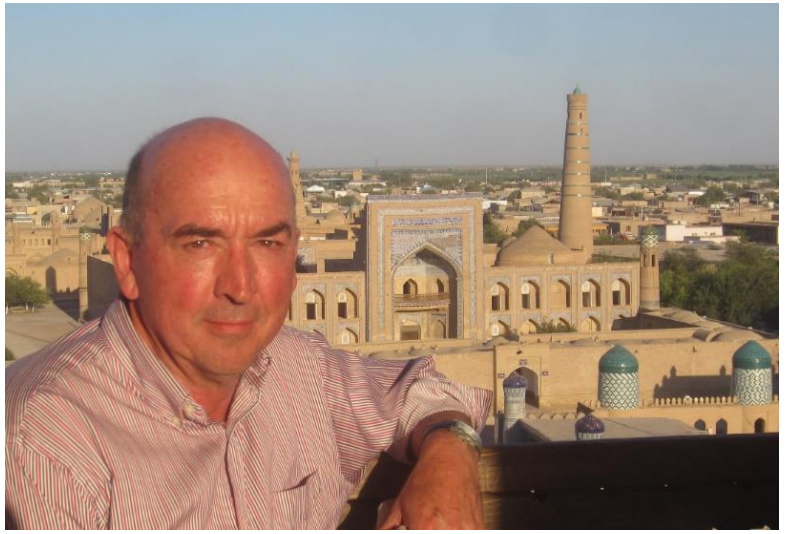
CAREC Road Safety and Sustainable Mobility Course

2024

Safer Roads and Roadside Infrastructure

“Key interventions in road safety engineering for CAREC road authorities”

Phillip Jordan, ADB Road Safety Engineering Consultant



Phillip Jordan

31+ years with a road authority in Australia

19 years consulting in traffic & road safety engineering.

48 countries including all 11 CAREC countries

Police and engineers to share crash data

Build up a RSE Section within your MoT

Start/promote a national blackspot removal program
Eliminate Y-junctions
Consistent delineation of highways
Tactile edge lines and centre lines
Low-cost pedestrian infrastructure

Require road safety audits of all major projects on major and regional roads.

Review and update standards
Safer drainage
U-turns
Bridge cross sections, roundabouts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Safer drainage
U-turns
Bridge cross sections, roundabouts


1) МВД
2) Минст Автотранс (автошкола)
3) Мин Авто дорог строительство
4) Инститyт проектирование авто дорог.
5) Минс. образование
6) Минс. здравохранение
Myradov

CAREC Road Safety and Sustainable Mobility Course

Phase 3 – 25th June 2024

Safer Roads and Roadside Infrastructure

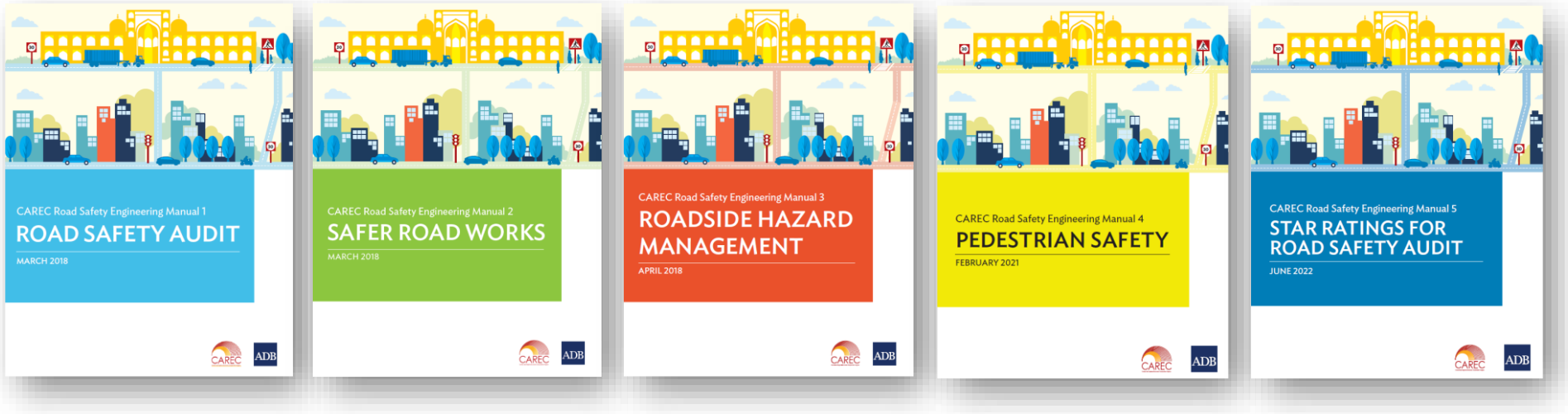
“The CAREC Road Safety Engineering manuals”

Phillip Jordan, ADB Road Safety Engineering Consultant

The key topics in road safety engineering:

- road safety audit,
- blackspot investigations,
- pedestrian facilities,
- roadside hazard management,

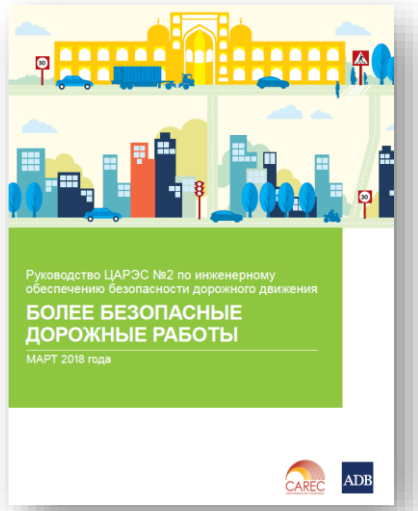
The CAREC Road Safety Engineering Manuals



The 5 CAREC road safety engineering manuals are useful to help you make your roads safer.

Go to the ADB website

Руководства по инженерному обеспечению безопасности дорожного движения ЦАРЭС



У вас есть 5 руководств по инженерному обеспечению безопасности дорожного движения ЦАРЭС?
Это полезная серия для помощи в обеспечении безопасности на ваших дорогах.
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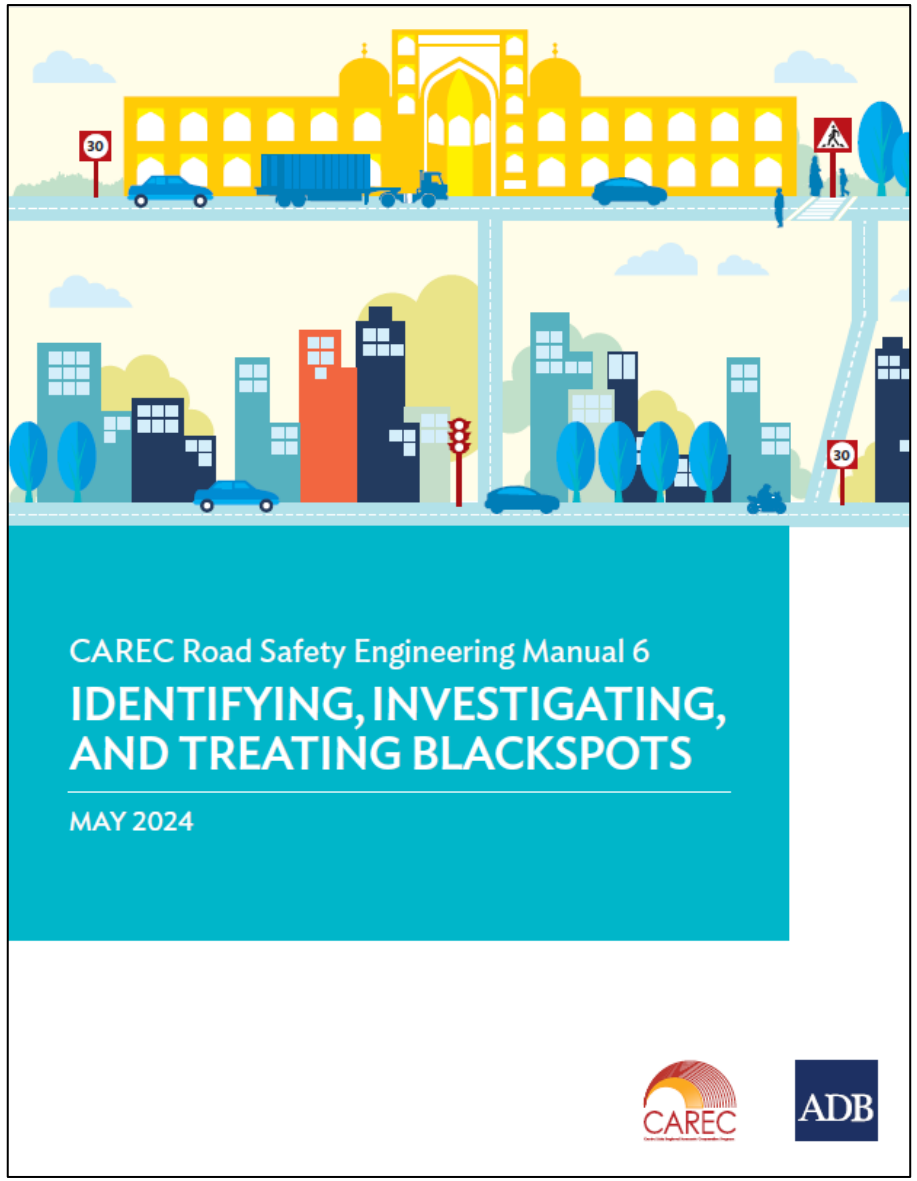
Филип Джордан, Консультанта-инженер по безопасности дорожного движения

Manual 6 – soon!

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INSTITUTE

CAREC Road Safety and Sustainable Mobility Course

Phase 3 – 25th June 2024

Safer Roads and Roadside Infrastructure

“The road safety audit process”

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

Decide

Select audit team

Pre-audit communication

Desktop audit

Inspect site

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 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
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)

Write audit report

Post-audit communication

Respond to the report

Implement

Key audit steps….

Appoint an audit team leader, who assembles an audit team

Key audit steps….

- inspect the site, day and night
- drive, walk, take time
- use checklists to remind….

What projects should be audited?

Road safety audit is for big projects

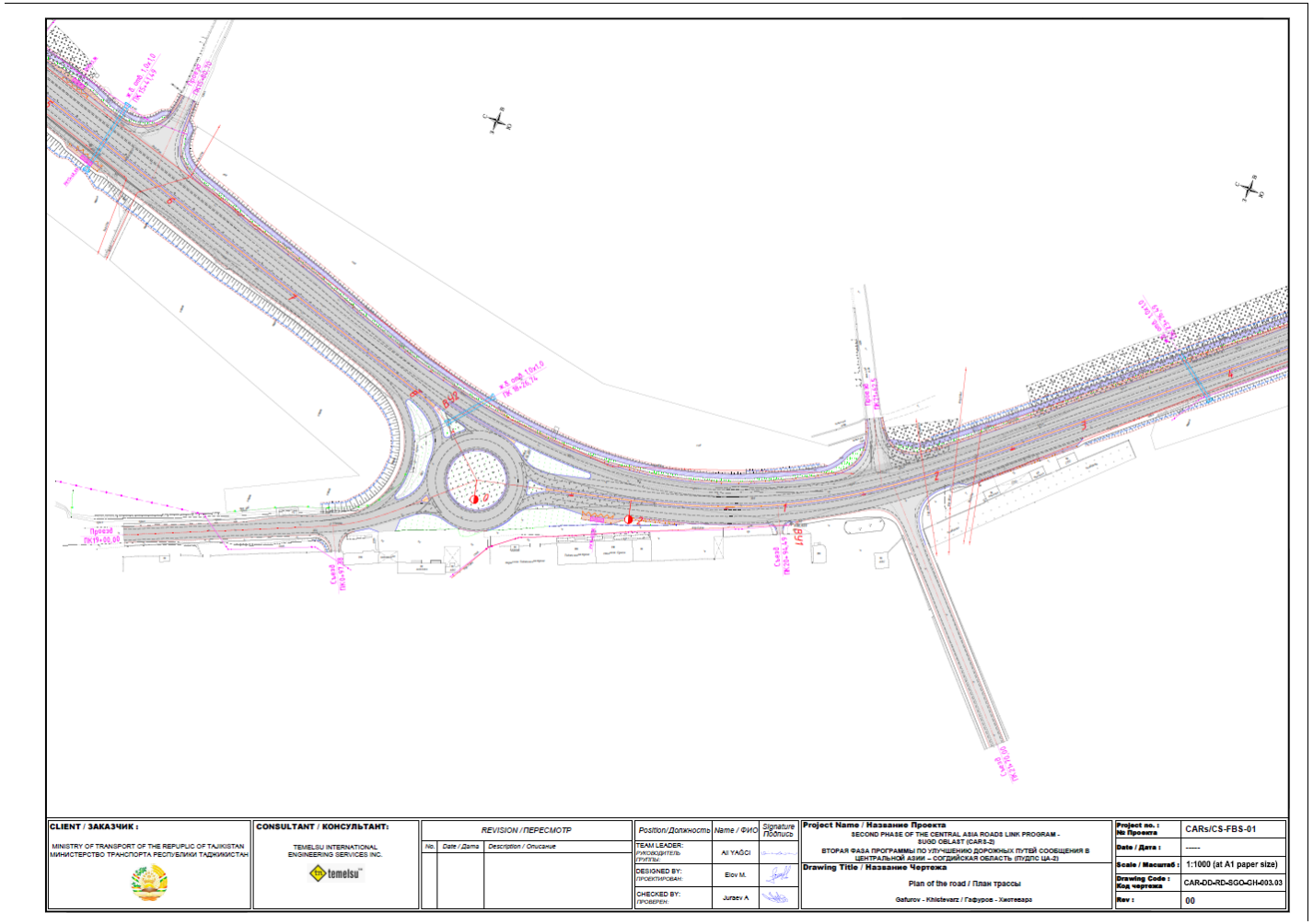
Road safety audit is for small projects

Road safety audit is for urban projects

Road safety audit is for road works

When are road safety audits undertaken?

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




Road safety audit is a positive process – its aim is to make a safer new road

Road safety audit is good for road safety. It can:

Prevent unsafe issues being introduced into new roads

Make designers more conscious of safety in design

Make engineers more aware of their role in safety

Develop a culture of safety in a highway authority

Save lives on new roads!

Road safety audit is good for road safety

- Road safety audit focusses on making road designs safer.
- They are undertaken by road safety engineering experts
- These people are independent of the design.
- Audits are not bound by costs, or by national standards

DISCUSSION 1

- The audit process *should* be welcomed by every road authority in every country. It *should* be a key part of their design process.

- Where is road safety audit today in your country?

- What is needed to imbed it in your new road projects?

DISCUSSION 2

A design team uses national standards and design guides.

Who updates these?

Who checks the *safety* of the standards in CAREC countries?

Audit teams report all safety issues they find. Some of these may be due to “out-of-date” standards, or common but unsafe practices.

Can this be improved?

DISCUSSION 3

Where can auditors be found in CAREC?

Most audits have been undertaken by foreign auditors brought in by development banks or Supervision Consultants.

This is expensive and doesn’t develop the profession in-country.

How can it become more efficient?


URMAT TILENBAEV
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NARGIZA ADYLBEKOVA
STATE ENTERPRISE
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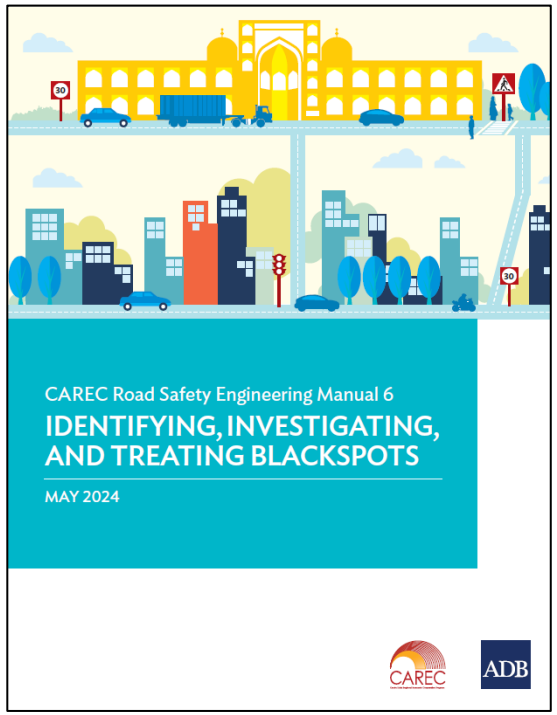


CAREC Road Safety and Sustainable Mobility Course

Phase 3 - June 2024

Safer Roads and Roadside Infrastructure

“The blackspot investigation process”

WHAT IS A BLACKSPOT?

- A blackspot is any site with many casualty crashes
- Casualty crash means a fatal crash, or a crash in which at least one person is injured
- Intersections, short lengths, or curves = blackspot
- Road length of 1km = black length

The blackspot process

IDENTIFICATION

INVESTIGATION

TREATMENT

Figure 3: The Blackspot Process

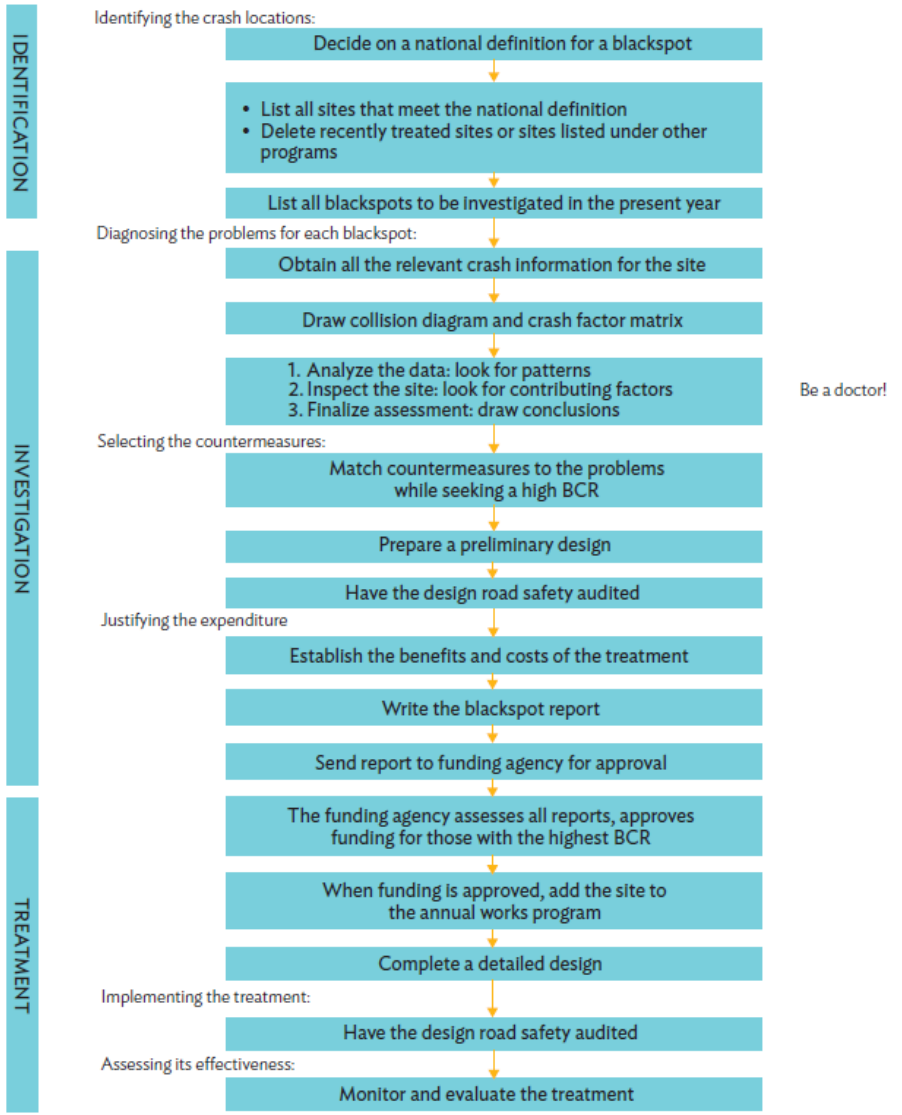
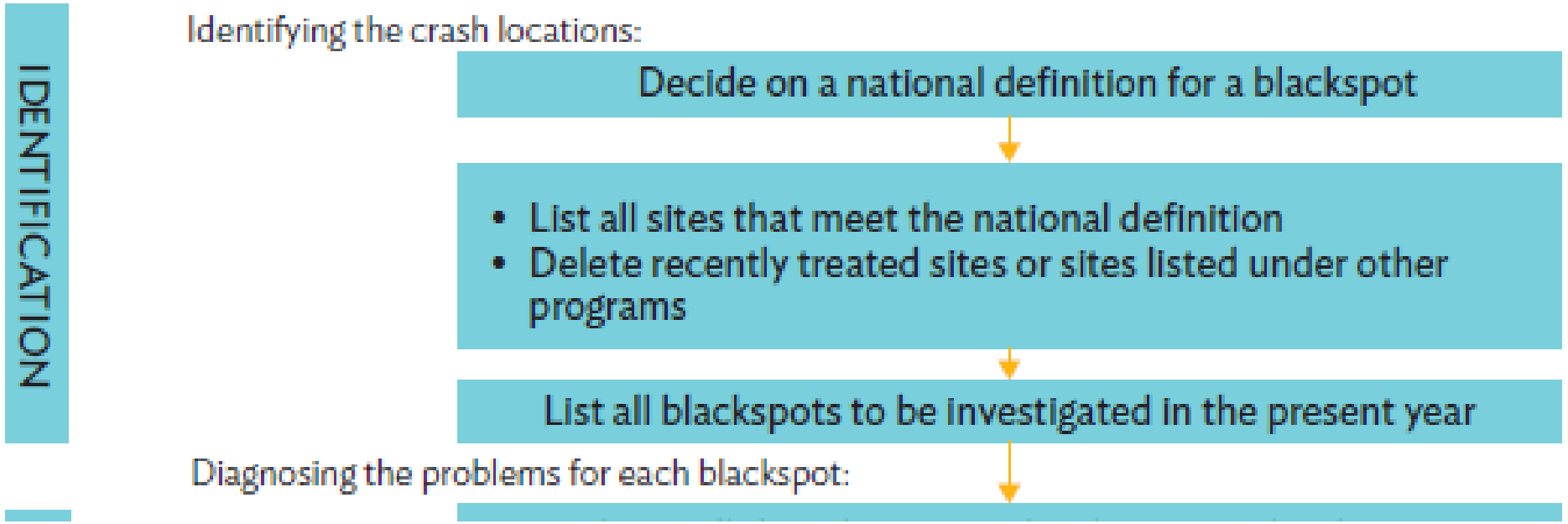


Figure 3: The Blackspot Process

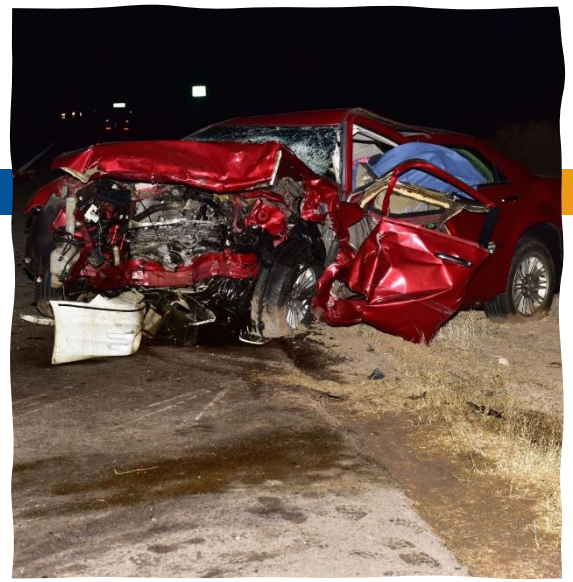


Police gather crash data...

- Date/time/location/directions
- Names/addresses/ages/sex of all involved
- Alcohol/drugs
- Vehicle types/registration
- Injury levels
- Any other information needed to prosecute the offender
- More

Best international practice is when Police record the crashes, store the crash data in a database, and share it with government stakeholders

DISCUSSION 4



Do your Police collect crash data accurately and completely?
Is it shared with stakeholders?
Can you use it to identify “hazardous locations”
If not – how will you know what sites to investigate?

1 Decide

your list of blackspots

How?

- National level, state or city level
- Locations with most fatalities?
- Locations with most crashes?
- A point system 10 for F, 5 for SI, 1 for PD.

INVESTIGATION

Diagnosing the problems for each blackspot:

Obtain all the relevant crash information for the site

Draw collision diagram and crash factor matrix

1. Analyze the data: look for patterns
2. Inspect the site: look for contributing factors
3. Finalize assessment: draw conclusions

Be a doctor!

Selecting the countermeasures:

Match countermeasures to the problems while seeking a high BCR

Prepare a preliminary design

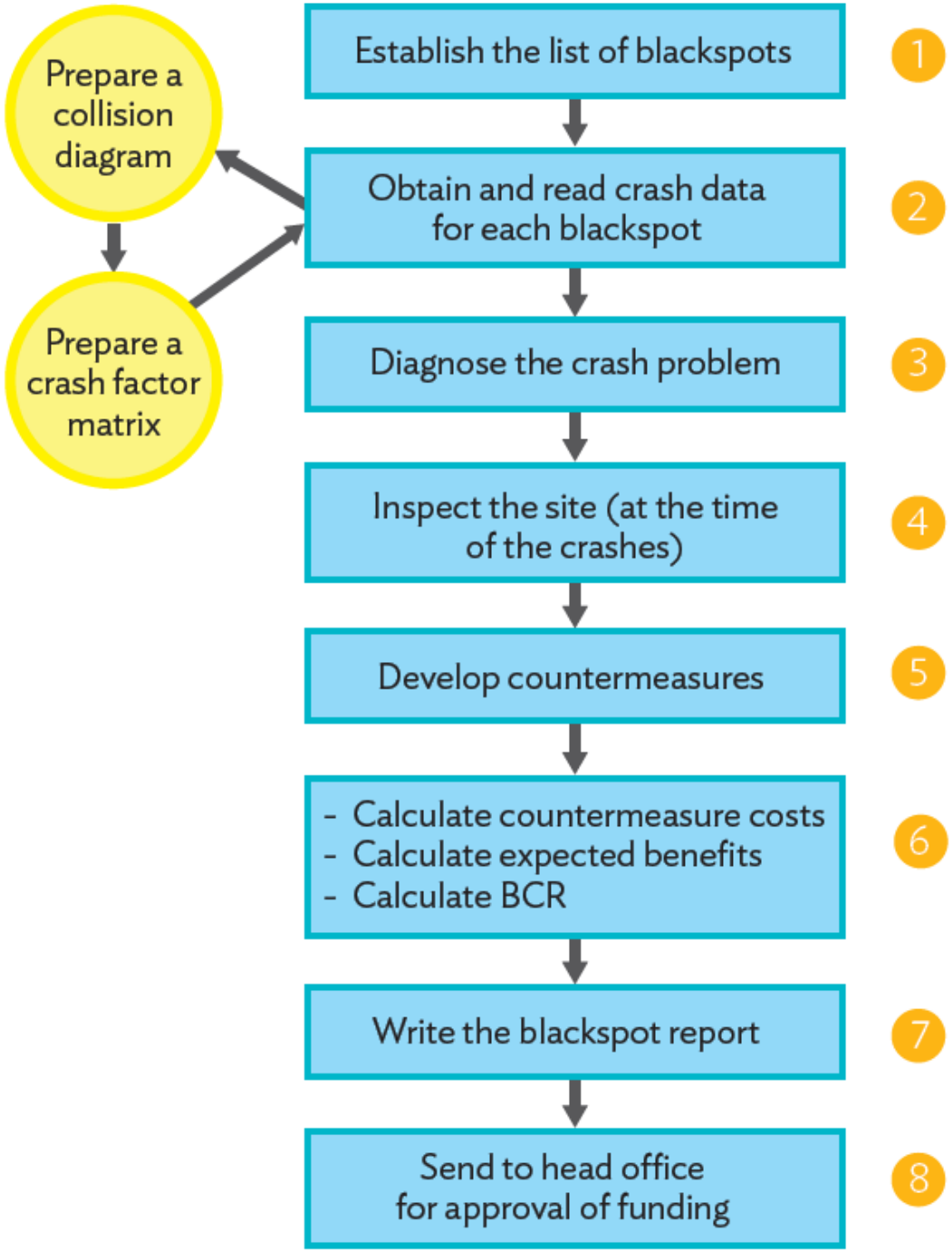
Have the design road safety audited

Justifying the expenditure

Establish the benefits and costs of the treatment

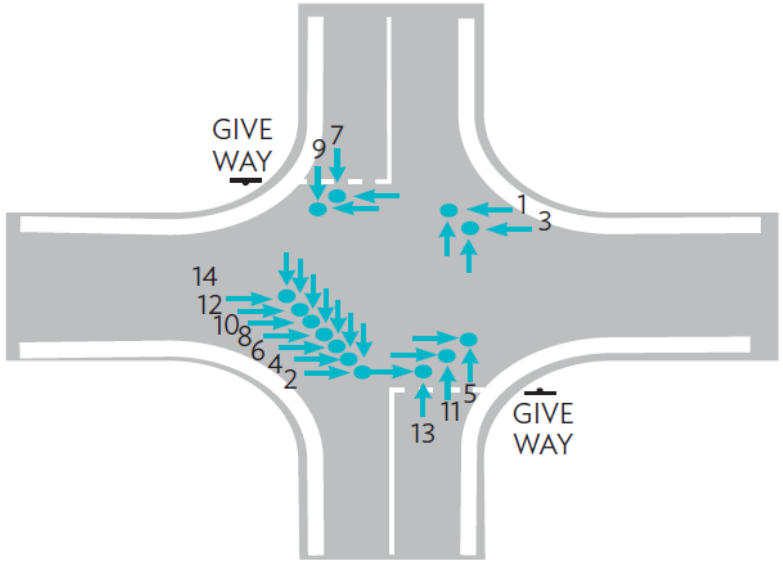
Write the blackspot report

Send report to funding agency for approval

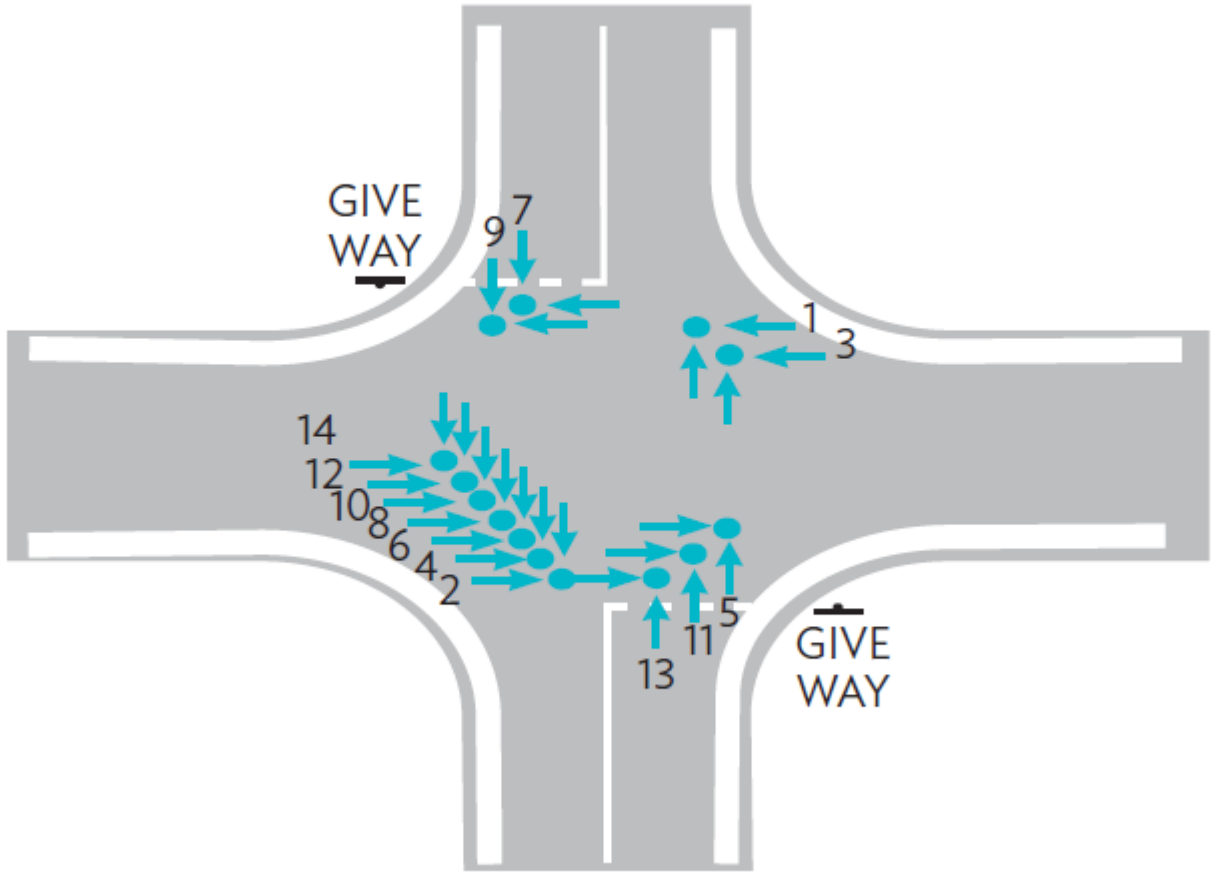

Prepare a collision diagram
Prepare a crash factor matrix
Establish the list of blackspots
1
Obtain and read crash data for each blackspot
2
Diagnose the crash problem
3
Inspect the site (at the time of the crashes)
4
Develop countermeasures
5
- Calculate countermeasure costs
- Calculate expected benefits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

2 Draw a collision diagram

- For each vehicle – draw an arrow to show its direction
- Show pedestrians, cars, trucks, buses differently
- Show the point of impact as accurately as you know



A Collision Diagram



2 Draw a crash factor matrix

Crash Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date: Month	3/06	04/10	19/11	08/06	03/07	07/11	30/12	27/02	03/05	24/07	18/04	21/05	14/06	20/08
Day of week	Sat	Wed	Thurs	Sun	Thurs	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	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Dry
DCC code	110	110	110	110	110	110	110	110	110	110	110	110	110	110
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)	W	E	W	E	E	E	W	E	W	E	E	E	E	E
Other														

- Microsoft Excel.
- Pen and paper is also OK.
- For each crash – summarise the details in one column.
- Add rows if extra information is known from the Police reports.

A crash factor matrix

An example of a Crash Factor Matrix

Crash Number	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Date: Month	3/06	04/10	19/11	08/06	03/07	07/11	30/12	27/02	03/05	24/07	18/04	21/05	14/06	20/08
Day of week	Sat	Wed	Thurs	Sun	Thurs	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	Wet	Wet	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Dry	Wet	Dry
DCC code	110	110	110	110	110	110	110	110	110	110	110	110	110	110
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)	W	E	W	E	E	E	W	E	W	E	E	E	E	E
Other														

3 Diagnose the crash problem

- A person is sick.
- He/she visits a doctor and tells the doctor about the illness.
- The doctor does not want to treat the patient incorrectly.
- Blackspot engineers are like a doctor.
- They diagnose a “sick” part of the road network (a blackspot).
- The blackspot cannot speak.
- The engineers must look, listen, read crash data, speak with Police, ask locals.
- This takes time, skill, and logic.
- We must give the patient the correct medicine!

3 Diagnose the crash problem

Examine the Collision Diagram and the Crash Factor Matrix

Look for *patterns*?

Day time vs night time?	Wet vs dry?	Type of crash - head on, or run-off-road, pedestrian etc	Type of road user?	Direction of travel?

4 Inspect the site – look for contributing factors to the pattern of crashes

If crashes happened at night, inspect at night!

Put yourself in the shoes of those involved.

Ask ….. why did they have their crash?

5 Develop countermeasures

- Signs – warning, regulatory, direction
- Line marking
- Delineation
- Shoulder sealing
- Roadside hazard removal (or shielding)
- Geometric changes
- Opening sight lines (benching, cut vegetation)
- Speed limits
- Traffic signals/ roundabouts
- Lighting

Keep ideas simple

Use low-cost options where possible

Persevere – some sites are difficult, but most locations will be open to low-cost countermeasures

WHY?

6 Finalise a preliminary design, and calculate a benefit/cost ratio for the recommendations

There will be competition for funding within a national blackspot program.

The national road authority will need to rank all sites so that funds are spent on the sites that will return the “best value” to the country.

How will we determine benefits and costs?

1. We need to know the benefits of the countermeasures (in $)
2. We need the cost of the countermeasures (in $)
3. Then we calculate the benefit/ cost ratio

BCR

To determine benefits and costs

Costs are easy!

But how do we calculate the benefits (in $).

Benefits = the number of crashes we expect to save, times how much would each one costs your country (in $).

This is what crash reduction factors can help us with!

PAVEMENT WORKS	%	YEARS
Road reconstruction	25%	20
Duplication short length	30%	20
Install raised median	30%	20
Add median strip	20%	20
Widen pavement	10%	20
Construct overtaking lane	25%	20
Add lane	10%	20
Widen road for Right Turn lane	50%	20
Widen road for Left Turn lane	15%	20
Lane widening - 0.3m	5%	20
Lane widening - 0.6m	12%	20
Widen shoulder not seal - 0.3m	3%	20
Widen shoulder not seal - 0.6m	7%	20
Widen shoulder not seal - 1m	10%	20
Widen shoulder and seal - 0.3m	4%	20
Widen shoulder and seal - 0.6m	8%	20
Widen shoulder and seal - 1m	12%	20

How to determine benefits and costs?

1. Establish your countermeasures
2. Get the Crash Reduction Factor
3. This is the *highest CRF* of those that apply to your treatments
4. Agree on a crash cost ($) for your country
5. Calculate the benefits of the countermeasures ($)
6. CRF x number of crashes saved x $ value for each crash

How to determine benefits and costs?

7. Calculate the cost of the works ($)
8. Calculate the benefit/ cost ratio
9. Include this BCR in your report
10. Head Office will approve funding based on BCR’s.

NOTE: Funding is approved on the basis of BCR’s – not the cost.

EXAMPLE OF CALCULATING THE BENEFIT COST RATIO

To work out the BCR we need to know the benefits (in $) of the countermeasures, and the cost (in $) of the countermeasures.

- An urban intersection blackspot with many right-angle crashes
- Some in day, some at night
- You believe it is a re-start (gap acceptance) problem
- You check traffic counts and recommend a roundabout – CRF's indicate it will save 70% of crashes for next 20 years
- The roundabout will cost $460,000 USD

	Treatments	Crash Reduction Factors	Treatment Life
	INTERSECTION		
	New roundabout (urban, single lane)	**70%**	20
	New roundabout (rural, single lane)	**80%**	20
	Modify roundabout (approach deflection)	**55%**	20
	New traffic signals	**45%**	20
	Convert intersection signals to roundabout	**30%**	20
	Staggered T low volume (<2000 AADT of through road)	**70%**	20
	Removal of Y-intersection	**85%**	20
	Splitter islands/median, urban	**20%**	20
	Splitter islands rural, low volume	**45%**	20
	Linemarking to improve intersection definition	**10%**	5
	Improve sight distance (remove/relocate obstruction)	**50%**	20
	Improve signage	**30%**	15
	Rumble strips on approaches	**30%**	5
	Install Stop signs	**30%**	15
	Install signs	**30%**	15
	Change to Stop signs	**5%**	15

Benefits – derived from a Crash Reduction Factor table

- 20 reported crashes in 5 years
- A roundabout will reduce 70% (14) of these crashes
- 20 years = 4 x 14 = 56 fewer crashes

- One serious *casualty crash* = $27,300 USD

- 56 x $27,300 = $1,529,000 benefits in 20 years

Benefit/ Cost Ratio
BCR

- Benefits of a roundabout = $1,529,000 USD
- Cost of the roundabout = $460,000 USD

BCR = 3.33

(This is a good BCR and will likely receive funding approval)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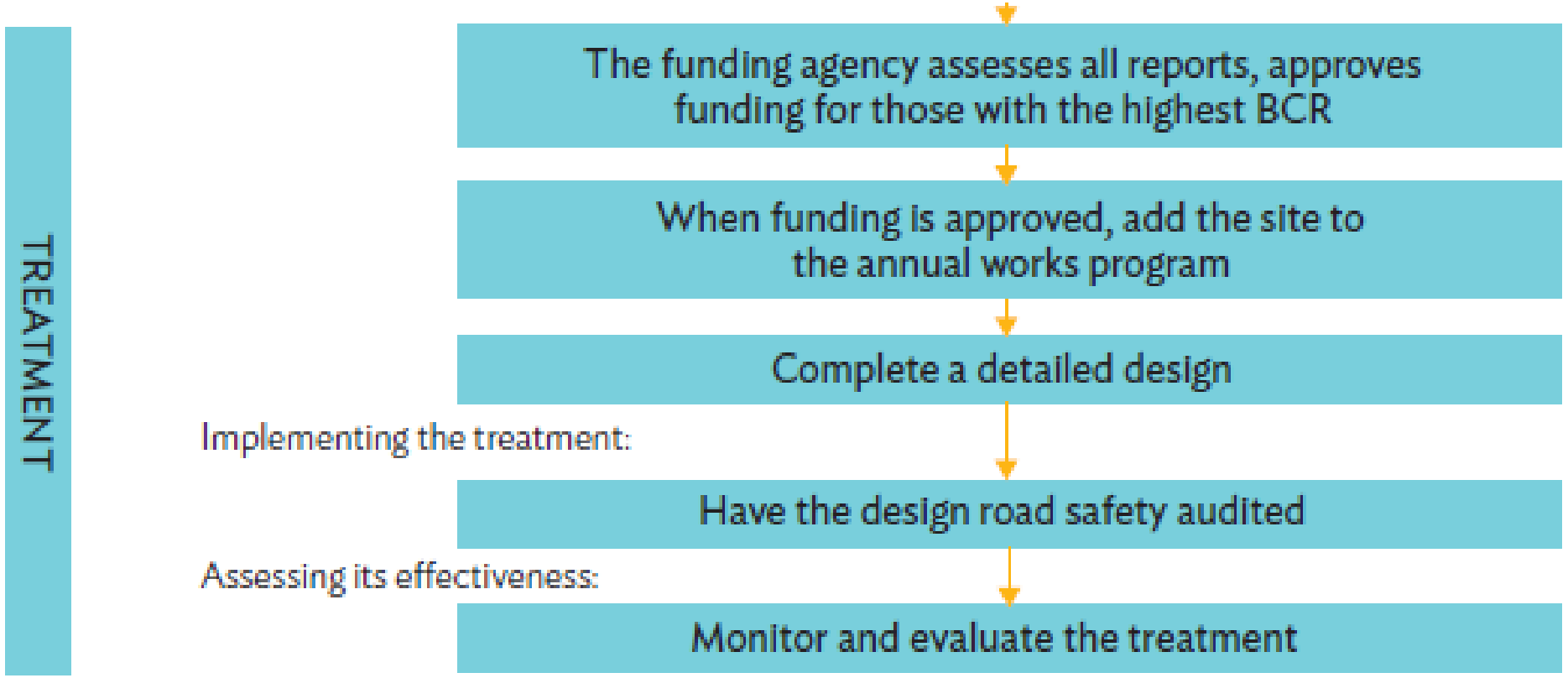
DMITRY SAMBUK
DEPUTY DIRECTOR GENERAL
EASTERN ALLIANCE FOR SAFE
AND SUSTAINABLE TRANSPORT
LUKE ROGERS
SALTANAT SALIEVA
WHO COUNTRY OFFICE
IN KYRGYZSTAN


TREATMENT
The funding agency assesses all reports, approves funding for those with the highest BCR
When funding is approved, add the site to the annual works program
Complete a detailed design
Implementing the treatment:
Have the design road safety audited
Assessing its effectiveness:
Monitor and evaluate the treatment

DISCUSSION 4

Do you have a national blackspot removal program?

Is it working well?

Is it well resourced?

Are crash changes at the treated sites being monitored?

If you don’t have a national blackspot removal program, what is holding you back?

CAREC Road Safety and Sustainable Mobility Course

Phase 3 - June 2024

Safer Roads and Roadside Infrastructure

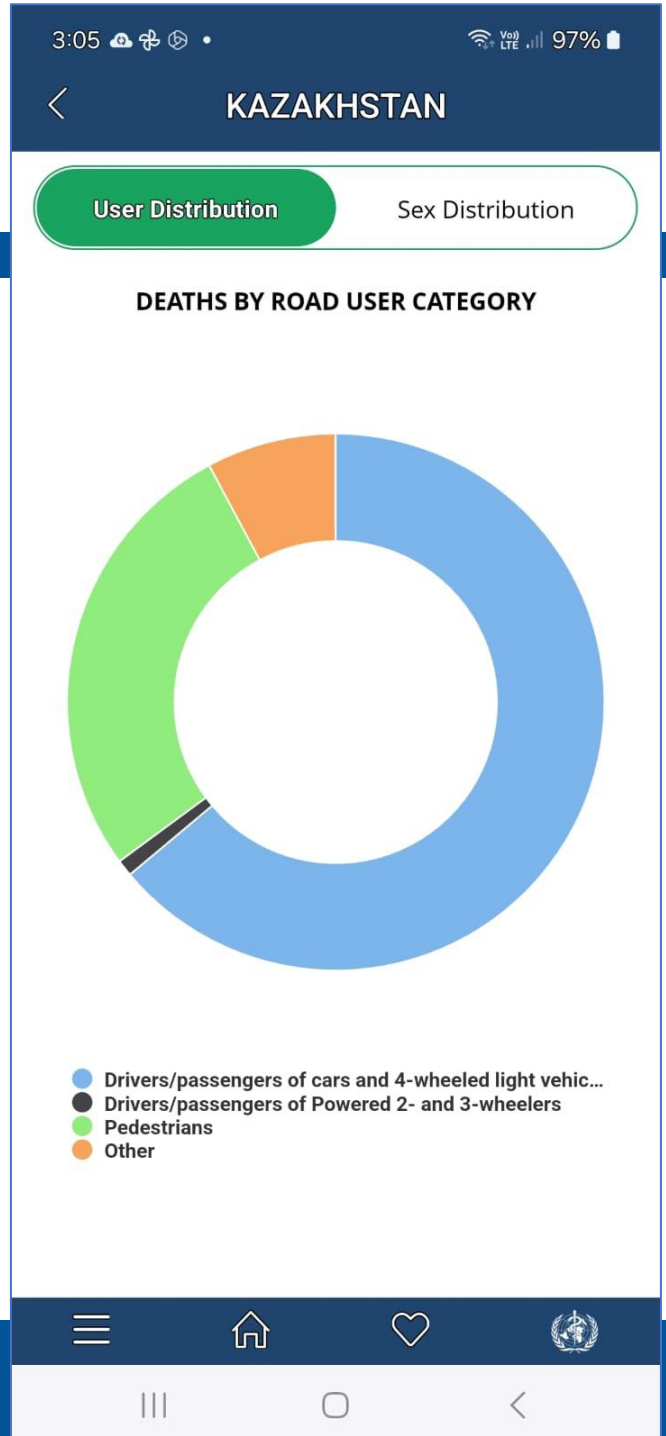
“Pedestrian safety”

Pedestrians are:

- the largest group of road users
- vulnerable
- about 40% of CAREC road fatalities

KAZAKHSTAN


World Health Organization
Global status report on road safety 2023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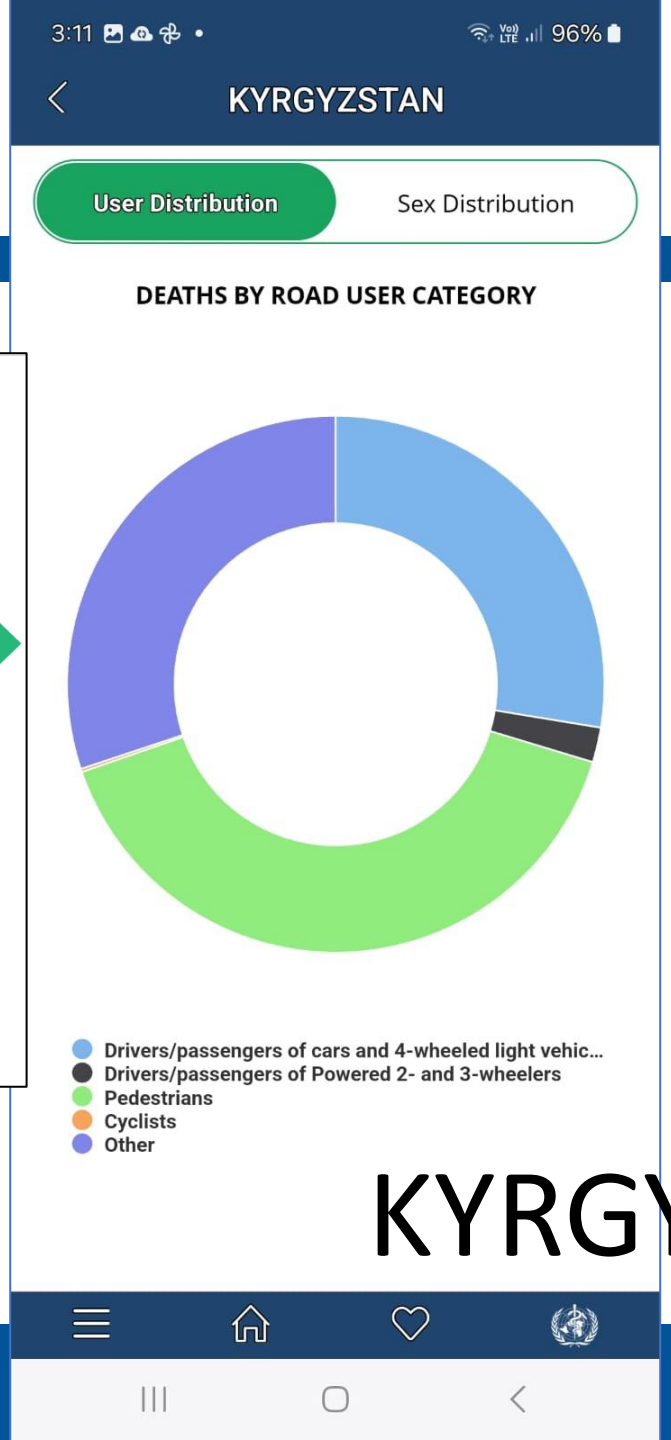
97%
KAZAKHSTAN
User Distribution
Sex Distribution
DEATHS BY ROAD USER CATEGORY
Drivers/passengers of cars and 4-wheeled light vehic...
Drivers/passengers of Powered 2- and 3-wheelers
Pedestrians
Other


World Health Organization
Global status report on road safety 2023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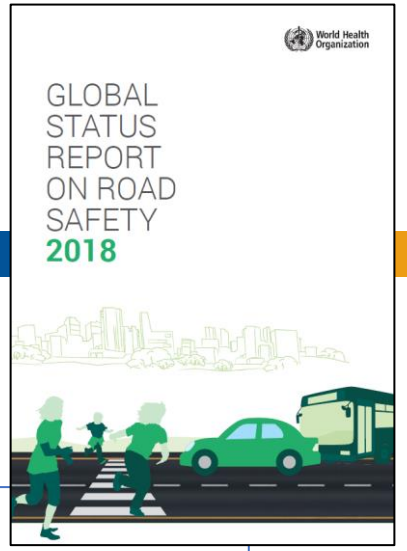
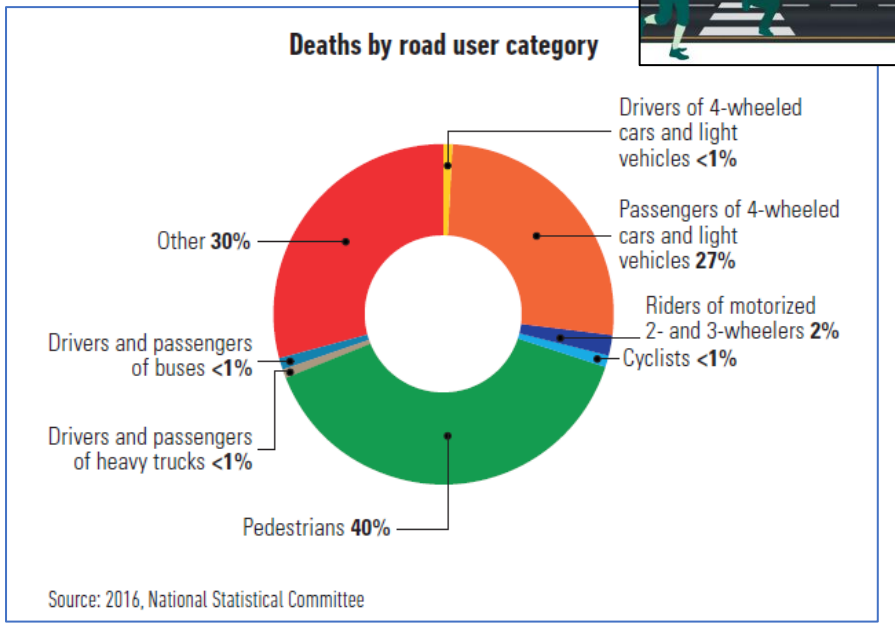
96%
KYRGYZSTAN
User Distribution
Sex Distribution
DEATHS BY ROAD USER CATEGORY
Drivers/passengers of cars and 4-wheeled light vehic...
Drivers/passengers of Powered 2- and 3-wheelers
Pedestrians
Cyclists
Other

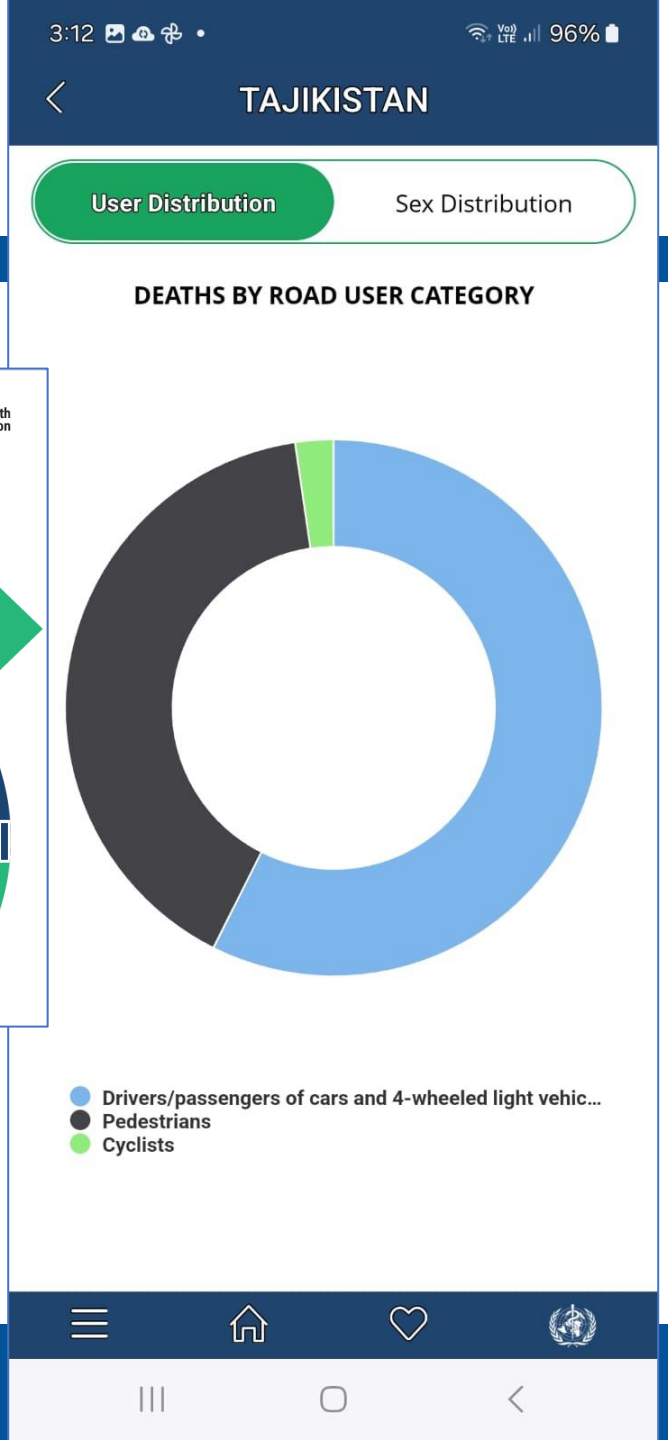

World Health Organization
GLOBAL STATUS REPORT ON ROAD SAFETY 2018

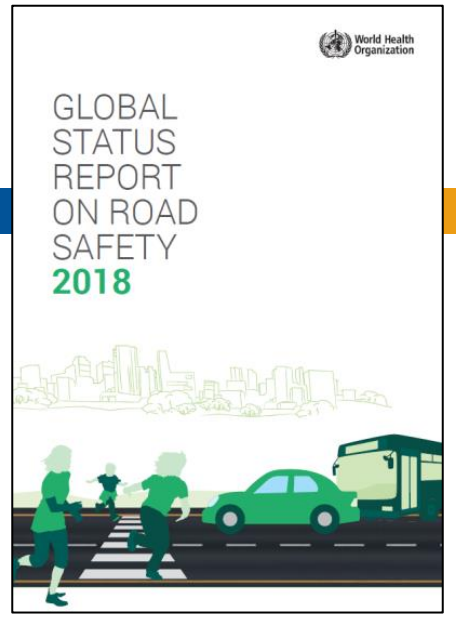

Deaths by road user category
Drivers of 4-wheeled cars and light vehicles <1%
Passengers of 4-wheeled cars and light vehicles 27%
Riders of motorized 2- and 3-wheelers 2%
Cyclists <1%
Drivers and passengers of buses <1%
Drivers and passengers of heavy trucks <1%
Pedestrians 40%
Other 30%
Source: 2016, National Statistical Committee

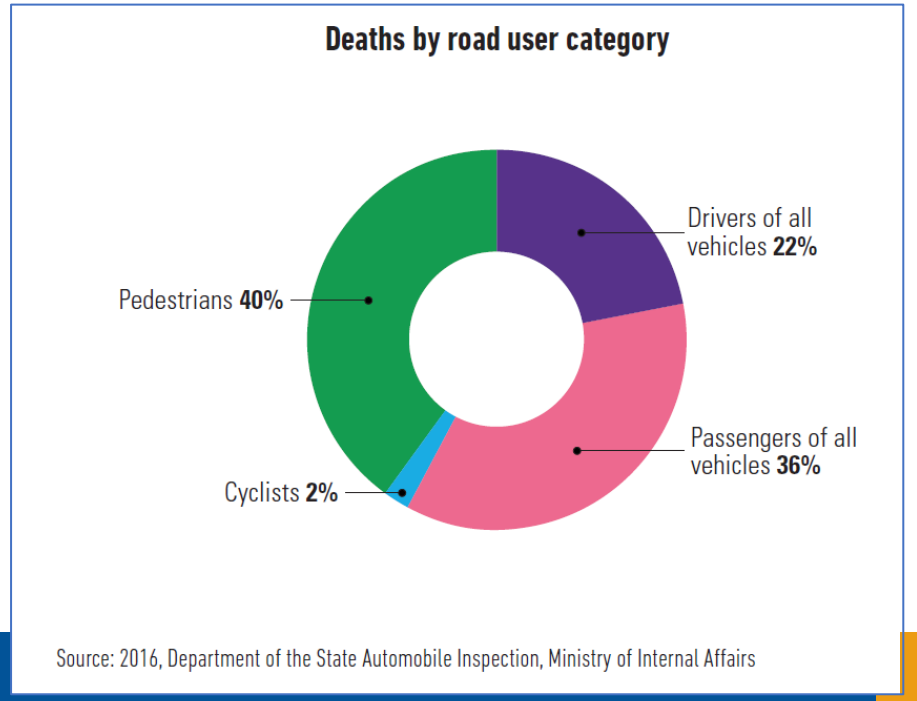
KYRGYZSTAN

TAJIKISTAN

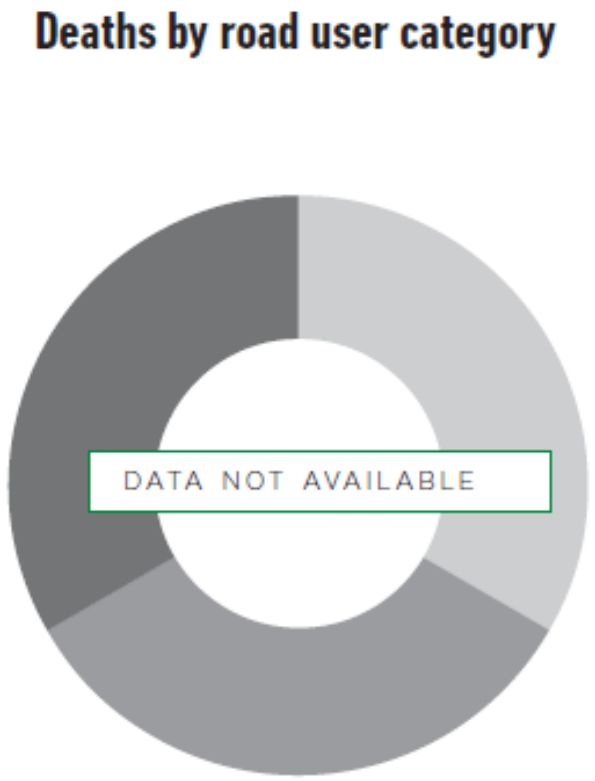

World Health Organization
Global status report on road safety 2023


3:12
96%
TAJIKISTAN
User Distribution
Sex Distribution
DEATHS BY ROAD USER CATEGORY
Drivers/passengers of cars and 4-wheeled light vehic...
Pedestrians
Cyclists


World Health Organization
GLOBAL STATUS REPORT ON ROAD SAFETY 2018

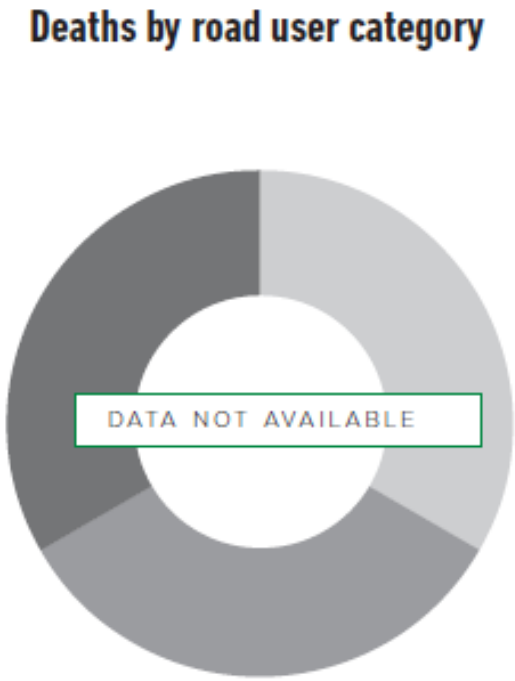

Deaths by road user category
Drivers of all vehicles 22%
Pedestrians 40%
Passengers of all vehicles 36%
Cyclists 2%
Source: 2016, Department of the State Automobile Inspection, Ministry of Internal Affairs

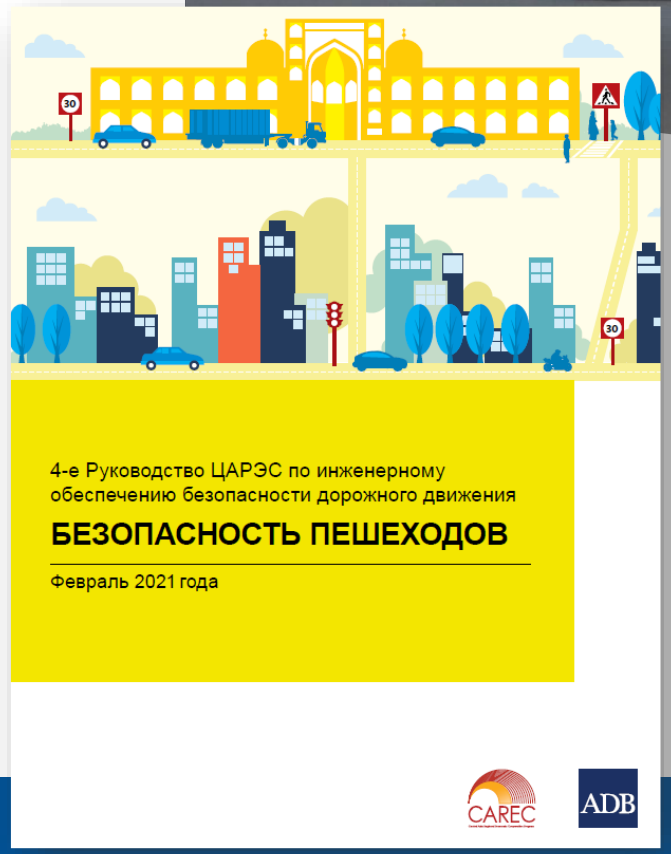
TURKMENISTAN



UZBEKISTAN


World Health Organization
Global status report on road safety 2023


Deaths by road user category
DATA NOT AVAILABLE



The CAREC manual can guide you to provide safer pedestrian facilities

Segregation
Separation
Integration

Segregation – expressways

Segregation – Malls

Segregation

Separation — in time

Integration — in space

Separation – in time

Separation – In Time

A humped Zebra (like this) has a proven 73% reduction in casualty crashes

Puffin Crossings

Pedestrian User-Friendly Intelligent Crossing

Separation in space

Separation in space

Separation in space

Separation in space

Separation in space

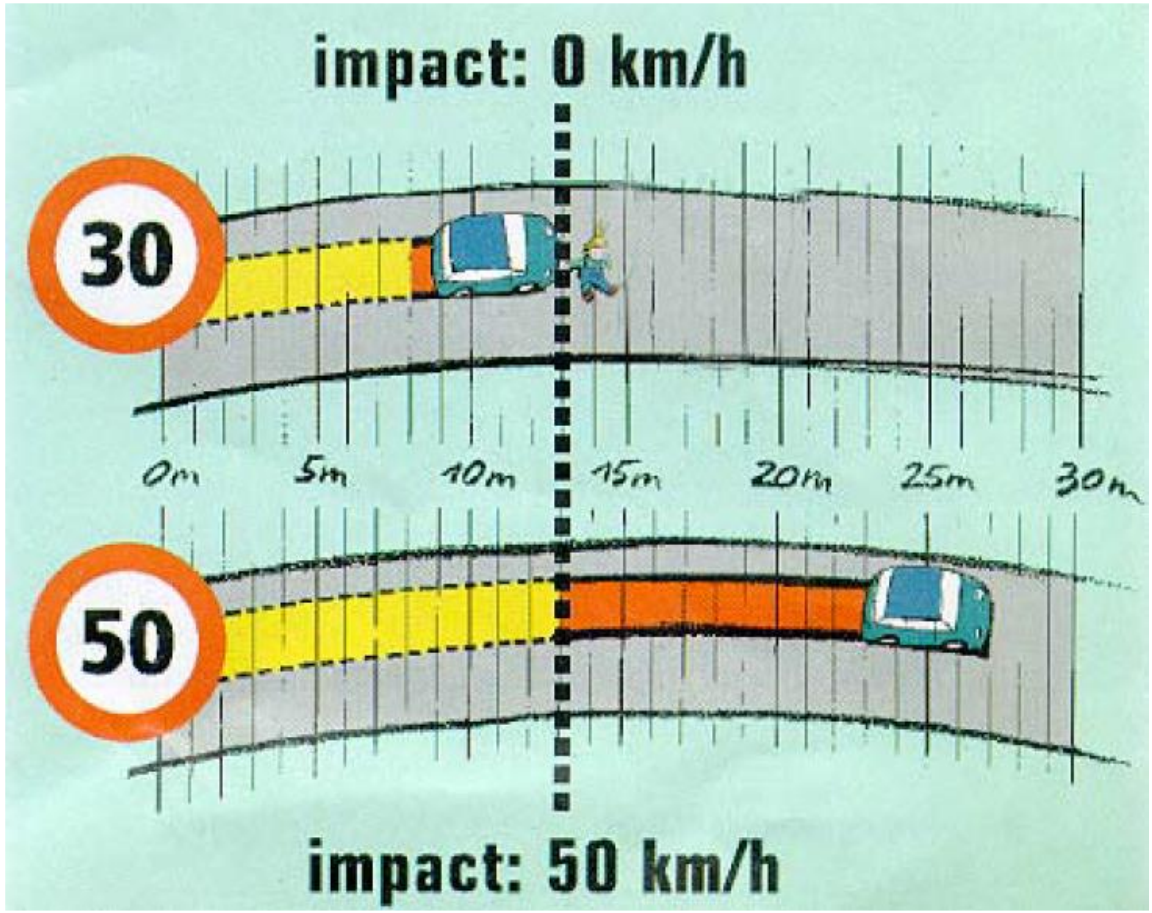
Are footbridges and underpasses really the best?

- Do pedestrians like grade separation?
- Most will use it *if* they can access it *and* it saves them time/distance.
- 95% of pedestrians will use grade separation if there is no loss of travel time compared with walking across the road (at grade)
- nobody will use them if it will take 50% longer (or more).
- Of the two (footbridge, underpass), people usually prefer a footbridge.
- But the disabled need assistance too. Ramps, elevators?


ПЕШВОИ МИЛЛАТ-ПОЯГУЗОРИ ТАМОМИ ТАШАББУСУ
ИҚДОМҲОИ БАЙНАЛМИЛАЛӢ ДАР СОҲАИ ОБ.

INTEGRATION – vehicles and pedestrians “share” the road (manage speeds)!

The effect of a small change in travel speed in an injury outcome



A small change in travel speed

↓

A relatively large change in stopping distance

↓

A much larger change in impact speed

↓

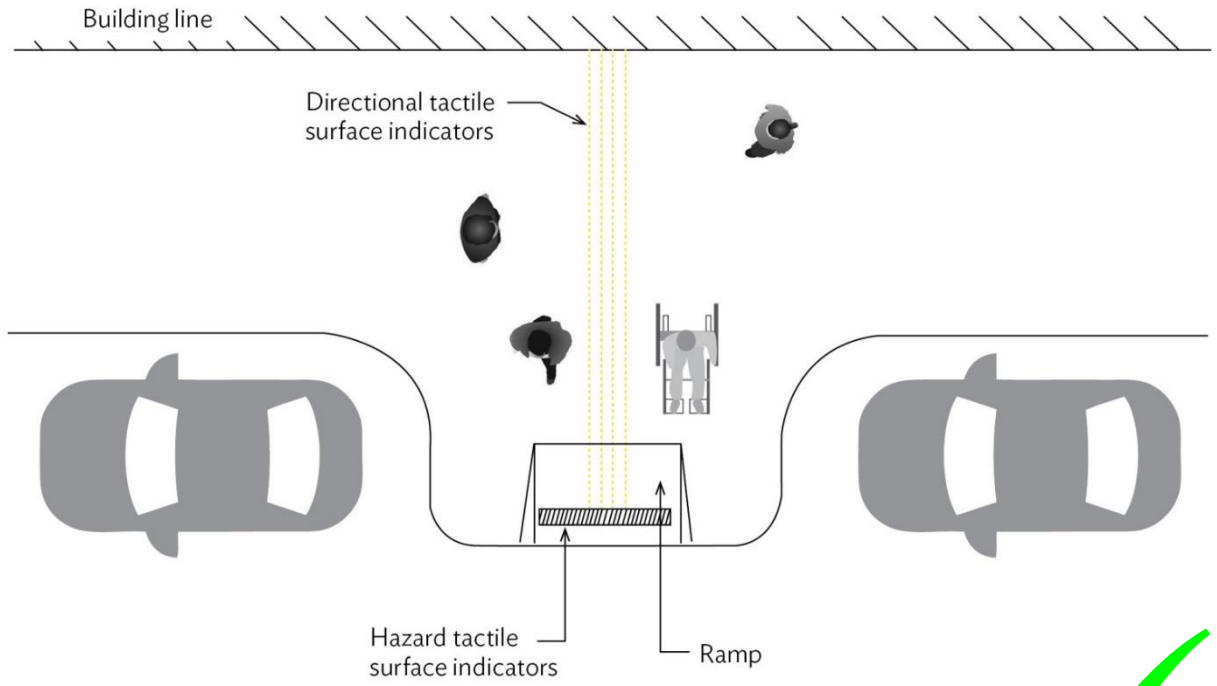
A still larger change in impact energy

↓

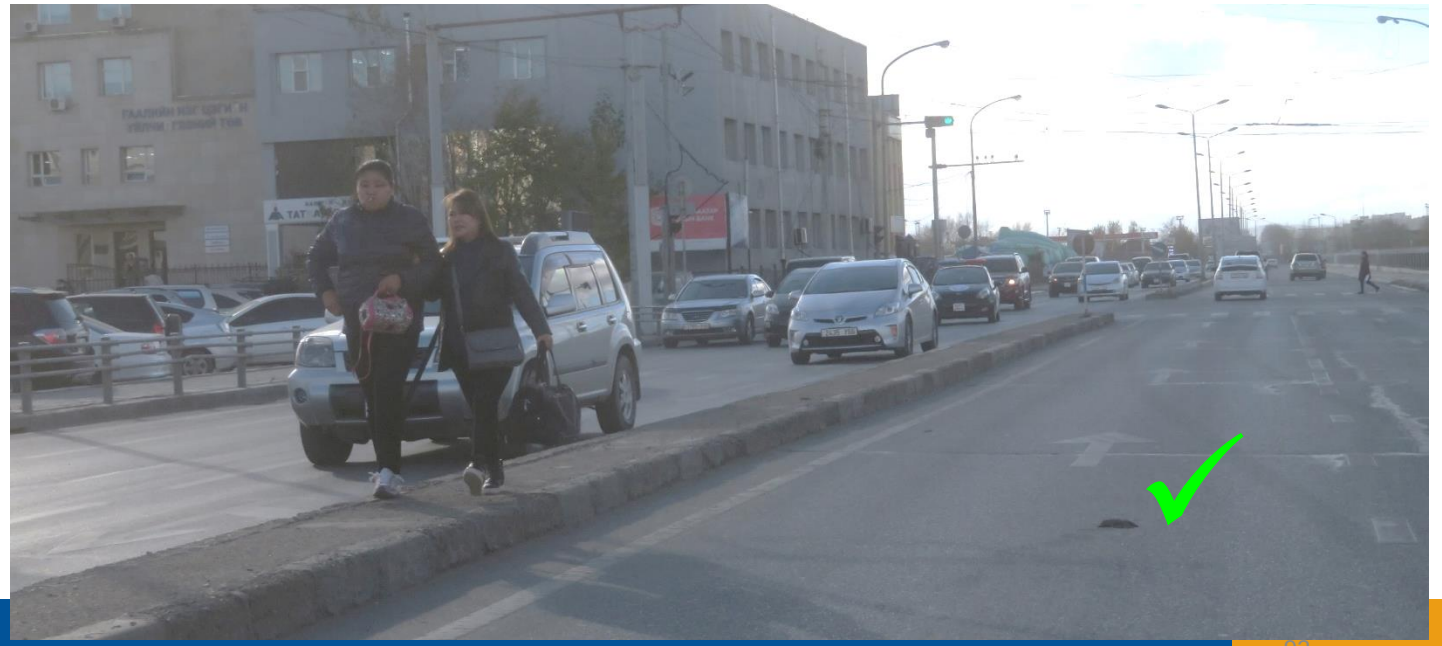
A very large change in probability of death and serious injury

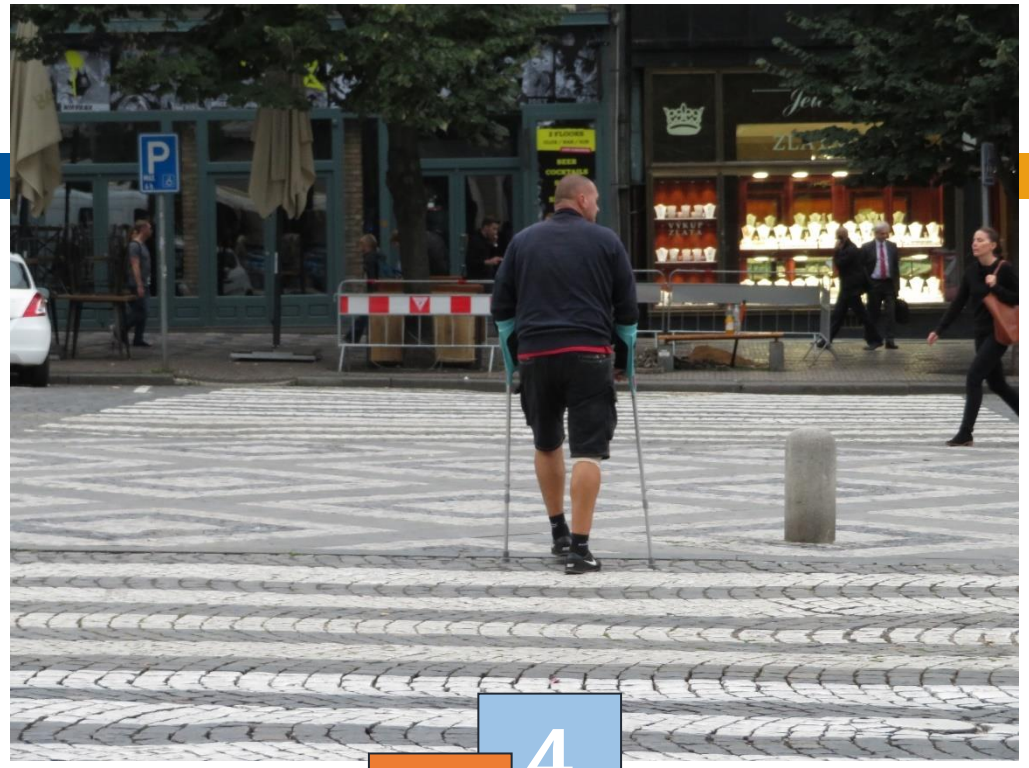
Small scale civil works – kerb ramps

A typical kerb extension



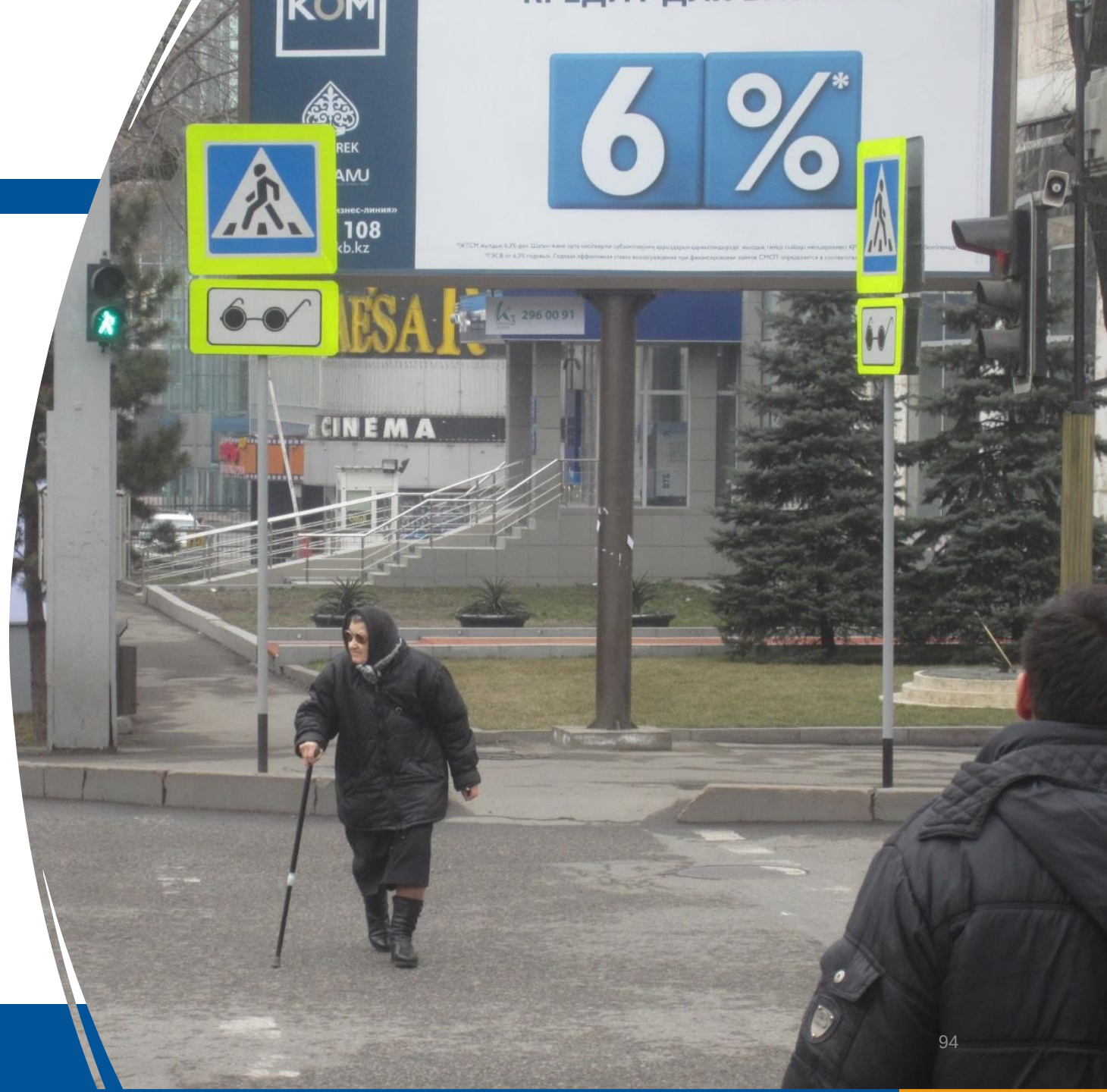
Medians – give separation (in space)





We need to think of all pedestrians, but there are four groups at greatest risk…

SENIORS - 19% of pedestrian fatalities are over 65 years



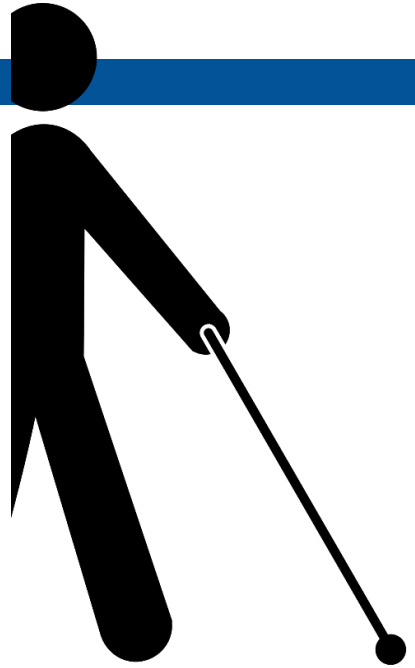
YOUNG - 20% of pedestrian fatalities are aged 4-12 years

The intoxicated

- 43% of nighttime pedestrian fatalities ≥ 0.15% BAC in Victoria

(3 times the limit for drivers in Australia)

THE DISABLED



Disabled pedestrians –
three main groups

- Mobility impaired
- Wheeled
- Sensory impaired

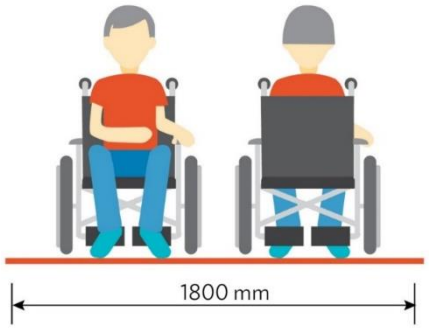
Mobility impaired pedestrians

People who may, or may not, need a walking stick, or a frame, or a supporting person – or they may simply move slowly, sometimes with a limp

A clear width of 1000 mm is adequate for people with ambulant disabilities.

- Signals – adequate clearance time? Is a PUFFIN needed?
- Have kerb ramps been provided on all corners/medians?
- Can kerb extensions be built?
- Can a wide refuge be provided?

Wheeled pedestrians

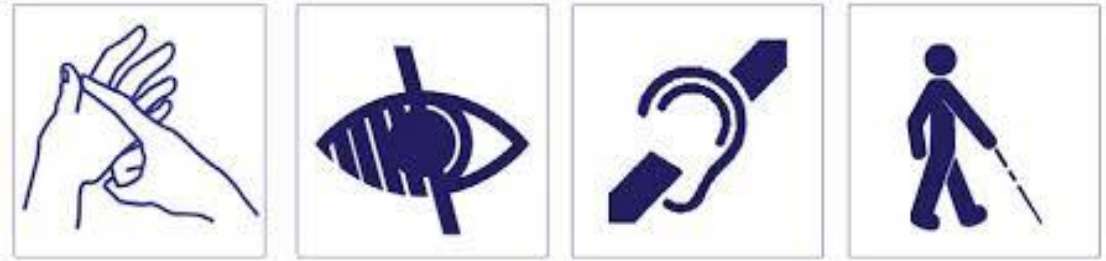


To allow wheelchairs to pass comfortably, a clear width of 1800 mm is required

- Adequate clearance time at signals? Is a PUFFIN needed?
- Have wide kerb ramps been provided on all corners/medians?
- Can kerb extensions be built?
- Can a wide refuge be provided?

Sensory impaired pedestrians

Visually impaired (not always totally blind), hearing impaired, maybe both



Do signals have audio-tactile push-buttons? Adequate clearance time?

Have kerb ramps been provided on all corners/medians?

Can kerb extensions be built? Street lighting?

Are DDA tiles in place? Correct?


Tactiles

What do sensory disabled pedestrians really need?

Pedestrian push buttons

Desirable features:

- Large push button
- Call record light
- Audio and tactile
- Arrow orientated to the crossing
- Consistent placement, height, orientation

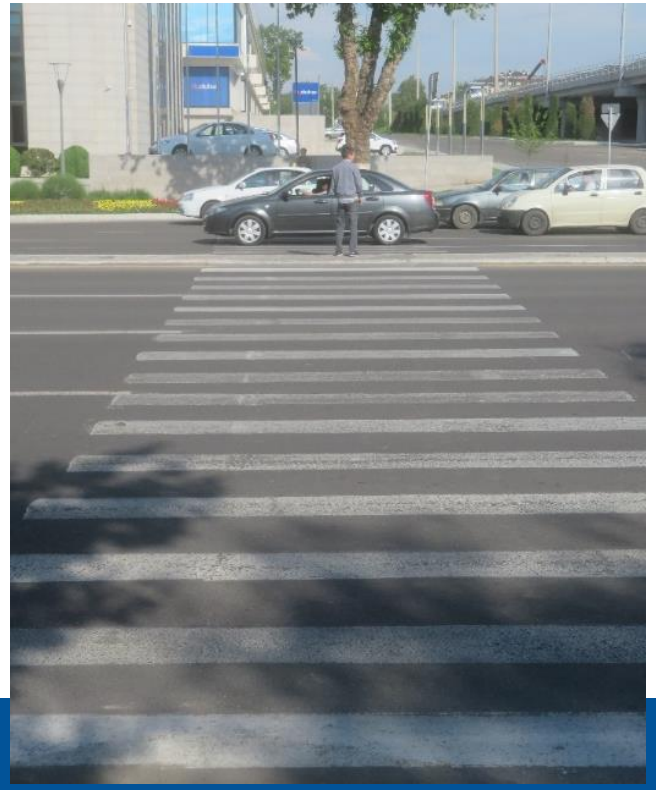
Never install a “Zebra” on a high-speed road or a road with more than a single lane per direction

Never allow a Zebra
on a high-speed road

Why do we install such crossings where they are not obeyed?

Zebra crossings rely on a driver seeing the pedestrian and deciding to give way.

Never allow a Zebra
across more than a single
lane in each direction.



More traffic calming of CAREC highways through villages is needed.

DISCUSSION 5

Is your authority providing:

- wide (1.5m) paved shoulders
- small scale civil works
- push button pedestrian signals
- pedestrian signals at all intersection signals
- good pedestrian clearance times at signals.
- traffic calming in villages
- Safe Zebra Crossings!

CAREC Road Safety and Sustainable Mobility Course

Phase 3 - June 2024

Safer Roads and Roadside Infrastructure

“Roadside hazard management”

Check out the CAREC "Roadside Hazard Management" manual

English
Russian
Mongolian
Chinese

Download from the ADB website

What is Roadside Hazard Management ?

Roadside hazard management aims to..... “identify, prioritise and treat roadside hazards in order to maximise safety by reducing the incidence and/or severity of such crashes.

THE THREE “I’s

- IDENTIFY
- INVESTIGATE
- IMPLEMENT

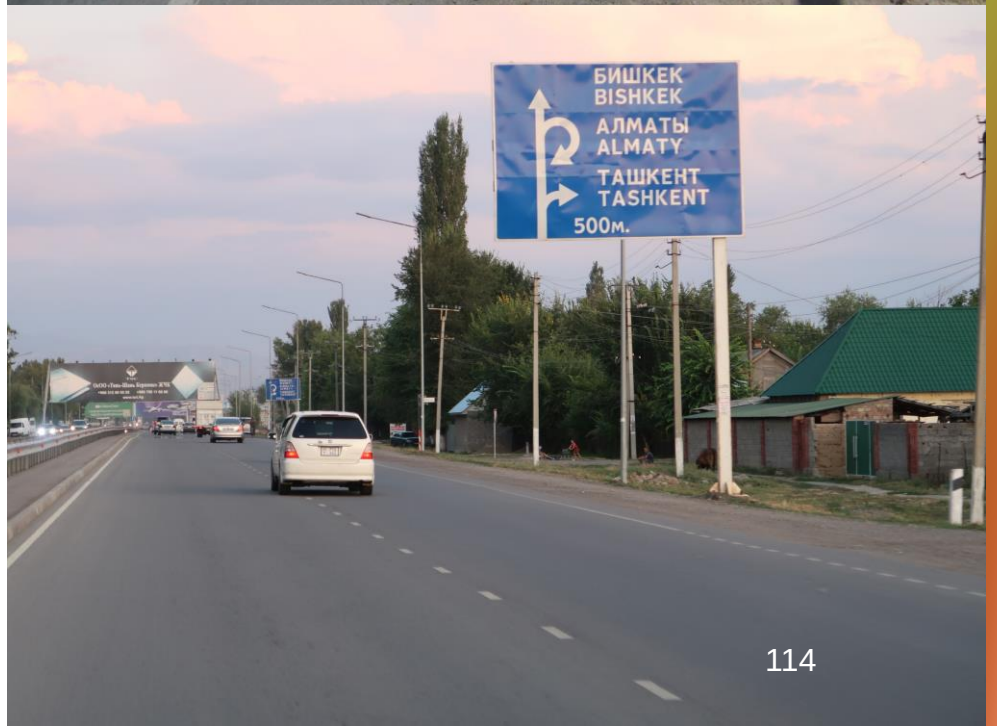
IDENTIFY

To provide a forgiving roadside environment, we need to ask…

- What is a hazard?
- How far off the road must a hazard be before it is “safe”?
- Is there one width that can be used for all roads?

A roadside hazard is….

…anything that is “fixed”, with a diameter of 100mm or more, and is on the roadside, within the clear zone.



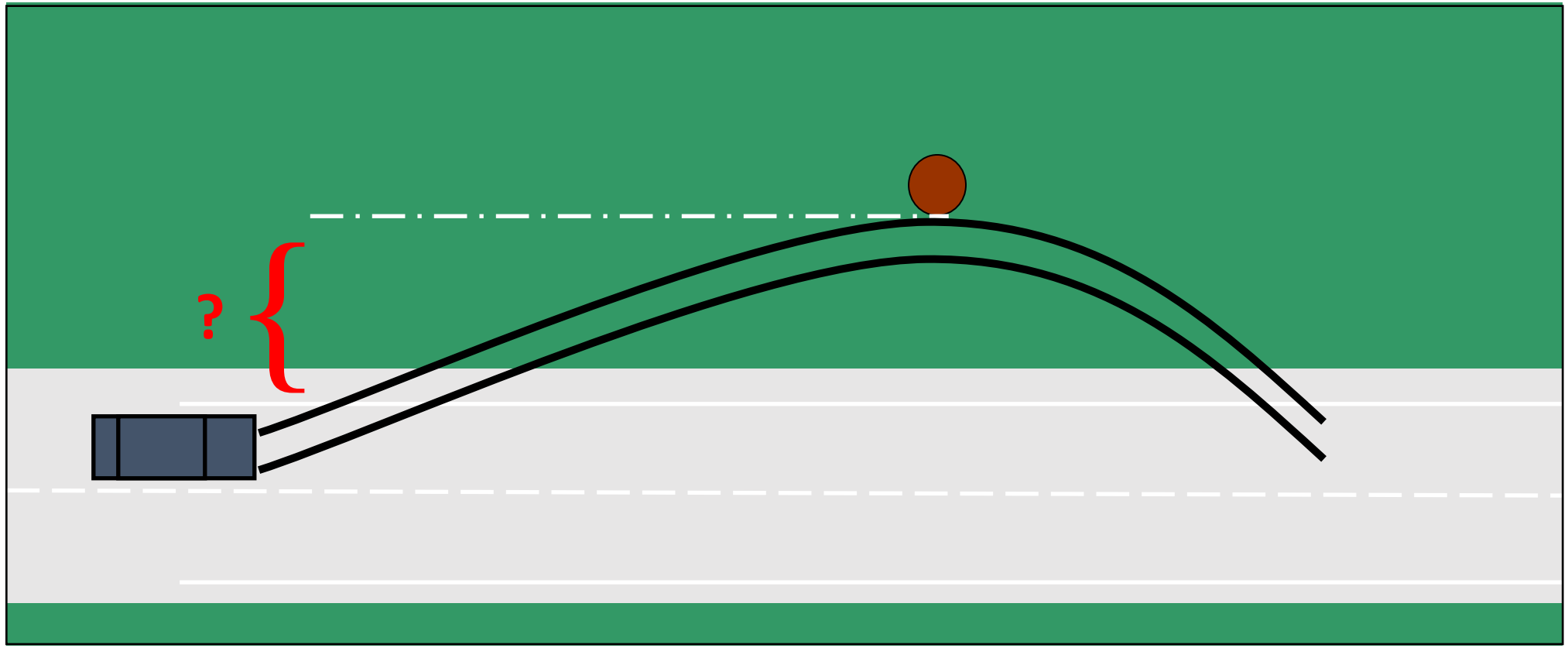

Манап
60

What is a Clear Zone ?

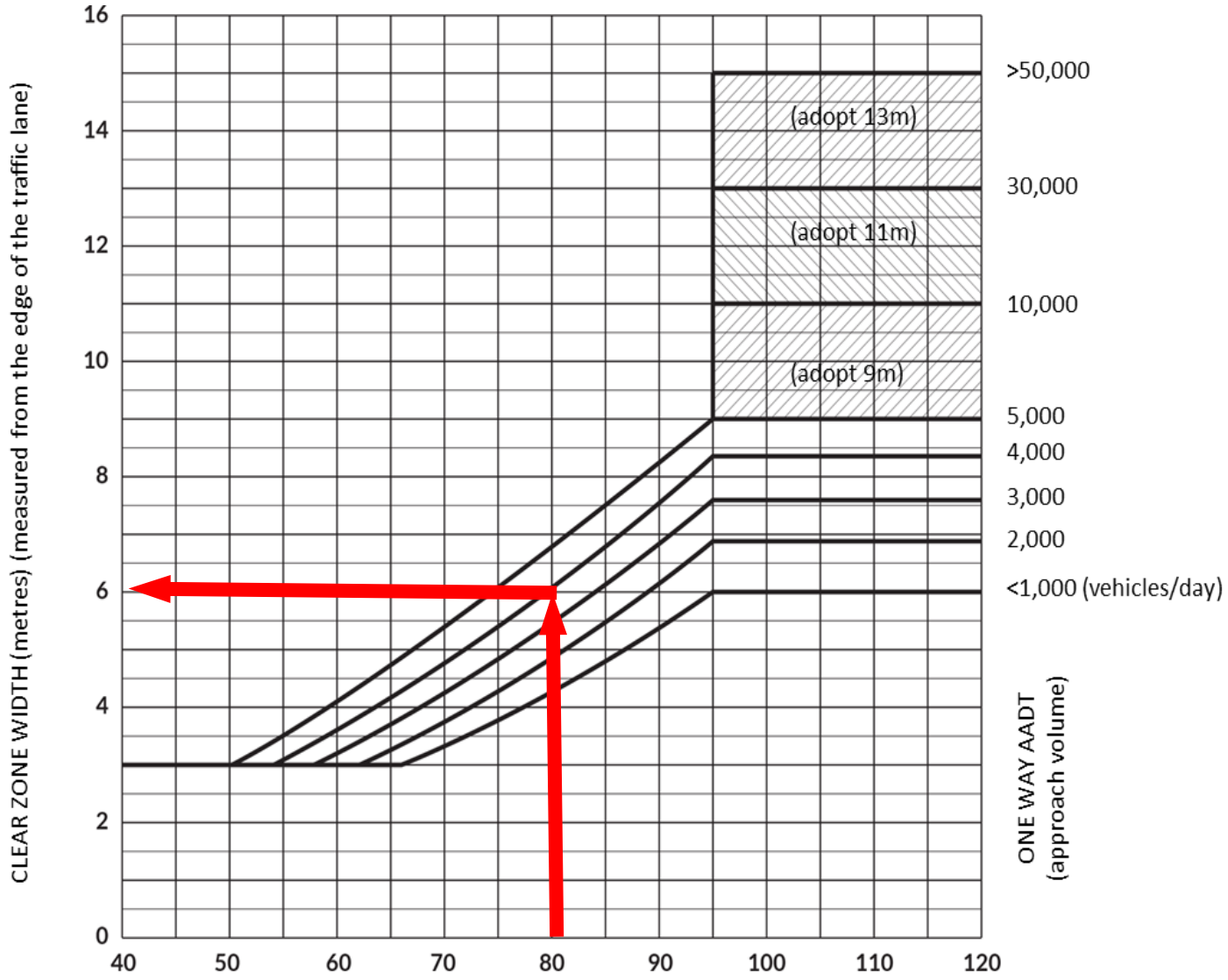
“A drivable roadside area that should be kept clear of hazardous objects in order to minimise the danger of a collision, should a vehicle leave the road”.

What is a Clear Zone ?

It depends on:
- vehicle speeds
- vehicle volumes
- road curvature
- embankment slope



Clear Zone graph - for straight roads



EXAMPLE 1 If the operating speed is 80km/h and the one way AADT is 4,000 vehicles/day, the clear zone width is 6m

EXAMPLE 2 If the operating speed is 100km/h and the one way AADT is 20,000 vehicles/day, the clear zone width is 11m (adopt range 10,000 - 30,000 vehicles/day)

- IDENTIFY
- INVESTIGATE
- IMPLEMENT

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. shield the hazard using barriers

What can engineers do to “keep all vehicles on the road”?

- Improve geometry
- Seal shoulders
- Line marking
- Edge lines (tactile)
- Guideposts
- Chevron alignment markers
- Improve sight lines - cut grass

Chevron alignment markers are effective at keeping vehicles on the road

Tactile edge lines – alert drivers when they drift off high speed roads.


Tactile edge lines – alert drivers
when they drift off high speed roads.

Remove the Hazard

Remove trees, poles
Place power underground
Demolish structures

Relocate the Hazard

Locate the hazard outside the clear zone, or at least to a less vulnerable position - to reduce risk

Frangible lighting poles

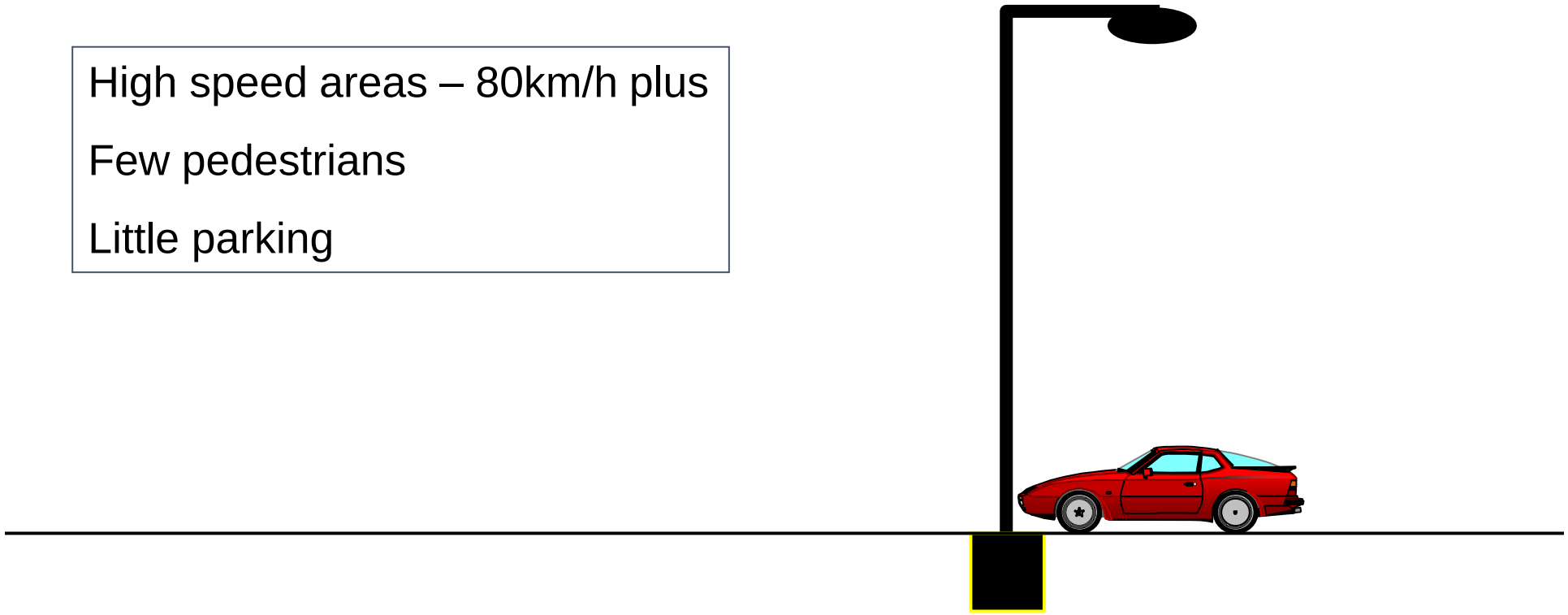
- slip base
- impact absorbing

Slip Base Pole

High speed areas – 80km/h plus

Few pedestrians

Little parking



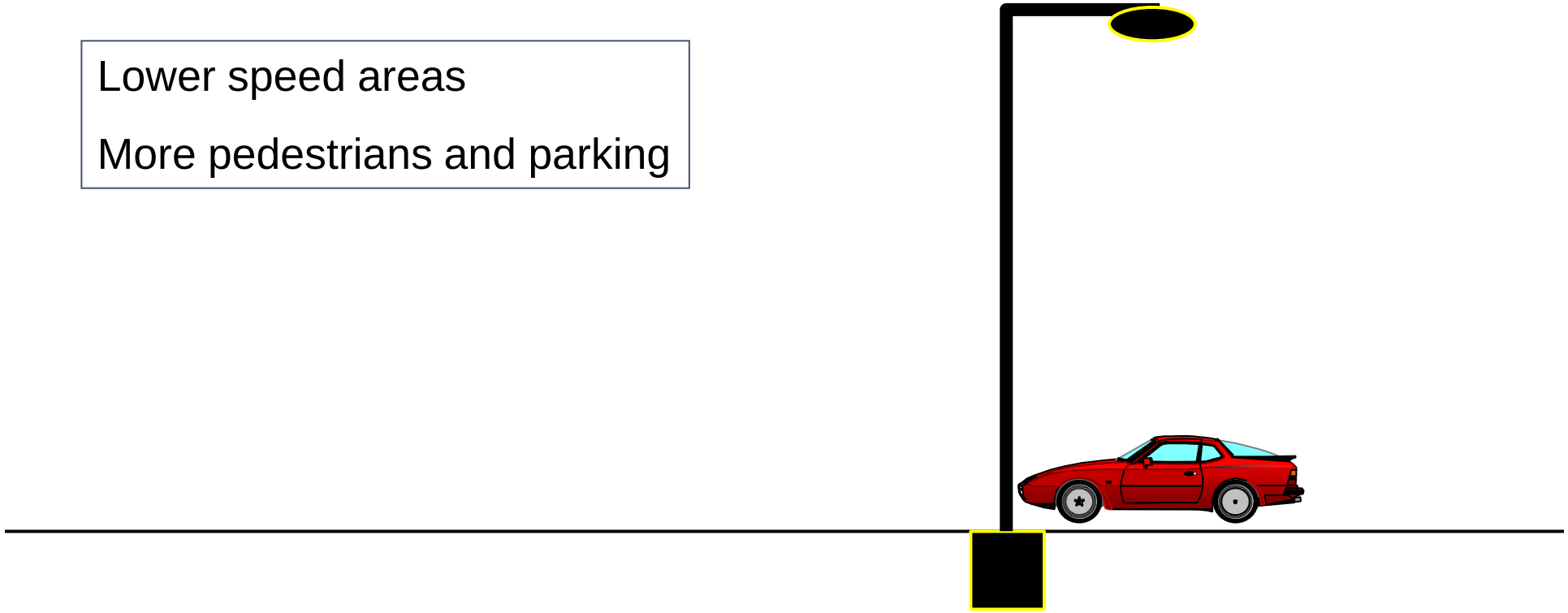
Slip Base Pole


Slip Base Pole
Before impact

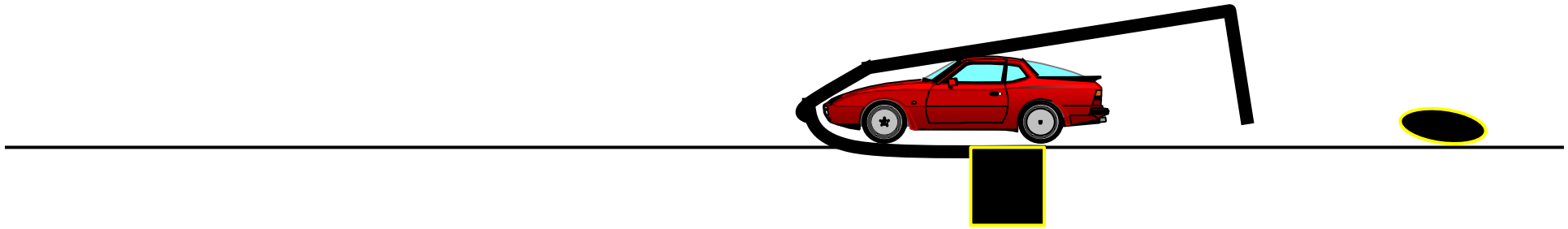
Impact Absorbing Pole

Lower speed areas

More pedestrians and parking



Impact Absorbing Pole



Impact Absorbing Poles

Why do we use safety barriers?

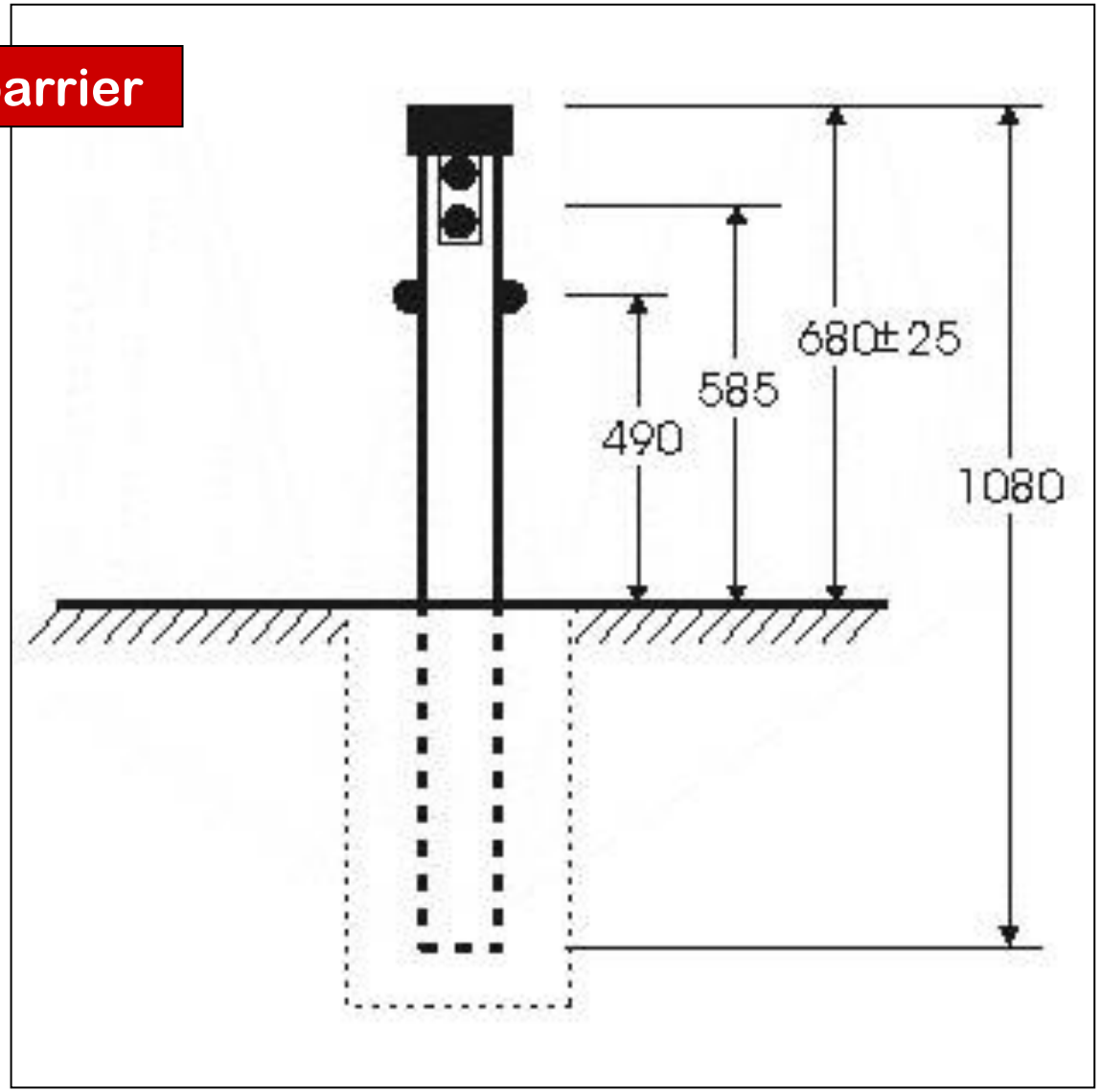
To protect the occupants of errant vehicles from more serious injuries than…

Three groups of barriers

Flexible barriers

- Deceleration forces on occupants are below the 20g critical impact force.
- Greater deflection (up to 2.5m), and thus impose lower deceleration forces on occupants.
- Therefore, less injuries to occupants.
- Safer!

Flexible barrier



Brifen Wire Rope Safety Barrier

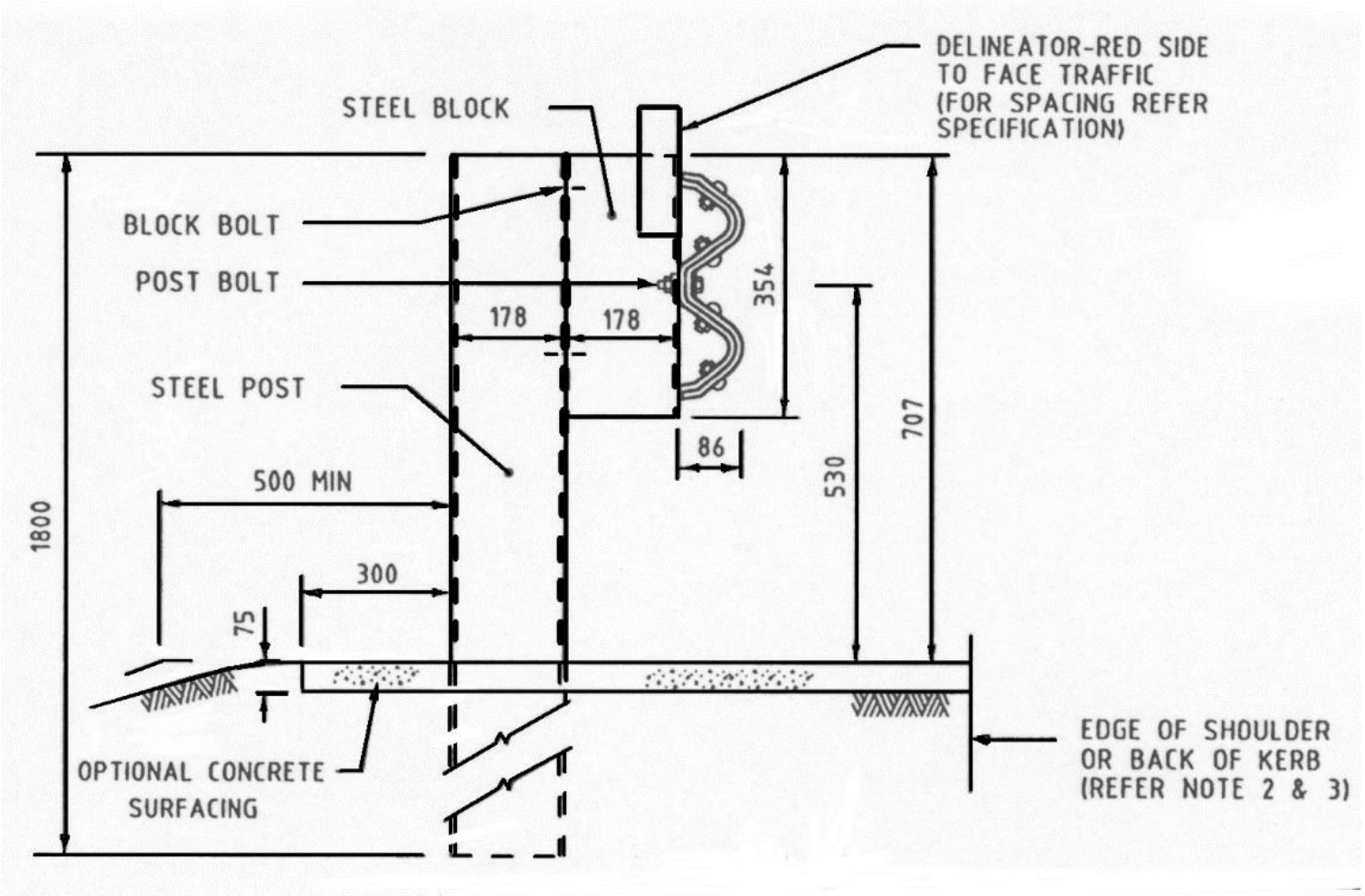

Filmed under test conditions

Three groups of barriers

Semi-rigid barriers

- The widely used W-beam
- Deflects up to 1.5m (not as much as WRSB)
- Block-outs prevent snagging
- Safe end terminals are vital

W Beam Safety Barrier



Semi-rigid barriers

- Deflect up to 1.5m (with 2.5m post spacing)
- Can reduce deflection by reducing post spacing

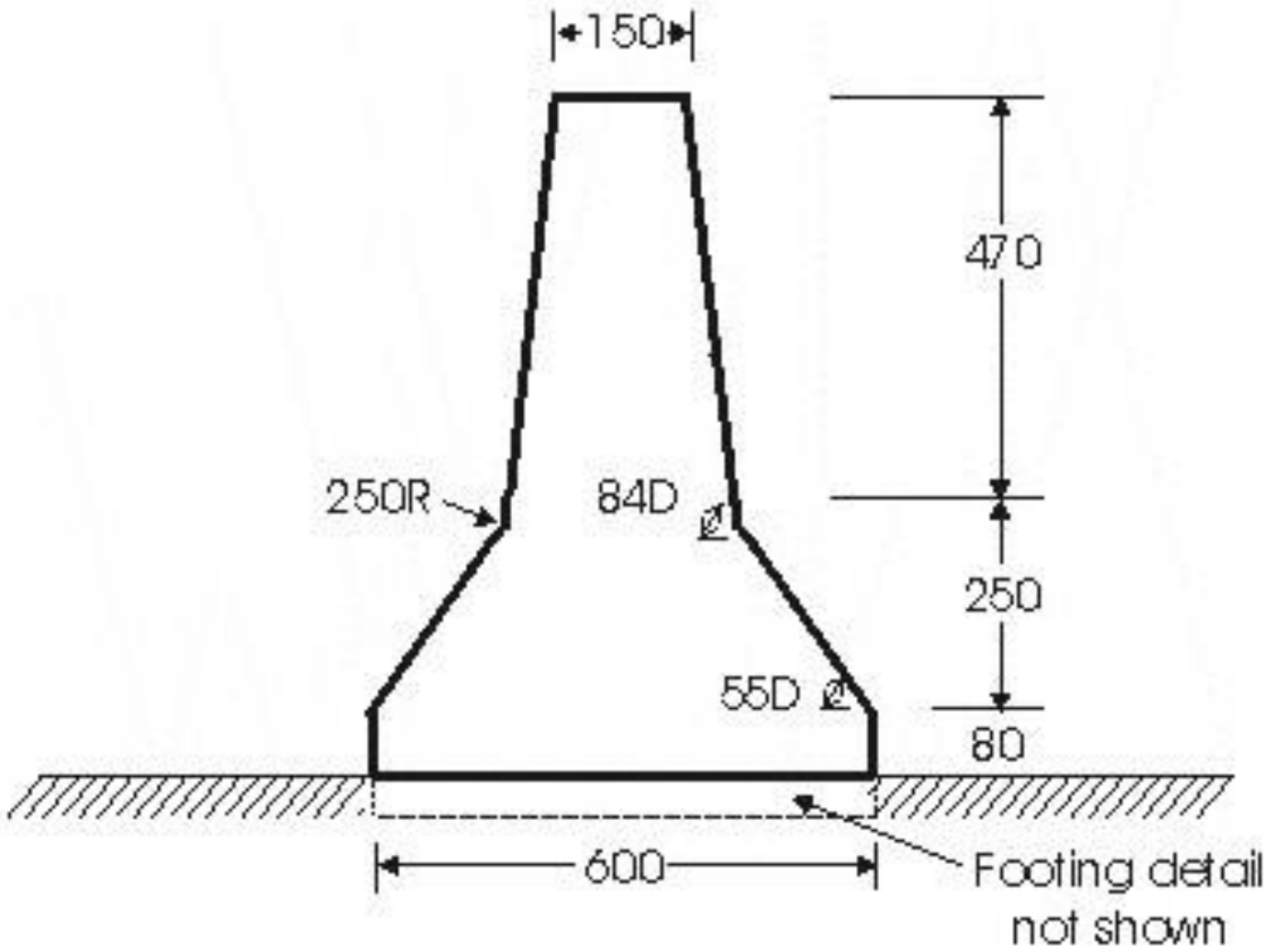
Three groups of barriers

Rigid barriers

- Cast in place, or set in place, concrete
- No deflection
- Minimal repairs necessary
- End treatments vital

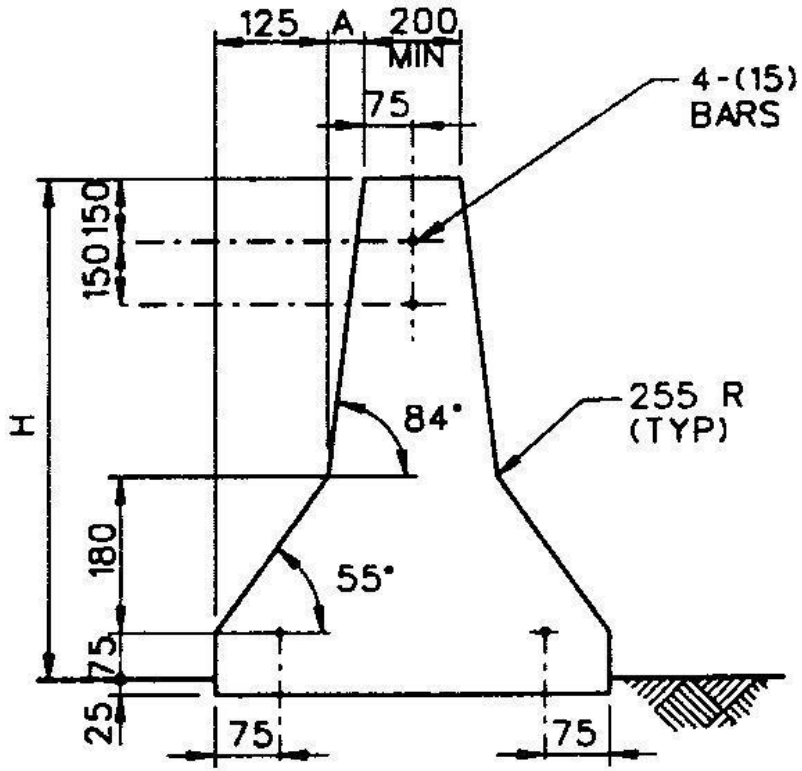
New Jersey Barrier

Rigid barrier



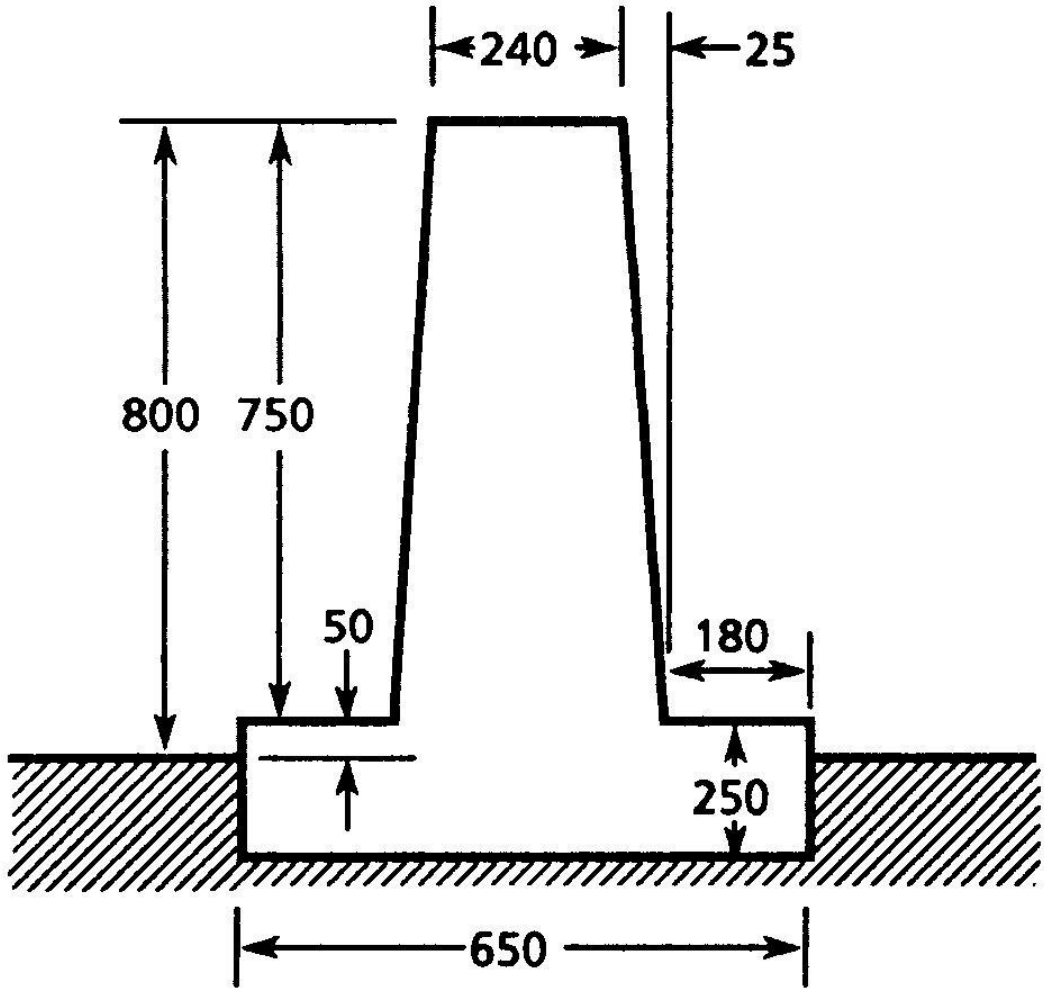
Rigid barrier

F Profile Barrier



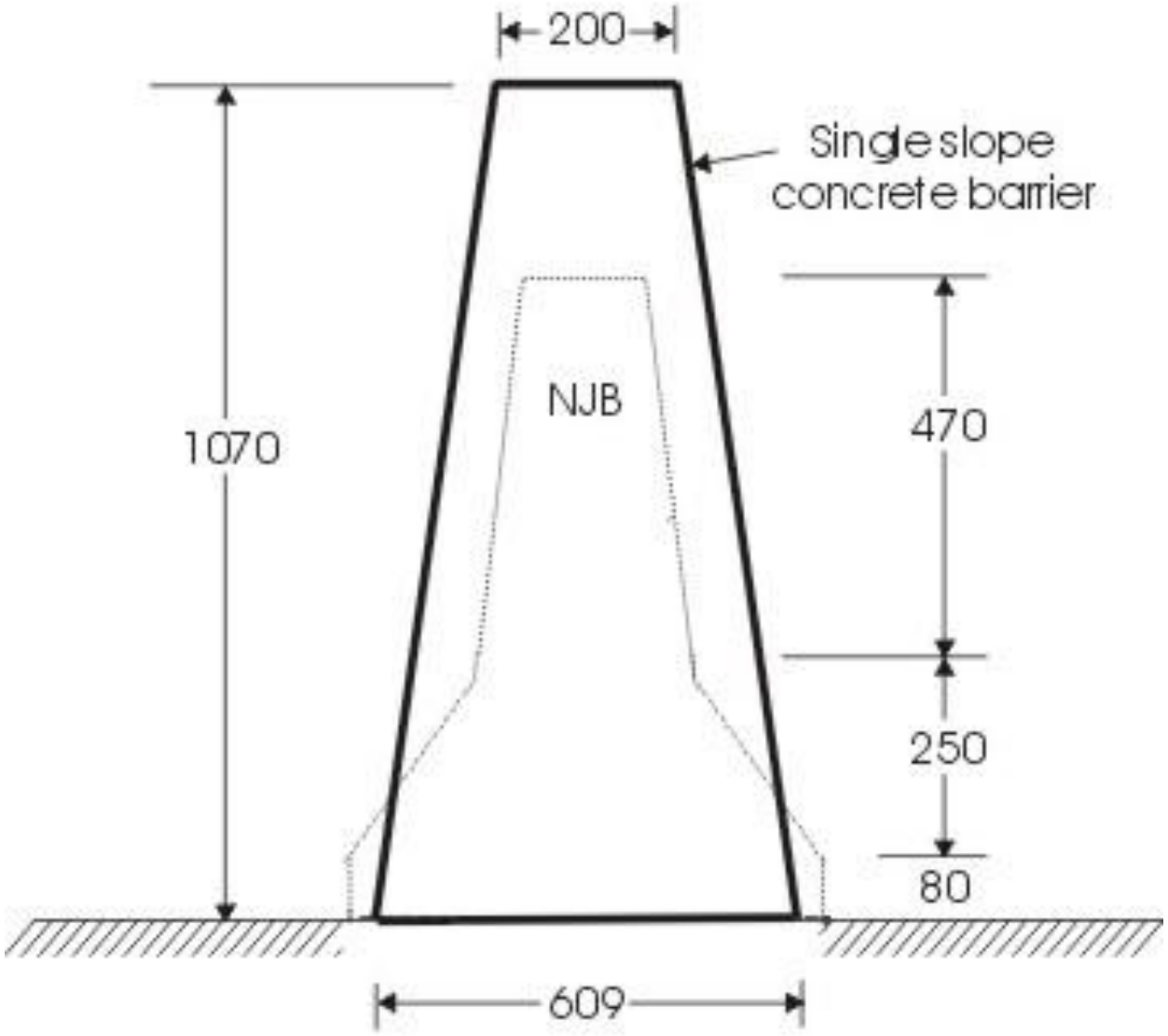
Rigid barrier

Vertical Face Barrier



Rigid barrier

Constant (single) Slope Barrier



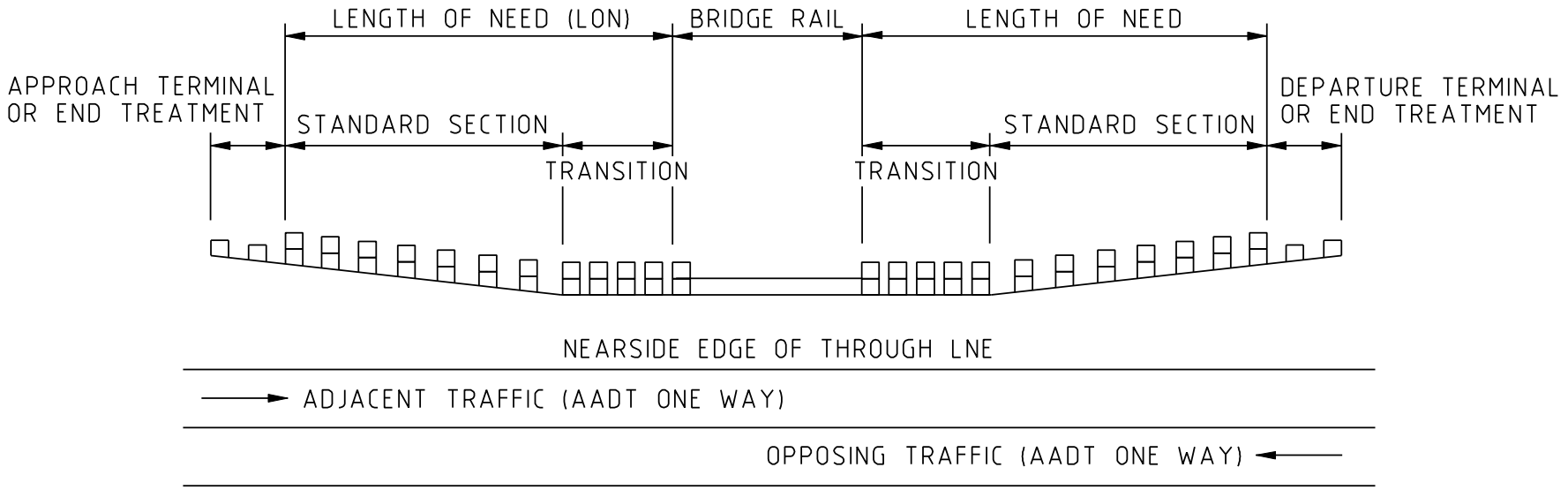
THE THREE I’s

- IDENTIFY
- INVESTIGATE
- IMPLEMENT

Eight things to look for when auditing barriers

Here are the 8 main things to think about when you are auditing a project with safety barrier involved.

- Length of need and barrier length
- Offset to the barrier
- Deflection
- Proximity to kerbs (avoid vaulting)
- Stiffen (prevent pocketing)
- Mounting height (watch for vaulting)
- End treatments (prevent spearing)
- Working Width (snagging)



1 Barrier length

The LON (nearside) plus the LON (offside) plus the length of the hazard, plus the end terminals


Too short. Does not satisfy
the Length of Need

2. Offset to the barrier from the traffic lane should generally be as far as possible except for rigid barriers

- Rigid barriers – less than 4 m from lane (to minimise angle of impact)
- Wire rope and W beam barriers – as far as practical
- Try to provide space for broken down vehicles to stop
  - 1.5m desirable minimum
  - 1.0m minimum
  - 0.6m absolute minimum

3 Space for deflection between the barrier and hazard

Always check that the barrier rail is at least 1.5m from the hazard (more for flexible barrier) – to allow for deflection during impact.

4 Avoid kerbing near barriers

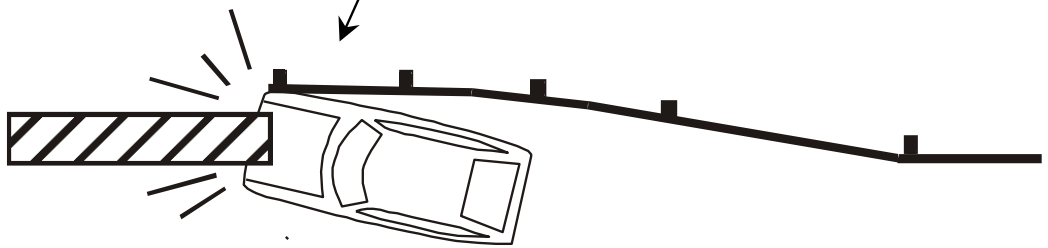
Have a smooth, paved surface between the traffic lane and the safety barrier - so that an impacting vehicle can hit the barrier at the correct height.

5 Avoid “pocketing”

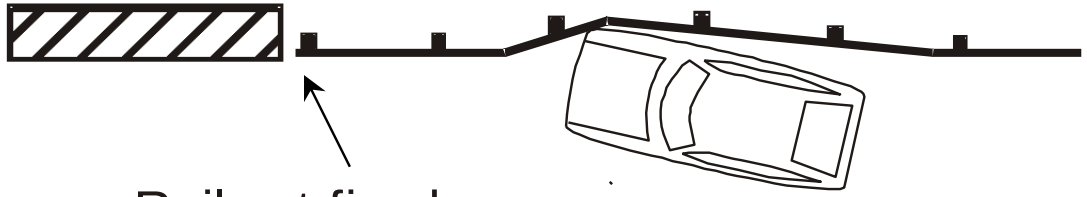
Gradually stiffen a semi-rigid barrier as it connects to rigid barrier (to keep an impacting vehicle away from the end of the rigid barrier)

“Pocketing”

Posts and guardrail deflect and leave the parapet exposed

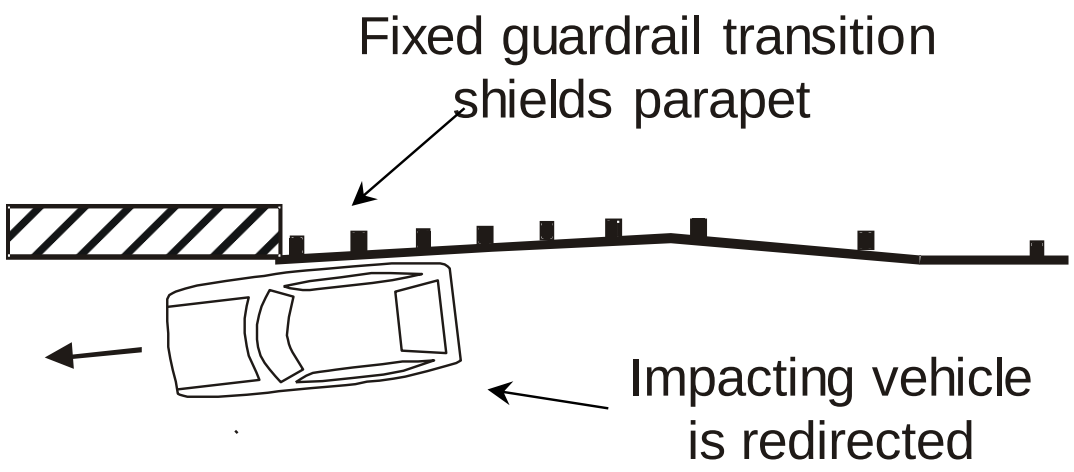


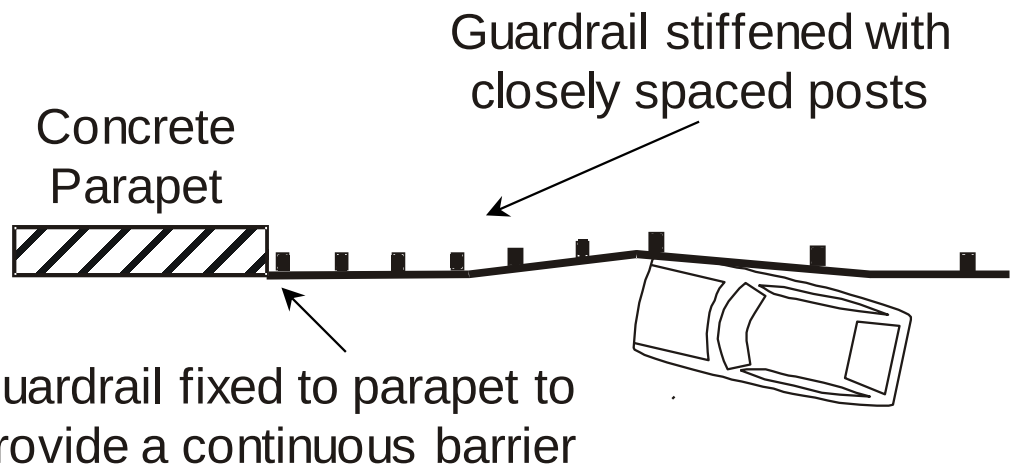
Concrete Parapet



Rail not fixed to parapet

No “pocketing”





When going from a less rigid barrier to a more rigid system, it is necessary to create a gradual increase in stiffness between the barrier systems so that vehicle “pocketing”, snagging or penetration is prevented along the transition.

6 Mounting height

7 (Un)safe terminals

Every length of barrier has a beginning, and an end.

Both ends need safe terminals.

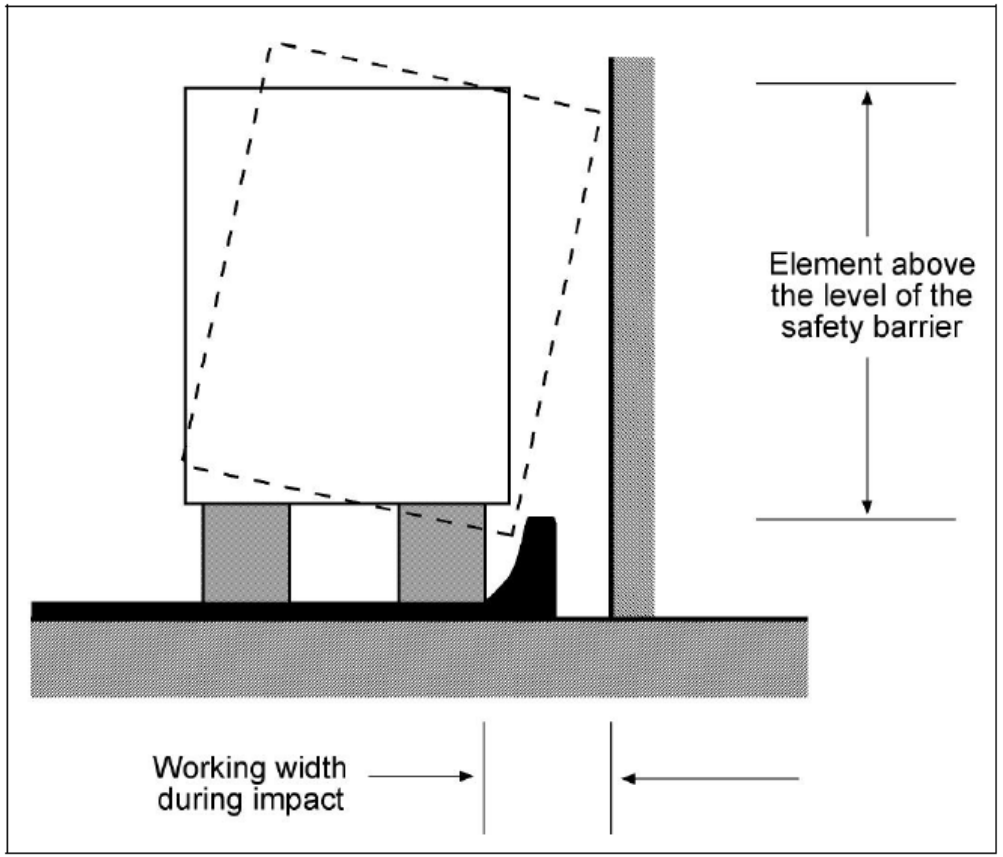
We must eliminate unsafe terminals

These terminals are safer but more expensive – if you cannot afford them, use flared (1m away from traffic) Bull Nose end terminals as a compromise – safety/cost.

Collisions with the ends of concrete barriers kill people. Never leave such hazards within the clear zone on your roads.

8 Working Width

The barrier must be far enough from any upright hazard to prevent “snagging” by large/tall vehicles


Element above
the level of the
safety barrier
Working width
during impact

I wish you well as you and your country move forward in road safety

You can save lives on your roads.

Your questions are welcome.

Thank You!

phillip.jordan@roadsafetyinternational.com