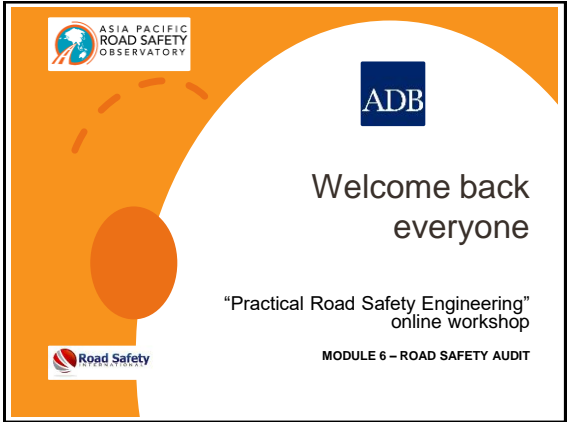


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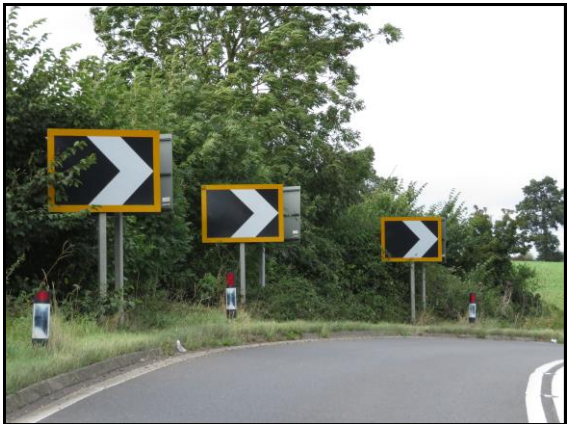
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8

Participant	Question
In rural village area, there is always an issue of theft of sign post that is made of metals. Is it advisable to put the sign plate on nearby road side tree trunk or electrical post?	Gopal Mitra

Yes – we have a duty to pass on essential information/warnings to the drivers/riders. While it is best to put a sign on a single post, exactly where you want it to be, if theft/damage is a big issue we have to act smarter.

Use a tree trunk, or a building, or a power pole.

Or put an additional message on the road (they cannot steal a marking!)

9



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14

Participant	Question
Is it necessary to install road signs on both side of the road if its two lane, two way road?	Hepisipa Oko

15

No – not necessary in most cases but always follow your national guidelines (and sometimes they specify where to use duplicate signs).  
In Australia speed restrictions signs are used in pairs when the speed zone changes, and often as repeater signs!

Two signs *may* be useful when:

- Traffic volumes are high, with many trucks to block view of signs ahead
- On H curves – easier to see a sign on the outside of a sharp curve
- When you have an “overshoot” problem (eg use 2 Give Way signs)

16

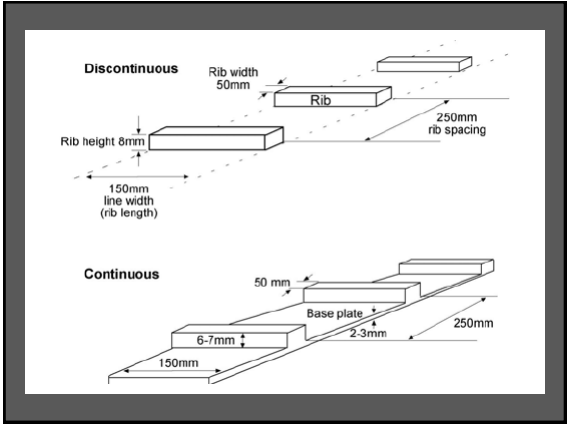


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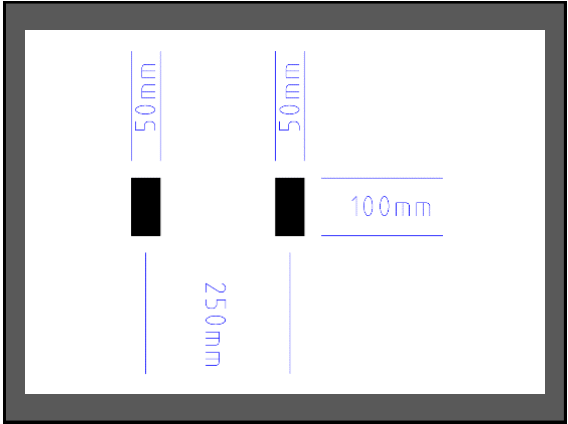
Participant	Question
What is the standard spacing of the tactile?	Md. Joynul Abadin

I have sent a Design Bulletin to ADB to be distributed to all!

18



19



20



21

Participant	Question
Material for line markings can cause skidding to 2-wheelers during wet conditions since they are mostly on the left sides (i.e. Malaysia is LHS country). How to solve the problems?	Nuura Addina Mohamad

All line marking, left and right sides, can present a problem for small, fast vehicles.

Thermoplastic has a higher skid resistance than paint. Placement of the lines is important. Try not to use a much in decision making locations (such as coming into traffic signals in higher speed zones etc).

One video I looked at trying to get a useful answer suggests m/c do not have issues with tactile edge lines.

22



23

## Road Safety Audit

My objectives today are to:

- outline the road safety audit process
- encourage the introduction of the road safety audit process in your national road authority,
- encourage you to undertake audits especially during the design stages of new road projects, and
- answer your questions about the audit process

24

# Road Safety Audit

My objective today is also:

- to open discussions mainly with ADB officers (but others also) about how to put RSA to best use.
- Why?

25

What is road safety audit?

Why do we need audit?

How do we do an audit?

Where?

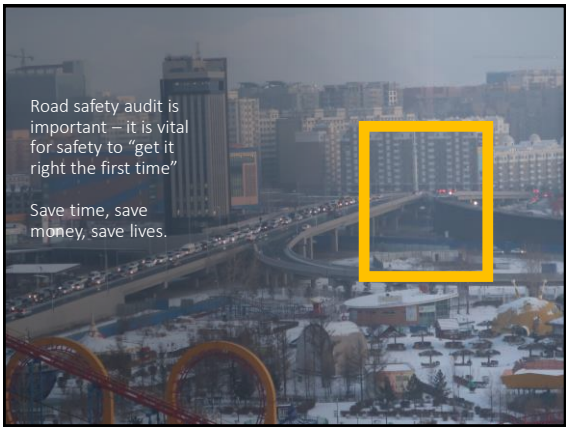
When?

Prevention is better than cure - by Phillip Jordan

26

Road safety audit is important – it is vital for safety to “get it right the first time”

Save time, save money, save lives.



27

Road Safety Audit

Prevention is better than cure



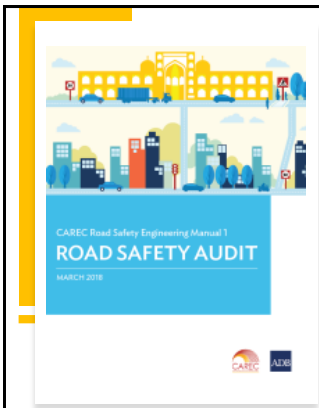
28

## Road Safety Audit guidelines



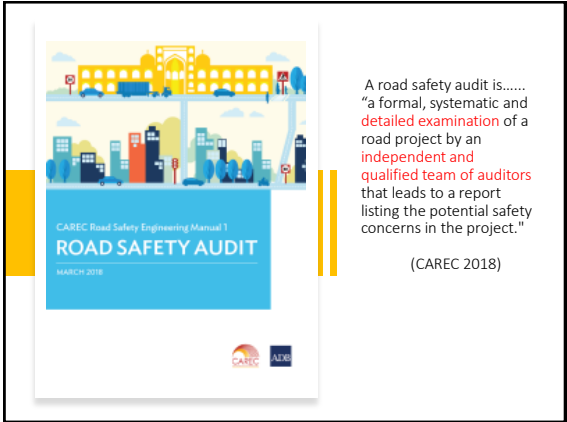
Prevention is better than cure

29



A road safety audit is.....  
“a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report listing the potential safety concerns in the project.”  
  
(CAREC 2018)

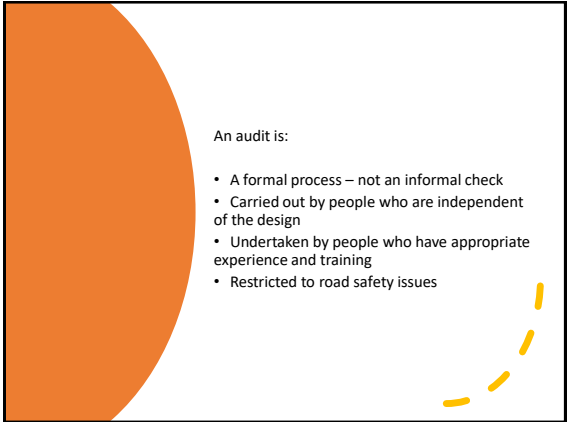
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A road safety audit is.....  
"a formal, systematic and  
**detailed examination** of a  
road project by an  
**independent and**  
**qualified team of auditors**  
that leads to a report  
listing the potential safety  
concerns in the project."

(CAREC 2018)

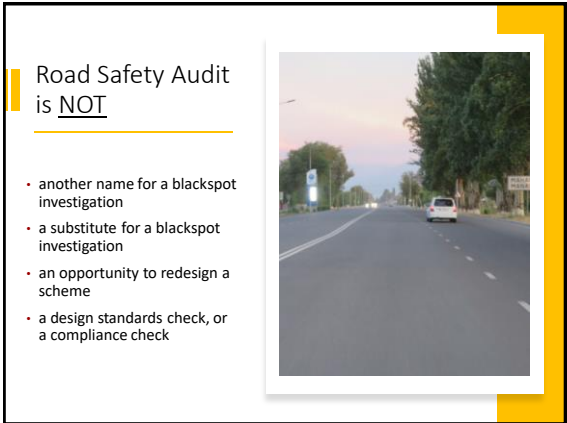
31



An audit is:

- A formal process – not an informal check
- Carried out by people who are independent of the design
- Undertaken by people who have appropriate experience and training
- Restricted to road safety issues

32

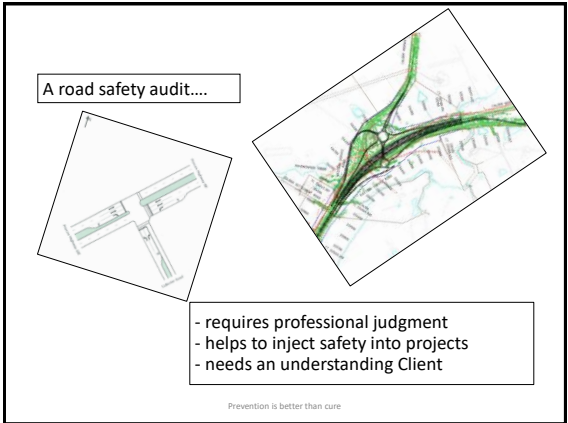


Road Safety Audit  
is NOT

- another name for a blackspot investigation
- a substitute for a blackspot investigation
- an opportunity to redesign a scheme
- a design standards check, or a compliance check



33

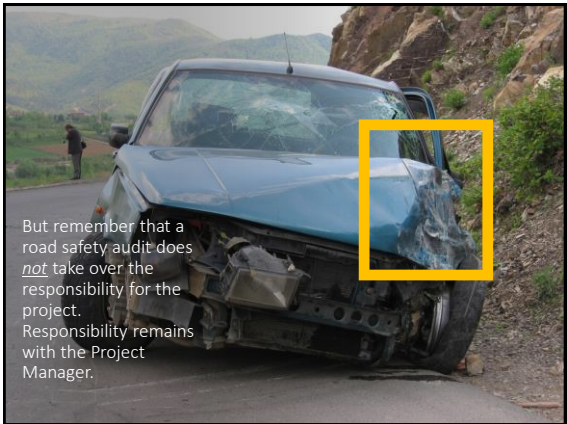


A road safety audit....

- requires professional judgment
- helps to inject safety into projects
- needs an understanding Client

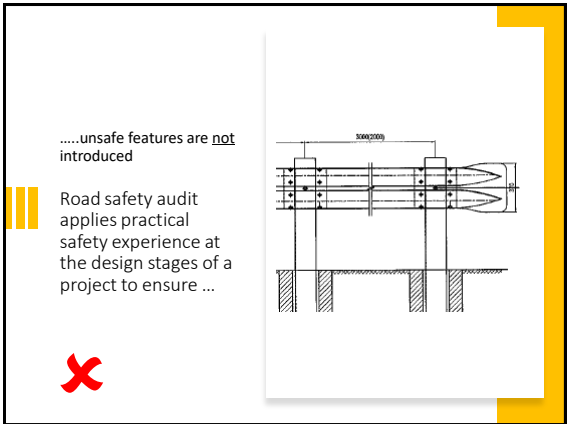
Prevention is better than cure

34



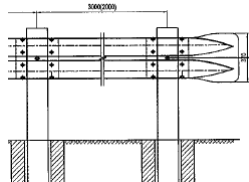
But remember that a  
road safety audit does  
not take over the  
responsibility for the  
project.  
Responsibility remains  
with the Project  
Manager.

35



.....unsafe features are not  
introduced

Road safety audit  
applies practical  
safety experience at  
the design stages of a  
project to ensure ...



38





Road safety audit applies practical safety experience at the design stages of a project to ensure ...

....unsafe features are not introduced

39



Road safety audit applies practical safety experience at the design stages of a project to ensure ...

....unsafe features are not introduced

40




Road safety audit applies practical safety experience at the design stages of a project to ensure ...

..... safe features are introduced

Prevention is better than cure - by Phillip Jordan

41



Blackspot investigations look at what did go wrong, why it went wrong, and suggests ways to reduce the risk of it from going wrong in future.

*RSA investigates what might go wrong and suggests methods to prevent this.*

Prevention is better than cure - by Phillip Jordan


42



Auditors are problem finders!



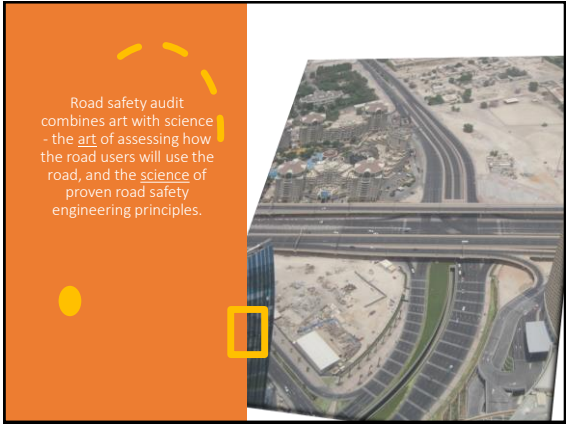
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Engineers are problem solvers

Auditors need to be problem finders!

44



45

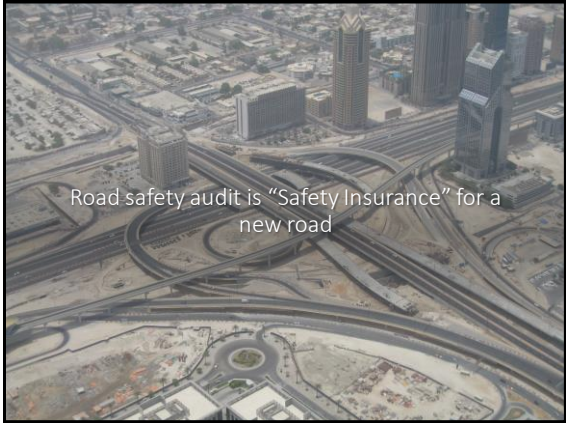
**Objectives of road safety audit**

- To minimise the risk of crashes occurring on a new road project, and to minimise the severity of the crashes that do occur;
- To minimise the risk of crashes occurring on adjacent roads (that is, to avoid the possibility that the project creates crashes elsewhere on the network);
- To recognise the importance of safety in road design (so that the needs and perceptions of all road users are met, and to achieve a balance where they may be in conflict);
- To reduce the long-term costs of a new road project, bearing in mind that unsafe designs may be expensive (or even impossible) to correct at a later stage;
- To improve the awareness of road safe engineering principles by all involved in the process of planning, design, construction and maintenance of roads.

46



47



48



49

**Table 1: Key Steps in the Road Safety Audit Process**

Road Safety Audit Step	Responsibility
1. Determine if an audit is needed.	Project manager
2. Select an audit team leader, who then engages the audit team.	Project manager and road safety audit team leader
3. Draft the pre-audit communication (drawings and design reports) about the project to the team leader, outlining the project and discuss the audit ahead.	Designer (via project manager) and road safety audit team leader
4. Assess the drawings for safety issues (the “desktop” audit).	Audit team
5. Inspect the site both during daytime and nighttime.	Audit team
6. Write the audit report and send to the project manager.	Team leader with assistance from audit team
7. Discuss the key safety issues and clarify outstanding matters during post-audit communication.	Project manager (plus designer) and road safety audit team leader
8. Write a response report, referring to each audit recommendation.	Project manager
9. Follow up and implement agreed changes.	Project manager (and designer)

**Process Flow:**


- Decide
- Select audit team
- Pre-audit communication
- Desktop audit
- Inspect site
- Write audit report
- Post-audit communication
- Respond to the report
- Implement

50




Key audit steps....

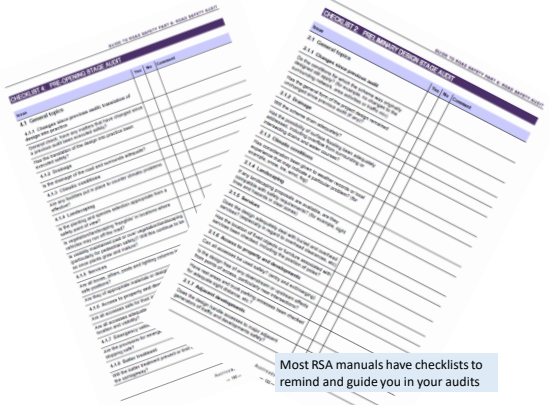
Closely review drawings



Use checklists



51





Most RSA manuals have checklists to remind and guide you in your audits

52

Key audit steps....  
inspect the site,  
day and night

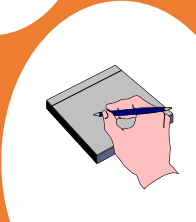
Use checklists to prompt....



53

Key audit  
steps....

Respond to the audit report

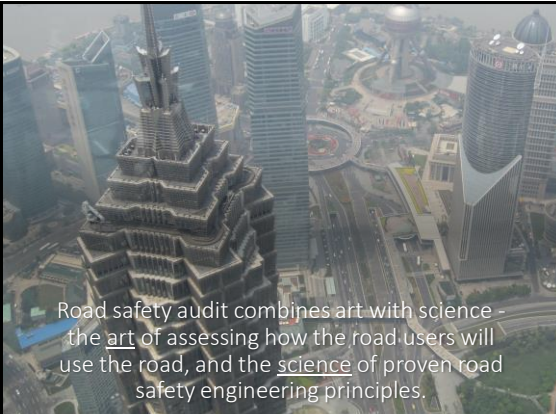


54



Road safety audit reports on safety issues - only!

55



Road safety audit combines art with science -  
the art of assessing how the road-users will  
use the road, and the science of proven road  
safety engineering principles.

56



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68






69

The 6 international stages of road safety audit

- Planning
- Preliminary design
- Final (detailed) design
- Traffic management
- Pre-opening
- Existing road (called road safety inspections)



70

Existing road audits are called "inspections" – their overuse is not recommended as they...

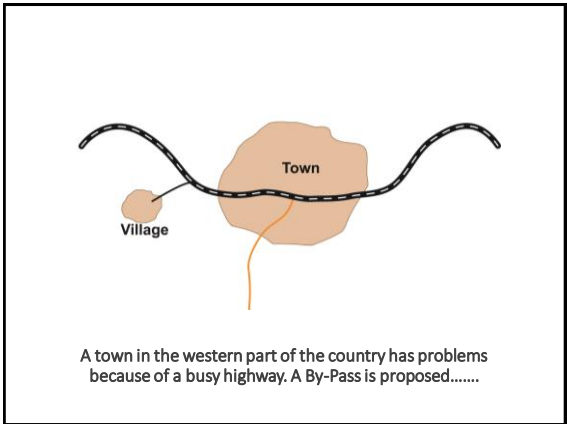
- Lead to unfulfilled expectations if remedial work is not undertaken
- May cause misunderstandings with the benefits of design stage audits
- May cause confusion with crash investigations (blackspots)
- Should already be part of a good maintenance regime.

71

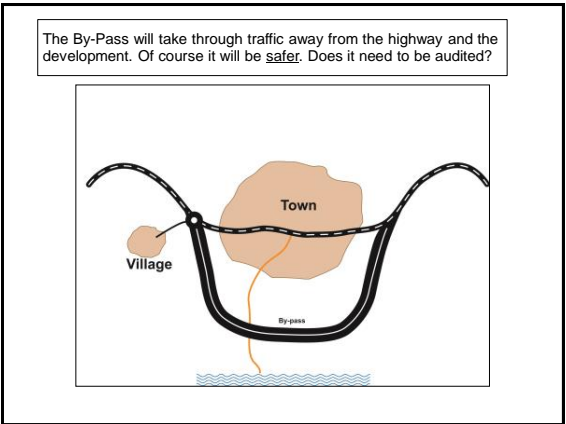
Planning stage audits consider.....

- route choice
- design standards
- impacts on the adjacent road network
- intersection types....and much more

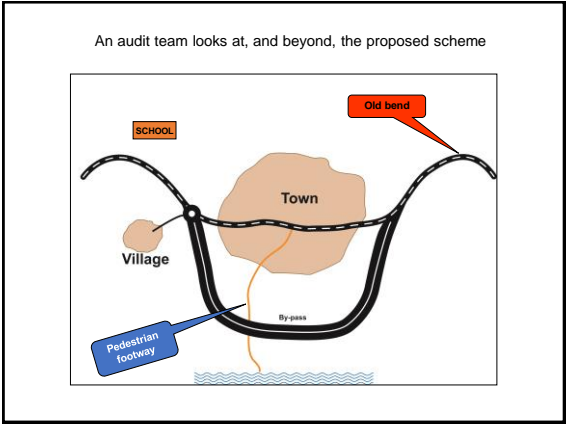
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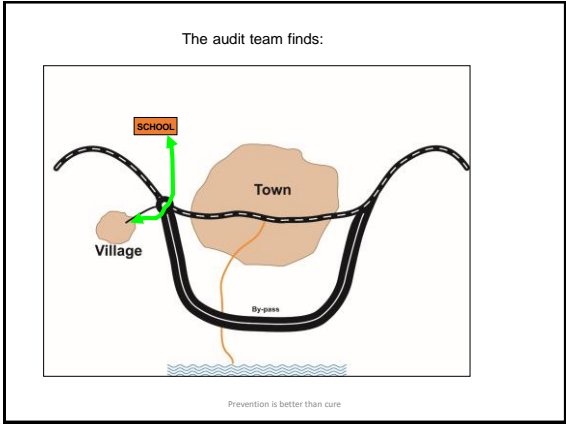
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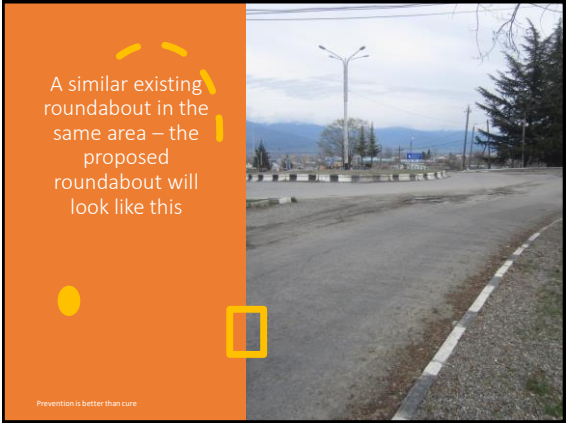
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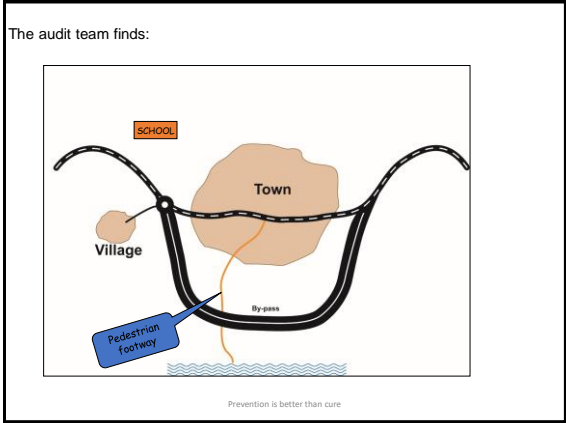
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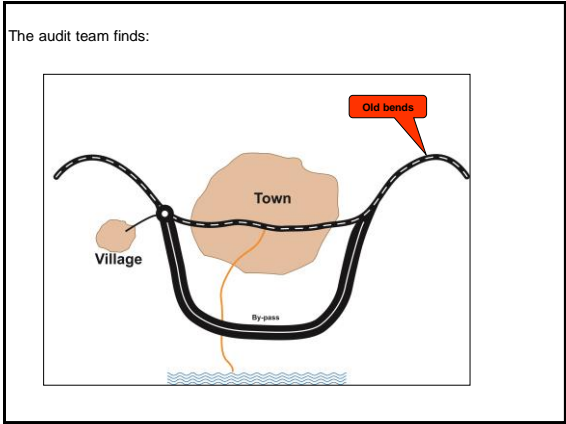
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80



81

The audit team reports on the possible safety concerns of.....

- Young pedestrians & cyclists at large roundabouts
- Pedestrians attempting to cross the By-Pass
- Higher speeds entering the old bends

*The Project Manager is now required to respond to these safety concerns and to follow up with necessary improvements.*

82

What should the Project Manager decide?

### Children at proposed roundabout

- Difficult issues
- Don't give up on a roundabout if possible
- Give options to the design team
- A Stop/Give Way cross road? But these have higher risk than roundabouts for other users.
- The designers are responsible for deciding and submitting new drawings to Project Manager

Prevention is better than cure

83

What should the Project Manager decide?

### Pedestrians crossing high speed road

- Difficult
- Offer options to the design team
- Overpass/underpass?
- Traffic signals?
- Break in median?
- Nothing!
- Not a zebra crossing!!!

Prevention is better than cure

84



85

Some people think road safety audit is a compliance check with standards.....

What standards are involved in this example?

There are none!

Road safety audit is not a compliance check against standards

86



Preliminary design stage audits consider...

- geometrics
- alignments
- intersection layouts
- cross sections
- vulnerable road users.....and more

87

Northern Bishkek By-Pass – preliminary design stage audit

88

Northern Bishkek By-Pass – preliminary design stage audit

89

90

91

Existing 2 lane roundabout

92

Safety concerns...

- The preliminary design for the proposed interchange for this location has several safety concerns:
- The exit to Bishkek from the east has a small radius curve. It will be a hazardous location for high speed exiting vehicles.
- Wrong-way movements into the ramp could occur as vehicles leave the small road serving the service station.
- The proposed U-turn on the southern side of the interchange has many conflicts within a short distance. It will become a location for sideswipe and rear-end collisions.

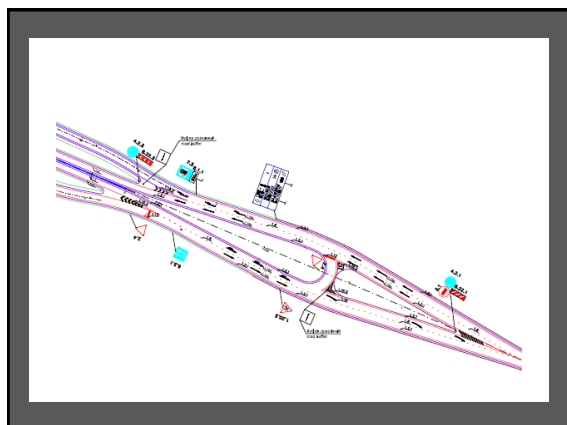
Medium risk

93

Recommendations

- Review the decision to construct this interchange.
- Consider improving and retaining a 2-lane roundabout.
- If an interchange is built, consider adopting a conventional closed diamond interchange (serving all approaches – even the approach with low traffic volumes).
- Remove the proposed U-turn.

94



95

Safety concerns...

- The proposed one-direction U-turn on the southern approach to this interchange will be located just near an entry ramp where 2 lanes of traffic will be merging into one lane just as the U-turn opens; but the U-turn does not have a sheltered turn lane. On the other carriageway, U-turners will enter the road just before an exit ramp.
- There will be a high risk of side swipe collisions on both carriageways.

High risk

96

Recommendations

Redesign this interchange as a conventional closed diamond interchange.

Provide for all approaches to have access to/from the Bypass through the interchange.

Do not construct the U-turn. It will not be needed with a closed diamond interchange.

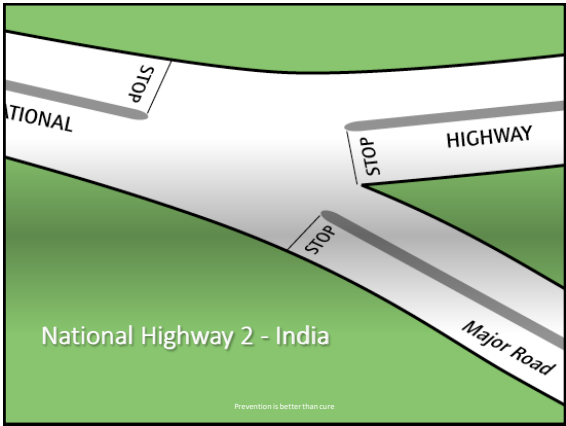
97

Detailed (Final) design stage audits consider...

- clear zone issues
- signs/line marking
- crash protection
- traffic control
- geometric design
- lighting.....and more

Prevention is better than cure

98



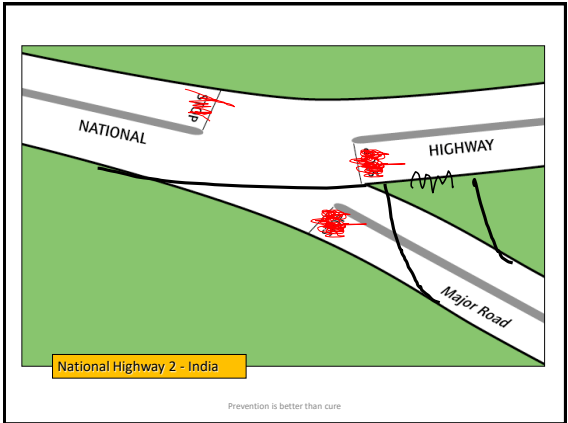
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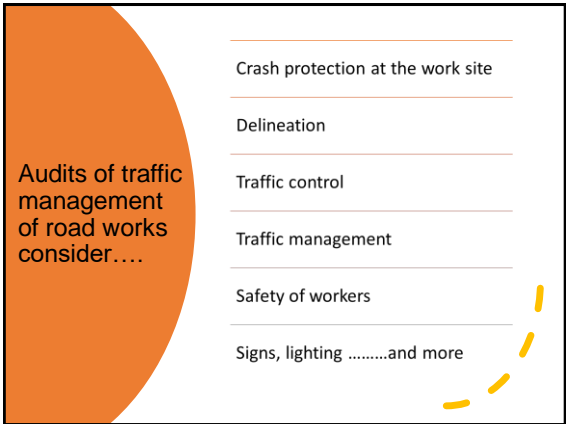
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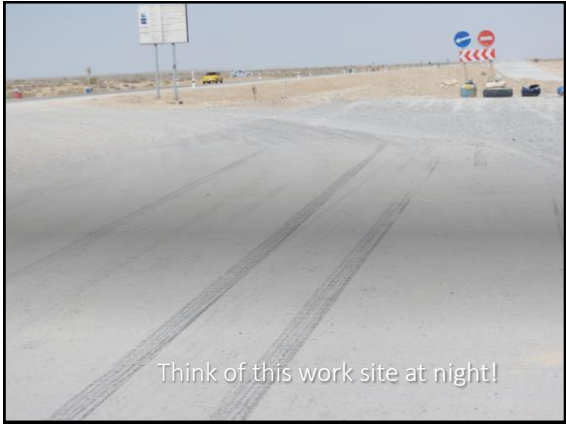


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108

Pre-opening audits consider

Previous audit issues – have they been adequately addressed

Roadside hazards, including how these have been treated

The correctness of signs and markings

Facilities for pedestrians, bicyclists, and other specific groups

Signal timings, phasing

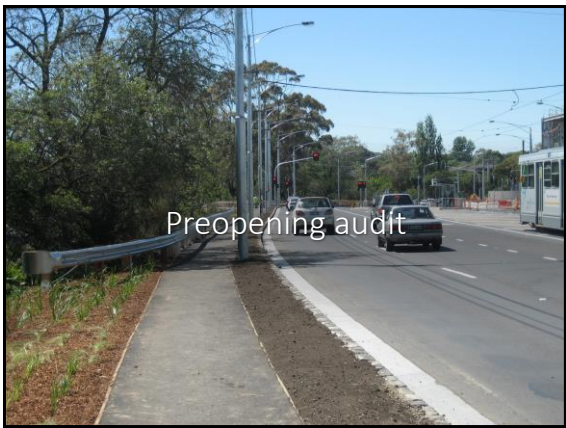
The road users' view .....and more

109

Pre opening audit in Melbourne

- Poles too close to road
- Poles in footpath
- Crash barrier issues
- Geometric issues
- Incorrect signs

110



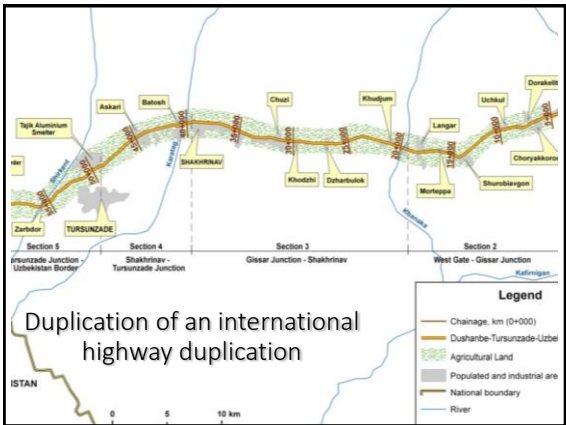
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114

**Pre/post-opening audit**

- High traffic speeds through villages (high risks for pedestrians).
- Geometric and traffic control issues (intersections and U-turns).
- Cattle and livestock.
- Variations in cross sectional (particularly the width of paved shoulders).
- Roadside hazards (including barriers, concrete barricades, lighting columns, bridges, open drains and culverts).

57 km of newly duplicated highway.  
Opened to traffic December 2015.  
8 fatalities in first 6 months of 2016.  
6 of these were pedestrians!

115



116

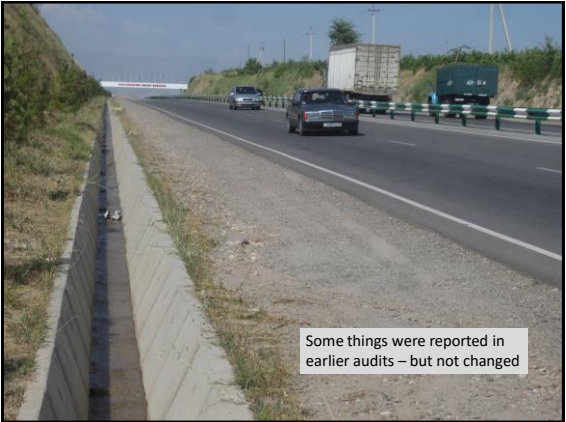


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129



If an existing road audit identifies a *potential* safety issue, how can the road manager justify spending money to rectify it, while there are "black spots" (with proven crash records) waiting for funds ?

130

But audits of existing roads....

- Can be useful in countries (like some African, Central and SE Asian and Middle Eastern countries) with incomplete crash data.
- It can guide engineers to high risk locations for improvement.

131

But remember, too many audits of existing roads may.....

- lead to unfulfilled expectations
- cause a misunderstanding of the benefits of design stage audits
- cause confusion with crash investigations

132

Road safety audit -the earlier, better - safer, cheaper

133

Road safety audit... may be the only time that road safety is explicitly considered in a project

134

The costs and the benefits of road safety audit

Road safety audits are a small part of the design cost...

- 1-2% of total design costs
- A fraction of 1% of total project costs (the bigger the project, the lower this percentage)

135

The costs and the benefits of road safety audit

Surrey County Council

- 19 audited sites were compared with 19 non-audited sites
- 2+ years of crash data were compared
- Audited sites had a casualty saving of 1.25 pa
- Non-audited sites had a casualty saving of just 0.25

136

The costs and the benefits of road safety audit

UK Highways Agency

- TRL examined 22 audited sites on trunk roads
- The costs of implementing the audit recommendations were compared with the costs of rectifying the sites after the project was constructed
- Average saving per site of £11,373

137

The costs and the benefits of road safety audit

Jordan

- 9 sites that had been constructed in the past decade (not audited) and had become safety problem sites
- It was assumed that, if the sites had been audited, they would not have required improvements later
- First year rate of return of 120%

138

The costs and the benefits of road safety audit

Denmark

- Assessed 13 schemes that had been audited during the design phase
- An evaluation panel conducted cost benefit analyses of these safety audits
- A general crash prediction method was used
- First year rate of return of 146%

139

The costs and the benefits of road safety audit

AUSTROADS

- Design audits had benefit cost ratios ranging from 3:1 to 242:1
- Existing road audits had benefit cost ratios ranging from 2:1 to 84:1


140

One road crash fatality in your country costs?



141

The costs and benefits of road safety audit



- Audits are low cost.
- Audits are high benefits

142

Road safety audit is a positive process



143

**CONCLUSION**  
Road safety will benefit from road safety audit for several reasons.....

- experience elsewhere has shown that the optimum road safety outcome is not achieved solely by compliance with standards
- road safety audit provides some "protection" against total reliance on standards
- road safety audit is a low-cost process, with demonstrated high benefits

144

**CONCLUSION**

- It is a "transparent" process – open for all to see and ask questions about
- It demonstrates professional responsibility in road safety engineering
- It is attractive - bureaucratically as well as politically

145

**CONCLUSION**

- There are growing concerns about road safety now, and these will increase.
- You have several large road projects ahead.
- You want to "get it right the first time"
- Who wants to build a blackspot?

146

**SUGGESTED RSA POLICY**

What projects are to be audited in your country?

"All road projects will be road safety audited at the following stages according to the class of road, in accordance with the procedures contained in the CAREC Road Safety Audit manual"

147

What road projects should be audited in your country?

AUDIT	EXPRESSWAYS & INTERNATIONAL HIGHWAYS	NATIONAL HIGHWAYS	MAJOR ROADS (URBAN/RURAL)	LOCAL STREETS & VILLAGE ROADS
FEASIBILITY	✓	Optional	Optional	N/A
PRELIMINARY DESIGN	✓	Optional	Optional	N/A
DETAILED DESIGN	✓	✓	✓	✓
ROAD WORKS	✓	Optional	Optional	Optional
PRE-OPENING	✓	✓	✓	✓
SAFETY REVIEWS OF EXISTING ROADS				
ACCORDING TO LOCAL POLICY AND RESOURCES				
NO. OF AUDITS	5	Minimum 2	Minimum 2	Minimum 2

Prevention is better than cure

148

I wish you well for this important road safety process, and I look forward to your questions

Prevention is better than cure

149