Welcome to the CAREC "Road Safety Engineering" Workshop

- for professionals in Turkmenistan

Module 1
Road Safety Engineering
- THE BIGGER PICTURE
Tuesday 12th April 2022

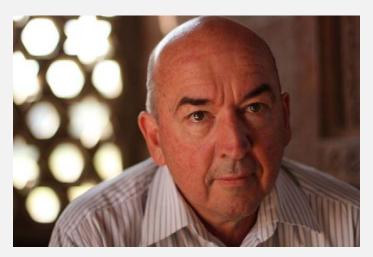


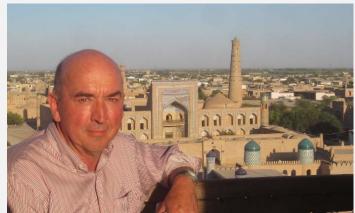


Successful completion of this workshop requires

- Participation in all six modules
- Attempted answers to the Poll Quiz questions
- Satisfactory preparation of a hazardous road
 location report with recommended treatments
- Satisfactory completion of a road safety audit report, with recommended treatments.







Friend
Foreigner
Fellow engineer
I have worked in all CAREC countries
– from PRC (in the east) across to
Georgia (in the west)

- Phillip Jordan
- 31+ years with VicRoads in Melbourne
- Program Manager, AUSTROADS Road Safety Audit
- 16 years in consulting
- Traffic and road safety engineering
- 45 countries of work so far......



- It is a great pleasure to be speaking with you (wherever you are) from Melbourne today.
- It is late autumn here. I hope you are comfortable and safe where you are.





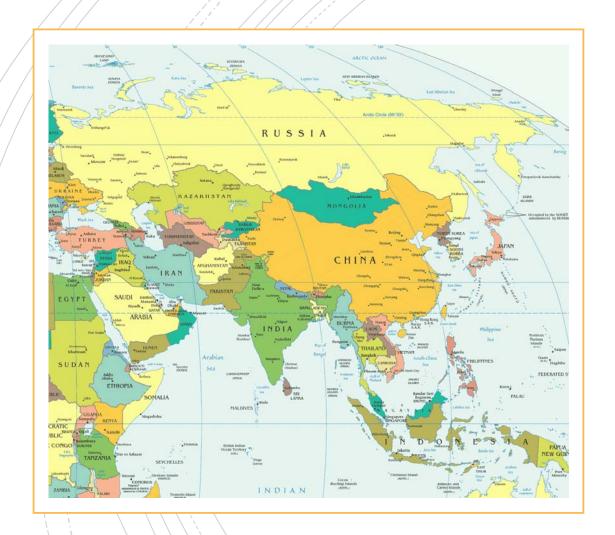
Objectives of this presentation:

- outline the extent of the global road safety problem.
- to discuss the cost of crashes in your country.
- to outline the "chain of events" leading to a crash
- to explain the "bigger picture" in road safety engineering
- to encourage you all to work towards safer road infrastructure.

Wally the Wombat.

Please count them all!





I am pleased to welcome every one of you to the workshop. And I want to emphasise in this module a simple message – the

world needs more road safety

engineers!

Module 1 - ROAD SAFETY ENGINEERING – THE BIGGER PICTURE

10:00–10:15	Opening Remarks - outlining the objectives of the workshop.
	Minister for Transport, Government of Turkmenistan (tbc)
	Senior Director, ADB (tbc)
	Mr. Syed Shakeel Shah, CAREC Institute Director
	Moderator: Dr. Iskandar Abdullaev, CAREC Institute Deputy Director
10:15–10:20	Welcome – outlining the objectives of the workshop. Setting the scene and introduction of the lead expert.
	Speaker: Mr. Transport Specialist, CWTC, ADB (TBC)
10:20–12:15	Road Safety Engineering – the bigger picture.
	Detailing what engineers can do to reduce road trauma, outlining the global and national road safety problem, emphasizing "the road" in road safety. Key processes in the road safety engineering
	profession – an overview of how engineers can successfully reduce crashes at hazardous locations,
	and how they can apply their knowledge in the design of new roads to prevent future crashes.
	Speaker: Mr. Phillip Jordan
	Moderator: Mr. Transport Specialist, CWTC, ADB (TBC)
12:15–12:30	Module 1 close: key takeaway and closing remarks.
	Moderator: Mr., Transport Specialist, CWTC, ADB (TBC)



Questions for you



How many deaths occur on the roads of your country each year?

Where will road safety be in your country in 10 years?

Global road safety

- The world has a major health problem involving road safety.
- 1,350,000 or more killed each year.
- Millions (up to 50 million) injured.
- The second Decade of Action in Road Safety commenced early last year (2021).





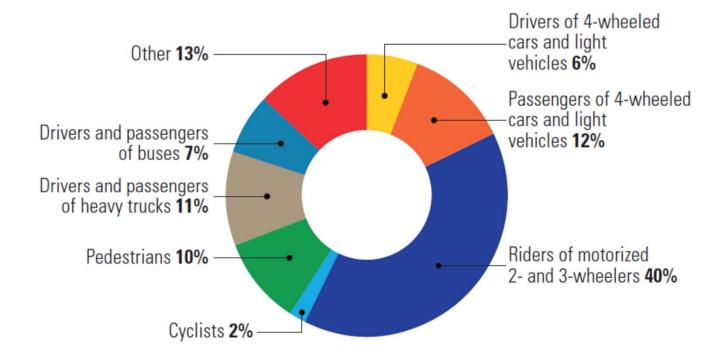
GLOBAL STATUS REPORT ON ROAD SAFETY 2018





INDIA 2016

Deaths by road user category



Source: Ministry of Road Transport and Highways, Road Accidents in India 2016

150,785 reported deaths299,091 deaths (WHO estimate)22.6 fatalities per 100,000 pop.

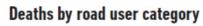
INDIA

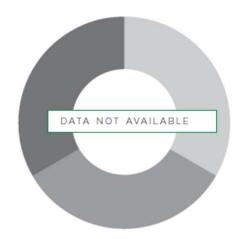


Population	\$GDP	Level	Reported road deaths	Estimated number of road deaths	Death rate per 100,000 pop
1,324,171,392	\$1680	Middle	150,785	299,091	22.6

TURKMENISTAN













TURKMENISTAN

Population	\$GDP	Level	Reported road deaths	Estimated number of road deaths	Death rate per 100,000 pop
5,662,544	\$6670	Middle	543	823	14.5



Fatality rates are high! (Central Asia)

WHO 2018

Afghanistan

Azerbaijan

• China

Georgia

Kazakhstan

Kyrgyzstan

Mongolia

Pakistan

Tajikistan

Turkmenistan

Uzbekistan

15.1 per 100,000 population

8.7 per 100,000 population

18.2 per 100,000 population

15.3 per 100,000 population

17.6 per 100,000 population

15.4 per 100,000 population

16.5 per 100,000 population

14.3 per 100,000 population

18.1 per 100,000 population

14.5 per 100,000 population

11.5 per 100,000 population



Fatality rates are low! WHO 2018



- Sweden
- United Kingdom
- Netherlands
- Denmark
- Australia

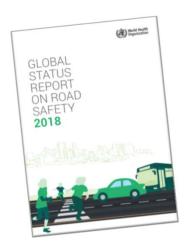
- 2.8 per 100,000 population
- 3.1 per 100,000 population
- 3.8 per 100,000 population
- 4.0 per 100,000 population
- 5.6 per 100,000 population

1.35 million deaths each year

8th
leading cause of death for people of all ages

times higher death rates in low-income countries than in high-income countries

leading cause of death for children and young adults 5-29 years of age



Global road trauma



Table 1: Leading causes of death, all ages, 2016

Rank	Cause	% of total deaths
	All Causes	
1	Ischaemic heart disease	16.6
2	Stroke	10.2
3	Chronic obstructive pulmonary disease	5.4
4	Lower respiratory infections	5.2
5	Alzheimer's disease and other dementias	3.5
6	Trachea, bronchus, lung cancers	3.0
7	Diabetes mellitus	2.8
8	Road traffic injuries	2.5
9	Diarrhoeal diseases	2.4
10	Tuberculosis	2.3

2016 WHO Global Health Estimates

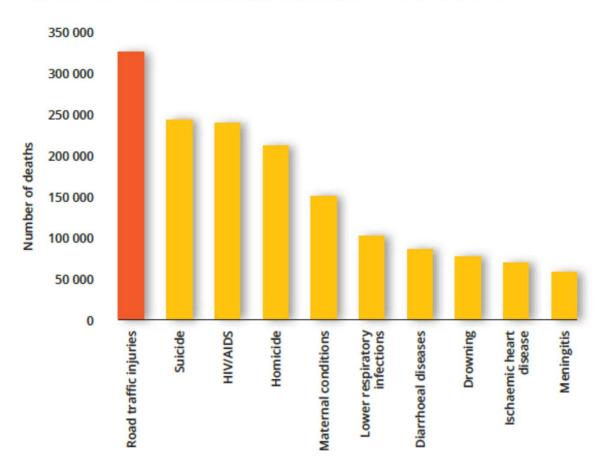
Global Road Safety – a challenge for us all

RANK	LEADING CAUSE 2004	%
1	Ischemic heart disease	12.2
2	Cerebrovascular disease	9.7
3	Lower respiratory infections	7.0
4	Chronic obstructive pulmonary disease	5.1
5	Diarrheal diseases	3.6
6	HIV/AIDS	3.5
7	Tuberculosis	2.5
8	Trachea, bronchus, lung cancers	2.3
9	Road traffic injuries	2.2
10	Prematurity and low birth weight	2.0
11	Neonatal infections and other	1.9
12	Diabetes mellitus	1.9
13	Malaria	1.7
14	Hypertensive heart disease	1.7
15	Birth asphyxia and birth trauma	1.5
16	Self-inflicted injuries	1.4
17	Stomach cancer	1.4
18	Cirrhosis of the liver	1.3
19	Nephritis and nephrosis	1.3
20	Colon and rectal cancers	1.1

RANK	LEADING CAUSE 2030	%
1	Ischemic heart disease	12.2
2	Cerebrovascular disease	9.7
3	Chronic obstructive pulmonary disease	7.0
4	Lower respiratory infections	5.1
5	Road traffic injuries	3.6
6	Trachea, bronchus, lung cancers	3.5
7	Diabetes mellitus	2.5
8	Hypertensive heart disease	2.3
9	Stomach cancer	2.2
10	HIV/AIDS	2.0
11	Nephritis and nephrosis	1.9
12	Self-inflicted injuries	1.9
13	Liver cancer	1.7
14	Colon and rectal cancer	1.7
15	Oesophageal cancer	1.5
16	Violence	1.4
17	Alzheimer and other dementias	1.4
18	Cirrhosis of the liver	1.3
19	Breast cancer	1.3
20	Tuberculosis	1.1

Leading causes of mortality 2004 and 2030

FIGURE 1
Top ten causes of death among people aged 15–29 years, 2012



The world needs more road safety engineers



THE COST OF CRASHES

What does a road crash fatality cost your country?



Calculating the cost of road crashes in your country

- The cost of a fatality is estimated 70 x GDP per capita
- GDP per capita in your country: USD\$X,000
- One death costs: 70 x USD\$ X thousand
- Cost of a serious injury: 0.25 x fatality cost
- A serious injury costs: 17.5 USD\$X thousand

Sources:

McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.



Road crashes cost Turkmenistan...

- The cost of a fatality is estimated 70 x GDP per capita
- GDP per capita in Turkmenistan: USD\$6,670
- One death costs: 70 x \$6,670 = USD\$466,900
- Cost of a serious injury: 0.25 x fatality cost
- A serious injury costs: USD\$116,725

Sources:

McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.

Multiple the number of deaths and injuries by these figures

WHO estimate 823 deaths on Turkmenistan roads (2016)

 $823 \times $466,900 = $384,258,700$ (almost 400 million USD each year!)

Serious injuries cost much more again (maybe 3-4 time this amount again, because there are about 10 serious injuries, and more slight injuries, for each fatality!)

Sources:

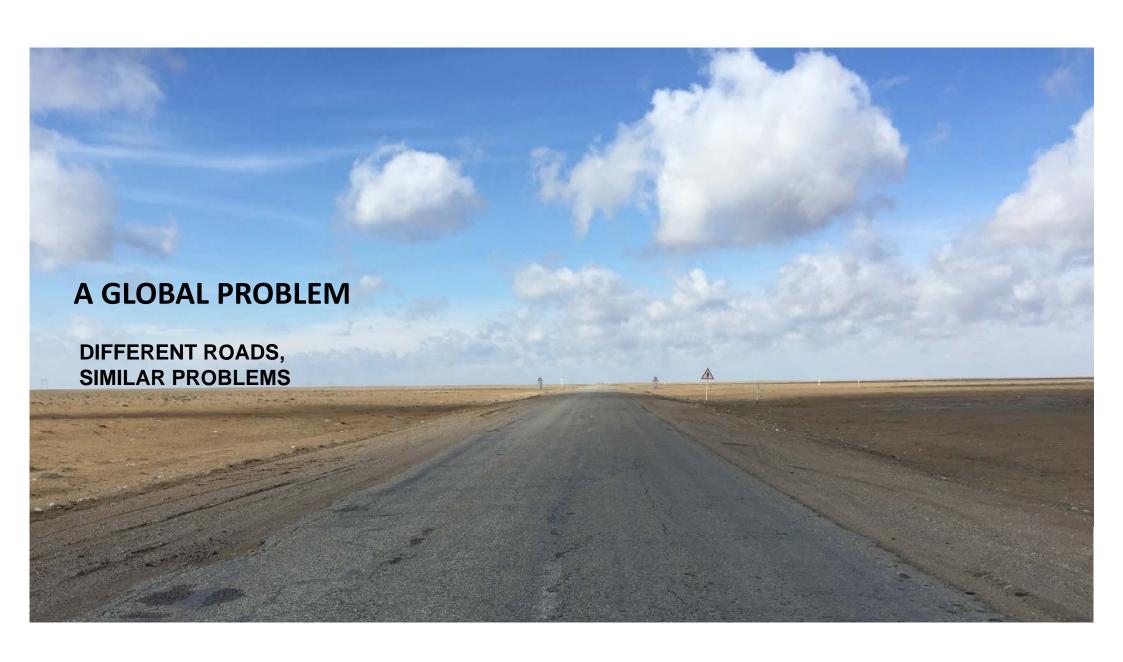
McMahon, K. and Dahdah, S. (2008) The True Cost of Road Crashes: Valuing life and the cost of a serious injury. http://irap.org/library.aspx; International Monetary Fund, 2013.

If you do not want to see a video of a violent crash....

...turn away now







A GLOBAL PROBLEM

DIFFERENT ROADS, SIMILAR PROBLEMS





A GLOBAL PROBLEM

DIFFERENT ROADS, SIMILAR PROBLEMS





A GLOBAL PROBLEM

DIFFERENT ROADS, SIMILAR PROBLEMS

























Why is <u>your</u> job important for safety?

- Different nations = different roads = different road user mixes.
- Improve the road network wider, straighter, flatter
- Then, many vehicles travel faster more vehicles run off the road; pedestrians at higher risk.
- Road safety engineering can help
- Safer work sites, treating blackspots, undertaking road safety audits, and roadside hazard management can help.
- They can be applied in any country.
- They need resourcing and co-ordination from a National Road Safety Action Plan
- Experienced trained road safety engineers are essential

I am from Victoria, Australia



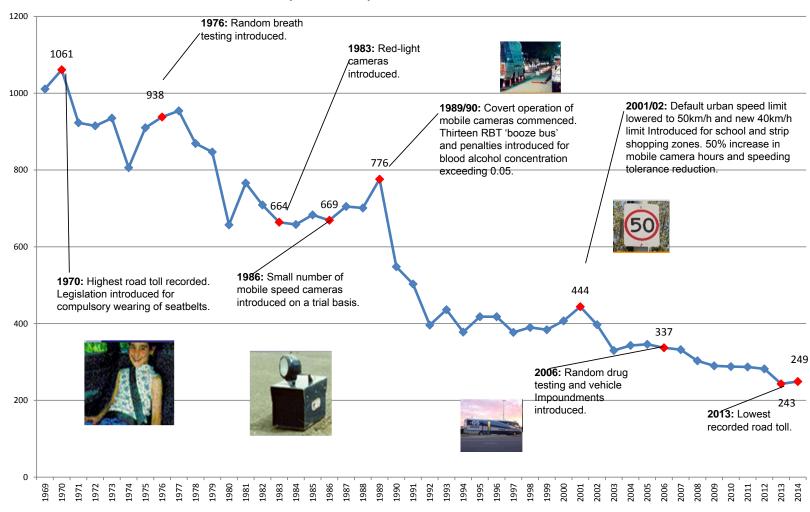
1970

- Terrible road crash record
- Drink driving common
- Speeding common
- Poor highways
- No freeways
- 1061 deaths
- > 30 deaths/100,000 pop.
- Higher than Turkmenistan today!

2020

- Lowest number of lives lost ever
- One of the lowest fatality rates in the world
- Seat belt law a world first!
- Random BAC testing
- Strong enforcement
- Safer roads many rural highways and freeways
- 211 deaths
- <4 deaths / 100,000 pop.

Lives lost, Victoria, Australia 1970 - 2014









Road safety engineering is NOT......

Placing signs that achieve nothing

Road safety engineering is NOT......

.....using safety barriers incorrectly







Our aim should be to.....

create easy-to-understand, forgiving roads for <u>all</u> our road users!







How? We have only a small number of tools...

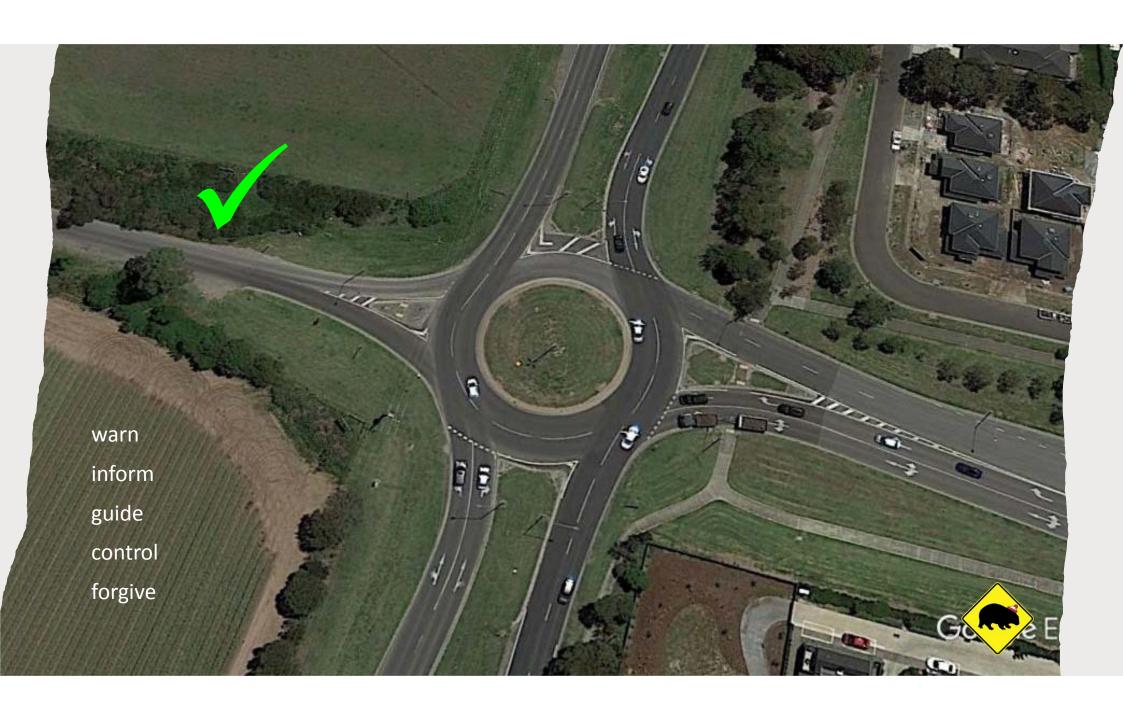
- warn
- inform
- guide
- control
- forgive





- warn
- inform
- guide
- control
- forgive







- warn
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- control
- forgive



- warn
- inform
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- control
- forgive





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- warn
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- warn
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- forgive

Its easy to look at photos of roads and traffic control devices like these....

Our big challenge is to know what/when/where to use these and how to correctly use them

That is what we will try to cover in various ways throughout this workshop



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



To break a chain, we need to remove one "link". Where do we start?

Let's look at a "typical" chain of events.....

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 on weekends - he maintains it.

Chain of events continued...

- He spends a whole (frustrating) weekend repairing it.
- The brakes were very worn. He replaces the discs.
- He finishes late Sunday much later than expected.
- 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 cold, but he must start early at a building site in the city.
- Little sleep, no breakfast, late for work.
- Drives the truck on a local road towards the National Highway to get to work.

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.







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 any warning.



- To avoid a "side swipe" 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 but the new brakes "grab". His truck slides.
- It side swipes the other truck.
- Our truck 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?

Possible causes.....

- 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 being stored on the road?
- The "slick" road conditions? The lack of sealed shoulders?
- The deep roadside drain?



Break one "link" and the chain will collapse.

Engineers could have:

- Stored materials away from the road.
- Inspected the road work site; ensured good warning signs.
- Removed/covered the deep drain.
- Maintained line marking



Engineers can save lives on your roads (and globally)

Throughout this series of workshops, we will have presentations on road safety audit, on blackspot programs, on low-cost ways to reduce roadside hazards and to improve pedestrian safety, and safer road works.

Today I will introduce you to some of the key road safety engineering concepts





What can engineers do to make roads safer for all?



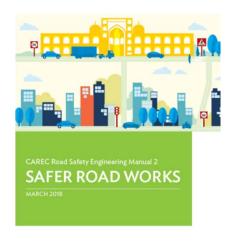




A sample of the key road safety engineering concepts:

- Road safety audit
- Treating hazardous locations (blackspots)
- Road work safety
- Roadside hazard management
- Pedestrian safety



















Do you have the CAREC road safety engineering manuals? They are a useful series to help you make your roads safer.

Go to the ADB website



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 are putting it to use in Turkmenistan.







Road Safety Audit

Prevention is better than cure







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."

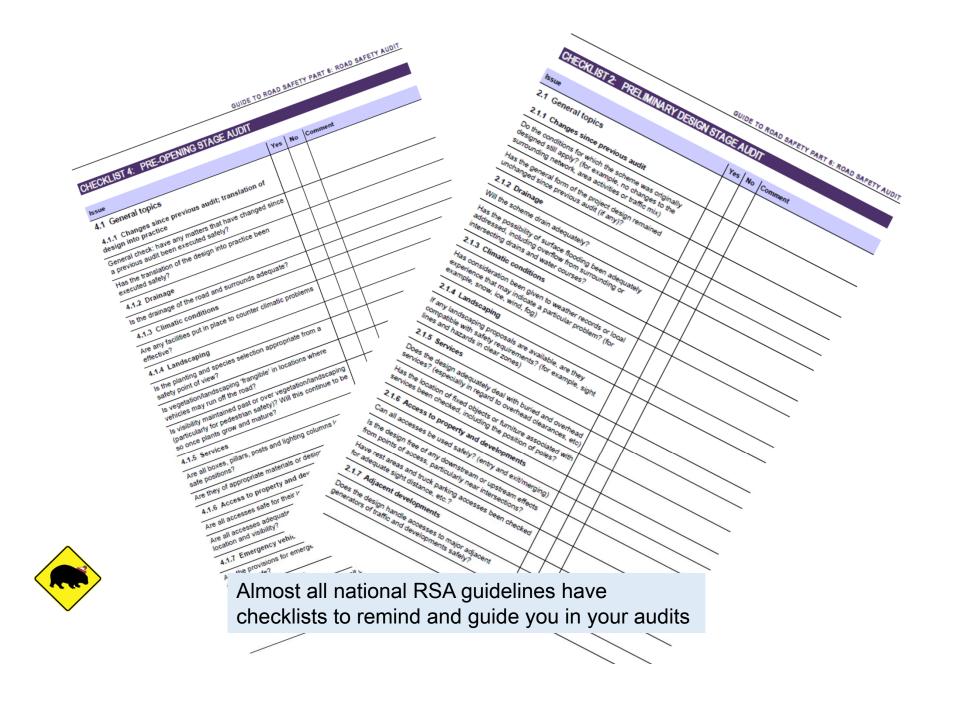
(CAREC 2018)

Road safety audit – prevention is better than cure

Road safety audit 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)



The steps in a road safety audit



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)



Prevention is better than cure - by Phillip Jordan

What projects should we audit?

Big road projects

Complex road projects

Small road projects

Projects on high-speed roads, and low speed roads

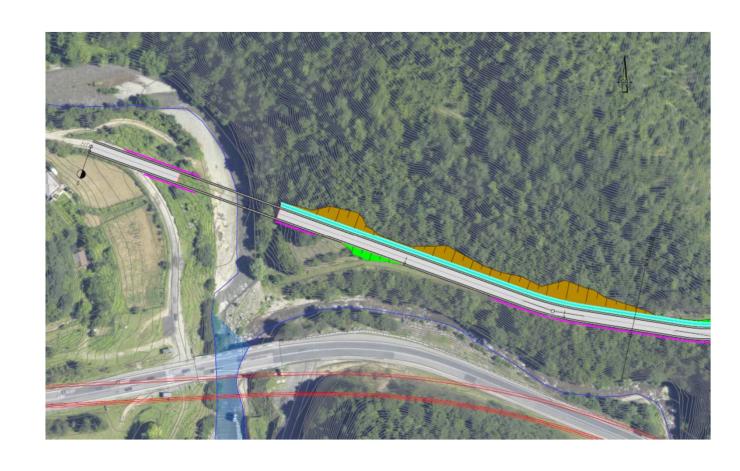
Rural projects

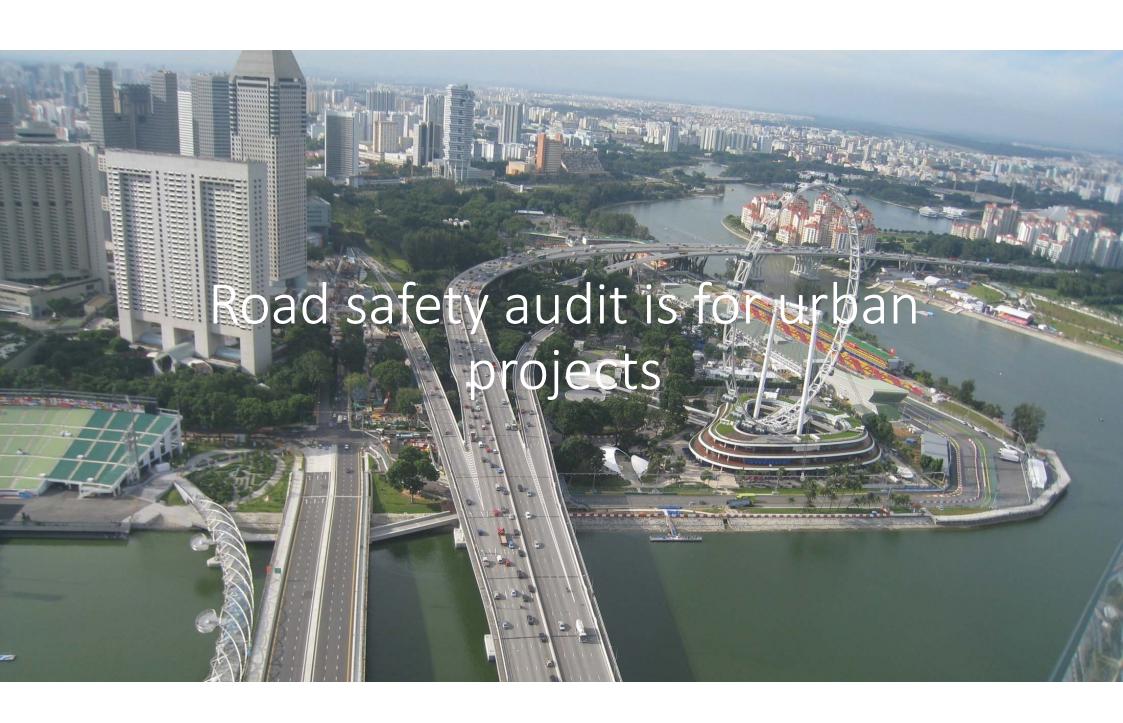
Traffic management schemes

Pedestrian projects/motorcycle projects/bicycle projects

Road works

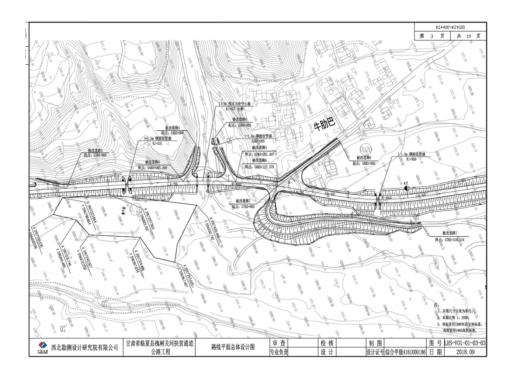
Road safety audit is for big projects







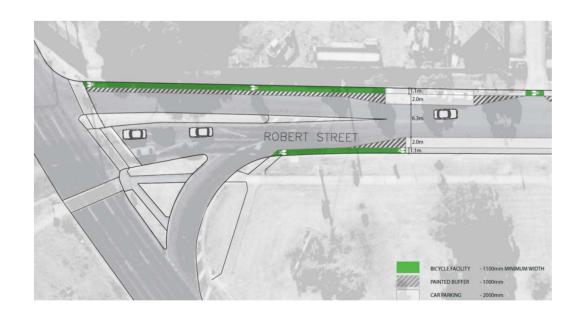
Road safety audit is for <u>rural</u> road projects



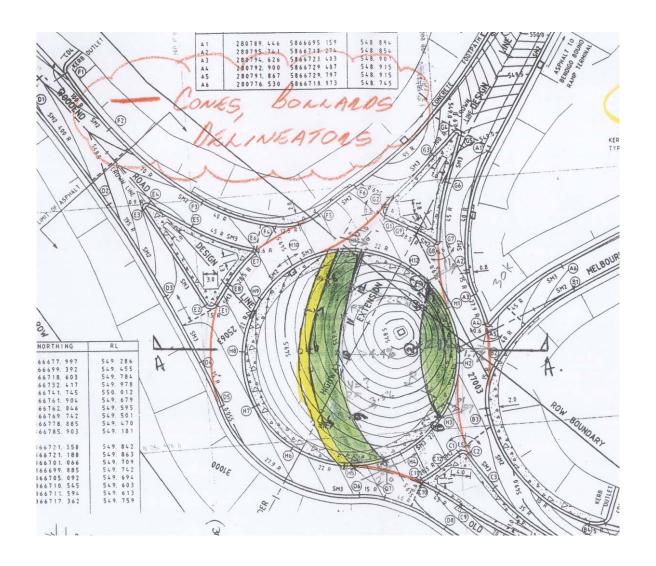


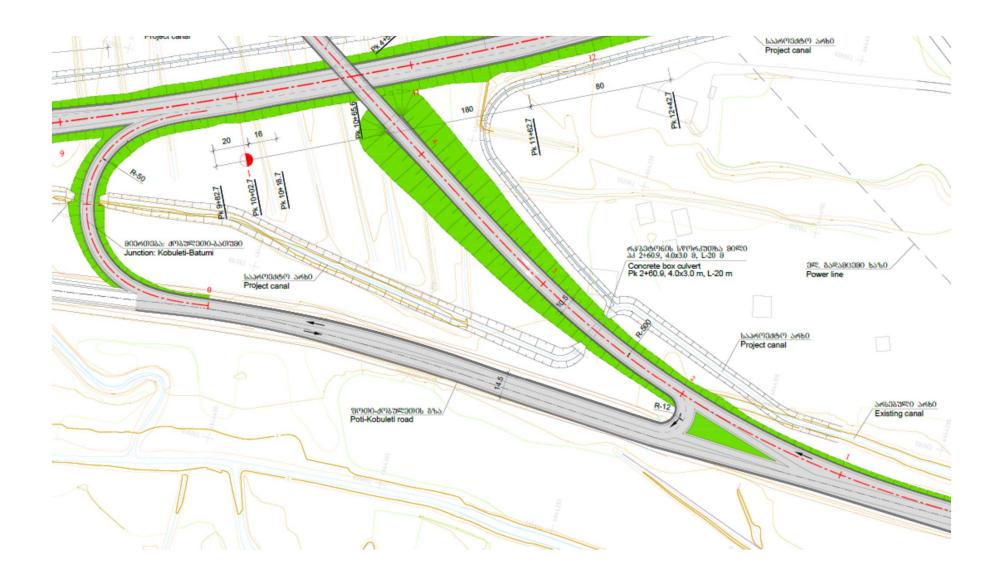
Road safety audit is for bicycle projects





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.







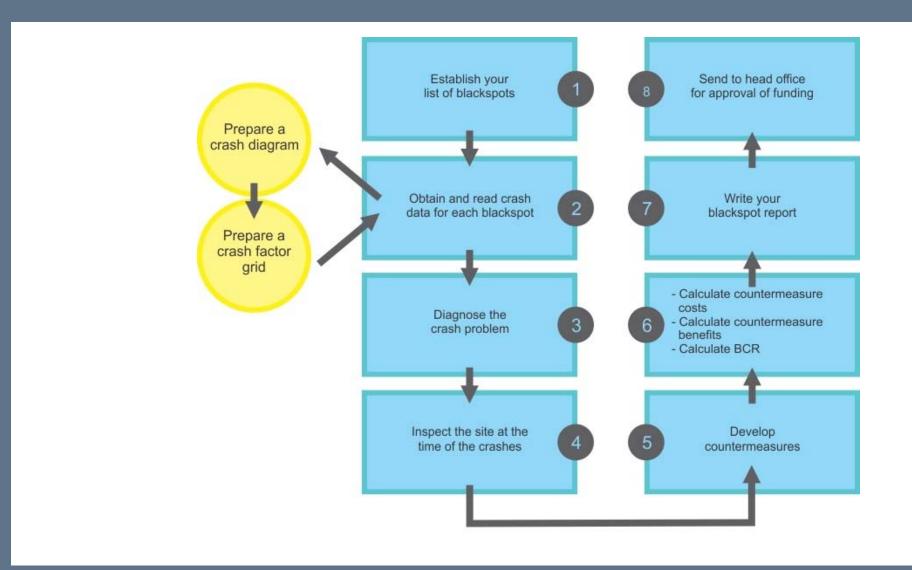
Low costs, high benefits
Well accepted in many countries
Valuable for Turkmenistan

Road safety audit



Investigating and treating blackspots



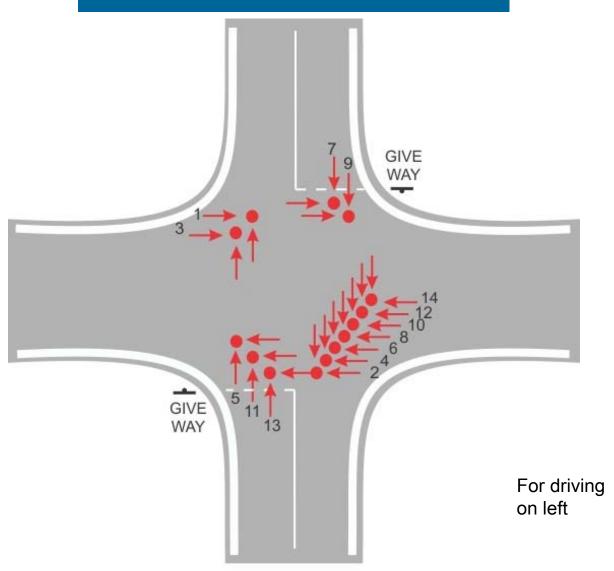


Draw a collision diagram

- 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	96	96	96	97	97	97	97	98	98	98	99	99	99	99
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)	Ε	W	Ε	W	W,E	W	Е	W,N	Е	W	W,E	W	W	W
Other														

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



Termination Zone

Work Zone

Work Zone

Figure 4 The Six Zone Concept

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

Of travel only

Work Zone

Taper Zone

Advance Warning Zone
(SOm urban / 100m rural)

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

Manual 3 Roadside hazard management

Too many people die in "run-off-road" crashes – in every country.







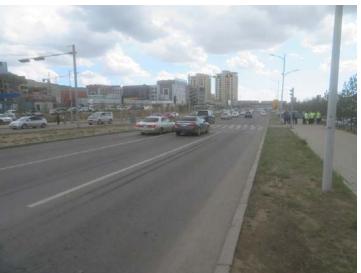




Manual 3 – Roadside Hazard Management







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

Culverts are dangerous





Wear your seat belt!



If you do not want to see a video of a violent crash.....

...turn away now



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



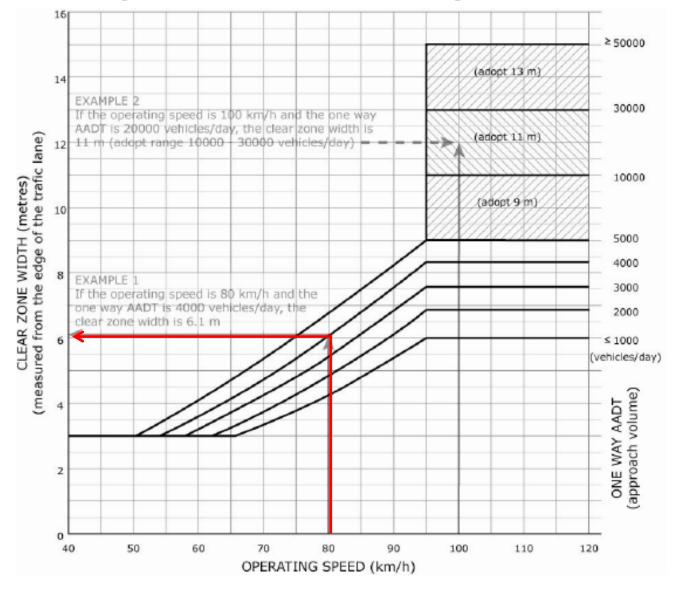


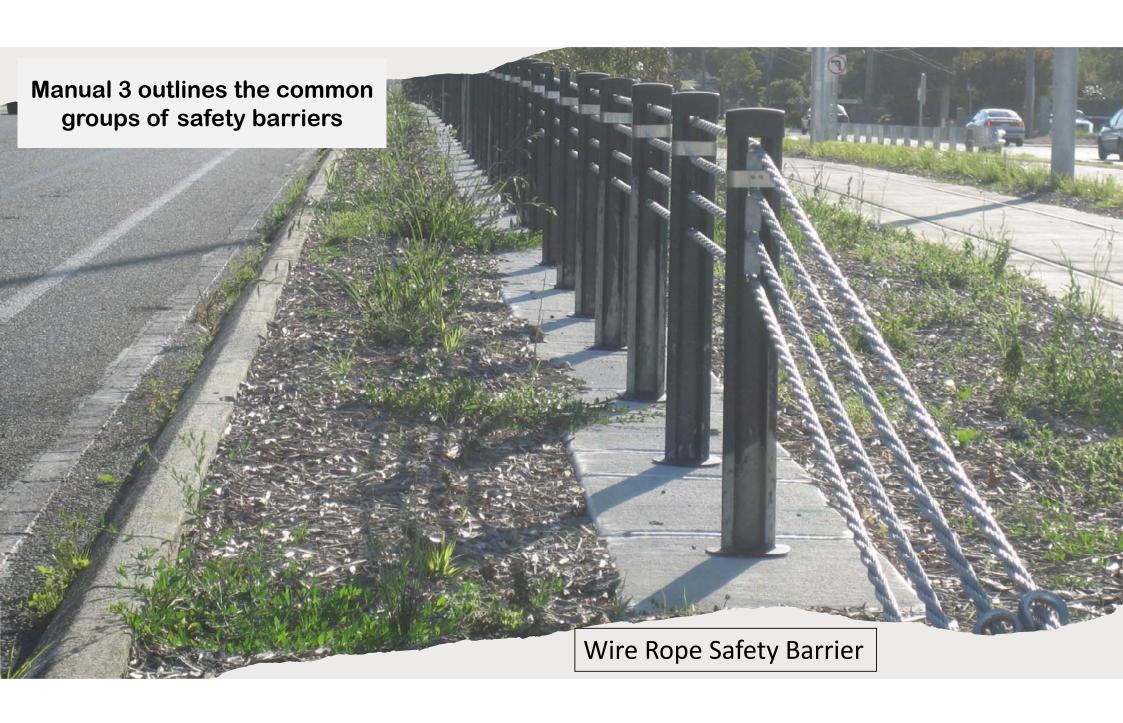


Chart

Clear Zone

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







W Beam Safety Barrier

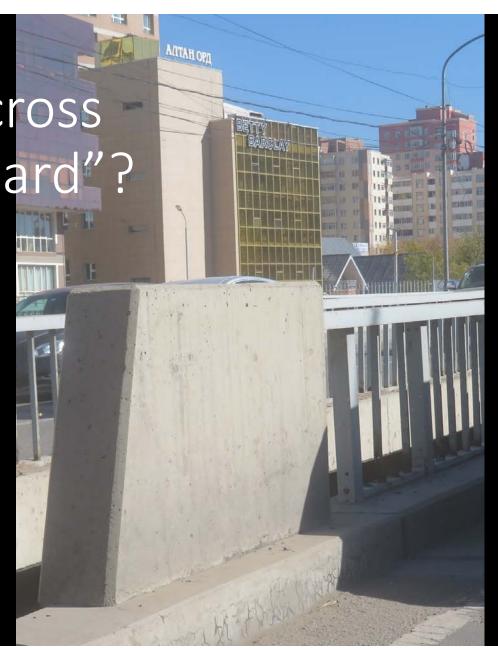
Rigid Barrier



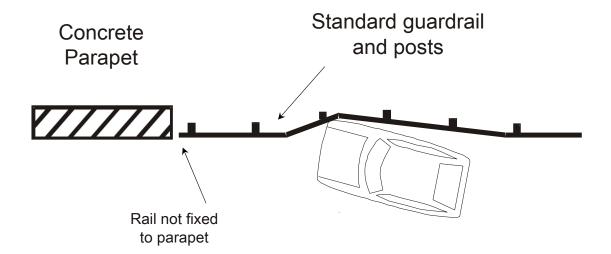


Is this bridge cross section "standard"?

Is it safe?

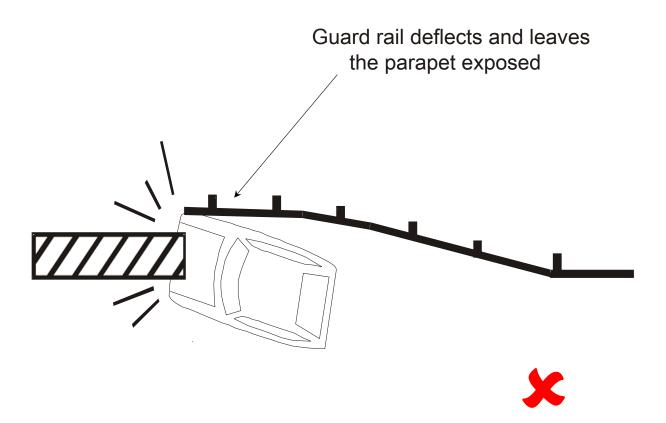


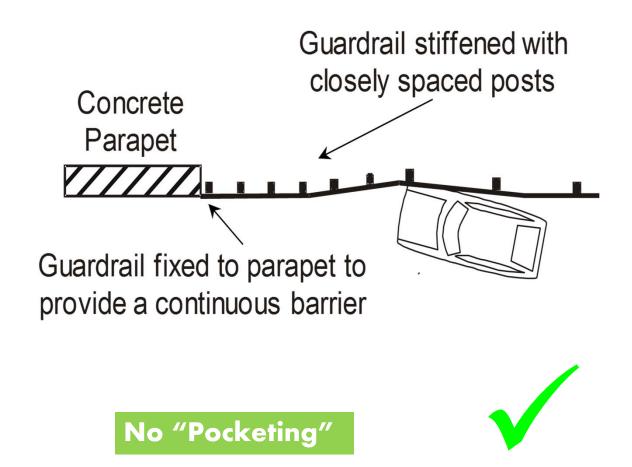
"Pocketing"

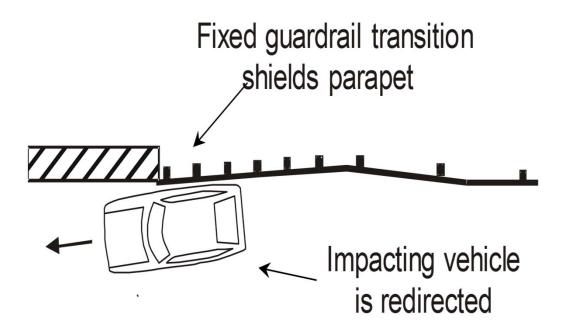




"Pocketing"







No "Pocketing"



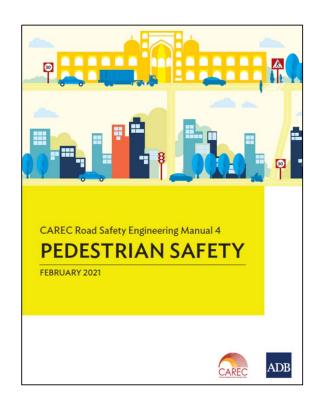


Unsafe! A safe terminal is needed to avoid spearing vehicles. Very unsafe!











Pedestrian safety

Think of all 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



There are three basic pedestrian strategies...

• <u>Segregation</u>

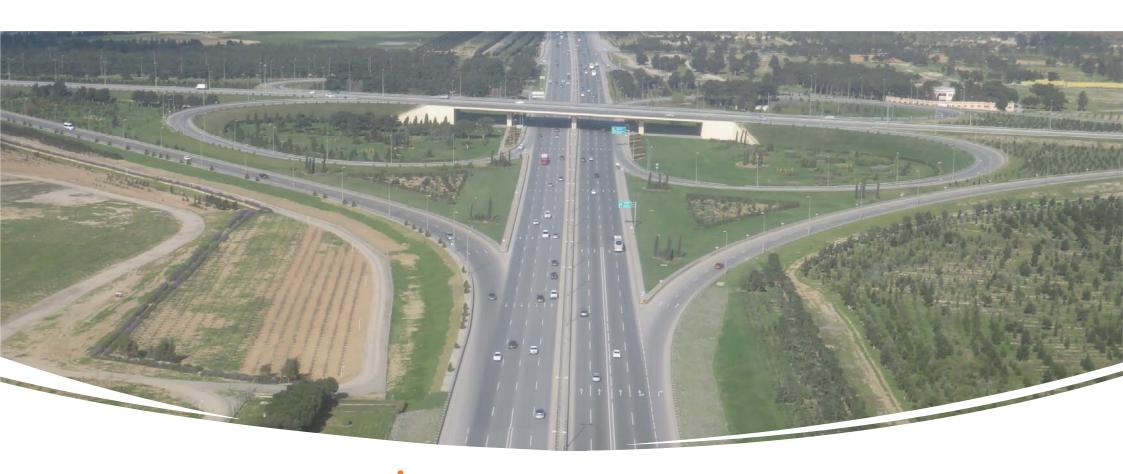
– freeways, malls

Separation

– in time or in space

• <u>Integration</u>

- where vehicles and pedestrians "share" the road



<u>Segregation</u> – expressways

Segregation – malls



SEPARATION – IN SPACE



SEPARATION – IN SPACE



SEPARATION – IN TIME



SEPARATION – IN TIME











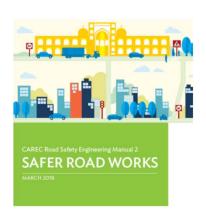




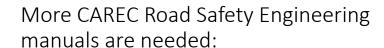


















Treating hazardous locations (blackspots) iRAP and audits
Intersection safety







CAREC roads can be made safer for all

Throughout this workshop we will have presentations on road safety audit, on blackspot treatments, on low-cost ways to reduce roadside hazards and to improve pedestrian safety, and safer road works.

We are eager to help you to move your country, and the CAREC Region, forward in road safety.





Engineers can save lives on CAREC roads (and globally)







THANK YOU – YOUR QUESTIONS ARE WELCOME