CAREC

Central Asia Regional Economic Cooperation Program

Key processes in road safety engineering

How engineers can make Mongolian roads safer?

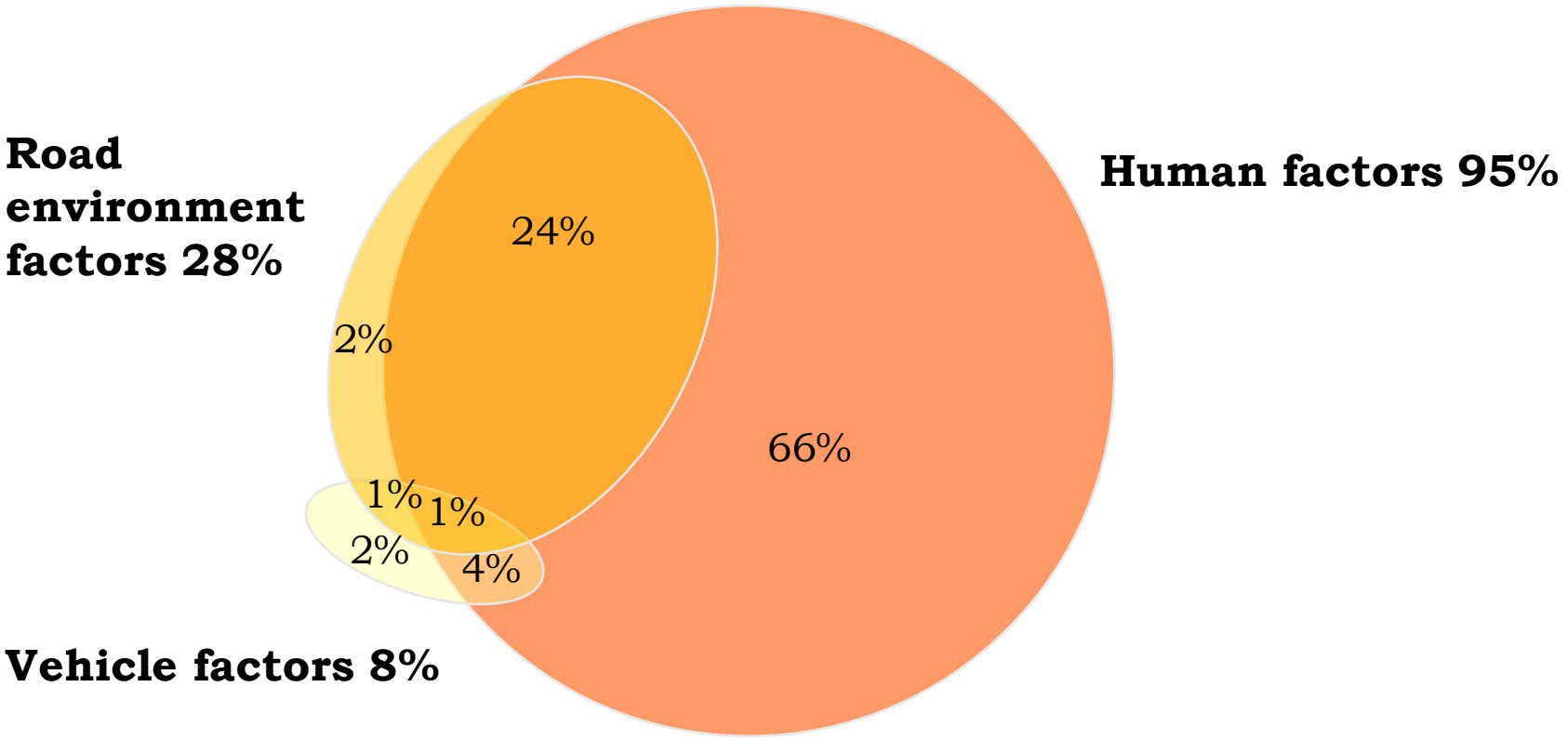

Objectives of this session:

1. We can make safer roads by:
   - Road safety audit
   - Treating blackspots
   - Roadside hazard management
   - Better pedestrian facilities

2. “Safer roads” are important for Mongolia


How can we make roads safer for all?

The factors involved with crashes



Based on British and American research

Do you have the CAREC road safety engineering manuals?

How can you make Mongolian roads safer?

- **Manual 1 – Road safety audit – improving safety in road designs**
- **Manual 2 - Safer road works – protecting road users and workers**
- **Manual 3 - Roadside hazard management – safety of roadsides**

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The manuals are for use by…

- Engineers in national road agencies
- Traffic Police
- Consultants, Contractors, PIU
- Academics and students

Road Safety Audit

This new manual is the focal point for the road safety audit process within the CAREC program.

I hope you put it to use in Mongolia.

Manual One
Road Safety Audit

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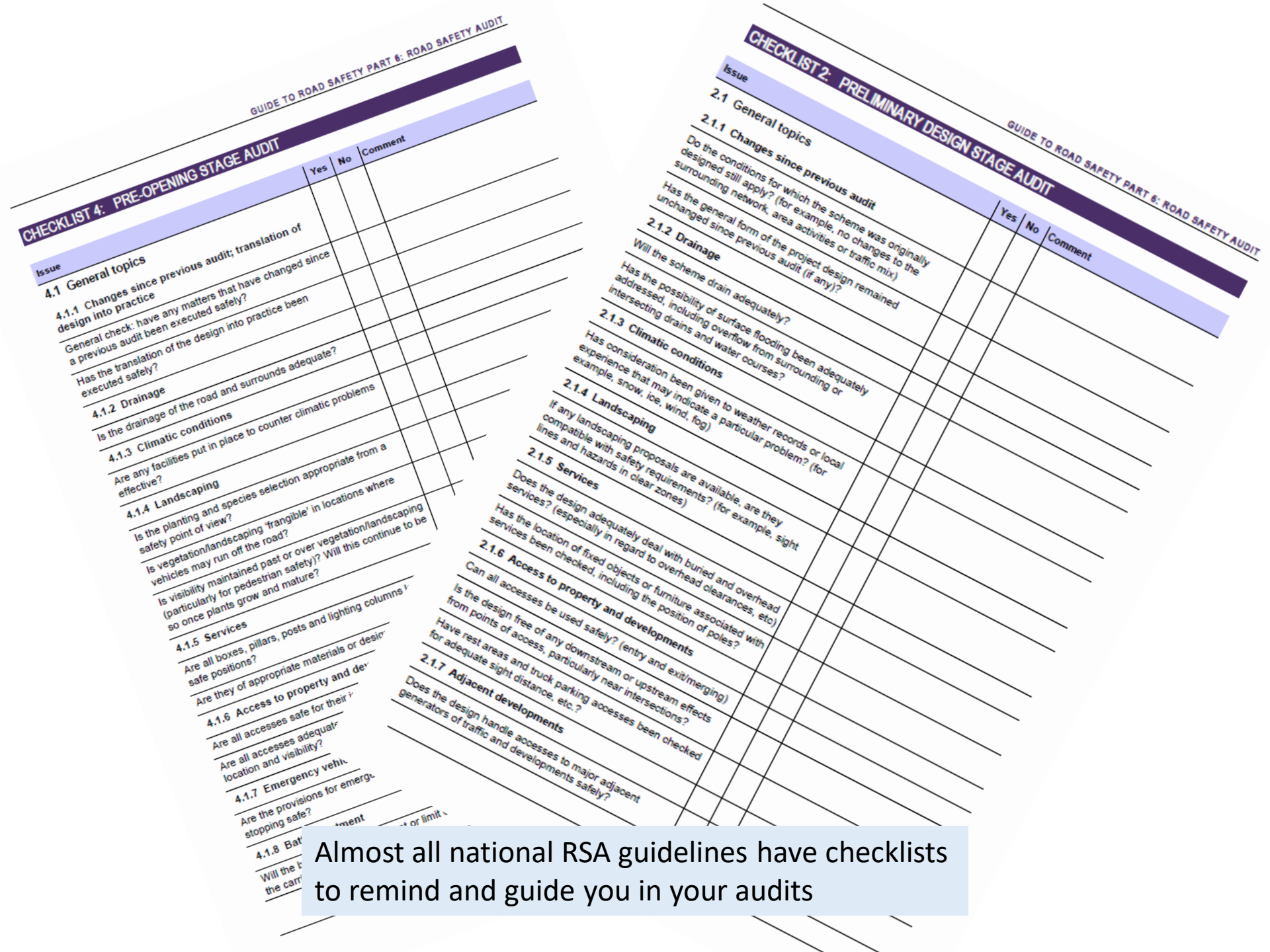
A road safety audit is “a formal, systematic and detailed examination of a road project by an independent and qualified team of auditors that leads to a report listing the potential safety concerns in the project."

(CAREC 2018)

Road safety audit – prevention is better than cure

The steps in a road safety audit

Road safety audit step	Responsibility
1. Determine that 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. Pre-audit communication – to provide information (drawings and design reports) about the project to the Team Leader. Outline the project and discuss the audit ahead	Designer (via Project Manager) and the Road Safety Audit Team Leader
4. Assess the drawings for safety issues (the "desktop" audit)	The audit team
5. Inspect the site – daytime and night time	The audit team
6. Write the audit report. Send to the Project Manager	The Team Leader with assistance from the audit team
7. Post audit communication – to discuss the key safety issues and to clarify outstanding matters	Project Manager (plus designer) and Road Safety Audit Team Leader
8. Write a response report, referring to each audit recommendation	Project Manager
9. The way forward - following-up and implementing agreed changes	Project Manager (and designer)



GUIDE TO ROAD SAFETY PART 6: ROAD SAFETY AUDIT

CHECKLIST 4: PRE-OPENING STAGE AUDIT

Issue	Yes	No	Comment
4.1 General topics			
4.1.1 Changes since previous audit; translation of design into practice			
General check: have any matters that have changed since a previous audit been executed safely?			
Has the translation of the design into practice been executed safely?			
4.1.2 Drainage			
Is the drainage of the road and surrounds adequate?			
4.1.3 Climatic conditions			
Are any facilities put in place to counter climatic problems effective?			
4.1.4 Landscaping			
Is the planting and species selection appropriate from a safety point of view?			
Is vegetation/landscaping 'frangible' in locations where vehicles may run off the road?			
Is visibility maintained past or over vegetation/landscaping (particularly for pedestrian safety)? Will this continue to be so once plants grow and mature?			
4.1.5 Services			
Are all boxes, pillars, posts and lighting columns i safe positions?			
Are they of appropriate materials or desig			
4.1.6 Access to property and de			
Are all accesses safe for their			
Are all accesses adequat location and visibility?			
4.1.7 Emergency vehi			
Are the provisions for emerg stopping safe?			
4.1.8 Bat			
Will the b the carri			

GUIDE TO ROAD SAFETY PART 6: ROAD SAFETY AUDIT

CHECKLIST 2: PRELIMINARY DESIGN STAGE AUDIT

Issue	Yes	No	Comment
2.1 General topics			
2.1.1 Changes since previous audit			
Do the conditions for which the scheme was originally designed still apply? (for example, no changes to the surrounding network, area activities or traffic mix)			
Has the general form of the project design remained unchanged since previous audit (if any)?			
2.1.2 Drainage			
Will the scheme drain adequately?			
Has the possibility of surface flooding been adequately addressed, including overflow from surrounding or intersecting drains and water courses?			
2.1.3 Climatic conditions			
Has consideration been given to weather records or local experience that may indicate a particular problem? (for example, snow, ice, wind, fog)			
2.1.4 Landscaping			
If any landscaping proposals are available, are they compatible with safety requirements? (for example, sight lines and hazards in clear zones)			
2.1.5 Services			
Does the design adequately deal with buried and overhead services? (especially in regard to overhead clearances, etc)			
Has the location of fixed objects or furniture associated with services been checked, including the position of poles?			
2.1.6 Access to property and developments			
Can all accesses be used safely? (entry and exit/merging)			
Is the design free of any downstream or upstream effects from points of access, particularly near intersections?			
Have rest areas and truck parking accesses been checked for adequate sight distance, etc.?			
2.1.7 Adjacent developments			
Does the design handle accesses to major adjacent generators of traffic and developments safely?			

Almost all national RSA guidelines have checklists to remind and guide you in your audits

When do we do audits?

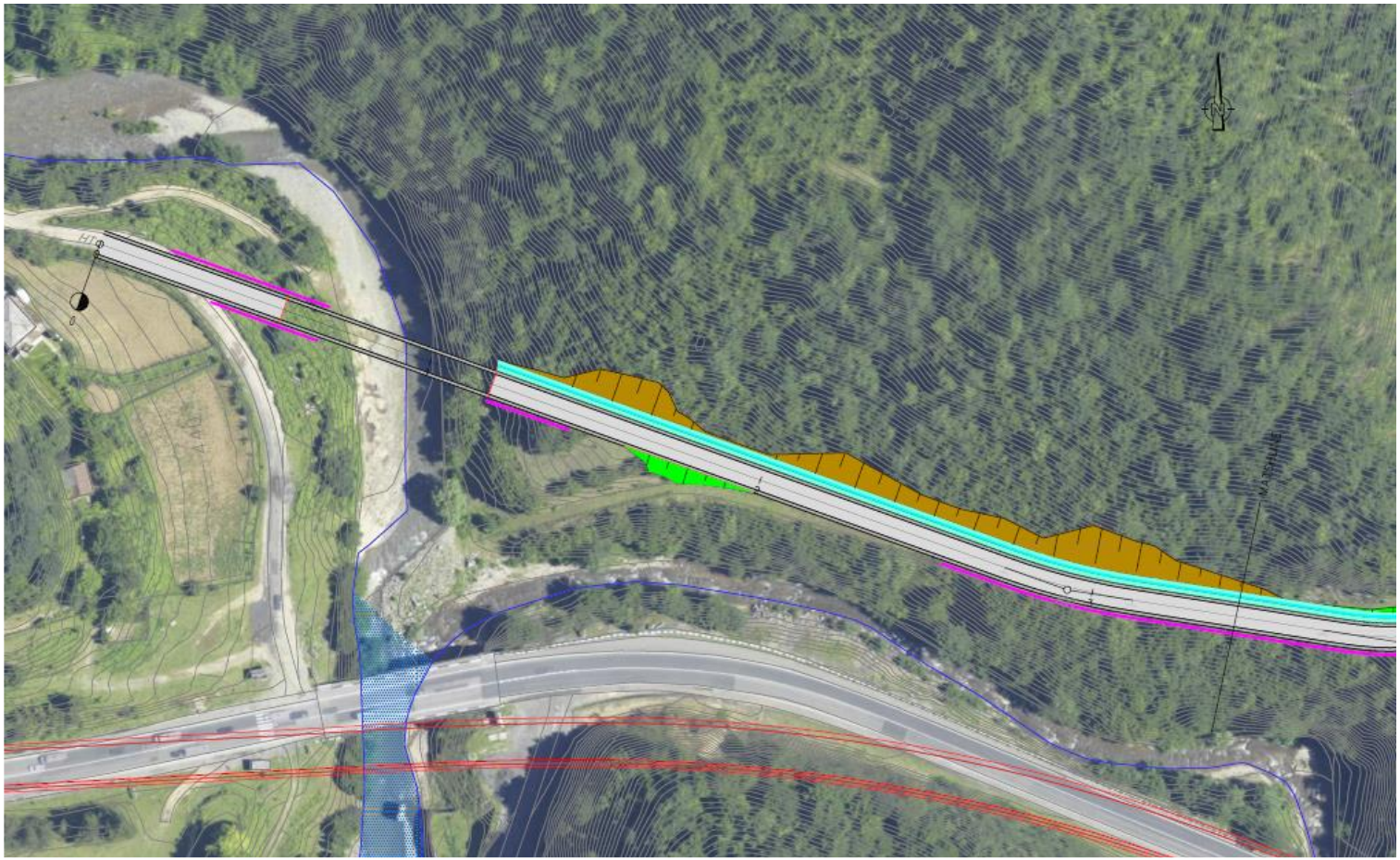
The stages of road safety audit

- Feasibility
- Preliminary design
- Detailed design
- During construction
- Pre-opening
- Existing road (Road safety inspections)

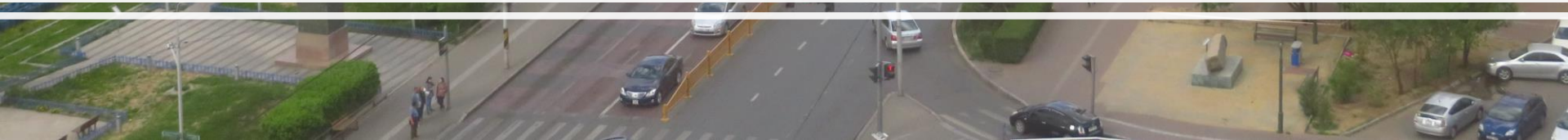
What projects should we audit?

- Big road projects
- Complex road projects
- Small road projects
- Projects on high speed roads, and low speed roads
- Rural projects
- Traffic management schemes
- Pedestrian projects/motorcycle projects/bicycle projects
- Road works

Road safety audit is for big projects



Road safety audit is for urban projects

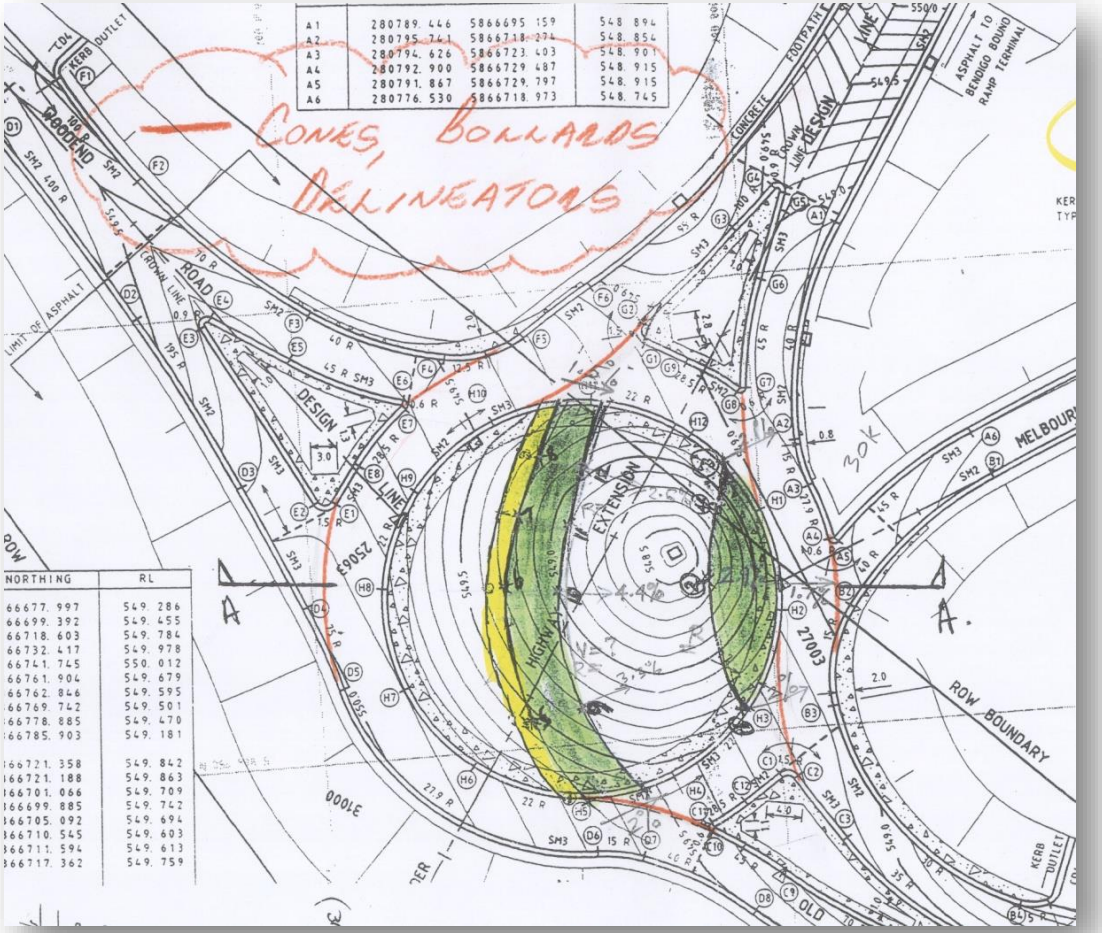


Road safety audit is for rural projects

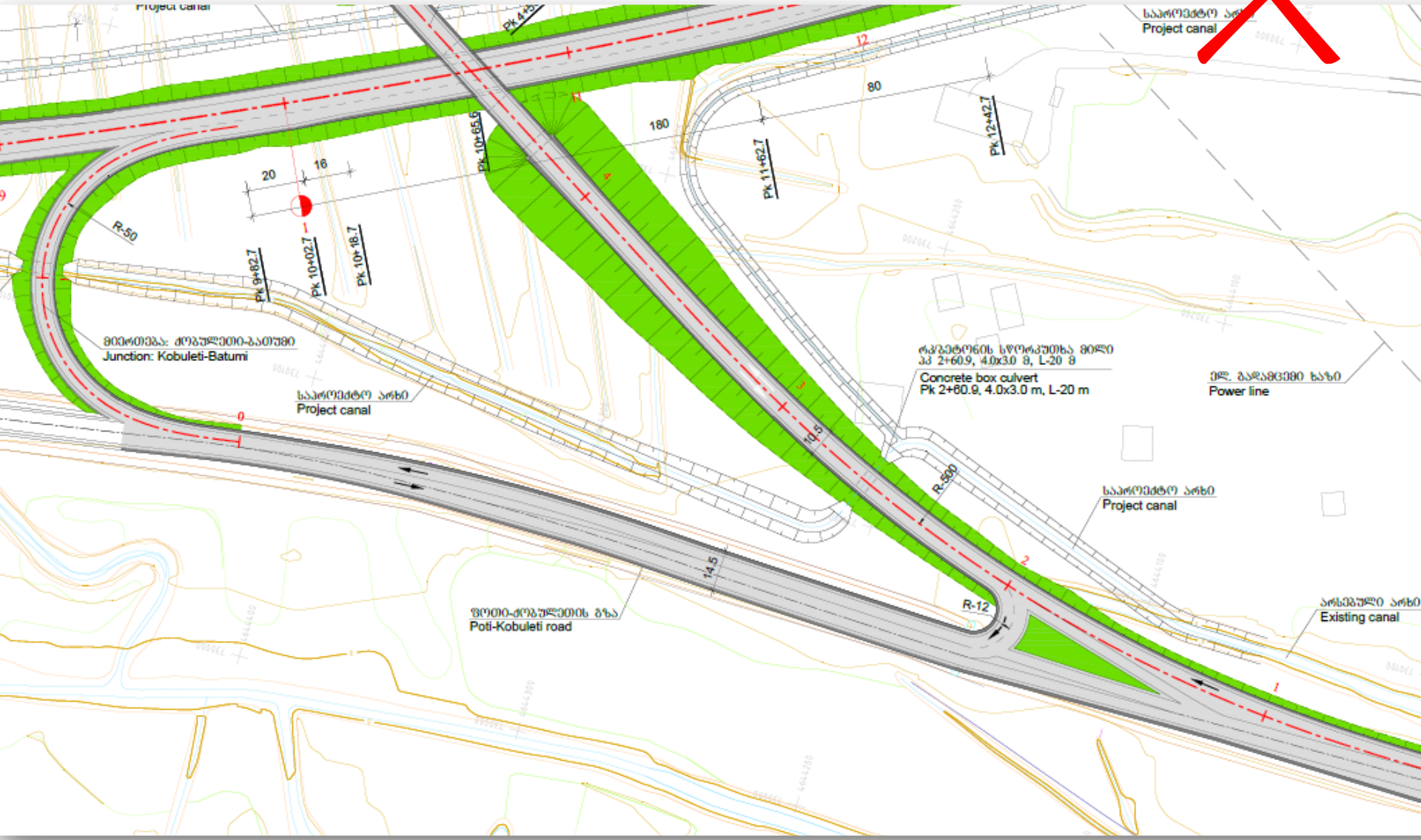
Road safety audit is for road works

Road Safety Audit

Prevention is better than cure



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.


Project canal
Pk 4+85
საპროექტო არხი
Project canal
12
80
180
Pk 10+65.6
Pk 11+62.7
Pk 12+42.7
20
16
R-50
Pk 9+82.7
Pk 10+02.7
Pk 10+18.7
მიერთება: ქობულეთი-ბათუმი
Junction: Kobuleti-Batumi
საპროექტო არხი
Project canal
რკინაბეტონის ყუთოვანი მილი
პკ 2+60.9, 4.0x3.0 მ, L-20 მ
Concrete box culvert
Pk 2+60.9, 4.0x3.0 m, L-20 m
ელ. გადამცემი ხაზი
Power line
14.5
R-500
საპროექტო არხი
Project canal
14.5
R-12
ფოთი-ქობულეთის გზა
Poti-Kobuleti road
არსებული არხი
Existing canal


700м
700м E70 ს2
ბათუმი
BATUMI
სარფი
SARPI
300м

Road safety audit

Low costs, high benefits

Well accepted in many countries

Valuable for Mongolia

Manual 2 – Safer Road Works

This manual details good road safety practices for work sites.

It encourages road authorities to include more road safety into the planning, design and operation of work sites.

Traffic management of road works should consider..

Six Zone Concept

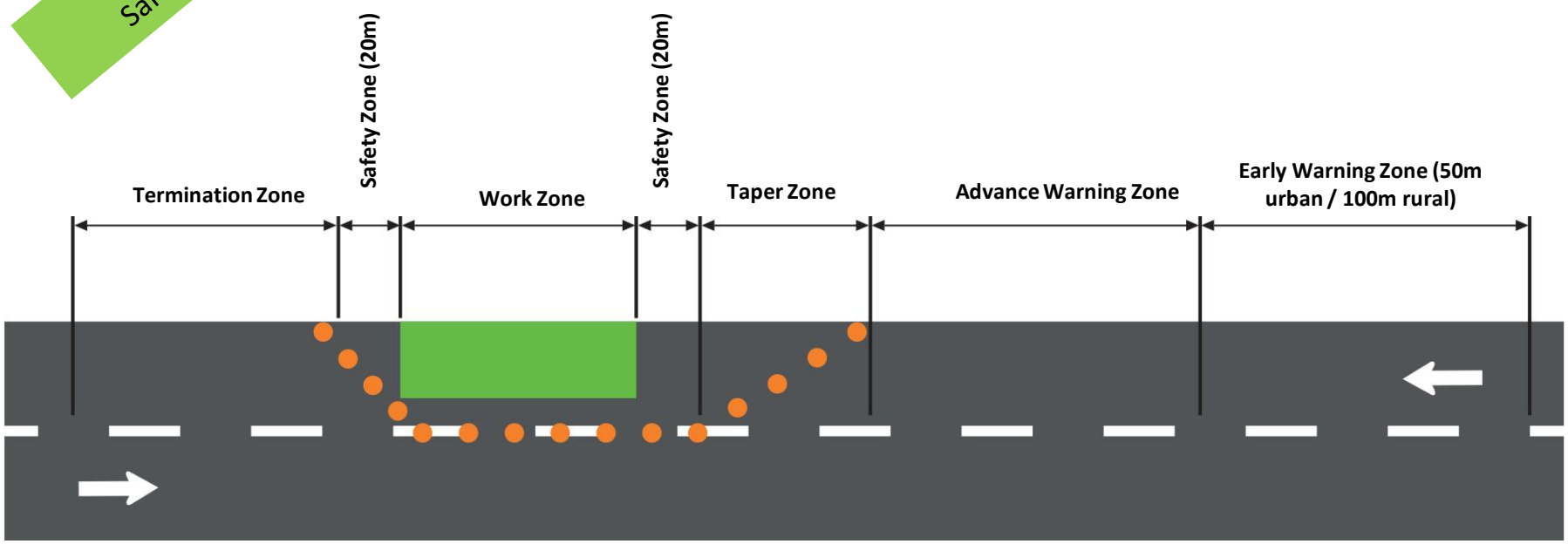
- delineation
- traffic control
- safety of workers
- signs, lighting … and more

Ulaanbaatar October 2018!

Manual Two - Safer Road Works

Figure 4 The Six Zone Concept

NOTE: The Figure shows a Traffic Management Plan for one direction of travel only



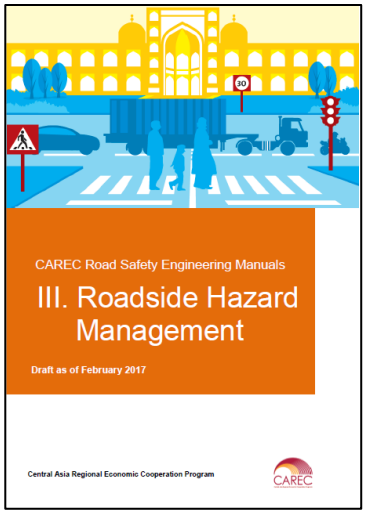
The CAREC Safer Road Works manual encourages the use of the six zone concept


A sign is useless……


… unless it can be seen !

Manual 3 – Roadside hazard management

This manual details roadside safety. Too many people die in “run-off-road” crashes



Manual Three - Roadside Hazard Management

Manual 3 – Roadside Hazard Management

Improve your highways, and speeds go up. “Run-off-road” crashes increase. Roadside hazard management is needed to minimise this risk.

Wear your seat belt!

If you do not want to see videos two violent crashes…..

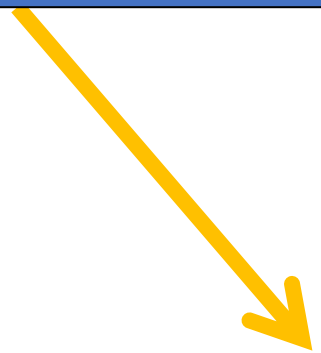
…turn away now


uidman.ca

Manual Three -
Roadside Hazard Management

A strategy for Roadside Hazard Management

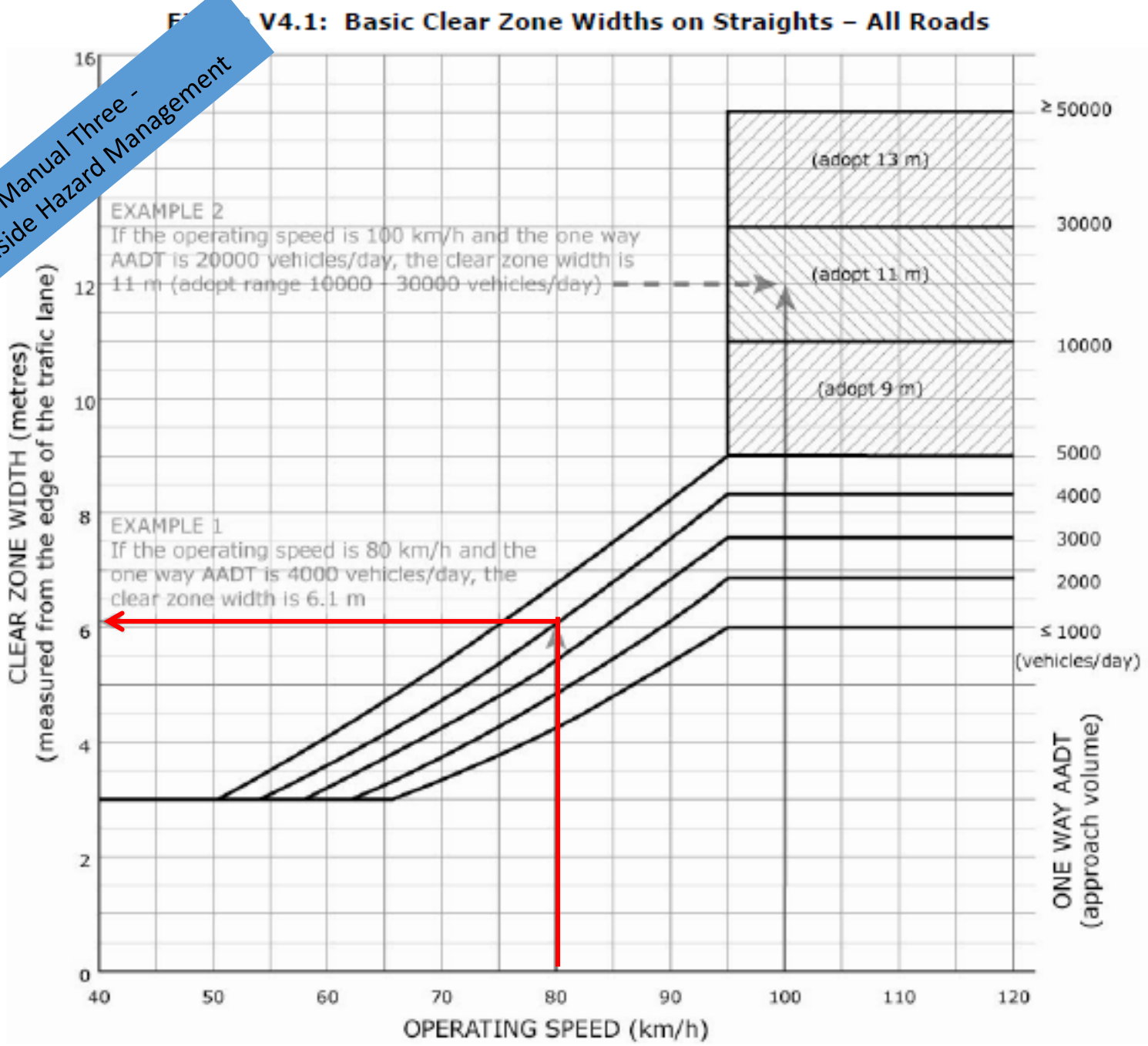
1. Keep vehicles on the road
2. Provide a forgiving roadside



i. remove the hazard
ii. relocate the hazard
iii. alter to reduce severity
iv. protect with barriers

Manual Three - Roadside Hazard Management

Clear Zone Chart




Manual Three -
Roadside Hazard Management
Manual 3 outlines the common groups of safety barriers
Wire Rope Safety Barrier

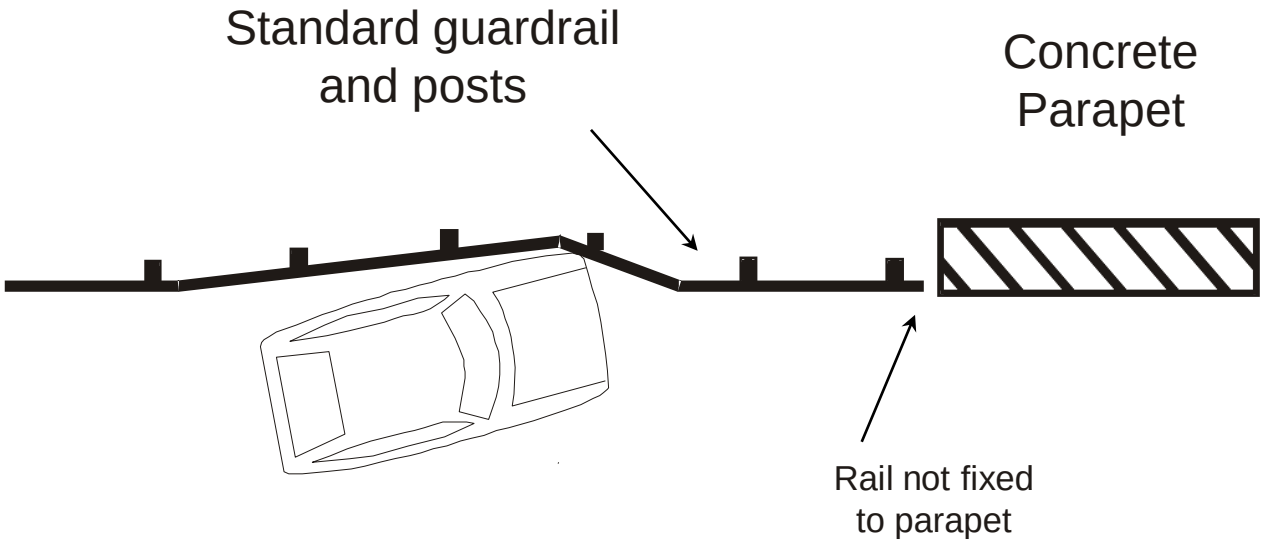

Manual Three -
Roadside Hazard Management
W Beam Safety Barrier


Rigid Barrier


ГҮҮР
Gurvaljin
bridge
City center
ЯАРМАГИЙН ГҮҮР
Yarmag bridge
ИХ ТЭНГЭР
ЦОГЦОЛБОР
Ikh tenger
complex

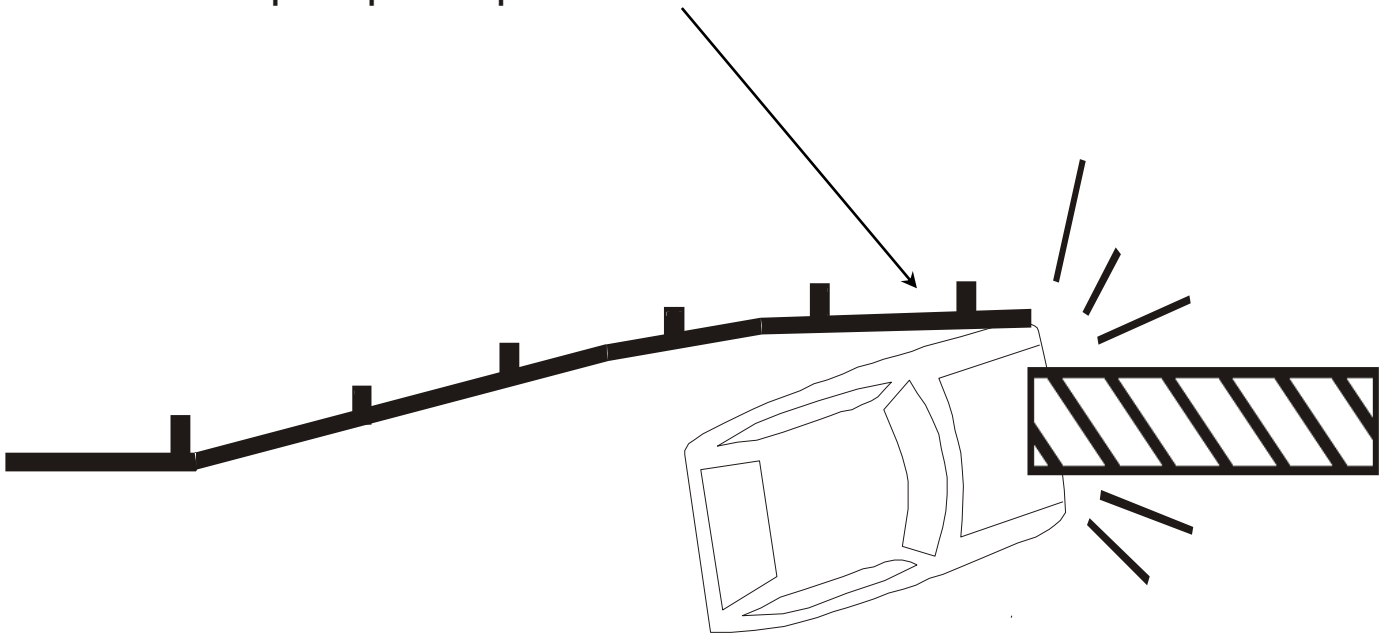
Is this bridge cross section “standard”?
Is it safe?

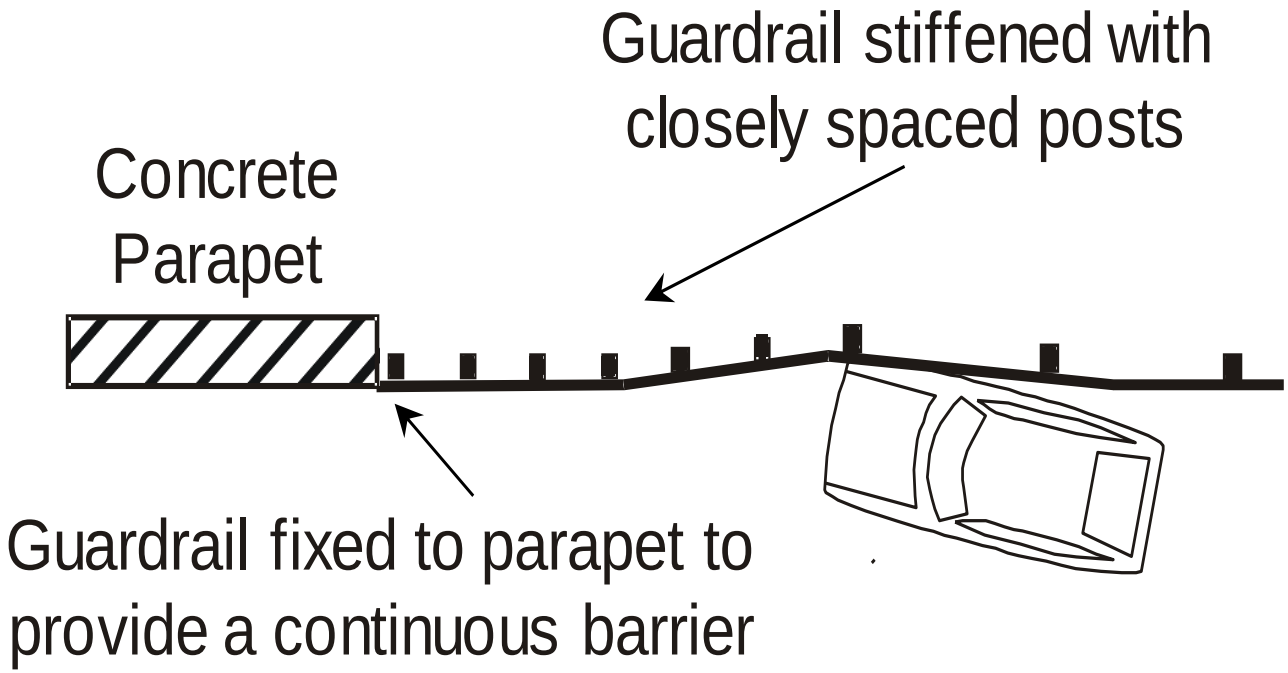
“Pocketing”


Standard guardrail
and posts
Concrete
Parapet
Rail not fixed
to parapet

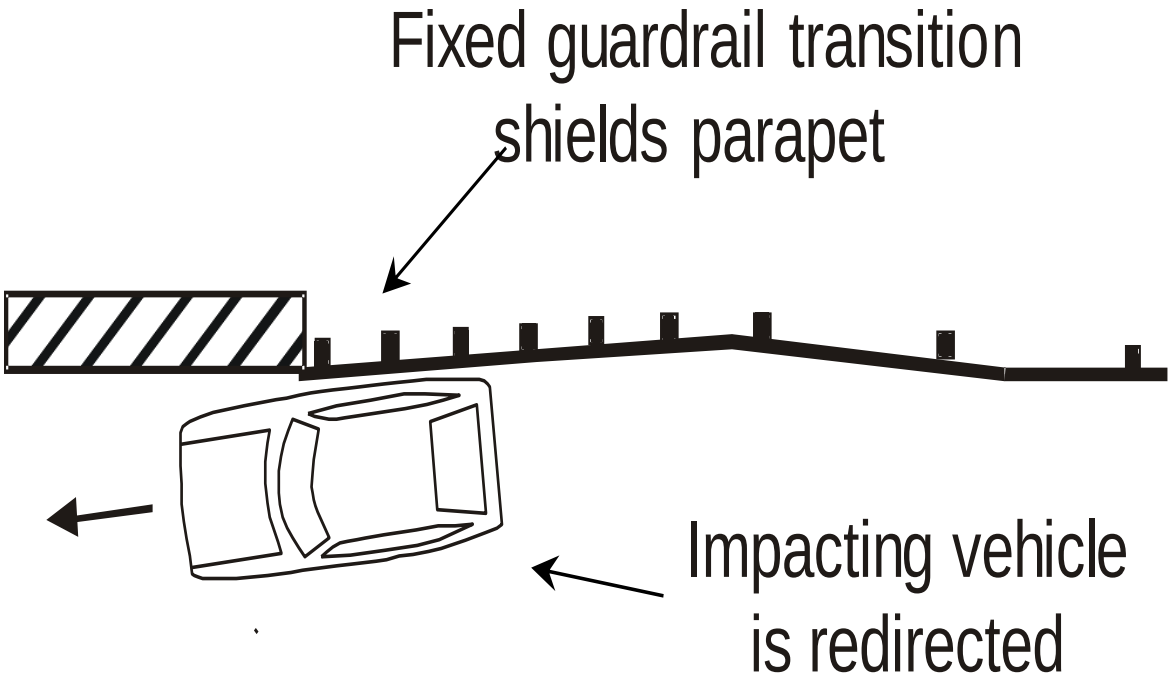
“Pocketing”

Guard rail deflects and leaves
the parapet exposed





No “Pocketing”



No “Pocketing”

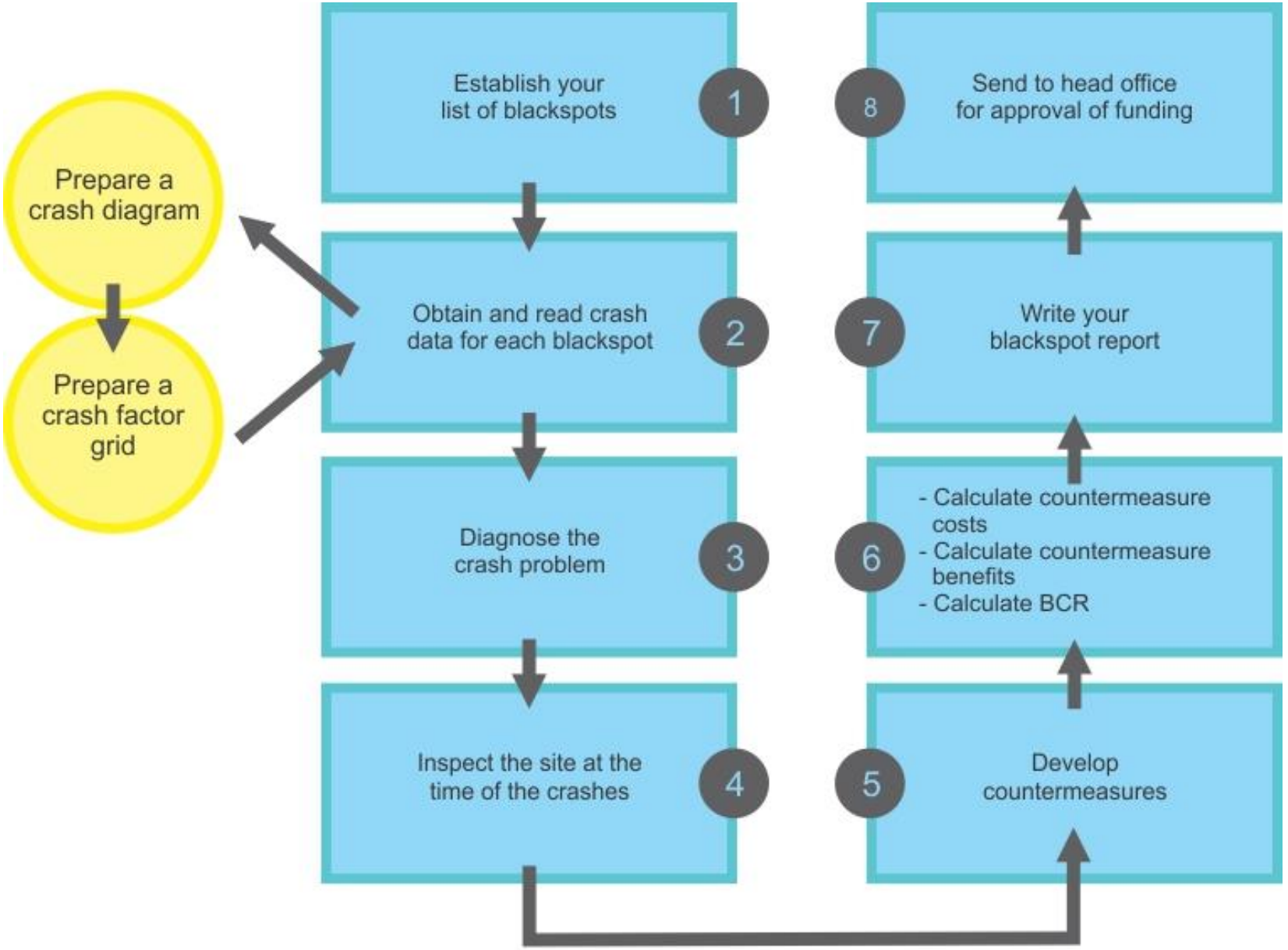
Unsafe! A safe terminal is needed to avoid spearing vehicles. Very unsafe!


End treatments are necessary to avoid penetration into the vehicle

More CAREC Road Safety Engineering manuals are needed:

- ✓ Treating hazardous locations (blackspots)
- ✓ Pedestrian safety

Investigating and treating blackspots


Establish your list of blackspots
1
Obtain and read crash data for each blackspot
2
Diagnose the crash problem
3
Inspect the site at the time of the crashes
4
Develop countermeasures
5
- Calculate countermeasure costs
- Calculate countermeasure benefits
- Calculate BCR
6
Write your blackspot report
7
Send to head office for approval of funding
8
Prepare a crash diagram
Prepare a crash factor grid

Crash occurs

Police report

Stored in database

Data extracted

Diagnosis

Develop countermeasures

Design, then audit and then build

Monitor

?

Draw a collision diagram

- For each vehicle – draw an arrow to show its direction
- Show m/c, pedestrians, cars, trucks, buses differently
- The point of impact should be accurately shown

An example of a Collision Diagram

Draw a crash factor grid (Matrix)

- Use Microsoft Excel (or paper will do).
- For each crash – summarise all the known details in one column.
- Add rows if extra information is known from the Police reports.

An example of a Crash Factor Matrix

Accident Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date: day: month	1307	0409	1912	0806	0307	0711	3012	2702	0305	2407	1804	2105	1406	2008
Date: year	17	17	17	18	18	18	18	18	18	19	19	19	19	19
Day of week	Sat	Wed	Thu	Sun	Thu	Fri	Tue	Fri	Sun	Fri	Sun	Fri	Mon	Fri
Time of day	1700	1855	1530	1900	1345	2145	1900	1220	1800	2000	1845	1610	1735	1855
Severity	3	3	2	3	2	4	3	3	4	2	3	2	2	3
Light conditions														
Road Conditions	W	W	D	D	D	D	D	D	D	D	D	D	W	D
DCA Code	101	101	101	101	101	101	101	101	101	101	101	101	101	101
Object 1	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Car	Van	Car
Object 2	Car	Car	Truck	Car	Car	Car	Car	Truck	Car	Car	Car	Car	Car	Car
Object 3					Car			Car			Car			
Direction 1	N	S	N	S	N	S	S	S	S	S	N	S	N	S
Direction 2 (& 3)	E	W	E	W	W,E	W	E	W,N	E	W	W,E	W	W	W
Other														

Decide on low cost countermeasures

- Signs – warning, regulatory, direction
- Line marking
- Delineation
- Shoulder sealing
- Roadside hazard removal
- Pedestrian facilities
- Speed limits
- Closures, bans, restrictions, prohibitions
- Traffic signals
- Roundabouts
- Lighting

Let's look at just one hazardous location

11 pedestrian fatalities in one year. All at night. Many intoxicated

Several signalised crossings and three Zebra crossings

Too few crossing points, and inconsistent control

What can we do – at modest cost?

Think about all of your customers:

SENIOR CITIZENS - 19% OF PEDESTRIAN FATALITIES ARE OVER 65 YEARS

YOUNG - 20% OF PEDESTRIAN FATALITIES ARE AGED 4-12 YEARS

INTOXICATED - 43% OF NIGHTTIME PEDESTRIAN FATALITIES ≥ 0.15% BAC

THE DISABLED


seniors - 19% of pedestrian fatalities are over 65 years of age

young - 20% of pedestrian fatalities are aged 4-12 years

intoxicated - 43% of adult male pedestrian fatalities ≥ 0.15% BAC in my State (Victoria).

What % in Mongolia?


How safe are the disabled in your city?

There are only three basic pedestrian strategies…

Segregation	– freeways, malls
Separation	– in time or in space
Integration	– where vehicles and pedestrians “share” the road

Segregation – freeways


Segregation - malls
VICHY
ICBC

Separation – in time

Use pedestrian push buttons to allow pedestrians to call up their phase

Puffin Crossings

My recommendations

Make all crossings signalised - consistency
Separate phases for each carriageway
Pedestrian push buttons
Increase flood lighting at each

Mongolia needs safer roads and more road safety engineers.

I hope you can join the challenge. I welcome your questions.