accident locations, caused a lot of time, money and effort to be wasted before identifying the correct position of the accident locations on the study road. Inaccurate recording of the accident locations was not through any failing on the part of the highway police, but due to lack of facilities such as maps and plans of the roads, and the road net work system in the country.

Until very recently there has been no road numbering system or distance signs on the rural roads, but in 1979 the Ministry of Roads began to number the rural roads and fix distance signs. Unfortunately this work has been disrupted by the revolution and it may take many years before all the roads are actually numbered and distance signs fixed every few killometres (eg. 1 km on 5km intervals).

In the meantime, some method of identifying and recording accident locations has to be devised before analysis of this data can reveal the high accident locations. However, different methods can be employed for different time periods, different situations. These are:

- (a) Immediate and short term method
- (b) Medium term method

### 8.5.1. IMMEDIATE AND SHORT TERM METHOD

Having studied the road accident problem in Iran and with some years of experience working closely with the Ministry of Roads and Transportation and the highway police, it was decided that the method described overleaf could be operated immediately.

The most practical and basic method that is possible is the one the author has used in this thesis for identifying the accident and high accident locations and both assumes that the roads are not numbered, distanced, lack of large scaled maps, aerial photographs, etc.

An up to date plan of each road in each highway police or preferably by the district ministry of roads to be prepared and provided to the highway police district.

These plans do not have to be very sophisticated ones as the data required on each plan is as follows:

- (a) the length of the road between two urban areas (the highway police can be used as an origin)
- (b) all the road side facilities and fixed objects (eg. cafes, buildings, bridges, hotels, lay-bys, signs etc.)
- (c) The vertical and horizontal alignment of the road
- (d) junctions along the road etc.

This plan should be to a scale of  $\frac{1}{50,000}$  (at least to give more accurate location of accidents), up to date aerial photographs of the road would help to add all the latest environmental changes (ponds, lakes etc) on to the plan but these may not be available. The plan of the roads should then be marked in 1 km sections with the correct position of the road side details.

Each highway police station could be used with its own territorial road plan. Then it would be easy to identify the accident locations by looking at the plan and marking the accident location to the nearest fixed object (eg. distance of the location to the nearest bridge, cafe, sign etc). Different coloured pens or code could be used for different

types of accident (eg. black for fatal, red for injury, and green for damage accidents).

By using the plan of the roads for identifying accident locations, after sometime the high accident "Spots" or stretches would themselves stand out, and the highway police would usually see the dangerous locations and then be able to concentrate on them.

The police could inform the Ministry of Road to take the remedial measures towards improvement of these locations and carry out further investigations at the dangerous locations and supply the accident sheets for data analysis. They could also suggest their own ideas on improvements at these locations to improve road safety.

However, there are different methods of identifying accident locations. Some of them are straightforward but some are more sophisticated and need more facilities. For example, when the roads are numbered and distance signs fixed, the road police could simply record the road number and the location of the accident to the nearest distance sign. As this is not yet possible, the distance from the accident location to the nearest road side facility or fixed object must be used.

A second method which could be used is the method of x and y co-ordination, but for this method a  $\frac{1}{150,000}$  or  $\frac{1}{100,000}$  scaled map of the area is needed. (See Section 8.5.2 (b)).

This method cannot be used in Iran due to lack of detailed and up-to-date maps of different parts of the country, and the fact that many maps of different parts cannot be used due to strict military security.

A third method which could be used is a navigation system called "LOWRANCEE" which is used by the navy. This method needs at least three radio transmitters around the road network. Each highway police man should be equipped with a receiver, and at an accident location the receiver could be turned on to receive radio waves from the transmitters and hence "fix" the location of the accident.

The advantages of methods like this are not appreciated by the Iranian government, so the system would not be set up. However, having identified the accident locations the following method could be used to record them (the author considers this method to be the simplest, easiest, cheapest, and most practical method to use with respect to the prevailing attitudes and resources available in Iran at the present time).

There are about 83 highway police stations in the whole country, and each of them could have a number, start with 001 (a three digit number is used to allow for the number of police stations to increase to three digits. The maximum which can then be catered for is 999). The roads can be classified (eg. first class paved road, 2nd class paved road, dirt road, etc) with a code number (eg. 1, 2, 3, 4, etc). Also the roads in each police station territory could be numbered (eg 1, 2, 3, 4, etc).

By using this method of identifying the accident locations and by using the above coding systems the 60 km "spot" accident location for a first class paved road in the district covered by police station 89 can be shown on the accident form as below:

0	8	9	0	0	0	1	0	0	0	1	0	0	6	0
Police station code or number			No. of the road in the district			Class of the road			Accident location					

The form (shown above) of accident locations recording can be altered to suit changing conditions but this basic method of recording is very much recommended for the country.

It should be noted that this method is for a short term solution until all the roads are numbered, coded, etc. by the Ministry of Roads. However, this method would enable each district of the highway police to keep a record of the accident locations of their own. The next stage of this method is when the roads for the whole country are numbered on a national basis. Then the old road numbers recorded at accident locations need changing to the new numbers. Because of this it would be wise to have more coding boxes for the road numbers for future improvement of the coding form eg. for short term recording only two digits are used, but for long term recording four digits may be used so allocate four coding boxes to allow for this.

#### 8.5.2 MEDIUM TERM METHOD

The medium term method of identifying and recording accident locations depends upon:

- (a) the availability of mapping facilities for the country, as maps and plans of the roads need to be prepared
- (b) all roads being numbered for identification
- (c) distances along roads being marked by signs

However, as was described in Chapter 2, road accidents are a complex phenomena, and have to be approached by joint co-operation of several agencies on a national basis. Therefore the highway police need to realise that any system for the recording and coding of accident data has to be capable of being understood by other national agencies (eg.



the Ministry of Roads). In other words, all the agencies related to road safety should use the same terminology, be aware of each others future plans, and work closely together. Otherwise there is going to be a lot of confusion, wasted time, wasted money, etc, before any results are achieved. This particularly applies to the Ministry of Roads and the highway police.

There are two methods recommended by the author for medium term identification and recording of accident locations. These are:

(a) The method of road numbering

This method is very simple provided that all the rural roads in the country are numbered and distances marked. Then it would be very easy for the highway police to simply record the number of the road and the accident location to the nearest distance sign. If the roads were numbered, but distance signs not fixed, the highway police would then need to obtain plans of the roads from the Ministry of Roads (see short term method) and record the number of the road and the location of the accident by using the plan of the road. The difference between this method and the short term method is that:

- i. the highway police would not have to code the police station and the road of its territory of identifying the accident location for record purposes
- ii. no further changes will be required to the accident records when the roads are numbered.

(b) The method of co-ordination

This method can be used for identifying and recording on accident locations when neither the roads are numbered nor the distances signed, but when a small scaled map (eg  $\frac{1}{250,000}$ ) of the whole country is

available. Each highway police station would have to be required with a detailed ( $\frac{1}{250,000}$ ) map of its territory. If this map was divided into 10 km x 10 km sections, it would be easier to identify the accident locations. Recording of an accident location could then be done by recording the number of the section and the x and y coordinates.

#### 8.6 CONCLUSION AND RECOMMENDATIONS

In Chapter One of this thesis, eleven suggestions were made by W.H.O. (2) as to why road traffic accidents were severe in developing countries. These suggestions will now be discussed in the light of the data analysis and "at-the-scene" study carried out in this study:

1. During this study it was found that many pedestrians do share the roadway with vehicles (eg. 10 km "Spot" on the AHVAZ-KHORAMSHAAR Road, and 60 km and 89 km "Spots" on the AHVAZ-ANDIMESHK Road. As a result 32% of the accident collisions at the 10 km "Spot" were vehicle/pedestrian collisions (Table 5.5), 17% at the 60 km "Spot" (Table 5.5) and 8.5% at the 89 km "Spot" (Table 6.9). Also 90% of the fatalities and 26% of the serious injuries were pedestrians at the 10 km "Spot" (Table 5.4.1).

Two reasons were discovered for this pedestrian/vehicle conflict problem:

- (a) the lack of pedestrian crossing facilities means pedestrians have to cross the road by dodging between the traffic;
- (b) the lack of mass public transport means that people stand on the road to thumb lifts.

2. Lack of accident data on the mechanical cause of the accidents made it extremely difficult to find out what percentage of accidents are caused by old and poorly maintained vehicles. However, it can be shown that an increase in the number of vehicles has caused an increase in the number of accidents (See Chapter 2). By interviewing many commercial vehicle drivers (especially those driving privately owned vehicles), it was found that due to the scarcity and expensive cost of vehicle parts, many vehicles go on for years without new and safe brake systems, tyres, lights, etc. However, because of lack of data it is unfair to judge the percentage of accidents caused by vehicle defects.
  
3. The lack of data on the level of driving performance, and the lack of reliable data on unlicensed vehicle drivers, made it difficult to judge the proportion of accidents caused by these types of drivers. One certain fact is that in Iran the driving test is very difficult to pass. This is because drivers have to pass a three stage driving test which includes parking, urban driving, and rural driving, plus a written test. Unfortunately, it is also true that when a person has obtained a driving licence, most of what has been learnt will soon be forgotten because of the lack of public driving education.
  
4. During the study it was found that large numbers of motor-cycles were in the vehicle population, but only in certain parts of the country. These were where there is a lack of mass transport for the people. Because of their cheapness, motor cycles are used for communication, especially by people who live a long way from their place of work. Using the data in Table 5.4, it can be seen that 30% of the vehicles involved in accidents at the 10 km "Spot" were motor cycles, but

Table 5.9 shows that for the 68-75 km stretch no motor cycles were involved at all. Therefore in certain parts of the country motor cycles are in the vehicle population.

5. It was found out during the course of this study that many commercial vehicles (eg vans) carry too many passengers. Using the information in Section 6.4.2. it can be seen that in a single accident between a van and a truck, all the thirteen passengers of the van were killed instantly although it was illegal for the van to carry any passengers. Illegal carrying of passengers occurs due to the lack of mass transport in many parts of the country. Also there is a lack of data about over-loaded vehicles, but according to the highway police it happens a lot in Iran.
  
6. Using the data in Figure 8.1 it can be shown that because of the lack of highway police law enforcement (due to the disruption caused by the revolution), the accident rate almost doubled in a one year period, while the number of vehicles did not increase at all.

Therefore it can be assumed that there is a wide spread disregard of traffic rules when the police are not on hand to enforce them. As there are very few highway police, disregard of the traffic rules must be high.

7. Using the data in Figure 8.1 it can be shown that the number of fatal and serious injury accidents dropped from 1974 to 1975 due to the new vehicle importation regulation, but during the same period the casualty rates rose. One probable factor for this was the rapid change in peoples lives because of the oil income.

Many new vehicles were imported into the country but the road system was inadequate for such high performance vehicles. Consequently the number of accidents was reduced due to the manouverability of the new vehicles, but the number of fatalities and serious injuries increased because the severity of each accident increased.

8. There was lack of data about the casualty details (eg, sex, age, profession etc) to enable the author to see what types of people were most at risk in road accidents. However, according to the KEYHAN National Iranian newspaper ( 8 ), in 1977 the only heart surgeon of the country, and four other specialist medical doctors were killed instantly in a single accident on the Mahshahr Road. Therefore it is clear how valuable these people are to the country. Also according to the AHVAZ emergency hospital and the Ministry of Health (36), most casualties involved in road accidents are between the ages of 20 and 30 years. Irrespective of their profession, these people are the most valuable to any country and it is a waste for them to be killed in road accidents.
  
9. Most vehicles in Iran are either imported from abroad (eg, USA, Japan, Western Europe, etc) or assembled in the country. All are designed and built to exactly the same standards. Therefore there are no special vehicles used in the country (such as scooter-based taxis in Asia), to increase the possibility of road accidents. However, the vehicles which are assembled in the country are not usually equipped with safety belts, and this can increase casualty rates as a result of road accidents.

10. It was found that accident data collection in Iran is still at a primitive stage, and inaccurate and unreliable recording of accident data is common (eg. inaccurate accident locations). Because the highway police do not collect sufficient information about the scale and nature of the traffic accident problem, the true picture is not appreciated by government official bodies. Consequently they do not bother to take the remedial measures necessary.

This lack of information is not any failing on the part of the highway police, but due to a lack of facilities. This problem also caused the author many difficulties throughout this research.

11. During the course of this research it was found that there is a lack of total understanding of the problem on the part of local, regional and national government authorities. This is due to lack of both information and experts in this field, in the country. There is confusion in the Ministry of Roads about how to introduce remedial measures to improve high accident locations. Also, as details about casualties are not recorded, it makes it very difficult for the Ministry of Health to plan future emergency hospitals in different parts of the country. There is a total lack of understanding in the different government ministry's finance offices about the amount of capital required for road safety development. This is due to lack of data and information about the true picture of the problem. Hence no cost/benefit analysis has been carried out. For example, the maintenance department of the Ministry of Roads is not capable of finding out the total amount of money needed for improving the high accident locations on the roads, or what actually causes the accidents eg. poor road surface, lack of road signs and/or markings,

narrow bridges, pedestrians etc. Each of these would cost different amounts to put right, and therefore accurate and reliable data is needed for a road safety plan.

Chapter 2 showed that fatalities resulting from road accidents on urban roads in developed countries are less than on rural roads. For developing countries the opposite is true i.e. more people are killed on urban roads than rural . The data analyses in Chapters 5 and 6 showed that populated areas have the highest number of accident locations. Also it was found during the site investigations that the lack of pedestrian facilities caused the bulk of the accidents. Consequently in urban areas in developing countries pedestrians are more exposed to accidents than the occupants of vehicles. (eg. 10 km SPOT of AHVAZ-KHORAHSHAHR road).

## 8.6 RECOMMENDATIONS

Road safety is a most extensive subject and this thesis does not purport to be fully comprehensive as it was far beyond the scope of the author to cover all the various aspects of the problem. A major difficulty encountered was the lack of understanding of the problem on the part of the local, regional and national government authorities. Being a relatively new problem in many areas, government agencies do not have the knowledge or ability to introduce remedial measures, and this has caused confusion and lack of unity over areas of responsibility between the highway police, ministry of roads and transportation, ministry of health, ministry of education, etc. Consequently every government agency has worked independently and not been aware of what the other agencies have been doing towards road safety development

The government must realise that there is no country in the World that cannot afford to take remedial measures towards development of their road safety, due to the enormous cost of road accidents.

By approaching road safety development in a scientific manner the cost, time and effort can be optimised to greatly reduce the accident rate and hence save many lives.

On the basis of the accident data analysis, appropriate proposals and suggestions for improvements were made for each high accident location on the study roads. In addition to this, recommendations for whole regions were made that should be used by agencies and people involved in the development of rural road safety. Due to lack of complete, accurate and reliable data, and also the lack of experts in Iran, the author's recommendations were based on:

- (a) the accident data analysis of the study roads
- (b) discussions with various organisations involved with road safety in Iran (see Appendix A )
- (c) the author's own experience of actually working for the government and working closely with the high way police and ministry of roads and transportation.
- (d) interviewing road users
- (e) "at the scene" studies of some fatal and serious injury accidents
- (f) information available from other sources (eg. W.H.O. (2)).

Although the recommendations were made to all the agencies concerned with road safety, the Ministry of Roads and Transportation should play the leading role in this process, as it was found out that the bulk of the



accidents were caused by lack of facilities provided by it for road users and pedestrians (See Chapter 7). Also it is the largest and most established organisation.

It is highly recommended, especially in the early stages of road safety development, that other countries experience should be used extensively instead of having to wait for Iran's own experience. An example of this is that Bohlin, in Sweden, showed that if seat belts were used it would reduce the number of fatalities by approximately half and lesser the levels of injury by a similar amount(2). The results of this experience could be applied directly to Iran, as other countries used it with success. For example, in 1970 the Australian Government made the wearing of seat belts compulsory, and the effect was outstanding as car occupant fatalities fell by approximately 25%. Scandinavia has had similar success (2).

Also, by making it compulsory for motor cyclists to wear crash helmets, the severity of accidents can be reduced dramatically. Research has shown that when using a helmet, the risk of sustaining a head injury is reduced on average by 30% and the risk of being killed is often reduced by 40%. (2)

By accepting the results of other countries experience, a lot of time, money, effort and (most important of all) lives can be saved. Also, countries need to realise that road accidents are not an individual problem of each country, but a world health problem. Therefore all countries should furnish W.H.O. regularly with their road accident data, instead of keeping the information to themselves (such as Iran does).

However recommendations are made for the agencies related to road safety development, as described below:

- (a) General recommendations
- (b) Recommendations for the highway police
- (c) Recommendations for the Ministry of Roads and Transportation
- (d) Recommendations for the Ministry of Health

(a) General Recommendations

The official government authorities need to be aware that road safety development is not a personal interest but a national problem and everyone needs to be encouraged to do something to help this serious health problem. Therefore research into the problem should be continuous, irrespective of the changes in ministry.

Consequently the first step is to set up a central and independent organisation with full power to carry out all the necessary data collection and storage related to road safety. If this is impossible, part of one of the agencies concerned with road safety should be designed to carry out this work (eg. part of the Ministry of Roads and Transportation).

Experts from different academic fields should be employed to supervise all the agencies on how to take remedial measures. All the agencies, such as the highway police, Ministry of Health, Ministry of Roads, etc would regularly send all the data they had collected about road accidents to this agency for analysis and storage.

This organisation could be called "The Road Safety Organisation of Iran" and would be responsible for the supervision of the items described in

diagram 8.1 which would be carried out by the relative agencies.

(b) Recommendations for the highway police

The highway police need to be made aware that the first step in road safety development is the analysis of the accident data collected by them.

Therefore the accident data should be readily available to researchers of other agencies related to the problem, and the highway police should not keep the information confidential and for themselves only.

This research suffered from this difficulty as the author had to dig out the necessary information from different offices of the highway police, and this was very time-consuming and difficult.

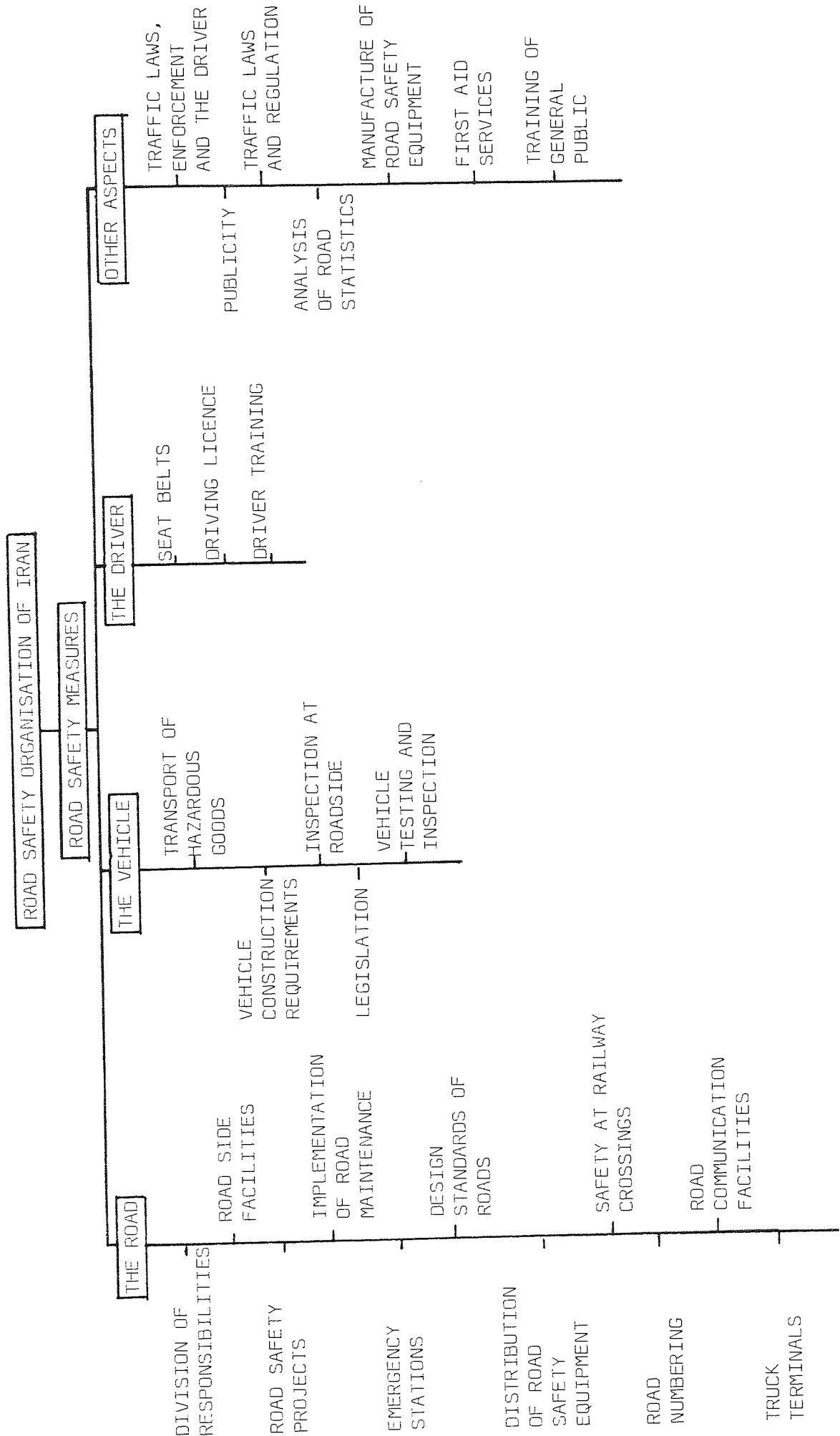
During the "at-the-scene" studies it was found that the lack of police officers and facilities meant that not all the accidents were attended or detailed investigations carried out. Consequently road police records underestimate the number of accidents and the number of casualties.

(1) Therefore the highway police should be given special training, be of sufficient numerical strength, and have enough equipment and vehicles for carrying out the essential function of accident prevention, traffic control and law enforcement. It should be noted that the enforcement is not the only way of preventing accidents.

However, specialist training and re-training of police officers should cover the following subjects:

- (a) traffic laws and regulations
- (b) road safety
- (c) traffic flow problems

DIAGRAM 8.1



- (d) a knowledge of accident investigation procedures
  - (e) first aid
  - (f) the mechanics of motor vehicles
  - (g) driving skill
- (2) Data collection systems of the highway police need to be improved to concentrate on the most important aspects ie:
- (a) precise identification of accident location
  - (b) the types of vehicles which cause most accidents (eg at 114 km "SPOT" of AHVAZ-KHORAMSHAHR Road, 61.5% of the total number of vehicles which caused accidents were trucks (Table 5.15)
  - (c) the conditions which cause more accidents than others ie. poor road conditions such as lack of road lighting, signing, markings, hard shoulders, pedestrian facilities, etc. Examples of the consequences of these poor conditions are:
    - (i) at the 89 km "SPOT" of the AHVAZ-ANDIMESHK Road, 65% of the accidents occurred during darkness (See Table 6.12)
    - (ii) due to lack of pedestrian facilities, 32% of accident collisions involved pedestrians at 10 km "SPOT" of AHVAZ-KHORAMSHAHR Road (See Table 5.5)
  - (d) the most frequent types of accident collisions (at each high accident location, the majority of collisions were vehicle/vehicle "HEAD ON"
  - (e) damage accidents need to be reported and recorded
  - (f) the details of the drivers involved in accidents. These should include such items as age, sex, amount of fatigue, amount of alcohol in the blood etc. Also the details of the vehicle occupants.
  - (g) data collection could be improved (see section 8.4), and a copy

of each accident sheet should be sent to the Ministry of Roads or other agencies which are going to be responsible for the analysis of the data.

(c) Recommendations for the Ministry of Roads and Transportation

1. Improvement of road communication facilities (eg. emergency telephones on the roadside).
2. Preparation of plans of the roads (eg to a scale of  $\frac{1}{50,000}$  ) with all the up-to-date features and facilities and make it available to the highway police.
3. Training of districts engineers how to identify high accident rate locations and their improvements.
4. For the short term, each district can concentrate on the improvement of hard shoulders, pedestrian facilities at populated locations, improvement of road signs and markings.
5. A road numbering system should be carried out and distance signs fixed.
6. Regular meetings and co-operation with the highway police should take place to include all the aspects of road safety (eg. movement of hazardous goods).
7. Improvements in the design standards of the roads should be a priority. These will include:
  - (a) Horizontal and vertical alignment
  - (b) The road cross section
  - (c) Traffic signs and markings
  - (d) Intersections and interchanges
  - (e) Road side facilities
  - (f) Pavement design
  - (g) Guard rails
  - (h) Traffic diversions

8. Road safety projects and research should be carried out continuously and should be independent investigations. The fact that different ministries have different opinions about road safety development should not affect these investigations.
9. It was shown in Chapter 5 that at 114 km "SPOT" of AHVAZ-KHORAMSHAHR Road, incorrect positioning of the truck station and lack of good management of handling truck drivers etc. caused 18 fatal and serious injury accidents. Therefore all the truck stations should be located in a safe position with good handling of the management.
10. Emergency stations should be set up at appropriate locations (equipped with road safety equipment) all over the country. In the event of an accident, equipment such as heavy lifting and towing equipment and power cutting tools as well as jacks, first aid kits, flashing lights, etc. should be quickly on the scene. These facilities should be distributed all over the country and not concentrated near Tehran as now.
11. Adequate and better management should be provided at the truck stations to minimise the time loss of the commercial drivers. This should help reduce the number of accidents caused by frustrated and impatient drivers.

(d) Recommendations for the Ministry of Health

1. In order to be able to take remedial measures it is necessary to examine in detail the events that occur between the time the accident takes place and the time that the injured persons are discharged from medical care. These events form an accident cycle, which is listed below in brief. The sequence of events is as follows:-
  - (a) Accident
  - (b) Detection plus possible first aid by the public

- (c) Notification to emergency services
  - (d) Dispatch and travel of emergency services to the scene
  - (e) Emergency treatment at the scene
  - (f) Transport to the hospital and treatment in transit
  - (g) Transfer to definitive medical care and emergency treatment
  - (h) Continued treatment, rehabilitation or discharge
  - (i) Discharge
2. There should be easily accessible and reliable communication modes (eg. emergency telephones) available during all stages of the accident cycle (eg. lack of road communication facilities caused the author and the police officer in charge to attend some fatal and serious injury accidents many hours after the time that the accidents occurred).
  3. It is convenient to examine the communication requirements for the emergency services in the time sequence, immediate, intermediate and definitive.
  4. Accurate records of road accidents and individual patients should be kept by the police, ambulance and hospital services, since this is important both immediately for the individual patients' management and in the future for defining overall provision and local distribution of emergency services, the distribution and planning of trained personnel, and provisions of appropriate facilities. This information should be made available for statistical analysis so that a comprehensive picture of the pattern of accidents and their management and final outcome can be built up both at local and national level.
  5. The system for the analysis of data can be a small system in this early stage of road safety development as complexity will make it more difficult to implement. At the very least, it should produce figures to relate the size of the road accident problem to other illnesses and injuries, and to monitor the efficiency of road safety measures.



These figures, therefore must include:

- (a) total number of road accidents
- (b) total number of fatalities defined as deaths occurring within 30 days of the accident
- (c) total number of injured patients defined as severe, moderate, or mild
- (d) total number of hospital admissions due to accidents in general, and road accidents in particular.

The above data should be collected and recorded by three organisations and a copy should be send to the "Road Safety Organisation of Iran".

These organisations are:

- (i) the highway police at the immediate stage
- (ii) the ambulance service at the immediate and intermediate stages
- (iii) the hospital at the definitive stage.

- i) The Ministry of health should advise the highway police to amend their current accident report form to include a short section on the part of the body, and severity of injury. For part of the body of injury, this could take the form of "head", "chest", "thorax", "abdomen", "arms" or "legs". For the severity it could be simply severe, moderate, minor or no injury. In addition questions concerning seat belts for car occupants, and protective helmets for motor-cycle riders, should be added. A copy of this form should always be sent to "Road Safety Organisation of Iran".
- ii) The Ministry of Health needs to realise that the ambulance report forms are an important source of information for two purposes:
  - (a) to inform the hospital doctors of the type of injury, the state of the patient at the accident scene, and the changes that have

taken place in the clinical state of the patient during transit which in Iran may have been over a considerable distance from a rural area.

(b) to provide detailed information on the part of the body and severity of injuries and the ambulance response time. This data is to be collected and statistically analysed for the purpose of planning future services.

iii) The Ministry of Health should require all the hospitals in the country to keep records of all the patients early and later process. This should be arranged in such a way that certain information can be extracted, stored and analysed for:

(a) correlation with the police and ambulance data in order to complete the overall statistics provided to the statistical analysis centre

(b) to allow hospital authorities to plan their staffing rotas, bed distribution and the provision of equipment and other facilities, to match requirements.

## FURTHER WORK

During this research it was found that due to lack of data and information, many of the points raised by the W.H.O. (2) could not be varified. As road accidents are a relatively new problem in Iran and many other developing countries, almost no research has been carried out towards road safety development. Road accidents are a complex phenomena and have to be approached by a joint national effort. Due to confusion and lack of understanding among the official authorities of different agencies responsible for road safety development in Iran, the true extent of the problem is underestimated and consequently the social and economical costs of road accidents are very much underestimated.

Consequently to be able to estimate the cost of road accidents and to be able to take the remedial measures, further research should be carried out:

- (1) on details of casualties as a result of road accidents (eg number, sex, age, profession, etc) and medical and ambulance costs.
- (2) on the loss of income of each casualty and its effect on his family etc.
- (3) on the police and administration costs.
- (4) on the cost of damage to properties and the extent of this.
- (5) on the contributory causes of accidents (eg. driver, vehicle, road, or environment)
- (6) on the long-term consequences of very serious injuries relating to brain damage, blindness and spinal trauma.
- (7) on the use of crash protective measures in developing countries.

- (8) on truck drivers, as it was found in this thesis that the bulk of accidents are caused by truck drivers.

In addition to the above,

- (a) Comparison studies with other roads (high accident rate locations approach).
- (b) Before and after study of these high accident rate locations.
- (c) Comparison with other countries.
- (d) Urban/Rural comparison studies.
- (e) Control data: research in vehicle mix flow, composition, tidal flows to ports etc, vehicle occupancies (in relation to seat belts provided), day/night characteristics, traffic counts, etc.

are essential for further research.

APPENDIX A

ORGANISATIONS WITH WHOM DISCUSSIONS TOOK PLACE

Organisations in Iran

Ministry of Health

Public Health Department

Tehran Emergency Service

Regional Health Authority, KARAJ

Ministry of Roads and Transportation

Planning and Research Department

Road Maintenance Department

Road Safety Department

(and other associated departments)

Highway Police Head Office in Tehran

Urban Road Police Traffic Division

Rural Medical Centres

(eg. Km 12 Tehran - Karaj Clinic)

Hospitals

AHWAZ - Jondi Shahpoor 1 Hospital

" " 2 "

Tehran Sina Hospital

### Organisations in United Kingdom

University of Birmingham, Accident Research Unit, Birmingham UK.

Royal Society for the Prevention of Accidents (RoSPA), Birmingham UK.

Transport and Road Research Laboratory (T.R.R.L.) in Crowthorne, UK.

Atkins International Epsom UK.

### Organisations in United States of America

Purdue University, Indiana State, Highway Commission, School of Civil Engineering, U.S.A.

Highway Safety Research Institute, The University of Michigan, Ann-Arbon Michigan 48109, U.S.A.

### Other Organisations

1. Rahvar Consulting Engineers, firm which was in charge of AHVAZ-KHORAMSHAHR Road improvement (Tehran).
2. SAOTI Italian firm designed and built AHVAZ-KHORAMSHAHR and AHVAZ-ANDIMESHK Road (Tehran).
3. National Iranian Insurance Company (Tehran)
4. AHVAZ-District Ministry of Roads Division (AHVAZ)
5. National Iranian Oil Company, Traffic Section (ABADAN).
6. Truck drivers union (KHORAMSHAHR)
7. B.C.E.O.M. French Consulting Engineers (Tehran)
8. Keyham and Etteat National Newspapers (Tehran)

## REFERENCES

1. OGREN J.R., 'A multidisciplinary team study of high-accident locations' J.H.R.P 78-18 (1979) Purdue University Indiana Highway Commission
2. MACKAY G.M., 'Protective Devices and restraint system.' Mekness, Morocco June 26-28 1979. World Health Organisation
3. STAUGHTON G.C. and Valerie J Stowie. 'Methodology of an In-Depth accident investigation survey.' T.R.R.L. LR 762 1977 Crowthorne U.K.
4. UNITED NATION (1970) 'Demographic Year Book 1969'.N.W. U.N. Organisation.
5. DEPARTMENT OF THE ENVIRONMENT. 'Road Accidents in Great Britain' 1973 London H.M.S.O.
6. ATKINS INTERNATIONAL TRAFFIC - 'Iran, Road Safety Plan', Part 7 of the Road Safety Study June 1977
7. B.C.E.O.M 'Transport Co-Ordination Study Phase One Final Report Volume 1.' 1976
8. KEYHAN NATIONAL NEWSPAPER (Central Information) 1978
9. DEPARTMENT OF ENVIRONMENT T.R.R.L. LR 546 1973 Crowthorne U.K.
10. HAYES, H.R.M.'Conflict at Junctions' Department of Transportation and Environmental Planning. University of Birmingham September 1973
11. BRITISH ROAD FEDERATION (1972)
12. SMEED, R.J., 'Some statistical aspects of road safety research' J. Roy Statist. Soc. (A) 112(1) 1949
13. JACOBS, G.D. and Fouracre P.R., 'Further research on road accident rates in developing countries' T.R.R.L. SR 270 Crowthorne U.K.
14. JACOBS G.D. and Hards W.A., 'Further research on road accident rates in developing countries (Second report)' T.R.R.L. S.R. 434 1978 Crowthorne U.K.
15. SMEED R.J., (1968) 'Variations in the pattern of accident rates in different countries and their causes'. Traffic Engineering Control 10(7) November 68, 364-371
16. SMEED R.J., (1953) 'The international comparison of accident rates, first road safety and traffic review'.1(1) January 1953
17. THE HIGHWAY POLICE OF IRAN (1980) Tehran
18. GARWOOD F and Munden J.M., 'Variations in the pattern of road accident rates in Great Britain over the last 10 years.' Proc. OTA 9th Int. Study week in Traffic Safety Engineering, 9-13 September 1968
19. ATKINS INTERNATIONAL TRAFFIC- Iran, 'First Aid Services' Part 5 of the road safety study June 1977.

20. FAULKNER, C.R., (1970) 'Research on accidents at rural crossroads'. T.R.R.L. Technical note TM 552 T.R.R.L. Crowthorne
21. DAWSON R.F.F., (1967) 'Cost of Road Accidents in Great Britain' T.R.R.L. Report LR 79
22. DAWSON R.F.F., (1971) 'Current costs of road accidents in Great Britain' T.R.R.L. Report LR 396
23. EMENALO S., PUUSTELLI M., CIAMPI A., and JOSHI HP., 'Analysis of road traffic accident data in Zambia.' University of Zambia, PO Box 2379, Lusaka, ZAMBIA (26 August 1976)
24. B.C.E.O.M. 'Transport co-ordination study phase one final report Vol. 2' 1976 (Tehran)
25. B.C.E.O.M. 'Transport co-ordination study phase one final report Vol 3' 1976 (Tehran)
26. B.C.E.O.M. 'Transport co-ordination study phase one final report Vol 4 1976 and study of high accident location 1977' (Tehran)
27. JOHANSON, H.D. and GANWOOD F (1971) 'Notes on road accident statistics' T.R.R.L. Report LR 394 T.R.R.L. Crowthorne
28. HADDON, W Jnr., Suchman E.A., and Klein D., (1964) 'Accident research'. New York Harper and Row Publishers.
29. NATIONAL SAFETY COUNCIL U.S.A. 1971
30. JONES J.H., (1946) 'Road Accidents.' London H.M.S.O.
31. REYNOLDS, D.J., (1956) 'The cost of road accidents.' Journal of the Royal Statistical Society, Series A, 119 (4) 393-408
32. THEDIE J. and ABRAHAM C., (1961) 'Economic aspects of road accidents'. Traffic Engineering and Control 2(10) 589-595 February.
33. THORPE J.O., (1963) 'Traffic accident measurements' Journal of the Institute of Engineers, Australia 2, 31-39
34. SABEY B.E., and TAYLOR H., 'The known risks we run' T.R.R.L. SR 567 1980 Crowthorne
35. SABEY B.E., 'Road Safety and Value for Money'. T.R.R.L. S.R. 581 1980 Crowthorne
36. THE MINISTRY OF HEALTH (Iran) 1977-1980
37. SARUNGI Prof. P.M., 'Traffic Accidents - A challenge to Tanzania' University of Daressalam, Tanzania, Paris 6/12/1979