GENERAL NOTE

The Transport Planning and Design Manual (the TPDM) consists of eleven volumes and is published primarily as a working document for Transport Department staff. It also provides information and guidance to others involved in the planning and design of transport infrastructures in Hong Kong.

It is intended that the information contained herein will be periodically revised to take account of the most up-to-date knowledge and experience. The inevitable time-lag however, means that certain sections may at a particular time be unavoidably not up-to-date. For this and other reasons, the standards contained in this manual should not be followed rigidly but rather treated as a framework within which professional judgment should be exercised to reach an optimum solution.

Generally speaking, the standards contained in the TPDM generally apply to new traffic and transport facilities and should not be considered as exhaustive. Situation may arise for which considerations and requirements are not fully covered by the TPDM. Practitioners are particularly required to exercise professional judgement when dealing with existing facilities that are subject to site constraints, and to endeavour to take into account the views from stakeholders. Practitioners are also advised to make reference to other publications relevant to their designs such as the latest legislations, code of practices, guidelines, datasets, etc. before applying the TPDM.

Transport Planning & Design Manual

VOLUME 5- Accident Investigation and Prevention

TPDM Volume 5 Chapter 1 – Introduction to Accident Investigation and Prevention

1.1 References

1 Accident Investigation & Prevention Manual - Department of the Environment Road Safety Directorate

2 Traffic Accident Evaluation - Monash University

3 Potential for Accident & injury Reduction in Road Accidents - T.R.R.L.

1.2 Introduction

1.2.1 Purpose of the Volume

1.2.1.1 The purpose of Volume 5 of the Transport Planning and Design Manual is to outline the stages involved in the analyzing of accidents and in the developing of appropriate counter measures for accident reduction.

1.2.1.2 Whilst every effort has been made to include information on all relevant topics, based upon the most recent data available, research in the subject is still continuing and it may be necessary to update and expand the Volume from time to time.

1.2.1.3 The criteria contained in this Volume are intended to be used as guidelines and not, unless otherwise stated, as standards to be rigidly adhered to. At all times a flexible approach should be adopted, in order to produce economic accident prevention design commensurate with practical considerations.

1.2.2 General

1.2.2.1 Road safety is a major consideration in transport planning and design. For a wide variety of reasons, however, traffic accidents still continue to occur, even on roads built to the latest and highest standards. Techniques have therefore been developed specifically for analyzing accidents and for designing appropriate countermeasures aimed at reducing accidents.

1.3 Approach Adopted in Accident Investigation

1.3.1 There is no single cause for a traffic accident; all accidents result from a combination of factors which involve the road user, the road environment and the characteristics of the vehicle involved.

1.3.2 Typical major contributory factors which give rise to accidents are:

(1) Inadequate visibility

(2) Violation of a mandatory sign

(3) Overshooting give way line

(4) Collision on restart from give way line

(5) Obscured give way sign

(6) Poor observance of pedestrian aspects by pedestrians

(7) Lack of junction conspicuity from side road

(8) No street lighting

(9) Misjudgement of speed of main road vehicles

(10) Acceptance of too small a gap due to excessive waiting period

(11) Excessive speed of main road vehicle

(12) Overtaking on the approach to a junction

(13) Parking on main road (reducing visibility)

(14) Wet surface obliterates give way lines

(15) Lack of adequate skid resistance

(16) Uneven lighting on main road conceals main road vehicles

(17) Obstructions on the footpath obscuring visibility

(18) Slow take off due to gradient on approach to give way line

(19) Collision with two-wheeler vehicles on main road

(20) PLB or taxi pick up/set down activity

1.3.3 The main contributory factors in any accident can usually be identified fairly readily.

1.3.4 For an accident investigation, all the data on injury accidents occurring at the study location during the study period should be assembled. A list of the major contributory factors for each accident should then be compiled, and a comparison of all accidents occurring at the site made to determine whether any major contributory factors are common to a number of accidents. At sites where common factors are identified, remedial measures can then be developed to obviate, or at least minimise, the effects that these common factors have in causing accidents.

1.3.5 In accident prevention studies at individual sites, the engineering remedies proposed should be designed to alter the road environment to make it more difficult for road users to make the mistakes which lead to accidents.

1.3.6 The remedial measures should be small scale, low cost improvements for the following reasons:

(i) Agreement on small-scale schemes is usually easy to achieve, and the scheme can usually be implemented very quickly after agreement.

(ii) A low-cost scheme will be very cost-effective in terms of the accident reductions achieved versus the costs of implementation.

(iii) When implemented quickly, the accident reduction benefits of the scheme can be recouped before any erosion in effectiveness occurs arising from changes in traffic patterns.

1.3.7 As accidents are random events, a 100% reduction in accidents is impossible to achieve. The remedial measures should be aimed at reducing the common-factor accidents only. Remedial measures which cater for "one-off" individual accidents are not cost effective, are unlikely to have a significant effect on the overall accident total, and should be avoided.

1.3.8 At stable sites which look "dangerous" but which have little or no accident history, the temptation to carry out improvement measures to make the location "safer" should be resisted. The current extent of knowledge on why certain locations are, or are not, accident blacksites is still very limited. It is therefore better to leave "dangerous" sites which have low accident records alone, rather than run the risk of introducing modifications which may make the accident situation worse. Obviously this does not mean that we do nothing to improve the situation at locations where, e.g. pedestrians are experiencing major difficulties crossing a road or where a parapet or crash barrier has not been installed and there is an unprotected steep slope. Traffic management improvement measures will continue to be required and carried out at a wide variety of locations, for a wide variety of reasons, not necessarily based on accident history.

1.4 Traffic Accident Data-Brief Introduction

1.4.1 All traffic accident studies rely upon historic accident data for the objective assessment of the accident situation. The accident data used are derived from Police records of injury traffic accidents.

1.4.2 By law all traffic accidents involving personal injury must be reported to the Police. Details of injury accidents are recorded on standardized Traffic Accident Report Booklets, Pol 281, 282 and 283. These 3 Booklets are exactly identical in the structure and format except in paper colour. Three different colour papers are used for these 3 Booklets by Police Officers basically for differentiation of the degree of severity of accidents, namely fatal, serious and slight accidents. Each of these Booklets comprises three parts:

(a) refers to the general circumstances of the accident, including date, time, weather conditions, etc.;

(b) refers to the details of the vehicle(s) and the driver(s) (n.b. one form is completed for each vehicle); and

(c) refers to the details of the casualties (n.b. there is space for 2 casualties in each Booklet. If there are more than 2 casualties, an additional sheet is used).

1.4.3 The raw data from these Booklets are then input into a computer system for validation, updating records, tabulation of statistical tables and accident file lists, and for general accident data manipulation. A consolidated database system is maintained by the Road Safety and Standards Division, Transport Department. The accident database can serve to:

(a) identify accident black-sites for investigation;

(b) provide data for detailed accident investigation;

(c) facilitate accident trend analysis;

(d) collate and analyze accident statistics for use in the formulation of road safety strategy and policy, for the review of legislations in relation to road safety; and

(e) collate and analyze accident statistics for the formulation of plans for road safety publicity campaigns, education and training.

1.4.4 From the data, territory norms are established for such factors as the proportion of "wet" accidents, "dark" accidents, and the split of various age groups involved in accidents. The territory norms can be compared with the proportions of the various types of accidents for an individual site so that factors falling outside the norms can be identified.

1.4.5 Some data is available from Police records on damage only accidents, however this is not computerized and requires a manual search to obtain it. This information gives an incomplete picture as only a small proportion of damage only accidents are reported to the Police and then normally only for an insurance claim. As there is no legal requirement to report damage only accidents which do not involve other property, and as those which are reported contain only basic details, for the purpose of accident studies these may be taken as reference to supplement the findings of the injury accidents

1.5 Threshold Values for Accident Blacksites

1.5.1 Based on current staff resources available in the Road Safety and Standards Division, TD, threshold values have been selected. For the time being, a site will normally qualify for detailed accident investigation if the number of accidents equals or exceeds any of the following:

(i) 6 or more pedestrian injury accidents/year;

(ii) 9 or more injury accidents of any description/year;

(iii) 2 or more fatal accidents in 5 years; or

(iv) 8 or more pedestrian injury accidents in 3 years.

1.5.2 Emphasis would tend to be placed on the sites with larger numbers of accidents. Nevertheless, when investigating sites with low accident histories, it may become difficult to discern accident patterns and hence difficult to recommend meaningful remedial measures. This problem can be overcome to some extent by lengthening the study period from one year to two or three years, but this is only possible at sites which have had a stable traffic history for the whole of the study period.

1.6 Estimates of Accident Reduction

1.6.1 Accident remedial measures are designed to reduce those accidents which have a common feature. Estimates of accident reduction should therefore relate directly to the types of accidents for which the remedial measures have been specifically developed. A successful accident reduction scheme should reduce those accidents specifically targeted by the remedial measures by approx. 50%. Full details of how a before and after study on accidents is carried out are found in Chapter 4 of this Volume.

1.6.2 It is more difficult to give a precise estimate of the overall reduction in accidents which can be anticipated from a successful accident reduction scheme. This is because the overall reduction depends upon the number of common accident factors found at the study site, and the proportion of total accidents containing these factors. As a rough guide, however, the aim of a successful scheme should be to reduce the overall accident total by approximately 30%.

1.6.3 Where the accident analysis indicates that only a small number of common-factor accidents exist, implementation of remedial measures for this small group may still be worthwhile even though the overall reduction in accidents achieved may fall short of the 30%.

1.6.4 The measure of the benefit/cost of an accident reduction scheme is known as the Economic Rate of Return (ERR). A successful accident reduction scheme should produce an ERR of at least 50%, i.e. the scheme should pay for itself within 2 years in terms of the accident reductions achieved versus the costs incurred in implementing the scheme.

1.6.5 ERR of 50% or more means that it is justified to implement accident reduction measures which may only remain in operation for 2 years before being superseded by major roadworks or road construction which alter traffic patterns. Many low cost sites have such a low initial cost and such a high ERR that they can be justified for periods even less than 2 years.

1.7 Publicity and Education

1.7.1 The field of human behaviour offers the greatest potential for accident reduction as, in many cases, human error or omission are major contributory factors in accidents

1.7.2 Road safety publicity and education programmes are very important in influencing behaviour patterns. Road safety publicity campaigns are effective in increasing public awareness of the dangers to road users, however, campaigns have to be repeated frequently to maintain impact. (see Chapter 6).

1.7.3 Road safety education, particularly for the young, is an important method of influencing behaviour. In this respect, teaching kits for use in schools are useful. The Road User Code, which is aimed at all road users, is also an important document in road safety education (see Chapter 6).

1.7.4 Unfortunately, altering road user's attitudes is a slow and difficult process. Frequently, as with seat belt wearing, legislation is required to bring about a significant change in people's habits on the roads. Publicity and education programmes should not be proposed as remedial measures to improve the accident situation at an individual accident blacksite location. Reliance should be placed on engineering measures at such sites.

1.8 Definitions

Fatal Accident

A fatal accident is one in which at least one person is killed immediately, or is injured and subsequently dies of his injuries within 30 days of the accident.

Serious Accident

A serious accident is one in which one or more persons is injured and detained in hospital for more than 12 hours.

Slight Accident

A slight accident is one in which one or more persons is injured but not to the extent that detention in hospital is required for more than 12 hours.

Note: All fatal, serious and slight accidents must by law be reported to the Police.

Damage only Accident

A damage only accident is one in which there is damage to vehicles or property only, with no personal injury involved. These accidents are not required by law to be reported to the Police.

Junction Accident Blacksite

Junction accident blacksites are those where the number of injury traffic accidents occurring within 70 metres of the junction meets the specified threshold criteria.

MASS Action

MASS is the Multiple Application of Standard Solutions. MASS action therefore is the application of a specific measure, which has been shown to be effective in reducing a particular type of accidents and could be applied on an area wide basis.

First Year Economic Rate of Return (ERR)

The first year economic rate of return (ERR) is defined as:

$$= \frac{\text{Value of accidents saved in the first year after implementation}}{\text{Cost of the scheme}} \times 100\%$$

TPDM Volume 5 Chapter 2 – Traffic Accident Data System (TRADS)

2.1 References

1 Road Safety Division (1981) *Report on The First Year of Operation*

2 Transportech and MVA Consultancy *Revision of the Traffic Accident Data System Final Report*

2.2 Introduction

2.2.1 Traffic accident studies and analysis for accident reduction and prevention are carried out based on the data of traffic accidents involving personal injury provided by the Hong Kong Police Force.

2.2.2 The objectives of traffic accident statistics are for:

(i) accident investigation work and analysis;

(ii) providing data support for road safety policy issues, such as the seat belt law, new road traffic legislation, etc.;

(iii) identifying major themes, target groups for road safety publicity campaigns and education programmes; and

(iv) providing accident data reference for road safety audit.

2.3 Data Validation and Processing for Accident Investigation and Prevention

2.3.1 Accident Location

2.3.1.1 Accurate accident location is necessary for the identification of accident cluster. In general, accident location is to be described by more than one of the spatial data below:

(a) Street names

(b) Grid references

(c) Lamp pole number

(d) Road chainage on strategic route

2.3.1.2 To ensure the accuracy of accident location inputted for accident cluster analysis, checking across all spatial data in the accident brief report furnished by Police is required.

2.3.1.3 For accident blacksite analysis, the most frequent retrieval is by location which can be carried out by (1) rectangular grid reference, (2) street name, (3) junction, specified by the intersection of two or more streets, or (4) a combination of (1), (2) and (3).

2.3.2 Data Interpretation

2.3.2.1 Information of every injury traffic accident reported to the Police is recorded in a Traffic Accident Booklet. It should be noted that some items in the Booklet were coded with subjective judgement. A notable example is the contributory factors of the accident. Decision on which factor to enter is subject to the officer responsible for the case. Hence factors coded as speeding, travelling too fast having regard to conditions, pedestrian negligence should be interpreted with caution.

2.3.2.2 All sensitive data retrieved from the data system of traffic accident involving personal particulars from Police files should be treated with confidential. They should only be used for the purpose of detailed accident investigation. Any release of the accident details should first be cleared with CE/RSS. The release of personal data such as the driving licence number or vehicle registration number is strictly prohibited by law.

2.3.2.3 Accident of common contributory factors or characteristics can be grouped for thematic study, and accident locations can be plotted on street map for identification. Examples accident grouping are as below:

(a) accident by time of day

(b) accident by date of week, month or year

(c) accident occurring on wet/dry surface

(d) casualties by age group

(e) drivers by age group

(f) vehicle type

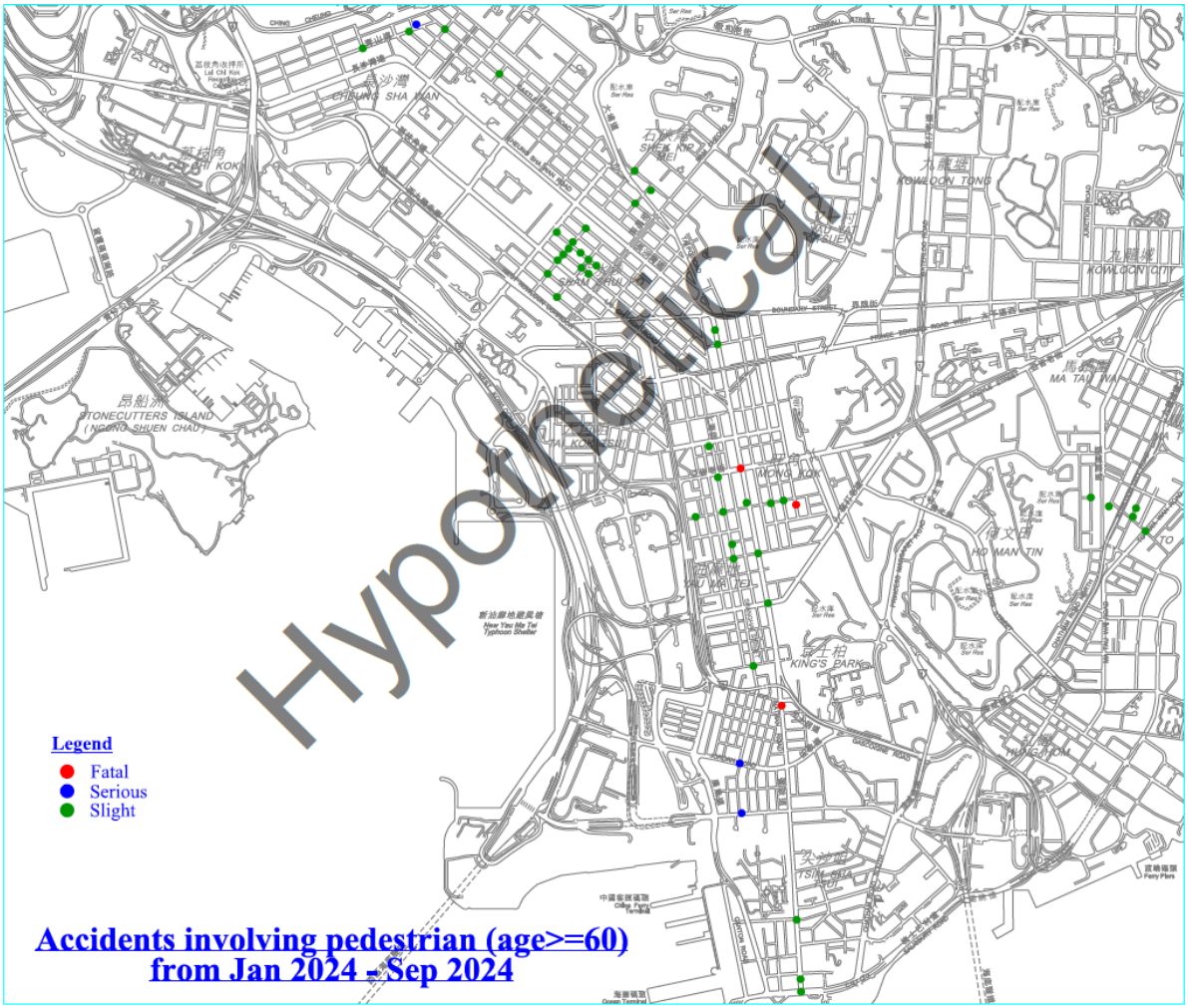
(g) collision type

(h) contributory factor

(i) type of junction control

A hypothetical accident location plot is shown on Diagram 2.3.2.1 below for reference.

DIAGRAM 2.3.2.1
HYPOTHETICAL LOCATION PLOT FOR ACCIDENT INVOLVING PEDESTRIAN (AGE >= 60)



2.3.2.4 Accident trend can be identified by comparing the numbers of accident with common factors happened over years. Change in road characteristic, traffic patterns, and implementation of new road safety enhancement strategy/measures during the period for review should be remarked for investigating the effect on the accident trend.

TPDM Volume 5 Chapter 3 – Accident Investigation and Analysis Techniques and Procedures

3.1 Reference

1 Department of Transport. Road Safety Directorate. Accident Investigation & Prevention Manual. London 1974

2 Organization for Economic Cooperation & Development. Hazardous road locations:identification and counter measures. OECD. Paris, 1976

3 Organization for Economic Cooperation & Development. Road Safety at Night. OECD. Paris, 1980

4 R. Byatt and R. Watts. Manual of Road Accident Investigation, Volume 2. Pitman, Great Britain, 1981

5 Michael Austin. Accident Blackspot. Penguin, 1966

6 R.W. Rivers. On-scene Traffic Accident Investigators' Manual. Charles C Thomas Publisher. Springfield Illinois, USA, 1981

3.2 Site Identification

3.2.1 Blacksite Selection

3.2.1.1 Due to limited resources, it is not possible to investigate all the traffic accidents which occur within the Territory. In order to maximize the benefit in accident reduction within the available resources, a priority system for the investigation of accident blacksites has to be established.

3.2.1.2 Computer sorting of accident data is used to produce lists of accident blacksites in descending order of the number of injury accidents at each location. Separate lists are also produced, sorted into descending order of pedestrian injury accidents at each location. Separate lists are produced for each region of the Territory.

3.2.1.3 Using these lists, sites falling within any of the following threshold criteria:

(i) 6 or more pedestrian injury accidents/year;

(ii) 9 or more injury accidents of any description/year;

(iii) 2 or more fatal accidents in 5 years; or

(iv) 8 or more pedestrian injury accidents in 3 years.

can be identified and priority lists for investigation can be prepared. Investigation of sites on the basis of 'worst first' is the usual approach and avoids erratic and subjective selection of sites.

3.2.1.4 A typical extract from a computer printout of accident blacksites, sorted by the number of accidents is shown in Fig. 3.2.1.1.

3.2.1.5 Sites falling outside the threshold criteria are not normally investigated. However, it should be noted that the definition of accident blacksite for investigation should not be enforced too rigidly. A degree of flexibility of approach investigations should be maintained so that locations which may have attracted special interest either from the general public or other Government Department can be included for investigation.

FIG. 3.2.1.1: TYPICAL COMPUTER ACCIDENT BLACKSITE PRINTOUT

TRAFFIC ACCIDENT DATA SYSTEM
ACCIDENT SITE LIST PERIOD: 01/04/2000 - 31/03/2001
BY REGION / BY NUMBER OF ACCIDENT

REG	DIV	STREET 1	STREET 2	PED	TOTAL	FA	SE	RANK
H	HV	MORRISON HILL RD	SPORTS RD	0	18	0	0	1
H	A	AP LEI CHAU BRIDGE RD	AP LEI CHAU DRIVE	3	13	0	4	2
H	WCH	JOHNSTON RD	FLEMING RD	9	11	0	4	3
H	WCH	GLOUCESTER RD	MARSH RD	2	11	0	0	4
H	WCH	HENNESSY RD	FLEMING RD	3	11	0	2	5
H	W	DES VOEUX RD W	CONNAUGHT RD W	4	11	0	1	6
H	WCH	GLOUCESTER RD	PERCIVAL ST	0	10	0	1	7
H	SKW	YIU HING RD	NAM HONG ST	7	10	0	3	8
H	CW	CHAI WAN RD	WAN TSUI RD	0	10	0	0	9
H	NP	TIN CHIU ST	KING'S RD	1	9	0	2	10
H	WCH	HENNESSY RD	PERCIVAL ST	3	9	0	1	11
H	WCH	HENNESSY RD	TIN LOK LANE	6	9	0	3	12
H	W	POK FU LAM RD	POKFIELD RD	1	8	0	1	13
H	WCH	HENNESSY RD	MARSH RD	5	8	0	2	14
H	NP	KING'S RD	SHU KUK ST	3	8	0	5	15
H	SKW	SHAU KEI WAN RD	NAM HONG ST	1	8	0	3	16
H	NP	KING'S RD	TONG SHUI RD	5	8	0	4	17
H	HV	WONG NAI CHUNG RD	QUEEN'S RD E	0	8	0	1	18
H	WCH	GLOUCESTER RD	CANNON ST	1	8	0	0	19
H	NP	CAUSEWAY RD	HING FAT ST	2	8	0	1	20
H	HV	MORETON TERRACE	CAUSEWAY RD	3	8	0	1	21
H	WCH	WAN CHAI RD	BULLOCK LANE	7	8	0	3	22
H	W	POK FU LAM RD	SASSOON RD	4	8	0	2	23
H	W	BELCHER'S ST	SANDS ST	4	8	0	2	24
H	A	ISLAND RD	DEEP WATER BAY RD	2	7	0	3	25
H	WCH	HENNESSY RD	YEE WO ST	3	7	0	2	26
H	WCH	PERCIVAL ST	LOCKHART RD	5	7	0	1	27
H	CW	TAI TAM RD	CHAI WAN RD	1	7	0	2	28
H	C	DES VOEUX RD C	PEDDER ST	2	7	0	2	29
H	A	REPULSE BAY RD	ISLAND RD	0	7	0	1	30

3.2.2 Size of Study Area at Each Accident Blacksite

3.2.2.1 Since the number of accidents at or near to a specific location depends very much on the extent of the site, it is important to define the limits of the site and to include in the study all the accidents which could be attributed to it and the features within it. In normal practice, it is often found that some accidents are not accurately coded, and therefore it is advisable to obtain the full computerized details of all the accidents recorded in the vicinity of the site and then checked manually to discard those which are thought to be irrelevant.

3.2.2.2 The size of accident blacksite chosen for investigation should be as specific as possible and usually it will centre around a single dominant highway feature such as a junction, a bend, a crest, a short stretch of road etc. With more complex features such as multilevel interchange, it is advisable to subdivide it into smaller individual features and consider each one on its own before considering their relation to each other and to the whole. This greatly simplifies the investigation procedure and provides a more orderly approach to what may at first appear to be very random unrelated accident pattern.

3.2.2.3 The following gives a very rough idea of the size of blacksites usually encountered :

Type of Blacksite	Limits	Remarks
i) Junction	Junction Area + 70m of each approach	Include all 'at' or 'near' junction accidents
ii) Bend/Crest	Area of bend + 100m/50m each side	Subject to site conditions
iii) A length of road	500m or 1000m	Subject to site conditions

Unfortunately it is not possible to be more specific on the limits of a site as these depend so much on site conditions. At a bend, for example, the extent of road beyond the bend which should be included in the investigation depends to a large extent on the severity of the bend. The situation is similar to that at the crest of a hill.

3.2.3 Problems in Identification of Blacksites

3.2.3.1 With the present Traffic Accident Data System, the ranked priority list sometimes cannot reflect the true accident situation of those sites whose locations can be described in a number of ways. Some examples are discussed below

(i) If a junction is formed by 2 roads, then all accidents which occurred ‘at’ or ‘near’ to the junction will appear in the priority list. However, if more than 2 roads join at a junction, the total accidents 'at' or 'near' to this junction will be obtained by summing up all the total accidents for each pair of road name combinations. For example, 3 road names given 3 "paired" combination and therefore requires 6 requests.

(ii) Problems also arise when some accidents are coded with different identifying features but refer to the same location. This can be exemplified as follows :-

(Lion Rock Tunnel Rd near Kok Tin Tsuen same as
(Lion Rock Tunnel Rd near Kat Tin Tsuen
(Sha Kok St near Pok Hong Estate same as
(Sha Kok St near Sha Kok Estate
(Castle Peak Rd near Yick Yuen same as
(Castle Peak Rd near Yick Yuen Tsuen

There is no easy answer to this problem. Advice on how to specify the location correctly can be obtained from Road Safety & Standards Division, TD.

3.3 Types of Investigation

3.3.1 General

3.3.1.1 There are four basic options for accident reduction by low cost remedial measures, namely individual blacksite investigation, route investigation, area investigation and MASS action plans. Which option to choose will depend upon the nature of the problem and the resources available, both for investigation and for implementation of any remedial measures developed.

3.3.2 Individual Blacksite Investigation

3.3.2.1 An individual blacksite investigation may be defined as an investigation at a precise location which is identified by a special feature of road geometry such as a junction, bend, crest of a hill etc.

3.3.2.2 The investigation of such a site is usually treated in isolated from the surrounding area, and remedial measures are developed which are specific to that location.

3.3.2.3 The advantage of this approach is that the site can usually be investigated quickly and the remedial measures proposed can usually be readily agreed and implemented.

3.3.3 Route Investigation

3.3.3.1 When a route exhibits an accident rate higher than the territory average rate for character of road and the traffic conditions, it is appropriate to carry out a route investigation.

3.3.3.2 The first step in this type of study is to plot the accidents on as large a scale plan as possible with great accuracy. It will almost invariably be found that the accidents tend to spread evenly along the route or are in the form of small clusters. The whole route is treated as a single entity, with emphasis being placed on identifying contributory factors which are common to a substantial number of the accidents/clusters along the route. Comprehensive route-orientated remedial measures are developed. Some examples of contributory factors identified and possible remedial measures are :

Contributory factor	Remedial measure
Darkness	Improvement in road lighting
Wet-skid	Improvement in road surfacing
Single loss of control at night	Reflective edgeline markings/road studs
Bend hazards	Advance warning/realignment of road
High risk for a particular vehicle type	Vehicle prohibition

3.3.4 Area Investigation

3.3.4.1 Area investigation is similar to a route investigation but usually covers an area with distinct characteristics. Using either manual plots or computer analysis, it is possible to identify a specific area having a particularly high accident densities. These areas may also require action on environmental grounds in addition to accident grounds and the accident situation may form the basis for discussions on the comprehensive improvement of the environment of the area or a comprehensive traffic management scheme.

3.3.4.2 Using this type of investigation, it may sometimes be possible to influence otherwise intractable traffic problem. However, it may also have the difficulties of obtaining agreement from various parties since the remedial measures recommended usually involve area-wide traffic management and have the disadvantage of taking a relatively long time to agree and implement. Area investigations are usually only appropriate for urban area problems.

3.3.4.3 Because of the difficulties of investigation, agreement and implementation of these area schemes, an area investigation may be more appropriate in providing background input as part of an area-wide traffic management study, as an aid in formulating proposals.

3.3.5 MASS Action Plans

3.3.5.1 MASS action is the Multiple Application of Standard Solutions as an accident remedial measure technique.

3.3.5.2 In MASS action studies, accident sites are identified where the application of known effective accident remedial measures is likely to be beneficial. Possible sites are identified using computer sorting techniques which highlight locations at which Territory norms for various types of accidents, e.g. in the wet, dark, or right turn accidents, are greatly exceeded. Standard solutions are then applied on a group basis, a number of locations being treated in one programme.

3.3.5.3 Computerized plotting of accidents to an appropriate scale assists in determining the extent of the treatment required at each location.

3.3.5.4 Typical problems and remedial measures suitable for MASS action techniques are listed below :

Specific factor problem	Possible Mass Action
Darkness	Improvement in road lighting
Wet-skid	Improvement in skid resistance of road surfacing
Right-turn	Ban the right turn/modify the method of control/indicative right turn green arrow
Single loss of control at night	Reflective edgeline marking/road studs
Conflict at junctions	Signalization/prioritization of junctions
Head-on collisions	Review of c/w markings, alignments, crossfall etc

3.3.5.5 The advantage of this technique is that it makes very efficient use of limited manpower resources to study accidents. Known effective accident reduction measures can be implemented at a large number of locations with a comparatively small amount of accident study at each location. Multiple application of a particular remedy measure that the work can be carried out efficiently and very cost-effectively.

3.3.5.6 This technique is also applicable to publicity and road user training schemes. Examples are :
Accidents to the elderly/the young
Speeding accidents
Cyclists accidents
Pedestrian crossing accidents

3.4 In-Depth Studies

3.4.1 Data Requirements

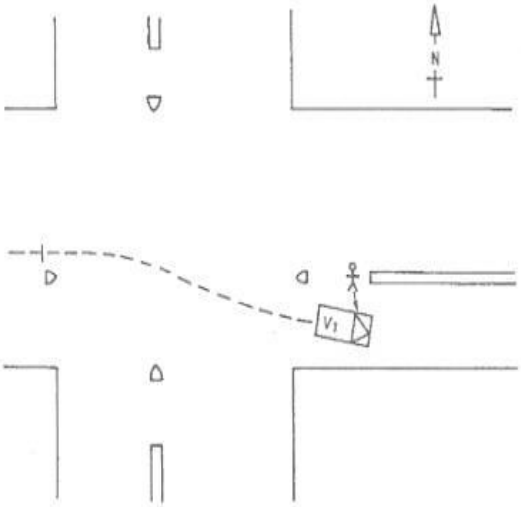
3.4.1.1 Before carrying out any in-depth study, it is necessary to undertake the following steps :

(i) Accident investigations should only be carried out at "stable" sites. Therefore, first check whether any road schemes/improvements which might affect the occurrence of the accidents have been (a) carried out within the past 12 months or (b) are likely to be implemented within the next 12 months. If either proves to be the case, in-depth investigations should be deferred until a suitable time after the alterations have been completed and the accident situation has been allowed to stabilize (usually 12 months). If, after the stabilization period, there still appears to be a problem then a full investigation should be carried out, that is, 12 months only is required after any modification before a study is carried out. At sites where a short term or recently introduced problem is blatantly obvious, remedial measures can and should be introduced earlier.

(ii) Obtain the full computerized details of all the accidents in the vicinity of the site. If it is considered that the computer data is not sufficient, individual police accident files including statements taken from drivers, witnesses etc. should be examined. Fig. 3.4.1.1 shows a typical synopsis of the details contained in the police file relating to one pedestrian accident. Normally the police files should be consulted if the detailed accident data in the computer is insufficient to locate the accident precisely. Also, police files should be checked if any conflicting data is found. Normally, a continuous 12-month period will be chosen as the study period. However, if difficulties are, or likely to be, experienced in establishing accident pattern for sites with relatively small number of accidents, it is advisable to extend the study period in multiples of 12 months in order to eliminate the effects of seasonal variations, say 24 months, or even 36 months. If the study period is extended to 24 or 36 months, the check on the traffic history of the location must also be extended accordingly.

(iii) Prepare a most recent site plan. Depending on the nature of the site, 1/2000, 1/1000 or 1/500 are the most convenient scales for individual site studies. A site visit may be necessary at this stage to confirm site details.

FIG. 3.4.1.1: SUMMARY OF POLICE TRAFFIC ACCIDENT FILE DAT

<table>
<tr><td rowspan="3">ARB No.</td><td rowspan="3">LOCATION
Nathan Rd. / Mong Kok Rd</td><td colspan="3">TIME 21:45 STATE OF LIGHT Dark</td></tr>
<tr><td colspan="3">DAY Mon STATE OF WEATHER Fine</td></tr>
<tr><td colspan="3">DATE 16.5.83 STATE OF ROAD SURFACE Dry</td></tr>
<tr><td colspan="2">CLASS SEVERITY
Ped Serious</td><td>AGE & NUMBER OF ROAD USERS
Male 47</td><td colspan="2">TYPE MAKE & NUMBER OF VEHHICLE INVOLVED
Bus A.E.C.</td><td>D/L No.</td></tr>
<tr><td colspan="3">VIOLATIONS AND ERRORS COMMITTED BY ROAD USERS
Nil</td><td colspan="2">VEHICLE DEFECTS
Nil</td><td>HIGHWAYS' DEFECTS OR LIMITATIONS</td></tr>
<tr><td colspan="3" rowspan="2">DETAILED SKETCH SHOWING ALL ROAD USER MOVEMENTS, AND CONFLICTS, TOGETHER WITH ALL ENVIRONMENTAL FEATURES WHICH COULD HAVE A BEARING ON THE ACCIDENT.
 
</td><td colspan="3">ACCIDENT STORY
V1 travelling E in outer lane of Mong Kok Rd. passed j/w Nathan Rd. struck ped.Crossing from nearside.
Driver stated he restarted from traffic signals reached 18mph in 3rd gear when passing crossing ped. Stepped out from nearside, he swerved right out nearside front of bus hit ped.
Ped. states he crossed Mong Kok Rd. without checking ped. signals, paused on central island looked left, saw no traffic and crossed.</td></tr>
<tr><td colspan="3">INVESTIGATORS' NOTES & COMMENTS
Another ped. looking the wrong way on the central island.</td></tr>
</table>

3.4.2 Analysis of Data

3.4.2.1 The normal procedure to be followed for the analysis of blacksites is as follows :

Step 1 Collision Diagram

(a) A collision diagram is prepared by reconstructing the accidents in accordance with their circumstances under which they occurred on a suitable scale site plan. The most important use of the collision diagram is to provide a starting point for the classification of each accident within the cluster and to show an initial picture of the accident situation.

(b) In preparing the collision diagram, it is much more important to plot accurately the points of actual conflicts rather than the terminal position of vehicles. In some cases, the point of origin of the sequence of events leading up to an accident may provide a much more important clue to the remedial action required than either the point of conflict or the terminal position of the vehicles. For example, on a straight downhill stretch of road following a bend, there were a substantial number of both head-on collisions and single vehicle accidents. It transpired that drivers were losing control on the bend, and whether they eventually recovered, left the road, or struck other vehicles was a matter of chance. In such a case, the point of origin may be a hundred metres or more from the point of conflict. Therefore, it is sometimes the point of origin and not point of conflict which is more important and should be plotted.

(c) Having carefully plotted the points of conflict/origin, the next step is to determine both the approach paths and the intended departure paths of the vehicles immediately involved. A typical collision diagram is shown in Fig. 3.4.2.1. The visual representation of the accidents is very useful in determining accident patterns. Fig. 3.4.2.2shows the diagrammatic representation of the accidents most commonly encountered.

FIG. 3.4.2.1: TYPICAL COLLISION DIAGRAM FOR A JUNCTION

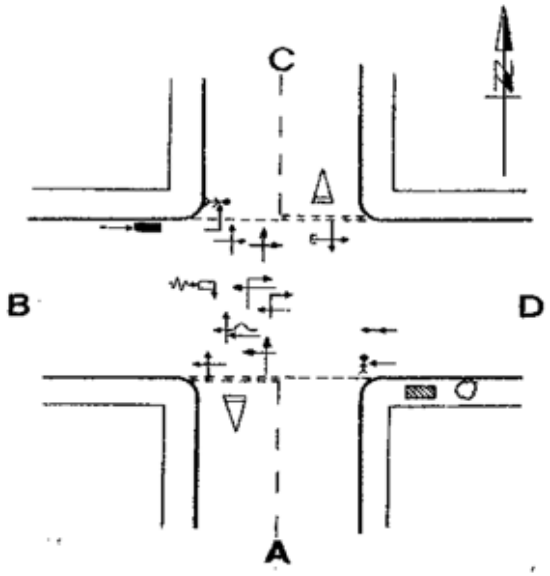
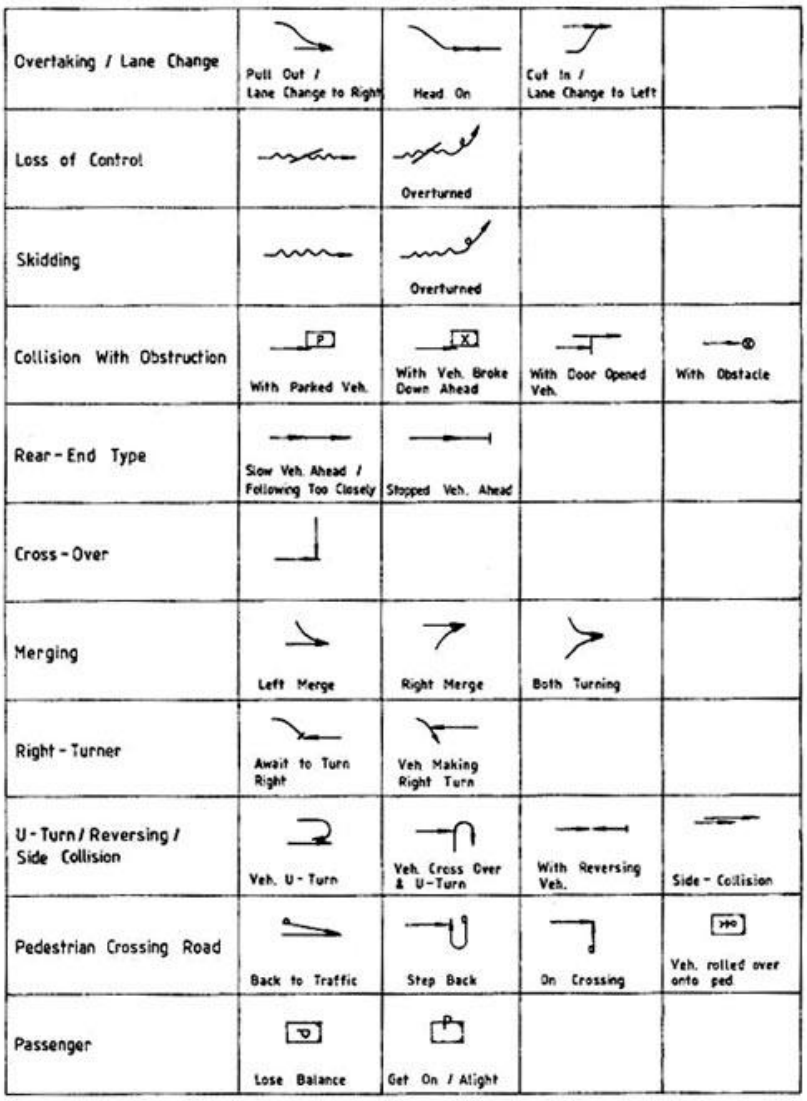


DIAGRAM 3.4.2.2: TYPES OF COLLISION SYSMBOLS



Step 2 Stick Diagram

(a) Following the collision diagram, a list of factors relating to each accident known as a stick diagram is produced in order to highlight the dominant accident patterns.

(b) In preparing the stick diagram, a rigid or standard list of factors should be avoided. It is true that factors such as severity, weather, light/dark, direction of travel etc. will usually appear, but other factors will also appear as the investigator studies each accident and eventually a list of factors unique to the study location will develop. Some of the factors may only apply to one or two of the accidents, but at the time of preparing the grid they should be included. They can be discounted later if it is felt that they are not relevant to the study or in determining the dominant accident type.

(c) Although the arrangement of the factor grid and its contents are personal to the investigator and permit him the flexibility to pursue the investigation as he considers appropriate, it is advisable to adopt some standards for symbols and methods of recording. It is also advisable not to make the symbols and information in the grid too elaborate. This only detracts from their usefulness. If there are 2 alternatives to a factor e.g. wet or dry, light or dark, it is advisable to record one only, the other being assumed by default. Symbols should be used in preference to words. In this way the contributory factors stand out and are not lost under a jumble of other data. A typical stick diagram is shown in Fig. 3.4.2.3.

(d) In order to make full use of the stick diagram, it is normal to cut the grid into strips or sticks for each individual accident and rearrange the strips until some order or pattern becomes evident.

FIG. 3.4.2.3: TYPICAL STICK DIAGRAM FOR A JUNCTION

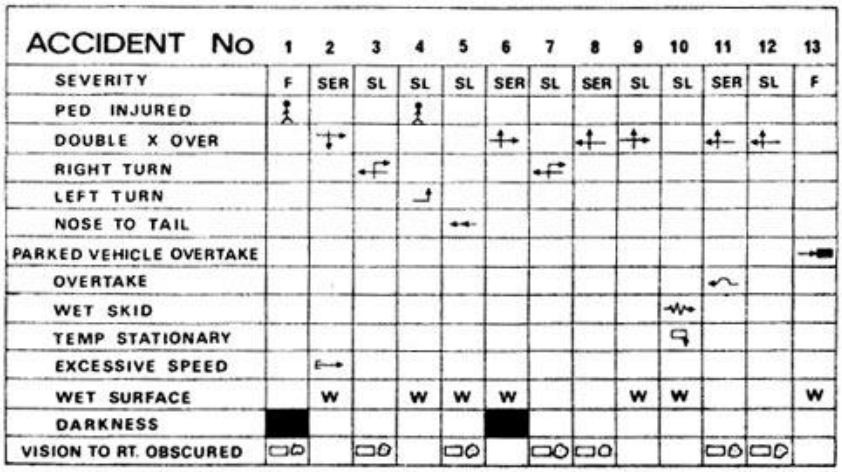
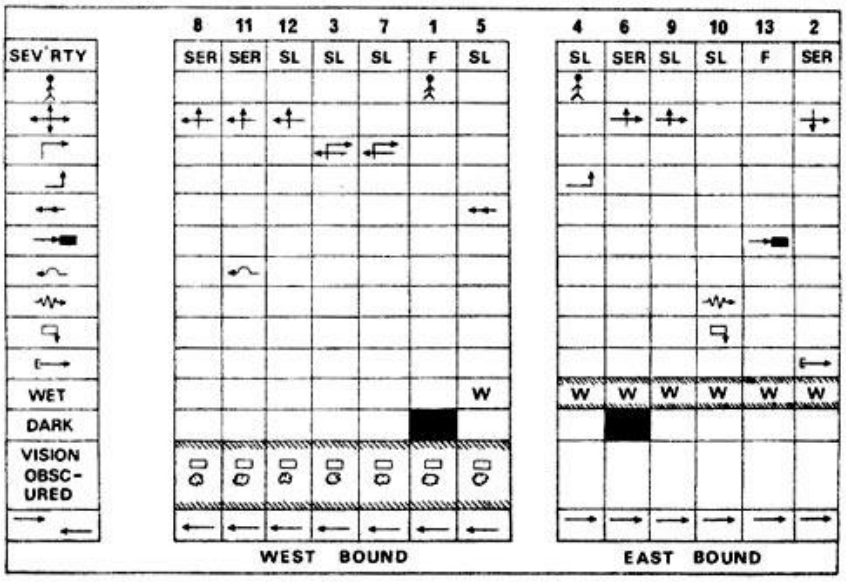


FIG. 3.4.2.4: TYPICAL STICK DIAGRAM, REARRANGED TO HIGHLIGT ACCIDENT PATTERNS



Step 3 Environmental Factors Histogram

(a) Factors which are not shown in the stick diagram are those relating to time. Many accidents occur simply because a number of factors combine at the same time and result in the occurrence, of an accident. However some of these factors only occur at specific times either a time of the day, day of the week or month of the year. They could for example occur at times of the day associated with schools closing or the end of a cinema or theatre performance or sports event. They could occur on certain days corresponding with recreational traffic or horse racing events. They could also occur at certain times of the year such as the pre-Lunar New Year shopping boom or the summer “rainy season".

(b) The best way to see if any of these "seasonal" factors is relevant is to prepare a histogram based on the number of accidents and the "time" that they occurred.

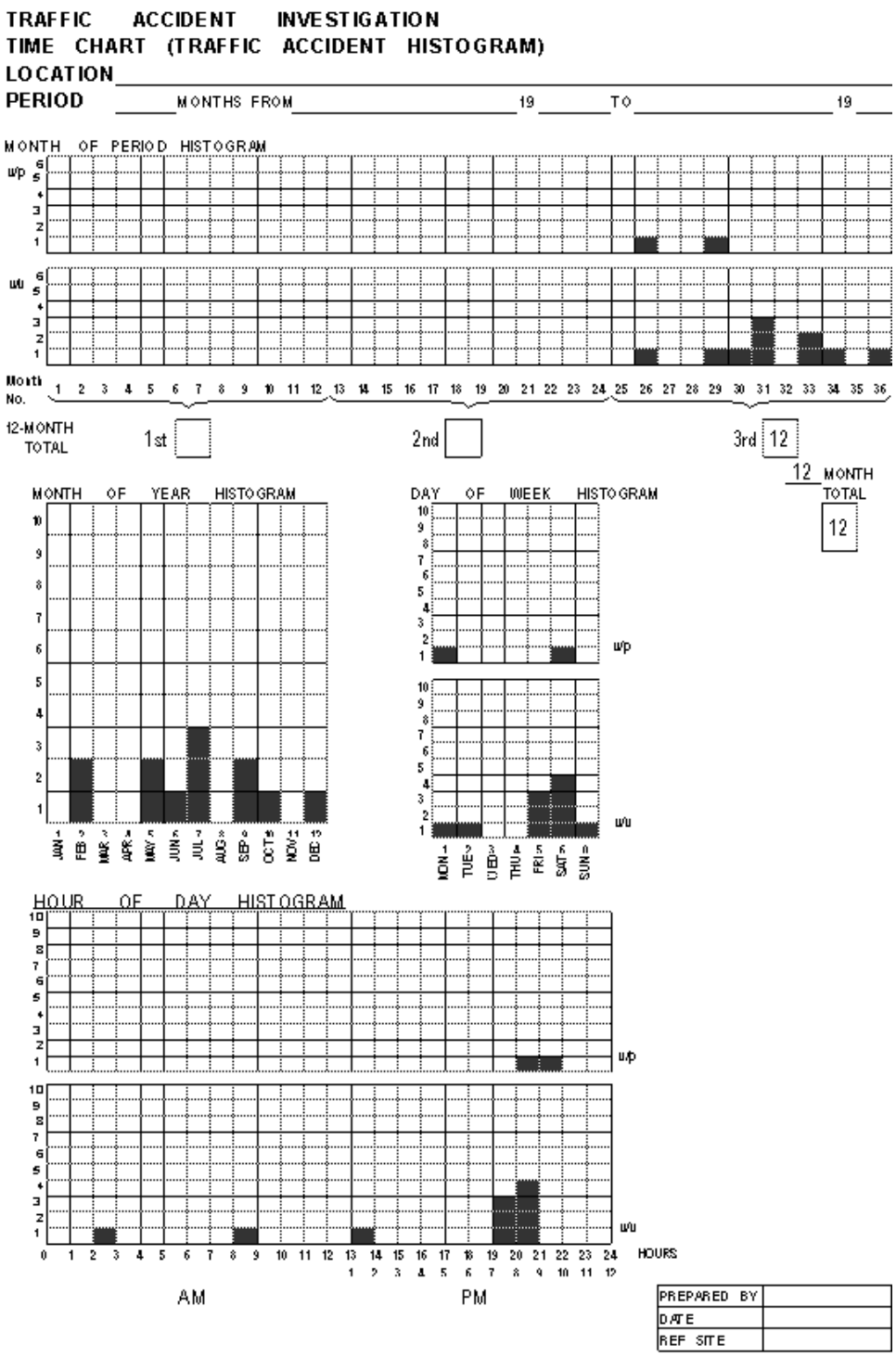
Step 4 Evaluating the Diagrams

(a) After the above diagrams are prepared, it is up to the investigator to look for an accident pattern e.g. time of accident, type, weather, location, road surface, visibility etc. As a rough rule-of-thumb, if 30% or above of the accidents tend to cluster at a particular location and/or possess common factors, it is considered as an accident cluster and tailor-made remedial measures are worthwhile pursuing for the location.

(b) Diag. 3.4.2.1 shows the typical collision diagram for the accidents over a 12-month period at a major/minor cross road junction. Some of the accident types appear to be similar, but generally there may not be an obvious pattern.

(c) Fig. 3.4.2.2 shows the diagrammatic representations of the accidents most commonly encountered. Fig. 3.4.2.3 shows the typical stick diagram for the accidents at the same junctions. By rearranging the strips, or the order of the accidents in Fig. 3.4.2.3 the arrangement in Fig. 3.4.2.4 emerges, and the common factors and the dominant accident types become clear. From this stick diagram, it is evident that in the 7 accidents involving westbound vehicles, there appears to be a visibility problem and with the 6 accidents involving eastbound vehicles, the road surface appears to cause problems when it is wet.

FIG. 3.4.2.5: TYPICAL ENVIRONMENTAL FACTORS TIME CHART HISTOGRAM



(d) With the same example, Fig. 3.4.2.5 shows the time chart for the above accidents. It is noted that there appears to be a significant peak on Fridays and Saturdays and also in the early evening. The investigator can then follow up this clue to see if some significant event takes place at these times. It could be a specific event or just something as simple as a very popular restaurant area which attracts a lot of customers on Fridays and Saturday evenings. The month of the year in which most of the accidents occur does not appear to be significant in this example.

Step 5 Systematic Site Survey

(a) Quite often many of the underlying factors will not appear in the accident detail selected for routine computer processing, or even in the source data. In many cases, they can only be obtained from a systematic site survey. Besides the traffic aids, it is therefore important to check on site other factors which are contributory to the accidents.

(b) A systematic site survey is divided into 3 stages :

(i) Getting the 'feel' of the problems which are experienced by the minority of road users who are involved in accidents. In order to appreciate the road users view point fully, it is advisable to start some distance from the site and drive along all the conflict paths.

(ii) Examination of the main features of the site: alignment, signing, lighting, condition of road markings etc.

(iii) Search for concealed factors relating to the accident types which occur.

(c) Since so many features need to be considered in carrying out the systematic site survey, it is strongly recommended that a check list be prepared beforehand. To this end, a check list such as that shown at Appendix 1 should be used.

Step 6 Identify Common Factors

(a) Using the data assembled in steps 1 to 5 above, an attempt should then be made to identify and list the factors common to groups of accidents. Once these common factors have been identified, remedial measures can then be developed to obviate or minimize the effect of these factors and hence reduce the risk of accidents arising from them.

(b) If no common factors are revealed after working through the above steps, then it may be worthwhile to consider extending the study period incrementally by 12 months provided that the traffic engineering history of the site is stable. If common factors are still not found, no remedial action should be taken at the location. It is not cost effective to undertake remedial measures which attempt to overcome factors which appear in single accidents only.

3.4.3 Formulation of Remedial Measures

3.4.3.1 After the common-factor problems of a blacksite have been identified, tailor-made remedial measures should be devised to reduce the accident risk. For any specific problem, there may be alternative treatments suitable or a combination of treatments may be the most effective. The selection of appropriate remedial measures essentially requires engineering judgement and one must take into account practicability of implementation and economic considerations. Therefore, recommended remedial measures should normally be relatively cheap and quick to implement, and should take into account such factors as junction/road capacity.

3.4.3.2 Actual measures taken will depend very much on the accident problem encountered, but some typical problems and possible solutions are briefly discussed below :

Problem	Possible Measures to be Considered
1) Pedestrian accidents at signal controlled junctions	a) Install pedestrian phase/signals to give a clear indication to pedestrians when they can safely cross the road.
	b) Increase pedestrian green time/reduce unused vehicle green time/check the pedestrian flashing green time.
	c) Eliminate split phase movements on the approach to crossings.
	d) Lay yellow stripe markings at signalised pedestrian crossings to highlight the crossing and to reduce vehicle blocking of the crossing.
	e) Provide central refuge islands/staggered crossings.
	f) Channelise pedestrian movements by guardrailing/central fencing.
	g) Adjust signal timings to reduce queue back problems/to reduce vehicle speed by altering progression speed through the signals.
	h) Breaking vehicle progression along a route with coordinated signals during off-peak periods.
	i) Close the crossing and channelise pedestrians to a safer crossing point using guardrailing.
2) High pedestrian/vehicle conflicts	a) Provide pedestrian crossing facilities - cautionary, zebra, signal controlled and grade-separated.
	b) Install warning signs.
	c) Channelise pedestrian movements.
3) Blocking of sight-lines by stopping of vehicles such as taxis, goods vehicles, PLBs, etc. for loading/unloading activities	a) Impose stopping restriction.
	b) Relocate bus/PLB stops.
	c) Erect central fencing to deter pedestrians from crossing at hazardous locations.
4) Pedestrian accidents at tram tracks adjacent to tram islands/refuge islands	a) Impose tram only lane.
5) Wet-skid accidents	a) Check texture depth/drainage and skid resistance of the road and if necessary consider most appropriate measures to effect improvement, e.g. improving skid resistance where necessary.
	b) Install warning signs.
	c) Provide U-channels to intercept water seeping out from adjacent slopes, if any.
	d) Check and adjust superelevation if necessary.
6) Single vehicle loss of control	a) Check road surface and need for resurfacing or even reconstruction.
	b) Lay reflective edgeline markings/road studs if majority are night-time accidents.
	c) Provide advance warning of isolated hazards such as 'bend' signs, chevron signs, 'SLOW' markings etc.
	d) Check superelevation.

7) Night-time accidents	a) Check adequacy of road lighting
	b) Install reflective road studs.
	c) Lay reflective edgeline markings (paint alternate black/white stripes on roadside kerb if road width is too narrow to allow edge lining).
8) i) Right-turn accidents at signal controlled junctions	a) Install indicative right-turn green arrow.
	b) Provide separate right-turn phase if approach speeds are high.
	c) Ban the right-turn (if this movement is light and an alternative safer route is available).
	d) Lay right-turn pocket.
	e) Check visibility obstruction.
8) ii) Right-turn accidents at priority junctions	a) Check visibility obstruction.
	b) Define clearly the priority.
	c) Form a protected right-turn lane by hatched markings if rear-end collisions are high.
	d) Prohibit movement if it is light and a suitable alternative is available.
9) Cross-over collisions	a) Define clearly the priority.
	b) Check visibility obstruction.
	c) Install traffic signals.
	d) Increase intergreen period.
10) Nose to tail collisions	a) Check skid resistance of road surface.
	b) Increase conspicuity of signals - backing boards/larger signal aspects/high intensity aspects at signal controlled junctions.
11) Head-on collisions	a) Install double white lines to prevent overtaking.
	b) Increase separation of opposing traffic flows by forming central hatched markings e.g. at bends.
	c)Provide central crash barrier/fencing.
	d) Install warning signs for isolated hazards.
	e) Check visibility obstruction.
12) Lane-changing collisions	a) Erect/relocate direction signs
	b) Lay appropriate reflective destination road markings on carriageway.
	c) Modify road markings to encourage lane discipline.

3.5 Conflict Studies

3.5.1 Conflict studies are studies of the "near-miss" incidents at locations where for various reasons accident history data is either insufficient or inconclusive.

3.5.2 Conflict studies may be useful at new locations where a potential accident problem is suspected and remedial measures are contemplated, without having to wait for a substantial accident history to develop. They are also helpful in confirming whether a particular common factor is having a marked effect on accidents at a particular site.

3.5.3 The suspected hazardous movement (or movements) is studied by observing the vehicle which is "surprised" or interfered with by the manoeuvering vehicle/pedestrian. The vehicle is usually observed from the rear, the breaking lights and swerving being an indication of conflict which could have resulted in a possible accident.

3.5.4 Conflict studies require significant staff inputs in site survey work and subsequent analysis. This can be minimized to some extent by the use of video recording techniques.

Appendix 1

SYSTEMATIC SITE SURVEY
MAIN SITE FEATURES

- 1 -

Feature	Aspect	Presence/Condition/Type	Remarks
ROAD	Carriageway	Width in m. _____ No. of lanes _____	
	Footway	Yes ____ No ____ width _____m	
	Marginal Strip	Yes ____ No ____ width _____m	
	Kerbs	Type _____ Condition _____	
	Boundary wall	Yes ____ No ____ height _____m	
	Hedge	Yes ____ No ____ height _____m	
	Railings	Yes ____ No ____	
	Hoarding	Yes ____ No ____ height _____m distance from kerb face _____m	
	Buildings	Yes ____ No ____ height _____ storey _____	
	Street furniture	Distance of nearest object from face of kerb _____m	
	Central Reserve	Yes ____ No ____ width _____m	
	Marginal Strip	Yes ____ No ____ width _____m	
	Channels	Type _____ Condition _____	
	Drainage gullies	Spacing _____m_ number _____	
	Trees	Yes ____ No ____. Visibility problem? Yes ____ No ____. Clearance Problem? Yes ____ No ____	
	Slopes	Yes ____ No ____. Visibility problem? Yes ____ No ____. Clearance Problem? Yes ____ No ____	

Feature	Aspect	Presence/Condition/Type	Remarks
ROAD	Shaded	Yes ____ No ____. Visibility problem? Yes ____ No ____	
	Carriageway definition	Poor ____ Av. ____ Good ____	
	Road Surface	Poor ____ Av. ____ Good ____	
	Manholes	Location and level difference Poor ____ Av. ____ Good ____	
	Crossfall	Poor ____ Av. ____ Good ____	
	Vertical profile	Level ____ Uphill ____ Downhill ____	
	Roadworks	Position _____ Major ____ Minor ____ Long term ____ Short term ____ Properly signed? Yes ____ No ____	
	Any other aspect worth noting	_____	
BENDS	Present	Yes ____ No ____ Single ____ Multiple ____	
	Approx. radius	_____m	
	Superelevation	Level ____ OK ____ Adverse camber ____	
	Approx. safe speed	_____ km/h	
	General approach speed of traffic	OK ____ Too fast ____ If too fast, why? _____ _____	
	Is approach deceiving	Yes ____ No ____	
	Vertical profile	Level ____ Gradient ____ Crest ____ Sag ____	
	Barriers/fences	Yes ____ No ____ Type _____ Do they obstruct visibility? Yes ____ No ____	
	Special surfacing	Yes ____ No ____ Type _____	

Feature	Aspect	Presence/Condition/Type	Remarks
JUNCTIONS		At ____ Near ____ remote from ____ type _____	
	Signals	Yes ____ No ____ High Intensity ____ Low Intensity ____. Properly aligned aspect heads? Yes ____ No ____. Damage? Yes ____ No ____ Specify _____ _____	
	Kerbed islands	Yes ____ No ____. Correctly positioned? Yes ____ No ____. Size _____ m X _____m	
	Ghost islands	Yes ____ No ____ Correctly positioned? Yes ____ No ____ Size ____m x ____m	
	Approx. turning radii	Right turns _____m Left turns _____m Compare with TPDM V.2, Table 3.3.3.1. Are radii adequate for general approach speed? Yes ____ No ____	
	Central refuge	Yes ____ No ____. Peds crossing in carriageway at junction? Yes ____ No ____	
	Obstructions	Yes ____ No ____ Type _____	
	Visibility	Good ____ Av. ____ Poor ____ Compare with TPDM V.2 Ch.4	
	Any other site specific problem	Yes ____ No ____ If yes give details _____ _____	
TRAFFIC SIGNS	Mandatory	Type _____	
	Warning	Type _____	
	Direction	Type _____	
	Chevron	Yes ____ No ____ Not needed _____	

Feature	Aspect	Presence/Condition/Type	Remarks
TRAFFIC SIGNS	Other	Type _____ Do any of the signs block visibility of or for peds? Yes ____ No ____ Do any sign poles obstruct peds? Yes ____ No ____	
	Conspicuity	Poor ____ OK ____ Good ____	
	Are all signs reflective	Yes ____ No ____ Which are not _____	
	Illuminated	Yes ____ No ____ Which are not _____	
	Correct size	Yes ____ No ____ Which are not _____	
	Correct position	Yes ____ No ____ Which are not _____	
	Any other facts	_____	
ROAD MARKINGS	Double white line	Yes ____ No ____	
	Warning lines	Yes ____ No ____	
	Edge lines	Yes ____ No ____	
	Slow	Yes ____ No ____	
	Arrows	Yes ____ No ____ Type _____ e.g. lane drop or lane marking	
	Destination	Yes ____ No ____	
	Give way/Stop	Yes ____ No ____	
	Conspicuity of all markings	Poor ____ OK ____ Good ____	
	Are all markings reflective?	Yes ____ No ____ If no, which are not _____	
	Any other facts	_____	

Feature	Aspect	Presence/Condition/Type	Remarks
PEDESTRIANS	Flow	Light ____ Medium ____ Heavy ____	
	Ped phase on Signals	Yes ____ No ____	
	Crossing type	Straight ____ Split type ____	
	Zebra	Yes ____ No ____	
	Guard rails	Yes ____ No ____ One side only ____ both sides ____ neither side ____	
	Footway	Yes ____ No ____ One side only ____ both sides ____ neither side ____ width _____ m	
	Obstructions to footway	Yes ____ No ____ Type _____ e.g. hawker stall, cfs, shop front	
	Lighting	Is lighting at crossing poor ____ adequate ____ good ____ ?	
	School route	Yes ____ No ____	
	Crossing patrol	Yes ____ No ____	
	Visibility	Any obstructions of or for peds Yes ____ No ____ details _____	
REGULATIONS	Speed limit	_____ km/h	
	Parking	Yes ____ No ____ times _____	
	Loading	Yes ____ No ____ times _____	
	One Way street	Yes ____ No ____	
	No right turn	Yes ____ No ____	
	No left turn	Yes ____ No ____	
	Other	_____	

Feature	Aspect	Presence/Condition/Type	Remarks
LIGHTING	Are there street lamps?	Yes ____ No ____	
	Height	_____	
	Type	_____	
	Intensity	Poor ____ Average ____ Good ____	
	Distribution	Poor ____ Average ____ Good ____	
	Column positioning	Poor ____ Average ____ Good ____	
	Any obstructions?	Yes ____ No ____ Type _____ e.g. neon signs etc.	
	Night time parking?	Yes ____ No ____	
VISIBILITY	General	Poor ____ Average ____ Good ____	
	Vertical curve	Poor ____ Average ____ Good ____	
	Horizontal curve	Poor ____ Average ____ Good ____	
	Into side roads	Poor ____ Average ____ Good ____	
	From side roads	Poor ____ Average ____ Good ____	
	Bus stops	None ___ Poor ___ Av. ___ Good ___	
	Poles/kiosks/boxes	None ___ Poor ___ Av. ___ Good ___	
	Slopes	None ___ Poor ___ Av. ___ Good ___	
	Vegetation	None ___ Poor ___ Av. ___ Good ___	
	Buildings	None ___ Poor ___ Av. ___ Good ___	
	Parking	None ___ Poor ___ Av. ___ Good ___	

Feature	Aspect	Presence/Condition/Type	Remarks
VISIBILITY	Is visibility blocked/reduced at certain times by loading/unloadings, illegal parking, PLB activity or other?	Yes ____ No____ type of obstruction_____ Time_____ frequency_____	

SYSTEMATIC SITE SURVEY FOR INDIVIDUAL SITES
CHECKLIST TO AID SEARCH FOR CONCEALED FACTORS

Type of Accident	Checks	Remarks
1.AT PRIORITY JUNCTIONS		
A.Junction overshoot (failure to stop at line when required)		
(i) Stop/Give Way line (Rm 1012/1013)	Is there a Stop/Give Way line? Yes ____ No ____ Is it well maintained? Yes ____ No ____	With all road markings an estimate of % wear would be useful.
	Is it in reflection material? Yes ____ No ____	
	Is it hidden from the driver under any conditions? Yes ____ No ____	
	If yes, specify conditions _____ _____	
	Is the marking correctly positioned? Yes ____ No ____	
	Could it be better positioned? Yes ____ No ____	
(ii) Hollow Triangle (Rm 1115)	Is there a hollow triangle? Yes ____ No ____	
	Is it well maintained? Yes ____ No ____	
	Is it in reflective material? Yes ____ No ____	
	Is it hidden from the driver under any conditions? Yes ____ No ____	

Type of Accident	Checks	Remarks
	If yes, specify conditions _____ _____	
	Is the marking properly positioned for approach visibility? Yes ____ No ____	
	If No, where should it be placed? _____	
(iii) Lane Markings on the approaches	Are all approaches marked in lanes? Yes ____ No ____	
	Are they lane markings (Rm 1101/1102) or hazard markings (Rm 1104/1105)? _____	
	Are the markings well maintained? Yes ____ No ____	
	Are they reflectorised? Yes ____ No ____	
	Are any markings concealed or obscured by other features or the road surface? Yes ____ No ____	
	If yes, specify _____	
	Have any old markings been removed/overlain? Yes ____ No ____	
	If yes have the old markings been properly obliterated? Yes ____ No ____	
	If no, specify problem _____ _____	
	Are any markings of mixed type (e.g. road paint/thermoplastic)? Yes ____ No ____	
	If yes, described layout _____ _____	

Type of Accident	Checks	Remarks
(iv) Lane direction Arrows. (These can increase the conspicuity of a junction as well as provide directional information).	Are there direction arrows in<u>all</u>lanes? Yes ____ No ____ Some ____ If some only, specify _____	
	Are the arrows well maintained? Yes ____ No ____	
	Are they reflectorized? Yes ____ No ____	
	Are they concealed or obscured? Yes ____ No ____	
	If yes, specify _____	
	Are they correctly positioned? (TPDM V.3 Ch.5) Yes ____ No ____	
(v) Worded Destination markings (like lane arrows these can increase junction conspicuity as well as give information).	Are there destination markings in all lanes? Yes ____ No ____ Some ____ If some only, specify _____ _____	
	Are they legible? Yes ____ No ____	
	Are they logical or confusing? _____	
	Are they reflectorized? Yes ____ No ____	
(vi) Stop/Give Way sign (TS 101/102)	(a) Is there a Stop/Give Way sign? Yes ____ No ____	
	Is it the size recommended in TPDM V.3 Table 2.2.2.1 having regard to the 85th percentile speed at the time of day at which the accidents occur? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(c) Is it well maintained? Yes ____ No ____	
	(d) Is it reflectorized? Yes ____ No ____	
	(e) Is kit positioned too far to the left? Yes ____ No ____	
	(f) Is it obscured? Yes ____ No ____ If yes, specify by what _____ _____	
	(g) Can its visibility be improved? Yes ____ No ____ If yes, how? ____ _____	
	(e.g. remove obstruction, realign kerb etc.)	
	(h) Does the sign merge with the background at the time of day at which the accidents occur? Yes ____ No ____	
	(i) Is the sign part of a close group of signs when viewed from a distance? Yes ____ No ____	
	(j) Is the sign lost in advertising signs? Yes ____ No ____	
	(k) Could strong sunlight affect driver's visibility at the time of day when the accidents occur? Yes ____ No ____	
	(l) Could nearby foliage obscure the sign? Yes ____ No ____	
	(m) Could large vehicles regularly obscure the sign at any time? Yes ____ No ____ (e.g. loading/unloading) If yes, specify _____	

Type of Accident	Checks	Remarks
(vii) Advance warning sign (TS401)	(a) Is there an advance warning sign? Yes ____ No ____	
	(b) Is it sited approximately at the distance from the junction recommended in TPDM V.3 Table 2.4.2.1? Yes ____ No ____	
	(c) Answer (vi)(b) to (m)	
(viii) Central refuges	(a) Is there a refuge island on any of the approaches? Yes ____ No ____ If yes, specify which approaches _____	
	(b) Can any refuges be provided? Yes ____ No ____ Specify _____ _____	
	(c) Do the refuges have duplicate Stop/Give Way signs on them? Yes ____ No ____ Some ___ If some, specify which _____	
	(d) Do the refuges have traffic bollards at the approach? Yes ____ No ____ Some ___ If yes, or some, specify type and sitting _____	
	(e.g. Keep Left on N refuge only, etc.)	
	(e) Can some/more bollards be provided? Yes ____ No ____	
	(f) Could junction conspicuity be improved by using a larger size Keep Left bollard on the approaches? Yes ____ No ____	
	(g) Is the central refuge staggered with respect to the one in the opposite side road? Yes ____ No ____ If No, can this be done? Yes ____ No ____	

Type of Accident	Checks	Remarks
(ix) Direction Signs	(a) Are there direction signs at the junction? Yes ____ No ____. If yes, specify type _____ _____	
	(e.g. flag type, map type)	
	(b) Are the direction signs reflectorised? Yes ____ No ____	
	(c) Are they well maintained? Yes ____ No ____	
	(d) Are they easily seen at the visibility distance appropriate to the speed of approach? Yes ____ No ____	
	If No, how could they be better sited? _____	
	(e) Are there map type advance direction signs? Yes ____ No ____	
	If No, could they usefully be installed to provide advance warning of the junction as well as directional information? Yes ____ No ____	
	(f) Is the main road indicated by a much thicker line than the side road? Yes ____ No ____	
	(g) Is the sign sited in accordance with TPDM V.3? Yes ____ No ____	
	(h) Can it be read and understood at a distance appropriate to the 85thpercentile speed prevailing at the time of day at which accidents occur? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(i) Does the sign obscure visibility of any other road signs or the junction detail? Yes ____ No ____	
	If yes, specify _____ (e.g. obscures Stop sign, etc.)	
	(j) Is sign reflectorised? Yes ____ No ____	
	(k) Is sign well maintained? Yes ____ No ____	
	(l) Does sign realistically show the junction layout? Yes ____ No ____	
(x) Perspective lines	(a) Do any of the following produce continuous perspective lines through the junction which could lead a driver to believe that he is on a straight length of road unbroken by a junction?	
	Building lines Yes ____ No ____	
	Walls Yes ____ No ____	
	Kerb lines Yes ____ No ____	
	Rows of trees/ shrubs Yes ____ No ____	
	Rows of utility poles Yes ____ No ____	
	Rows of lighting columns Yes ____ No ____	
	Centre line markings Yes ____ No ____	
	Lane line markings Yes ____ No ____	
	Edge of carriageway markings Yes ____ No ____	

Type of Accident	Checks	Remarks
	No Parking/ Yes ____ No ____ Stopping markings	
	Apparently (but Yes ___ No ___ not actually continuous verges)	
	Continuous Yes ____ No ____ reinstatement of trenches across the main road	
	(b) Can continuous perspective lines be broken by any of the following?	
	(i) A central refuge with duplicate Stop/Give Way sign (Answer questions in section viii) Yes ____ No ____	
	(ii) Flag type direction signs at the junction Yes ____ No ____	
	(iii)Kerbline adjustment to provide a slight stagger Yes ____ No ____	
	(iv) Staggering central refuges in opposing side roads Yes ____ No ____	
	(v) Resiting utility poles, lighting columns or trees and shrubs Yes ____ No ____	
(xi) Conspicuity	(a) Can junction conspicuity be improved by any of the following?	
	(i) Improved lighting (if there are nighttime accidents) Yes ____ No ____	

Type of Accident	Checks	Remarks
	(ii) Minor alterations to the vertical alignment to remove sightline obstructions such as humps or hollows Yes ____ No ____	
	(iii) Larger or additional signs Yes ____ No ____	
	(b) Is there a left turn filter lane on any of the roads? Yes ____ No ____	
	(i) If yes, is it really needed? Yes ____ No ____	
	(ii) Could if be absorbed into the carriageway to help form a slight stagger? Yes ____ No ____	
	(iii) Could it be replaced by footpath thus allowing the Stop/Give Way sign to be better placed in driver's line of sight? Yes ____ No ____	
(xii) Visibility/warning obscured by horizontal curvature	(a)Is the junction hidden by a bend in the road? Yes ____ No ____	
	If yes, could visibility of the junction be improved by alterations to any of the following?	
	(i) Earthbanks Yes __ No __	
	(ii) Walls Yes __ No __	
	(iii) Rows of trees or shrubs Yes __ No __	
	(iv) Rows of parked vehicles Yes __ No __	

Type of Accident	Checks	Remarks
	(v) Rows of utility poles or lighting columns Yes __ No __	
	(b) Can the amount of advance warning be increased by any of the following :-	
	(i) "SLOW" road marking prior to bend Yes __ No __	
	(ii) Stop/Give Way advance warning sign Yes __ No __	
	(iii) Increase distance of A.D.S. from junction Yes __ No __	
	(c) Can conspicuity of the bend be increased with chevrons or edgelines? Yes ____ No ____	
	(d) Is realignment of the road feasible? Yes ____ No ____	
(xiii) Visibility/warning obscured by vertical curvature	(a) Is the junction hidden by a hump or hollow in the road? Yes ____ No ____	
	(b) Answer questions (xii)(b) to (d)	
(xiv) Other factors	(a) Has a conflict study been carried out? Yes ____ No ____ Results _____	
	(b) Is there any evidence of heavy/late braking? Yes ____ No ____ Describe _____ _____	
	(c) Is the skid resistance adequate? Yes ____ No ____ If No, how can it be improved? _____	

Type of Accident	Checks	Remarks
	(d) Is the speed limit realistic? Yes ____ No ____ If No, what would be realistic? _____km/h	
	(e) Does water lay on the road surface? Yes ____ No ____ If Yes, is texture depth adequate? Yes ____ No ____ Is drainage adequate? Yes ____ No ____ (specify possible improvement) _____	
	(f) Is super elevation on approach bends adequate? ____ Inadequate? ___ Non existent? ___	
	(g) Does some local commercial, industrial or social centre particularly attract traffic to this road? Yes ____ No ____ Is yes, specify _____	
	(h) Could any traffic be re-routed by careful signing to avoid this junction? Yes ____ No ____	
	(i) Could conflict be avoided by a one way system making the side roads one way away from the junction? Yes ____ No ____	
	(j) Is the side road a through route or local traffic route only? _____	
	(k) Could an area signing programme persuade through traffic to use another route? Yes ____ No ____	

Type of Accident	Checks	Remarks
B.<u>RESTART from stop / Give Way Line</u> (Entering a single carriageway)	Note : It is most important to differentiate between RESTART accidents and OVERSHOOT accidents as they require different remedial measures. It will be necessary to check witnesses statements and carry out conflict studies to discover which type is occurring.	
(i) Stop / Give Way line	(a) Is the Stop/Give Way line clearly defined? Yes ____ No ____	
	(b) Is it in paint or reflective material? Yes ____ No ____	
	(c) Is it excessively slippery? Yes ____ No ____	
	(d) Has the Stop/Give Way line been moved in the last 12 months? Yes ____ No ____	Needs check with T.E. or Highways
	(e) Are there patches of old marking present? Yes ____ No ____	
	(f) Does excessive quantity of marking lead to wheel slip, so increasing clearance times? Yes ____ No ____	
	(g) Is the Stop/Give Way line positioned right up to the edge of the main carriageway thus giving the emerging driver the maximum view along the main road, the earliest possible view of overtaking traffic and the shortest time between decision to restart and clearance of the conflict area? Yes ____ No ____	

Type of Accident	Checks	Remarks
(ii) Stop / Give Way line (T.S. 101/102)	(a) Is there a Stop/Give Way signed? Yes ____ No ____	
	(b) Is the sign positioned too far in advance of the Stop/Give Way line for adequate visibility along the main road, increasing vehicle clearance time? Yes ____ No ____	
	(c) Can the kerb alignment be altered to allow the sign to be sited closer to the line? Yes ____ No ____	
(iii) Refuge Islands	(a) Are there refuge islands in the side roads? Yes ____ No ____	
	(b) If yes, are they sited more than 3m from the edge of the main road leading to problems as per (ii)(b) above? Yes ____ No ____	
	(c) Can the refuges be brought forward to 3m from the main road? Yes ____ No ____	
	(d) Can drivers be encouraged to pull right up to the line by placing hatching between the nose of the refuge island and the edge of carriageway of the main road? Yes ____ No ____	
	(e) Is the drivers view to the right obstructed by anything on the refuge island? Yes ____ No ____	
(iv) Visibility	(a) Is the driver's view to the right and/or left obscured by any of the following :-	
	(i) Foliage including long grass Yes ____ No ____	

Type of Accident	Checks	Remarks
	(ii) Walls, fences, railings, earth banks Yes ____ No ____	
	(iii) Hawker stalls or extended shop fronts Yes ____ No ____	
	(iv) Illegal structures Yes ____ No ____	
	(v) Stored materials Yes ____ No ____	
	(vi) Regular parking/loading activities Yes ____ No ____	
	(vii)Anything else. Specify _____	
	(b)Can any of these visibility obstructions be removed/resited/ reduced in any way? Yes ____ No ____	
(v) Junction layout	(a) Does the side road meet the main road at an angle which makes drivers turn their heads excessively to obtain visibility? Yes ____ No ____	
	(b) If yes, can be junction layout be improved to remove or reduce this? Yes ____ No ____	
	(c) Can the kerbline be altered to guide drivers into a better position? Yes ____ No ____	
	(d) Is the emerging driver's view to left or right reduced by the horizontal curve of the road? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(e) If yes, can the main road be re-aligned to prevent this? Yes ____ No ____	
	(f) Is the emerging driver¡¯s view to left or right obscured by the vertical curve of the main road? Yes ____ No ____	
	(g) If yes, can any alteration to the main road vertical alignment be made? Yes ____ No ____	
(vi) Junction conspicuity	(a) Are junction warning signs provided on the main road? Yes ____ No ____	
	(b) If yes, are they of the size recommended in TPDM V.3 Table 2.2.2.1? Yes ____ No ____	
	(c) Are they reflectorized? Yes ____ No ____	
	(d) Are they well maintained? Yes ____ No ____	
	(e) Are they sited in accordance with TPDM V.3 Table 2.2.2.1 having regard to the 85thpercentile speed on the main road? Yes ____ No ____	
	(f) Do they need reinforcing with a “SLOW” road marking? Yes ____ No ____	
	(g) Can junction conspicuity, when viewed from the MAIN road be improved by :-	
	(i) Refuge islands and bollards on the main road Yes ____ No ____	
	(ii) Increasing side road splays for visibility Yes ____ No ____	

Type of Accident	Checks	Remarks
	(iii) Providing large flag type direction signs for main road traffic both to inform and attract attention to the junction Yes ____ No ____	
	(iv) Upgrading the main road markings to hazard markings (RM.1104/1105) Yes ____ No ____	
	(v) Edge line markings (RM.1109) Yes ____ No ____	
	(vi) Improved lighting Yes ____ No ____	
	(vii)Contrasting lighting Yes ____ No ____	
(vii) Overtaking	(a) Are overtaking vehicles on the main road involved? Yes ____ No ____	
	(b) Can overtaking be reduced by providing an exclusive right turn lane? Yes ____ No ____	
	(c) Can refuge islands be provided/ enlarged to prevent overtaking? Yes ____ No ____	
(viii) Side road exit delays	(a) Are vehicles exiting from the side road delayed by :-	
	(i) Pedestrians Yes ____ No ____	
	If yes, can these be re-routed with guard rails? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(ii) PLBs or buses picking up/ setting down passengers Yes ____ No ____	
	If yes, can the stops be re-sited or stopped restriction extended? Yes ____ No ____	
	(iii) Parking/loading vehicles Yes ____ No ____	
	If yes, can parking/stopping restrictions be introduced/revised/ extended? Yes ____ No ____	
(ix) Conflict area clearance	(a) Are turning radii and lane widths sufficient to allow rapid clearance of the conflict area? Yes ____ No ____	
	(b) Does any street furniture or the nearside kerb line cause drivers to take a wider line through the junction, thereby increasing the conflict time? Yes ____ No ____	
(x) Accidents at peak flow	(a) Do the accidents occur when the main road traffic flows are heavy? Yes ____ No ____	
	(b) Are the number of safe gaps in the main road flow too few, thereby tempting side road drivers to accept gaps that are too small? Yes ____ No ____	
	(c) Could the junction be signalized? Yes ____ No ____	
	(d) Could a mini roundabout be provided? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(e) Can the high risk movement be banned or re-routed? Yes ____ No ____	
	(f) Is a traffic management scheme needed? Yes ____ No ____	
	(g) Is the type of junction control appropriate? Yes ____ No ____	
	(h) Is there any reason to change the type of control? Yes ____ No ____ Specify _____	
(xi) Risks	(a) Does any one manoeuvre carry a much greater risk than others in the cluster? Yes ____ No ____	
	(b) Can this higher risk manoeuvre be banned? Yes ____ No ____	
	(c) Can it be physically prevented? Yes ____ No ____	
(xii) Task simplification	(a) Can the task of the driver emerging from the side road be simplified by any of the following :-	
	(i) Defining the priorities Yes ____ No ____	
	(ii) Signalization Yes ____ No ____	
	(iii) A roundabout Yes ____ No ____	
	(iv) Separate lanes for particular movements Yes ____ No ____	
	(v) Indicative turning arrows and signalization Yes ____ No ____	

Type of Accident	Checks	Remarks
C.<u>Restart from stop/Give Way Line</u> (Entering a dual carriageway)		
(i) Central reserve	(a) First answer question 2(i) to 2(x).	
	(b) Is the central reserve wide enough to provide adequate waiting space? Yes ____ No ____	
	(c) Are there collisions with the rear end of large vehicles protruding from the central reserve? Yes ____ No ____	
	(d) Can the central reserve be physically widened? Yes ____ No ____	
	(e) Is there conflict between vehicles crossing the dual carriageway from the side road and vehicles turning right into the side road? Yes ____ No ____	
	Note : It often happens that a side road driver finds an acceptable gap in main road traffic and a clear space in the central reserve and decides to proceed. However, before he reaches the shelter of the central reserve the gap is blocked by vehicles turning right from the main road.	
	(f) Can the layout and marking in the central reserve be redesigned to avoid conflict between vehicles entering and leaving the side road? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(g) Can it be arranged so that they pass offside to offside? Yes ____ No ____	
	(h) If (g) were done would turning vehicles mask each other? Yes ____ No ____	
	(i) Can the emerging side road traffic be given priority by placing a Give Way line at the end of the right turn deceleration/filter lane on the main road? Yes ____ No ____	
	(j) Can right turns into the side road be banned? Yes ____ No ____	
	(k) Can right turning traffic be re-routed to a nearby intersection or roundabout? Yes ____ No ____	
(ii) Follow-through	(a) Is there a follow-through problem? Yes ____ No ____	
	Note: When the traffic flow is heavy in the side road and the number of acceptable gaps in the main road traffic is limited there is a tendency for the second and subsequent vehicle drivers in the side road to blindly follow the first vehicle through the junction.	
	(b)Can the reservoir space in the central reserve be increased? Yes ____ No ____	
	(c) Are signals needed? Yes ____ No ____	
	(d)Is a roundabout needed? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(e) Is grade separation needed? Yes ____ No ____	
(iii) Staggered side roads	Note: Where side road through traffic has to turn left and immediately right the safest way is to drive across the main carriageway at right angles and enter the right turn deceleration/filter lane as soon as possible. The most dangerous way is to enter the left turn acceleration/filter lane and turn right into the central reserve gap from the nearside. It is also dangerous to drive diagonally from the side road to the central gap. The aim should be to reduce the "exposure time" to a minimum.	
	(a) Is there a left hand stagger? Yes ____ No ____	
	(b) Can drivers be encouraged to make the safer manoeuvre by providing turn left, straight on and turn right lanes in the side road with suitably adapted arrows? Yes ____ No ____	
	(c) Can the direction signs and their siting be adapted to encourage the safer manoeuvre? Yes ____ No ____	
	(d) Can the manoeuvre be banned? Yes ____ No ____	
	(e) Answer questions (ii)(c), (d) and (e)	
(iv) Exit from central reserve	(a) Are there collisions between vehicles emerging from the central reserve gap and the main road traffic approaching from the left? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(b) Are drivers waiting in the central reserve encouraged to accept too short a gap in the main road traffic because :-	
	(i) The reserve is not wide enough to shelter them? Yes ____ No ____	
	(ii)They are pressed from behind by traffic following through? Yes ____ No ____	
	(c) Do vehicles in the central reserve gap wait in echelon thus masking each other from traffic approaching from the left? Yes ____ No ____	
	(d) Can the layout and marking of the central reserve gap be redesigned to discourage waiting in echelon? Yes ____ No ____	
	(e) Would this substantially increase the follow through problem? (See (ii)(a)) Yes ____ No ____	
	(f) Is the view to the left obscured by traffic waiting in the deceleration/ filter lane to turn right into the side road? (See (i)(f) to (k)) Yes ____ No ____	
(v) Alignment	(a) Is there a bend or crest on the main road reducing visibility from the side road? Yes ____ No ____	
	(b) Is re-alignment possible? Yes ____ No ____	

Type of Accident	Checks	Remarks
2.ACCIDENTS AT TRAFFIC SIGNALS		
(i) Signal timings	(a) Was there a lot of unused green time at the time the accidents occurred? Yes ____ No ____	
	(b) Is the choice of settings the best possible? Yes ____ No ____	
	(c) Do any phases overlap? Yes ____ No ____	
	(d) Can separate phases be provided? Yes ____ No ____	
	(e) Are the present settings appropriate to the present flows and distribution of traffic? Yes ____ No ____	
	If no, specific _____	
	(f) Is a traffic survey needed? Yes ____ No ____	
	(g) Are any movements particularly high risk? Yes ____ No ____	
	If yes, specify _____	
	(h) Can these high risk movements be eased by timing or phasing changes? Yes ____ No ____	
(ii) Controller facilities	(a) Do the available controller facilities meet the present traffic needs? Yes ____ No ____	
	(b) Are pedestrians adequately accommodated? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(c) Can additional facilities be added with the present controller? Yes ____ No ____	
	(d) Is a new controller needed? Yes ____ No ____	
	(e) Is a new installation needed? Yes ____ No ____	
	(f) Would indicative green arrows help? Yes ____ No ____	
	(g) Does the junction need to be redesigned to make full use of the present facilities? Yes ____ No ____	
	(h) Are more pedestrian phases needed? Yes ____ No ____	
(iii) Clearances/visibility	(a) Is the approach speed of vehicles in excess of 50 km/h, particularly at off peak times? Yes ____ No ____	
	(b) Is there sufficient intergreen time to allow vehicles to clear the junction before opposing flows receive a green signal? Yes ____ No ____	
	(c) Can the intergreens be varied? Yes ____ No ____	
	(d) Are H.I. heads provided? Yes ____ No ____	
	(e) Is better timing warranted? Yes ____ No ____	
	(f) Are vehicles waiting at the Stop line on the opposing phase clearly visible? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(g) Are vehicles on the terminating red phase continuing straight through on red and amber with no reduction in speed? Yes ____ No ____	
	Note: At 50 km/h a vehicle travels 13.89m every second. Therefore an increase of 1 second in clearance time will usually avoid conflict.	
	(h) Are vehicles on the terminating red phase starting off on red and amber? Yes ____ No ____	
	(i) If the problem is on one arm of the junction only can a late start be provided on that arm? Yes ____ No ____	
	(j) Should the minimum intergreen time be increased? Yes ____ No ____	
(iv) Right turners	(a) Are there accidents involving right turners? Yes ____ No ____	
	(b) Does the junction cover a wide area? Yes ____ No ____	
	(c) Does this encourage right turners to try to beat the oncoming traffic? Yes ____ No ____	
	(d) Is the junction small and difficult for right turners? Yes ____ No ____	
	(e) Could the oncoming traffic be held by a late release to provide more clearance time for the right turn? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(f) Can the junction layout be changed to make the right turn easier? Yes ____ No ____	
	(g) Is the oncoming traffic traveling at a high speed? Yes ____ No ____	
	(h) Do right turners misjudge the speed of oncoming traffic? Yes ____ No ____	
	(i) Is the straight ahead view of the right turning driver obscured by :-	
	(i) The Keep Left bollards on the opposite central refuge? Yes ____ No ____	
	(ii) The secondary signal pole Yes ____ No ____	
	(iii)Other street furniture on the central refuge? Yes ____ No ____	
	(iv) Traffic in the opposing right turn lane? Yes ____ No ____	
	(v) The road alignment on the opposing arm? Yes ____ No ____	
	(j) Can the visibility obstructions be resited? Yes ____ No ____	
	(k) Can a separate, unopposed right turn phase be provided? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(l) Can a traffic management scheme be devised to avoid the right turn completely? Yes ____ No ____	
	(m) Is an indicative right turn arrow needed? Yes ____ No ____	
	(n) If a right turn overlap phase exists, is the secondary signal head for the early cut off direction correctly positioned? (TPMD V.4 Diag. 2.3.3.1) Yes ____ No ____	
	(o) Do the accidents involve opposing vehicles trying to beat the lights? Yes ____ No ____	
	(p) Is there congestion in the street which the right turners are entering? Yes ____ No ____	
	(q) Do the accidents involve right turning drivers attempting to complete their manoeuvre without pausing? Yes ____ No ____	
	(r) Can an early cut-off be used to hold one of the conflicting movements? Yes ____ No ____	
3.<u>ACCIDENTS AT ROUND-ABOUTS</u>		
(i) General	(a) Is there adequate warning on all approaches to the roundabout? Yes ____ No ____	
	(b) Are there “Roundabout Ahead” signs? (TS 425) Yes ____ No ____	

Type of Accident	Checks	Remarks
	(c) Are these sited in accordance with TPDM V.3 Table 2.2.2.1? Yes ____ No ____	
	(d) If approach speed is 70 km/h or greater do the signs have accompying “Reduce Speed Now” plates (TS 737)? Yes ____ No ____	
	(e) Is there a map type A.D.S.? Yes ____ No ____	
	(f) Is it reflectorized? Yes ____ No ____	
	(g) Is “SLOW” painted on the road? Yes ____ No ____	
	(h) Are signs in accordance with TPDM V.3 para 2.4.2.16 and Diag. 2.4.2.3 erected? Yes ____ No ____	
	(i) Are there Give Way lines? Yes ____ No ____	
	(j) Are they reflectorized? Yes ____ No ____	
	(k) Are they well maintained Yes ____ No ____	
(ii) Approach islands	(a) Are there collisions with the central reserve or the splitter island at the end of the approach road? Yes ____ No ____	
	(b) Is the deflection too sharp? Yes ____ No ____	
	(c) Are the Keep Left bollards on the approach side large enough? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(d) Is the roundabout hidden by :-	
	(i) A bend? Yes ____ No ____	
	(ii) A crest? Yes ____ No ____	
	(iii) A drop off? Yes ____ No ____	
	(iv) A bridge pier? Yes ____ No ____	
	(v) Anything else? Yes ____ No ____	
	If yes, specify _____	
	(e) Can the advance warning be improved, particularly by duplicate signs on the central reserve? Yes ____ No ____	
	(f) Could edge lines (RM1109) be provided? Yes ____ No ____	
	(g) Is realignment possible? Yes ____ No ____	
(iii) Central Island	(a) Is there overrunning of the central island? Yes ____ No ____	
	(b) Is the approach straight and fast? Yes ____ No ____	
	(c) Can the advance warning signs be resited at a distance from the roundabout which is consistent with the 85thpercentile speed at the time at which the accidents occur? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(d) Can the advance warning be improved by a duplicate warning sign on the central reserve? Yes ____ No ____	
	(e) Can the conspicuity of the central island be improved by :-	
	(i) Larger Keep Left signs? Yes ____ No ____	
	(ii) Chevrons or bigger chevrons? Yes ____ No ____	
	(iii) Landscaping? Yes ____ No ____	
	(iv) Improved lighting? Yes ____ No ____	
(iv) Failure to negotiate roundabout	(a) Do vehicles fail to negotiate the roundabout? Yes ____ No ____	
	(b) Does the layout provide a smooth line of entry? Yes ____ No ____	
	(c) Is the skid resistance and texture depth acceptable? Yes ____ No ____	
	(d) Is the crossfall satisfactory, particularly the transition from that on the approach road to that on the roundabout? Yes ____ No ____	
	(e) Are the lane widths adequate? Yes ____ No ____	
	(f) Does the shape of the central island allow both a smooth entry and smooth circulation? Yes ____ No ____	
(v) Exit accidents	(a) Are there accidents on the exit from the roundabout? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(b) Does the layout provide a smooth exit line? Yes ____ No ____	
	(c) Is the skid resistance and texture depth acceptable? Yes ____ No ____	
	(d) Is the crossfall satisfactory particularly the transition from that on the roundabout to that on the exit road? Yes ____ No ____	
	(e) Is the exit manoeuvre make more difficult by weaving problems? (See (vi) below) Yes ____ No ____	
	(f) Is any exit obstructed by :-	
	(i) Slow moving vehicles? Yes ____ No ____	
	(ii) Parking/loading activity? Yes ____ No ____	
	(iii)Bus stops? Yes ____ No ____	
	(iv) Pedestrian crossings? Yes ____ No ____	
	(v) Pedestrians jaywalking? Yes ____ No ____	
	(g) Can any of these obstructions be resite or removed? Yes ____ No ____	
	(h) Are there sufficient flag type direction signs at exits? Yes ____ No ____	
	(i) Are they reflectorized? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(j) Are they well maintained? Yes ____ No ____	
(vi) Weaving	(a) Are there accident arising from weaving movements? Yes ____ No ____	
	(b) Are the following satisfactory :-	
	(i) Entry radii? Yes ____ No ____	
	(ii) Weaving lengths? Yes ____ No ____	
	(iii) Exit radii? Yes ____ No ____	
	(iv) Diameter of central island? Yes ____ No ____	
	(v) Lane widths? Yes ____ No ____	
	(c) Is the advance direction signing and the direction signing at the roundabout clear to give approaching drivers sufficient time to decide on their proper course without sudden last minute changes? Yes ____ No ____	
	(d) Could the situation be simplified by using one or more mini roundabouts? Yes ____ No ____	
	(e) Could the situation be improved if the junction was re-designed for traffic signals? Yes ____ No ____	
(vii) Failure to give way	(a) Are there accidents involving vehicles entering the roundabout and failing to give way to vehicles approaching from the right? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(b) Is the view to the right obscured by :-	
	(i) Keep Left bollards? Yes ____ No ____	
	(ii) Direction signs and poles? Yes ____ No ____	
	(iii) Earth banks? Yes ____ No ____	
	(iv) Vegetation? Yes ____ No ____	
	(v) Anything else? Yes ____ No ____	
	If yes, specify _____	
	(c) Can these obstructions be removed/ resited? Yes ____ No ____	
	(d) Do the vehicles entering the roundabout do so at a tangent? Yes ____ No ____	
	(e) Can adequate deflection be introduced? Yes ____ No ____	
	(f) Is the angle of entry to the roundabout such that :-	
	(i) The driver has to strain to see over his right shoulder? Yes ____ No ____	
	(ii) His view is obstructed by parts of his own vehicles? Yes ____ No ____	
	(iii)His view is obstructed by other vehicles? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(iv) Restarting from the Give Way line is difficult? Yes ____ No ____	
	(g) Do the vehicles from the right enter the roundabout at a tangent or have such an unrestricted entry that it is difficult to estimate their speed? Yes ____ No ____	
	(h) Can enough deflection be introduced to slow down vehicles approaching from the right? Yes ____ No ____	
	(i) Would redesign of the junction in any of the following ways simplify the situation (if feasible) :-	
	(i) One or more mini roundabouts? Yes ____ No ____	
	(ii) Traffic signals? Yes ____ No ____	
	(iii)Grade separation? Yes ____ No ____	
4.ACCIDENTS AT BENDS		
(i) General	(a) Are they single vehicle accidents? Yes ____ No ____	
	(b) Is the speed limit realistic? Yes ____ No ____	
	(c) Is there adequate advance warning of the bends? Yes ____ No ____	

Type of Accident	Checks	Remarks
(ii) Signs	(a) Is there a Bend warning sign? Yes ____ No ____	
	(b) Is it of the size and at the distance from the bend recommended in the TPDM Vol 3 having regarding to the 85thpercentile speed? Yes ____ No ____	
	(c) Is it reflectorized? Yes ____ No ____	
	(d) Is it well maintained? Yes ____ No ____	
	(e) In the case of a dual carriageway, is there a duplicate sign on the central reservation? Yes ____ No ____	
	(f) Is there a 'SLOW' marking on the road? Yes ____ No ____	
	(g) Are there chevrons at the bend? Yes ____ No ____	
	(h) Are they correctly positioned? (TPDM V.3 Diag. 2.4.2.4.) Yes ____ No ____	
	(i) Are they large enough? Yes ____ No ____	
	(j) Are there enough of them? Yes ____ No ____	
	(k) Are they reflectorized? Yes ____ No ____	
	(l) Are they well maintained? Yes ____ No ____	
(iii) Barriers	(a) Are there safety barriers? Yes ____ No ____	

Type of Accident	Checks	Remarks
	(b) Are they painted black and white? Yes ____ No ____	
	(c) Are they well maintained? Yes ____ No ____	
	(d) Do they provide an adequate guide line? Yes ____ No ____	
	(e) Are the ends ramped down? Yes ____ No ____	
	(f) If steel, is the overlap in the correct direction? Yes ____ No ____	
(iv) Edge lines	(a) Are there edge line markings? Yes ____ No ____	
	(b) Are they reflective? Yes ____ No ____	
	(c) Are they well maintained? Yes ____ No ____	
(v) Street lighting	(a) Is the road lit? Yes ____ No ____	
	(b) Do the lighting columns provide an adequate guide line both by day and night? Yes ____ No ____	
	(c) Do they give a false impression of the layout by day or night? Yes ____ No ____	
	(d) Do they contrast with the background? Yes ____ No ____	

TPDM Volume 5 Chapter 4 – Evaluation of Remedial Measures

4.1 References

(1) Organization for Economic Cooperation & Development (1981) *Methods for evaluating road safety measures.*

(2) Department of Transport (1986) *Accident Investigation Manual*, U.K.

(3) Institution of Highways and Transportation (August 1990) *Highway Safety Guidelines: Accident Reduction and Prevention. International Edition*, U.K.

(4) Austroads (July 2021) *Guide to Road Safety Part 2: Safe Roads*

4.2 Introduction

4.2.1 Efficient management of road safety activities requires that programmes are pursued to maximize safety, subject to constraint on available resources. Hence programmes must be evaluated by comparing their social cost and benefit both to (i) determine priorities among them and (ii) to suggest the overall level of justifiable effort on road safety relative to other policy objectives.

4.2.2 Economic evaluation of measures requires the interpretation of the appropriate social values of the resources consumed and the benefit produced. These must include the tangible as well as the intangible resources and benefits, some of which have no normal money value.

4.2.3 The evaluation results should also serve as a feedback into the process of selection & implementation measures.

4.2.4 This Chapter presents an outline of the monitoring and evaluation methods usually adopted in road safety analysis.

4.3 Monitoring Principles

4.3.1 For accident reduction and prevention, monitoring not only gives an assessment of the effect of actions taken but also gives an indication of changes in the state and usage of the road system which might give rise to future accident problems.

4.3.2 Monitoring for assessment of the effect of reduction and prevention measures is required at 2 levels – over the whole area and for individual schemes or groups of schemes. Also, monitoring is a prerequisite to feedback and therefore data requirements should be taken into account in the early stages of investigation and scheme design.

4.4 Area Monitoring

4.4.1 Monitoring of trends throughout an area or region should aim to measure the overall success of the remedies taken. It needs to be related to territorial trends to distinguish between those effects which have arisen from legislation, regulation or environmental changes and any effects which result from local activities. The overall trends will result from a combination of economic effects, and efforts by way of engineering, traffic management, regulations, education and enforcement. It is therefore important to break down identified trends into specific target groups which may then identify apparent successes and failures of different kinds of remedies.

4.4.2 The main sub-divisions in terms of accident factors and locations should answer the following questions :-

Where? - urban or rural, junction or non-junction

Who? - type and class of road user and severity of injury

What? - type of vehicle involved

When? - time of day, day of week, month

Road/environment conditions – dry/wet/icy, daylight/darkness.

4.5 Scheme Monitoring

4.5.1 Monitoring the performance of schemes is essential for 3 main reasons :-

(i) to ensure that, if an accident situation worsens rather than improves following implementation of a measure, further steps are taken quickly to reverse the situation;

(ii) to identify the manner and degree of success and whether or not there might be any decay with time in the effect of the measure that should be rectified by specific periodic maintenance;

(iii) to evaluate the benefits of the scheme in relation to the operational objectives in order that positive justification for past actions and expenditures is available.

4.5.2 Reasons (i) and (ii) should add to the engineer's overall knowledge and experience of accident studies and of operating within the discipline of a safety strategy. All 3 reasons will provide the justification for continuing on the same lines or will indicate the need to reassess the strategy and the basis on which decisions "to do something" and to adopt a particular remedy are taken.

4.5.3 The most suitable technique for measuring the effect of a safety improvement is by "before and after" analysis. It should be noted here that it is not sufficient merely to monitor accident levels or accident totals – a medium depth study of "after" accidents is nearly always required to determine the characteristics of the residual accidents in order to compare them with the "before" data and to test the reasoning for choosing the specific remedial measure. Staff resources will be a limiting factor on the extent to which this can be done.

4.6 Analysis for a Single Site

4.6.1 The most direct indicator of a remedy's success is a change in accident frequency which can be attributed to the scheme. The main feature of an evaluation is the comparison of accident frequency after the remedy has been applied with what would have been expected had nothing been done. The main problem is to distinguish a change due to the treatment from a change due to other effects. These other sources of change might be described as threefold :-

(a) Systematic changes in the environment which also affect the long term mean accident frequency of the site. Such changes could be territorial or local in scale – for example :-

(i) A change in the speed limit for the class of road on which the site is located. This may alter the speed characteristic of the traffic passing the site and so change the accident risk.

(ii) Closure of a nearby junction could produce marked changes in traffic flow, and hence in accident patterns at the site.

(b) Random variations which, while not necessarily biasing the result of an evaluation, introduce extra variability in accident data, making the effect of the treatment difficult to detect.

(c) Random variation will have a biasing effect if combined with a tendency to select sites for treatment (at least partly) on the basis of their past accident records. This is because such a selection process tends to produce sites which happen to be at the peak of their fluctuations in accident frequencies an such sites will tend to experience reduction in accident frequency in a subsequent period even if no treatment is applied. This effect is commonly referred to as "regression-to-the main".

4.6.2 Hence "expected" accident frequencies should be derived so that effects (a) and (c) described above, will not influence their comparison with actual frequencies after treatment.

4.6.3 In the past, controls have often been used as a basis for comparison. That is, the change in accident frequency at an untreated site or area whose trends are believed to reflect what would have been expected at the treated site had it been left alone. This might take care of (a) above, but it is not likely to provide an allowance for the regression-to-mean effect since controls are not usually chosen for their high accident frequency.

4.6.4 In principle, allowance for (a) and (c) above could be made by using a control site chosen in exactly the same way as the treated one and identified as having similar problems and so being a candidate for similar treatment, but left untreated for the period of the assessment.

4.6.5 In practice, it is difficult to find suitably matched control sites, on an individual basis, and to leave investigated sites untreated; but alternative methods, using less than ideal controls, will not fully eliminate the regression-to-mean effect in calculations for individual sites.

4.7 Choice of Before & After Period

4.7.1 A number of points to be considered when choosing before & after periods for study are :-

(i) the before & after period should be identical for the treated sites and the control sites;

(ii) a period during which remedial works are carried out should be omitted from the study. If it cannot be identified precisely, a longer period containing it should be omitted;

(iii) the before period should be long enough to provide a reasonable amount of accident data, so as to restrict as far as possible the effect of random fluctuation, but not so long as to include a period with quite different characteristics; and

(iv) the after period should also be long enough to provide a good sample of accident data.

4.7.2 In the Hong Kong situation where traffic patterns change so often, the before or after period should be chosen so as to contain a reasonably stable (traffic pattern) period and a reasonable sample to smooth out the accident randomness. One year is generally regarded as a reasonable period to use.

4.8 Choice of Control Sites

4.8.1 The criteria for the selection of control sites are chosen to remove systematic errors and regression-to-mean effects.

4.8.2 The control site should be similar to the treated site in general characteristics and should be geographically close to it so as to minimize any local variations in factors likely to affect safety, e.g. weather, traffic flows.

4.8.3 The control site should be chosen by the same mechanism that identified the treated site. Thus when some fairly formal system (such as that using a “threshold level” – see chapter 3) is used to identify sites with safety problems, the control site (as well as the treated site) should be one of the problem sites.

4.8.4 When sites with problems are identified by less formal methods, it may be more difficult to identify a control site to compare with each treated site. Nevertheless, the effort should be made; if the control site were to be chosen by a different method, benefits due to the treatment would almost certainly be over-estimated because of regression-to-mean effect. In the absence of a proper control site, a less than satisfactory suggestion is to use the regional, area or territory total.

4.8.5 If this identification of controls and sites for treatment by the same method were carried out regularly, it might lead to the system being amended to find pairs of sites for treatment, one of which would be left untreated for use as a control. The choice of which one to treat and which to leave untreated would be made at random.

4.9 Estimate of the Treatment's Effect Using a Control Site

4.9.1 An evaluation of a treatment is an attempt to find out whether the treatment is effective and if yes, how effective. The former can be answered by the application of a statistical significance test (chi-square test). The latter can be addressed by estimating the magnitude of a treatment's effect and also the standard error of the estimate. (The standard error is a statistical quantity which describes the precision with which some parameters have been estimated).

4.9.1 Chi-square Test. The accident frequencies to be compared, using a control site or group of sites, can be presented in a 2 x 2 table :-

	Before	After
Treated Site	b	a
Control Site	B	A

4.9.3 The test procedure is given below :-

(i) Suppose the treatment has no effect. Then accidents are expected to change similarly at the treated site and at the control site.

(ii) Then the total number of accidents observed is distributed among the 4 cells of the table in such a way that before : after ratio is the same for both sites.

Expected accident frequencies in the "No-effect" situation.

	Before	After
Treated Site	$\frac{(b+a)(B+b)}{t}$	$\frac{(b+a)(a+A)}{t}$
Control Site	$\frac{(B+A)(b+B)}{t}$	$\frac{(B+A)(a+A)}{t}$

Where t = a+b+A+B

(iii) The actual number of accidents can be compared with the expected. The Chi-square statistic is computed by the formula.

$$X^2 = \frac{(bA - aB)^2}{(b+a)(B+A)(b+B)(A+a)}$$

$$Simplifying\ X^2 = \frac{(bA - aB)^2}{(b+a)(B+A)(b+B)(A+a)}$$

4.9.4 A sufficiently large value of X^2 (this being judged by comparison with tabulated value of the Chi-square statistics X^2) is taken as evidence against hypothesis of "no effect" being true. If the hypothesis were true, then the probability of obtaining a value of X^2 greater than 3.841 would be 0.05 or one in 20 chances. A value greater than 3.841 is then said to be "significant at the 5% level"; at that level of probability, it is a sign that the hypothesis of no effect is unlikely to be true.

4.9.5 Estimate of Size of Effect using Standard Error. The following describes a method of estimating the size of the effect which also provides an alternative to the above Chi-square test method of indicating whether there has been effect.

Expected accident frequency $= b * \frac{A}{B}$

(if the treatment has no effect)

Let r = (ratio of actual after frequency to expected)

= $\frac{a}{b*\frac{A}{B}}$ [r = 1 if treatment ineffective expected = observed]

4.9.6 It has been found that the distribution of 1n (r) is symmetrical and normal and define (λ = effectiveness)

λ $= \ln[(a * B)/(b * A)]$ if a, b, A, B $\neq$ 0

or

$= \ln[\frac{\left(\left(a+\frac{1}{2}\right)*\left(B+\frac{1}{2}\right)\right)}{\left(\left(b+\frac{1}{2}\right)\left(A+\frac{1}{2}\right)\right)}]$ if a, b, A, B = 0

$= \ln\left(\frac{a}{b}\right) - \ln(\frac{A}{B})$ if a, b, A, B $\neq$ 0

or

$= \ln\left[\frac{\left(a+\frac{1}{2}\right)}{\left(b+\frac{1}{2}\right)}\right] - \ln[\frac{\left(A+\frac{1}{2}\right)}{B} + \frac{1}{2}]$ if a, b, A, B = 0

A negative λ indicates an apparent reduction in accident frequency at the treated site relative to the expected, while a positive value indicates an increase.

Standard error of $\lambda(s) = \sqrt{V}$ where

$$V = \frac{1}{a+1} + \frac{1}{b+1} + \frac{1}{A+1} + \frac{1}{B+1}$$

subject to a maximum of 2

i.e. $V = \min[2, \frac{1}{a+1} + \frac{1}{b+1} + \frac{1}{A+1} + \frac{1}{B+1}]$

4.9.7 Since each frequency enters the expression for S in inverse form, it follows that, for a given value of λ, the higher the frequency on which it is based, the smaller will be its standard error (S) and so the more precise will be the estimate ofλ,or the greater amount of data yield more precise estimates of effectiveness.

4.9.8 Using the estimate λ and the standard errors, the degree of confidence for the estimate of λ can be calculated by computing the standard normal

$$Z = -\frac{\lambda}{S}$$

4.9.9 The following worked example will help to illustrate the calculation.

	Before	After
Treated Site	7	0
Control Site	9	5

Using the λ equation in para. 4.9.6

$$\lambda = \ln\left[\frac{\left(0+\frac{1}{2}\right)}{\left(7+\frac{1}{2}\right)}\right] - \ln\left[\frac{\left(5+\frac{1}{2}\right)}{\left(9+\frac{1}{2}\right)}\right]$$

$$= \ln\left(\frac{0.5}{7.5}\right) - \ln\left(\frac{5.5}{9.5}\right) = -2.16$$

$$V = \frac{1}{1}+\frac{1}{8}+\frac{1}{6}+\frac{1}{10} = 1.39$$

$$S = \sqrt{V} = 1.18$$

$$Z = \frac{2.16}{1.18} = 1.83$$

The corresponding probability (p) (for standard normal Z = 1.83) value lies between 0.96 and 0.97 implying that we are 97% confident that the treatment is beneficial and the best estimate of the size of this benefit

$$\exp(\lambda) = \exp(-2.16)$$
$$= 0.12$$

which is equivalent to r,
i.e. there is an 88% (i.e.$100*(1-0.12)$%) reduction in accident frequency.

4.9.10 This should not be quoted in isolation from an indication of its uncertainty. Such an indication might be given in the form of "y percent confidence limit" i.e. a range of values within which we can have y percent confidence that the true effectiveness lies.

4.9.11 If we construct a 90% confidence interval, from the statistical tables of normal distribution for which

p = 0.05 and 0.95 is ± 1.64

Hence $(x - \overline{\lambda})/s = \pm 1.64$

$$x = \overline{\lambda} \pm (1.64 \times s)$$

$$= -2.16 \pm (1.64 \times 1.18)$$

$$= -0.22 \text{ and } -4.10$$

transforming these from the logarithmic scale :-

exp (x) = 0.80 and 0.02

i.e. 90% confidence limit indicates that the reduction in accident frequency due to treatment lies somewhere in the range from 20% to 98% (so that the best estimate of 88% is seen to be uncertain).

4.9.12 Hence this method can give three items of information.

(a) a measure of confidence that treatment is beneficial,

(b) best estimate of the size of its effect and reduction,

(c) a range of value within which one can have reasonable confidence that the size of the effect lies.

4.9.13 The method, together with Chi-square test approach and other alternatives, all share a feature indicating that the amount of accident data normally available from a single site (and its control) is insufficient to give precise indication of the presence or magnitude of a treatment's effect.

4.10 Increasing the Sensitivity of an Evaluation

4.10.1 A major short-coming of the analysis of a single site accident is the insensitivity of the result to real effects of the treatment. Sensitivity can only be improved by increasing the amount of data. Basically there are 2 ways by which more reliable indications of effectiveness might be obtained :-

(a) measured variables other than accident frequencies which are expected to respond to treatment and for which a large volume of data might be available. Suggested variables to be considered may be conflicts or speed of vehicles. However such variables have the disadvantage that they do not give direct measure of the magnitude of any improvement in safety.

(b) pool the result of analyses of accident data at several sites, all of which have been given the same treatment. A suggested method is given in reference (ii).

4.11 Mass Action Evaluation

4.11.1 When a large number of sites have been selected for similar treatment, it is important to split the sites into 2 groups of roughly equal size, one group being left untreated as controls.

4.11.2 Allocation of sites to one of these groups should be random. If there are sufficient sites to permit this randomization to work effectively, then matching sites in pairs becomes unnecessary. The effect of treatment is then estimated by comparing the change in accident frequencies averaged over the sites in the treated group with the same change averaged over the control group.

4.11.3 The uncertainty of many of these estimated average benefits should be noted. By proper evaluation of all new schemes updated and more precise estimates can be made and these will assist the assessment of potential savings from future schemes.

4.12 Economic Evaluation of Remedial Measures

4.12.1 While the scheme may be shown to be effective, the evaluation would not be complete if the benefit was not compared with the cost it incurred. This will apply not only to civil engineering works, but also to remedial measures which include items such as publicity campaigns, education/training programmes and increased enforcement of traffic orders.

4.12.2 The benefits of the schemes generally include cost of the accidents saved plus any other benefit (saving in traveling time), less disbenefit (additional travel time and maintenance cost). The "economic worth" of the measure selected can then be determined when the savings are compared with the capital cost of its implementation.

4.12.3 It should be emphasized that the economic calculations are presented in terms of simple values for costs and benefits. In practice the figures (especially accident reduction benefits) are subject to a range of values. It would therefore be more realistic to regard the figures used in the economic evaluations as "central" figures, subject to a margin of error, which may be considerable.

4.12.4 For comparison of cost & benefit, it is usual to calculate the First Year Rate of Return (FYRR). This is the net monetary value of the accident (and other) savings and disbenefits expected in the first year of the scheme expressed as a percentage of total capital cost.

4.12.5 An alternative more elaborate method for comparing cost & benefit is to take the stream of benefits & costs throughout the life of the scheme. This is the Net Present Value method (NPV) which discounts all the costs & benefits to the present value. While this method is generally used for evaluating highway or commercial projects, it is recognized that its application for evaluating road safety schemes is not appropriate. This is because usually the life of remedial schemes is known to be short and the traffic levels and accident savings change markedly from year to year. This makes assumptions for parameters in future years difficult and dubious.

4.12.6 It should be noted that performance of individual schemes varies widely, from a nearly total elimination of accidents at some sites to an apparent increase in accidents at others. The following statistics show the wide range of FYRR for the schemes implemented in the Territory in the year ending June 1991.

FYRR	% of Scheme
Negative	11%
0- 100%	5%
100 - 1000%	26%
Over 1000%	58%

TPDM Volume 5 Chapter 5 – Traffic Safety Considerations in Engineering Design

5.1 References

(1) Accident Investigation & Prevention Manual
U.K. Department of Transport

(2) The Evaluation of the Effectiveness of Low Cost Traffic Engineering Projects. Nicholas Clark and Associates. Australian D.O.T. Office of Road Safety

(3) Accident Analysis & Prevention Vol. 18 No.4. August 86 “Youth and Traffic Accident Risk

(4) T.P.D.M. Vols 3, 4 and 6

(5) Code of Practice for the Lighting, Singing & Guarding of Roadworks – Research & Development Unit, HyD, Sept 1984

5.2 Background

5.2.1 The road and junction layout standards and design criteria included in the T.P.D.M. in general ensure that acceptable standards of road safety are attained in the design of new roads and in the modification of existing road layouts. Investigations into traffic accidents occurring in the Territory have highlighted, however, that a small number of road design options can in certain circumstances, lead to potentially hazardous layouts on street.

5.2.2 The purpose of this chapter is to highlight those design features which give rise to problems, and to indicate the circumstances/combinations of circumstances in which these hazards arise.

5.3 Engineering Measures which should be used with Caution

5.3.1 Use of speed limits as a traffic management measure

5.3.1.1 At sites where there is a real or suspected accident problem and a higher speed limit of 70 or 80 kph is in force, there is often pressure to relieve the situation by lowering the speed limit. Such a measure should only be introduced if the criteria laid down in Chapter 6 Vol 6 of the TPDM are met.

5.3.1.2 If the speed limit is reduced and the above criteria are not met, it is possible that speeds will not decrease (and in some cases may increase) and the police could be left with an ongoing and unpopular enforcement problem. The effect of inappropriate reductions in speed limits on accidents is likely to be insignificant in terms of accident reduction.

5.3.1.3 On higher speed roads, if there is an accident problem, emphasis should be placed on implementing engineering remedial measures which address the common-factor accident problems, e.g. advance warning signs, edge-markings and chevrons if the problems occur on a bend.

5.3.1.4 At sites where an inappropriately low speed limit exists, it has been shown in other countries that increasing the speed limit to its appropriate value may in some cases reduce the spread of speeds and the average speed may decrease slightly.

5.3.1.5 The start of a higher speed limit should be avoided immediately upstream of hazard such as a sharp bend, junction, etc.

5.3.2 Use of the early cut off in signals to control right turning traffic

5.3.2.1 The right turn overlap in signals is a very simple effective way to control medium to heavy right turn movements in signals. Its use in certain circumstances can, however, give rise to potential accident problems.

5.3.2.2 If the signal is on a rod with a speed limit of 70 kph or above, right turn overlaps should not be used to control the right turn flow. The higher approach speeds coupled with the difficulties of judging the speed of the traffic coming head on can lead to possible accidents. In these circumstances all right turns which conflict with oncoming high speed traffic should be separately controlled to avoid turns across fast moving traffic.

5.3.2.3 Separate control of the right movement should also be considered at other locations where approach speeds are high or where visibility of the oncoming straight ahead flow is restricted.

5.3.2.4 Where a right turn overlap is used, the opposing minor right turn flow (which has no special phase) should if possible be prohibited. This is because the two waiting right turn flows can obscure each other's sight line, and the minor right turn flow will in most cases be turning across a very undersaturated (and hence fast moving) opposing straight ahead flow. If the two right turns are permitted, the secondary aspect for the early cut off phase must be relocated as shown in Diagram 2.3.3.1 of Chap 2 Vol 4.

5.3.2.5 Where a double right turn pocket is used for the overlap right turn, care must be taken to ensure that the sight line for the second right turn lane is adequate. In these circumstances, no opposing minor right turn flow should be permitted.

5.3.3 Double white lines and broken lines to control overtaking

5.3.3.1 Where double white lines/broken lines are used as a traffic management measure to restrict/permit overtaking on winding roads, overtaking sight lines should always be checked on site, preferably using radio communication to determine sight distances accurately. This is especially important in cases where the lengths of permitted overtaking are at or near the minima set out in Vol 3 Ch 5 of the T.P.D.M. Ideally the appearance of the markings should also be checked out by day and by night from the user's viewpoint to ensure that instruction to the drivers is clear and unambiguous. The procedure for checking visibility for setting out double white lines/broken lines is given in Appendix I, Vol 3, Ch 5 of the TPDM. This procedure will probably require closure of the road & police assistance.

5.3.3.2 Lengths of overtaking prohibited should be kept to the minimum compatible with safety, particularly on uphill sections of route, as frustration can build up in motorists trapped behind slow moving vehicles. Whenever it is safe to allow overtaking, the road markings should reflect this, except that very short sections of permitted overtaking should be avoided to preclude the possibility of platoons of overtaking motorists "running out of road".

5.3.3.3 Where overtaking is permitted and sight lines are approaching the minimum, regular site checks should be carried out at locations where foliage and vegetation may restrict sight lines.

5.3.3.4 The effect of gradient should also be carefully considered where appropriate, i.e. uphill where it may be necessary to allow a longer distance for overtaking or downhill where it may be appropriate to curtail overtaking a little earlier before a bend because of the likelihood of increased speed.

5.3.4 Use of Zebra Crossings

5.3.4.1 Zebra crossings provide a useful an flexible traffic management tool at locations where pedestrian flows are not high and vehicle flows are light and slow-moving. In other situations the ill-defined priority at these crossings, and their lack of conspicuity can give rise to problems.

5.3.4.2 Zebra crossings are inappropriate for any situation where either :-

(a) vehicular traffic is fast-moving

(b) vehicular or pedestrian flow is anything other than light

(c) either pedestrian flow or vehicular flow is continuous, making a change of priority difficult to achieve.

5.3.4.3 Zebras should not be located on stretches of road interspersed between traffic signals. As they are much less conspicuous than signals, they are unexpected by motorists who are conditioned along such stretches of road to expect signal control for conflicting movements. The location of a zebra crossing in a road interspersed with traffic signals will also affect the linking of signals along the road. In these cases, the zebra should be replaced by a signal-controlled pedestrian crossing. More information on the design of zebra crossings is found in TPDM Vol 2.

5.3.4.4 Locations where zebras have been installed should be regularly monitored, particularly in the New Town areas, where traffic conditions are changing rapidly. They should be replaced by signalized pedestrian crossings immediately it becomes apparent that they are inappropriate for the traffic conditions.

5.3.5 Pedestrian phases in signals with light pedestrian or vehicle flows

5.3.5.1 Under most traffic conditions, pedestrians should be given a positive indication in traffic signals of when they may cross. With fixed time signal control, however, there are some occasions when this may be inappropriate on the minor legs of the junction, with low and slow moving vehicle flows.

5.3.5.2 When the vehicle flow is light, the vehicle green time should normally be kept as short as possible. When this cannot be done, for example where the phase runs in conjunction with a parallel heavier flow, there can be gaps in which pedestrians may cross. It may be preferable to consider not installing pedestrian aspects in these cases, if it appears likely that there is going to be significant abuse of the signals by pedestrians. An "illogical" pedestrian red may undermine the significance and observance of pedestrian signals in other, more critical, locations. Every case must be examined on its own merits. The sites where this situation is likely to apply will be :-

(a) Narrow one way streets

(b) Slow moving traffic

5.3.5.3 Where pedestrian flows are very light or where there is a heavy peak pedestrian flow, with very low flows off-peak, pedestrian actuation should be introduced for the off-peak condition. If vehicle flows are delayed unnecessarily for nonexistent pedestrian flows, signal abuse by motorists is likely to ensue.

5.3.6 Use of 'Stop' sign & Marking

5.3.6.1 Stop signs and markings should only be used where they are absolutely necessary on safety grounds – see TPDM Vol 3 Chapter 2 paragraphs 2.3.2.3 – 2.3.2.14. If stop sign are used when a give way would be adequate, this leads to abuse of the sign and to erosion of its significance elsewhere.

5.3.6.2 Stop signs should not be used in conjunction with give way markings at 4-way priority junctions to define the priority of the minor movements. Other methods of traffic management should be used.

5.3.7 Sign Clutter

5.3.7.1 Sign clutter is a major problem in Hong Kong, which is aggravated by the distraction caused by the overhead advertising signs. It is extremely difficult for the motorist to concentrate on driving and simultaneously absorb all the information imported by the road signing.

5.3.7.2 It is of great importance from a safety viewpoint that :-

(i) Signs should be kept to a minimum in number.

(ii) Signs should be located such that they are not on the periphery of a drivers cone of vision.

(iii) Signs should be spaced apart at sufficient interval for a passing motorist, unfamiliar with the location, to perceive and absorb their message without having to slow down or take his concentration off the road and the other traffic.

(iv) Signs should be hierarchically placed so that the most important is perceived first. The most important sign is the one which, if ignored, would have the greatest effect on safety. Please see TPDM, Vol 3 Section 2.2.3.

(v) Markings should likewise be kept to the minimum consistent with safety conveying the desired message to the driver bearing in mind approach speed, density of traffic and other local factors.

5.4 Engineering Measures which should be Avoided

5.4.1 Use of Medians & Refuge Islands on One-way Streets

5.4.1.1 The road user, particularly the pedestrian, makes his decision on how to negotiate a road crossing based on his assessment of the road layout, traffic density etc. The road layout should not therefore contain any features which are misleading to the road user and which cause him make the mistakes which lead to accidents.

5.4.1.2 With a one-way street it is very important that it does not contain any features which make it appear to be a two-way street. In this respect central medians and splitter islands should be avoided in one-way streets as pedestrians crossing to such a median tend to look the wrong way when crossing one half of the road.

5.4.1.3 Removal of such splitters or medians may create large areas of carriageway for pedestrians to cross. This problem can be minimized, at locations where the carriageway provision is excessive by widening one or both of the footpaths. In cases where local widening is inappropriate, provision of a signalized crossing should be considered.

5.4.1.4 If use of medians or splitters is unavoidable, pedestrian jaywalking can be reduced by channelising pedestrians to selected crossing locations using guardrailing. The selected crossing points should preferably be signal controlled.

5.4.1.5 The converse of the above is also true. A two-way road should be made to appear so by the introduction of splitter islands and medians where necessary to highlight to the road users that they should expect traffic in two directions.

5.4.2 Vehicular Traffic Passing Both Sides of a Tram Island

5.4.2.1 When pedestrians cross to a tram island, or to a splitter island between tram tracks and the vehicular traffic movements, the presence of the island leads them to expect only trams to pass along the track section. As a result significant accident problems develop at locations where other vehicular traffic is allowed to pass on both sides of such an island in the same direction. Pedestrians walk out from the island across the tram tracks and are knocked down by vehicles traveling along the tram track area.

5.4.2.2 There is no doubt that this feature is a major contributory cause of pedestrian/vehicle accidents. Where this problem has been evident and a tram only lane has been installed as an accident remedial measure, this accident problem has disappeared.

5.4.2.3 Vehicular traffic passing both sides of a tram island in the same direction should not be permitted in any proposed tram layouts, and steps should be taken to remove this feature at all existing layouts where it is used. If this results in congestion, other measures such as relocation of the tram island to a less critical position should be considered.

5.4.3 Split Movement Control at Traffic Signals

5.4.3.1 To overcome capacity problems at signals, or to incorporate pedestrian phases whilst maintaining turning movements, split movement control is often proposed at traffic signals, where, for example, the ahead movement will be controlled under a different phase from the right turn movement on this approach. These complexities can prove confusing to pedestrians and motorists alike and it has been demonstrated that they lead to accidents.

5.4.3.2 The accidents arise from two main factors :-

(i) Motorists in one lane see traffic in the adjacent lane move off and mistakenly start to cross the junction themselves, when their own movement is held on red. This can lead to cross-over accidents in the junction.

(ii) When one lane of traffic is held (particularly a nearside lane) and the other lanes have a green signal, pedestrians see the held traffic lane and assume it is safe to cross (frequently even in spite of a red pedestrian signal). They step out unsighted from in front of the held vehicle into the path of the oncoming traffic.

5.4.3.3 For all proposed signalized junctions, or for modifications to existing signalized junctions, the implementation of new split movements should be avoided if at all possible. If this cannot be done, a channelising island should be introduced to separate the split movements, an if possible the pedestrian crossing should be relocated. Pedestrian crossings should not be located immediately in front of split movements which do not have at least a channelising island.

5.4.4 Excessive Green Time in Signals

5.4.4.1 Excessive vehicle green time in signals should be avoided as speeds can become too high on very unsaturated approaches. Pedestrians crossing such approaches are also tempted to cross in gaps in the flow and may misjudge the speed of oncoming fast-moving traffic. The excessive green time can lead to an unnecessarily long cycle time and hence to longer red time to other movements, notably pedestrians. Pedestrians tend to ignore the signals if held on a red signal for too long.

5.4.4.2 Excessive pedestrian green time and pedestrian phases called unnecessarily are also unsatisfactory as vehicles are needlessly delayed. They can also lead to abuse and mistrust of signals by motorists.

5.4.4.3 The problem can be overcome in the following ways :-

(i) For isolated fixed time signals, the timings should be regularly reviewed (at least once in 2 years) to ensure that they are appropriate for the traffic conditions. Consideration should also be given to converting them to vehicle and pedestrian – actuated operation. This is especially effective in reducing delays late at night when pedestrian phases are otherwise called unnecessarily.

(ii) For linked signals the problems are more complex if linking has to be maintained between major and minor junctions. The difficulties can be minimized by using double or triple cycling of the minor locations i.e. operating them at half or 2/3 of the major junction cycle time. It may also be worthwhile to consider operating the signals unlinked at non-critical times. It is also possible to overcome the adverse effect on linking due to the location of a mid-block signal controlled pedestrian crossing through the installation of a “slave pedestrian” controller to control the pedestrian crossing. The slave pedestrian controller shall be linked to a master controller at an adjacent junction. The master controller can inhibit/delay the demand for pedestrian green in the slave pedestrian controller so that a linked green wave will not be disrupted.

5.4.5 Signals Phasing which Appears Illogical, Especially to Pedestrians

5.4.5.1 Illogical signal phasings i.e. signals which are or appear to be on red unnecessarily, encourage mistrust and abuse of signals by road users. This problem is most common in pedestrian signals across dual carriageways, where straight pedestrian crossings across both carriageways are common. On the carriageway arm approaching the signals, where the signals is red to vehicles, pedestrians can cross in safety to the central divider, however a pedestrian green phase may not be possible as traffic may still be passing on the other carriageway. This situation encourages pedestrians to cross (illegally) against the red, and when it is a frequent occurrence the layout should be altered to minimize signal abuse.

5.4.5.2 The problem can be overcome by installing a staggered pedestrian crossing when space permits. Care must be taken however to ensure that sufficient pedestrian storage space is available at the central refuge.

5.5 General Safety Considerations in Traffic Engineering

5.5.1 Anti-skid Remedial Measures

5.5.1.1 At many sites with a pattern of loss of control accidents in the wet, improvements to the skid resistance of the surfacing are normally considered.

5.5.1.2 On high speed roads where skidding is normally associated with aquaplaning, measures which improve the drainage of the layer of water on the road surface and provide macro texture are most appropriate e.g. porous friction course material which is suited to free flow traffic conditions or similar for flexible carriageways and transverse grooving for concrete carriageways.

5.5.1.3 Where the surface texture is identified as being deficient and speeds are not so high consideration should include all available treatments meeting texture depth requirements. These include textured wearing course or applied epoxy based or other similar suitable skid resistant veneer material for flexible carriageways and texturing or applied epoxy based or other similar suitable skid resistant veneer material for concrete carriageways. If the accidents are occurring on bends of the high speed road, the superelevation of the bend should be checked to see if any modification is required.

5.5.1.4 On roads in the urban area and where vehicle speeds are lower, porous friction course materials which are suited to free flowing traffic conditions are not appropriate. Consideration should again include all available treatments meeting texture depth requirements. These include textured wearing course or applied epoxy based or other similar suitable skid resistant veneer material for flexible carriageways and texturing, or applied epoxy based or similar suitable skid resistant veneer material for flexible carriageways.

5.5.1.5 At sites where loss of control is associated also with irregularity in the road surface, it is usually advisable to check whether the road construction has failed. If this proves to be the case, applied surface treatments to improved skidding resistance are inappropriate and the road should be reconstructed.

5.5.2 Monitoring of New Signal Locations

5.5.2.1 When a new signalized junction is commissioned, the intergreens, green times and methods of control installed are based on theoretical calculations. It is important to monitor the situation on site after commissioning to confirm that all the above features are appropriate for the traffic situation encountered. Several visits to the site may be necessary to assess the situation under varying traffic conditions.

5.5.2.2 Monitoring of the on-site situation is particularly relevant for signals in the new and expanded town areas, where the opening of a new housing estate can radically alter the traffic patterns in the surrounding area. Methods of control which are appropriate for low pedestrian flow conditions may be entirely unsuitable for heavy pedestrian loadings.

5.5.2.3 In addition, when signal layouts or methods of control are altered, especially if this involves a change of priority in the signals, conspicuous temporary warning signs should be erected on all approaches to alert motorists to the changes. This simple measure can prevent many accidents.

5.5.3 The use of Absolute Minimum Standards for Bends

5.5.3.1 The absolute minimum standards for bends should only be used as a last resort when all other design options have been thoroughly explored and found impracticable. Convincing justifications demonstrating that the use of absolute minima is unavoidable should be provided for each case.

5.5.3.2 When these standards have to be used, the provision of large chevrons, advance warning signs, “slow” markings on the road, edge-lining and reflective road studs should be considered to highlight the problem to motorists. Additional superelevation on the bend should also be considered. See also TPDM Vol.3 Section 2.4.2.

5.5.3.3 Absolute minimum standard bends can be particularly hazardous when they are located at the transition from a new high standard road to a lower standard existing road. Motorists on the new road become accustomed to the higher standards and the lower standard bend is unexpected. Advance warning at such locations is essential.

5.5.4 Monitoring of Temporary Traffic Arrangements at Roadworks

5.5.4.1 Any temporary traffic arrangements or traffic divisions which have to be implemented to facilitate roadworks or new road construction are a potential hazard to road users. They normally involve substandard features and motorists and pedestrians passing through the area are frequently unfamiliar with the arrangements.

5.5.4.2 To alleviate the problem, a Code of Practice on the Lighting, Signing and Guarding of Roadworks has been produced by HyD. This sets the minimum standards for the work and all temporary traffic arrangements should conform with the standards laid down in the Code.

5.5.4.3 Accident remedial measures cannot be introduced for these sites if an accident problem develops because the layouts in general are only in operation for a short period of time. For this reason, if a temporary layout is giving rise to accidents (site staff will be very well aware of the problem) the onus is very much on the supervisory staff to identify and alter any hazardous layout before more accidents occur. Immediate feedback from police to the respective staff in HyD and TD highlighting any hazardous location should also be encouraged.

5.5.4.4 Where it is unavoidable to reduce the clear headroom, particular for cases with height restriction less than 4.7m, the project proponent must consult Police, TD and HyD with the temporary traffic arrangement including the associated warning arrangements, and if required, the diversion plans.

TPDM Volume 5 Chapter 6 – The Role of Publicity in Accident Prevention

6.1 References

(1) Road Safety Publicity - quantifying the effectiveness of public service advertising by J.P. Morris

(2) Manual of Road Safety Campaigns; OECD Road Research Group 1975

(3) Road Safety Campaigns - design and evaluation; OECD Road Research Group 1971

(4) Marketing road safety to pedestrians by Mr. Braam Van Der Vyver paper to 1985 International Road Safety Conference H.K.

(5) Hong Kong Road Safety Council Annual Reports

(6) TRRL LF 684 – Percentage Contribution to Road Accidents

(7) TPDM other chapters of Volume 5

(8) Potential for Accident and Injury Reduction in Road Accidents 1976 by Barbara E. Sabey

(9) Road Users' Code and Annual Reports on Road Traffic Accident Statistics prepared by Transport Department, The Government of the HKSAR

6.2 Introduction

6.2.1 General

6.2.1.1 The significance of road user's contribution to road accidents was confirmed by the Transport Research Laboratory, UK (TRL) in an in-depth study in the early seventies. Results indicated that human factors contributed to nearly 95% of all accidents and were the sole factors in 65% of these cases (see Dia. 6.2.1.1). This means that, apart from using engineering means to improve the safety standard of roads, many of the road accidents could have been prevented by improving the skills and rectifying problematic attitudes of drivers, as well as changing the behaviour of pedestrians. However, it is not always easy to change a person's attitude or behaviour within a short period of time. Very often it takes a lot of efforts to achieve the objective, but such efforts are worthwhile considering the lives that can be saved. As such, publicity and education is a very important facet of the Government's long term objective of continually improving the road safety condition in Hong Kong.

6.2.1.2 The general aim of road safety publicity is, of course, to reduce accidents but to achieve this goal, publicity can be used more specifically in three main areas :

a) to make road users aware of new information on, for example, new laws or new signs;

b) to change road users' attitudes in a desired direction and so modify their behaviour for the improvement; and

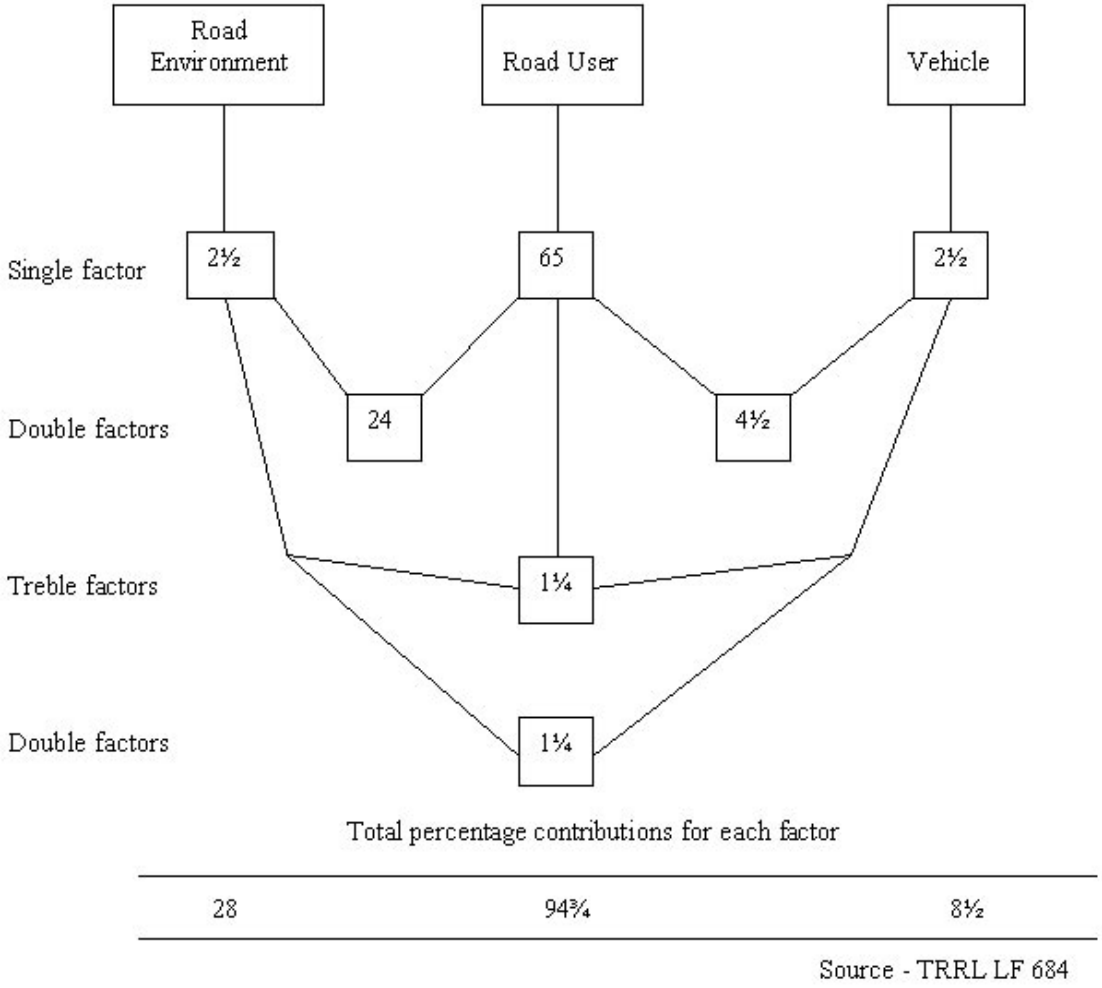
c) to give information concerning particular accidents.

6.2.2 Topics for a Publicity Campaign

6.2.2.1 In essence, topics for campaigns should be chosen on the basis of road accident data but it may also be necessary to take into account information on traffic violations, road user behaviour and perceived knowledge and the attitudes of the general public. Obviously if the campaign is topical it can have more of an impact and can be better understood by the public.

6.2.2.2 A theme for a safety campaign must be specific and unambiguous. If the topic is of a very general nature (e.g. appeals for caution or courtesy) it has been found that the campaigns are less effective. Campaigns with precise topics get better results. Also there is evidence to suggest that more complex skills and judgements such as overtaking are more difficult to improve by means of publicity alone (it may be better to use other measures such as driver training). Therefore the simpler elements of road user behaviour should, wherever possible, be selected for topics.

DIAGRAM 6.2.1.1: PERCENTAGE CONTRIBUTION TO ROAD ACCIDENTS



Source - TRRL LF 684

6.2.3 How Road Safety Publicity is organised in Hong Kong

6.2.3.1 The Road Safety Council (RSC) is a government advisory body committed to reducing the number and severity of traffic accidents in Hong Kong by formulating road safety initiatives and undertaking education and publicity programmes to encourage everyone to take up responsibility to ensure the safety of every road user (see Appendix I for brief description of its membership and function). On publicity and education works, it is supported by the Road Safety Campaign Committee (RSCC), which is chaired by a non-government official. The membership of the RSCC includes representatives of most of the Departments forming the RSC, e.g. Hong Kong Police Force, Transport and Logistics Bureau, Transport Department, Home Affairs Department, Education Bureau, Information Services Department, Social Welfare Department, and other non-official members. The terms of reference of the RSCC are shown in Appendix II.

6.2.3.2 The road safety campaign is a major government publicity campaign. The objective of the campaign is to promote the message of road safety and the principal targets are often vulnerable road users including the elderly and school children.

6.2.3.3 The publicity strategy for the campaign is submitted to the RSC for endorsement, and is then implemented by the RSCC. The campaign, directed to the general public in large, is the co-ordinated effort of various government departments and interested organisations.

6.2.3.4 The publicity media to promote road safety changes with times and enrich with development of new technologies. Some commonly used media are listed for reference.

(i) Television and radio announcements in public interest;

(ii) Press releases;

(iii) Posters, leaflets, bulletins, newsletters (hard copies or soft copies on internet);

(iv) Variable message signs;

(v) Radio break-in messages at government's tunnels;

(vi) Publicity covers on traffic signal controllers; and

(vii) Feeds (including posts, promotion videos or animations) on social media platforms.

6.2.3.5 Local community groups are reached by means of road safety events in each district, jointly organised by District Councils, the Police and the Home Affairs Department. Several government departments are involved in organising these events, which serve to involve the community at all levels. Police enforcement campaigns at local accident-prone sites are normally timed to coincide with these events. Special events are organized to attract territory-wide interest.

6.2.4 Road Users' Code

6.2.4.1 The Road Users' Code (RUC) is the source document giving details of a wide range of rules, advice and information for all road users. The RUC is updated from time to time as certain laws or conditions change and it is also a guide for drivers preparing for their driving tests. A copy of the RUC is given to all learner drivers and is on sale at the Publications Sales Unit of Information Services Department and the online Government Bookstore. The RUC has also been uploaded to TD's Homepage to facilitate access of the public.

6.2.4.2 It is therefore imperative that any road safety campaign should be based on the rules and advice given in the RUC. The RUC should have sufficient information to cover what is needed unless the campaign is designed to introduce new legislation.

6.2.4.3 Apart from the RUC, other codes which may give more specialised information for particular campaigns are the Code of Practice for the Lighting, Signing and Guarding of Road Works, the Code of Practice for the Loading of Vehicles and the Code of Practice for Private Roads.

6.3 Target Groups

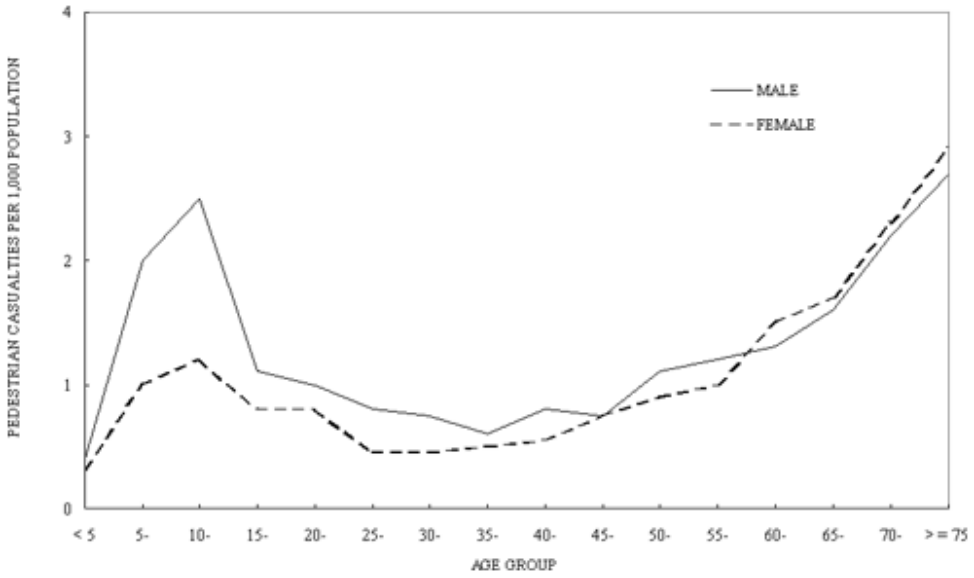
6.3.1 This can be split into Target Behaviour i.e. road user behaviour known to be related to accidents and Target Audiences i.e. type of road user, type of vehicle, demographic classification (age, sex, years of driving experience and type of trip).

6.3.2 It is unlikely that one campaign alone will be suitable for the entire population. It is therefore essential to determine from the outset the purpose of the campaign, in particular the types of road users it seeks to target, and the behavior it intends to change or the attitude to inculcate. Very often the accident analysis work in the Road Safety and Standards Division (RSSD) will reveal a particular age/sex group involved in a particular type of accident or a particular behaviour; for instance it can easily be shown (Dia. 6.3.2.1) that those most at risk in crossing the road are males aged around 10 and all pedestrians over the age of 60. This sort of information should be borne in mind in devising a general publicity campaign.

6.3.3 RSSD also produces reports on various types of accidents based on District Council Area or Police District. This information is useful in planning more localised campaigns. For instance it can be shown that the accidents in the Mongkok area are, not surprisingly, more likely to involve old people crossing the road whereas those in a New Town housing area might involve very young pedestrians or cyclists.

6.3.4 Apart from RSSD, the Police will also put forward particular types of accident or behaviour to "target" or the Road Safety Council itself might decide on a particular target group as well as the theme for education and publicity campaign.

DIAGRAM 6.3.2.1: AGE SPECIFIC PEDESTRIAN CASUALTY RATE BY SEX IN A TYPICAL YEAR



6.4 Choice of Message and Appeal

6.4.1 Given a target behaviour and a target audience, the campaign designer will have to choose between the various appeals he may make to the message recipients in order to maximise attention and audience motivation. It is generally advised that two or more campaigns do not run simultaneously unless they are clearly aimed at different target groups.

6.4.2 Although, as stated in Section 6.2.3, the organization and designing of road safety campaigns is the responsibility of the Road Safety Campaign Committee of the Road Safety Council, the Transport Department is directly involved with these bodies and some knowledge of campaign strategy is desirable for those officers taking part in the discussions.

6.4.3 In order for campaigns to be effective the materials used must be appealing to the target audience. This is achieved by determining and adopting the most suitable appeal or combination of appeals for that target. Some variations of type are :

- horror
- fear
- family responsibility
- factual/statistical
- involvement of a famous person or celebrity
- humour
- satire
- grief
- authority

Studies have attempted to estimate the effectiveness of different approaches or combinations of appeals and, although there is no conclusive evidence in favour of one appeal for road safety campaign, it is usually recommended that a serious rather than a humorous approach is used. Horror can be effective but material which is too frightening is often rejected and generally it is not advisable to frighten road users with horrifying scenes of road accidents.

6.5 Choice of Media

6.5.1 Choice of media depends on the message to be delivered and the principal targets. Advice may be sought from TD's Information and Public Relations Unit or the Information Services Department. Some commonly used publicity media are listed in Section 6.2.3.4 for reference.

6.5.2 To enhance publicity and for wider dissemination of road safety messages, the Road Safety Unit of Traffic Headquarters and the Regional Road Safety Teams may also arrange publicity through the mass media as when necessary. Road safety events organized in Districts on a regular basis are venues where particular items of the campaign can be emphasized in line with their particular needs and target groups.

6.5.3 It may be that a particular junction or a particular pedestrian crossing is shown by RSSD to have problems unique to the vicinity of a nearby development or school. In such a case the particular publicity and the medium for the publicity is very localised and site dependent. Either through the Traffic and Transport Committee of corresponding District Council or a direct approach to a school principal would enable the problem to be aired and the "target audience" contacted and hopefully influenced to change behaviour.

6.6 Education

6.6.1 Education has always been an important aspect in reducing traffic accidents. Comprehensive road safety programme is designed for different road user groups coupled with other publicity programmes. Road safety education is an integral part of the school curriculum. Some educational television programmes have also included road safety messages.

6.6.2 Regular lectures are given by Police Road Safety Teams (RST) at schools to reinforce road safety education. In addition to theory learnt from other sources, students have an opportunity of getting first hand information from the Police. Officers from the RST relate to students regarding their first hand experience in dealing with traffic accidents and the technique in how to prevent them. Apart from visits to schools, on-street education is being conducted by officers of RST.

6.6.3 The four Road Safety Towns provide simulated road environment for children to enhance their road safety awareness. The day-to-day management and maintenance of the Towns are the responsibility of the Leisure and Cultural Services Department whilst the Regional Road Safety officers provide road safety lectures to visitors.

6.6.4 The Road Safety Bus serves as a mobile road safety exhibition and lecturing centre, visiting schools, housing estates and youth centres for disseminating road safety knowledge.

6.6.5 The Student Road Safety Patrols (RSP) in kindergarten, primary and secondary schools operating under the auspices of the Hong Kong Road Safety Association (RSA) play a significant role in school road safety education. Police were used to be responsible for training secondary and primary school RSPs. Recently, a train-the-trainer approach is adopted by the Police to provide footdrill training to the RSPs.

6.6.6 A commercial publicity campaign may use access to schools as part of an educational effort but also as a way of keeping the interest of sponsors who have exposure to a contained and definable audience.

6.6.7 In fact, partnership approach is proved effective in publicity campaigns and educational programmes. Taxi and trade associations and franchised bus companies are often approached with a view to educating their members or drivers and to having a wider dissemination of road safety messages.

Appendix I

Road Safety Council - List of Membership and Function

List of Membership

Deputy Commissioner of Police (Operations) (Chairman)
Representative of the Transport and Logistics Bureau
Representative of the Highways Department
Representative of the Transport Department
Representative of the Education Bureau
Representative of the Home Affairs Department
Representative of the Information Services Department
Representative of the Hong Kong Police Force
Non-official Members

Secretary
Chief Inspector of Police, Road Safety Unit, Traffic Branch Headquarters, Hong Kong Police Force

Function

The Road Safety Council is a government advisory body committed to reducing the number and severity of traffic accidents in Hong Kong by formulating road safety initiatives and undertaking education and publicity programmes to encourage everyone to take up responsibility to ensure the safety of every road user. The Council is supported by two committees and five working groups, namely the Road Safety Campaign Committee, the Road Safety Research Committee, the Road Safety Council Annual Report Working Group, the Road Safety Publicity Strategies Working Group, the Road Safety Focused Action on Target Groups Working Group, the Road Safety Innovation and Technology Working Group, and the Road Safety Strategic Engagement Working Group.

Appendix II

Road Safety Campaign Committee - Terms of Reference

1. To assist the Road Safety Council in organizing road safety publicity campaigns and in disseminating road safety information through the media.

2. To advise on budget allocation and to monitor expenditure on road safety programmes funded by the Government.

3. To consider and formulate road safety publicity programmes for the Road Safety Council and to monitor activities carried out by operational organizations.

4. To formulate a systematic and comprehensive road safety education programme for people of different age groups and different road user groups.

5. To monitor the road safety educational activities of the operational organizations.

6. To advise on and to assist in the production of road safety educational materials.

TPDM Volume 5 Chapter 7 – Road Safety Audit

7.1 References

(1) GG 119, Road Safety Audit, Revision 0, Design Manual for Roads and Bridges, UK, October 2018

(2) Guide to Road Safety - Part 6: Road Safety Audit, Austroads, January 2009

(3) Road Safety Audit, Document SQA-0170-May 2014, Transport for London, UK

(4) Road Safety Audit For Road Projects – An Operational Tool kit, Asian Development Bank, Manila, June 2003

(5) CAREC Road Safety Engineering Manual 1 – Road Safety Audit, Asian Development Bank, March 2018

(6) Road Safety Audit, The Institution of Highways & Transportation, October 2008

7.2 Introduction

7.2.1 Road Safety Audit (RSA) is a formal and systematic examination and reported by an independent qualified team on the road safety performance of highway infrastructure projects for all road users. Road Safety Audit Team, by leveraging on road safety engineering techniques, will identify and address problematic areas using the experience gained from highway design, road safety engineering, accident analysis and road safety related research.

7.2.2 To ensure that the road safety implications of new road projects are fully considered for all road users, it is recommended that the permanent scheme of new public roads, or improvements to existing public roads which will result in change in road characteristics, should be subject to RSA at the following stages:--

a) Stage 1 - Feasibility study/Investigation

b) Stage 2 - Detailed design

c) Stage 3 - Construction

7.2.3 For new public road projects carried out by government departments, the project office (i.e. Civil Engineering and Development Department, Highways Department, or other government departments carrying out the feasibility study, investigation, design and construction of the public road projects) should include in the engineering project consultancy brief the requirement for the Consultants to carry out the required RSA in accordance with the guidelines stipulated in the Transport Planning and Design Manual (TPDM) (see Annex A)

7.2.4 Roads should be designed in accordance with the prevailing traffic engineering standards and requirements as promulgated in TPDM, and other relevant guidance notes and technical circulars. While these documents provide the basis of standards for a safe design, experience has shown that there can still be potential hazards, for example, some designs may include standards inappropriate for that type of road or the situation; sometimes, when combining various elements which are individually up to the design standards may yield a result not the best in safety; and changes made during construction have not taken into account operational safety factors. RSA would identify design aspects that could give rise to potential road safety problems and suggest modifications that could improve the overall safety of the road scheme as a whole.

7.2.5 RSA procedures in Section 7.6 have been developed to ensure that operational road safety experience is applied during the design and construction process in order to minimise the risk and severity of traffic accidents. Audited schemes will also lead to reduction in road safety remedial works after the road project is in operation.

7.2.6 For minor public road works scheme where there is little or no impact on road user behaviour, the scheme may be exempted from RSA if agreed by the Transport Department (TD). In such situations, project office should provide justifications for the exemption and seek agreement from TD at the early stage of the project. It should however be noted that any exemption on RSA is stage specific.

7.3 Scope of Road Safety Audit

7.3.1 RSA shall only consider matters with road safety implications. It is neither a technical check that the design conforms to the prevailing standards, requirements and/or best practice guidance, nor a means of option selection. It is the responsibility of the design team to ensure that the designs are in compliance with the prevailing standards/guidelines and have also gone through the appropriate independent check prior to the RSA.

7.3.2 Advice is given on the general aspects that should be addressed at the RSA Stages 1, 2 and 3 in the respective lists in Annexes B, C and D.

7.3.3 The lists in Annexes B, C and D are not exhaustive. They only provide a prompt for optional supplementary checks of common elements that Road Safety Audit Teams could make following their less prescriptive and more wide-ranging RSA.

7.4 Stages of Road Safety Audit

7.4.1 Stage 1 Road Safety Audit: Feasibility Study/Investigation

7.4.1.1 Stage 1 RSA should normally be undertaken at the feasibility study/investigation, which can influence fundamental issues such as the alignment, continuity with the existing adjacent network, and provision of junctions and interchanges. These issues are also critical for determining the land requirement of projects. It is therefore essential that Stage 1 RSA considers all the fundamental road safety issues, in particular those having a bearing upon land take (see Annex B for details).

7.4.1.2 The feasibility study/investigation must be sufficiently progressed such that all significant features are clearly shown upon completion.

7.4.1.3 Road Safety Audit Team must examine the site together to see if the road scheme involves permanent change to existing highway layout or feature, or tie-in to existing carriageways.

7.4.2 Stage 2 Road Safety Audit: Detailed Design

7.4.2.1 Stage 2 RSA should normally be undertaken at the detailed design. At this stage, the Road Safety Audit Team is concerned with the more detailed aspects of the road scheme and will be able to consider in greater depth the geometry (such as the layout of junctions, horizontal and vertical alignments, and cross-sections), street furniture, traffic control systems, road restraint systems, road markings, and other issues (see Annex C for details).

7.4.2.2 Stage 2 RSA should include a review of the issues raised in the feasibility study/investigation stage. Any issues that have not been satisfactorily resolved in the Stage 1 RSA either by the element of the scheme being redesigned or as a result of clarification by the provision of further information, should further be reviewed in the Stage 2 RSA Report.

7.4.2.3 Road Safety Audit Team must examine the site together to see if the road scheme involves permanent change to existing highway layout or feature, or tie-in to existing carriageways.

7.4.3 Design Changes and Stage 1 and 2 Road Safety Audit Shelf Life

7.4.3.1 Stage 1 and 2 RSAs must be repeated if –

a) the scheme design materially changes;

b) there are many minor changes which could together have impact on road user safety; or

c) the previous finalised RSA for the relevant stage is more than 5 years old.

In the case of minor changes, the repeated RSA should only be concerned with the elements of the scheme that have been changed. If the changes are more significant or if there are many minor changes, then the whole RSA stage should be repeated.

7.4.4 Stage 3 Road Safety Audit: Construction

7.4.4.1 Stage 3 RSA should be undertaken when the road is substantially completed to ensure the safety needs of all road users are provided. The audit involves detailed site inspections at various site conditions, which should be carried out before the road is opened for use.

7.4.4.2 Road Safety Audit Team is required to examine the road from all road users' viewpoints and should drive, walk and/or cycle through the road to assist their evaluation and ensure they have a comprehensive understanding (see Annex D for details) of the site conditions.

7.4.4.3 Road Safety Audit Team must examine the site together to consider potential impact on road safety during various site conditions such as during daylight, hours of darkness, peak/off-peak traffic periods, adverse weather condition, etc. The site visit may be conducted with the future maintenance agents of the road where necessary.

7.5 Road Safety Audit Team ("Audit Team")

7.5.1 The design team should propose an appropriate and independent Audit Team for project office's approval. It is a fundamental principle of the Road Safety Auditing process that the Audit Team must be completely independent from the design team. If the Audit Team is also under the same design organization, it should not be involved in any work of the project except the audit work. The project office should ensure that appropriate declarations have been made in this respect before approving the Audit Team and the Observers.

7.5.2 Audit Team should consist of one Team Leader and at least one Member. A maximum of two Observers may also join the Audit Team to gain experience and the skills involved in carrying out the audit process. However, Road Safety Audit Observers are not counted as part of the Audit Team.

7.5.3 The Audit Team Leader, Members and Observers should possess the relevant professional qualifications, training, experience and skills for conducting the Road Safety Audit of the project. Any changes to the approved Audit Team and its individual members as well as Observers will require further approval from the project office. The recommended acceptance criteria for Audit Team and Observers are as below:

a) **Road Safety Audit Team Leader**: should have a minimum of 4 years of post-qualification accident data analysis or road safety engineering experience, and completed satisfactorily at least 5 road safety audits as team leader or member in the past 24 months.

b) **Road Safety Audit Team Member**: should have a minimum 2 years of post-qualification accident data analysis or road safety engineering experience, and completed satisfactorily at least 5 road safety audits as team leader, member or observer in the past 24 months.

c) **Road Safety Audit Observer**: should have a minimum 1 year accident data analysis or road safety engineering experience.

7.5.4 All members of the Audit Team as well as Observers must be corporate members of recognized professional institutions such as the Hong Kong Institution of Engineers in the Civil Discipline or Logistics and Transportation Discipline (or equivalent qualifications), and have received at least 10 days formal training on accident data analysis or road safety engineering.

7.5.5 Where necessary and subject to the approval of the project office, the Audit Team may appoint Specialist Advisor who is not a member of the Audit Team to advise on particular features of the road project such as complex signal controlled junctions, or traffic control and surveillience systems.

7.5.6 Project office may seek comments and advice from TD where necessary on the acceptance of the Audit Team and Observers proposed by the design team.

7.6 Road Safety Audit Procedures

7.6.1 Road Safety Audit Brief

7.6.1.1 The design team should prepare and submit a Road Safety Audit Brief for project office's approval. The Road Safety Audit Brief should define the scope and details of the RSA to be undertaken (see Annex E). If the Audit Team considers the Road Safety Audit Brief to be insufficient for their purpose, requests for further information shall be made to the design team with copy to the project office.

7.6.1.2 Project office may seek comments and advice from TD or any other concerned parties on the Road Safety Audit Brief prepared by the design team if the project contains any particular features.

7.6.2 Road Safety Audit Process

7.6.2.1 The design team should allow sufficient time in the project programme for the Audit Team to complete the RSA and make due allowance for incorporation of necessary design changes at various stages.

7.6.2.2 The design team should ensure that the Audit Team is given sufficient notice of when the scheme will be ready for the RSA at each stage and the date by which the report will be required.

7.6.2.3 After conducting the RSA, the Audit Team Leader should prepare a report containing a separate statement for each identified potential problem to describe the location and nature of the problem and the type of accidents or incidents considered likely to occur as a result of the problem. When deciding whether to include a potential problem, the Audit Team must consider how road users will be involved in a likely accident and how the accidents happen.

7.6.2.4 Each problem must be followed by an associated recommendation. The Audit Team must aim to provide proportionate, cost-effective and viable recommendations to eliminate or mitigate the identified road safety problems.

7.6.2.5 The Road Safety Audit Report should not include technical matters that have no implications on road safety or any other matters not covered by the Road Safety Audit Brief, such as maintenance defects observed during site visits. The Audit Team Leader should refer these matters to the project office or the maintenance agent direct in separate correspondence for necessary follow-up as soon as possible.

7.6.2.6 The Audit Team should submit the Road Safety Audit Report to the design team with copy to the project office. With the agreement of the project office, the design team may discuss the findings of the Report with the Audit Team where necessary.

7.6.2.7 Stage 1, 2 and 3 Road Safety Audit Reports should contain but not limited to the items listed in Annex F. However, it is not necessary to include the checklists in the Report.

7.6.3 Road Safety Audit Response Report

7.6.3.1 It is the project office's responsibility to ensure that all potential problems raised by the Audit Team are given due consideration. To assist with this, the design team must prepare timely a Road Safety Audit Response Report to each Road Safety Audit Report completed at various stages.

7.6.3.2 The Road Safety Audit Response Report should contain but not limited to the items listed in Annex G.

7.6.3.3 The design team shall submit a draft Road Safety Audit Response Report to the project office for consideration. The project office may seek advice or comments from the Audit Team as well as other concerned parties on the draft Response Report as and when necessary. Where the project office agrees an amendment to a response with the design team, this amendment shall be incorporated into the final Road Safety Audit Response Report.

7.6.3.4 It is possible that the project office may not be able to agree with all the responses by the design team. In this situation, the project office should make the final decision and the final Road Safety Audit Response Report should identify and record all the differences in opinion.

Annex A : Sample clause to be included in engineering project consultancy brief for carrying out RSA

The Consultants shall carry out Road Safety Audit for the Project in accordance with the requirements stipulated in the Transport Planning and Design Manual unless otherwise agreed by the Director's Representative.

Annex B : Stage 1 Road Safety Audit Checklists – Feasibility Study/Investigation

List B1 – General

Item		Possible Issues
(a)	Departures from design standards	What are the road safety implications of any departures from design standards or guidelines?
(b)	Cross-sections	Can the cross-sections accommodate the forecast amount and mix of traffic, drainage, ducting, signing, fencing, lighting and pedestrian and cycle routes safely? Will the scheme have any adverse camber? Will the lane widths, marginal strips, hard shoulders, medians and other cross-section features be adequate for the function of the roads? Will the design be free of undesirable variations in cross-sectional design? (particularly if the scheme differs from adjacent or adjoining lengths of road) Will the crossfalls of road section be safe?
(c)	Drainage	Will the proposed road drainage prevent road sections from ponding, particularly at trough or low-lying area? Will excessive surface run-off flow across the highway from adjacent land? Will there be any roadside drains without cover?
(d)	Landscaping	Will areas of landscaping conflict with sight lines (including during windy conditions) or increase the severity of an accident? Will road lights be easily obstructed by overgrown of trees? Will trees (new or when mature) be a hazard to an errant vehicle? Will planting affect lighting or shed leaves onto the carriageway?
(e)	Public Utilities/Services Apparatus	Will utility apparatus easily be struck by an errant vehicle? Will utility apparatus or any highway furniture obscure sight lines? Will the design adequately deal with overhead services (especially in regard to overhead clearance, etc.)?

(f)	Lay-bys	Has adequate provision been made for vehicles to keep clear of the carriageway in an emergency? Will parked vehicles affect sight lines? Will lay-bys be located in a safe location (e.g., away from vertical crests or tight horizontal alignments with limited visibility)?
(g)	Access	Is the visibility to/from accesses adequate? Can multiple accesses be linked into one service road? Will there be any conflicts between turning and parked vehicles? Is the design free of any downstream or upstream effects from point of access, particularly near intersections?
(h)	Emergency Openings/Contingency Openings	Are emergency openings/contingency openings suitably designed to prevent cross-over and head-on collisions?
(i)	Staged Opening of Roads and Future Widening	Where a single carriageway scheme has to form part of a future dual carriageway, is the two-way road clear to road users and the road is adequately designed and constructed for two-way traffic? Is the transition between single and dual carriageway (either way) handled safely?
(j)	Adjacent Development	Will adjacent development cause interference/confusion? (e.g. lighting or traffic signals on adjacent roads may affect a road user's perception of the road ahead) Has the design handled access to major adjacent generation of traffic and developments safely?
(k)	Climate Conditions	Has consideration been given to weather records or local experience that may indicate a particular problem? (for example, sunglare, wind or fog, etc.)
(l)	Design speed	Are the design speeds and speed limits appropriate for the road type (for example, consider the terrain and function of the road)?
(m)	Public transport	Have the needs including access of public transport users been considered? Have the manoeuvring needs of public transport vehicles been

considered?

Have bus stops been well positioned for safety?

List B2 – Alignment

Item		Possible Issues
(a)	Geometry of Alignment	Have the horizontal and vertical alignments been fitted together correctly? Is the design free of visual cues that would cause a driver to misread the road characteristics (for example, visual illusions, subliminal delineation such as lines of trees, pole, etc.)? Have the alignment been provided for speed consistency?
(b)	Visibility	Are horizontal and vertical alignments consistent with required visibility? Will sight lines be obstructed by permanent or temporary features e.g. bridge abutments, parked vehicles, railings, noise barrier?
(c)	New/Existing Road Interface	Will the proposed scheme be consistent with the standard of provision on adjacent sections of road and if not, is this made obvious to the road users? Does interface occur near any potential hazard such as at crest or bend after a steep gradient? Has the need for advance warning been considered? Where a new road scheme joins an existing road, or where an on-line improvement is to be constructed, will the transition give rise to potential hazards? Where the road environment changes (e.g. urban to rural, restricted to unrestricted) is the transition made obvious by appropriate signing and carriageway?

List B3 – Junctions

Item		Possible Issues
(a)	Layout	Have acceleration/deceleration lanes been adequately provided?
		Are splitter islands and guard rails required on minor arms to assist pedestrians at junctions?
		Are there any unusual features that affect road safety?
		Are widths and swept paths adequate for all road users? Will large vehicles overrun pedestrian or cycling facilities?
		Are there any conflicts between turning and parked vehicles?
		Are any junctions sited at or near a crest that could cause sight line problem?
		Is the junction type appropriate for the traffic flows and likely vehicle speeds? Any traffic calming measures needed?
		Is the design free of any upstream or downstream geometric features that could affect safety? (for example, merging of lanes)
(b)	Visibility	Are sight lines adequate on and through junction approaches and from the minor arm?
		Are visibility splays and sight line adequate and clear of obstructions such as street furniture, landscaping or parked vehicles?

List B4 – Pedestrians and Cyclists Provision

Item		Possible Issues
(a)	Adjacent Land	Will the scheme have an adverse effect on safe use of adjacent land?
(b)	Pedestrian/Cyclists	Have pedestrian and cycle routes been provided where required?
		Can verge strips dividing footways/cycle tracks and carriageways be provided?
		Are footbridges/subways sited to attract maximum use? Any likely jaywalking problem nearby?
		Is specific provision required for special and vulnerable groups? (i.e. the young, the elderly, mobility and visually impaired persons?)
		Are tactile paving, flush or dropped kerbs and guard railing proposed? Is it specified correctly and in the best location?
		Are these routes clear of obstructions such as signposts, lamp columns, bollards, etc.?
		Are pedestrian refuges provided where needed?
		Where cycle track terminates at junctions of adjacent to the carriageway, has the transitions treatment been handled safely?

List B5 – Traffic Signs, Road Markings and Lighting

Item		Possible Issues
(a)	Traffic Signs	Is there likely to be sufficient space to provide the traffic signs required?
		Are sign gantries needed?
		Are traffic signs located in appropriate locations where they can be seen and read in adequate time, and away from locations where there is a high strike risk?
		Are both vertical and horizontal clearances adequate?
(b)	Poles/Columns	Will poles/columns be appropriately located and protected?
(c)	Road Markings	Has the appropriate standard of delineation and marking been adopted?
		Are the proposed road markings consistent with the works on the adjoining section of the route?
		Are the previous/adjacent road markings to be upgraded? If not, will safety be maintained?

Annex C : Stage 2 Road Safety Audit Checklists – Detailed Design

List C1 – General

Item		Possible Issues
(a)	Departures from design standards	Review road safety aspects of any departures granted since the Stage 1 Road Safety Audit.
(b)	Typical cross sections	Are lane widths, shoulders, medians and other cross section features adequate for the function of the road? Is the width of traffic lanes and carriageways suitable in relation to - Alignment? - Traffic volume? - Vehicle dimensions? - The speed environment? - Combinations of speed and traffic volume? Are the shoulder or marginal strip widths adequate up to standard and adequate for broken down vehicles? Are median widths adequate for road furniture? Is superelevation consistent with the road environment? Are the shoulder crossfalls safe for vehicles to traverse? Will the design be free of undesirable variations in cross-sectional design? (particularly if the scheme differs from adjacent or adjoining lengths of road) Will the crossfalls of road section be safe?
(c)	Drainage	Have adequate drainage facilities (e.g. gully spacing, gully locations, flat spots, crossfall, ditches) been designed for the roads? Do features such as gullies obstruct cycle routes and footpaths? Do the locations of features such as manhole covers or gullies give concern for motorcyclist/cyclists' stability? Will excessive surface run-off flow across the carriageway and increase the risk of aquaplaning under adverse weather conditions? Are flat spots avoided or adequately dealt with at start/end of superelevation?
(d)	Landscaping	Will planting (new or when mature) encroach onto the carriageway or obscure traffic signs, traffic signals or sight lines (including during windy conditions)?

		Will earth bunds or landscape hard works obscure traffic signs or visibility?
		Will trees (new or when mature) be a hazard to an errant vehicle?
		Will planting affect lighting or shed leaves onto the carriageway?
		Will 'frangible' vegetation be planted in possible run-off road areas?
(e)	Public Utilities/Services Apparatus	Can maintenance vehicles stop clear of traffic lanes on expressways? If so, will they obscure traffic signs or sight lines?
		Are boxes, pillars, posts and cabinets located in safe positions away from locations that may have a high potential of errant vehicle strikes? Do they interfere with visibility?
		Has sufficient clearance to overhead cables been provided?
		Are there any utility inspection chambers in between live traffic lanes and/or wheel tracks?
		Do they give concern for motorcyclist/cyclist stability?
(f)	Laybys	Is the layby positioned safely?
		Are the dimensions adequate for safe use by vehicles?
		Will parked vehicles affect sight lines of pedestrians and other vehicles?
		Any sight line problem for vehicles exiting the layby (particularly layby located at a left-hand curve)?
		Will the layby affect pedestrian flow and safety?
(g)	Access	Is the visibility to/from accesses adequate?
		Are the accesses of adequate length to ensure all vehicles clear the main carriageway?
		Is the design free of any downstream or upstream effects from access, particularly near intersection?
(h)	Skid Resistance	Are there locations where anti-skid resistance surfacing (such as on approaches to junctions and crossings) would be beneficial?
		Do surface changes occur at locations where they could adversely affect motorcyclists' stability?
(i)	Fences and Road Restraint Systems	Is there a need for road restraint systems to protect road users from roadside hazards such as structural columns, gantries, abutments, falls, steep embankments or areas of water (including stream, channels, sea,

		etc.)? Can the proposed road restraint systems give appropriate and adequate protection to errant vehicles? Are the road restraint systems long enough? If there are carriageways on both sides of the fence, is an interlocking-design necessary to prevent impalement on impact? Are the barrier fences lapped correctly in the direction of traffic? Are there any gaps in between anchor end blocks or at start and end of the barrier fences that could allow an errant vehicle to pass through? Are the end conditions of the crash barrier safe and satisfactory?
(j)	Emergency, breakdowns, emergency and service vehicle access	Has provision been made for safe access and movements by emergency vehicles? Are emergency openings well designed to prevent cross-over and head-on collisions? Have broken-down vehicles or stopped emergency vehicles been adequately considered?
(k)	Staged Opening of Roads and Future Widening	Where a single carriageway scheme has to form part of a future dual carriageway, is the two-way road clear to road users and the road is adequately designed and constructed for two-way traffic? Is the transition between single and dual carriageway (either way) handled safely?
(l)	Adjacent developments	Does the design handle access to major adjacent generations of traffic and developments safely? Will adjacent development cause interference/confusion? (e.g. lighting or traffic signals on adjacent roads may affect a road user's perception of the road ahead) Are there any safety issues relating to the provision of noise barriers?
(m)	Public Transport	Have the needs for public transport been considered, adequately signed and catered for? Have the needs of public transport users been considered? Have the manoeuvring needs of public transport vehicles been considered? Have bus stops been well positioned for safety?

List C2 – Alignment

Item		Possible Issues
(a)	Geometry of horizontal and vertical alignment	Have the horizontal and vertical alignments been fitted together correctly? Is the design free of visual cues that would cause a driver to misread the road characteristics (for example, visual illusions, subliminal delineation such as lines of trees, pole, etc.)? Have the alignment been provided for speed consistency?
(b)	Effect of cross sectional variation	Is the design free of undesirable variations in cross section design? Are crossfalls safe? (particularly where sections of existing highway have been used, there have been compromises to accommodate access) Is superlevation provided and sufficient at all locations where required?
(c)	Road layout	Are all traffic management features designed so as to avoid create unsafe traffic conditions? Is the layout of road markings able to deal satisfactorily with changes in alignment? Have public transport requirements been adequately catered for?
(d)	Visibility	Obstruction of sight lines by - Safety fences - Boundary fences - Street furniture - Parking facilities - Signs - Landscaping - Structures - Noise barriers - Crests - Features such as buildings, plant or materials outside the highway boundary Is the forward visibility of at-grade crossings sufficient to ensure they are conspicuous? Are light rail crossings, bridges and other hazards all conspicuous?

		Is the design free of other local features which may affect visibility? Is the design free of overhead obstructions which may limit sight distance at sag curves? Has the minimum visibility splay been provided at junctions or frontage access?
(e)	New/Existing Road Interface	Where a new road scheme joins an existing road, or where an on-line improvement is to be constructed, will the transition give rise to potential hazards? Where the road environment changes (e.g. urban to rural, restricted to unrestricted), is the transition made obvious by appropriate signing and road markings? Have implications for safety at the interface been considered? Is the transition from old road to the new scheme satisfactory? If the existing road is of lower standard than the new scheme, is there clear and unambiguous warning of the reduction in standard? Have appropriate warning been given for marked reduction in speed limit? Is access or side friction handled safely? Does the interface occur well away from any hazard? (for example, a crest, a bend, a road side hazard or where distractions may occur.) If carriageway standards differ, is the change effected safely? Is the transition where the road environment changes (for example, urban to rural; restricted to unrestricted) done safely? Have the need for advance warning been considered, adequately signed and catered for?

List C3 - Junctions

Item		Possible Issues
(a)	Layout	Are the junctions and accesses adequate for all vehicular movements?
		Are there any unusual features, which may have an adverse effect on road safety?
		Have guard rails/safety fences been provided where appropriate?
		Do any roadside features (e.g. guard rails, safety fences, traffic bollards signs and traffic signals) intrude into drivers' line of sight?
		Are splitter islands and guard rails required on minor arms to assist pedestrians or formalise road users' movements to/from the junction?
		Are stopping areas for buses, taxis and public utilities vehicles situated within the junction area? Are they located outside visibility splays?
		Are widths and swept paths adequate for all road users? Will large vehicles overrun pedestrian or cycling facilities?
		Has pavement of anti-skid treatment been provided where needed?
		Are there any conflicts between turning and parked vehicles?
		Are any junctions sited at or near a crest that could cause sight line problem?
		Will excessive speed in approaching the junction cause safety problem? Any traffic calming measures needed?
(b)	Visibility	Are visibility splays and sight line adequate and clear of obstructions such as street furniture, landscaping or parked vehicles?
		Are sight lines adequate on and through junction approaches and from the minor arm?
(c)	Signing	Is the junction signing adequate, consistent with adjacent signing and easily understood?
		Do all the direction signs along the route follow the same signing principle?
		Have the appropriate warning signs been provided?
(d)	Road Markings	Do the road markings clearly give the appropriate message to the concerned road users?
		Are the road markings suitably chosen and correctly used?
		Are the dimensions of the road markings appropriate for the speed limit/design speed of the road?
		Have old road markings and road studs been adequately removed where necessary? Covering of old markings by black paint is not accepted.

(e)	T, Y and Cross Junctions	Have shadow island cum right turn lanes and refuges been provided where required? Do junctions have adequate stacking space for turning movements?
(f)	All Roundabouts	Are the deflection angles of approach roads adequate for the likely approach speed? Is the use of a roundabout and its type suitable at the concerned junction? Are splitter islands necessary? Is visibility on approach adequate to ensure drivers can perceive the correct path through the junction? Where chevron signs are required, have they been correctly sited? Are dedicated approach lanes required? If provided, will the road markings and signs be clear to all users? Are the approach speeds for each arm likely to be appropriate for a mini roundabout? Is the mini roundabout well perceived by approaching drivers and the centre island clearly visible from all approaches?
(g)	Traffic Signals	Are advance warning signs for the signals necessary and adequate? Are the signals clearly visible in relation to the likely approach speeds? Any split phase of signals in front of pedestrian crossing? (To be avoided) Is “overshoot of the junction” likely to be a problem? Is the visibility of signals likely to be affected by sunrise/sunset? Will larger signal aspects and/or backing boards improve visibility? Will overhead traffic signal units be of value? Is the stopline in the correct location? Are lane directional arrows appropriate, positioned correctly and clearly seen? Are the lengths of any pedestrian crossings excessively long? Are the proposed tactile paving layouts correct? Are the markings for right turning vehicles adequate? Is there a need for box junction markings? Is the phasing appropriate?

Does the number of exit lanes equal the number of approach lanes?

Is adequate time including intergreen provided for each vehicular traffic/ pedestrian phase?

Any likelihood of signals being misread by drivers?

Are lanterns for other approach directions adequately shielded from view?

Has the vertical alignment been considered to ensure sufficient sight distance?

Will the design layout of the crossing likely mislead pedestrians looking in the wrong direction for coming traffic?

Any need of road markings to guide vehicles in passing through the junction?

List C4 – Pedestrians and Cyclists Provision

Item		Possible Issues
(a)	Adjacent Land	Will the scheme have an adverse effect on safe use of adjacent land? Are accesses to and from adjacent land/properties safe to use? Has adjacent land been suitably fenced?
(b)	Pedestrians	Are crossing facilities placed and designed along pedestrian desire lines to attract maximum use and avoid jaywalking? Are roadside guardrails or central dividers present/required to deter pedestrians from crossing the road at unsafe locations? Are tactile strips and dropped kerbs proposed? For each type of crossing facility (footbridges, subways, at-grade), have the following aspects been fully considered? - visibility of motorists and pedestrians; - use by mobility and visually impaired persons; - use by the elderly and children/schools; - need for guardrails in verges/central reserve; - provision of necessary signs and road markings; - width and gradient of the road; - skid resistance of the road surfacing; - avoidance of channels and gullies which may affect road users; and - need for good lighting. Are the width and gradient of the pedestrian paths, waiting areas, crossing, etc. satisfactory? Will the layout of the crossing likely mislead pedestrians looking in the wrong direction for coming traffic? Will the design force pedestrians to wait in the middle of the road?
(c)	Cyclists	Have the safety and needs of cyclists been considered especially at crossings and junctions? Do the signing and marking make clear the intended use of the cycling facilities? Has adequate lighting been provided on cycle routes? Will any roadside objects or facilities on the cycle tracks cause safety hazards to cyclists?

List C5 - Road Signs, Carriageway Markings and Lighting

Item		Possible Issues
(a)	Traffic Signs/Direction Signs	Do destinations shown accord with the current signing policy? Are the signs easy to understand? Will the sign posts cause obstruction to sight line? Is there a need for overhead signs? Are adequate and clear direction signs provided well in advance before exit/diverging point? Are there any sign clutter problem? Do all the direction signs along the route follow the same signing principle? Have the appropriate warning signs been provided? Are the signs appropriately located and of the appropriate size for approach speeds? Are the sign posts passively safe or protected by safety barriers where necessary? Are the traffic signs illuminated where required? Are the traffic signs located in positions that minimise potential strike risk? Are the mounting height and lateral clearance of the sign faces appropriate? Are the sign posts located on either side of the footpath? Any posts located in other areas of footpath that will likely obstruct pedestrian flows and passengers of wheelchairs? Are the signs provided with clear forward visibility and located before bends? Are there any roadside trees or plantings where overgrown in future may obstruct the sign?
(b)	Variable Message Signs	Are the legends relevant, and messages easily read and understood? Are the signs passively safe or located behind safety fencing?
(c)	Lighting	Has lighting been considered at new junctions and adjoining existing roads? Is there a need for lighting, including lighting of signs and bollards? Are lighting columns passively safe? Are lighting columns located in the best positions e.g. behind safety fences and not obstructing pedestrians and cyclists routes?

(d)	Road Markings	Are the road markings suitably chosen/correctly used and appropriate to the location? (re. the regulations/TPDM) Do the road markings clearly give the appropriate messages to the concerned road users? Are the dimensions of the road markings appropriate for the speed limit/design speed of the road? Have old road markings and road studs been adequately removed where necessary? Covering of old markings by black paint is not accepted.
(e)	Poles and Columns	Are poles and columns necessary and passively safe? Are poles and columns protected by safety fencing where appropriate?

Annex D : Stage 3 Road Safety Audit Checklists – Construction

List D1 – General

Item		Possible Issues
(a)	Departures from design standards	Are there any adverse road safety implications of any departures from standards granted since the Stage 2 Road Safety Audit?
(b)	Drainage	Have adequate drainage facilities (e.g. gully spacing, gully locations, flat spots, crossfall, ditches) been designed for the roads? Do features such as gullies obstruct cycle routes and footpaths? Do the locations of features such as manhole covers or gullies give concern for motorcyclist/cyclists' stability? Will excessive surface run-off flow across the carriageway and increase the risk of aquaplaning under adverse weather conditions? Are flat spots avoided or adequately dealt with at start/end of superelevation? Are features such as manhole covers or gullies located in the likely wheel tracks for motorcyclists or cyclists?
(c)	Landscaping	Will planting (new or when mature) encroach onto the carriageway or obscure traffic signs, traffic signals or sight lines (including during windy conditions)? Will earth bunds or landscape hard works obscure traffic signs or visibility? Will trees (new or when mature) be a hazard to an errant vehicle? Will planting affect lighting or shed leaves onto the carriageway? Will "frangible" vegetation been used in possible run-off area?
(d)	Public Utilities	Can maintenance vehicles stop clear of traffic lanes? If so, could they obscure traffic signs or sight lines? Are boxes, pillars, posts and cabinets located in safe positions away from locations that may have a high potential of errant vehicle strikes? Do they interfere with visibility? Has sufficient clearance to overhead cables been provided? Are there any utility inspection chambers in between live traffic lanes and/or wheel tracks? Do they give concern for motorcyclist/cyclist stability?

(e)	Access	Is the visibility to/from accesses adequate?
(f)	Skid Resistance	Do any joints in the surfacing appear to have excessive bleeding or low skid resistance? Do surface changes occur at locations where they could adversely affect motorcycle stability?
(g)	Adjacent Development	Have noise barriers been provided and do they create a potential hazard?
(h)	Fences and Road Restraint Systems	Is there a need for road restraint systems to protect road users from roadside hazards such as signs, gantries, parapets, abutments, falls, steep embankments or water hazards? Do the road restraint systems provided give appropriate and adequate protection? Are the road restraint systems long enough? If there are roads on both sides of the fence, is an interlocking-design necessary to prevent impalement on impact? Are the barrier fences lapped in the direction of traffic? Are there any gaps in between anchor end blocks or at start and end of the barrier fences that could allow an errant vehicle to pass through? Are the end conditions of the crash barrier safe and satisfactory?
(i)	Emergency vehicles and access	Are the provisions for emergency vehicles access and stopping safe?
(j)	Roadside Hazards	Is the road free of newly installed or overlooked roadside hazards?

List D2 - Alignment

Item		Possible Issues
(a)	Visibility	Are the sight lines clear of obstruction?
(b)	New/Existing Road Interface	Is there a need for additional signs and/or road markings?

List D3 - Junctions

Item		Possible Issues
(a)	Visibility	Are all visibility splays clear of obstructions?
(b)	Signs	Are the visibility, locations and legibility of all signs (during daylight and darkness) adequate? Are signposts protected from vehicle impact or passively safe? Will signposts impede the safe and convenient passage of pedestrians and cyclists? Have additional warning signs been provided where necessary? Are there any sign clutter problem?
(c)	Road Markings	Are all road markings/studs clear and appropriate for their location? Have all superseded road markings and studs been removed adequately?
(d)	Roundabouts	Can the junction be seen from appropriate distances and is the signing adequate? Where chevron signs are required, have they been correctly sited?
(e)	Traffic Signals	Can the traffic signals be seen from appropriate distances? Can drivers see traffic signal heads for opposing traffic? For the operation of signals: Do signal phases correspond to the design? Do pedestrian and cycle phase give adequate crossing time? Will pedestrian mistakenly view the “green man” signal for other pedestrian phases? Is the alignment of lanterns and general correctness of installation satisfactory?
(f)	T, Y and Cross Junctions	Are priorities clearly defined? Is signing adequate?

List D4: Pedestrians and Cyclists Provision

Item		Possible Issues
(a)	Adjacent Land	Has suitable fencing been provided?
(b)	Pedestrians	Are the following adequate for each type of crossing (bridges, subways, at grade)? - visibility; - signs; - surfacing; - other guardrails; - dropped kerb or flush surfaces; - tactile paving.
(c)	Cyclists	Do the following provide sufficient levels of road safety for cyclists on, or crossing the road? - visibility; - signs; - guardrails; - dropped kerb or flush surfaces; - surfacing.

List D5: Road Signs, Carriageway Markings and Lighting

Item		Possible Issues
(a)	Signs	Are the visibility, locations and legibility of all signs (during daylight and darkness) adequate? Are signposts protected from vehicle impact or passively safe? Will signposts or signs impede the safe and convenient passage of pedestrians and cyclists? Have additional warning signs been provided where necessary?
(b)	Variable Message Signs (VMS)	Can VMS be read and easily understood at distances appropriate for vehicle speeds? Are they adequately protected from vehicle impact or passively safe?
(c)	Lighting	Does the street lighting provide adequate illumination of roadside features, road markings and non-vehicular users to drivers? Is the level of illumination adequate for the road safety of pedestrians and cyclists? Is lighting obscured by vegetation or other street furniture? Are lighting poles located behind safety fences? Will the poles obstruct walking and cycling routes?
(d)	Road Markings	Are all road markings/studs clear and appropriate for their location? Have all superseded road markings and studs been removed adequately?
(e)	Crash barriers	Are all crash barriers in place and safely located? Is the length of any guard fence adequate? Is the guard fence correctly installed?

Annex E : Contents of Road Safety Audit Brief

A Road Safety Audit Brief should contain but not limited to the items listed below:

(a) A description of the proposed road scheme with its objectives clearly stated.

(b) Drawings showing the full geographical extent of the scheme including the areas of influence beyond the tie-in points.

(c) Details of determined and pending departures from the TPDM and other relevant technical guidance notes or circulars, and/or the design strategy record(s).

(d) Clear identification of the elements of the scheme proposals included within the scope of the Road Safety Audit to be undertaken and also those elements of the scheme that fall outside of the scope, including strategic decisions. Areas where the scope of the Road Safety Audit has been extended to allow consideration of strategic decisions should clearly be specified.

(e) General scheme details, to help give an understanding of the purpose of the scheme and how the layout will operate, including design speeds, speed limits, traffic flows, forecast flows, queue lengths, and pedestrian facilities and their desire lines. Also details of any environmental constraints on the design and how these may have affected any strategic decisions made.

(f) Details of any safety risk assessments undertaken as part of the design process.

(g) Any other relevant factors which may affect road safety such as adjacent developments (existing or proposed), proximity of schools, elderly homes, institution for the disabled, access for emergency vehicles, etc.

(h) The locations of the road which are required to be visited at a particular time of the day (e.g. peak traffic periods, or beginning or end of the school day) should be indicated.

(i) For on-line schemes and at tie-ins, the previous 36 months personal injury accident data (details to be obtained from the Road Safety and Standards Division, TD). The data should cover both the extent of the scheme and the adjoining sections of road.

(j) Details of any changes introduced since the previous Road Safety Audit, if any.

(k) Any changes to the road scheme that are not shown on the design or as-built drawings.

(l) Plans using an appropriate scale for the Road Safety Audit Team to mark up for inclusion in the Road Safety Audit Report.

(m) Previous Road Safety Audit Reports and Road Safety Audit Response Reports, if any.

(n) Contact details of the Maintenance Agents of the existing roads to whom any identified maintenance defects should be notified (by telephone and immediately confirmed in writing for serious defects) separately from the Road Safety Audit Report.

(o) Details of the appropriate Police contact.

(p) The time for completion and submission of the Road Safety Audit Report at various stages should clearly be specified. The Road Safety Audit Response Report should be issued to the Road Safety Audit Team and copied to the project office within 1 month (or a period as agreed with the project office) after the design team received the Road Safety Audit Report.

Annex F : Contents of Road Safety Audit Report

Stage 1, 2 and 3 Road Safety Audit Reports should contain but not limited to the items listed below:

(a) Identification of the Road Safety Audit stage including a unique document reference number and the status of the Road Safety Audit Report.

(b) A brief description of the proposed road scheme including details of its location and its objectives, and scope of the Road Safety Audit.

(c) Details of the personnel who prepared/approved the Road Safety Audit Brief, and appointed/approved the Road Safety Audit Team.

(d) Details of the Road Safety Audit Team membership as well as the names of others contributing such as the Police and Maintenance Agents.

(e) Details of attendees who were present at the site visit, the date and time period(s) when the site visit was undertaken and what the site conditions were on the day of the visit (weather, traffic congestion, etc.).

(f) The specific road safety problems identified, supported with the background reasoning and the potential accident types.

(g) Recommendations for action to mitigate or remove the road safety problems.

(h) A location map based on the scheme plan(s), marked up and referenced to problems and if available, photographs of the problems identified.

(i) A statement, signed by both the Road Safety Audit Team Leader and the Road Safety Audit Team Member(s) confirming their independence and certifying that the Road Safety Audit has been carried out in accordance with the Road Safety Audit Brief.

(j) A list of documents and drawings reviewed for the Road Safety Audit.

Annex G : Contents of Road Safety Audit Response Report

The Road Safety Audit Response Report should contain but not limited to the items listed below:

(a) A summary of the scheme, the Stage of Road Safety Audit, the document reference and date of the Road Safety Audit Report it considers.

(b) Full consideration of each problem and recommendation raised in the Road Safety Audit Report.

(c) The Road Safety Audit Response Report should reiterate each problem and recommendation made, followed by a suggested Road Safety Audit response from the design team. The Report should include the problem location plan provided in the Road Safety Audit Report.

(d) The Road Safety Audit Response Report should, for each problem and recommendation, do one of the following:

  (i) accept the problem and recommendation made by the Road Safety Audit Team;

  (ii) accept the problem raised, but suggest an alternative recommendation, giving reasoning for the alternative recommendation; or

  (iii) disagree with the problem and recommendation raised, giving appropriate reasoning for rejecting both the problem and recommendation.

(e) Details of the representatives from the design team who prepared the Road Safety Audit Response Report.