KEMENTERIAN PEKERJAAN UMUM
DIREKTORAT JENDERAL BINA MARGA

CONTACTS
Road Safety Engineering Unit
Directorate General of Highways
Ministry of Public Works
Jalan Pattimura No. 20, Kebayoran Baru, Jakarta 12110

Gedung Sapta Taruna Lantai 6
Subdit Teknik Lingkungan dan Keselamatan Jalan

Phone: 021- 7246654

Australia Indonesia Partnership
Kemitraan Australia Indonesia

MAKING INDONESIA'S ROADS SAFER

An Australia-Indonesia Partnership in Road Safety Engineering

December 2010

Australia Indonesia Partnership
Kemitraan Australia Indonesia

MAKING
INDONESIA'S ROADS SAFER

An Australia-Indonesia Partnership in Road Safety Engineering

KEMENTERIAN PEKERJAAN UMUM
DIREKTORAT JENDERAL BINA MARGA

INDONESIA INFRASTRUCTURE INITIATIVE

MAKING
INDONESIA'S ROADS SAFER

An Australia-Indonesia Partnership in Road Safety Engineering

PREFACE

This book has drawn from numerous technical and evaluation reports, PowerPoint presentations, and other technical information generated through the work of the Road Safety Engineering Unit (RSEU) within the Directorate General Highways (DGH), Ministry of Public Works. The AusAID Infrastructure Program formed a partnership with DGH to create the RSEU in 2009. The AusAID funded Indonesia Infrastructure Initiative (IndII) provides financial and technical support to the RSEU. This book summarises the RSEU's work and achievements in its first two years. The content of the book has been extensively formed around the writings and presentations of IndII consultant Phillip Jordan, in his role as the Road Safety Engineering Consultant to the RSEU. The book has also drawn heavily on the work of the other members of the RSEU – Jany Agustin, Victor Taufik, Arief Rizaldi and Andria Muharami Fitri. The RSEU was originally under the management and direction of Jany Agustin; since September 2009 that task has been assigned to Nurmala Simanjuntak.

The book also provides a short summary of recent road safety initiatives in Indonesia, drawing from technical reports published by AusAID including *Initial Investigation of a Possible AusAID Road Safety Project in Indonesia* by Eric Howard (2008) and *Recommendations for a Road Safety Unit at the Ministry of Public Works* by David Foster (2009).

Facts and figures relating to the global/ASEAN scenario are drawn from: *The True Cost of Road Crashes,* www.irap.com; *Facts and Figures*, www.grsproadsafety.org; and *World Bank Roads and Road Safety*, www.worldbank.org.

Cover Photo: Courtesy of Timur Angin

ACKNOWLEDGEMENTS

IndII's road safety activities are part of a broader Government of Australia (GoA) engagement with Government of Indonesia (GoI) on roads and road transport programming. Synergy with other GoA programs is essential and IndII would like to acknowledge the close cooperation with two programs in particular: the Eastern Indonesia National Roads Improvement Project (EINRIP) and the Indonesia Transport Safety Assistance Package (ITSAP). IndII and the RSEU have carried out a short program of improved traffic management during construction on various EINRIP projects, demonstrating improved practices which can be expanded to roadworks throughout Indonesia. Also, although not captured in this book, IndII has recently commenced a new activity to carry out Road Safety Audits on EINRIP projects at the request of the EINRIP Monitoring Unit. IndII also coordinates closely with ITSAP on a range of transport safety matters and is expecting to build upon this cooperation with the possible design and implementation of new transport safety related technical assistance and grants programs.

IndII also acknowledges DGH efforts in setting up the RSEU. We would like to thank Djoko Murjanto, Director General of Highways for his advice and support to the RSEU to undertake various Road Safety Engineering activities. We would also like to thank Purnomo S., Director of Technical Affairs; Danis H. Sumadilaga, Former Director of Technical Affairs; senior DGH officials including Herry Vaza, Acting Head of Environmental and Road Safety Sub-directorate; Nurmala Simanjuntak, Section Head of Environmental and Road Safety Sub-directorate; and DGH staff for their cooperation and help in preparing and organising road safety activities at both central level (in Jakarta) and at Balai level (DGH regions).

IndII would like to extend gratitude to David Ray, IndII Facility Director; David Shelley, IndII Technical Director Transportation; and David Foster, IndII Lead Advisor at DGH, for their support and valuable inputs; and to the following persons for providing technical advice, photos and professional opinions: Jany Agustin; Nurmala Simanjuntak; Syarkowi Mansyur; Erika Pangaribuan; Arief Rizaldi; Andria Muharami Fitra; Victor Taufik; M.Faiz Akbar EZ; Arif Susanto; and Phillip Jordan.

Thanks should also go to Efrulwan, Carol Walker, Eleonora Bergita, Pooja Punjabi and Ruth Davidson for editing the book; and Arif Susanto (KertasPutih.com) for the book's design.

Table of Contents

Foreword

ANYONE visiting Indonesia for the first time is immediately struck by the astonishing amount of traffic crammed onto every available piece of road. In Greater Jakarta alone, around 650 new cars and 3,400 new motorcycles are registered every day, and these numbers are rising fast. At the same time, the country's infrastructure is being expanded to cope with these huge increases. While the building of new roads and the upgrading of existing ones undoubtedly involves huge challenges, it is also creating outstanding opportunities for improving the safety of Indonesian road users.

Australia's technical expertise in road safety engineering and education has greatly reduced our own road toll over the last few decades. In Australia we have learnt what works through experience gleaned from the massive program of road building that accompanied economic growth in the 1980s and 1990s. Through rigorous research and continual review we improved our safety record even as car numbers more than doubled. Recognising the great potential for enhancing road safety, particularly through engineering, the AusAID Infrastructure Program formed a partnership with the Directorate General of Highways (DGH) to create a Road Safety Engineering Unit in 2008. Our partnership with DGH seeks to share Australian knowledge and expertise with Indonesian road engineers at all levels.

There is a growing awareness and desire in Indonesia to bring about positive and permanent changes in national road safety culture. Engineering safer roads is, of course, only part of the solution. The behaviour of road users must also be addressed, as must issues of compliance with traffic laws. Nevertheless, by building safer new roads and improving safety on existing ones, engineers can take the lead in addressing this huge national challenge. I am convinced that by bringing together Australian and Indonesian road safety professionals we will not only save lives and reduce injuries but also greatly improve national productivity.

This book gives a short summary of some of the DGH-AusAID road safety work to date. In doing so, the book gives a glimpse into the fact that a small but essential step has been taken down the path towards safer roads for every Indonesian.

Jacqui De Lacy

Minister-Counsellor, AusAID Indonesia

Foreword

ROAD safety is one of the issues that needs the Government's attention for present and future road infrastructure development. Road safety relates not only to the behaviour of road users and technical aspects of vehicles on the road, but also the technical aspects of road construction. A road that is designed and constructed by considering the safety elements will enable risk reduction in the event of a collision or accident.

In Indonesia, road safety is regulated under Law no. 38/2004 concerning the road, Government Regulation no. 34/2006 on the road, and Law no. 22/2009 on Road Traffic and Transportation. The Directorate General of Highways (DGH), Ministry of Public Works is the agency that manages the national roads in Indonesia and carries out various efforts in improving road safety. This effort is supported by the vision and mission of DGH to create safer roads. DGH Strategic Plan 2010-2014 contains road safety measures that can become the umbrella to accelerate road safety efforts and activities in the future.

The main goal to improve road safety in Indonesia should be directed primarily to the planners and executors of the road in DGH. The institution has the initial responsibility for constructing roads keeping the safety aspect in mind. In the next stage, this effort should also involve the Directorate General of Land Transport and Traffic Police Directorate, Republic of Indonesia, to manage the traffic on the roads.

Support provided by the AusAID funded Indonesia Infrastructure Initiative (IndII) in order to improve road safety is an initial strategic step. The efforts to improve road safety, as has been done in many other countries, will take a long time. Therefore, efforts should be started and continued. The planners and executors in DGH in the Central Office or in the regions should be the first in line in introducing the road safety element in road construction.

We welcome IndII initiatives in publishing this book on the various activities that have been carried out by DGH and supported by IndII. Training activities and workshops which are a very good start have been held to give a better insight to road safety engineers while designing roads. Blackspot investigation – a relatively new concept in Indonesia – is very important to reduce the number of collisions or crashes and reduce the risk of casualties. Meanwhile, road safety audits are preventive measures that should be implemented while designing a road. Proper blackspot investigations and road safety audits can bring about good improvements in the area of road safety.

Hopefully the publication of this book will help to provide insights to planners, executors, and other stakeholders on the importance of road safety, on which combined efforts by various parties is the need of the hour.

Djoko Murjanto

Director General of Highways,
Ministry of Public Works

The book emphasises the role that road safety engineers can play to bring about considerable improvements in the area of road safety

Introduction

INDONESIA faces a very serious road safety problem, with approximately 40,000 traffic fatalities occurring annually. Unless action is taken, this number is sure to rise. The subject of road safety is still at a nascent stage in Indonesia, with few engineers having sufficient understanding of road safety measures.

This book on road safety is therefore both necessary and timely. The book is produced by the Indonesia Infrastructure Initiative (IndII), an Australian Government funded project designed to promote economic growth in Indonesia by enhancing the relevance, quality and quantum of infrastructure investment. IndII is currently assisting the Directorate General of Highways (DGH) within the Ministry of Public Works in the area of road safety. The road safety project is into its second year and a Road Safety Engineering Unit (RSEU) has been set up in DGH. There have already been marked improvements in the understanding of road safety issues and in the creation of safer roads in Indonesia.

The book begins with a brief overview of the global road safety problem, followed by the road safety situation in Indonesia. It stresses the importance of the *road* in road safety. The book gives an overview of recent road safety engineering work undertaken by the IndII supported RSEU within DGH. It then goes on to summarise some of the major outputs, results and findings of almost two years of road safety engineering work by the RSEU. It is hoped that the book will provide an insight into how DGH and IndII – working in cooperation – are assisting with the development of safer roads in Indonesia. It is also hoped that this book generates interest in and enthusiasm for road safety engineering.

The book is for all road safety stakeholders; from policy-makers to engineers. It emphasises the role that road safety engineers can play to bring about considerable improvements in the area of road safety.

Globally, every 30 seconds a person is killed in a road crash - more than 3,000 per day - and as many as 50 million are injured annually

1 Dangerous Roads: A Global Concern

More than 1.3 million people worldwide die in road crashes every year.

PICK up a daily newspaper in any country in the world, and in all likelihood you will come across at least one news item describing a road crash. The global road crash 'epidemic' and its resulting deaths and injuries are a cause for great concern among governments across the globe.

Worldwide, more than 1.3 million people die in road crashes every year. That is equivalent to 3,500 road deaths per day, or one death every 30 seconds. In addition to these fatalities, each year another 50 million people are injured on the world's roads.

And these are just the official numbers. Police records seriously under-report crash and casualty numbers. In some countries, less than half of the deaths resulting from road crashes are reported to the police.

Worldwide, the extent of the road safety problem has been widely acknowledged. In 2004, a joint initiative between the World Health Organisation (WHO) and the World Bank produced the *World Report on Road Traffic Injury Prevention*. In 2009, government ministers from 70 countries gathered in Moscow for the first-ever Global Ministerial Conference on Road Safety. This resulted in a joint pledge to gear up road safety efforts and to formally ask the United Nations to declare 2011-2020 the Decade of Action for Road Safety. Accordingly, on 2 March 2010, the General Assembly of the United Nations adopted the resolution.

Road Fatalities are Higher in Lower Income Countries

The good news is that road deaths in higher income countries are generally low and falling. The bad news is that in lower income countries, road fatalities are high and rising. More than 85 percent of the world's road traffic deaths and injuries occur in low and middle income countries, despite the fact that their citizens own less than 40 percent of the world's motor vehicles.

WHO recently predicted that unless action is taken, deaths from road crashes will go up from 1.3 million in 2004 to 2.4 million in 2020, making road crashes the fifth leading cause of premature death in the world. These additional deaths will occur mainly in low and middle income countries as motor vehicle ownership expands.

Road crashes are the second biggest killer of young men. Only HIV/AIDS claims more lives globally.

Road Crashes' Impact on the Young

Road crashes are the second biggest killer of young men. Only HIV/AIDS claims more lives globally. Road crashes are particularly traumatic because young men are the traditional breadwinners or future breadwinners of a family. When they are killed, or permanently disabled, their family is often thrown into poverty – magnifying the already tragic impact of the crash.

Road crashes are also very inequitable – about two-thirds of global deaths are pedestrians. Many of these people will never own a motor vehicle – and yet they pay the highest price through the desire of others for mobility.

The Economic Costs

Road crashes cost governments between one and three percent of Gross National Product (GNP), placing a huge strain on state finances. These are resources that no country can afford to lose, especially a developing economy. It is estimated that the global cost of road crashes is USD 500 billion every year - almost twice the total amount of development assistance received by developing countries worldwide. These losses undoubtedly inhibit the economic and social development of these countries.

It is estimated that developing countries currently lose in the region of USD 100 billion every year from road accidents.

According to estimates, the total cost of traffic crashes in Indonesia is equal to 2.9 percent of the country's GDP

2 The Road Safety Problem

IN THE ASEAN REGION:

The Association of South East Asian Nations (ASEAN) region, home to more than 530 million people, is one of the fastest growing regions in the world. Its strong economic growth has contributed to a significant increase in the number of vehicles on the roads, especially motorcycles. Motorcycles are the most popular form of transport within the region due to their relatively low cost and suitability for the environment.

However, in many ASEAN nations, the development of the road infrastructure, legislation and education needed to support this expansion in motor vehicle ownership has not occurred. Studies in this region reveal a lack of attention and commitment to road safety by decision makers, often leading to insufficient road safety management and leadership. Most ASEAN countries also suffer from low levels of road safety knowledge and awareness, unsafe vehicles and road conditions, and inadequate legislation and enforcement, all of which contribute to poor road safety performance.

IN INDONESIA:

Indonesia faces a serious road safety problem. This situation is likely to deteriorate further as a result of the rapid growth in vehicle fleet (particularly motorcycles), population, economy, and other factors.

Road Crash Reporting in Indonesia

Police records suggest that about 20,000 Indonesians die on the roads each year (see table below), but hospital records and independent research suggest the actual number is over 40,000, with injuries estimated at over a million.

Problems in recording crashes - resulting in severe under-reporting - have meant that road safety has attracted only limited public and government attention for a serious public health issue. Road safety has a major economic impact, with one recent study estimating that the total cost of traffic crashes is equal to 2.9 percent of Indonesia's GDP.

Number of Traffic Crashes, Deaths, Serious Injuries and Slight Injuries in Indonesia, 2005 -2008

Year	Number of Traffic Crashes	Deaths	Seriously Injured	Slightly Injured
2005	91,623	16,115	35,891	51,317
2006	87,020	15,762	33,282	52,310
2007	49,553	16,955	20,181	46,827
2008	59,164	20,188	23,440	55,731

Source: National Police of Indonesia

Fatality rates per 10,000 vehicles are about eight times higher in Indonesia than in Australia, and more than twice the level in Malaysia, a neighbouring ASEAN country with good road safety practices. And the issue is urgent – if nothing is done, road fatalities in Indonesia are soon expected to exceed 50,000 per year.

It is most common for people **to blame the road user** for all the **road safety problems** in a country

In basic terms, the road safety problem originates in a combination of factors - human error, the vehicle and the road. Early attempts to improve road safety in most countries are often directed at one component only; road user behaviour - obeying road rules, using seatbelts, and wearing motorcycle helmets.

It is common for people to blame the road user for all the road safety problems in a country. In Indonesia, most people blame motorcyclists. They add that public awareness of road safety issues must be improved and that police enforcement of rules applying to motorcyclists should be better.

While public awareness campaigns are essential and valuable, the key factor in a successful national attack on poor road safety is the prudent use of national resources through close cooperation and coordination among all government agencies.

3 Addressing the Road Safety Problem

Road conditions are largely controllable. Road maintenance and upgrading can prevent crashes and reduce injury severity.

Crucial to Define Crash Causes

"We have to change the way we think about crashes. The majority of people think that crashes are due to fate. We have to think of a crash as a preventable event, that a death in a crash is a premature death."

Diza, mother of Thiago de Moraes Gonzago, killed in a road crash aged 18[1]

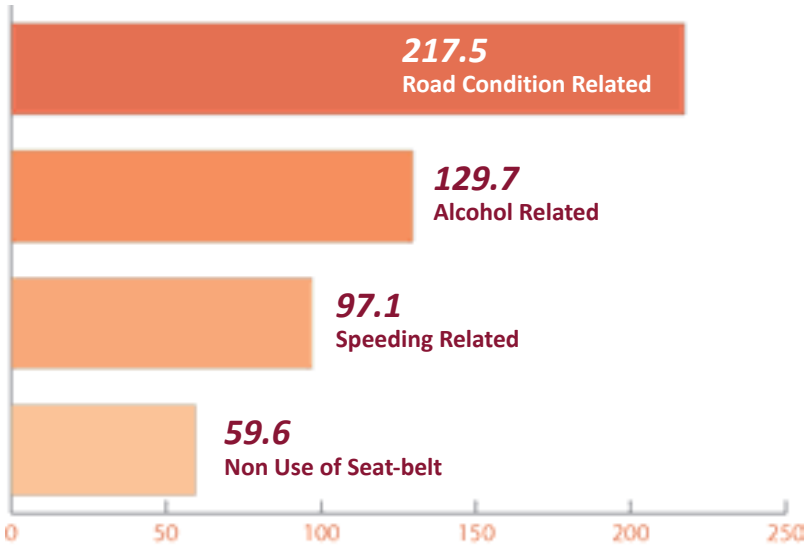
As mentioned, road safety involves the interaction of the vehicle, the person and the road. It is commonplace to blame the driver for a road crash, or the condition of the vehicle driven. If the driver and vehicle are blameless, then a crash is often seen as fate, or just bad luck. Historically, road crashes have been, and often still are, described as accidents. Road safety engineers (RSEs), however, view a crash as, "a rare, random, multi-factorial event in which one or more road users have failed to cope with their environment."[2]

The distinction between an accident and a crash is crucial. Accidents are the work of fate or luck; nothing can be done to prevent them. A crash, though, can be avoided through preventive steps. Action can be taken to reduce crash risks and many of these risks are predictable.

Analyses of road crashes in many countries have shown that while drivers make mistakes and vehicles may be unfit for the road, the condition of the road itself is often the greatest threat to human life and contributes significantly to the number and severity of road crashes.

[1] Faces Behind the Figures WHO www.who.int
[2] British Dept of Transport training definition

Costs Due to Road Crashes in USA (USD Billion)



The graph above, taken from a recent U.S. report by Dr Ted Miller and Dr Eduard Zaloshnja, illustrates the extent to which road conditions contribute to crash costs in the United States.

The report's authors point out that, "although driver factors are involved in most crashes, avoiding those crashes through driver improvement requires reaching millions of individuals and getting them to sustain best safety practices. That is not fail-safe. It is far more practical to make the environment more forgiving and protective." Regarding costs, they observe that the large share of crash costs related to road conditions underlines the importance of these factors in highway safety. "Road conditions are largely controllable. Road maintenance and upgrading can prevent crashes and reduce injury severity."

United Nations has declared 2011-2020
the decade of action for Road Safety

4 Background to the Current AusAID Initiatives to Improve Road Safety

Successful road safety activity, more than in most public policy areas, relies upon agencies in a number of sectors playing their part in a coordinated way at local and national levels.

AS is the case with many other developing countries, institutional management functions for road safety are not adequately developed in Indonesia.

Successful road safety activity, more than most other public policy areas, relies on agencies in a number of sectors to coordinate action at local and national levels. A lack of coordination between central agencies in Indonesia, including the Directorate General of Land Transport (DGLT), the Traffic Police and DGH, has been very apparent, and has prevented a more effective road safety response.

However, the new traffic and road transport law – Law no. 22/2009 - sets out and clarifies the responsibilities of these key agencies:

Directorate General of Highways

The DGH has responsibility for identifying road safety problems areas such as blackspots (sites where crashes tend to occur), developing improvement programmes, and implementing measures for crash reduction. However, DGH responsibility for these improvements only extends to realignment and/or geometric changes and modifications to street furniture or other facilities in the right of way. Traffic signs, signals and road markings are specifically excluded. In the area of crash prevention, DGH is responsible for carrying out new road projects and road safety audits for road improvement.

Directorate General of Land Transport

The DGLT shares responsibility with the DGH for identifying road safety problem locations. It also has responsibility to provide for or modify road markings, traffic signs and signals.

Traffic Police

The police share the responsibility for identifying road safety problems with the DGLT and DGH and can recommend to both agencies that action be taken. The police have full responsibility for crash investigation and for the enforcement of traffic laws.

The Local Situation

There are 33 provinces, 401 regencies (*kabupaten*) and 97 municipalities (*kota*) that operate as autonomous local governments following the decentralisation of government authority in the late 1990s. They exercise many of the powers that affect road safety outcomes, including most of the day-to-day infrastructure and traffic operation responsibilities. Local government is therefore a crucial player in improving Indonesia's road safety performance. Capacity has been very limited, with a lack of expertise and training opportunities. Road safety has not been a prime focus to date, with issues such as traffic and congestion management, and public transport demanding priority. There is some evidence, however, of a stronger interest in improving road safety emerging in some regencies.

Making Progress

IndII has joined forces with DGH to advance road safety engineering at a time when other factors have contributed to a positive and fertile situation in which the new Road Safety Engineering Unit (RSEU) has been able to grow and expand.

In addition to Law no. 22/2009, there are several initiatives that reflect growing concern at the number of road casualties in Indonesia and the need to improve road safety. These include:

- **ADB - ASEAN Regional Road Safety Program, *Country Report and Action Plan for Road Safety in Indonesia (2005)***

  This is a comprehensive series of documents that includes the identification of 15 strategies formulated in an Action Plan.

- **DGLT Road Safety Action Plan 2008-2012**

  This plan proposes to implement road safety programmes that focus on vulnerable road users. Its purpose is to reduce the number of fatalities and injuries on the road.

- **DGH 2010–2014 Plan**

  This plan contains the first road safety engineering programme for Indonesia. Blackspot investigations are the main features of the programme, with their numbers gradually increasing over the lifetime of the plan.

- **The Global Road Safety Partnership (GRSP)**

  The GRSP established operations in Indonesia in late 2007. Initial activity in Indonesia has focused on helmet wearing campaigns. GRSP is examining opportunities for further activities, including those that can build coordination between agencies.

All motorcyclists are required to wear a helmet in Indonesia.

Improving Road Safety Engineering Practices

IndII has been putting resources into an area that offers major benefits but which is often considered long term and too hard – making national highways safer.

Improving Indonesia's road safety engineering practices is a daunting challenge for the nation because it has so few trained RSEs. IndII is helping Indonesian officials to address this problem by providing training on blackspot investigations and safety auditing at both national and local levels.

But these efforts alone are not enough to maintain road safety improvements over the long term; institutional change is also needed. Therefore IndII has assisted the DGH to create a RSEU that will lead efforts to promote the development of professional RSEs throughout the nation.

DGH initiated a programme of road safety engineering workshops in mid 2009 with IndII support

5 DGH and AusAID – a Partnership in Road Safety Engineering

THE TEAM

Road safety engineering is defined as "the modification of the physical road environment, using proven processes and techniques, that endeavours to reduce risk for all road users."

INDONESIA'S first RSEU was formed in 2009 with five members, including national consultants Jany Agustin and Victor Taufik, and DGH engineers Arief Rizaldi and Andria Muharami Fitri. The team was led by Phillip Jordan, IndII Road Safety Engineering Consultant.

Given the novelty of road safety engineering in Indonesia, an early challenge for the RSEU was to strengthen the knowledge of DGH officials in the area of road safety engineering. Effective dissemination of this knowledge to local governments was also an early priority. These two priority goals were achieved by training DGH team members on technical issues while simultaneously involving them in training efforts at the local level.

Workshops held in the *balai* (DGH regions) were not just learning opportunities for local trainees, but also a training ground for team members to hone their skills in presenting, leading and developing workshop activities.

The workshop schedule has been challenging. Over a three-month period, the RSEU undertook several road safety engineering workshops in three balai, comprising a total of 18 training days. One hundred and ten people were involved in the workshops and 14 blackspot and audit case study sites were inspected. Feedback was given on 33 group reports from the study sites and design work was undertaken to eliminate several blackspots.

Improving road safety is a long term commitment, but these initial efforts have quickly established a programme by which local blackspots can be investigated and treated. Through the team's activities, the aim is to enhance the sophistication of road safety personnel at all levels, resulting in better engineered roads and reduced injuries and deaths.

THE WORKSHOPS

With IndII support, DGH initiated a programme of workshops in mid 2009.

Road Safety Engineering Workshops:

No.	Location	Date	Attendance
1	Palembang	29 June - 1 July 2009	40
2	Jambi	13 - 14 July 2009	25
3	Medan	12 - 14 August 2009	41
4	Bandung	18 - 20 August 2009	50
5	Palembang	15 - 16 October 2009	30
6	Bandung	20 - 21 October 2009	25
7	Medan	28 - 29 October 2009	25
8	Denpasar	07 - 08 October 2010	31
9	Makassar	12 - 13 October 2010	34

The workshops typically included members of DGH, the Traffic Police and DGLT. Given that safer roads rely on cooperation amongst these three agencies, it makes sense for them to work together at the earliest opportunity.

Workshops are currently led by IndII's consultant Phillip Jordan, with strong support from the core team members. IndII is assisting DGH to develop its expertise in delivering training, so that in the future the work can expand to other locations.

Training exercises employ a combination of discussions, presentations, and practical exercises on road research and investigation.

The classroom sessions allow participants to begin to consider how they can practically improve safety on the road. Sessions then move on to explain these techniques and processes with reference to real roads and real problems.

A typical workshop spans two days and includes these sessions:

- DGH role in road safety in Indonesia
- An introduction to road safety engineering
- The blackspot investigation process
- An introduction to the road safety audit (RSA) process
- Group exercises (involving a practical discussion of local road safety issues)

The first day consists of a series of presentations about road safety engineering in Indonesia, including information about blackspot investigations and RSAs. The second day is field-based and involves site inspections for RSAs and/or investigations of crashes at blackspots.

For instance, a workshop held in Jambi, Sumatera included a pre-opening stage audit of a length of the National Highway being widened and strengthened; a detailed design-stage audit of the design for remodelling a signalised intersection on a by-pass immediately south of Jambi; and an inspection of a sharp curve along a blacklength. The curve had excessive super-elevation (see glossary for the definition of super-elevation). Due to severely damaged pavement and shoulders, the overloaded trucks that used this road had to travel slowly, increasing their risk of roll-over crashes. This crash investigation is reported in more detail on page 47 of this book.

Over time, the team has modified the original workshop content to deliver training more effectively. For example, it was decided to review each report during refresher workshops and to give each team a copy of the consultant's report for audits and blackspots, so that trainees can more effectively use the consultant report as an indication of the standard to be aimed for in future reports.

It was also suggested that future workshops be extended to three days to allow follow-up discussions on site inspections. Moreover, the workshops now include efforts to ensure that blackspot countermeasures recommended during workshop audits and inspections are put in place quickly. For this purpose, funding was sought to have the blackspots treated with the agreed countermeasures so that team members could see positive, practical outcomes from their work.

Workshops on Road Safety at Roadwork Sites

The crash risk at a roadwork site is about three times the crash risk on any other section of a highway. In other words, work sites are locations where special attention needs to be paid to road safety. This attention has been lacking in Indonesia.

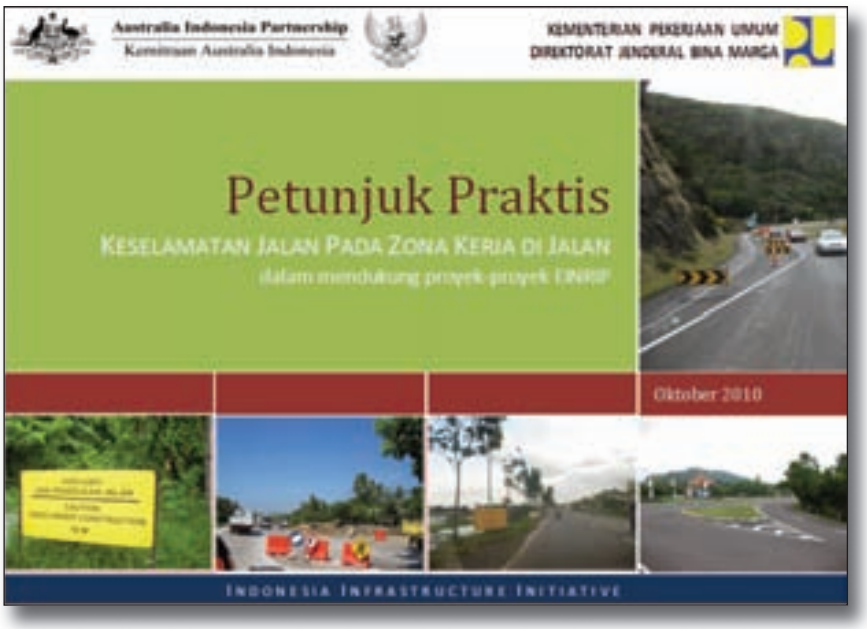
Consequently, it was decided that IndII would fund two training workshops focusing on raising the technical knowledge of contractors and consultants working on the AusAID funded Eastern Indonesia National Roads Improvement Project (EINRIP).

The two locations where this could best be demonstrated were the Tohpati Kusamba Road in Bali (where the roadworks are on-going and are within close proximity to a suitable workshop location) and ESS-02, which is about three hours' drive from Makassar, Sulawesi.

These two workshops were designed to be practical, involving a site visit during which existing road safety problems could be identified and useful low-cost safety improvements could be highlighted.

- Sixty contractors, consultants, and balai engineers attended the two 2-day workshops on "Road Safety at Roadwork Sites" held in Bali and Makassar.
- Both workshops were rated very highly by those attending – both for technical content and for presentation and interest. The average score in participant feedback was 80-85 percent.
- There is a clear need for many more similar workshops. They should become a regular part of the RSEU/DGH/IndII training program.
- The games (see next page) were highly successful, and will be continued at all future workshops.
- The site inspections were important to highlight present deficiencies.

A field guide for traffic control at roadworks was prepared by the RSEU. A copy was presented to each workshop attendee. This field guide formed the basis for the two workshops, and provided a reference for consultants and contractors in good road safety practice. It was introduced as the booklet to be used for safety at EINRIP (and other) roadwork sites.



Field guide for traffic control at roadworks prepared by the RSEU.

The Roadwork Game

The RSEU used a simple 'game' that involved a basic drawing of a generic road layout together with some small signs that could be placed along the road, simulating a work site. The RSEU took this concept further by enlarging six EINRIP site drawings and preparing hundreds of small signs and bollards to be used by workshop participants. The drawings were so large that they had to be placed on the floor of the workshop venue, and participants were asked to prepare safe and efficient traffic management layouts for each location.

One of these sites was a large intersection, one involved a lane drop, one involved a narrowing but no lane drop, and another was close to a bridge. These games proved very informative and helped attendees to quickly grasp the many technical issues involved in safety signing at work sites.

The RSEU had put much effort into the preparation of the game, and the success of the workshops was largely due to the enthusiasm that they generated.

Participants Found the Workshops Interesting, Informative and Useful

All the workshops were well received by participants, who felt that they provided valuable technical knowledge.

Workshop attendees were generally positive and did their best to provide useful material in their investigation reports. However, it became clear that most participants were inexperienced in audits and blackspot investigation. This is fairly consistent with what happens during the first round of audits and blackspot investigations in any country where road safety engineering is still a new profession. In countries such as Canada, Australia and New Zealand, where road safety engineering has been in place for the past 25+ years, engineers new to this field tend to make similar mistakes in the audit case studies. However, they have the benefit of greater technical knowledge to assist them in developing blackspot countermeasures.

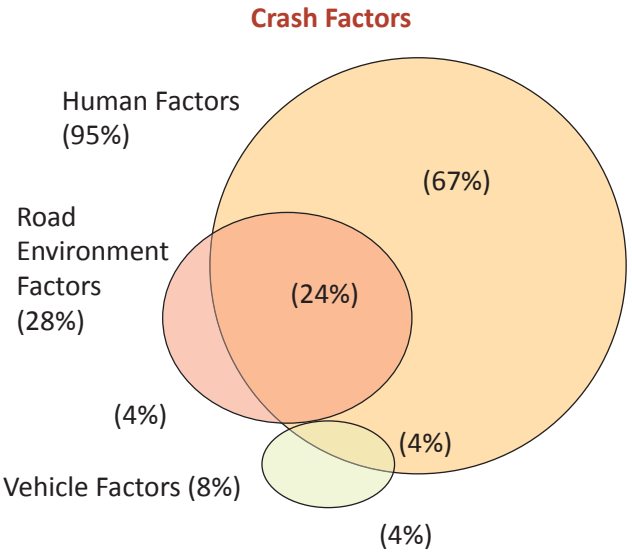
Workshop Sessions

A few of the classroom sessions and some practical exercises covered in the workshops are described in more detail in the seven lessons that follow.

LESSON 1: DGH Engineers Have an Important Role to Play in Road Safety in Indonesia

A significant number of crashes are attributable to road conditions.

RSEs must combine an understanding of road engineering, road design, and human factors with logic and sound judgment. For example, the RSE has to be able to recognise what is causing or might cause a crash problem, decide whether the problem is due to road design, human error or a combination of both, and then come up with strategies which will address all issues relating to the problems. Acknowledging the role that the road plays in contributing to crash numbers and severity, the RSE aims to lessen inherent risks in the design of the road. Recognising that human error also contributes to crash numbers, the RSE creates road conditions that take this into account in an attempt to reduce the potentially calamitous effects of human error.



Engineers can provide roads that are simple, clear and easily understood by road users. The engineers will recognise that they provide roads to be used by people – and that people make mistakes. Engineers will provide roads and devices that Warn, Inform, Guide, Control and Forgive road users. How they achieve this is at the heart of the road safety engineering profession. Some insights are given below.

LESSON 2: Used Correctly, Warning Signs Can Improve Road Safety

For warning signs to be effective, they must be placed at the correct distance from the hazard they are warning road users about. If the sign is too close to the hazard, and vehicular speed is fast, road users will arrive at the hazard before they have had time to think about and react to the information they have been given. Further, warning signs that are not reflective might not be seen at night. Signs that are vague or non-standardised may be seen but not understood. Any of these conditions can lead to unfortunate results.

Drivers need time to react to the information and they also need to understand what the warning sign means. The sign should be easily understood, and carry a positive message.

This particular sign is too vague to be helpful. Shouldn't drivers/riders always be taking care?

LESSON 3: Good, Timely Information Improves Safety

Information must be placed where it is needed in order to be useful. This blacklength (refer to photo below), for example, is a pair of gentle 'reverse curves' where there have been numerous head-on and side-swipe crashes over recent years.

The road authority is aware that safety is poor here, and it has installed several warning and guide signs. But these signs are hidden among trees. A sign can only be effective if it can be seen. In this case, the signs were put up before the trees were planted. This highlights the need for all agencies to work together. It also highlights the need for RSEs to maintain their work through regular monitoring of past achievements.

On high-speed roads, information may have to be repeated at regular intervals.

**Can you see the signs on the left hand side of the highway? There are five, including three warning signs!
The trees are obscuring these important safety signs.**

Information signs (like warning signs) should be reflective so that they are visible at night.

There is little doubt what is happening here.

A sign that is not comprehensible.

A major direction sign partly hidden behind a tree.

The key things to remember about signs, delineation and line marking are the 6 C's:

- Conspicuous (able to be seen)
- Clear (legible)
- Comprehensible (understandable)
- Credible (believable)
- Correct (the right sign for the hazard)
- Consistent (same sign used for same situations)

LESSON 4: Road Users Need Clear Guidance on Where to Go

Where the road is tricky to negotiate or may have surprises for the road user along its route, the RSE must consider how best to guide the user safely along the road.

This piece of road (refer to photo above) provides clear guidance in the form of a speed limit and chevron alignment markers (CAMs) that run the entire length of the bend. Reflective guideposts are continuous along the road, providing mid-range delineation for drivers and riders. Road users are also guided by the continuous edge line painted on both sides of the road, and are warned not to overtake by the central double line.

To be effective, guidance should be continuous along a route and consistent across a network. Signs should be standardised so that guidance means the same thing wherever it is found. Again, it must be remembered that these guides must be reflective in order to be effective at night.

In this example (refer to photo below) the road user is given guidance in choosing which lane to follow. Hatching encourages the user away from the 'gore' (central point) well before there is a risk of crashing into it. CAMs guide the user around both sets of curves, and a warning alerts people choosing the left lane of a potential hazard ahead.

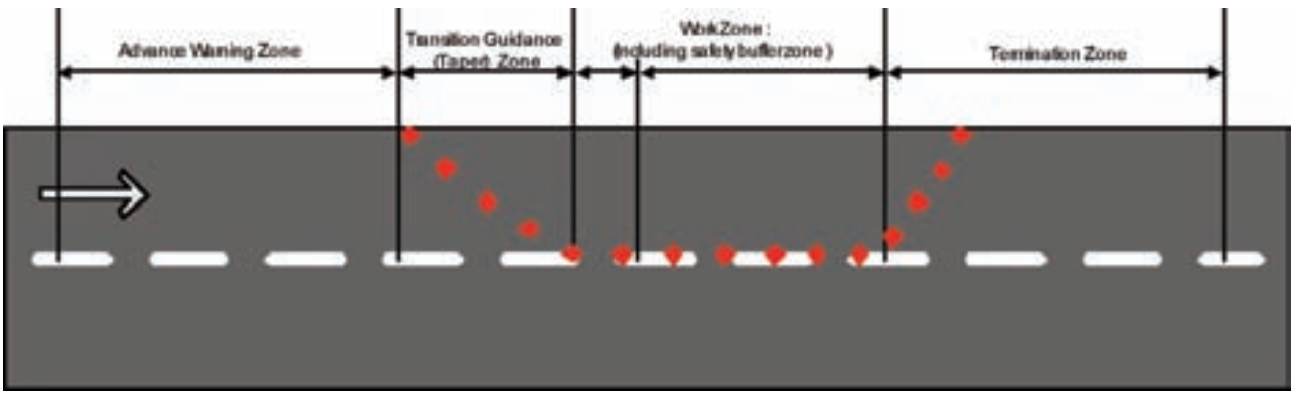
LESSON 5: Roadwork Sites Must Be Safely Managed

The risk of a fatal or serious crash at a roadwork site is three times the risk of a similar crash on another part of the road network. Work sites are dangerous for road users and for road workers.

Engineers have a responsibility to reduce risk at roadworks by:

- Preparing Traffic Management Plans (see glossary for definition) and implementing these for each roadwork site.
- Using signs, cones, and delineators that satisfy each of the six C's (see page 33).
- Adopting the 'Zone Concept' for their work site and managing it accordingly.

The Zone Concept considers the work site to be comprised of four zones – an Advance Warning Zone, a Transition Guidance Zone, the Work Zone and finally the Termination Zone. Drivers/riders on the road are first alerted to the presence of the works ahead, then they are guided (if necessary) into the correct lane and managed to the safe speed. All this happens before they reach the work zone. After they have crossed the work zone, they are guided and controlled back into the correct lane and the correct speed to continue their journey.



The Zone Concept for Managing a Roadwork Site

Two of the most critical failings at roadwork sites in Indonesia at present are:

- Failure to use any signs to warn approaching drivers/riders of the workers ahead, and
- Failure to place warning signs far enough from the work zone. Some signs are placed just a metre or two ahead of the workers (see photo above).

IndII and the DGH RSEU have been working together to encourage project managers and their traffic safety coordinators to adopt the zone concept and place all signs and cones well in advance (usually a few hundred metres) of the work area.

An absolute lack of signs at a work site in South Sulawesi. Notice that vehicles are driving on both sides of the road.

IndII and the RSEU have been encouraging contractors to ensure that all workers are provided with a high visibility reflective vest to be worn at all times while on-site.

IndII provided assistance to EINRIP by presenting two 2-day workshops on "Road Safety at Roadwork Sites" – one in Denpasar and one in Makassar. The key points were emphasised. Project managers and their traffic safety coordinators were urged to avoid "surprises" at their roadwork sites. It was evident from the site inspections undertaken during these workshops that there are far too many "surprises" at roadwork sites in Indonesia today.

Some positive changes have been noted already – the two workshops were very well received and feedback suggests that some contractors are now trying to do better. IndII is keen to see significant positive changes in the safety signage of Indonesian roadwork sites over the coming years, and will continue to work with DGH and the RSEU to achieve this.

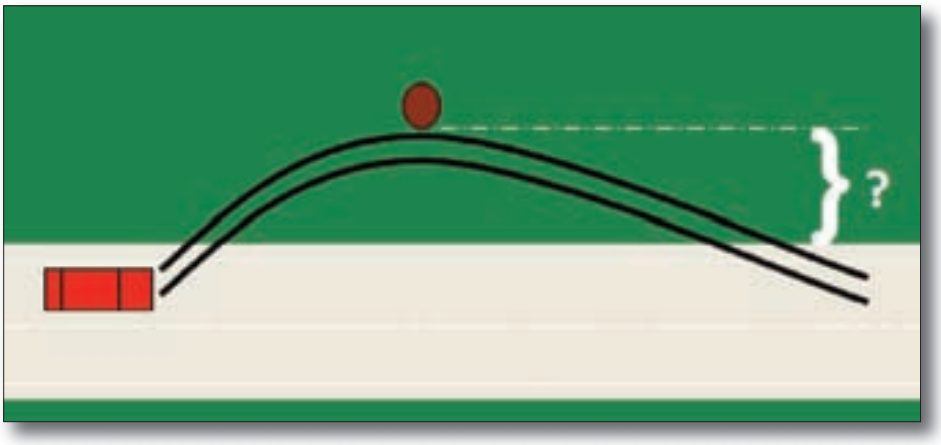
LESSON 6: Roadsides Should be Forgiving

Understanding that human error will always compromise road safety, engineers can design roads that will accommodate human failure without costing lives. Drivers/riders can make mistakes anywhere and anytime – and in some cases their vehicles leave the road. Along Indonesian roads there are many roadside hazards: uncovered drains, trees, poles, steep slopes, bridge piers and abutments, and sometime buildings. The RSEU has endeavoured to raise awareness of these hazards, and to introduce the "clear zone" concept.

An understanding of the "clear zone" concept helps the RSE to increase safety for road users.

A clear zone is an area alongside the road that should be free of roadside hazards (fixed objects with a diameter greater than 100 mm) to minimise the consequences of run-off-road crashes. The width of the clear zone depends on vehicle speed, traffic volume, the curvature of the road, and the slope of the embankment.

Clear Zone Concept



In this example (refer to photo on the left), the driver's probable exhilaration at finding a large stretch of open road is mediated by the roadside signage and continuous line markings, indicating the extent of the curve here. Even if the driver fails to take the curve at a reasonable speed, there are no off-road collision points, trees, drains or ditches that would increase the risk of a serious crash. The outside curve of the road has a sealed shoulder, making it less likely that the driver would lose control. The road design, information and delineation all help the driver to safely negotiate the curve. Consequently, if a driver's poor judgement causes the vehicle to leave this road, a serious crash is much less likely.

Motorcycles get pushed off the road by larger vehicles.

This dramatic drop off could be dangerous for motorcyclists.

Another serious and widespread safety concern on Indonesian roads is the lack of sealed shoulders. Most roads have unsealed shoulders, and many of these have deep drop offs from the road pavement – sometimes up to 200mm! Such drop offs create big risks for road users, particularly motorcyclists, who may suddenly have to leave the road in order to avoid other road hazards such as oncoming trucks or buses, or potholes.

These drop offs are one of the major risks facing motorcyclists in Indonesia today. The RSEU is encouraging the DGH to seal the shoulders along all highways – to eliminate drop offs and to improve road safety for all (especially motorcyclists). There are other maintenance bonuses as well – sealed shoulders help to preserve the road.

An example of a sealed shoulder – welcomed by motorcyclists and great to minimise the risk of vehicles running off the road. The sealed shoulder helps to maintain the road, and it eliminates dangerous drop offs.

Roadside hazards may also include so-called "safety devices" – such as concrete guide posts and solid street lighting columns. Although there are Indonesian standards for such devices, it is now understood that these devices are inherently unsafe and that there are safer options that can greatly reduce the consequences of serious injury when vehicles leave the road.

A plastic guide post – a low cost idea from the Fact Finding Mission to Melbourne in April 2010

The RSEU is encouraging engineers to install plastic guide posts and use frangible lighting columns that will give way when struck by cars, buses and trucks. The latter are quite expensive however, and it will take time for their use to become widespread.

Culverts (a drain under the road) and open drains also pose serious risks to drivers and riders. Culverts can be extended to a point outside the clear zone wherever possible. One improvement that has come from the work of the RSEU is an extended culvert under a road in Central Java. A culvert is a risk to any errant vehicle. Rather than shielding the culvert with a barrier, these culverts under the Pantura were extended. They now end outside the "clear zone".

A culvert that has been extended in Central java. The further a hazard is relocated from the road, the lower the overall risk of the road.

Other crash risks include shops and roadside stands that encroach on the shoulders of the road, attracting pedestrians. If these are located where traffic is high-speed, it increases the risk of crashes between vehicles and pedestrians emerging into the flow of traffic. Such vendors should be removed to make the road safer.

LESSON 7: Install Crash Barriers Only Where Necessary

Building roads that are forgiving reduces the need for crash barriers. Crash barriers should only be installed where it is necessary to reduce the consequences of a more serious crash. A crash barrier is itself a roadside hazard, and should only be installed at locations where a more serious crash outcome can be expected if the barrier is not installed.

A crash barrier constructed in such a way that it does not contribute to increased crash severity.

The end points (terminals) of crash barriers should be constructed so that they do not increase the chance of serious injury. Barriers should be installed at the correct height, and with adequate offset to the hazard (so that when the barrier deflects the vehicle is not "pocketed" into the hazard). Barriers at bridges should be strongly connected to the bridge abutment. The RSEU is assisting DGH engineers to think carefully about when to use, and equally when *not* to use, crash barriers. Installation details are vital.

Blackspot Investigations and Road Safety Audits

Accident blackspot investigation (a reactive process) relies on the crash record for a site, and aims to reduce the crash frequency and/or severity at that site.

A road safety audit (a proactive process) applies the same skills to the design stages of a new road project to prevent crashes.

BLACKSPOT INVESTIGATIONS

Police records and local knowledge will often help in the identification of blackspots.

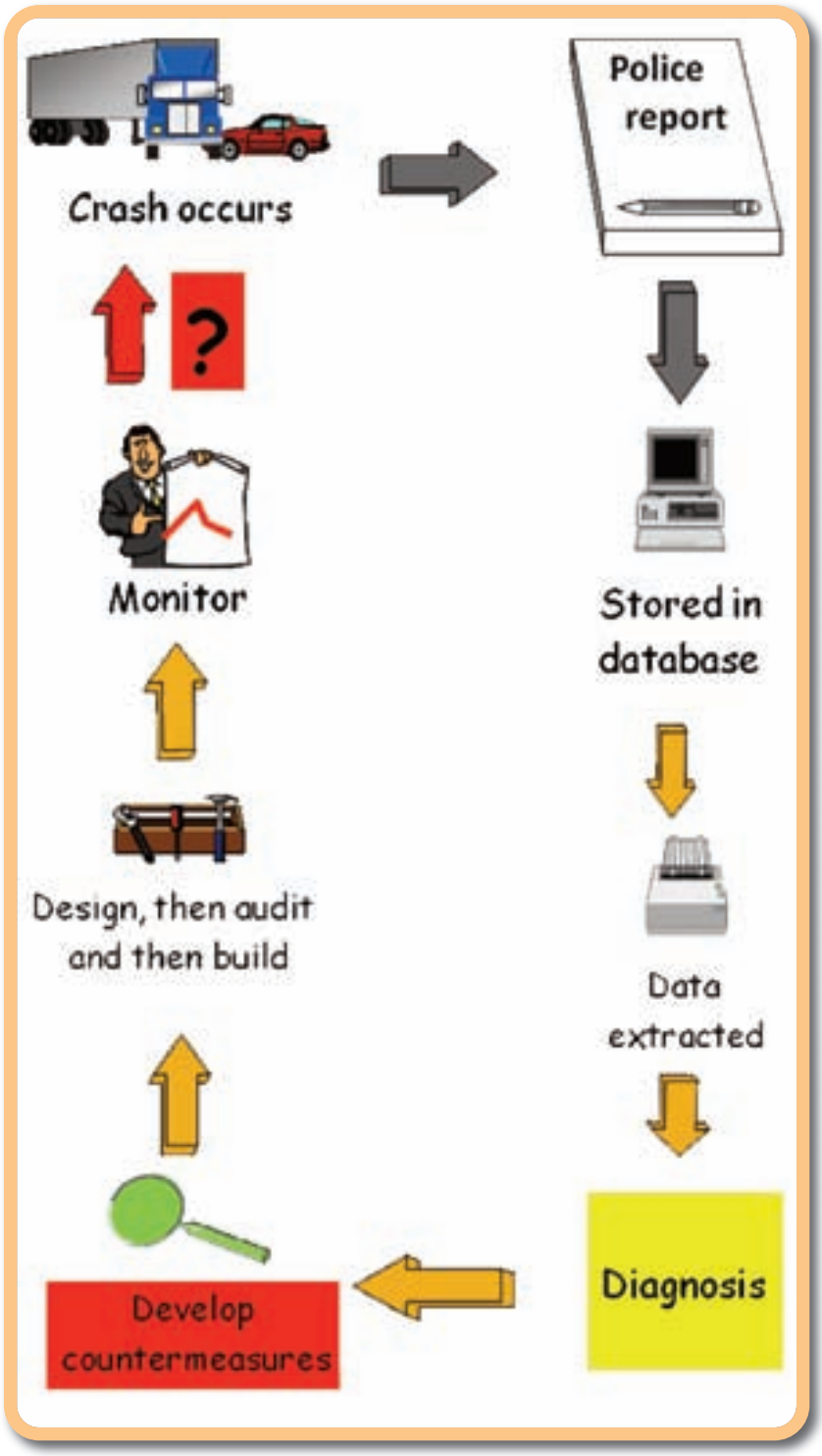
A blackspot is an area of road where crashes regularly happen. Different countries have different definitions: In Victoria, Australia, the definition of a blackspot is now three casualty crashes in five years. In 1980, when blackspot investigations began, the definition was a terrifying 12 casualty crashes in three years.

Different countries can set their own definitions for blackspots. A suggested definition for Indonesia over a three-year period is:

- 10 points for each fatal crash
- 5 points for each serious casualty crash
- 1 point for another crash

Sites within a province or region that notch up the highest number of points over a three-year period would be considered blackspots. That is the starting point to identify the most appropriate candidate sites. Accurate and complete police crash data is essential for blackspot investigations. While there are still difficulties in obtaining accurate police records of crashes at present, local police officers and local knowledge will often help in identifying blackspots in Indonesia.

There is a set order for carrying out a blackspot investigation, from when the crash happens through to when the countermeasures designed by RSEs are implemented (see flowchart).



The two most important steps in the blackspot investigation process are the diagnosis of the crash problem and the development of suitable countermeasures.

Diagnosis

If the information is available, RSEs will draw a collision diagram, clearly identifying each vehicle/pedestrian involved and accurately representing the point of collision.

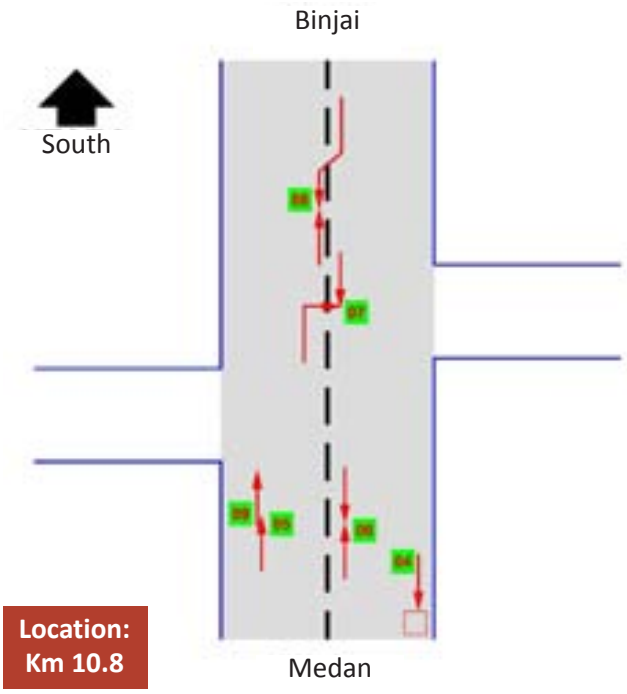
Repeating this exercise for each crash, a collision diagram can reveal a pattern of crashes.

A crash factor grid allows engineers to look for further patterns (time of day, wet/dry, day/night, etc.) that might assist them in selecting appropriate countermeasures.

RSEs are rather like doctors – their patients are 'sick locations' and the RSE attempts to diagnose the nature of the illness. Unlike humans, however, blackspots cannot speak –so the RSE has to search for other clues to help with the diagnosis. It is therefore important for the RSE to inspect the site.

Site Inspection

It is important to visit the site under the same conditions that were present when crashes occurred. If a crash happened at night, the inspection should be done at night whereas if it occurred during a rain storm, an umbrella will be needed. The engineer has to look at the road from the point of view of the road user, and try to determine why the crashes occurred.



Location: Km 10.8

East Crossroad Sumatera – Crash Details
Blackspot-1, Medan

Nr.	4	5	6	7	8	9
Location Km	10,7	10,8	10,8	10,8	10,81	10,81
Direction Vehicle-1	North	South	South	South	North	South
Day	Saturday	Tuesday	Thursday	Tuesday	Saturday	Sunday
Date	23-08-08	30-09-08	28-08-08	05-08-08	03-09-05	29-01-07
Hour	5:30	1:00	9:00	3:00	11:30	3:45
Weather Conditions (bright/dark)						
Deaths	-	-	-	-	-	1
Seriously Injured	1	1	1	1	1	1
Slightly Injured	-	-	-	-	-	1
Road Surface	?	?	?	?	?	?
Crash Type	Pedestrian	Back-crash	Head on crash	Turn right- crash	Head on crash	Back-crash
Traffic Condition	Light	Light	Medium	Light	Medium	Light
SEVERITY	SERIOUS	SERIOUS	SERIOUS	SERIOUS	SERIOUS	FATAL
Vehicle-1	Motorcycle	Motorcycle	Motorcycle	Angkot	Pedicab	Motorcycle
Vehicle-2	Pedestrian	Angkot	Truck	Trailer	Minibus	Pedicab
Police report on crash	Motorcycle hit pedestrian	Motorcycle hit small vehicle in the back	Motorcycle goes to the right way of the center line and hit by the truck	Angkot from the other way hit by a trailer when it turned.	Pedicab tried to cut the truck way, and hit by minibus	Pedicab hit by motorcycle in the back

Location: Km 10.8

Develop Countermeasures

Having determined what factors contribute to the blackspot, RSEs must then decide which countermeasures are most likely to reduce the frequency and/or severity of future crashes. For example, traffic signals will reduce right-angle collisions at an intersection, but may increase rear-end collisions. Street lighting will improve night-time conditions, but does little to prevent day-time crashes. While a crash barrier will not reduce crashes, it can reduce their severity. Each case calls for experience and judgement.

Like a doctor, who should not deal with a heart attack by treating the patient for a skin ailment (simply the wrong treatment!), an RSE must seek the right countermeasure for the problem presented.

Low-cost countermeasures are preferred, since they are more likely to be implemented. Since colleagues, the police and DGLT may all contribute to the success of blackspot countermeasures, they should all be consulted on the appropriate steps to counter the crash risks.

Design, Audit...

Once appropriate countermeasures have been decided, the RSE needs to get funding approval for the necessary works. To obtain the funds, the RSE has to provide justification for the works. This justification should be arrived at by comparing the cost of the countermeasures with the benefits to be gained by implementing the changes.

A report calculating the cost-benefit ratio is submitted to the funding agency, and if everything is in order, it will be agreed that the countermeasures should be installed.

...And Build

Depending on the type of countermeasures identified, the team responsible for implementing them may or may not be the DGH. In any case, the RSE is responsible for making sure that the work done conforms to the final design.

Monitor

Once the countermeasures are in place, the site should be monitored to ensure that the countermeasures are appropriate and sufficient to reduce or eliminate further crashes.

How to Conduct a Blackspot Investigation: The Jambi Example

Jambi Blackspot

The Jambi ring road is part of a busy National Highway around Jambi. It is a two-lane, two-way road with a number of horizontal curves and several small hills. The ring road is in a semi-rural area but many businesses and houses are being built along it. It is a route heavily used by trucks and it is in poor overall condition.

Free travel speeds are generally about 50km/hour when traffic conditions permit. Since the speed limit is not well signed, road users may not know what it is. There are numerous potholes along the road, and many locations with large drop-offs from the road pavement to the shoulder. Many of the trucks that use this road appear to be heavily overloaded and therefore travel at very low speeds as they negotiate the rough road sections.

The sharp bend at Station 2.850 is a reported blackspot. For traffic travelling away from Jambi, it is a sharp right-handed curve with an estimated radius of 40-50 metres. Starting at the bend, the road descends away from Jambi at a gradient estimated to be 5–6 percent. There is a sign to warn of the slope, but there is no warning of the bend and no delineation other than one old guidepost.

There is very high super-elevation on this bend – calculated to be in excess of 12 percent (the standard super-elevation for curves of this radius is 6–7 percent). The location of the bend is very poorly maintained. There are large logs on the inside of the curve that have fallen from trucks and been abandoned. There is also sand and gravel around the inside of the bend. In wet weather, the inside of the bend becomes very muddy and soft, suggesting inadequate drainage. There is no delineation of the curve, and no lighting. The pavement is narrow – barely 7m wide around the curve. On the southern approach, heading towards Jambi, there are a number of rough patches on the pavement that drivers may move to the right to avoid. There is a large drop-off, more than 100mm high, from the pavement to the outside shoulder around this bend.

The Crash Problem

There have been an unknown number of crashes at this bend. Based on local knowledge and police information, it appears that these crashes are a combination of:

- Truck roll-over crashes
- Head-on crashes between trucks/buses with vehicles approaching from the other direction
- A lesser problem involving run-off-road crashes

Although there are no details of these crashes, locals in the area report that there may be up to four or five crashes each year at this bend. Since head-on crashes are typically serious, one or more fatalities are possible annually.

Crash Analysis

Truck roll-over crashes

Trucks travelling towards Jambi travel slowly around this bend as they are climbing a 5–6 percent grade. They are often overloaded, so drivers try to negotiate the largest radius they can while also trying to navigate the smoothest path between potholes and away from logs and debris. Drivers are aware that the super elevation is extreme. They tread an uneasy line between staying in their correct lane (and possibly damaging the truck), and travelling too slowly and toppling over on the extreme super-elevation.

Head-on crashes

Because truck and bus drivers try to negotiate this bend carefully, they often pull to the wrong side of the road to maximise their radius and find the smoothest path. In particular, trucks and buses headed towards Jambi often pull to the wrong side of the road. This can surprise oncoming drivers and riders. With the vegetation on the inside of the curve tending to restrict sight lines, the chance of head-on collisions is high when trucks and buses swing out wide.

Run-off-road crashes

Traffic speeds of vehicles travelling away from Jambi can be quite high. The bend is at the end of a long straight, and the ring road has a downhill grade at this location. Trucks, buses, cars and motorcycles may therefore approach this bend at unsafe speeds. There is a small side road that runs off the ring road at a tangent which some drivers may think is a continuation of the ring road. At night, with no delineation or lighting, some drivers and riders may not see the bend, and may lose control on the rough unsealed shoulder, leading to run-off-road crashes.

Recommended Countermeasures

By employing a crash analysis, the team members were able to produce a list of low-cost countermeasures aimed at reducing the risks of crashes on the road:

- Clear away logs and debris on the inside of the bend.
- Open sight lines on the inside of the bend by cutting back the vegetation.
- Improve drainage on the inside of the bend by clearing existing drains or making a new one as necessary.
- Install a series of CAMs around the outside of the bend – for drivers/riders from both directions. Place four CAMs in each direction on the outside edge of the shoulder.
- Install one new street light at the bend.
- Place curve warning signs 50m in advance of the tangent point on each approach to this bend.
- Build up the unsealed shoulder around the outside of the bend by compacting suitable earth/rock and shaping it to suit the local topography.
- Install a solid centre line through the bend, and for at least 50m on each approach, to define the centre of the road and prohibit overtaking.
- Post speed limit signs along the ring road (possibly 60km/hour, but to be agreed with the traffic police). Ensure that drivers/riders are given a clear message about the maximum permissible speed.
- Re-design and re-construct the bend to provide for correct super-elevation coupled with wide sealed shoulders (at least 1.5m) on both sides.
- When the bend is reconstructed, ensure that edge lines and a centre line are installed to guide drivers.

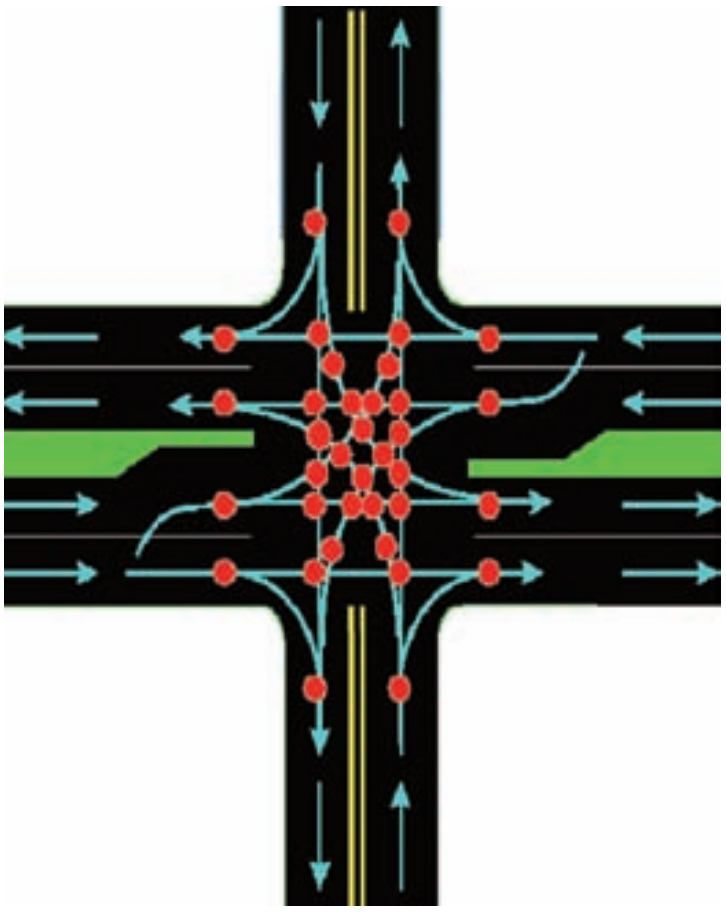
The Jambi blackspot was treated with these countermeasures after the investigation. It will be monitored to ensure that the measures taken are successful in reducing crashes.

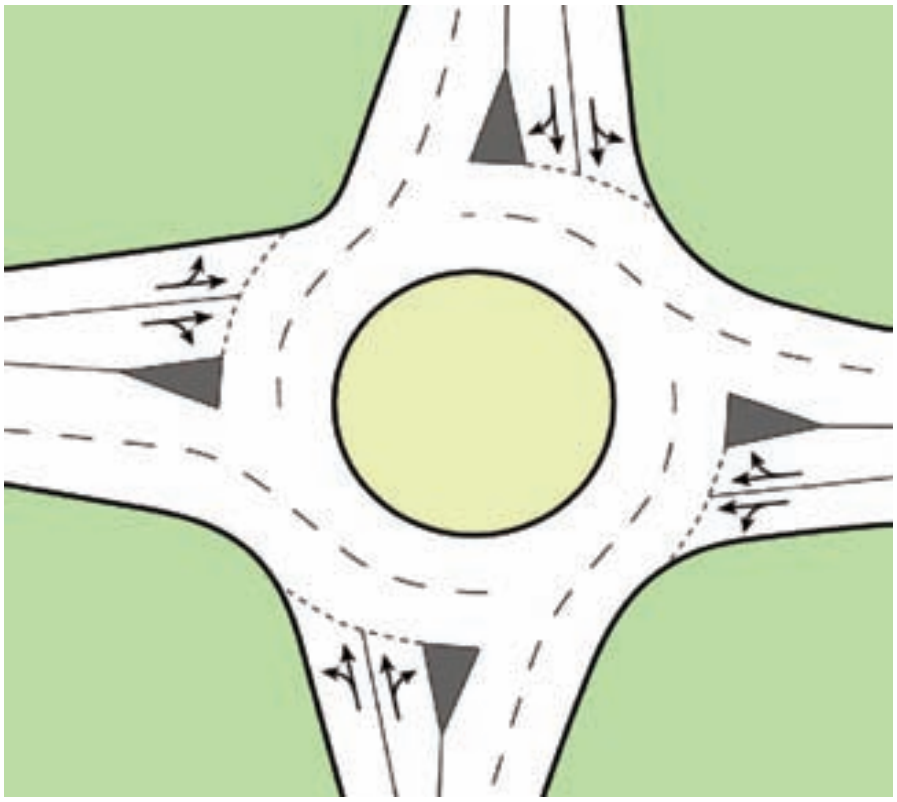
INTERSECTIONS

The fewer points of conflict, the fewer crashes.

Intersections are locations of higher risk for all users and deserve special consideration. Forty-three percent of urban casualty crashes and 11 percent of rural casualty crashes occur at intersections. At a crossroads junction, for example, there are 36 possible points of conflict (indicated by red dots in the diagram).

Crashes at intersections are often severe due to lack of side impact protection and high relative impact speeds. The more conflict points there are, the higher the risk of a collision. Fortunately, there are a number of countermeasures available. The introduction of a roundabout, for example, reduces the possible points of conflict to just four. On roundabouts, particularly those with splitter islands, the risks to pedestrians are also reduced, since vehicles slow down when approaching a roundabout, and the islands provide a refuge for road crossers.





Source: Australian Line Marking For Roundabouts

Where crashes have been a problem at intersections, it is important to differentiate between overshoot and re-start crashes because the solution to each problem is very different.

If a driver involved in a crash *did not* notice the intersection, then the problem is overshoot. If the driver *did* notice the intersection and stopped, but then picked the wrong time to move into the road, this is a restart problem.
To reduce the likelihood of overshoot, the intersection should be made more conspicuous. This can be done by duplicating regulatory signs, marking centre lines so the intersection is more obvious, and providing advance warning signs and direction signs so that the driver/rider can anticipate the intersection in time.

Lighting may also be necessary, and other road layouts such as staggered T-junctions or roundabouts might be considered.

To reduce the likelihood of a restart problem, the intersection needs to be opened up. Sight lines (to left and right) can be improved by cutting vegetation, trimming trees, removing encroaching development, and banning parking. Sometimes bus stops need to be relocated. Roundabouts and traffic signals – while more expensive – can reduce restart problems.

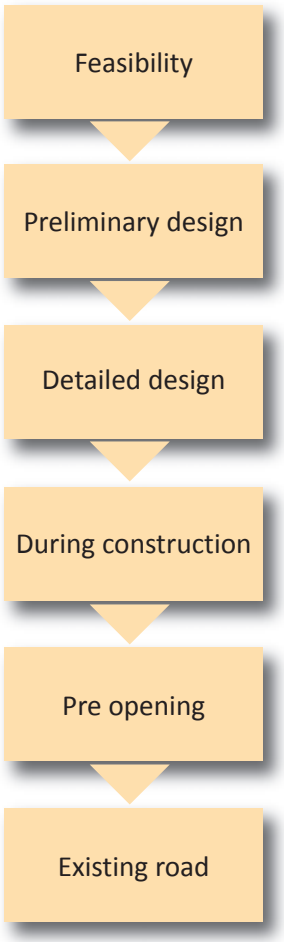
ROAD SAFETY AUDITS

A road safety audit is "a formal examination of a road/traffic project in which an independent, qualified team reports on the project's crash potential."

(AUSTROADS 2009)

Unlike a blackspot investigation, which is a *reactive* process in response to existing crash problems, an audit is a *proactive* process aiming to identify and eliminate potential safety issues before they occur. The main objective of the audit is to ensure a high level of safety for all new or existing road schemes. A road safety audit (RSA) ensures that safety is given thorough consideration in each phase of a road project. Road crashes have a very wide range of contributing factors, and therefore an audit cannot guarantee that every potential safety concern has been identified. However, careful consideration and adoption of RSA recommendations will reduce the risk to road users.

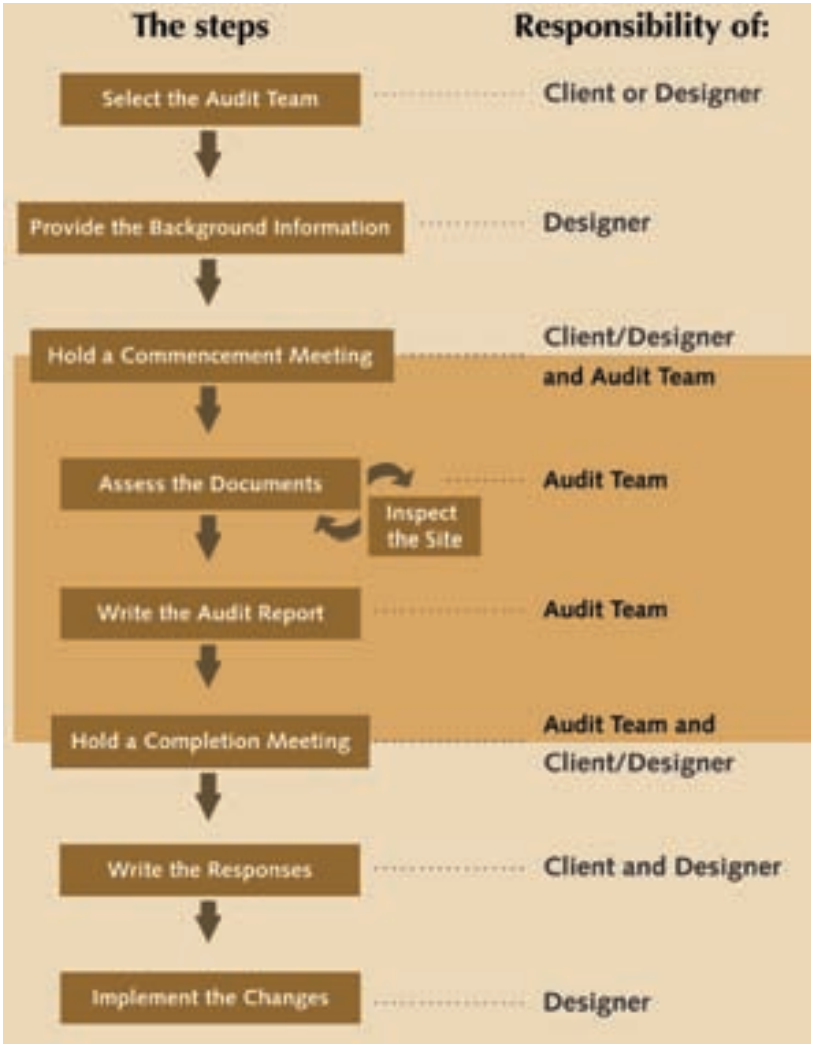
An RSA can take place during any or all stages of road design and construction, i.e.:



For large road projects, an audit should take place during each stage of the process.

An RSA on an existing road should not be confused with a blackspot investigation. An audit investigates potential problems, whereas a blackspot investigation looks to improve road safety after problems have arisen.

Whatever the stage of design or construction, the audit report follows a similar pattern of steps from commencement to completion.



Source: AUSTROADS Road Safety Audit Guide, 2002

At each stage, there are recognised risk ratings for RSAs to assess safety deficiencies in planning and construction (see box):

- VERY HIGH RISK – major safety issues with a high probability that traffic crashes will occur and/or that those crashes will result in multiple deaths.
- HIGH RISK – major safety issues with a high probability that traffic crashes will occur and/or that those crashes will result in serious injury or death.
- MEDIUM RISK – safety issues with a lesser risk that crashes will occur and/or that those crashes will result in less serious/minor injuries only.
- LOW RISK – safety issues that can be reasonably expected to result in few crashes and/or crashes that result in minor injuries only.
- VERY LOW RISK – safety issues that can be reasonably expected to result in few crashes and/or crashes that will only result in property damage.

The auditors then describe in detail the measures that can reduce the risks. High risk issues clearly demand the most immediate attention, but they do not necessarily require high cost solutions. Where road plans are at an early stage of design, it is often possible to remove risks before they actually exist, whereas compensatory features must be added to existing roads where the problem is "built in". Audits are effective in reducing risks at any stage of design construction, but will be more cost effective the earlier they are implemented. Wherever audits are employed in the development of a road, however, they represent a tiny proportion of the overall costs.

Pre opening stage RSA of highway improvements on Sumatera National Highway - Jambi

An example of a real-life audit is the one conducted by RSEU workshop participants in Jambi. The project involved the improvement and rehabilitation of approximately 19km of National Highway through hilly terrain north of Jambi, Sumatera. The work included widening the pavement and shoulders, drainage works, line marking and improved delineation, and some pavement rehabilitation and strengthening.

This highway has a history of traffic congestion and road crashes, but it would be too costly to construct a new highway that is both wider and straighter. It was therefore decided to widen and strengthen the existing alignment.

Most of the improvements had been completed by the time of the audit inspection. The section of highway that was audited is a two-lane, two-way road. In some places it has large drains on each side. It has two 3.5m wide traffic lanes and unsealed 1.5m wide shoulders. The highway has many horizontal and vertical curves, with a safe driving speed estimated at just 40km/hour (although actual driving speeds are usually higher).

Safety Concerns:

A number of road safety concerns were observed along the newly improved highway. In addition a number of safety issues were associated with the ongoing roadworks.

The safety deficiencies identified were given a risk rating by the audit team in accordance with the established ratings (see table).

SAFETY CONCERN	RISK	RECOMMENDATION
1. SAFETY CONCERNS IDENTIFIED IN THE PRE-OPENING AUDIT		
The clear zone for a road with expected high volumes and expected speeds of (approximately) 75km/h (estimated) should be 6m (according to VicRoads clear zone graph). Although the clear zone concept is new in Indonesia, this 6m figure represents an internationally recognised width that should be kept clear of roadside hazards on both sides of the highway.	**VERY HIGH**	• Note that good international practice requires a clear zone of at least 6m for the highway. • Attempt to place all roadside hazards outside these distances. • Cover the drains with suitable driveable cover. • Alternatively, use a correctly installed crash barrier (guardrail) to shield any roadside hazards.
The highway continues to follow the same alignment that it did before this work was undertaken. This means that the same horizontal and vertical limitations remain. There are locations where faster traffic would benefit from an overtaking lane for slow moving trucks and buses.	**HIGH**	• Note that an opportunity to reduce the risk of overtaking crashes has been missed. • Programme the construction of overtaking lanes for a future works programme. • Improve sight lines in a future works programme.
The shoulders have been improved but are not sealed. A national highway carrying this volume and mixture of traffic should have sealed shoulders – at least 1.5m wide – for safety. The absence of sealed shoulders is particularly a safety problem for motorcyclists – they can be cut off and may face overtaking vehicles approaching them – and they have no reliable escape path. This shortcoming should be addressed promptly.	**HIGH**	Seal the highway shoulders (at least 1.5m wide) promptly.
The line marking was not complete at the time of the inspection. Because of the curvilinear nature of the highway (many H and V curves) it is essential for safety to delineate the curves strongly in order to minimise the risk of run-off-road crashes. Edge lines are needed consistently along the entire length of the highway.	**HIGH**	Install edge lines along both sides of the highway.

SAFETY CONCERN	RISK	RECOMMENDATION
There were no CAMs installed on any of the curves at the time of the inspection. It is not known if installation of such CAMs is planned. However, because of the H and V alignment of this highway, CAMs are essential on the curves to delineate the path – especially at night.	HIGH	Install series of CAMs around those curves where the radius is 200m or less.

The delineation on this section of highway is very good. However, the highway improvements did not seal the shoulders. The shoulders will erode in time and will not provide the necessary safe space for drivers to use for evasive action.

The highway has many curves. The guideposts provide good delineation but on selected sharp curves there is a need for CAMs as well.

The guideposts used on this project are roadside hazards. They present a risk of injury to any motorcyclist who hits them.	MED	Replace all the concrete guideposts with plastic guideposts. Ensure that reflective strips are placed on each post.
There are no speed restriction signs along the highway. This leads to an unsafe situation in that drivers/riders do not know what the legal maximum speed is. Some downhill speeds are too high for the geometric conditions.	LOW	Install speed restriction signs (in pairs) at locations every 2km along the road (for the whole length of the highway).

SAFETY CONCERN	RECOMMENDATION
	
The highway has edge lines in some sections but not in others. There is a need for continuous delineation. This pair of reverse curves was at the north end of the highway improvement. The combination of horizontal and vertical curves is not good – the horizontal curve cannot be seen until the crest, and some drivers may run off the road to the left before recognising the correct path. There is a need for strong delineation here. The guideposts are a start but CAMs are necessary.	These guideposts have not yet been painted. This should be done soon. The posts are made of reinforced concrete and are roadside hazards – especially for motorcyclists. There are cheaper and safer plastic options available. These should be used.
	
This side slope is undriveable and is within the clear zone. Located on this reverse curve, there is a high risk that a vehicle could leave the highway and drop over this slope. Delineation (edge lines and guide posts) will help to reduce this risk, but a crash barrier is needed.	This drain is one of many along the highway that are roadside hazards. If a vehicle leaves the road and drives into these drains the occupants of the vehicle will suffer serious injuries. There is a need to create more forgiving roadsides along national highways in Indonesia.

NO.	SAFETY CONCERN	RISK	RECOMMENDATION
2. SAFETY CONCERNS ASSOCIATED WITH THE ROADWORKS			
	There is inadequate signage or delineation of the roadworks. There are few warning or information signs. They are not reflective and do not delineate the route through or past the roadworks adequately. The speed limit past the roadworks is unknown – it should be clearly signed at 40km/h to emphasis to drivers/riders the need to travel slowly in these areas.	**MED**	• Use reflective signs placed 500m and also 100m in advance of each worksite to inform drivers/riders of the works. • Use 40km/h speed restriction signs to control traffic speeds. • Use plastic cones (witch's hats with reflective strips) to delineate the roadworks zone.
	Workers were not wearing reflective high visibility vests. For their own safety, especially when working close to moving traffic, they should be required to wear these vests.	**MED**	• Provide reflective high visibility vests for all workers on site. • Require them to wear these when working.
	There are few signs used to warn drivers/riders of the roadworks. Those signs that were used did not provide adequate information to fully assist drivers. These are common deficiencies at roadwork sites in Indonesia and they need to be addressed for the safety of the road workers and the road users.	**MED**	• Use reflective signs placed 500m and also 100m in advance of each worksite to inform drivers/riders of the works. • Use 40km/h speed restriction signs to control traffic speeds.

This work site appeared to be repairing a slip area. The highway was reduced to one lane at this point, but the advance warning sign was quite basic. It warned of a rock slide, but it did not inform drivers that one lane of the highway was closed, and that Jambi bound traffic must use the other lane (with a risk of on-coming vehicles).

This team of road workers was working further along the highway. They were close to the road, but there were no advance warning signs to alert approaching drivers to their presence. None of them were wearing reflective safety vests.

The signs were not reflective and would not be seen at night. There is a high risk that a vehicle could run into the slip area after dark – especially when traffic volumes decrease and speeds increase.

One of the workers asked why the engineers were wearing safety vests but the workers were not. It was a fair question. He was given a safety vest and he put it on. All workers on roads should be required to wear safety vests.

PEDESTRIANS

While we commonly think of drivers and riders as the main users of roads in Indonesia, the largest group on the roads is actually pedestrians. Given that 65 percent of global fatalities are pedestrians, RSEs are duty bound to consider pedestrian safety on their roads.

While every pedestrian is at risk trying to navigate traffic, there are several groups that need special consideration: the elderly, the young, the intoxicated, and the disabled.

Elderly - 45%
of fatalities
are over 60 years of age

Intoxicated - 25%
of fatalities are above 0.15%
Blood Alcohol Concentration (BAC)

Young - 20%
of fatalities
are aged 4-12 years

Disabled - data not available

Australian pedestrian statistics. The situation in Indonesia is not accurately known

The Elderly

Elderly pedestrians may require street lighting. Some may not be able to see traffic in poor lighting conditions. Footpaths should be smooth but not slippery, and potholes should be filled in. Refuges in the middle of the road should be accessible to people who are slow moving or have difficulty stepping up onto a kerb.

Where there are signalled crossings, the length of the walk time should be appropriate for elderly people. RSEs must repeatedly look at their planning from the point of view of the people who will be using the road.

Tne Intoxicated

Most people who drink alcohol or take drugs do so more commonly in the evening. Their subsequent lack of inhibition and coordination can be compounded by poor lighting. Where there are bars, fencing might help to separate the inebriated from the road. An intoxicated motorist poses an even greater risk to pedestrians.

The Young

Children are easily distracted and often have little sense of danger. They can surprise motorists by suddenly appearing on the road. RSEs need to accommodate the safety needs of children by considering such things as parked vehicles. A child crossing a road from behind a parked car will not be seen until very close up. Near schools, features such as trees and buildings can reduce visibility between young pedestrians and motorists.

Fences and school gates need to be located safely. Children piling out of school at dismissal time can create dangerous conditions if the gates lead directly onto the road. Footpaths should be clear and continuous so that children can use them safely. In addition, traffic should be slowed in areas surrounding a school.

The Disabled

RSEs need to consider how a blind or deaf person would know where to cross a road. They also have to consider whether a person with mobility problems would be able to navigate existing crossings. For example, would a person in a wheelchair be able to cross a road with a raised median? RSEs must put themselves in the position of a pedestrian whose safety is in their hands. Assessing the risks for pedestrians as well as other road users allows the RSE to develop strategies to mitigate these risks.

School gates should not open onto highways. The walk to/from school for many Indonesian children has many dangers. The RSEU is working to help engineers to develop greater safety for young pedestrians.

There are three main pedestrian strategies.

Segregation
Freeways, malls

Separation
In time or in space

Integration
Where vehicles and pedestrians share the road

Segregation

Keeping vehicles on freeways and people in malls is perhaps the ideal solution to ensure pedestrian safety.

Separation

Where segregation is not possible, pedestrians can be separated in space and time from other road users. Road crossings with traffic lights allow vehicles and pedestrians to safely use the same space by separating the times that each uses the road. Obviously, timings have to suit the needs of both sets of users, and crossings must be clearly visible to all. Crossings also need to consider the speed of the vehicles using the road. If vehicle speed is too high, traffic calming measures will be needed to reduce speed. This works quite well in urban areas, but in rural areas, where traffic speeds are high and crossings might not be enforced, zebra crossings may be dangerous for pedestrians. Where no safe crossing can be constructed at road level, "grade separation" can be used to prevent pedestrians coming into contact with vehicles. This technique requires the use of overpasses or underpasses.

Here the pedestrian is separated from vehicular traffic by time.

Separation can also be achieved by creating a safe space (a refuge) in the middle of the road for pedestrians. By walking along the road, RSEs can put themselves in the shoes of the people who walk the road. Some questions to be considered are whether continuous, well maintained footpaths are provided, and whether there are squeeze points where pedestrians might be forced into the traffic. If there are no footpaths, perhaps the shoulders could be sealed to provide one.

Integration

Integration is when pedestrians and traffic share the same space. In these conditions it is vital to control vehicle speeds so that injuries are light if or when a collision occurs.

Road safety engineers
given the training and technical support to carry out their responsibilities will come to recognise their role in protecting the lives of their fellow travellers

6 Achievements and Future Activities

ACHIEVEMENTS

THE route to safer roads is a long journey with many challenges, but progress is already measurable. The list below is a short summary of some of the more notable recorded successes of the new RSEU in its first two years.

Blackspots

In 2009, some 27 blackspots were investigated, reports prepared and presentations given. These included curves on rural highways, cross roads in urban areas, several Y-junctions, a pedestrian blacklength, and several locations where divided sections of highway reverted to undivided road.

In 2010, this work continued, with investigations of blackspots in a number of parts of Indonesia including:

- **Duri, Riau on 1-2 March**
- **Jambi on 3-5 March**
- **Menteng, Jakarta on 19 May**
  This location was the site of a tragic crash in January 2010 when a car with five young people inside lost control at speed and struck a fence. Four died. Through co-operative efforts between the RSEU, Traffic Police and Provincial DKI, a package of low-cost signage improvements were installed as a priority. A key presentation about the safety deficiencies of this site to Traffic Police (POLDA Metro Jaya) and DGLT officials in Jakarta helped to establish this successful partnership.
- **Bangka Island, Bangka Belitung on 1-3 June**
- **Lombok, West Nusa Tenggara on 28-30 July**
- **East Java on 2 September**

One blackspot in Jambi has already been treated with low-cost improvements. Following RSEU workshops, the local authorities in Bandung and Palembang have agreed to commit funds to eliminate four blackspots in their areas.

Road Safety Audits

Three major RSAs have been carried out at the request of the Project Managers in Tanjung Priok (Jakarta), Nagreg (West Java) and Rembang (Central Java). This indicates that forward-thinking project managers are keen to use the RSEU skills and knowledge on their projects. The injection of road safety engineering knowledge is valuable and long overdue in Indonesia.

- **Tanjung Priok Toll Road, Jakarta, July and August 2010:**
  At the request of the Project Manager, the RSEU undertook two RSAs of this major new expressway. Two audit reports (roadwork and pre-opening) were prepared and presented to the Project Team at its Tanjung Priok Office.

- **Nagreg, West Java, February and September 2010:**
  At the request of the Project Manager, a RSA of the cut/cover tunnel was undertaken, followed by a presentation to the design consultant and the DGH Design Sub-Directorate. Immediately prior to Idul Fitri 2010, again at the request of the Project Manager, road safety engineering comments on the Temporary One-Way Bypass in Nagreg were reported to the Project Manager and his Director.

- **Rembang, Central Java, October 2009**
  To assist the Balai in the upgrading of the Pantura over a 30km length north of Rembang, the RSEU inspected the site and reported on a number of safety concerns. As a result of that report, plastic guide posts have since been installed here to improve delineation, and culverts have been extended to reduce the number of roadside hazards. Other improvements are pending.

Melbourne Fact Finding Mission

A Fact Finding Mission (FFM) to VicRoads, Melbourne, Australia was funded by IndII and conducted on 8-17 April 2010. The Indonesian delegation consisted of 24 people from the Ministry of Public Works, the Ministry of Transportation, the Indonesian Traffic Police, the National Development Planning Agency (Bappenas), and the University of Indonesia. A network of FFM members has since developed of its own volition, and meets regularly at Bappenas to advance ideas for future road safety initiatives. One of the expected benefits emanating from this group is the commencement of a number of demonstration projects at which road safety engineering can be showcased.

Central Java on 3 September 2010:
It was great to note that one of the engineers on the FFM to Melbourne cut PVC pipes in half to make plastic guideposts. Adding a strip of reflective material to each one, he created a low-cost and excellent series of guideposts to assist road users. These plastic posts do not present a roadside hazard, unlike the older concrete posts.

More "Road Safety at Roadworks" Workshops

The RSEU presented these workshops for IndII and EINRIP. The unit prepared a Roadwork Safety Field Guide that was distributed to all attendees. Of special note was the development of a 'game' – a scaled drawing of several parts of the case study road, which was prepared by Victor Taufik. He also prepared hundreds of scaled down signs and cones. Attendees were asked to develop traffic management plans for each situation. It was wonderful to see grown men and women on the floor of the workshop venue, debating vigorously about the correct location for a cone, or the correct sign to be used. This "game" had a strong impact on attendees, and will continue to be used in future planned workshops.

Updating Technical Manuals

Discussions have commenced for revising and updating standards and manuals and, importantly, the DGH has committed to resource the new road safety engineering team.

FUTURE ACTIVITIES

INDII is convinced that continued engagement with DGH will improve the quality of road safety engineering in Indonesia. After this book is published, IndII will continue capacity building efforts in the form of workshops, skill-sharing and training to build up technical skills within government departments (both centrally and at the local level) and within the local consultant sector.

Regular funds will be committed to making road safety improvements as movement towards the adoption of a national blackspot program gains momentum.

IndII's road safety work to date has identified weaknesses in technical manuals, which contain outdated practices in view of current safety perspectives. These manuals will be updated to reflect a contemporary focus on safety.

Having encouraged cross-agency cooperation by engaging trainees from the National Police and DGLT at the local level, IndII will continue to encourage and foster closer cooperation with these agencies, with the aim of developing a coordinated approach to road safety at all levels.

By initiating training and supporting the development of low cost road traffic engineering in Indonesia, IndII is confident that over time the economic benefits will become apparent. Furthermore, RSEs who have received the training and technical support to carry out their responsibilities, will come to recognise their role in protecting the lives of their fellow travellers.

Afterword

INDONESIA is experiencing a road safety crisis that ranks amongst the worst in the world. Hospital records show over 40,000 people die on Indonesian roads each year. If nothing is done, road fatalities in Indonesia are predicted to soon exceed 50,000 a year. Against this backdrop, IndII has begun working closely with Indonesian engineers to improve road safety. With its focus on infrastructure, IndII started by directing its efforts towards engineering safer roads. It has funded consultants to assist the national highway authority (DGH) with the establishment of a road safety engineering team, and to raise the skill level of local engineers in road safety engineering. Based in the DGH Head Office, the RSEU has spent nearly two years working with and training DGH engineers (plus Traffic Police and DGLT officers) in road safety engineering. This is the first step towards the establishment of a sustainable road safety engineering team in the DGH.

With IndII support, DGH held seven major training workshops in various cities based along the eastern Sumatera Corridor and the Northern Java Corridor (the two busiest and most notoriously dangerous highways in Indonesia). More recently, two major workshops focussing on road safety during roadworks were held in Makassar and Denpassar. Among the first of their kind, they were well received by those attending. There are now plans to replicate these workshops nationwide.

Two new road safety engineering activities have recently commenced at DGH. The first is a program of road safety audits and crash investigations that aims to assist DGH to conduct blackspot investigations. With technical support from Australian consultants VicRoads International, this activity aims to strengthen the capacity of the RSEU within DGH, and builds on the project activities described in this book.

The second is the preparation of a series of road safety engineering manuals and matching DVDs by Road Safety International. Intended to raise the knowledge and awareness of DGH engineers on topics including roadside hazard management, safety at roadwork sites, signs and line marking, blackspot investigations, and road safety audits, these manuals and DVDs are expected to become benchmark road safety documents for Indonesia.

Australia has been able to reduce its road fatality rates to among the best in the world. Our experience can be used to help countries such as Indonesia "jump ahead" more quickly. We can assist Indonesian experts to save lives.

Road safety is a long-term investment in a country – the greatest results will come from coordination, communication and cooperation between government agencies. Indonesian champions have to be found, nurtured, encouraged and assisted. IndII knows that international consultants can assist, lead, train, encourage and enthuse – but eventually the solution lies with local efforts and local champions.

IndII is pleased to assist Indonesia in its road safety efforts. Additional inputs will be made in the coming year in engineering the national highways for safety. Assistance will continue jointly with DGH to pass on the necessary skills and knowledge to be able to cost-effectively manage this global health issue.

A start has been made. Much more work lies ahead. I believe that Indonesians are now "on the journey to safer roads."

Phillip Jordan

IndII Road Safety Engineering Consultant
Jakarta, November 2010

Feedback

DGH feedback on road safety initiatives undertaken by the RSEU

"THE RSE training has increased our knowledge and provided us with a wide range of options for impro - ving road safety. I think officials related to road safety, along with stakeholder agencies should take the training too...the workshop was great!

Through the workshops we are now more aware of what road safety is. We used to think only about the technical aspects, but as a matter of fact, there are lots of low cost solutions which can increase road safety while at the same time reducing crash risk factors.

One of our first steps was to increase awareness among stakeholders on road safety. A small example is that we now pay close attention to the issuing of permits for advertising boards on the streets".

Ir. Erika Pangaribuan, MM
Head of Section Road Supervision, Road Regional Office I, Medan

"RAISING awareness and focusing the relevant bodies' attention on road safety has been a very important aspect of the project. Road safety is not a new concept in Indonesia but people only paid attention when things went wrong.

IndII has coordinated road safety activity with the three main bodies concerned – Ministry of Public Works, DGH and the police. We can build on this to include other agents like consultants and contractors. Ideally, the project will continue to build momentum so that road safety activities and training become established commitments within local and national planning institutions.

Along with continuing to develop activities and training in other areas of Indonesia, comparative studies of other countries in the region that face the same challenges might add to our ability to solve local problems".

Ir. Syarkowi Mansyur, M.Sc
Head of Design and Supervision Division, Road Regional Office (Balai) III, Palembang

"STAKEHOLDERS such as the police, DGH and transportation agencies, both at national and regional levels, should strengthen their institutions' commitment to and understanding of road safety. At the moment there continues to be a lack of human resources in terms of road safety auditors and related roles. I think we still need technical support from international and national experts in order to develop and expand our RSE programmes.

Although the programme is in its early stages we have already gained positive results from the training. For example, we have realised just how dangerous concrete barriers are for motorcyclists and drivers. So, we have to standardise these aspects of road safety across the board. Having participated in investigations in several Provinces with the balai, I think that this 'learning by doing' method of training is very effective".

Ir. Nurmala Simanjuntak, MEng.Sc
Head of Section West Region Sub-Directorate Environmental Engineering, Directorate of Technical Affairs, DGH

Glossary

Angkot: A van or minibus, which is used as one of the transportation vehicles in a city or trans city in Indonesia.

BAC: The acronym for blood alcohol content, a measure of intoxication.

Blacklength: A length of road with a high number of casualty crashes per kilometre.

Blackspot: An area of road with a high number of crashes.

Blackspot investigation: An investigation that looks to improve road safety after problems have arisen. It looks at what went wrong, why it went wrong, and suggests ways to reduce the risk of it going wrong in the future.

CAM: The acronym for chevron alignment marker. CAMs are used in a sequence to indicate the extent of a bend in the road.

Clear zone: The area beyond the road that should be kept free from obstacles and dangerous slopes. The width of the clear zone required is calculated from vehicle volume, vehicle speed, radius of curvature and side slope.

Countermeasures: Steps that are implemented to lower crash risks.

Crash barrier: A barrier that is strategically placed beside the road to prevent vehicles that leave the road from striking a more hazardous object.

Crash cost: The total cost of a crash, consisting of many components such as medical cost, lost wages, and property damage.

DGH: Directorate General of Highways.

DGLT: Directorate General of Land Transport.

EINRIP: The Eastern Indonesia National Roads Improvement Project. This is an AusAID funded initiative with the Government of Indonesia.

Fatal injury: An injury from a road crash that results in death either immediately or within 30 days of the crash.

Forgiving roadside: Roadside that ensures that injuries to anyone unfortunate enough to run off the road are minimised.

Frangible light poles: Light poles that are constructed to 'give' when they are struck by vehicles, softening the impact and reducing human injury.

Give way signs: Traffic signs that indicate that a driver must prepare to slow down and give way to let a driver on another approach proceed.

Guardrail: The common name of the steel W-beam barrier.

Head-on crash: A collision in which the front ends of two vehicles hit each other.

Line markings: Lines on a road surface to guide, direct or control drivers/riders.

Pavement: A durable surfacing of roads and walkways**.**

Property damage only (PDO): A type of crash that only involves damage to property. The nature of the damage is expressed in monetary terms.

Railway crossing: The intersection of a railway line and a road.

Road accident: See road crash.

Road crash: A traffic collision (motor vehicle collision, motor vehicle accident, car accident, or car crash) that occurs when a road vehicle collides with another vehicle, pedestrian, animal, road debris, or obstacle. Road crashes can result in death, injury or property damage

Road fatality: A victim who dies within 30 days of a road crash as a result of its consequences.

Road hump: A correctly designed and constructed physical hump across a road intended to slow traffic speeds and/or reduce through traffic.

Road marking: any kind of device or material that is used on a road surface to guide, direct or control drivers/riders.

Road safety audit: An audit that investigates potential problems, examining what might go wrong and suggesting methods to avoid this.

Road safety engineer (RSE): An engineer who works to improve road safety along roads through the adaptation of the physical road environment. RSEs are typically skilled in blackspot investigations and road safety audits.

Roadside hazards: A fixed object (more than 100mm in diameter) within the clear zone of a road.

Road trauma: Trauma that is caused by a road crash.

Road users: People who use roads, including pedestrians; bicyclists; motorcyclists; car, truck and bus drivers; and so on.

Roll-over crashes: A type of vehicle crash in which a vehicle tips over onto its side or roof.

Roundabouts: A type of circular junction in which road traffic must travel in one direction around a central island.

Run-off-road crashes: A single-vehicle crash that occurs when a vehicle leaves the roadway.

Safety barriers: Also known as crash barriers, these are steel or concrete barriers that prevent errant vehicles from striking a more dangerous roadside hazard.

Sealed road: A road that has been covered with pavement.

Serious injury: An injury that requires admission to a hospital and treatment for over 30 days.

Shoulder: An area by the edge of the road that is constructed and improved. They assist with drainage and preservation of the road and its sub-base. If sealed they provide an excellent recovery area for errant vehicles, or escape route from head-on collisions. In addition, they can provide a safer environment for pedestrians walking along the road.

Super-elevation: The slope on a curved section of road provided to enhance forces assisting the vehicle to maintain a circular path. If the angle of super-elevation is too great, however, and vehicles using the road are top-heavy, there is an increased risk that a vehicle may topple over.

Traffic Management Plan: A plan that shows clearly all the signs, barriers, and other devices that are to be installed at a roadwork site.