

Being proactive in road design – road safety audits

What is road safety audit, how can it lead to safer CAREC roads?



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Objectives – to outline:

- the audit process
- where, how and why RSA commenced
- costs and benefits of RSA
- managing the RSA process
- lessons being learnt from RSA around the world
- the future of RSA in CAREC





In presenting these topics I hope to:

- promote its use across CAREC
- encourage you to adopt and use road safety audit

Road safety audit should be a key part of your Action Plan



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 with a list of potential safety concerns in the project" (CAREC 2018)

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Road Safety Audit guidelines

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CAREC Road Safety Engineering Manual 1
ROAD SAFETY AUDIT

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MARCH 2018

AD SA

FOR



MANUAL ON ROAD SAFETY AUDIT

INDIAN ROADS CONGRESS

Second edition

SAFETY AUDIT

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Road Safety Audit

STANDARDS

RC:SP:88-2010



Road Safety Audit

Prevention is better than cure



Where, when and why, did the audit process start?

Great Britain - 1980's.

A blackspot investigation team in Kent was investigating blackspots and funding treatments to reduce crashes at those blackspots.



They realised that many of the blackspots they were investigating were new – designed and constructed by their County colleagues only a year or two earlier.



Where, when and why, did the audit process start?

Their leader spoke with the County Surveyor and agreed that no new works would proceed without the teams "safety approval" of the design.



That system of checking became know as road safety audit.

It spread to other counties across Britain; IHT adopted it and prepared the world's first manual on this process – released in September 1990



Where, when and why, did the audit process start?

It then spread internationally.

Australia/NZ 1994

Denmark, Malaysia, Singapore, Canada mid late 1990's

ADB 2003

USA 2006



banks adopted Donor the process and included it into the procedures for new roads in developing countries.

Objectives of road safety audit

- To minimise the risk of crashes on a new road project
- To minimise the risk of crashes occurring on adjacent roads
- To recognise the importance of safety in road design
- To reduce the long term costs of a new road project
- To raise the awareness of road safe engineering

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



Engineers are problem <u>solvers</u>. Auditors need to be problem finders!



How do we do a road safety audit?

NAMES OF TAXABLE PARTY OF TAXABLE



The steps in a CAREC road safety audit



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 to provide information (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
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)



When do we do road safety audits?

There are six agreed stages





The 6 international stages of road safety audit





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Issue Yes No NA Comments 1. Horizontal and vertical alignments
1. Horizontal and vertical alignments Will horizontal and vertical alignments be consistent with safe visibility requirements? Are vertical alignments suitably safe for all road users, especially Image: Construct of the same suitable safe for all road users, especially
Will horizontal and vertical alignments be consistent with safe visibility requirements? Are vertical alignments suitably safe for all road users, especially
Are vertical alignments suitably safe for all road users, especially
large trucks and buses that can lose momentum on long steady uphill grades?
Is there adequate provision for "safe" overtaking?
2. Typical cross-sections
Will all lane, shoulder, and median widths be safe for the expected volume and mix of traffic?
In particular, is the cross-section wide enough to provide sheltered turn lanes within the median?
Will the median be wide enough for the safe installation of street lighting either during the proposed works or later?
Will the median be wide enough and clear enough to be an effective pedestrian refuge?
Are shoulders proposed to be paved?
Are shoulders continuous across bridges and flyovers?
Are overtaking and/or climbing lanes being provided, especially in hill sections?
Will safe provision be made for broken down vehicles, and emergency vehicles?
3. New and/or existing road interface
Will the transition from the existing road to the new scheme be safe?
4. Staged works
If the scheme is to be constructed in stages, are the stages arranged to ensure maximum safety?
Is the transition between single and dual carriageway (either way) handled safely?
5. Intersections
Is the type of Intersection (crossroads, T, roundabout, and signals) appropriate and safe?
Will the design be free of sight obstructions due to structures, fences, trees or parking.?
Will the traffic signal controls at the intersection(s) be clearly seen and understood?
Will the traffic signal phasing be safe?
Is adequate time proposed for all traffic and pedestrian movements at the signals?
Do pedestrians have push buttons to activate the signals, together with suitable pedestrian signals on each corner of the intersection?
With roundabouts, is adequate deflection provided for all approaches?

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What projects are audited?





CAREC



Road safety audit is for big projects



Road safety audit is for small projects (on low speed roads)



Road safety audit is for rural road projects



Road safety audit is for road works

Prevention is better than cure



Road safety audit is for bicycle projects



Road safety audit is for pedestrian projects



Planning stage audits consider...





A small town along a CAREC highway has increasing traffic and safety problems. A By-Pass is proposed...





The By-Pass will take through traffic away from the town. An audit is undertaken at this early stage.





3to

The audit team looks at, and beyond, the proposed scheme



Old curves outside project

The audit team reports on:







The audit team reports on:







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

Higher speeds entering the old bends

Young pedestrians & bicyclists at large roundabouts

Pedestrians attempting to cross the By-Pass

The Project Manager is required to respond to these concerns and decide the necessary improvements.







What might the audit team recommend?

The old curves – just outside the proposed By-Pass

- Geometric improvements?
- Extend the By-Pass to include these in the work?
- Delineate?
- Nothing!




What might the audit team recommend?

Children at the proposed roundabout

- Offer options to design team
- A different junction control?
- The designers are responsible for deciding and submitting new drawings to Project Manager







What might the audit team recommend?

Pedestrians crossing a high speed road

- Overpass/underpass?
- A gap in the median?
- Traffic signals?
- Not a zebra crossing!
- Nothing!



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

- But what standards are involved in this example?
- None!
- Road safety audit is <u>not</u> a compliance check against standards

Preliminary design stage audits consider....

Geometrics – grades, radii, K values, alignments

Intersection layouts

Cross sections, including shoulders Assistance for vulnerable road users.....and more

Detailed design stage audits consider....

Clear zone issues and roadside hazard management	Signs, line marking, delineation	Pedestrian safety
Traffic control of intersections	Geometric design	Street lightingand more

Traffic management audits of road works consider...



Pre-opening stage audits consider...

Changes made during construction – safe/unsafe	Roadside hazard management	Delineation
Traffic control	Pedestrian facilities	Signs, lighting and more

Road safety inspections consider...

...all aspects of the existing road that may lead to a crash or may increase the severity of a crash on that road









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



Blackspots - audits

Blackspot investigations look at what <u>did</u> go wrong, why it went wrong, and suggests ways to reduce the risk of it from going wrong in future. RSA investigates what <u>might go wrong and</u> suggests methods to prevent this.





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

- Less than 2% of the design costs
- Under 0.5% of total project costs





Surrey County Council

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





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 £11,400





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%





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%





AUSTROADS

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





In summary.....

Low cost
High benefits
Road safety audits <u>are</u> worthwhile





Audit Team



Two person (minimum) teams for arterials, expressways and other big proposals

One person "team" - only for small local street projects





Audit Team qualifications

Most countries have two levels of auditor:

- Senior Road Safety Auditor experienced, has done numerous audits, is able to lead an audit team.
- Road Safety Auditor understands the process, and has completed an RSA workshop.





Audit Team qualifications

A university degree or similar experience? No

Experience with road design, blackspots or road safety engineering? Yes

Completion of an RSA workshop. Yes

Experience doing audits before leading a team. Yes







- Road safety audit is "mainstream" in western highway authorities
- Designers understand the audit process; they look at their designs more critically
- Vulnerable road users get more consideration
- Safety is now <u>on the agenda</u>





- Development banks promote audits in their road projects.
- But this does not always improve safety.
- Many managers don't know what to do with RSA reports.
- Many audit reports are not responded too.
- Some highway authority's respond that a recommendation is "not standard" – and the bank often accepts that.
- The management of audits is <u>very</u> important.





- Are we learning from audits?
- The same safety issues arise audit after audit
 - Barrier terminals
 - Barrier bridge connections
 - Lack of paved shoulders
 - Inadequate delineation of rural roads
 - A tendency to try to control our customers instead of providing what they need (eg closing intersections and sending them unnecessarily to U-turns)
- Many standards in CAREC countries need to change.







- Engineers in too many countries think a RSA is a compliance check against national standards.
- Some good audit recommendations and reports have been rejected by a Client saying "not standard".
- Remember standards do <u>not</u> always equal safety.



A serious roadside hazard issue. This is a "standard" design – but it is unsafe.

A serious roadside hazard issue. This is a "standard" design – but it is unsafe.



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IV. Managing a Road Safety Audit

Draft terms of reference for commissioning a road safety audit

register of road safety auditors

A suggested road safety audit policy



- Audits need experienced road safety engineers.
- Audits will not take hold nor have a positive effect in countries with few road safety <u>engineers.</u>
- The world does not have enough road safety engineers!
- Build your road safety engineering profession – in public and private sectors



- Many people have heard of RSA.
- Not all of them know what it is, and what it is not.
- Some senior managers ask for an audit – without knowing what they are <u>really</u> asking for.
- Some people think by having an audit done the finished road will be "safe".
- Audits must be "followed through"





- Most Western countries have a policy. Some base their audits on the class of road, some on the cost of the project.
- Emerging countries usually only undertake audits when required by ADB, World Bank, EIB, or EBRD.
- These countries need audits, and need their own national audit policy.





What CAREC projects shall be audited?

SUGGESTED RSA POLICY FOR CAREC

"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"





Audit	Expressways and International Highways	National Highways	Major Roads (Urban/Rural)	Local Streets and Village Roads	
Feasibility	1	Optional	Optional	Not applicable	
Preliminary design	1	Optional	Optional	Not applicable	
Detailed design	1	1	1	1	
Road works	1	Optional	Optional	Optional	
Preopening	1	1	1	1	
Road safety inspections (existing roads)	According to local policy and resources				
Number of audits	5	Minimum 2	Minimum 2	Minimum 2	







Manage the process

- Establish a national co-ordinating committee
- Start with a national RSA policy
- Draft terms of reference to engage audit teams
- Establish a national auditor accreditation system
- Train managers so they understand what they are "buying"






Technical matters:

- Audits need experienced road safety engineers.
- Does CAREC have enough road safety engineers?
- Develop a healthy road safety engineering profession.
- From this your auditors emerge
- In-service training
- "Advanced" training for experienced auditors
- Share audits with neighbouring countries





Big issues

- Large road projects take years to move from concept through finance approvals and planning into design.
- Then because of a timeframe and a budget set 3+ years earlier – all the technical work has to be made to fit.
- Often an alignment is adopted because of a desire to minimise land acquisition.
- Sometimes a narrow cross-section is adopted because of a desire to minimise the loss of agricultural land, or to minimise resettlement.
- Such decisions should be subjected to a Planning Stage RSA. They rarely are!

Dushanbe – Tursunzade Highway

• 2012

CAREC

- Detailed design stage audit
- Reported concerns for:
 - Future high speeds in villages, leading to pedestrian safety issues
 - U turns
 - Cattle
 - Signage

• 2016

- Pre/post opening stage audit at request of ADB
- Highway open for 6 months.
- In that time 8 people killed (6 pedestrians, of which three were children).







- The cross section was too restricted for safety.
- There was no planning audit, and no preliminary design audit.
- The 2012 detailed design audit was too late (construction had commenced).
- Many of the safety concerns raised then had already been constructed. Costly to rectify.
- No written responses to the detailed design stage audit report have been seen.









The 2012 detailed design audit reported many potential safety concerns:

- Speeds through villages
- Intersection controls
- Pedestrian facilities
- Roadside hazard management
- U-turns
- Cattle crossings





The highway was completed in December 2015

At least 8 people (including 6 pedestrians) were killed in crashes in the first 6 months
A "post-opening" stage road safety audit was urgently requested – it revealed many safety concerns.....





Rural sections

- U-turns unusual signs, and acceleration lanes
- Unsealed shoulders
- Barrier wrongly installed
- Many roadside hazards

Urban sections

- High speeds in villages
- No traffic calming
- Median barrier blocking pedestrian movements







The post-opening audit listed many safety concerns. Some had been reported in the detailed design audit (but no action was taken); some were due to poor construction.

NOW



Many of the hazards were created because the initial planning and land acquisition restricted the cross section

It is difficult to fully address road safety when cross sections are narrow, speeds are high and many different road users compete for use of the highway.



One good safety initiative – a pedestrian refuge!



Ц ВАТАНИ МАХБУБАМОНРО БОЗ

М ОБОДУ ЗЕБО ГАРДОНЕМ.

PPPPPPP



The future for road safety audit

- Positive
- It continues to expand around the world at different speeds in various countries
- It should be a high priority for every CAREC road authority





The future for road safety audit

- Will have most impact where there is a solid road safety engineering profession, and where management understands it
- Your country learn from others
- Move forward with a national audit policy, a national register of auditors. Regular workshops; annual conference.
- Keep the audit process simple





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

Prevention is better than cure

