# ROAD SAFETY AUDIT

# FOR

# ROAD PROJECTS

## AN OPERATIONAL TOOL KIT

**Asian Development Bank**
**Manila**

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# ABBREVIATIONS

| | | |
|---|---|---|
| ADB | – | Asian Development Bank |
| CSP | – | country strategy and program |
| CSPU | – | country strategy and program update |
| DMC | – | developing member country |
| MOU | – | memorandum of understanding |
| RRP | – | report and recommendation of the president |
| RSA | – | road safety audit |
| TA | – | technical assistance |
| TOR | – | terms of reference |
| UK | – | United Kingdom |
| US | – | United States |

$ refers to US dollars

# ACKNOWLEDGMENTS

This road safety audit (RSA) tool kit for the Asian Development Bank (ADB) and its developing member countries was prepared by Alan Ross, Road Safety Adviser, under the general supervision of Charles Melhuish, Lead Transport Sector Specialist, ADB.

The scope, content, and focus of the tool kit reflect the discussions with and needs identified by ADB project officers who are now or previously were engaged in developing and supervising ADB-funded roads projects.

The tool kit draws extensively on the experiences and practices of developed and developing countries that have introduced the RSA, and on the various guidelines, checklists, procedures, and the RSA documents in use in these countries. Most of the important documents referred to in preparing this tool kit are listed in the document. The authors would like to acknowledge their gratitude to the authors and publishers of these documents.

# CONTENTS

# FOREWORD

Rapid increases in vehicle ownership, especially in motorcycles in the Asia and Pacific region during the past 3 decades have placed considerable pressure on the road networks, their traffic and control devices, and on users of road facilities. The number of people killed and injured in traffic crashes has been steadily increasing. In a recent Asian Development Bank (ADB)-funded regional study, *Regional Initiatives in Road Safety*, it was estimated that over 235,000 persons were killed and that at least 3–4 million were injured or crippled in road traffic crashes in the region each year by the mid-1990s. Recent statistics from large countries in the region show that in 2002, there were more than 450,000 deaths per year with a further 4 million crippled or injured annually. Such tragic deaths and injuries are a major socioeconomic cost to the region that can typically amount to 1–2% of annual gross domestic product in each country. An ADB regional study indicated that the economic losses due to traffic crashes by the mid-1990s already amounted to well over $20 billion per year. At this level, the losses exceeded the combined total annual ADB and World Bank lending to the region. The continued steep increase in the number of crashes and fatalities indicates that these losses are even higher today and are undoubtedly inhibiting the economic and social development of the region and adding to the poverty and hardships of the poor.

As the leading development agency in the region, ADB plays an important role in infrastructure development in its developing member countries (DMCs). ADB loans and technical assistance support countries in their efforts to improve, expand, and manage their road networks to increase their economic and social development.

Unfortunately, in the rush to develop and expand road networks, problems can sometimes arise in new construction and especially in rehabilitation schemes if insufficient attention is given to road safety impacts that can be associated with road infrastructure projects. The higher speeds that become possible on improved roads can lead to an increase in road safety risk for communities along such routes and for vulnerable road users. This, in turn, can lead to an increase in the number of deaths and casualties on such roads.

Conscious of this potential outcome, ADB needs to make every effort to ensure that it does not, through its infrastructure projects, inadvertently add to what is already a major socioeconomic concern facing its DMCs.

Ideally, each DMC should adopt a comprehensive approach to tackle road safety as advocated in ADB's *Road Safety Guidelines for the Asian and Pacific Region* (available from ADB). This publication presents guidance on developing and implementing a multidisciplinary multisector approach within a coordinated action plan covering engineering, education, and enforcement. ADB stands ready to assist its DMCs in developing and implementing comprehensive approaches and to provide funding for such activities as necessary.

Even if such comprehensive multisector approaches cannot be adopted at present, there is much that can be done within the roads agencies themselves. Several DMCs have already begun to strengthen their capacity to address road safety issues and in several countries (e.g., Bangladesh and Fiji Islands) ADB has assisted the governments in establishing road safety units or cells within roads departments. The following are the two most effective things that can be done by such units.

(i) **Traffic Crash Reduction.** Existing hazardous locations can be systematically identified and analyzed and appropriate remedial measures implemented to eliminate or reduce the crash risk at such locations**.**

(ii) **Traffic Crash Prevention.** Specific efforts can be adopted to prevent the development of hazardous locations by systematically analyzing of potential risks and eliminating those that might make the road unsafe.

This document focuses on traffic crash prevention by undertaking a formal systematic checking procedure. Experience around the world has demonstrated that it is possible to substantially reduce potential safety problems by implementing systematic safety checks of proposed road projects at various stages in the planning, design, and construction process. These systematic safety checks known, when formalized, as road safety audits (RSAs) while not guaranteeing total safety, enable many obvious potential hazards to be identified and eliminated before construction. This makes it more likely that the road will operate safely in the environment in which it has to operate.

In this regard, it is worth emphasizing that a "high" design standard does not necessarily eliminate the need for such RSAs. It is important to view the road within the operational environment where it will function and to ensure that, where necessary, mitigating measures are taken to ensure safe operation under the particular mix of traffic, road user behavior, and general environment.

This tool kit is intended primarily to assist road authorities and their consultants involved in road and highway projects, and has been prepared to provide general advice, a source of reference on the RSAs, and a tool kit of information and checklists to facilitate the application of RSAs on all ADB road and highway projects.

The use of this tool kit and the introduction of formal RSA systems are strongly recommended so that safer road networks can be created for the Asia and Pacific region and help reduce the growing carnage on the region's road networks.

**Transport Sector Committee**
**Asian Development Bank**

# I. INTRODUCTION AND BACKGROUND

## A. Introduction

Road safety is now recognized as a major socioeconomic concern facing the Asia and Pacific region and an Asian Development Bank (ADB) regional study estimated in 1997 that over 235,000 people are killed annually and a further 3–4 million are crippled or injured in road accidents in its developing member countries (DMCs) each year. More recent statistics suggest that fatalities now account for about 450,000 a year. These human and economic losses, estimated to be in excess of $20 billion/year, are inhibiting development of the region. ADB, in collaboration with other international agencies such as the World Bank and the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP), is now actively involved in the global effort to reduce such carnage on the region's roads. Unfortunately, the commonly high percentage of two- and three-wheeled traffic and nonmotorized road users in the region create particularly difficult challenges to those seeking to improve road safety in the region.

Increasing traffic volumes, the rapid growth in two- and three-wheeled traffic, and the higher speeds made possible by construction improvement and rehabilitation of roads can all add to the safety problem. In view of the significant role that ADB plays in the funding and development of road infrastructure, it is very important to ensure that ADB-funded road projects do not inadvertently add to the safety concerns of its DMCs.

## B. Road Safety is a Multidisciplinary Problem

It is well recognized that road safety is a multidisciplinary multisector problem and ADB has produced comprehensive guidelines to assist its DMCs in formulating and implementing policies that enhance road safety. The tool kit recommends that the most effective way of improving road safety is to have the key agencies in each country collaborate and implement a coordinated action plan with each agency carrying out activities in its own areas of responsibility. Coordination is best undertaken by a road safety council with representatives of all key stakeholders or by a multisector committee chaired by a lead ministry. Details of possible institutional arrangements and priority actions that can be undertaken in each sector are presented in the *Road Safety Guidelines for the Asian and Pacific Region* available from ADB.

## C. Important Role of Roads Authorities

Roads authorities have a particularly important role to play as they provide and maintain the road network for road users. They, along with traffic police who provide enforcement, can have a very strong influence on driver behavior and safety of the road network. Badly designed or maintained roads can contribute to driver error and lead to road accidents. Conversely, well designed and maintained roads, where the needs of road users have been anticipated, can reduce potential risks and result in safer road networks.

In the early stages of motorization, the emphasis of most roads authorities was toward building and extending the road network and in connecting remote parts of the country to open them up for economic and social development. Roads authorities focus mainly on building the network and often little to no effort is placed on operational aspects. Such roads generally have poor sign and markings and junctions are rarely channelized. However, in the early years, traffic volumes were usually quite low, conflicts were rare, and the system operated for some time without too many constraints.

As traffic levels increase and vehicles and roads improve, faster speeds become possible with the consequence that more conflicts arise resulting in increased safety problems. Roads authorities are then forced to address road safety and traffic issues and it becomes necessary to establish specialist traffic engineering and road safety units to take responsibility for the operational aspects of the road network. Such units monitor the network and identify congested or unsafe locations for improvement. In doing so, they often build up unique insights into the range of circumstances that can contribute to road crashes.

ADB has assisted many of its DMCs in establishing traffic or road safety units. These are normally located within the planning division in the roads authority. They collect (from police records) accident data for each road section and analyze them to identify the most dangerous locations on the network and then develop and implement hazardous

location improvement programs **("traffic crash reduction")**. They may also carry out **"traffic crash prevention"** activities by conducting road safety audits (RSAs) directly themselves or subcontract such work to suitably qualified domestic consultants. Whether they carry out audits themselves or oversee such work, they are normally responsible for developing, updating, and managing the RSA procedures on behalf of the roads department.

The RSA is therefore a formal, systematic procedure that incorporates traffic safety knowledge into the road planning and design process to prevent traffic accidents. The intention is for experienced road safety specialists to identify potential hazards during the planning and design stages of road projects. Through such minor modifications to the design, safer road networks can be created and potential hazards eliminated.

### D. Content and Structure of this Tool Kit

This tool kit provides an overview of the RSA process. It is designed to assist ADB, road authority personnel, and their consultants in providing information for support efforts to ensure that adequate safety checking is undertaken of proposed road schemes at critical stages in the planning and design process.

Following this introduction, *Chapter 2* explains what the RSA is, why it is necessary, and why it is particularly important to apply such safety checks on ADB road projects. *Chapter 3* then outlines how the RSA is undertaken, the organizational arrangements, and what needs to be done at each stage. *Chapter 4* then discusses the interventions that ADB staff can make during the project cycle to encourage the adoption of the RSA and safety checking. The potential benefits of implementing the RSAs are summarized in *Chapter 5*, followed by appendixes that expand and support the content of the preceding chapters. The *appendixes* include supporting information such as sample terms of reference (TORs) and checklists for the different stages of the RSA process.

## II. ROAD SAFETY AUDIT: AN OVERVIEW

### A. What Is Road Safety Audit?

The RSA is a systematic procedure that brings traffic safety knowledge into the road planning and design process to prevent traffic crashes. The RSA is a formal systematic road safety assessment or "checking" of a road or a road scheme. This is usually carried out by an independent qualified auditor or a team of auditors who report on ways of minimizing risks to road users. These auditors can be in-house safety experts of the road authority or external specialist consultants.

### B. Where Is Road Safety Used Around the World?

The RSA concepts were originally developed and introduced in the United Kingdom (UK) in 1989. The benefits of such systematic checking were soon recognized around the world and many countries have since established their own similar systems. The most active countries have been Australia, Denmark, New Zealand, and UK and many other developed countries are moving toward adopting such safety checking procedures. Several developing countries including Fiji Islands, Malaysia, Singapore, Thailand, and Viet Nam have introduced the RSAs into their road planning and design procedures. The RSA concepts are increasingly being adopted and they are beginning to have an impact in preventing the development of unsafe road networks.

### C. In Which Situations Can Road Safety Audit Be Used?

The RSA can be applied to all kinds of road projects—new road construction as well as rehabilitation of existing roads. It can be applied to small and large projects and used on rural as well as urban roads. The RSA can be applied to specific operating and maintenance activities on existing roads as well as for systematic assessment of road safety aspects on existing roads and road networks.

### D. What Are the Benefits and Costs of Conducting Road Safety Audit?

In the UK, the Lothian Regional Council has estimated the benefit-cost ratio of the RSA as being

15:1, while TRANSIT New Zealand has estimated the benefit-cost ratio as 20:1. Consequently, there seems to be evidence from developed countries that significant benefits can result from introducing the RSA procedures. The benefit-cost ratio of such work in developing countries is likely to be even higher as the opportunity for avoidance of serious safety problems is even greater in the developing world where the road networks and road design are sometimes at an early stage of development.

### E. How Much Will Road Safety Audit Add to the Cost of the Scheme?

Australian and New Zealand experiences suggest that RSA can add up to a maximum of 4% to the cost of a road project. However, this has to be set against the potential benefits such as

(i) savings in time and cost by changing project details at the planning and design stage rather than the more expensive option of removing or changing road infrastructure once installed;

(ii) reductions in the number of accidents and the consequent savings in road accident-related costs; and

(iii) reductions in possible litigation costs.

It may even be possible that there is little or no additional cost. The experience in one of the earliest RSA applications and safety checking on an ADB-funded project in the Republic of Korea in 1990 demonstrated that minor modifications in design to incorporate safety improvements could, at some locations, actually reduce the cost of the proposed scheme. In general, the available evidence suggests that the costs of changes introduced as a result of the RSA are significantly outweighed by the benefits accruing from such work.

### F. How Can a Road Be Unsafe When High Design Standards Are Used?

A road designed and built in an industrialized country may be adequately safe in its own operating environment. After the road is built, the highway authority will have traffic engineers and resources to ensure that road markings and signs, and other features such as pedestrian guardrails, are all correctly positioned and maintained. There will be development control to prevent illegal accesses appearing at unsuitable locations, such as on sharp bends. Specialist traffic police will patrol the road to ensure that road users comply with the regulations. Furthermore, driver education and knowledge will generally be good.

The same road when constructed in a DMC, although having the same engineering design standards, will have a very different operating environment. Whereas the basic engineering standards may be adequate, the road is likely to function under very different operating conditions. For example, in some countries in the Pacific such as Papua New Guinea, large numbers of pedestrians move along rural roads and footpaths or other special facilities may be needed. In Asia, paratransit vehicles, bicyclists, and various nonmotorized modes may need special attention. In developing countries, driver behavior, vehicle road-worthiness, compliance with regulations, and vehicle types may be different from those in developed countries. Furthermore, the ability of the highway authority in developing countries to control access, to operate the network efficiently by traffic engineering, and to maintain signs and road markings is lower, as is the effectiveness of the traffic police.

Consequently, the same road that operates without serious safety concerns in the United States (US) or Europe can operate unsafely in developing countries. In recent years, these outcomes may inadvertently have been exacerbated by the changing emphasis of ADB and other funding agencies toward rehabilitation projects. These projects are often restricted to improving the road surface along existing alignments, even where the alignments are poor. The increased speed along the improved road may result in an increase in traffic crashes at sections with poor alignment, particularly at junctions and where the road passes through or is adjacent to small communities. Such traffic crashes occur, not because the rehabilitation work is deficient, but because the operating environment has not been given adequate attention in the planning and design process. It is therefore imperative that adequate attention is paid to the safety needs of road users who are likely to use that road and especially to the safety needs of regular users and of the small communities through which such roads pass.

### G. The Road Safety Audit Does Not Solve All Problems

The RSA is only a check of road safety aspects and is not concerned with monitoring whether a certain road standard has been followed or checking whether drainage, structural strength, and other elements are appropriate for that road and location.

In some instances, there will be conflicts between the desire for increased capacity at low cost and the safety needs of road users. The RSA cannot itself solve these issues but can highlight them so that decisions can be made with a more complete understanding of the potential consequences of such decisions.

The RSA is also focused only on **accident prevention** and does not usually address the separate issue of **accident reduction.** For safe road networks to exist, it is necessary to carry out both accident prevention (using the RSA) and accident reduction (using hazardous location improvement programs). The RSA alone cannot solve all safety concerns but can play an important part in preventing the circumstances that can lead to road accidents.

## III. CONDUCTING ROAD SAFETY AUDITS

### A. Introduction

There are four main aspects to be considered in conducting the RSA:

(i) institutional framework for RSA,
(ii) arrangements for undertaking the audit,
(iii) audit stages, and
(iv) audit process.

The roles and responsibilities of all concerned and the range and scope of the audit should be clearly specified in the TORs. These TORs should include any special requirements of the audit and the format to be used in presenting the results (*Appendix 1*).

The roles, responsibilities, and parties involved vary from country to country depending upon local resources and practices (*Appendix 2*). The general institutional framework for implementing the RSA, the arrangements for undertaking the audit, the RSA stages, and the general procedures and processes are described in the following sections.

### B. Institutional Framework for the Road Safety Audit

RSAs are best done by road or traffic engineers who have had experience of undertaking hazardous location improvement programs as this type of work often enables them to develop better insights into the range of situations and circumstances that can lead to unsafe conditions.

It is preferable that the RSA be undertaken by members of the road safety unit within a roads department or be overseen by them with the work being done by a suitably qualified domestic consultant. (However, in the early stages, before domestic consultants are trained, this may need to be carried out by an international consultant.)

RSA procedures and their application will generally be the responsibility of the road safety unit where one exists. Where a unit does not exist yet, the road authority is strongly advised to establish a specialist unit within its traffic or planning section. ADB has assisted some of its DMCs (e.g., Bangladesh, Fiji Islands, and Philippines) in establishing traffic and safety units and these are now carrying out excellent work in accident reduction and prevention.

### C. Arrangements for Undertaking the Audit

There are normally three parties involved in the RSA.

1. The **designer(s)** of the project. These could be an in-house team (from the road authority) or specialist consultants engaged by the road authority.

2. The **client**. This is the road authority responsible for the project but usually represented by the senior line manager or project manager directly responsible for the project. If disagreements occur between the designer and the auditor, it should be the client

who makes the final decision as to whose view prevails.

3. The **auditor(s)** who carry out the audit. These may be from within another independent part of the roads authority (e.g., from the road safety unit, if one exists) or specialist consultants engaged by the client. Irrespective of where they come from, such auditors must be road safety specialists with adequate experience in carryingout a thorough RSA and identifying potential hazards that might lead to road safety problems.

Where projects are being formulated in countries that do not yet have a formal RSA system in place, it may be desirable for ADB to ensure that TORs for the road engineering design consultant include about 3 person-months of safety auditor input within the design team. This could be an independent in-house specialist or an independent consultant with extensive road safety experience/knowledge (this is discussed further in *Chapter 4*).

## D. Audit Stages

It is almost always preferable to undertake the RSA at several successive stages during the course of planning, designing, and implementing a road project. The following five audit stages are typically used to ensure that the needs of all road users are considered during each stage of the planning and design process. Auditors should not only consult with the designers and visit the scheme but should also consult with the various communities through which the roads pass.

### Stage 1: Planning Phase

The RSA in this phase deals with traffic safety aspects of the initial design and covers a range of topics such as choice of route alignment, number and types of junctions, service to local communities, and facilities.

### Stage 2: Preliminary Design Phase

At this stage, the outline design of the scheme has been developed but can still be adjusted without too much difficulty. The RSA, in this phase, examines the general alignment, cross-section, and proposed layout of junctions. This audit of the outline design should ideally be conducted before the design has been approved by government and budget allocations made for design and construction.

### Stage 3: Detailed Design Phase

At this stage, the focus of the RSA is on examining the detailed design of junctions, proposed road markings, roadside equipment, and proposed alignment to identify potential hazards resulting from adverse combinations of design elements (e.g., vertical and horizontal alignment). Implications arising from drainage choice, traffic signing, etc. should also be examined.

### Stage 4: Construction Phase

The focus at this stage is a site inspection by day **and** at night at, or just prior to, opening to traffic. Placement of guardrailing, signing, lighting, etc. can be checked in situ and particular attention should be given to checking that needs of **all** road users, including pedestrians, cyclists, as well as motorized users, are adequately catered for. This is the last chance to check that the road will operate in a safe and efficient manner. Stage 4 audits generally also cover the audit of traffic management arrangements **during** construction. Such auditing should be done periodically during construction or rehabilitation to ensure that traffic using the road during this "temporary works" period is given adequate advance warning and guidance as the work progresses.

### Stage 5: Monitoring Existing Roads

This stage involves monitoring a road a few months after opening to ensure that it is operating as anticipated. It can also be used to assess whether an existing road or a road network is operating safely and to identify possible low-cost measures that could be taken to enhance safety on such roads.

Checklists have been developed in different countries for use during each stage of the RSA. Although checklists are a useful reminder to auditors, it must be borne in mind that such checklists are not exhaustive and do not cover every single detail.

*Appendix 3* presents a typical set of checklists that could be used for road projects in the Asia and Pacific region. These draw heavily on checklists developed in other countries. Although there can be no definitive checklist as the needs, traffic mix, and focus will vary by country and even by project, they provide a useful starting point for safety auditors operating in ADB member countries. **These checklists can be modified and supplemented as required by safety auditors using them**.

For each auditing stage, the safety auditors prepare a report with comments and recommendations in the form of suggestions or ideas for improving safety wherever a potential problem has been identified.

The RSA involves one set of professionals checking aspects of the work of other professionals and this calls for diplomacy and respect. Auditors need to understand the background to the design decisions made and avoid being overcritical or petty. The job should be seen as an opportunity to sensitize road engineers to safety issues and highlight consequences of different designs and alternative layouts. Conversely, road design engineers whose work is being audited need to keep an open mind and accept that the audit team members are specialists in their field and that they may be able to improve safety aspects of the design. The audit process simply incorporates specialist road safety advice into the design process—it is not a test of the competence of the road designers.

## E. Audit Process

The audit process is specified in the RSA procedures or audit guidelines in each country that has introduced the RSA system. In most countries, such RSAs are mandatory for all or some roads while in others they are only advisory. Mandatory schemes are usually more effective as they remove the ambiguity as to whether an audit should be done. ADB recommends that the RSA should be mandatory in all DMCs.

The process typically consists of various steps or stages as below.

### 1. Initiating the Audit

The roads authority (client) will usually commission an RSA but in some cases (where it may have been written into the design contract) this may be done by the designer or even by ADB or an external funding agency directly. Where there is a road safety unit within the roads authority, suitably qualified staff may exist in-house to organize the audit. They may be able to do the audit themselves or they may find it more convenient to subcontract such work to specialist consultants.

### 2. Gathering the Project Reports and Plans

The designer must supply the auditor with the necessary information for a thorough audit. This will include feasibility study and engineering design, reports, drawings, etc. The information needed for each RSA stage is listed in *Appendix 3* at the top of the checklists for each audit stage.

### 3. Studying the Plans

The auditor reviews the plans and makes a preliminary assessment of potential safety concerns and issues based on the information provided, together with knowledge and experience. Some preliminary discussions with designers during the commencement meeting can help clarify reasons for particular design decisions and allow the auditor to explain his role and the audit process.

### 4. Undertaking the Audit

Using appropriate checklists (depending upon the stage), the auditor first reviews the plans and documents. The auditor then visits the site and carries out an audit, identifies any road safety concerns (referenced by chainage), and suggests ways of minimizing them. The audit findings are recorded in a formal report and given to the designer and to the client. Although the report should give a clear indication of what needs to be done and possible alternatives, it is not necessary for the auditor to provide detailed designs—that is the designer's job. However, appropriate diagrams, sketches, and annotated copies of plans can be included in the report. Guidance on the report structure and content is given in *Appendix 4* of this tool kit.

### 5. Completion

The designer will now need some time to review the problems and issues raised in the auditor's report to see which of the recommendations to adopt and identify those that might be difficult to implement. At this stage,

it may be beneficial for the designer and the auditor to meet and see whether all issues can be resolved to both parties' satisfaction. If any issues remain unresolved, the designer presents the area of disagreement to the client, who makes the final decision. The designer then describes and records any modifications to the project and the audit is then complete. The recommendations made and agreed changes are rechecked at the commencement of the next stage of the RSA.

## IV. OPPORTUNITIES FOR INTERVENTION DURING THE PROJECT CYCLE

### A. Introduction

The main purpose of this tool kit is to guide and facilitate the work of road agencies, their consultants, and ADB staff. It is aimed at encouraging the systematic incorporation of the RSA into the planning and design process of ADB-funded road projects. Suggestions are included below on what can be done at key stages of the project cycle.

The major steps in the project cycle are: (i) sector reviews, (ii) project preparation, (iii) project processing, (iv) project implementation, and (v) postevaluation.

There is little scope to include the RSA as such in the sector review stages, but it is certainly possible at this stage to highlight the scope and scale of the road safety situation, and the growing economic and social losses sustained in road accidents; and to record existing institutional arrangements and responsibilities in road safety, and the need for ADB and its DMCs to be more proactive in tackling and preventing road safety problems.

However, considerably more opportunities exist for interventions during the project preparation, processing, implementation, and postevaluation stages. Opportunities for intervention at each stage of the internal project cycle are outlined below.

### B. Opportunities During Sector Reviews

#### 1. ADB Operations Papers and Studies

Reviews describing the socioeconomic structure, development plans, external assistance, ADB ongoing projects within a country, etc. are presented in the country strategy and program (CSP) and the annual CSP updates (CSPUs). The CSP/CSPU should incorporate assessments of recent developments and performance of the country not only in economic terms, but also in its social and other development so that future needs for external assistance can be defined. Since a CSP/CSPU is presented as an annual Board information paper, it provides a useful opportunity to review a country's socioeconomic progress in relation to ADB's strategy for that country.

The CSP/CPSU should also include a sector plan for transport, particularly in those countries where transport is included as a strategic focus for operations. These sector plans or road maps describe medium-term targets and plans for the road sector including planned policy reform, institutional development, and investment initiatives. These road maps should include a description of the road safety situation in the country and indicate priority requirements to be addressed. Inclusion of key road safety indicators should be an integral component of the road map and will facilitate monitoring and evaluation of sector performance over time. Such indicators could include size and composition of the vehicle fleet, number of accidents including fatalities and injuries, fatalities per 10,000 vehicles, fatality index (deaths÷total casualties), and the percentage of vulnerable road users involved in accidents. The economic cost of accidents should also be estimated.

#### 2. Economic, Sector, Subsector and Issue-Focused Studies

These types of studies are normally undertaken on an ad hoc basis as needs arise to review progress, fill gaps in knowledge, and provide directions for future strategies and policy or investment opportunities. The extent to which road safety issues might be covered will depend upon the nature of the study, the perceived priorities, and the resources available. With one recent ADB regional technical assistance (TA) study (TA 5620) already highlighting the urgency of the road safety problem across the region and the fact that it is a multisector concern, there is an obvious need to see what could be done in health, education, institutional strengthening, and other projects, as well as

infrastructure projects. Opportunities for safety intervention exist in many sectors and it could be beneficial to develop operational notes to help DMCs implement improvements in each of the different sectors of safety. ADB staff could and should emphasize the high socioeconomic costs of road accidents in such studies wherever feasible, so that road safety more correctly comes to be recognized as an important health, economic, and social concern and is not just identified as a "transport" problem.

## C. Project Preparation

### 1. Preliminary Review

The aim of the preliminary review on road infrastructure projects is to identify potential beneficiaries and those likely to be adversely affected by the proposed project. Project preparation should identify the needs of people affected, and assess the capacity of beneficiaries to "pay" for the capital and recurring costs of the project and the capacity of the proposed executing agency to manage and implement the project.

The project profile prepared at the country programming stage will provide some information on those likely to be affected by the project. This information augmented by data from site visits and other sources will enable assessment to be made as to whether the project is likely to have any significant road safety implications. Each road profile should be annotated to indicate relevant road safety concerns and potential safety problems that will need to be addressed in suggesting any future improvements. These concerns should be tracked during subsequent stages of the project cycle to ensure that they have been adequately dealt with. Almost all road rehabilitation schemes will have significant impact on road safety for road users and communities living along the road and even new construction can (perhaps surprisingly) result in unanticipated increases in traffic crashes on the **old** road as well as at the intersections of the **new** road.

Based on this preliminary review it should be possible to identify the scope of safety studies or activities that may be necessary, the TORs for such studies, and the fields of expertise required for project preparation. If the project is likely to have a significant effect on road safety, it is desirable to have a road safety expert join the TA fact-finding mission.

### 2. Project Preparation: TA Fact-Finding and Prefeasibility

The TA fact-finding is usually undertaken to clearly define the scope of project preparation, draw up detailed TORs, identify the expertise required for the feasibility study, estimate input costs, and agree on implementation and monitoring arrangements. The field visits allow more detailed examination of proposed route(s) and communities and road user groups likely to be affected by the proposed road(s). Arrangements could also be made at this stage for compiling basic statistics that give the numbers of reported accidents, deaths, and injuries resulting from road accidents during the previous 3 years for each kilometer section of the existing road to be rehabilitated or improved. The data are often available from records of police stations along the route. The findings of the TA fact-finding mission should be discussed with the executing agency and the government, and agreement reached on the main aspects to be included in the TA.

These elements are then incorporated in the draft TA board paper for review by ADB staff and for consideration by ADB management and Board of Directors. The need to address road safety issues and the scope of work to address them should be described in the TA paper. In addition, the TA logical framework should identify road safety parameters that should be monitored during project implementation.

### 3. Project Preparation TA Implementation (Feasibility Study)

This normally involves fielding a team of consultants to assist the executing agency in preparing and implementing the feasibility study to assess the project's technical, financial, and economic viability, and its social and environmental sustainability.

Inserting a suitable clause into the consultant's TORs at the feasibility study stage can ensure that the consultant collects the necessary information and data, and carries out the activities necessary to giving to road safety during later stages. *Appendix 5* suggests a paragraph on this.

## D. Project Processing

The basic steps in project processing include fact-finding, preappraisal and appraisal, loan negotiations, and consideration of the project proposal by the

ADB's Board of Directors. Opportunities for incorporation and presentation of road safety aspects at these various project processing stages are outlined below.

### 1. Loan Fact-Finding

As part of preparations for loan fact-finding, it is normal to review the final feasibility study report and to visit the project area with client government officials for discussion with potential beneficiaries and others affected by or with an interest in the project. During this phase, details of technical, institutional, financial, economic, social, and environmental aspects of the project are discussed and agreed, along with required adjustments and reforms in local policies, laws, and regulations. The findings and agreements of the loan fact-finding mission are summarized in a report and recommendation of the president (RRP), and the extent of coverage of issues such as road safety will depend upon the nature of the project. At a minimum, the RRP could include an overview of the magnitude of road safety issues, indicate recurring economic losses sustained, and present recent trends of traffic crash deaths and injuries. It should highlight the need to avoid worsening the situation and outline the arrangements included within the project to minimize potential adverse road safety effects during project implementation.

The RRP is reviewed at a management review meeting, at which guidance is given on aspects such as project scope, financial plan, policy dialogue, and covenants. The fact that road safety is included in the RRP will raise its profile and make it more likely that it will be included within the subsequent policy dialogue and loan covenants.

### 2. Preappraisal and Appraisal

These constitute the comprehensive stage of the project cycle when wider social issues are appraised along with technical, institutional, economic, environmental, and financial considerations. During this stage the foundation is laid for implementing the project and evaluating it upon completion. It is during this stage that various important aspects need to be finalized. In the case of road safety issues, the following are important tasks to be finalized during this stage.

(i) **Obtain the commitment of the government and its executing agencies regarding the need to improve road safety and agree on the mechanisms needed to achieve this objective**. This may require the client to establish a road safety unit and/or strengthen the RSA procedures. These commitment and agreement must be recorded in the memorandum of understanding (MOU) between the ADB mission and the government and later, incorporated into the eventual loan and project agreements. There should also be mention, within the section on implementation arrangements, that the design consultant contract will include provision for an independent road safety specialist to carry out the RSA at key stages during the design process. Typical sample paragraphs of the type that could be included in an MOU are given in Appendix 4.

(ii) **If not already under way, start collecting road traffic crash statistics for the proposed route**. The data (numbers of deaths, injuries, and traffic crashes), ideally tabulated for each kilometer or section of the proposed route, should permit the design consultants to identify the worst existing and potential future hazardous locations so they can be addressed within the new design.

(iii) **Finalize arrangements for carrying out monitoring and evaluation for the project**. An understanding should be reached with the government as to what indicators will be used to monitor progress and the frequency of monitoring reports. In this area it is important that there be at least three or four indicators related to road safety, such as the following:

- implementation of RSA during at least the preliminary design, detailed design, and opening stages;
- no increase in accidents, deaths, or injuries compared with the situation for a similar period before the road was improved;
- no complaints from communities along the road about deterioration in road safety; and

- specialist staff at the roads authority regularly monitoring road safety performance of the improved road and taking remedial action as necessary.

### 3. Loan Negotiations

Most significant issues and obligations will already have been discussed and agreed at preappraisal and appraisal, recorded in the MOU of the appraisal mission, and incorporated into the draft loan and project agreements. It is important to ensure that any commitment and agreement on road safety in these earlier documents are not eroded during loan negotiations. Although road safety will generally be only a small part of any road project, it has an importance and impact far in excess of expenditures on it within a project. Failure to address road safety could result in adverse publicity if roads are later seen as "dangerous" in the public eye. It is important to address safety issues and concerns and avoid building unsafe roads. Adopting and promoting RSAs on ADB-funded roads will do much to avoid such potential **problems**. Any commitments and conditions to promote safety agreed during project processing should therefore be retained at this stage.

## E. Project Implementation

During implementation, the project is monitored by ADB through periodic review missions and progress reports submitted by the executing agency. ADB, in consultation with the government, also undertakes midterm reviews to assess progress and to see whether minor changes are needed to facilitate better implementation. There are, therefore, several opportunities during this phase for ADB to oversee activities and to ensure that those related to road safety are implemented as agreed. The monitoring criteria developed in earlier phases and included in the logical framework should have included indicators, some of which are specifically related to road safety and should be regularly monitored.

The bulk of the RSA work will be done during this phase. The RSAs appropriate to the various points within this phase are the following.

### Stage 1: Planning and Feasibility Stage

This phase will often be the first practical point when funds are available for fielding a road safety specialist to carry out a Stage 1 RSA. Often, some provision will have to be made in the design consultants contract for inputs by an independent safety auditor. Possible checklists that could be used in this RSA are given in *Appendix 3*. Time required for this RSA will be dependent upon the length of routes to be examined and their accessibility. On their average, around 12 working days should be sufficient for this RSA. About 2–3 days will be spent in examining plans in the office prior to a site visit, 3–4 days on-site looking at the proposed road and nearby roads, 2–3 days for writing the Stage 1 RSA report, and 2–3 days for travel.

### Stage 2: Preliminary Design Stage

Once the design consultants are hired and an outline or preliminary design is available, it is possible to do a Stage 2 RSA. The documents, plans, and information required plus a typical checklist that could be used for this are presented in *Appendix 3*. Around 16 working days will be needed, comprising 3–5 days for examining plans and background documents in the office, 4–5 days for a site visit plus discussion with designer, and 3–5 days for writing the Stage 2 RSA report. As before, 2–3 days are assumed for travel.

### Stage 3: Detailed Design Stage

Once the detailed designs are available, it is possible to do a Stage 3 RSA. Documents, plans, and reports needed are listed in *Appendix 3* along with checklists that can be used during this stage. Around 21 working days will be needed with 6–7 days spent examining the detailed plans, junction layouts, etc. and 5–6 days undertaking site visits to check intersections and safety features and to discuss various aspects of the design. The Stage 3 RSA report will require a further 4–5 days to produce and 2–3 days are assumed for travel.

### Stage 4: Project Construction and Preopening of Project

Stage 4 Audit will be the first real opportunity to see the project as it will appear to road users. This stage is focused on site inspections that will be done both during daytime and often at nighttime (especially when inspecting

during construction). The documents, plans, and information needed plus typical checklists for this stage are given in *Appendix 3*. The 21 working days needed comprise 3–4 days in the office examining documents and having discussions with designers, 8–10 days on site visits (daytime and nighttime), and 4–5 days writing a Stage 4 RSA report. As before 2–3 days are assumed for travel.

In practice, it is likely that different sections of the scheme will be at different stages of design at any time. It may be appropriate, for example, on a single visit to carry out a Stage 3 Detailed Design Audit on one section of the scheme while carrying out a Stage 2 Audit on another section of that same road that is only at outline design stage. The individual projects and work program will govern how the safety auditors' time can best be used on any single visit.

These four stages comprise around 60 working days of total input. It is necessary to allocate about 3–4 person-months for each road rehabilitation or road improvement project. The actual times required for each audit stage depend upon the length of road to be examined and its accessibility from the main city, but the estimates given earlier provide typical average times needed for each RSA stage on an average road project.

### F. Project Completion

A project completion report is prepared at conclusion of the implementation. This provides a factual record of problems encountered and how they were overcome, whether targets were met, and the performance of the different parties. Since the report is also expected to highlight any adverse effects of the project on local people, it is important to demonstrate that communities along the road were consulted and that efforts were made to avoid road safety problems. This explicit reference to road safety in the project completion report raises its profile and makes it more likely that this issue will be rechecked during the postevaluation and any useful lessons learned eventually disseminated.

### G. Postevaluation

This is normally done by preparing a project performance audit report for the project, typically a year or more after significant project benefits have begun to flow. It is important that the road safety impact of the project is examined in this report and if the safety interventions were not successful, that this is recorded. The postevaluation findings are disseminated to ADB staff and the executing agency and other government agencies. The lessons learned are incorporated into subsequent operations in the road sector.

Consequently, raising the profile of successful road safety interventions such as RSA will be a good way of getting such activity integrated into ADB "good" practice. Conversely, highlighting instances where ADB (by omitting the RSA) has "worsened" the road safety situation with its road schemes should put pressure on those not yet using such preventative tools to adopt better practices.

Including emphasis on road safety in key ADB documents will focus attention on this neglected area and encourage a more safety-conscious attitude by ADB and its clients in the formulation, design, implementation, and operation of road projects.

## V. RECOMMENDATIONS AND THE WAY AHEAD

### A. Introduction

This tool kit is intended primarily for use by road authorities and their consultants. The tool kit is also a useful guide for task managers of road projects to ensure that RSA assessments have been adequately applied. The purpose of the tool kit is to provide (i) an overview of the RSA process, (ii) suitable safety checklists, and (iii) guidance on how such systematic checking of safety aspects could be applied to ADB-funded road projects.

This Chapter summarizes the main findings and suggests how ADB staff and their DMC counterparts can promote and encourage such safety checking on road infrastructure projects in the Asia and Pacific region.

## B. Summary of Main Findings

- Existing processes in road design and construction can inadvertently permit the implementation of deficient or inappropriate combinations of elements of road design in a project.

- Road safety problems that become evident a year or two after opening the new or rehabilitated road could often have been identified beforehand by conducting a formal RSA.

- The UK experience suggests that at least 33% of accidents can potentially be avoided or their severity reduced by conducting the RSA.

- The budget implications of the RSA can be small and Australian and New Zealand experiences suggest that the RSA add up to 4% (maximum) to road project costs.

- The greatest benefit of implementing the RSA is that it reduces the overall life cycle costs of a road project by saving lives and reducing crippling injury.

- Evidence from the UK and New Zealand suggests that the cost-benefit ratio of the RSA activity is between 15:1 (UK) and 20:1 (New Zealand).

- The RSA has been recognized as an important preventive tool for improving road safety in many developed countries and its potential benefits in developing Asia are likely to be even higher.

- The RSA is now a mandatory requirement in several industrialized countries (e.g., Australia, Denmark, New Zealand, and UK) and several DMCs (e.g., Fiji Islands, Malaysia, Singapore, Thailand, and Viet Nam) have now also introduced it.

- Countries using the RSA have found that it helps create safer roads and sensitize road engineers to safety implications of different options in road design.

- The RSA can be used on all types of road projects to reduce the risk but it can only contribute to accident prevention. It is also necessary to undertake accident reduction by identifying and improving hazardous locations.

- The RSA is normally undertaken at various stages of the planning, design, and construction process and appropriate checklists can be used at each stage to ensure that relevant aspects are examined.

- The RSA should be undertaken by an independent safety specialist and this could either be a suitably qualified individual from the road safety unit within the roads authority or a consultant with relevant expertise.

- This expert can work according to the procedures and checklists suggested in this document or use checklists that may have already been introduced by the relevant roads authority.

## C. The Way Ahead

Opportunities exist for including of road safety interventions at various stages of the project cycle and the planning, design, and construction process. The most urgent action that can be taken within DMCs and ADB itself follow.

### 1. Actions Required within Roads Authorities of DMCs

- Establish a mandatory RSA procedure initially using this tool kit and later, if required, developing country-specific guidelines to ensure that all new and rehabilitated roads are safety audited (ADB assistance may be available for such activity).

- Establish a road safety unit within the road and highway planning division to carry out traffic crash prevention and reduction activities (ADB assistance may be available for such activity).

### 2. Actions Required within ADB

- Raise awareness of the socioeconomic costs of road accidents in country and sector operations reports and studies.

- Include road safety in major documents prepared during the project preparation, processing, and implementation phases.

- Make the RSA mandatory for ADB-funded road infrastructure projects.

- Assist DMCs in establishing the RSA systems and procedures and in training local road safety auditors.

- Assist DMCs in establishing and training road safety units that carry out accident prevention and accident reduction activities to create safer road networks.

- Include road safety components in relevant ADB projects as an element of best practices.

This tool kit on the RSA for road projects primarily focuses on what can be done within road infrastructure projects in traffic crash prevention. Other detailed guidelines are available on what can be done in traffic crash reduction and in other sectors that affect road safety (*Appendix 6*). The ADB publication *Road Safety Guidelines in the Asian and Pacific Region*, for example, provides a comprehensive overview of the types of actions that can be taken by other sectors, which can influence road safety.

# APPENDIXES

# OUTLINE TERMS OF REFERENCE NUMBER 1

# STAGE X: ROAD SAFETY AUDIT

## A. Background

The Asian Development Bank (ADB) is increasingly concerned about the growing road safety problems affecting its developing member countries (DMCs). Road safety components have been included in many road projects and ADB has collaborated with several other funding agencies such as the United Nations Economic and Social Commission for Asia and the Pacific (UN ESCAP) and the World Bank in promoting road safety throughout the Asia and Pacific region. ADB recently financed a major regional study on road safety and published comprehensive road safety guidelines to assist member governments in addressing this important problem. Road accidents are now estimated to cost the region over 1% of its annual gross domestic product and such recurring losses are inhibiting the social and economical development of the region.

Despite these efforts, instances still arise where newly constructed or, more frequently, newly rehabilitated roads funded by ADB end up contributing to a worsening of the road safety situation because of a failure to properly assess the safety implications of the project. Road design standards and construction practices in many DMCs do not always adequately address the safety needs of vulnerable road users such as pedestrians, cyclists, and motorcyclists. Road rehabilitation can, because of resulting increases in vehicle speeds on the improved road, result in substantial increase in road safety problems for vulnerable groups using them and for communities through which such roads pass. As part of continuing efforts at improving its operations, ADB endeavors to reduce the adverse road safety impact that can occur if safety implications are not considered at all stages of project design, implementation, and operation.

## B. Objectives

The objective of this assignment is to carry out a Stage [X] Road Safety Audit (RSA) of the proposed [insert name of project] [insert name of country] so that potential road safety problems can be minimized.

## C. Scope of Services

The consulting services will be provided by a road safety specialist with particular experience or knowledge of road safety engineering and the scope of services include, but are not necessarily limited to, the following tasks.

(i) Review plans, documents, and reports provided by the design consultants.

(ii) Discuss with design consultants to clarify ambiguities and to gain a full understanding of the proposed scheme.

(iii) Visit the site of the proposed project and review proposed project from a road safety perspective. The road safety auditor will use appropriate checklists from ADB RSA tool kit or other similar checklists from another relevant source.[1]

(iv) Produce a concise RSA report identifying potential safety concerns on the proposed scheme and recommending design changes to eliminate or minimize potential problems. The report should address the safety needs of road users, with particular emphasis on the needs of pedestrians, cyclists, and communities along the proposed route. The structure and content of the report should be based on the recommendations in the ADB RSA tool kit.

## D. Required Inputs

The assignment is expected to take a total of about 21 days, including travel time, and will consist of 3–5 days reviewing documents, plans, etc., either in the consultant's home office or in the design consultant's office. This will be followed by 7–10 days in the field for site visits along the route. The

[1] Where the country already has an RSA procedure and local checklists, these can be used if they are considered to be more comprehensive or more appropriate for the relevant project.

remaining 5–7 days will be spent discussing proposed improvements and producing an RSA report. (Note: The required inputs should be tailored to the project scope and project requirements.)

**E. Reporting**

The safety auditors will submit the RSA report to the road authority, with copies to the design consultant and the ADB project officer.

## OUTLINE TERMS OF REFERENCE NUMBER 2

## SAFETY AUDIT DEVELOPMENT AND TRAINING

### A. Background

Road safety audit (RSA) is a formal procedure for assessing accident potential and safety performance in the provision of new road schemes, the improvement and the rehabilitation of existing roads, and in the maintenance of existing roads. It should form an integral part of highway planning, design, construction and maintenance, and it requires an objective approach to the assessment of accident risk. The principal method of ensuring this objectivity is through the independent assessment of schemes by persons who are independent of the original design team.

The basis for the RSA is the systematic application of safety principles. Specific aims are

(i) to minimize the risk of traffic crashes occurring in the scheme and to minimize the severity of accidents that do occur;

(ii) to minimize the risk of traffic crashes occurring on adjacent roads as a result of a scheme to avoid creating crashes elsewhere on the network;

(iii) to recognize the importance of safety in highway design to meet the needs and perceptions of all types of road users; and to achieve a balance between needs where they may be in conflict;

(iv) to reduce the long-term costs of a scheme, bearing in mind that unsafe designs may be expensive or even impossible to correct at a later stage; and

(v) to improve the awareness of safe design practices by all involved in the planning, design, construction, and maintenance of roads.

The RSA procedure includes within it feedback loops to auditors and designers so that designers are made aware of the implications of their design on safety. This frequently assists the design engineers in avoiding simple pitfalls in future designs and generally results in fewer safety problems.

In [insert country name], there is at present no mechanism or model for evaluating the degree of safety of a road location or a road network. The RSA is not carried out. It is expected that it will become mandatory in a similar way as environmental impact assessment studies are carried out. This project is to develop RSA capability and activities in [insert country name].

### B. Objectives

(i) Inculcate safety consciousness among the [insert country name] highway engineers and road authorities by introducing to them the concept and application of RSAs through practical training on selected national and state roads.

(ii) Carry out RSAs along selected sections of national and state highways to identify typical recurring problems and possible solutions.

(iii) Train highway engineers and officials of road authorities so they can carry out or organize others to carry out RSAs.

### C. Scope

(i) Carrying out RSAs along selected sections of national corridors, comprising a range of road types (e.g., hilly, plains, desert) typical of local conditions

(ii) Identifying typical problems in carrying out RSAs along such roads

(iii) Developing appropriate solutions for 15–20 recurring problems and standard details or approaches for use in design standards

(iv) Preparing guidelines on introduction and application of safety procedures and RSAs

(v) Developing a 5-day RSA course and training engineers and instructors within the national and state road authorities on such issues through practical RSA exercises

**D. Duration**

The project would be of 2 years' duration.

**E. Phasing**

**1. Phase 1**

The first 6 months would be devoted to agreeing and then preparing RSA procedures, guidelines, and safety checklists suited to [insert country name] road conditions, and in preparing an RSA course and training materials.

**2. Phase 2**

In the second stage, 12 months would be devoted to imparting training to selected future RSA trainers and practitioners and in actually carrying out RSAs along the selected sample sections of national and state highways in various terrain conditions.

**3. Phase 3**

In the final stage, the last 6 months would be devoted to critically reviewing a sample of the RSAs conducted by those trained in Phase 2, by providing additional training where needed and in finalizing the various documents.

**F. Manpower**

It is anticipated that the work will be carried out by specialist consultants working with suitably qualified domestic universities, institutes, or domestic consultants. The following are expected inputs:

(i) 30 person-months of international consultants, and

(ii) 75 person-months of domestic consultants.

**G. Outputs**

(i) The RSA guidelines are developed, complete with procedures and safety checklists.

(ii) A 5-day RSA course, training materials, and instructor pack are developed.

(iii) The RSA is completed on selected sections of existing national and state roads in various terrain conditions to identify a total of 15–20 typical, most frequently recurring problems requiring improvement.

(iv) Standard details or guidance are developed on how to solve the safety problems identified by the RSA.

(v) Practical training is provided for national and state roads authority engineers through participation in the RSA on the sample of roads (10 locations).

(vi) A few of the best national and state level officials are identified and trained as RSA instructors.

**H. Reporting/Documentation**

The consultants are expected to produce the following reports and documents:

(i) inception report by the end of month 2;

(ii) interim RSA procedures/guidelines by the end of month 4;

(iii) interim RSA course by the end of month 6;

(iv) RSA reports (as available) for 10 sites by the end of month 18;

(v) composite RSA report (summarizing implementation experience, typical safety deficiencies, and possible solutions for sites audited) by the end of month 21;

(vi) final RSA guidelines by the end of month 23;

(vii) final RSA course and instructor pack by the end of month 23; and

(viii) final report by the end of month 24.

## CHECKLISTS FOR ROAD SAFETY AUDITS

This appendix contains a series of checklists that can be used when conducting the different stages of the road safety audit (RSA). For convenience, the items to be checked are displayed in tabular form and space is left for ticking off each item and adding comments as the audit is undertaken.

The plans, documents, and information required for each RSA stage are listed at the start of each checklist.

## ROAD SAFETY AUDIT — STAGE 1
## PLANNING AND FEASIBILITY STAGE

| Checklist | | Comment |
|---|---|---|
| **Information Required for the Audit**<br>◆ Maps/plans of the region and road network<br>◆ Traffic reports showing existing and projected traffic<br>◆ Flow information on the arterial road network<br>◆ Details of any proposed local and area-wide traffic management strategies<br>◆ Maps/plans showing existing and proposed land-use strategies<br>◆ Planning reports and associated plans, typical cross-sections<br>◆ Proposed grade lines comprising the plans to be audited | | |
| **Audit Items**<br>◆ **Road Network Effects**<br>General traffic management strategy<br>Functional classification of the road in question<br>Network structure and hierarchy<br>Major traffic generators<br>Location and spacing of intersections/interchanges<br>Terminal problems<br>Access control strategy<br>Traffic management during construction<br>◆ **General Geometric Standards**<br>Appropriateness to route class, function<br>Topography and environment<br>Meeting community and road user expectations<br>Route continuity and consistency<br>Stage development of the project<br>Unusual features such as tunnels, long bridges that may have reduced standards<br>◆ **Outline Provision for Users with Special Needs**<br>Pedestrians<br>Pedal cyclists<br>Motorcyclists<br>◆ **Access Control Details**<br>Use of one-way or two-way service roads<br>Needs of special road user groups<br>Adequacy of alternative routes of access where access is restricted<br>◆ **Environmental Considerations**<br>Prevalence of high winds, fog, etc.<br>Scenic vistas and outlooks that may distract driver attention<br>◆ **Consideration of Alternatives**<br>Is road safety performance included in the evaluation criteria | | |

## ROAD SAFETY AUDIT — STAGE 2
## PRELIMINARY (DRAFT) DESIGN

| Checklist | | Comment |
|---|---|---|
| **Information Required for the Audit**<br>◆ Details of any Stage 1 (Planning Stage) Audit, including decisions made on the matters raised in that audit<br>◆ Planning and "route adoption" reports, on which the preliminary design has been based<br>◆ Traffic reports containing existing and predicted traffic flows, including "design flows" for all movements at intersections and interchanges<br>◆ Preliminary layout plans, cross-sections, grade lines, etc. to be audited | | |
| **Audit Items**<br>**Design Criteria**<br>Check<br>◆ that criteria are appropriate to the functional class of road, the nature of the topography, and the volume and type of traffic. | | |
| **Cross-Section**<br>Check<br>◆ Adequacy of lane widths, shoulders, roadside clearances, width of medians and separators, including the provision of adequate right-of-way width for grading, verges, footpaths etc.<br>◆ That, if special lanes or carriageways are required for motorcycles, or bicycles, the widths are adequate<br>◆ For consistency of the cross-section along the route | | |
| **Horizontal and Vertical Alignment**<br>Check<br>◆ the design speed of horizontal curves for consistency<br>◆ for any substandard curves<br>◆ that vertical alignment standard is consistent and coordinated with the horizontal alignment<br>◆ adequacy of stopping sight distance, and the availability of overtaking sight distance<br>◆ for unsatisfactory combinations of vertical and horizontal alignment, which may mislead drivers in respect to overtaking or the direction of the route ahead | | |
| **Interchanges and Intersections**<br>Check<br>◆ The appropriateness of type of interchange or intersection<br>◆ The adequacy of the layout from a capacity viewpoint<br>◆ The provision of auxiliary lanes and the achievement of proper "lane balance" and "through lane" continuity and the avoidance of "trap lanes" | | |

| Checklist | | Comment |
|---|---|---|
| ◆ The achievement of various sight distance criteria, including approach sight distance, entering or crossing sight distance, safe intersection sight distance, sight distance to queued vehicles, sight distance for pedestrians, sight distance at interchange entry and exit ramp noses<br>◆ That the layout caters adequately for large vehicles and for public transport vehicles where applicable; the need/provision of specific safety-related features, e.g., median barriers, street lighting<br>◆ That the need for special arrangements of traffic signing for safe operation is identified for action at the detailed design stage<br>◆ That the specific needs of particular road users, such as motorcyclists, bicyclists, and pedestrians, have been considered and any action required at the detailed design stage has been noted | | |
| **Access Control/Provisions**<br>Check<br>◆ The appropriateness of access control, particularly in the vicinity of interchanges and intersections<br>◆ Where access is to be restricted, check the suitability and adequacy of alternative access, particularly to large traffic generators<br>◆ Where pedestrian access is to be restricted, check that the need for appropriate fencing is noted for action at the detailed design stage | | |
| **Major Land Use Developments**<br>Check<br>◆ That major land use developments adjacent to highways properly consider the road safety implications<br>◆ The adequacy of access and egress arrangements, e.g., avoidance of entry and exit driveways too close to interchanges and intersections and the avoidance of queues from driveways extending onto the highway<br>◆ That the layout of driveways and type of traffic control are appropriate to the function of the highway; that the needs for pedestrians and public transport access to the development have been identified and provided for<br>◆ The adequacy of "off-street" parking, and the provision of parking controls on the highway | | |
| **Stage Development of Major Projects**<br>Check<br>◆ That the stage development strategy takes account of traffic safety requirements<br>◆ The arrangement and siting of temporary terminals, avoiding locations of poor sight distance, locations complicated by busy intersections and restricted alignment standards<br>◆ For unexpected changes in geometric standards, and situations that are likely to result in the unexpected onset of traffic congestion | | |

## ROAD SAFETY AUDIT — STAGE 3
## DETAILED DESIGN

| Checklist | | Comment |
|---|---|---|
| **Information Required for the Audit**<br>◆ Audit report and decisions on earlier stage audits<br>◆ Locality plan showing road network and general topographic details in the region of the project<br>◆ Statement of the design criteria<br>◆ Relevant traffic demand information<br>◆ Horizontal and vertical alignment plans<br>◆ Cross-sections<br>◆ Grading and drainage plans showing the location and general details of drainage structures<br>◆ Bridge layout plans including cross-sections and details of barrier systems<br>◆ Interchange and/or intersection layouts<br>◆ Traffic signal layouts and design information<br>◆ Traffic signing and road marking plans<br>◆ Street lighting layouts and design information<br>◆ Landscaping and beautification plans and tree planting details<br>◆ Plans showing relevant overhead services/utilities | | |
| **Audit Items**<br><br>**General Items to be Checked**<br>◆ Design criteria<br>◆ Consistency among the items relevant to road safety<br>◆ Route planning and location<br>◆ Aspects that have adverse safety implications, or previous decisions that have "locked in" constraints to the detailed design that may lead to unsatisfactory safety performance<br>◆ Adequacy of reservation width to achieve a safe cross-section, considering the needs of all road users<br>◆ Appropriateness of the proposed access control | | |
| **Management Strategy Proposed, Considering Such Aspects as the Following**<br>◆ Proposed speed limit<br>◆ Vehicle type restrictions<br>◆ Proposed segregation of vulnerable road users<br>◆ On-street parking provisions/restrictions<br>◆ Turn restrictions<br>◆ Special provisions for pedestrians and/or bicyclists<br>◆ Special provisions for motorcyclists<br>◆ Special provisions for trucks and/or buses<br>◆ Provision of "motorist facilities" such as rest and service areas, laybys, etc. | | |

| Checklist | | Comment |
|---|---|---|
| Check that climatic and weather implications have been taken into account, e.g.:<br>◆ Wet weather and flooding effects<br>◆ High winds<br>◆ Fog-prone areas | | |
| **Geometric Design Elements**<br>Check the horizontal alignment in respect to<br>◆ Correct choice and application of design speed<br>◆ Consistency of horizontal alignment along the route<br>◆ "Substandard"curves<br>◆ Provision of transition curves (spirals) where appropriate<br>◆ Horizontal alignment at the "interface" between the proposed construction and the existing road network<br><br>Check the vertical alignment in respect to<br>◆ Consistency along the route<br>◆ Sight distance.<br><br>Check combination of horizontal and vertical alignment for<br>◆ Adequacy of stopping sight distance<br>◆ The achievement of overtaking sight distance<br>◆ The achievement of approach sight distance at intersections<br>◆ Adequacy of sight distance at locations where there is a discontinuity in the cross-section standard<br>◆ Combination of horizontal and vertical alignment that results in unexpected areas of "hidden" pavement or areas | | |
| **Grades**<br>Check for<br>◆ Sections with steep downgrades<br>◆ Sharp curves on steep downgrades, check adequacy of super elevation rate to achieve appropriate design speed<br>◆ Sections with steep upgrades and the need for "slow vehicle" provisions | | |
| **Cross-Section**<br>Check for<br>◆ Number and width of traffic lanes, width of shoulders or emergency stopping lanes<br>◆ Median and separator width (where applicable)<br>◆ Batter heights and slopes and guardrail requirement<br>◆ Use of correct types of kerbs (avoid barrier kerbs)<br>◆ The provision of footpaths<br>◆ Clearances to barriers and barrier types<br>◆ Appropriate transitions at locations where the cross-section changes significantly | | |

| Checklist | | Comment |
|---|---|---|
| ◆ Special provisions needed for vulnerable road users such as pedestrians, bicyclists, motorcyclists<br>◆ Differences in level between the roadways of divided roads at intersections or access driveways<br>◆ Sight line obstruction by batter slopes through cuttings on curves | | |
| **Interchanges and Intersections**<br>Check<br>◆ General layout logic<br>◆ Visibility and sight distance<br><br>Check the following sight distance criteria applicable at intersections, and identify any situation where a deficiency is evident<br>– Approach sight distance<br>– Entering or crossing sight distance<br>– Safe intersection sight distance<br>– Sight distance to queued vehicles<br>– Sight lines and visibility to traffic signals and signs<br><br>At interchanges, check the following additional sight distance criteria<br><br>– Sight distance to exit nose and "gore" area<br>– Sight distance to the entry and merge area<br><br>◆ Auxiliary lanes and lane continuity<br>Protection for "turning" vehicles at important intersections<br>Avoidance of "trap" lane arrangements<br><br>◆ Island size and shape<br><br>Traffic islands should be large enough to be easily visible; cater adequately for any traffic signs, signals, street lights; and provide adequate refuge for pedestrians<br><br>Shape of the islands should guide vehicles into the correct travel path<br><br>Approach noses should be properly offset from the edge of traffic lanes<br><br>At roundabouts, check the shape and positioning of the approach "deflection/splitter islands" to ensure control of entry speed<br><br>◆ Land and turning roadway widths to provide adequately for large/ heavy vehicles turning at low speed<br><br>◆ Kerbs type<br>Incorrect kerb usage may constitute a hazard to road users, particularly motorcyclists<br><br>◆ Provisions for Pedestrians<br>– Lack of provision of footpaths and kerb ramps at crossing points | | |

| Checklist | | Comment |
|---|---|---|
| – Adequate area/width for medians and roadway separators, including pedestrian refuge islands<br><br>◆ Signals, signs, lighting, and other road furniture<br>Not to be placed in vulnerable locations such as at the nose of traffic islands<br><br>Should not obstruct normal pedestrian movements<br><br>◆ Vehicle parking and bus stops<br><br>– Identify the need for parking restrictions and check that proposed bus shelters and "waiting" buses will not obstruct sight lines important for the safe and efficient operation of the intersection.<br>– Check that where on-street parking is to be provided, parking maneuvers will not interfere with traffic moving through the intersection.<br>– Identify sites where stationary buses at bus stops will interfere with the movement of other traffic.<br><br>◆ Property access points<br>Are they likely to create unexpected traffic conflicts or otherwise hazardous traffic conflicts? | | |
| **Audit of Traffic Signal Installations**<br>Check that<br>◆ Traffic signals proposed only where they are warranted<br>◆ Proposed signal phasing provides adequately for the required traffic (and pedestrian) movements<br>◆ No unexpected conflict situations arise in the signal phasing, and that special phases for right turn movements are provided where justified<br>◆ Required "intergreen time" for each phase change is sufficient to allow safe operation<br>◆ The number and location of signal heads and posts ensure that each separately controlled vehicle movement has at least two (and preferably three or four) signal heads controlling it and that minimum visibility requirements are met<br>◆ Adequate clearances are provided between the face of kerb and the signal head not located in islands and medians too small or narrow to afford the equipment adequate protection from vehicle impacts<br>◆ The correct signal size and brightness are provided and that back plates are provided<br>◆ Pedestrian signal displays and associated "call buttons" are provided at sites where it is expected that pedestrians will cross signal-controlled roadways | | |

| Checklist | | Comment |
|---|---|---|
| **Audit of Traffic Signing and Road Marking**<br><br>**Traffic Signs**<br>Check that<br>◆ Traffic signing provides "positive" guidance rather than abstract and indefinite information<br>◆ Necessary regulatory signs are provided and properly positioned to control, both legally and practically, the movement of traffic along or across the roadway<br>◆ Appropriate warning signs are shown on the traffic signing plans<br>◆ Any unnecessary warning signs are identified and removed<br>◆ Proposed direction and guide signing (consider "unfamiliar drivers")<br>◆ Letter/legend size is adequate to enable drivers to read the information displayed in the time available<br>◆ Positioning of proposed direction signs will enable drivers to take any necessary action safely<br>◆ Appropriate reflectorization is specified or that internal or external lighting of the signs is required<br>◆ Provision of overhead (e.g. gantry-mounted) signs where complex multilane roadway layouts require vehicles to get into specific lanes to reach particular destinations<br>◆ Positioning of signs does not obstruct sight lines at intersections and on the inside of curves<br>◆ Positioning of signs and selection of the type of signposts prevent these structures themselves from being a significant roadside hazard | | |
| **Road Marking and Delineation**<br>Check<br>◆ That the correct type of longitudinal line markings, in terms of line pattern and width, is shown on the relevant plans<br>◆ That lines are properly positioned to guide vehicles in respect to the correct use of various traffic lanes and to effectively designate locations of merge and diverge situations, shoulders, and emergency stopping lanes<br>◆ For any case of discontinuity in "through" traffic lanes and any unavoidable and inadequately signed "trap" lanes or other illogical lane marking arrangement<br>◆ That all horizontal and/or vertical curves on two-lane two-way roadways, at which overtaking sight distance is not achieved, are shown to be properly marked with double (barrier) lines and identify lane marking arrangements that may confuse or be unexpected by drivers<br>◆ That double (barrier) lines are shown to be marked at any horizontal and/or vertical curves on two-lane two-way roadways at which overtaking sight distance is restricted, in accordance with appropriate guidelines<br>◆ Closely spaced short lengths of barrier lining, which may lead drivers into unsafe overtaking maneuvers, are identified | | |

| Checklist | | Comment |
|---|---|---|
| ◆ That approach hazard markings are shown on plans at the approach end of traffic islands, medians, and separating islands and in the exit ramp "gore" areas at expressways and other interchanges<br>◆ The correct positioning of all transverse lines such as "stop" lines, holding (or "give way") lines, and pedestrian crossing lines<br>◆ That reflectorized road markings are specified to enhance night-time visibility<br>◆ That retro-reflective pavement markers or road studs are specified to supplement surface markings where there is a need for longer distance visibility at night and more effective pavement delineation | | |
| **Audit of Street Lighting Design**<br>Check that<br>◆ The extent of street lighting is appropriate to traffic safety needs of road users and identify situations where unlit short lengths of roadway are mixed with lit sections<br>◆ The standard of lighting including uniformity and possible "glare" effects is appropriate to the needs of the traffic situation<br>◆ Lighting transitions are provided where street lighting ends<br>◆ Lighting poles themselves do not constitute a roadside hazard<br>◆ Lighting poles do not significantly obstruct driver sight lines | | |
| **Audit of Roadside Safety Provisions**<br>Check<br>◆ The provision of a "clear zone"<br>◆ The use of frangible types of road furniture<br>◆ Guardrail provisions and design details<br>◆ Minimum length of guardrail required to ensure that it functions properly<br>◆ Guardrail positioning relative to kerbs and objects being protected<br>◆ Bridge ends and guardrail to bridge rail transitions<br>◆ Barriers and railings on bridges and elevated roadways<br>◆ Landscaping and beautification<br>◆ Other roadside hazards<br>◆ Safety treatment of uneven rock cut batters<br>◆ Roadways close to permanent deep water such as rivers<br>◆ Lakes or seashore slopes close to the traffic lanes<br>◆ Horizontal rails in pedestrian fencing close to roadways | | |
| **Audit of Provisions for Special Road Users**<br><br>**Pedestrians**<br>Check<br>◆ Lack of footpaths or locations where footpaths are obstructed by posts and other road furniture | | |

| Checklist | | Comment |
|---|---|---|
| ◆ Lack of kerb ramps or "dropped kerbs" at crossing points particularly at signalized intersections<br>◆ Lack of specific crossing facilities such as signalized crossings, refuge island, zebra crossings, or grade separations where warranted<br>◆ Lack of specific pedestrian signal heads and signal phasing at locations where there is significant nighttime pedestrian activity<br>◆ Insufficient space for pedestrian refuge on traffic islands, medians, etc.<br>◆ Traffic management and devices to enable pedestrians to cross wide roadways with continuous uninterrupted traffic flows | | |
| **Motorcycles**<br>Check<br>◆ Horizontal and vertical alignment and sight distances, appropriate to the expected operating speed<br>◆ Cross-section standards, which provide adequate width of lanes or roadway for motorcyclists<br>◆ Appropriate clearances to roadside objects, merge and diverge areas<br>◆ Clear designation of priority between conflicting streams of traffic at junctions<br>◆ Adequate line and pavement marking to ensure an orderly flow of vehicles and good delineation of the route ahead<br>◆ Appropriate regulatory, warning, and direction signing with legibility and sign positioning<br>◆ Appropriate types of guardrails or barriers<br>◆ Provisions such as fully paved shoulders or special treatments at signalized intersections | | |

## ROAD SAFETY AUDIT — STAGE 4
## DURING CONSTRUCTION

| Checklist | | Comment |
|---|---|---|
| **Information Required for the Audit**<br><br>In the Stage 4 Audit, there is less emphasis on reviewing plans and the major part of the audit will involve site inspection activities. The auditor will therefore require the following<br>◆ A full set of construction plans, including plans for any traffic diversions and layouts associated with traffic management during construction<br>◆ Tape for distance measurement<br>◆ Photographic equipment<br>◆ Note taking and/or recording equipment | | |
| **Audit Items**<br><br>**General Grading, Alignment, and Cross-Section**<br>Check<br>◆ Sight distance (e.g., stopping sight distance) over crests, across the inside of horizontal curves, and on the approaches to intersections and at "entry" and "exit" ramps at interchanges<br>◆ Combinations of horizontal and vertical alignment resulting in areas of "hidden pavement" that may confuse a driver as to the direction of the route ahead or small depressions that may hide a vehicle momentarily in a potentially hazardous overtaking situation<br>◆ The general need for provision of guardrails at embankments and steep side slopes | | |
| **Roadway Layout Features**<br>Check<br>◆ The general alignment geometry, particularly in respect to sight distance<br>◆ The width of roadways (number of lanes), shoulder parking lane width, widths of median and dividers, and the size of traffic islands<br>◆ The logic and "clarity" of the layout of channelizing islands and medians at intersections, as seen from a driver's perspective<br>◆ The provision of appropriate clearances and offset at the approach noses of traffic islands, medians, and other dividers<br>◆ The type of kerb being constructed (e.g., the incorrect use of barrier kerbs)<br>◆ The alignment of tapers into and out of auxiliary lanes and the voidance of "trap" lane situations<br>◆ The location and treatment of pedestrian walkways and standing areas | | |

| Checklist | | Comment |
|---|---|---|
| **Traffic Signing and Road Marking**<br><br>**Traffic Signs**<br>Check<br>◆ The overall traffic signing strategy on the plans and on-site<br>◆ Regulatory and warning sign provisions and placement<br>◆ Type, size (letter height), amount, and arrangement of legend on traffic signs and the adequacy of their legibility distance<br>◆ Types of reflective sheeting, colors, grade, etc. on traffic signs<br>◆ The correct positioning of direction and other guide signs<br>◆ Obstruction to the visibility of traffic signs by other road furniture items<br>◆ The obstruction of essential sight lines by poorly located traffic signs<br>◆ The mounting structure of traffic signs (do not create a roadside hazard)<br>◆ General structural adequacy of traffic signs mounted over the roadway<br>◆ The need for protection of gantry columns with guardrailing<br>◆ The adequacy of the mounting height of traffic signs<br>◆ The adequacy of clearance under traffic signboards, particularly where mounted over footpaths and the avoidance of sharp edges or corners that could be a danger to pedestrians, pedal cyclists, or motorcyclists<br>◆ The need for provision of and arrangement of external lighting for "overhead" signs | | |
| **Road Marking**<br><br>Review the type, location, and arrangement of road markings, both on onstruction plans and during site inspections.<br><br>Check<br>◆ Correct use of the different types of lines to designate (to road users) the required traffic management requirements at particular locations<br>◆ Appropriate positioning of stop/give way lines at intersections<br>◆ The existence of "trap" lanes and discontinuity of "through" traffic lanes, and where unavoidable, the provision of appropriate warning and guide signing<br>◆ The provision of raised retro-reflective pavement markers (or road studs), where considered necessary for safe traffic operation<br>◆ The correct provision of "arrow" pavement markings, required to designate traffic lanes that are restricted to particular traffic movements | | |

| Checklist | | Comment |
|---|---|---|
| **Roadside Safety Features**<br>Check<br>◆ The provision of guardrail or other barrier at hazardous fixed roadside hazards<br>◆ The type of guardrail or barrier, and the adequacy of its length in relation to the length of the hazard<br>◆ Structural adequacy of the guardrail, e.g., height of the railing, post spacing, rail overlap, etc.<br>◆ Location of the guardrail or barrier relative to the hazard, e.g., clearance allowed for deflection during an impact<br>◆ Treatment of the approach end of a guardrail or barrier, end anchorage, etc.<br>◆ The type of bridge barrier or railing system appropriate to the situation and that allows no horizontal rails to protrude beyond the end posts<br>◆ The need for higher-than-normal barrier height on bridges over or close beside a busy roadway below and that the type and height of the railing are adequate to restrain a vehicle from going over the top<br>◆ The treatment of the approaches to bridges, to ensure that the hazard caused by the approach ends of the bridge are treated with approach guardrail properly transitioned into, and strongly anchored to the rigid bridge railing system<br>◆ The avoidance of kerbs directly in front of barrier or guardrail systems, or where it is unavoidable, the position of kerb relative to the face of the barrier or guardrail<br>◆ The type of median barrier, where applicable, and the treatment of its ends<br>◆ The provision and treatment of guardrail or barrier at fixed hazards such as rigid posts, poles, or bridge piers located in a narrow median or road divider<br>◆ The correct treatment of lighting poles placed within a median barrier<br>◆ The treatment of other narrow isolated hazards such as bridge piers and overhead sign gantry columns within the "clear zone"<br>◆ Measures ensuring that the item cannot be relocated out of the hazardous area<br>◆ Guardrail protection of the item<br>◆ The provision of a suitable "impact attenuator" or "crash cushion" to reduce the severity of likely impacts<br>◆ The treatment of culvert ends and "end walls"' and other drainage structures, including deep monsoon drains, that they do not create hazards within the "clear zone" | | |

| Checklist | | Comment |
|---|---|---|
| **Landscaping**<br>Check<br>◆ Trees and other plantations or landscaping features obstructing sightlines<br>– Stopping sight distance or overtaking sight distance (where applicable), particularly across the inside of curves<br>– Sight lines to the "exit" nose and at "entry" at expressway and other interchanges, particularly where the approach to them is on the inside of curved alignment<br>– Various sight distance criteria at intersections, including signalized intersections and roundabouts<br>◆ The sight line across a median, required by the drivers of vehicles making a "right turn" at an intersection or a "U" turn median opening for this purpose<br>◆ Sight lines between pedestrians and vehicular traffic, where pedestrians are expected to cross a roadway at a grade, whether signalized or not<br>◆ Sight lines of vehicle drivers (including motorcyclists and pedal cyclists) to traffic signals and traffic signs<br>◆ Trees and landscaping as potential roadside hazard<br>◆ The species of trees and the expected "mature" trunk size of trees planted within the "clear zone"<br>◆ Effect of trees on street lighting<br>◆ The positioning of trees relative to the lighting poles, their expected canopy height and spread of foliage relative to mounting height of the luminaire and its "outreach"<br><br>**Other Effects**<br>Check<br>◆ Foliage likely to overhang the traffic lanes and infringe the vertical and horizontal clearances for large high vehicles<br>◆ Planting of large trees too close behind semirigid guardrail such as "W" beam and flexible systems such as "wire rope" types, allowing insufficient clearance for the expected deflection of the barrier during an impact | | |

## ROAD SAFETY AUDIT — STAGE 5
## AUDIT OF EXISTING ROADS

| Checklist | | Comment |
|---|---|---|
| **Vertical and Horizontal Alignment**<br>◆ General alignment standard<br>– Check for consistency throughout the route, note any location where alignment standard changes abruptly and is not as expected by drivers<br>◆ Substandard curves<br>– Identify any curve with a speed value of more than 10 kilometers (km)/hour (h) below the 85th percentile approach speed; note any evidence of vehicles running off the roadway<br>◆ Inadequate sight distance<br>– Check and record any location with inadequate stopping sight distance<br>– Check and record any location with inadequate overtaking sight distance at which "double lines" have been marked | | |
| **Cross-Section**<br>◆ Note any location where the cross-section standard changes abruptly along the route, or is otherwise inconsistent with driver expectations<br>◆ Identify any locations where the capacity of the roadway is restricted<br>◆ Note locations of regular traffic congestion<br>◆ Note any absence of provisions protecting "turning vehicles" at intersections<br>◆ Note any locations with inadequate shoulder width; check that the correct type of kerb has been used and note any location where speeds are greater than 50 km/h and "barrier kerb" has been used<br>◆ Check that the cross-section provides adequately for "vulnerable road users"<br>– Pedestrians—have paved footpaths, adequate refuge width on median and islands, and proper ramps up and down kerbs, where there is regular pedestrian traffic<br>– Bicyclists—segregated areas (e.g., paved shoulders) where numbers are significant<br>– Motorcyclists—segregated lanes (paved shoulders), separate roadways, where warranted by demand<br>◆ Lack of access control—Identify any location where the cross-section does not allow the development of appropriate access control | | |
| **Intersections**<br>◆ Sight distances<br>– Check that the sight distances are appropriate for speed limits<br>– Approach (stopping) sight distance<br>– Entering sight distance<br>– Safe intersection sight distance | | |

| Checklist | | Comment |
|---|---|---|
| **General Layout Features**<br>Check<br>◆ That the general layout of the intersection caters safely for all road users (pedestrian, bicycles, motorcycles)<br>◆ That the layout is logical for various traffic movements, that it correctly favors the major traffic movement<br>◆ For any lack of auxiliary (turning) lanes<br>◆ For any discontinuity of "through" traffic lanes<br>◆ For any instance where "through" vehicles have to change lanes to continue on through an intersection<br>◆ For the occurrence of "trap" lanes, i.e., where a "through" lane is suddenly marked, or aligned, as a lane for traffic turning off a roadway<br>◆ Any location where the length and width of the "right turn" merge is substandard and instances where pedestrian movements across the continuous traffic flow movement are not properly catered for<br>◆ For operational problems at roundabouts, e.g., inadequate deflection (and speed reduction) of traffic at entry point, high vehicle speeds within the roundabout, inadequate width of entry or circulating roadway, etc.<br>◆ For situations where channelization islands are too small to be easily seen by drivers, or for pedestrian refuge or for protecting traffic signs, signals, and other road furniture<br>◆ That barrier kerbs are not used where traffic speeds are likely to be greater than 50 km/h | | |
| **Expressway and Other Interchanges**<br>Check<br>◆ That interchanges are appropriately located (e.g., at the important roads), properly spaced, and suit a logical traffic management strategy for the region<br>◆ For situations/problems associated with the incompatibility of mixing at-grade intersections and interchanges on the same route<br>◆ That appropriate and consistent standards of layout geometry exist at exit and entry ramps<br>◆ Locations where the provision of auxiliary lanes is inadequate or otherwise inappropriate, e.g., where two-lane exits are not preceded by at least 300 meters (m) of auxiliary lane and two-lane entry ramps are not followed by at least 500 m of auxiliary lanes<br>◆ The "start" and "end" tapers of auxiliary lanes and note any instance where "through" traffic may lead inadvertently into auxiliary lanes<br>◆ For any location where the ramp alignment and length are inconsistent with the speed of traffic entering the ramp, bearing in mind deceleration requirements, and likely queuing of vehicles at the ramp intersection<br>◆ For any deficiency in sight distance requirements at entry and exit points | | |

| Checklist | | Comment |
|---|---|---|
| **Traffic Signal Installations**<br>Check<br>◆ That traffic signals are provided only where warranted for safe, efficient, and equitable management of traffic flow along and across arterial roads and for the safe crossing of pedestrians<br>◆ That the provision, location, and spacing of traffic signals reflect a sensible traffic management strategy along the route<br>◆ That signals installed are operating effectively and efficiently<br>◆ For any location where there is inadequate signal hardware (signal faces, etc.) to safely control various traffic movements, bearing in mind the need for some redundancy to cater for failed light globes, etc.<br>◆ That the signal hardware and phasing provides adequately for pedestrians; specific signal faces and phasing should always be provided for pedestrians in urban and other "built-up" areas<br>◆ The positioning and visibility of signal faces and record instances where visibility of signals is obstructed by tree foliage, traffic signs, etc., or where approach roadways are more than three lanes wide, overhead signal faces are not provided | | |
| **Street Lighting**<br>Check<br>◆ That street lighting is provided on arterial roads and highways in cities, towns, and other "built-up" areas, particularly where there are pedestrians and parking along the road<br>◆ That where lighting is installed, it is of an appropriate standard, consistent with the needs of the location, pedestrians, and other factors<br>◆ Locations where the street lighting poles constitute a hazard to traffic, e.g., on small islands, noses of medians, on the outside of sharp curves, etc.<br>◆ For situations where street lighting poles could be eliminated by joint sharing of traffic signal pedestals and electric power poles<br>◆ That the arrangement of street lights enhances "route guidance" rather than confuse the driver's ability to "see the direction of the route ahead" | | |
| **Traffic Signing**<br><br>**General aspects**<br>Check<br>◆ For cases of unauthorized traffic signs and use of nonstandard signs (color and shape)<br>◆ The location and spacing of signs and note locations where there are too many signs, or the signs are too close together<br>◆ That traffic signs are clearly visible and are prominently displayed to the intended road users | | |

| Checklist | | Comment |
|---|---|---|
| ◆ For instances where the legibility of the information on traffic signs is inadequate, bearing in mind the speed of vehicles and the amount of information displayed<br>◆ For instances where signs contain too much information to be capable of being read by drivers traveling at normal operating speed<br>◆ The effectiveness of traffic signs by observing them at night and identifying any lack of reflectorization<br>◆ The type of signposts used and record situations where sign posts constitute a fixed roadside hazard or where the use of frangible signposts should be considered<br>◆ For cases where there is a lack of clearance to traffic signs<br>◆ For situations where traffic signs themselves are obstructing essential "lines of sight" for drivers and pedestrians | | |
| **Regulatory and Warning Signs**<br>Check<br>◆ That the appropriate regulatory signs are provided where necessary<br>◆ That warning signs have been used only where they are warranted | | |
| **Guide and Direction Signs**<br>Check<br>◆ That guide and direction signing has been done on a systematic route or regional strategy, that it is logical and meets needs of unfamiliar drivers<br>◆ That all important intersections are provided with<br>– Advance direction signs<br>– Intersection direction signs<br>– Reassurance (distance) signs<br>◆ That these signs are correctly positioned to allow the required action to be taken by the intended drivers<br>◆ For instances where there are inconsistencies in destination names on consecutive signs, e.g., on "advance direction signs" followed by "intersection direction signs," followed by "reassurance direction signs"<br>◆ For any lack of providing "road names" on direction signs, particularly in urban areas, and "route numbers"<br>◆ For instances of poor legibility and poor arrangement of information on signs | | |
| **Pavement Marking**<br>Check<br>◆ The general adequacy and visibility of pavement marking, both at night and in wet weather | | |

| Checklist | | Comment |
|---|---|---|
| ◆ That the correct type of line marking has been used in the various situations, e.g., "continuity lines" at merge and diverge sections, "double (barrier) lines" where overtaking is to be prohibited, etc.<br>◆ For any discontinuities in "through traffic lane" marking and the existence of any "trap" lanes<br>◆ For any deficiency in the delineation of merge and diverge areas, including situations where through traffic may inadvertently lead into auxiliary and turn lanes<br>◆ For locations where there is a lack of "hazard marking" at approach ends of islands and medians, etc.<br>◆ For locations where auxiliary "turn lanes" have been designated with appropriate pavement arrows and locations where the wrong type of arrow has been used<br>◆ For locations where pavement arrows and other markings are confusing to drivers, particularly where "old incorrect" markings have not been properly removed<br>◆ That the positioning of "stop" lines and "holding" lines are appropriate<br>◆ The justification for any "yellow bar" marking and record locations where it is inappropriately used (such markings should be rarely used)<br>◆ The effectiveness of road markings at night and in wet weather, consider the need for retro-reflective pavement markers or road studs to supplement line and hazard makings; identify inadequate provision of these devices and in the use of nonstandard arrangements of them | | |
| **Roadside Safety and Landscaping**<br>Check<br>◆ The "clear zone width" generally available along both sides of the road, and comment on this aspect in the RSA report<br>◆ The "fixed roadside objects" that occur within the "clear zone width" and comment on the need to treat them in the interests of road safety<br>◆ The provision of guardrail along the road, consider whether it is really justified and identify locations where it is not justified and locations where it has not been provided where it is warranted<br>◆ That the correct treatment has been applied to the ends of guardrail sections, including "soft" end treatments, end anchorage, and approach end flaring<br>◆ For the adequacy of "bridge railing" systems on all bridges. Take particular note of inadequate railings that will not restrain an impacting vehicle—this is often the case with bridges | | |

| Checklist | | Comment |
|---|---|---|
| ◆ The treatment of "approach guardrail" to bridges; record situations, where there is no "strong" anchorage of the approach guardrail to the bridge railing system and/or no proper transition of the rigidity of flexible or semirigid approach guardrail as it approaches and meets the rigid bridge railing<br>◆ That ends of median barriers are properly treated to reduce the severity of possible end collisions; identify the need for "crash cushions" or other impact attenuation devices<br>◆ The extent to which trees and other vegetation obstruct driver and pedestrian sight lines, which are essential for safe traffic operation<br>◆ The existence of poles of various kinds along the road and comment on whether some or many can be removed, relocated to less hazardous positions, or (in the case of street lighting poles) made "frangible"<br>◆ The degree of hazard associated with large trees, boulders, etc. and whether these can be treated to improve roadside safety | | |
| **General Traffic Management Items**<br>Check<br>◆ To see what, if any, special provisions have been made for motorcycles and comment on the need for the provision of such improvements as "paved shoulders," "segregated motorcycle lanes," or "separated motorcycle roadways" in accordance with any adopted warrants, guides, and practices<br>◆ The degree of safety afforded to pedestrians, particularly school children, and record instances where there is a need for special provisions to be made<br>◆ The adequacy and credibility of existing speed limits and comment if they are not appropriate to the traffic situation and the nature of abutting development or are otherwise unrealistic in the view of most motorists<br>◆ The effectiveness of speed limit signing: consider the need for more prominent signing of the start of "restricted" speed zones and for "reminder signs" within the speed zone, particularly near intersections where large numbers of vehicles enter the road in question from side roads<br>◆ Substandard curves and low speed curved sections of the road; consider the need for "positive" advice to motorists about the safe travel speed and consider the need for "advisory curve speed" signing<br>◆ The need at substandard curves, for other delineation improvements such as the provision of "guide post" delineation, the placement of "chevron alignment" signs, and the use of retro-reflective road studs | | |

Appendix 3 (Stage 5), page 22

| Checklist | | Comment |
|---|---|---|
| ◆ The degree of safety afforded to all road users in town centers, particularly where highways pass through shopping centers or near schools, record the need for "traffic calming" techniques to improve safety in these sensitive locations<br>◆ The availability of overtaking opportunities along the route as a whole and comment on the need of specific "overtaking lanes" at regular intervals along two-lane undivided roads, particularly where traffic flows are high in hilly terrain<br>◆ Consider the need for rest areas and other roadside stopping places, e.g., truck stops, scenic viewpoints, wayside picnic areas, etc., and note any current "unofficial" places where vehicles stop and the degree of hazard that this involves<br>◆ The existence of roadside stalls and other roadside business activities within the "right of way" of the road; comment on the relative safety of these and the possible need for formal parking arrangements and other regulatory controls<br>◆ The safety of bus stop locations and provisions for buses to stand clear of traffic lanes; also the need for a street light at these locations for the security and safety of bus patrons<br>◆ For any special problems and requirements that may be necessary to improve safety during "festive season" and holiday periods, when traffic demands are heavy and most drivers are relatively unfamiliar with the road | | |

## STRUCTURE AND CONTENT FOR A ROAD SAFETY AUDIT REPORT

The main task of a road safety audit (RSA) report is to succinctly address the aspects of the proposed scheme that may contribute to creating unsafe conditions, and to recommend corrective actions. The recommendations should indicate the nature or direction of a solution, rather than specifying in exact detail how to solve the problem. The task will be done by the designer.

The report provides the list of items and problems on which corrective action will need to be decided. The purpose of the audit report is not to "rate" the design but simply to highlight any major safety concerns. It is therefore not necessary to mention positive or good design as all designs can be assumed to have some elements of good in them.

Items for attention should be included in a sequence that is logical for those considering corrective action. On long roads, it may be beneficial to split the project into sections and to identify each location using the chainage or other identifier along the route. Each potential problem should be described and a recommendation made as to how that problem can be eliminated or minimized. Each problem and recommendation must be uniquely numbered so that they can be more easily referred to in follow-up reports.

There may be merit in making general observations/comments that are applicable to the whole scheme before commencing discussion of specific problems or deficiencies. Any safety issue that is considered to be a sufficient hazard to warrant immediate attention for removal, protection, or warning should be identified in the recommendations with the words "**FOR IMMEDIATE ATTENTION.**" Similarly, any safety problem that the auditor considers as having great potential for danger can be identified as "**IMPORTANT.**" This does not mean that other issues are unimportant but simply highlights those items requiring the most urgent attention.

The safety auditor should certainly try to resolve uncertainties and misunderstandings by discussing with the designers before finalizing the audit report. However, it is important that the auditor is seen to be totally independent so he/she should not be required to provide a draft report to the client or the designer. The road safety auditor's report is his/her professional opinion and whether the client or designer agrees or disagrees with the audit findings, the auditor must submit his/her findings as he/she sees them.

The designer may choose not to take such findings or recommendations on board, but he/she then must show the client why he/she is not going to accept that finding/ recommendation. In the event of a dispute, the client will decide whose view will prevail. The actual content of an RSA report will obviously be governed largely by the stage of audit, the particular checklist used, and the nature of the problems identified. However, the report should typically contain the following types of material.

### A. Title Page

This should include

(i) a report title giving the name of the project, together with the stage of construction or rehabilitation at which the RSA is being undertaken (e.g., Stage 2 [Outline Design] RSA of [insert project title]); and

(ii) names of the auditor or audit team and date when the audit was conducted.

### B. Background Information

This includes

(i) the introductory statement explaining what the report covers, a description of the scheme, who requested the audit, and when it was done;

(ii) details of names, qualifications, and affiliations of the safety auditor or the RSA team;

(iii) details of when and where the RSA was conducted; and

(iv) a list of supportive materials made available such as plans, etc. (this could be referred to and listed as an appendix).

### C. Findings and Recommendations

This section is the most substantial part of the report. For each location along the route that was identified as having potential hazards, there need to be

(i) **problem description**, which briefly outlines what safety problem was found at that point from the site visit and review of plans/ materials; this could be in the form of statements cross-referenced to annotated plans; it could also be supported by photographs or sketches; and

(ii) **recommendations**, if any, for any corrective action (these should be clearly and uniquely numbered for easy future cross-referencing and referral).

### D. Formal Auditor's Statement

This section consists of a signed and dated statement by the auditor or the team of auditors indicating completion of the audit.

It is important to note that recommendations made at each earlier stage of an audit (Stage 1, Stage 2, etc.) are reviewed at the start of each subsequent stage to ensure that the safety issue or problem raised previously has been addressed. It is therefore imperative that each "problem description" and "recommendation" have a unique number for easier referencing between documents. It may also be convenient to use the same headings and items as used in relevant checklists for each stage of the RSA.

Appendix 5

## SAMPLE PARAGRAPHS FOR INCLUSION IN ADB DOCUMENTS

This appendix includes sample paragraphs that could be used in documents at various stages of the project cycle. In each case the stage of the project cycle is indicated and the suggested wording shown in bold.

**Sample 1: Paragraph for inclusion into terms of reference (TORs) for consultant carrying out the road project feasibility study**

"Road Safety

The consultant will gather (either from police headquarters or from ledger books held at individual police stations along the route) basic statistics on the number of road accidents, number of deaths, and number of injuries for each kilometer or section of the route for each of the previous 3 years. These data will be included, along with national statistics and trends on road accidents, as an appendix to the feasibility report. The feasibility report itself must include a section on road safety, indicating typical current problems along the existing route and outlining what will be done within the project to enhance safety and what arrangements should be made to carry out road safety audits (RSAs) during the planning and design phases of the downstream project."

**Sample 2: Paragraph for inclusion into TORs for design consultants**

"Road Safety

The design consultant will ensure that adequate attention has been given to the road safety implications of the proposed design and will arrange for an independent RSA to be undertaken at key stages of the planning and design process as recommended in the RSA guidelines. Design consultants must ensure that appropriate safety checklists (such as those provided in the Asian Development Bank [ADB] tool kit) are used to carry out the RSA and that the RSA is carried out at the feasibility, outline design, design, and preopening stages. The design consultant should include provision of 3 person-months of RSA inputs within the project team. The safety auditor must be an experienced road safety specialist and independent from the design team."

**Sample 3: Paragraph for a memorandum of understanding (MOU) at project preappraisal/ appraisal stage**

**i. Under "Policy Dialogue," include**

"Road Safety

The Mission and Government agreed on the growing seriousness of the road safety problem and the importance of taking proactive steps to reduce the numbers of deaths and injuries. The Government agreed to improve coordination among key agencies with road safety responsibilities and to establish a road safety unit within the roads agency to monitor and improve road safety aspects of the road network. They also undertook to introduce as soon as practical a mandatory RSA procedure for all major road schemes. In the meantime, to prevent further deterioration of road safety, the Mission and Government agreed that the RSA will be included at various key stages of the proposed project and that provision for such specialist services will be included within the contract of the design consultants."

**ii. Under "Implementation," include**

"Consulting Services

International consulting services totalling xx person-months (of this yy person-months will be provided for construction supervision and 3 person-months for a road safety specialist to carry out an RSA at various stages in the design process)."

The above sample paragraphs are included only as examples of the type of wording needed to ensure that road safety is mentioned in each of key document during the project cycle. Only by bringing it to the forefront can we ensure that it is given the attention it deserves in ADB operations.

## ROAD SAFETY AUDIT BIBLIOGRAPHY AND REFERENCES

This appendix provides a list of the most important documentation available worldwide on road safety audit (RSA) and related issues. Some are RSA guidelines used in the industrialized or developing countries, while others are documents with useful information or overviews of RSA and its application around the world.

In preparing this tool kit, the author has drawn freely and extensively on these documents and their checklists. Acknowledgement is therefore due to the various authors and governments who produced and financed these earlier documents. Sharing their expertise and commitment will assist the Asian Development Bank (ADB) in its efforts at spreading the use of effective RSAs throughout the Asia and Pacific region. The author has also consulted and drawn from internal ADB guidelines on environment and social dimensions to maintain consistency in general style and terminology.

The most important documents on the RSA and related issues are listed (not in any order of importance) below.


1. ADB. 1998. *Road Safety Guidelines for the Asian and Pacific Region*. Manila.

2. AustRoads. 1996. *Road Safety Audit*. Sydney, Australia.

3. Danish Road Directorate. 1996. *Manual of Road Safety Audit*. Ministry of Transport. Copenhagen, Denmark.

4. Estimating Global Road Fatalities. 2000. *TRL Report 445*. G. Jacobs et. al. Crowthorne. United Kingdom.

5. Federal Highway Administration. 1997. *Road Safety Audits*. Part 1 and Part 2. Washington, DC.

6. Government of Nepal. 1997. *Road Safety Audit Manual*. Department of Roads, Ministry of Transport, Nepal.

7. Institution of Highways and Transportation. 1996. *Guidelines on Safety Audit of Highways*. London.

8. Ministry of Transport and Highways. *Sri Lanka: Road Safety Audit.* Checklists prepared by SWEROAD.

9. Overseas Development Administration. 1991. *Towards Safer Roads in Developing Countries*. Part IV: Road Safety Check Lists. United Kingdom.

10. Public Works Department (JKR). 1997. *Road Safety Audit: Guidelines for the Safety Audit of Roads and Road Projects in Malaysia*. Kuala Lumpur.

11. Ross, Alan. January 1992. *Road Safety Checks*. Infrastructure Note, Transport RD-9. Infrastructure and Urban Development Department. World Bank. Washington, DC.

12. Ministry of Transport. January 2003. *Thailand Road Safety Audit Manual*. Thailand.

13. Transfund New Zealand. 1999. *Interim Procedures for the Safety Audit of Traffic Control at Roadwork Sites*. Report No. RA98/6895, Wellington, New Zealand.

14. Transit New Zealand. 1993. *Safety Audit Policy and Procedures*. Wellington, New Zealand.

15. COLTO. May 1999. *South Africa Road Safety Manual*. Committee of Land Transport Officials, South Africa, Final Draft.

16. World Bank. 1992. *Review of World Bank Experience in Road Safety.* Technical Paper INU 193. Washington, DC.

17. World Bank. *Roads and the Environment: A Hand Book*. Chapter 17: Impacts on Human Health and Safety. Washington, DC.

The following are internal ADB guidelines referred to and used in preparing this tool kit.

1. ADB. 1993. *Guidelines for the Incorporation of Social Dimensions in Bank Operations*. Manila.

2. ADB. 1998. *Environmental Assessment Requirements of the Asian Development Bank*. Manila.

3. ADB. 1997. *Regional Initiatives in Road Safety*. Manila.