



CAREC Road Safety and Sustainable Mobility Course

February 2024

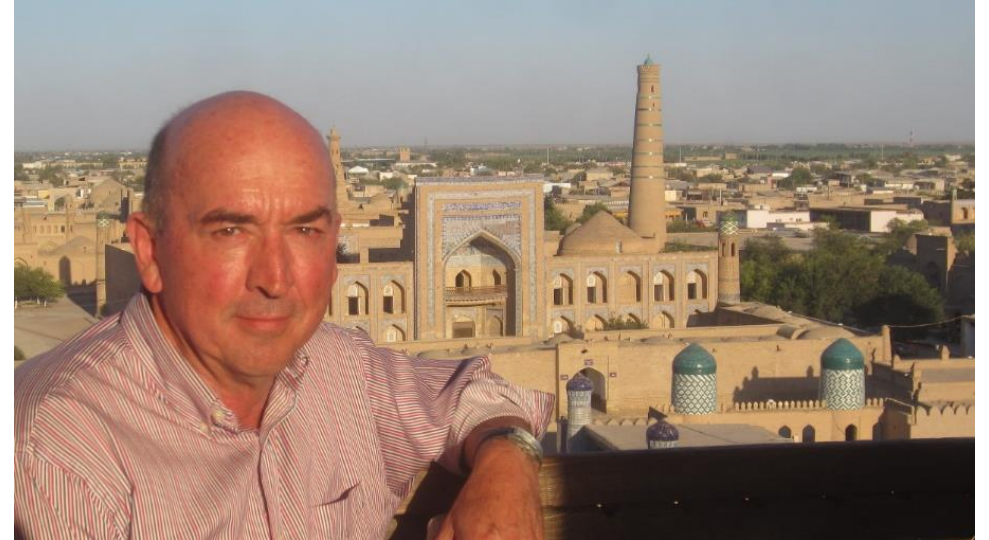
Safer Roads and Roadside Infrastructure

“Putting the road into road safety”

Phillip Jordan, ADB Road Safety Engineering Consultant

Phillip Jordan
31+ years with VicRoads (Australia)
18 years consulting in traffic and road safety
engineering.

46 countries of work, including all 11 CAREC
countries



What is the main cause of road crashes in your country?

The road user?

The vehicle?

The road?

Something else?

They all contribute – some more than others.

As a road safety engineer, my task is to convince you that your roads can be made safer – and not always at high cost \$\$

A GLOBAL PROBLEM

DIFFERENT ROADS,
SIMILAR PROBLEMS



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DIFFERENT ROADS,
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Why is your job important for safety?

- Improve a road – wider, straighter, flatter.
- Vehicles travel faster.
- More vehicles run off the road; pedestrians at risk.
- Road safety engineering is necessary.
- Audits, blackspots, roadside hazard management, pedestrians, signs/markings.
- The principles are the same in every country.
- They need resourcing and co-ordination via a National Road Safety Action Plan
- Experienced road safety engineers are essential

Safer Roads and Roadside Infrastructure

Road users are our “customers”

We need to build trust with our customers

The world needs more road safety engineers.



Lives lost, Victoria, Australia 1970 - 2023

1970 1061 lives lost (> 30 deaths/100,000 population)

2023 296 lives lost (<4 deaths/100,000 pop.)

(And this was our worst year since 2008!)

A road crash is the end result of a chain of events...



To break a chain, we need to remove a link.

Where do we start?

The chain of events.....



A 35-year-old male is the driver of this truck. His boss allows him to drive it home to his village, provided he maintains it.

Chain of events.....

- He spends a whole weekend repairing it.
- The brakes were worn; he replaces the discs.
- He finishes late Sunday.
- Friends drop around just as he finishes.
- They relax, chat, drink, and eat until very late.
- He does not get much sleep.

Chain of events.....



- Monday morning – he must start early at a building site in the city.
- Little sleep, no breakfast, late for work.
- Drives the truck towards the National Highway.

He drives closer and closer to an old truck ahead of him – eager to overtake. That truck is not well maintained; it has broken rear lights.





They reach the National Highway; there is frost; the pavement is slippery.
It has unsealed shoulders; he travels fast.



Our truck driver knows there is an overtaking lane ahead – he accelerates so he can overtake the truck.



Suddenly.....roadworks! The right lane is blocked; no warning signs.
The old truck ahead swerves to the left - without warning.



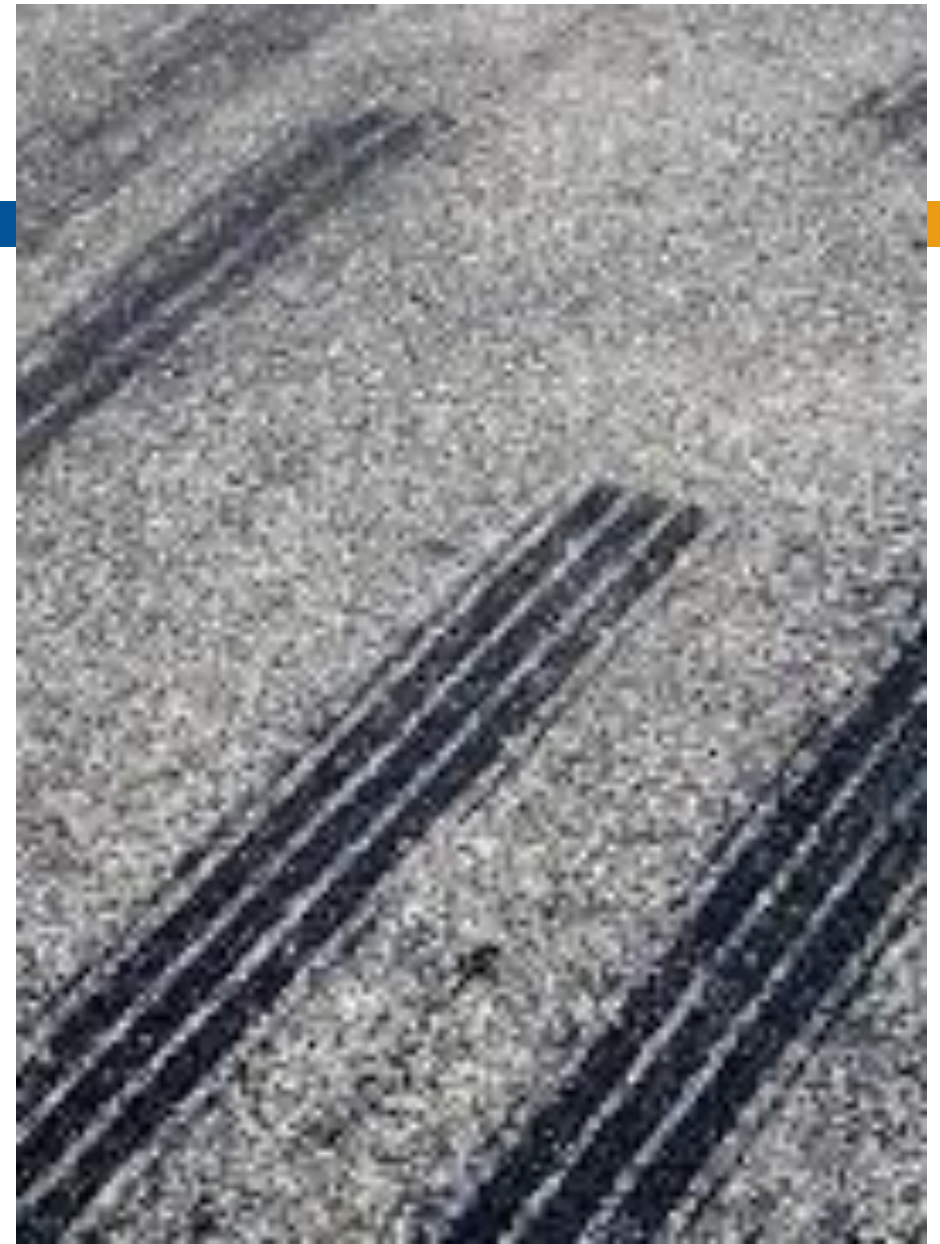
To avoid a “side swipe” collision, our driver swerves his truck left.
At that instant, a bus is passing in the other direction.
There is a deep drain beside the road.

Our truck driver brakes hard; the new brakes “grab”. His truck slides.

It strikes the other truck.

Our truck then careers across the highway, directly into the bus, still at speed.

The bus driver has little time to react, and the deep drain restricts his options.





Our truck driver and two bus passengers are killed. The other truck driver is seriously injured along with 10 bus passengers.



What “caused” this crash?

And what could our profession have done to prevent it – or minimise its effects?

What “caused” this crash?



- His frustrating weekend? His drinking?
- His lack of sleep? Excessive speed?
- His impatience and inattention?
- The new brakes of his truck?
- The damaged rear lights on the other truck?
- The frost/ice?
- No advance warning of the roadworks?
- Materials stored on the road?
- The “slick” road? The lack of sealed shoulders?
- The deep roadside drain?

Break one “link” and the chain will collapse.



Engineers could have:

- Inspected the road work site; ensured good warning signs.
- Stored materials off the road.
- Removed/covered the deep drain.



Engineers can
save lives on
your roads

5 key topics in the profession of road safety engineering:

- road safety audit,
- blackspot investigations,
- roadside hazard management,
- pedestrian facilities,
- signs, line markings and delineation



The CAREC Road Safety Engineering Manuals



Do you have the 5 CAREC road safety engineering manuals?
They are a useful series 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.
Загляните на вебсайт АБР

Филип Джордан, Консультанта-инженер по безопасности дорожного движения



The CAREC manuals are for:

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

1 Road Safety Audit

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

I hope it is in use in your country.





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)

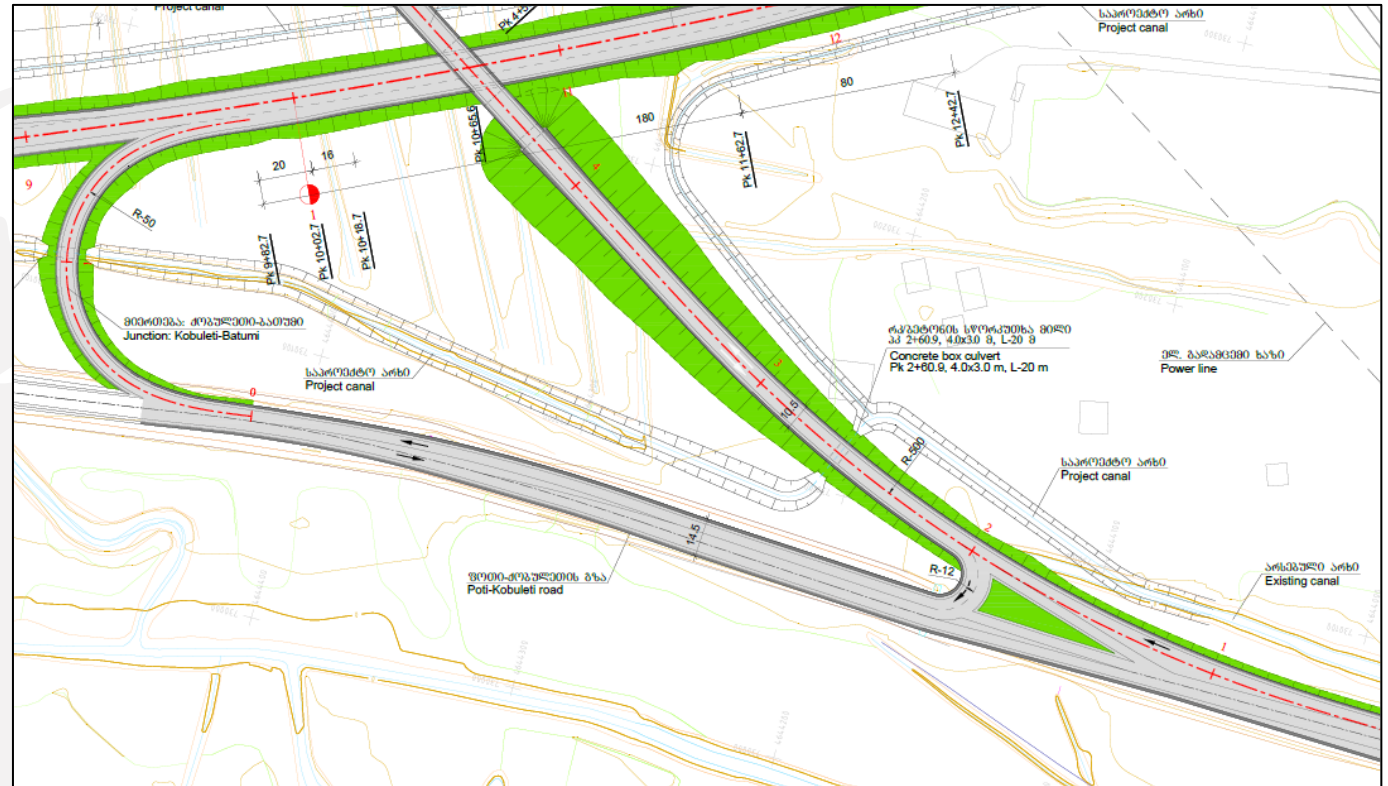


Road safety audit – prevention is better than cure

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.

Do you have enough road safety engineers to do the audits?

Are your design standards up to international levels of safety?



What projects do
you audit?

Any, all, none?

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

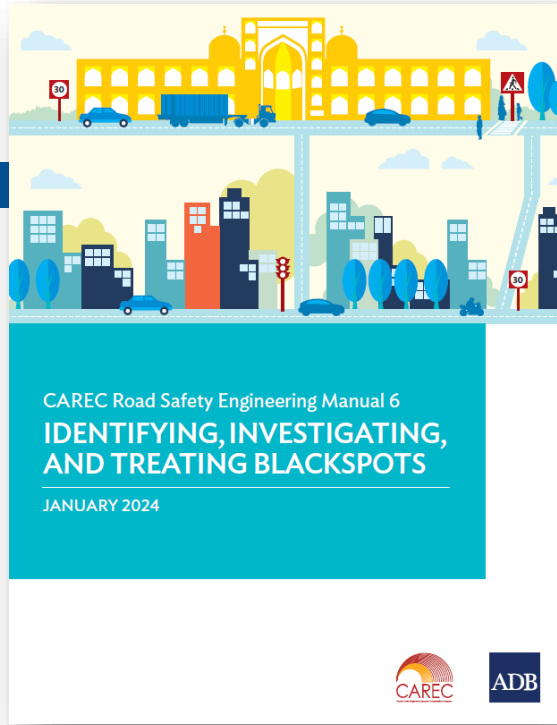


Road safety audit

Low costs, high benefits

Well accepted in many countries

Valuable for all CAREC countries



2 Investigating and treating blackspots

To be able to understand the crashes at a site we need accurate Police crash data.

Police have an important job collecting crash data.

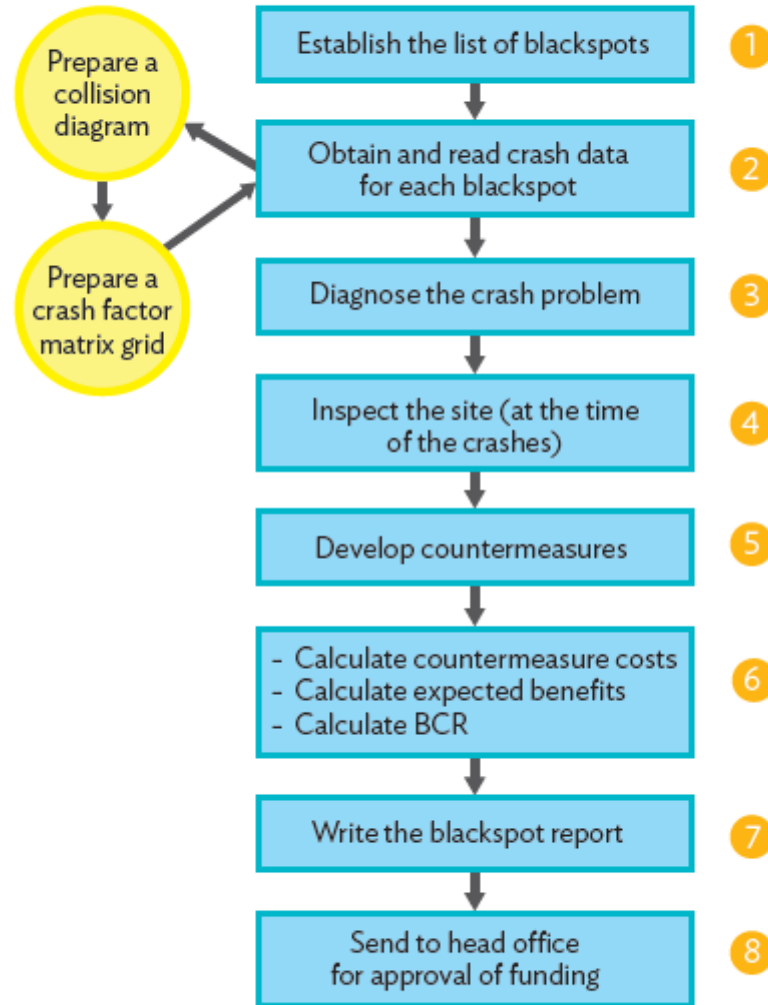
It must then be shared

Often the Police do not appreciate that engineers need, and use, the crash data.





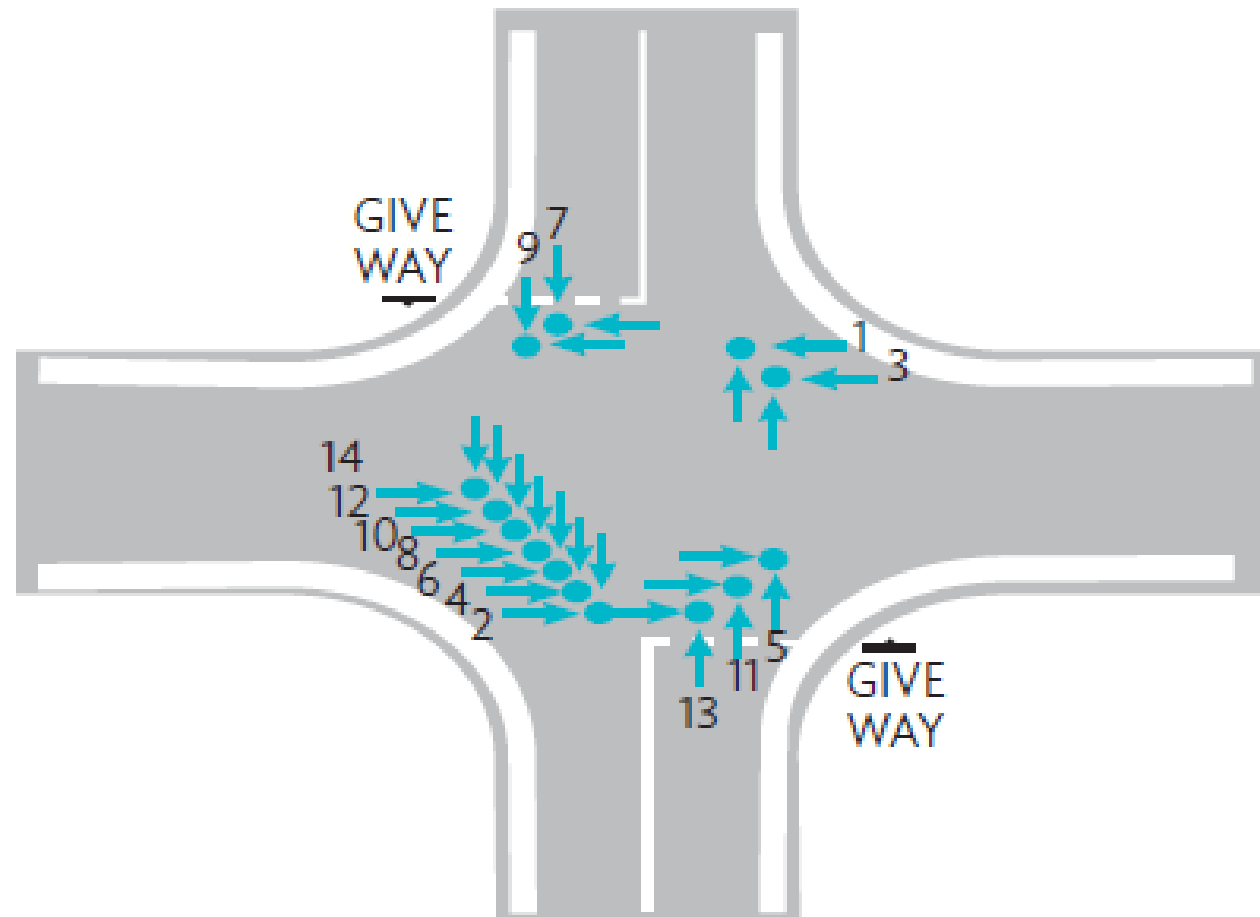
Figure 5: The 8 Key Steps in the Investigation Stage of the Blackspot Process



BCR = benefit/cost ratio.

Source: ADB road safety engineering consultant.

Figure 6: A Collision Diagram for a Blackspot at a Crossroad Intersection



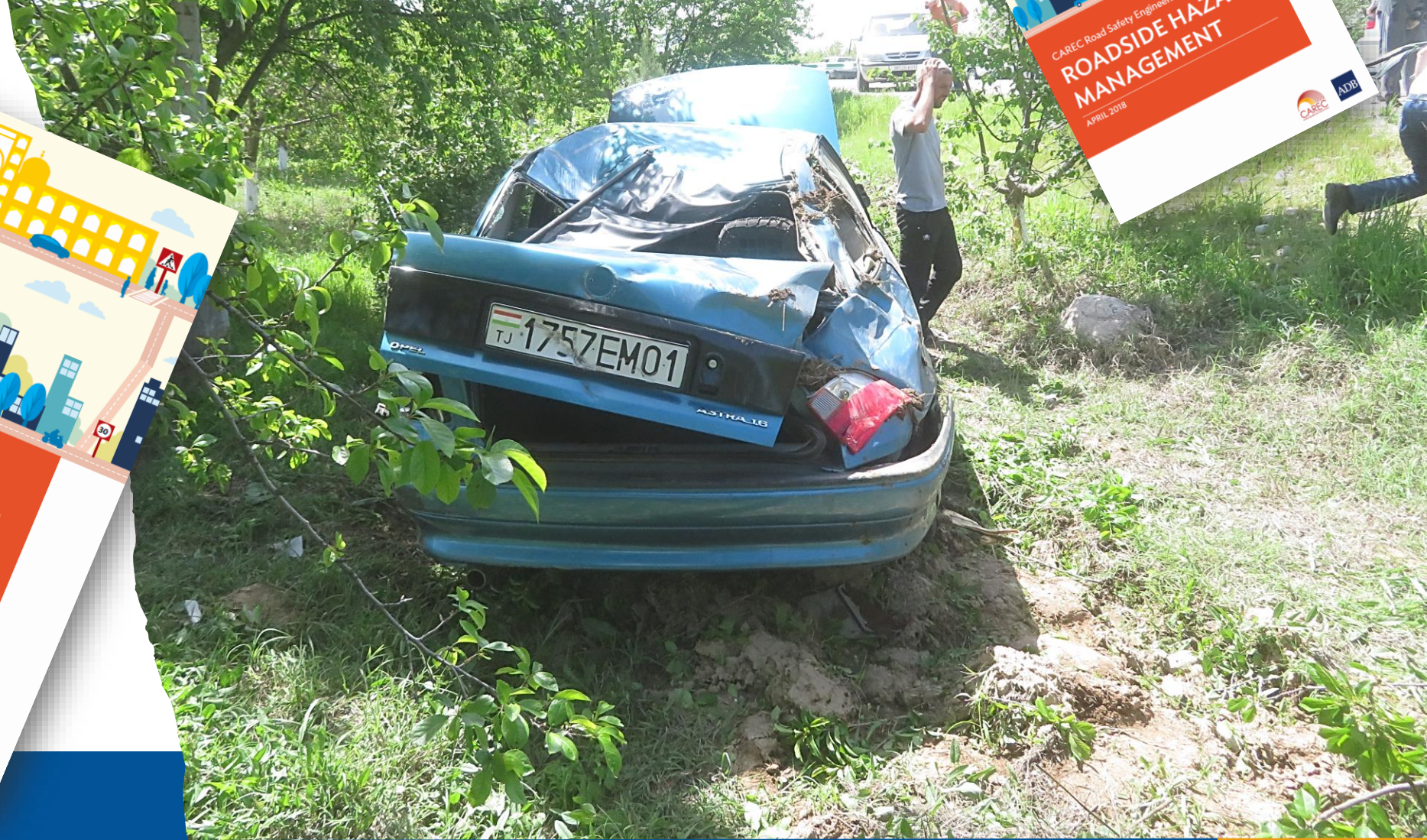
Note: This collision diagram illustrates a clear pattern of right-angle collisions, with 9 out of 14 crashes involving vehicles from the north.

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 the 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	Grey	Black	Yellow	Black	Yellow	Black	Black	Yellow	Grey	Black	Black	Yellow	Grey	Black
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

Crash Factor Matrix

Experience shows \$1 spent on blackspot treatments
returns \$4 in crash savings to the community

3 Roadside hazard management



Seat belts may not prevent
a crash, but they do save
lives



Do you wear your seat belt!





IDENTIFY
INVESTIGATE
IMPLEMENT

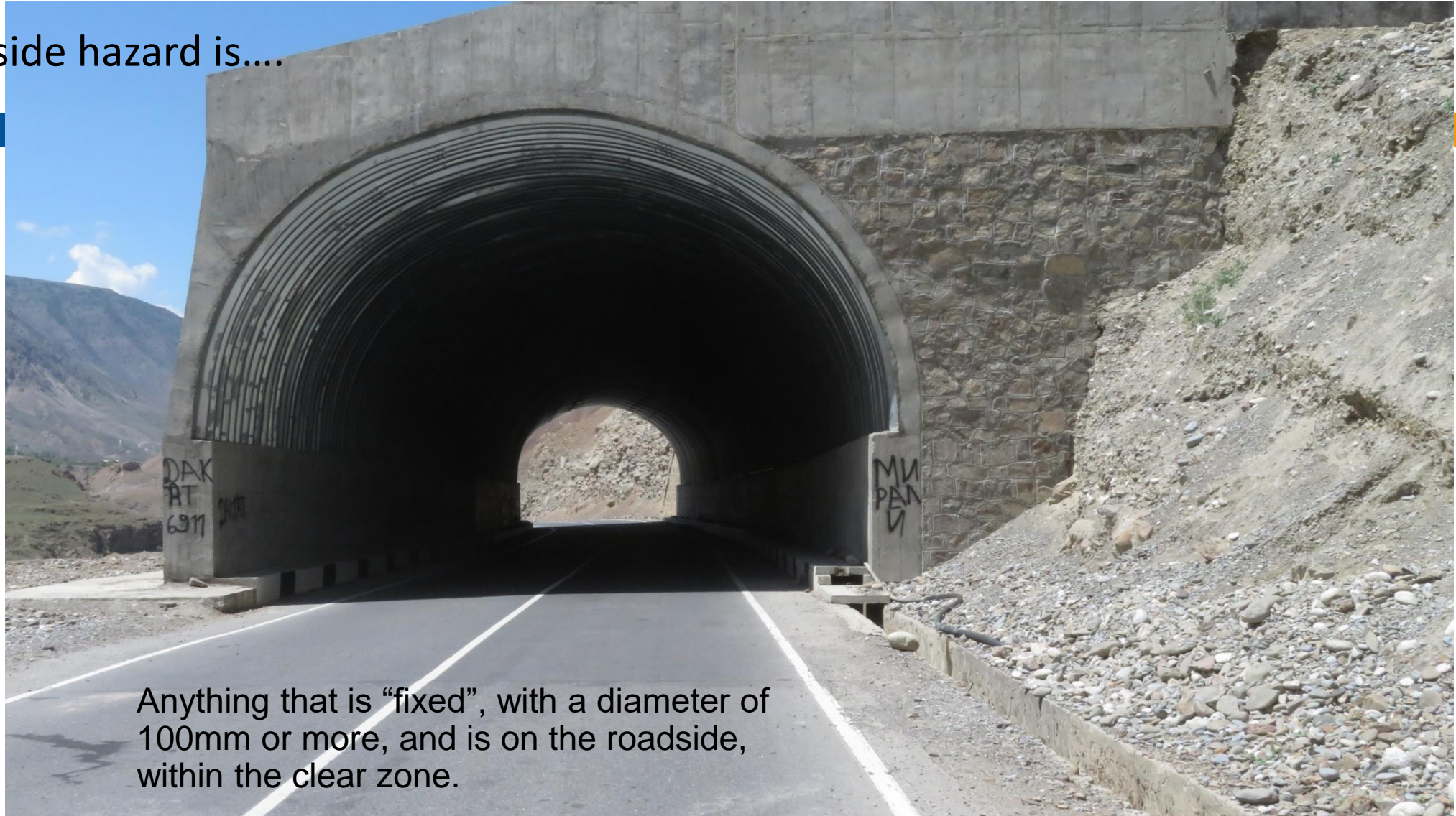
A roadside hazard is....



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



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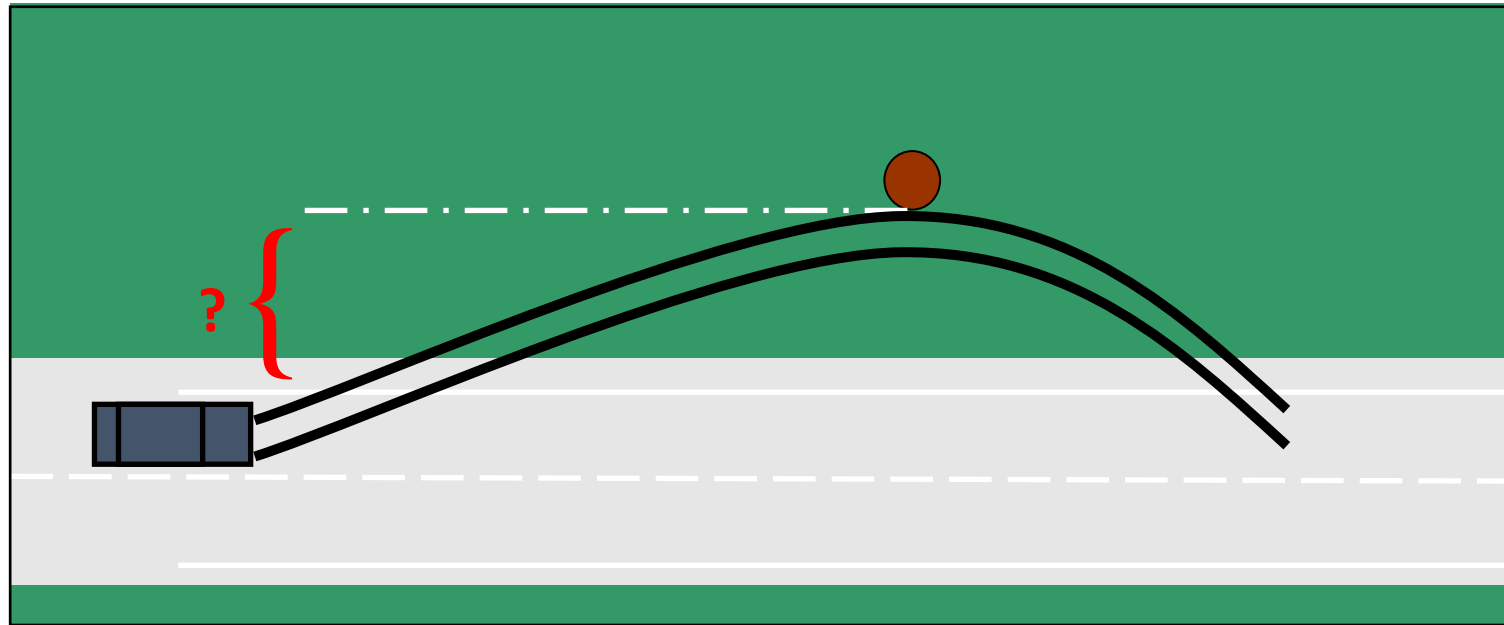


A roadside hazard is....



What is a Clear Zone ?

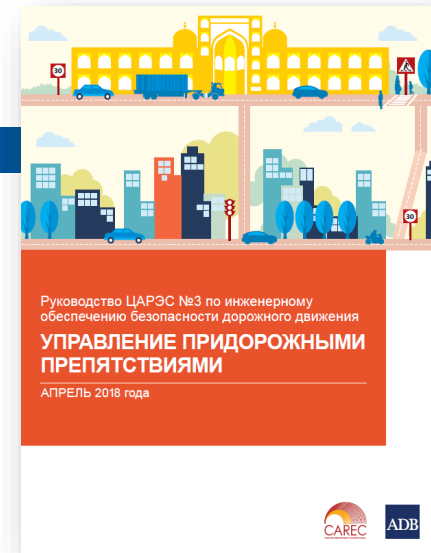
“A drivable roadside area that should be kept clear of hazardous objects in order to minimise the danger of a collision, should a vehicle leave the road”.



A strategy for Roadside Hazard Management

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

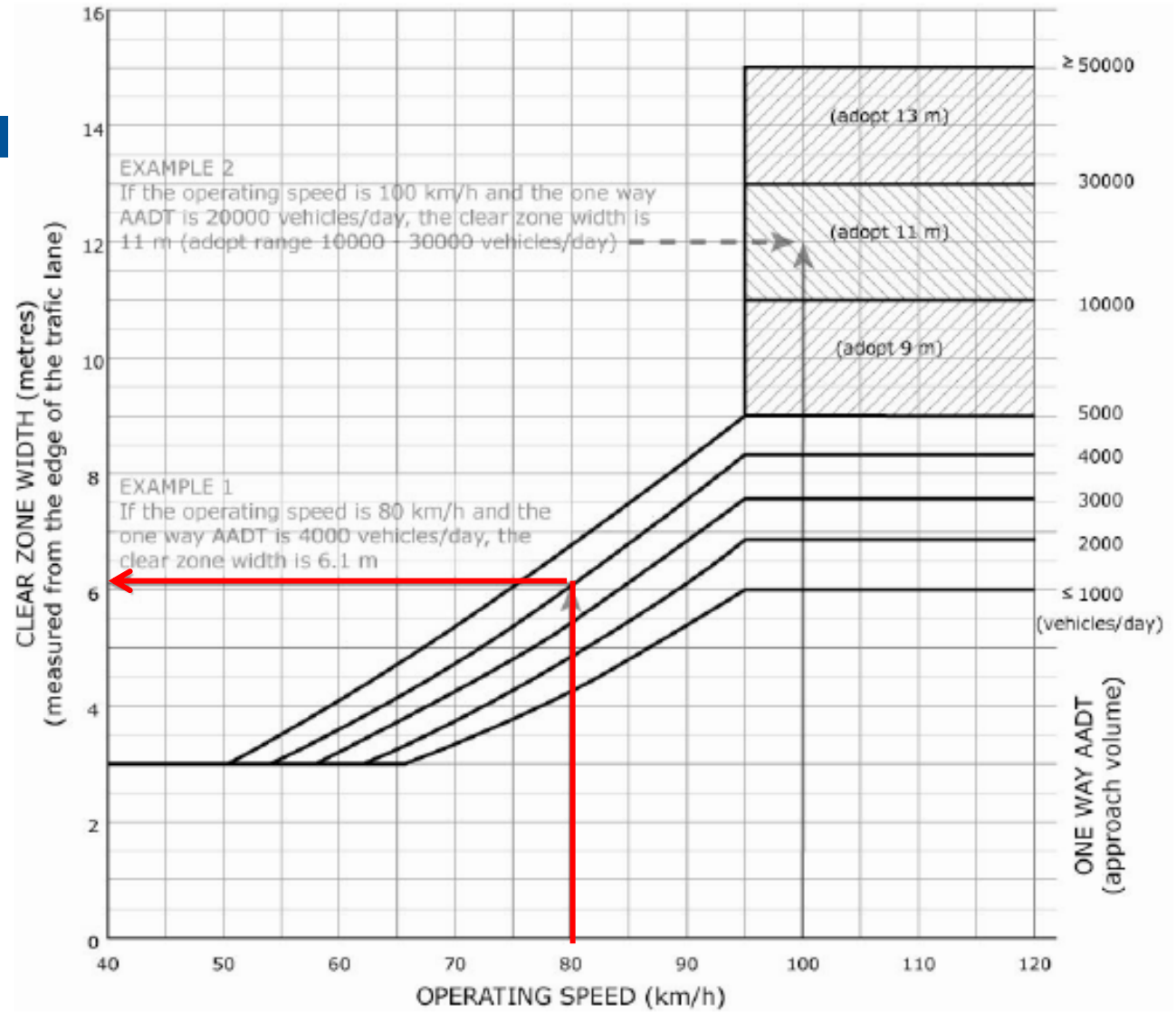
- i. remove the hazard
- ii. relocate the hazard
- iii. alter to reduce severity
- iv. shield with barriers





Clear Zone Chart

Figure V4.1: Basic Clear Zone Widths on Straights - All Roads



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



Chevron alignment markers are effective

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

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

Do you have these?





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



Consistent guideposts are very useful in rural areas!

Remove the hazard

Remove trees, poles
Place power underground
Combine services onto a single pole
Demolish structures

Relocate the hazard

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

Alter the hazard to reduce impact severity

- frangible lighting poles and signposts
- “soften” steep side slopes (4H:1V or flatter)
- drivable culverts

Install safety barrier. Three groups of barriers



Knowing where, and how, to correctly use these barriers requires experienced road safety engineers.

Does your road authority have enough RSE's?





Filmed under test conditions



4 Pedestrian safety

Pedestrian crashes...



- up to 40% of road fatalities in CAREC
- due to vehicle speed, inattention, alcohol, inadequate facilities (or all).
- the most vulnerable of road users.









PEDESTRIAN FOOTBRIDGES



PEDESTRIAN FOOTBRIDGES

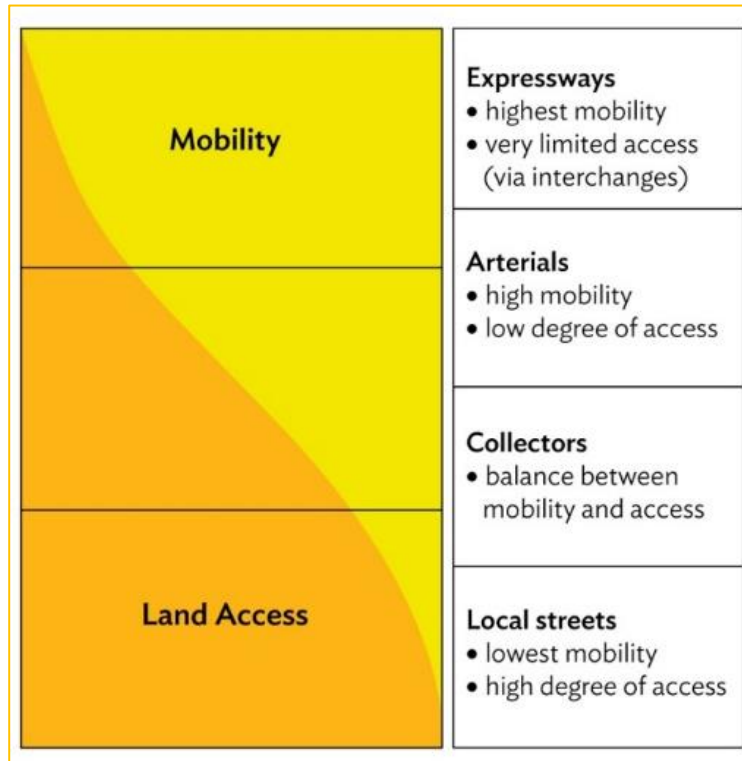


Are footbridges and underpasses really the best?

- Do pedestrians like grade separation as much as engineers do?
- Most will use it if they can access it and it saves them distance.
- USA research (Zegeer 1993):
 - 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?

Diagrammatic representation of mobility vs land access

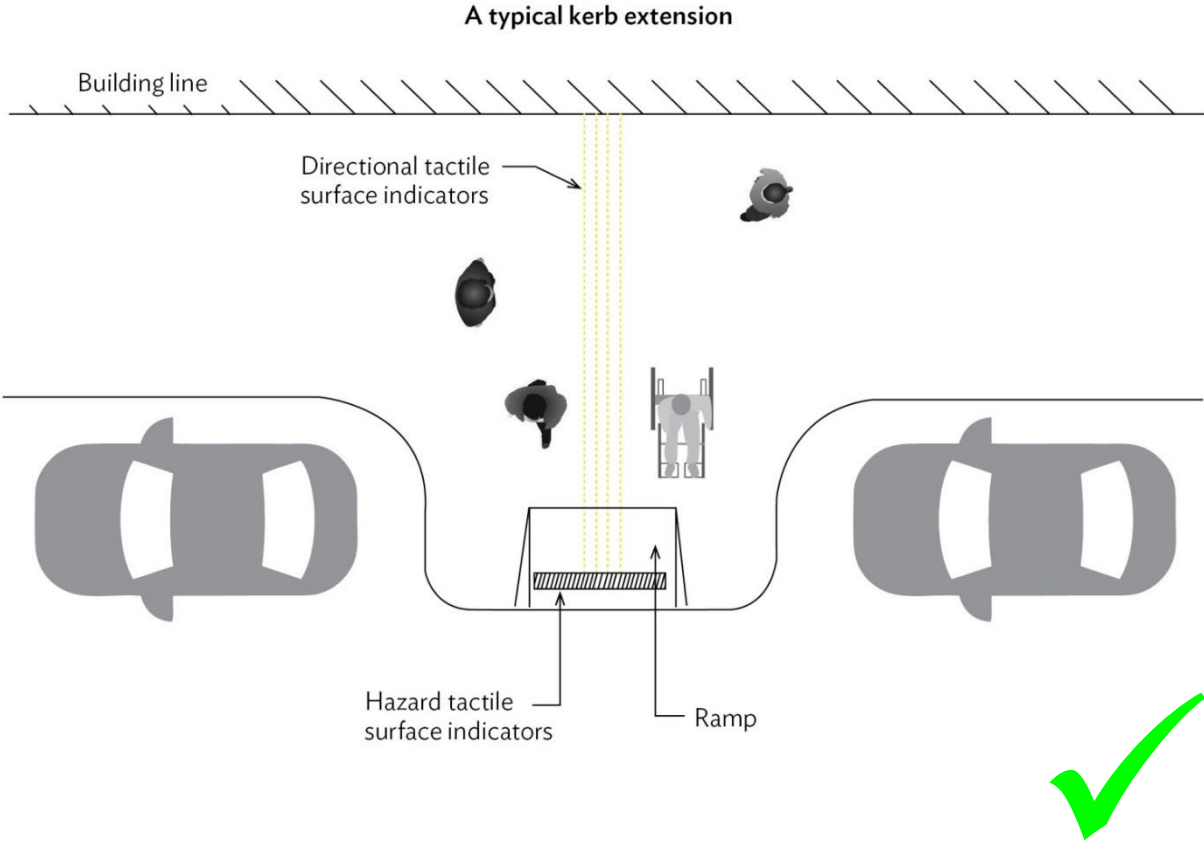
- Expressways – always grade separate
- Arterials – examine all options
- Collectors – separation in space, Zebra Crossings if narrow, PUFFINS if busy and/or wide.
- Local streets – traffic calming and small civil works



Small scale civil works are effective



Small scale civil works are effective



5 Signs, lines and delineation

The 6C's of good signs

Conspicuous - easily seen

Clear - legible, able to be read in time

Concise - as few words as possible

Comprehensible – understandable

Credible – believable

Correct – must be the correct sign



- Conspicuous
- Clear
- Concise
- Comprehensible
- Credible
- Correct



- Conspicuous
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- Conspicuous
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Maintenance of signs is important



Thank You!

Engineers can save lives on your roads.

Have I made the point that your roads and roadsides can be made safer, at modest cost?

Your questions are welcome.

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