

INTERNATIONAL GOOD PRACTICE ON ROAD SAFETY MEASURES

Tbilisi, 07.03.2018.

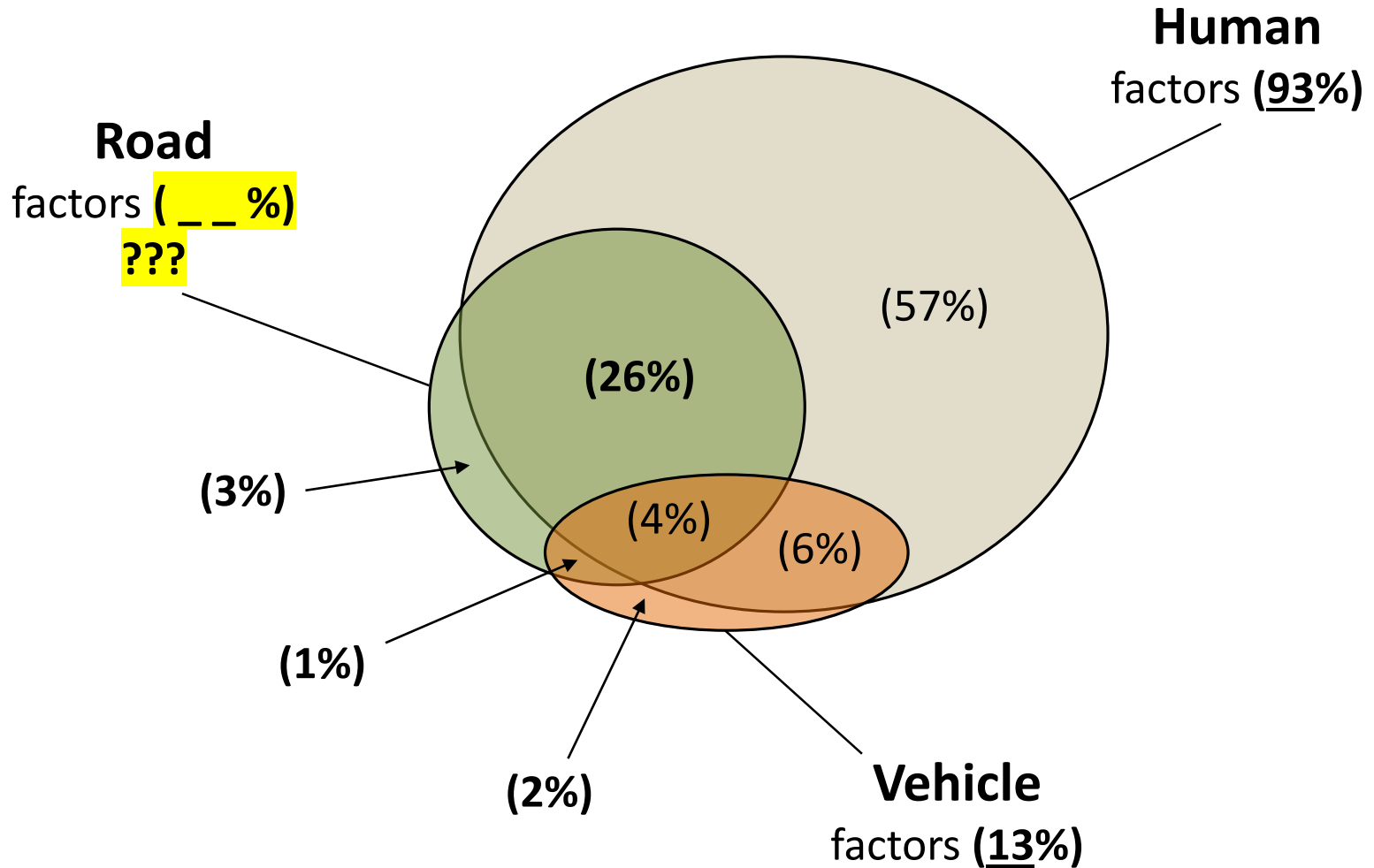
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About the presentation (before we start)

- Presentation is based on actual traffic situations identified as road safety deficiencies and available international good practice.
- International practice is based on PIARC (World road association) approach (description of road safety infrastructure problems in 8 chapters).
- There are plenty of illustrations from EaP and SEETO Regions which will help participants to easily understand typical road safety deficiencies and proposed safety measures.

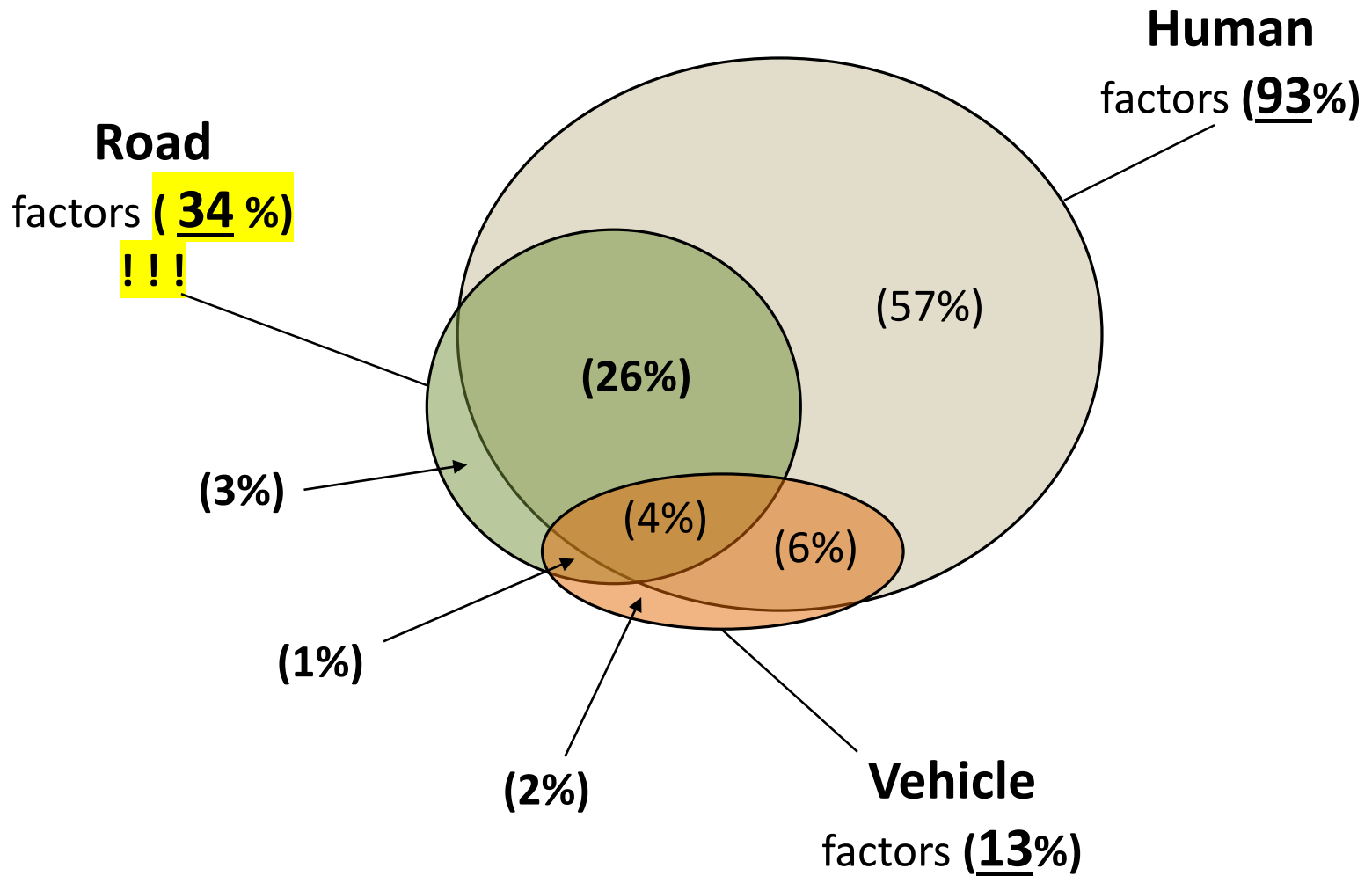
... But, before we start, please propose missing value in next graph ...

Accident contributing factors



Source: PIARC RSM 2003

Accident contributing factors



Source: PIARC RSM 2003

Thus...

Most accidents are caused by road users' mistakes (we are humans and we make mistakes)

But...

The road users cannot be expected to follow the rules and behave safely **if they are not given the possibilities and sufficient on time guidance**

So...

A road traffic system where common **(provoked) human mistakes are leading to serious injuries** should not be accepted!

Can we improve this?

Simple answer is, **YES!**

Following safe system approach, additional energy should be placed to the weakest point in whole system – **ROADS.**

But,

Before we act, we need to understand the most usual (typical) road safety deficiencies...

Structure of Road Safety Deficiencies (Problems) and proposed measures

In accordance with World Road Association (PIARC) approach, road safety deficiencies (problems) and proposed measures are categorized into following groups:

1. **Road Function,**
2. **Cross Section,**
3. **Alignment,**
4. **Intersections,**
5. **Public and Private Services along road,**
6. **Vulnerable Road Users,**
7. **Traffic Signing, Markings, Lighting and**
8. **Roadside Features (passive safety devices).**

WHY?



Where is a problem?

1. **Function,**
2. **Cross Section,**
3. **Alignment,**
4. **Intersections,**
5. **Public & Private Services,**
6. **VRU,**
7. **Traffic Signing, Markings, Lighting &**
8. **Roadside Features**



What can help?

08 04 2014

Typical road safety deficiencies and proposed solutions (measures)

1. Road function

- 1.1. Roads with mixed function (linear settlements)
- 1.2. Access control
- 1.3. Excessive speed

2. Cross section

- 2.1. Types of cross profiles (with of the road)
- 2.2. Drainage

3. Alignment

- 3.1. Vertical and horizontal curves (consistency)
- 3.2. Sight distance (visibility)

4. Intersections

- 4.1. Channelization of traffic flows
- 4.2. Intersection types ("Y" type, Roundabouts, etc.)
- 4.3. U-turns

5. Public and private services; service and rest areas, public transport

- 5.1. Services along roadside
- 5.2. Facilities for Public Transport (BUS stops)

6. Vulnerable road user needs

- 6.1. Pedestrian crossings
- 6.2. Footpaths

7. Traffic signing, marking and lighting

- 7.1. Signing
- 7.2. Marking
- 7.3. Lighting

8. Roadside features and passive safety installations

- 8.1. Roadside obstacles plantings, trees, light poles, advertisements, .)
- 8.2. Guardrails

+

9. Temporary signing and marking at Work Zones

+ ...

1. Road Function

1.1 Roads with mixed function (Linear settlements)

Problem:

A mixture of road functions (usage of the road as fast distributors for fast long distance motorised traffic and as a route for slow local traffic) causes one of the major road safety problems.

Are we talking about road or street?

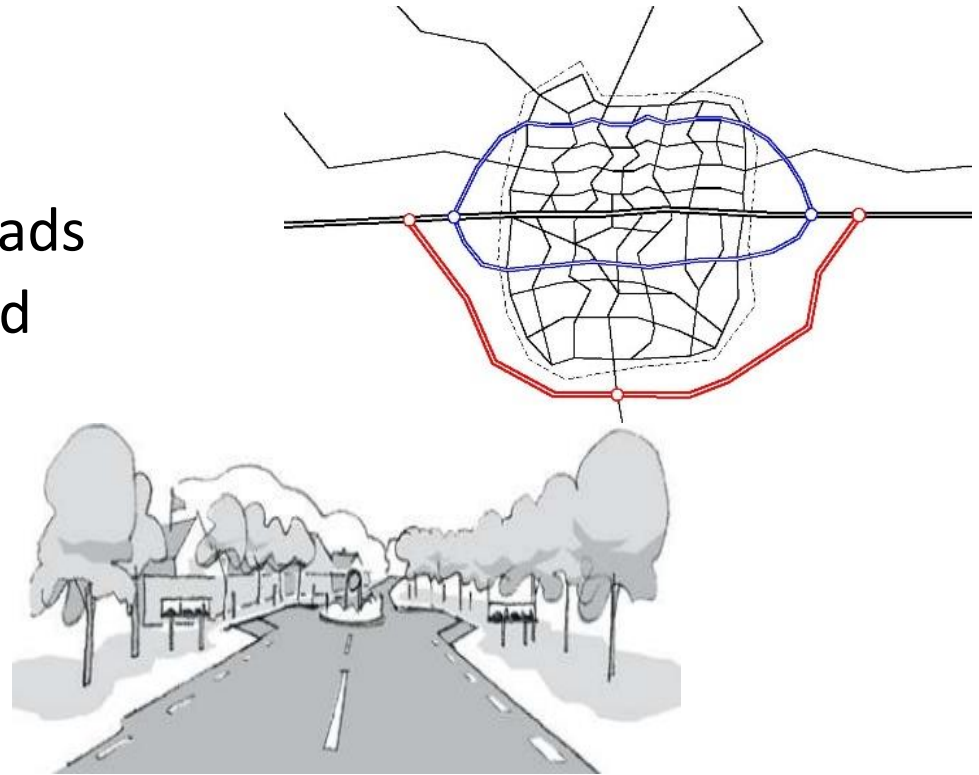


1.1 Roads with mixed function (Linear settlements)

Solution/s:

There is no cheap measure.

- **Separation of slow and fast traffic** by small distributor roads either between the main road and house or behind those,
- Construction of **road system outside built up areas**,
- Construction of **bypass**,
- **Separation, ...**



1.2 Access control

Problem:

Limiting the number of access points to the road/street is necessary in order to reinforce a road hierarchy and to concentrate potentially dangerous turning movements at a single junction (difference in speeds).

What do we want? Mobility VS accessibility?



1.2 Access control

Solution/s:

- **Closing of direct access to road** and construction of parallel service road which will collect traffic and connect to the main road at only a few better-designed junctions,
- Construction of **bypass**,
- Traffic signage and **traffic calming measures**,
- ...



1.3 Excessive speed

Problem:

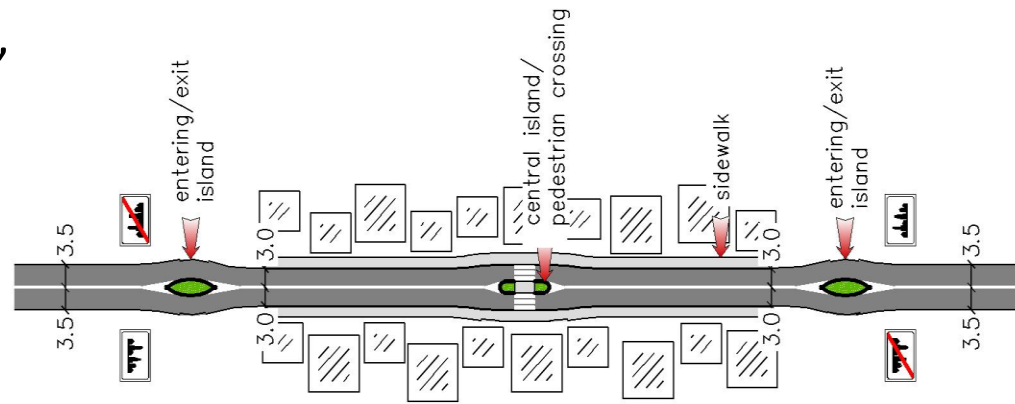
- Interurban sections: Long straight road sections, can increase speed...
- Urban areas: In a residential area, where city by-passes or separation of long distance and local transport does not exist, through traffic strongly interacts and conflicts with local inhabitants and therefore should be treated in a different way. In this case, the road acts as a local street.



1.3 Excessive speed

Solution/s:

- On interurban road section:
 - **speed limit management** (reduction in speed limits),
 - **lane width reduction** (overtaking traffic lane from 3.75 to 3.50 m),
 - **speed cameras**,
 - **variable message signs**,
 - **traffic police speed control**, ...
- Through traffic in a residential area ,
 - built-up areas **entering islands**,
 - **narrowing of the road**,
 - **central (refugee) island**,
 - **rumble strips**,
 - **Bumps**, ...



2. CROSS SECTION

2.1 Width of the road

Problem:

Dangerous cross sections of express roads and highways are frequently being used in EaPCs. For example, a four lane road without a crash barrier or two lane road with wide hard shoulders.

A road with a wide hard shoulder can sometimes be misused by drivers as a very narrow four lane road, with disastrous results and very serious crashes.

Opposite, too narrow lanes, is dangerous too.



2.1 Width of the road

Solution/s:

- **Reconstruction of cross section:**
 - **Changing into one of the safest solutions**
 - Introducing of the 2+1 cross-section,
 - New **median barrier** for 4-lane roads
- Road improvements (Rehabilitation),
- **Better signing and marking.**



2.2 Drainage

Problem:

Usually deep and steep-sided drainage channels can result in more damage in the case of vehicles going off the road.

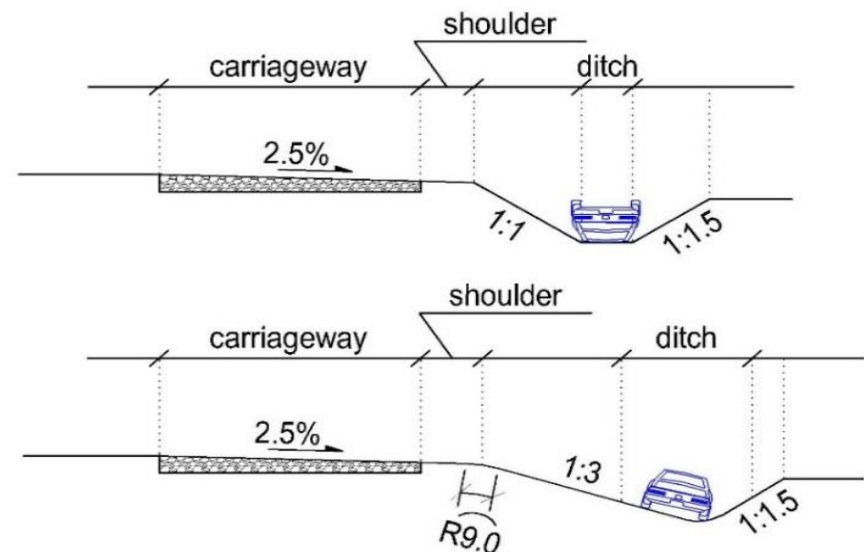
In a case of hitting high curbstones with a sharp shape, the vehicle overturn with serious results.



2.2 Drainage

Solution/s:

- Road improvements:
 - adding of **ditches with gentler slopes**; adding of the gutter,
 - **Adding of culverts** where is necessary,
 - **Closing of drainage system**,
 - improving of **friction coefficient**
- Traffic signage and traffic calming measures:
 - Usage of **protective devices**
- Maintenance of drainage system:
 - **Cleaning** of ditches,
 - **Covering** of drainage system.



3. Alignment

3.1 Vertical and horizontal curves (consistency)

Problem:

Unexpectedly tight horizontal curves can lead to crashes as drivers try to drive through them at too high a speed. Cross section in curves, Steep gradients, Transition areas, etc. can be very dangerous.



3.1 Vertical and horizontal curves (consistency)

Solution/s:

Reconstruction of curves:

- increasing the **radii of horizontal** curve,
- construction of **transition**,
- reducing the **gradient** of vertical curve,
- the **consistency of alignment**
- **widening of curves**,
- **resurfacing** of the top layer of pavement

Improving sight distance in curves:

- open **visibility**

Better signing and marking



3.2 Sight distance (visibility)

Problem:

Do we have ensured:

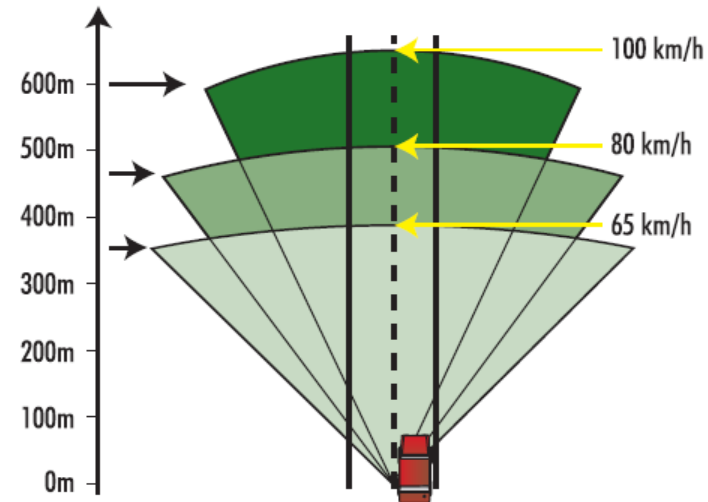
- Stopping sight distance?
- Orientation sight distance?
- Passing sight distance?
- Sight distance at junctions?



3.2 Sight distance (visibility)

Solution/s:

- **Reconstruction** of the curve, intersection, pedestrian crossings, etc,
- Opening of **visibility**,
- Enable proper **orientation for drivers** ,
- Improved **signing and marking**



4. Intersections

4.1 Channelization of traffic flows

Problem:

Golden rules for intersections are sometimes compromised:

- Every intersection must be visible early enough;
- Traffic regulation must be understandable from the signing and marking;
- The design should support traffic regulations;
- Good sight conditions for all users;
- The geometry has to ensure enough space for the relevant driving manoeuvres.



4.1 Channelization of traffic flows

Solution/s:

- **Construction of raised (kerb) islands:**
 - **Narrowing** of traffic lanes,
 - Additional **lighting** ,
 - Sufficient length for left/right **turning lane**
- **Usage of markings and traffic equipment:**
 - Clear marking of traffic lanes for **better guiding** of drivers,
 - **Plastic markers**, flex poles and other rubber elements can be used,
 - **Advance information signs** for lane direction, ...



4.2 Intersection types ("Y" type, roundabouts, etc.)

Problem:

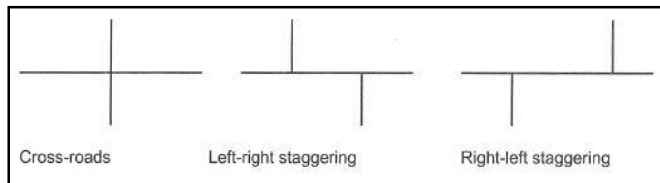
If an inappropriate junction type is used at a particular site, such as a "Y" type junction, significant safety problems can occur, including high crash rates, unnecessary delay, and congestion.



4.2 Intersection types ("Y" type, roundabouts, etc.)

Solution/s:

- Full **reconstruction** from "Y" type into "T",
- Improving **visibility**,
- Improving **signing and marking**,
- Adding of **rumble stripes**,
- Clear **prioritisation** of main traffic stream by signage and markings.



4.3 U-turns

Problem:

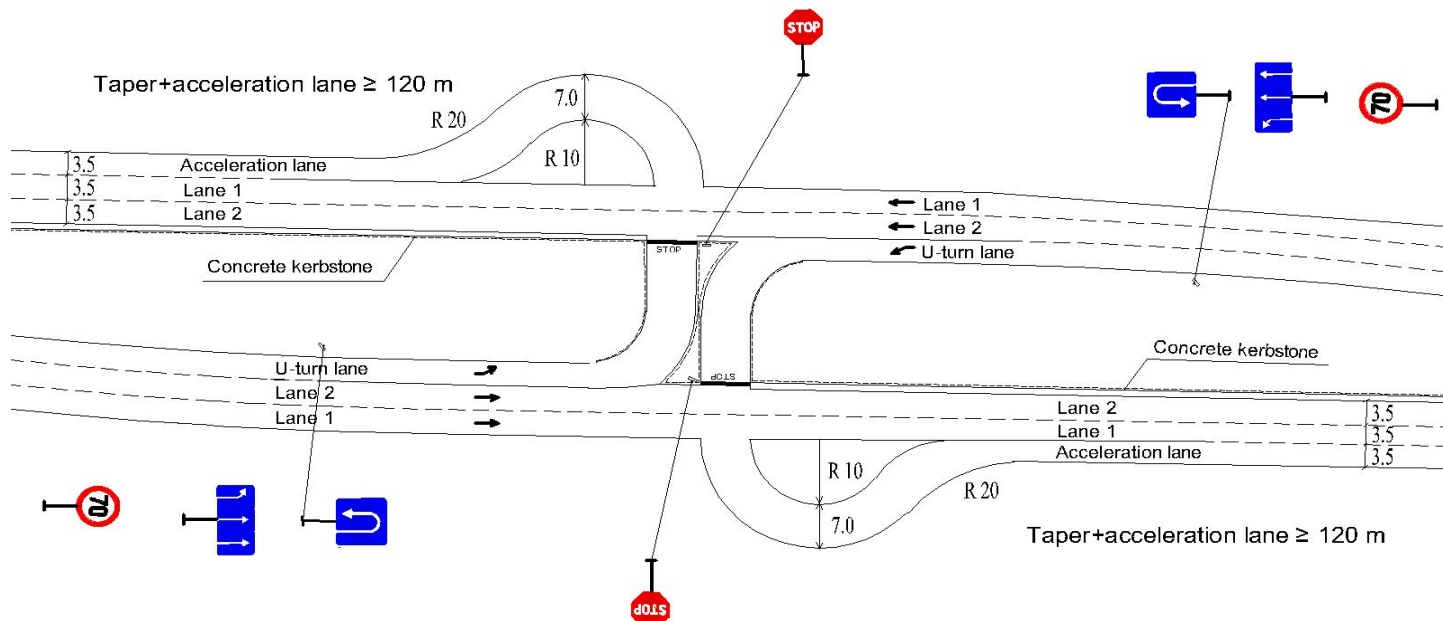
- Road crashes tend to cluster at median gaps particularly on dual carriageways mainly due to the conflict between the slow manoeuvre of a wide turn and fast approaching vehicles (usually with high speed) from the other direction and from behind (If there is no protected lane from which to make the U turns).



4.3 U-turns

Solution/s:

- Construction of “flyover” U-turns (**grade separation** of traffic),
- Changing existing U-turn into **safer solution** with grade separation of traffic streams,
- Protected deceleration lane for turning vehicle,
- ITS implementation to reduce traffic speed,
- Additional signing and markings, ...



4.4 Railway crossings

Problem:

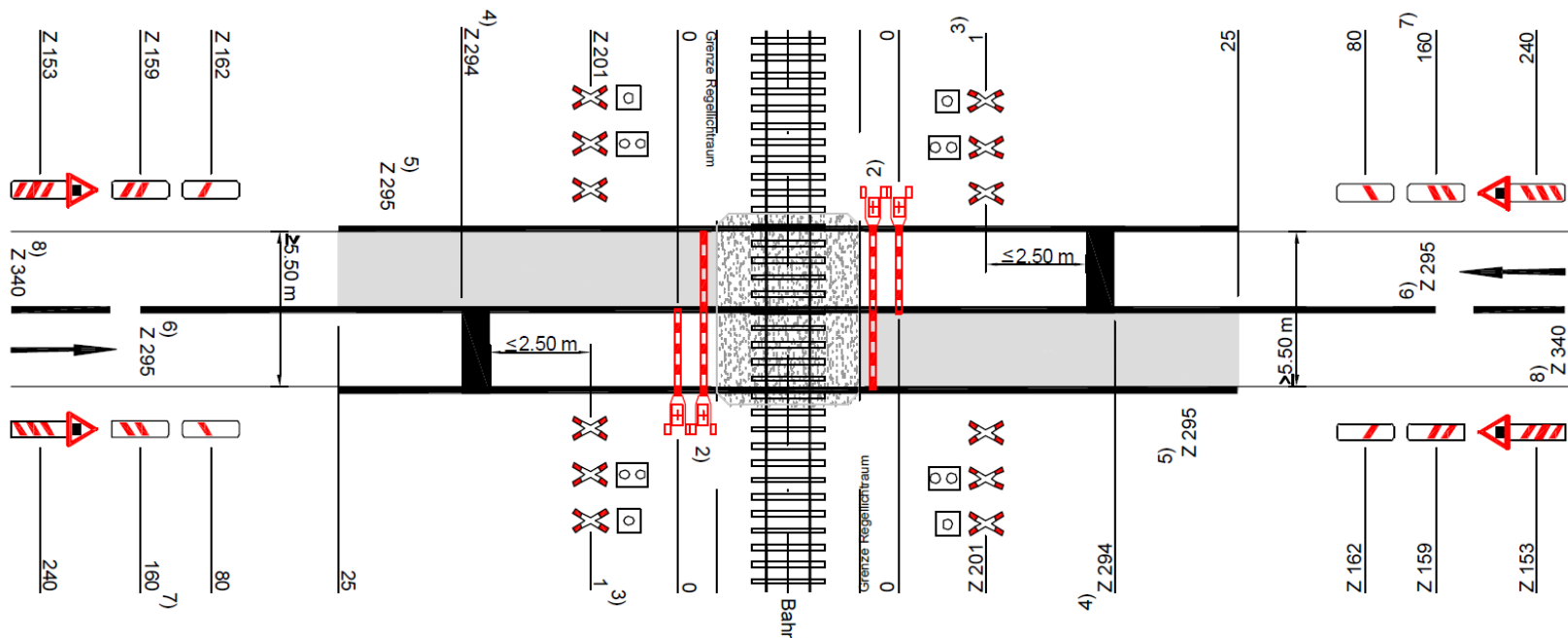
- Level, crossings can be hazardous because of the crash severity when a train hits a vehicle.
- In most of EaPCs there are still many railway crossings operated just by warning signs.



4.4 Railway crossings

Solution/s:

- installing **warning lights**,
- installing **barriers** (automatically controlled ramps),
- **grade separation**



5. Public and private services

5.1 Services along roadside

Problem:

Entrances and exits to and from Service and Rest areas can cause disruption to traffic on the main carriageway if they are not separated well, and particular attention must be given to design and maintenance of deceleration and acceleration lanes.



5.1 Services along roadside

Solution/s:

- **Improving entrance/exit to services along roadside**
(Construction of adequate deceleration and acceleration traffic lanes & Channelization of traffic flows at entrance/exit).
- **Improving parking areas**
(Separation from traffic, Adding and remarking of pedestrian walkways, ...)
- **Improving signing and marking of services along the roadside**
(Proper signing/markings, Adding of proper lighting, ...)



5.2 Facilities for public transport (bus stops)

Problem:

In rural areas, bus bays provided with a divider from the main carriageway are often not used by buses, which stop on the carriageway instead.

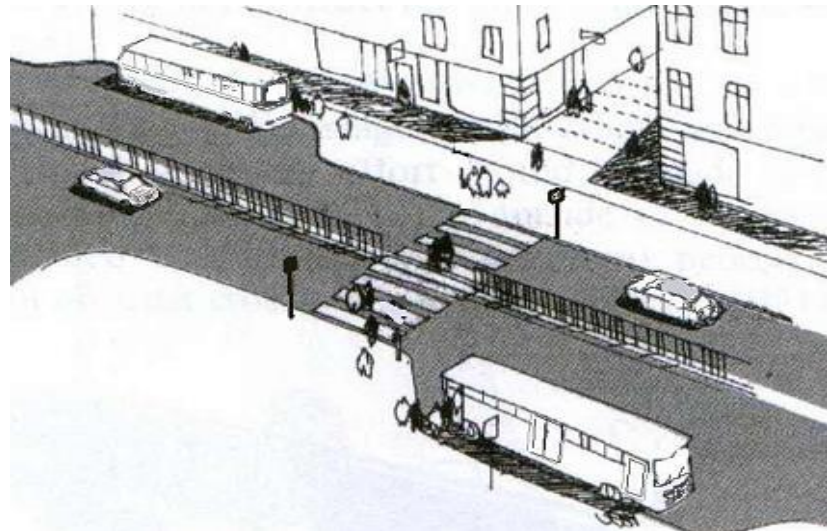
At those stops, conflict can exist between the bus and other vehicles and vulnerable road users such as pedestrians and cyclists.



5.2 Facilities for public transport (bus stops)

Solution/s:

- **Removing Bus stops from main traffic flow:**
 - Separation of Bus bays from main traffic flow & connection with pedestrian crossings
 - Construction of pedestrian footpaths
- **Improving Bus bay within existing traffic:**
 - Traffic calming measures,
 - Relocation of BUS bay
- **Improving signing /marking and road furniture of Bus Stops:**
 - Adding of proper lighting,
 - Additional installation of guardrails, ...



6. Vulnerable road user needs

6.1 Pedestrian crossings

Problem:

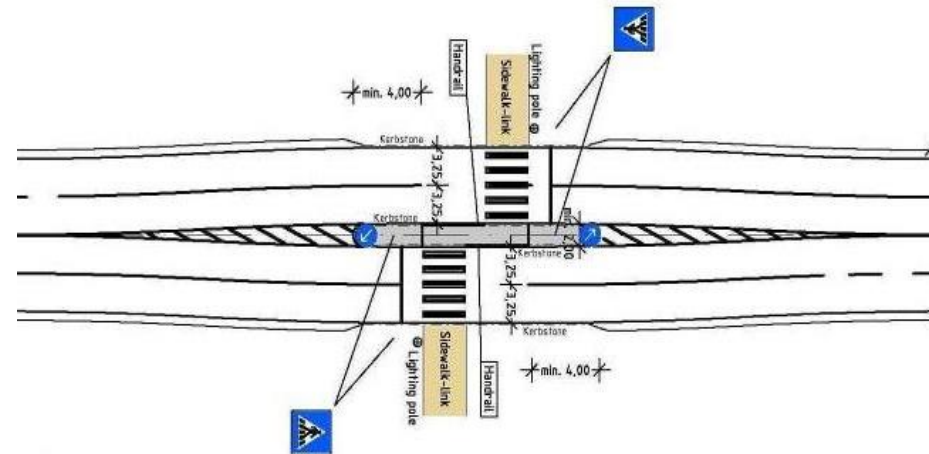
- Serious problems can arise when we have road sections of important highways with a high traffic volume passing through towns or cities combined with a high numbers of pedestrians.
- The single main contributing factor regarding pedestrian safety is the speed of traffic, which is typically much higher than planned.



6.1 Pedestrian crossings

Solution/s:

- **Separated pedestrian crossings** (Construction of underpasses or overbridges, lighting, Installation of pedestrian guardrail in wider zone of underpass/overbridge, ...).
- **Narrowing of road and usage of refuge islands** (Narrowing of the traffic lanes, Installation of refuge island with fencing to redirect pedestrians to face traffic before crossing, Adding pedestrian traffic lights, ...).
- **Connecting of pedestrian paths (walking routes) with crossings, ...**



6.2 Footpaths and footways

Problem:

Pedestrian accidents contribute a substantial proportion of road accident deaths and injuries. Pedestrians should not have to walk at all along interurban, high-speed roads. Hard shoulders are not intended for vulnerable road users but for emergency use by vehicles only.

If there are building along both side of the through road, the footpaths should also be on both sides of the road.



6.2 Footpaths and footways

Solution/s:

- Separation of motorised traffic and vulnerable road users wherever possible...
- Time separation...
- Good signing and marking of urban and rural footpaths, footways, and cyclist tracks/lanes...



7. Traffic signing, marking, and lighting

7.1 Signing

Problem:

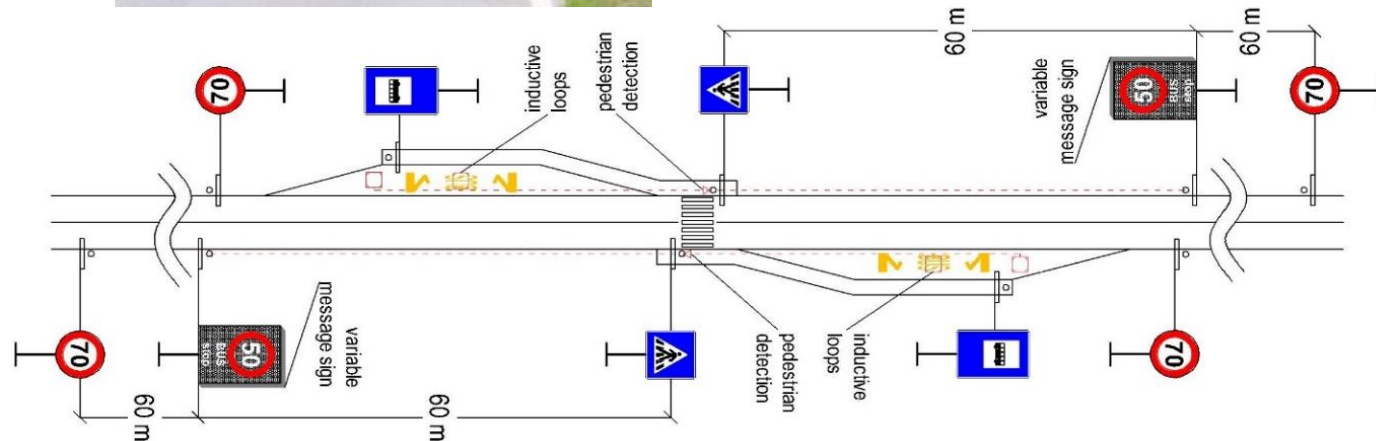
Signs poorly designed (by meaning and micro locations), in bad condition and with low level of reflectivity...



7.1 Signing

Solution/s:

- Usage of **high class of reflectivity materials** for traffic signs ...
- Variable message signs (**VMS**) usage ...
- **Maintenance** of traffic signs ...



7.2 Marking

Problem:

Although EaPCs have national standards for road marking, some of the roads often do not have good markings (e.g. without reflectivity and/or are partially missing). This is partly because road marking paint available locally often tend to be of poor quality while imported road marking paint is often considered to be too expensive (although it lasts longer and reduces the risk of crashes).



7.2 Marking

Solution/s:

- **Improved road markings** (Reflective glass beads for road markings, cold plastic, thermoplastic, fabricated tapes, **delineators**, reflective **road markers / studs**, **rumble strips**, different **colours** of road markings, ...).
- **Maintenance of road markings** (Remarking, cleaning of markings)...



7.3 Lighting

Problem:

Street light missing, poorly designed (by type and strength) and in the bad condition (poor maintenance).



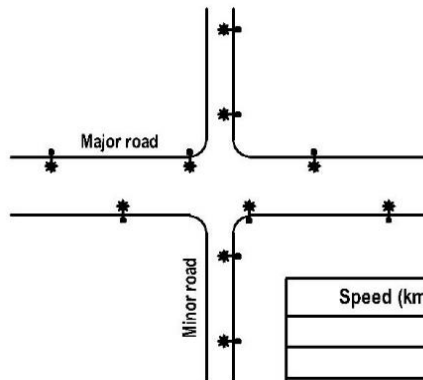
7.3 Lighting

Solution/s:

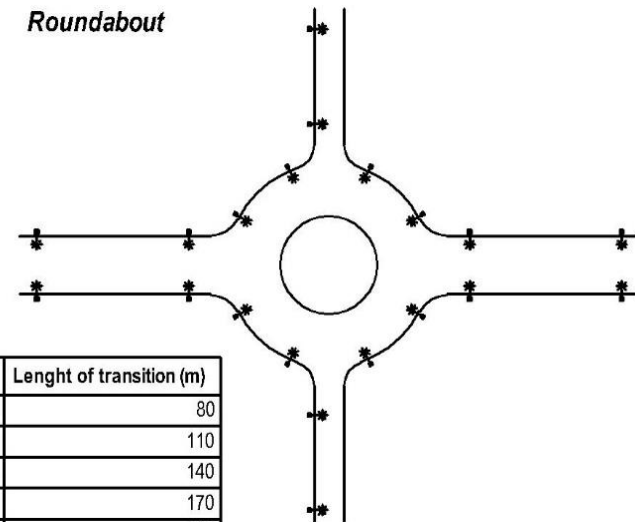
- Addition of light where needed ...
- Evenness of illumination (improving existing lighting quality) ...
- Maintenance of lighting ...



4-leg intersection



Roundabout



Speed (km/h)	Length of transition (m)
50	80
60	110
70	140
80	170
90 and higher	200

**8. Roadside features,
passive safety installations,
civil engineering structures**

8.1 Roadside Obstacles (Plants, Trees, Light Poles, Advertisements, Etc.)

Problem:

- Existing of roadside features which may obstruct visibility, lead to crashes, or increase crash severity (Hazard near to road, Hazard with un-breakable structure, Un-protected obstacles near by road).

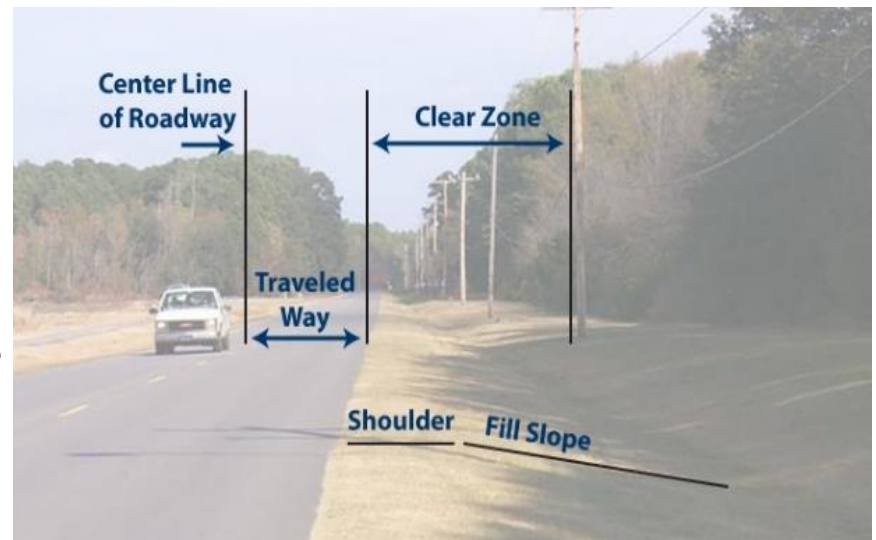


8.1 Roadside Obstacles

(Plants, Trees, Light Poles, Advertisements, Etc.)

Solution/s:

- Removing roadside objects from road to create a “**clear zone**” without potential obstacles.
- **Relocation of hard roadside objects.**
- **Alter to reduce severity or protect roadside hazards** (Frangible lighting/sign/etc. poles, Grade steep slopes, 4:1 or flatter, Safe culverts, Installation of guardrails, Marking of roadside object to make them more visible)



8.2 Longitudinal barriers (guardrails)

Problem:

The risk of colliding with hazardous obstacles such as trees, bridge supports or simply rolling over down a high embankment can be significantly reduced by the use of **properly designed, tested, installed and maintained longitudinal barriers.**

Which is mostly missing on EaPCs roads!!!



8.2 Longitudinal barriers (guardrails)

Solution/s:

- **Adding right type of guardrails when missing**
(Installation of proper barrier type (EN 1317), Adding barriers connection elements, Adding barriers connection elements, ...).
- **Maintenance of road markings**
(Closing of “open windows”, Using of appropriate beginning/end elements, ...).

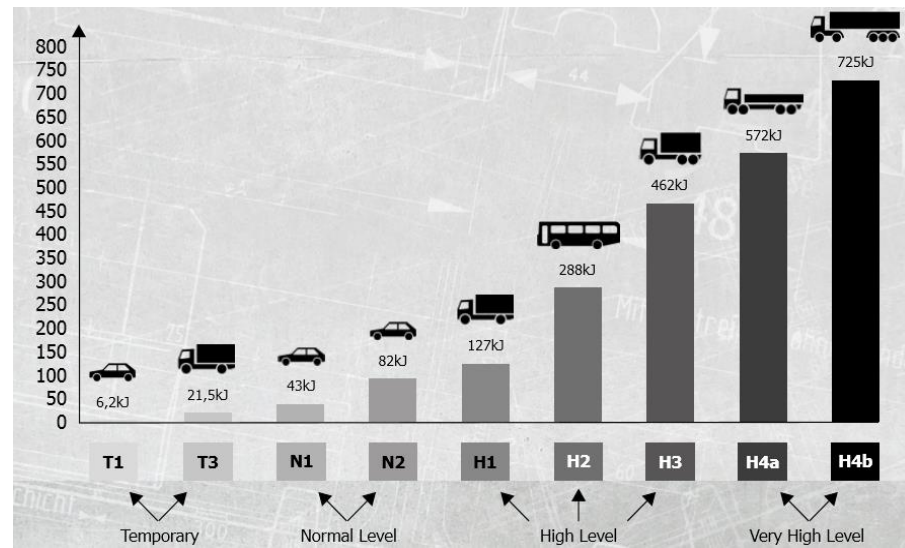
EN 1317

- EN 1317-1 (Terminology)
- EN 1317-2 (Performance classes barriers)
- EN 1317-3 (Performance classes crash cushions)
- EN 1317-4 (Energy absorbing).
- EN 1317-5 (CE-mark)
- EN 1317-6 (Pedestrian)
- EN 1317-7 (Ends, Slops)
- EN 1317-8 (Motorcycle)



EN 12767

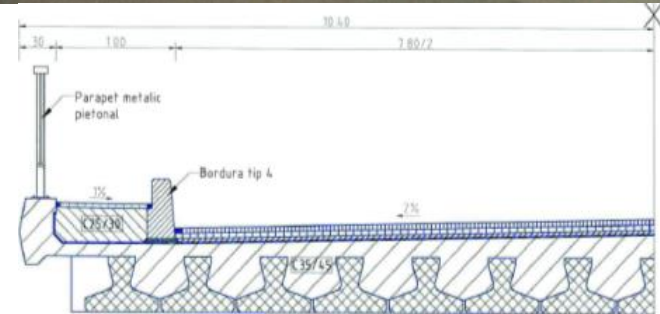
Traffic Safety Equipment; lighting columns, sign post, etc...



8.3 Civil engineering structures

Problem:

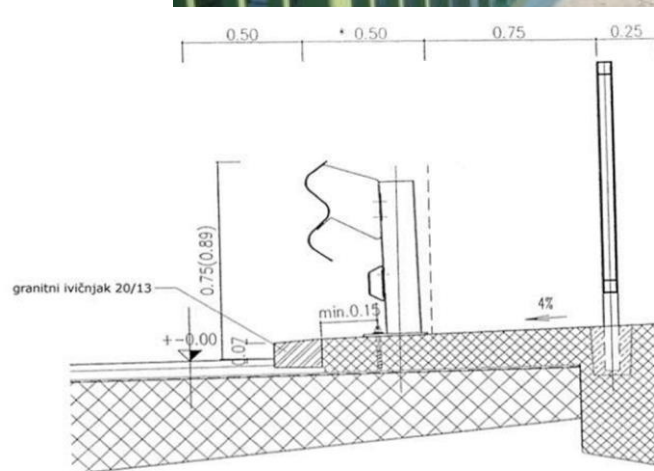
A civil engineering structure can be an obstacle for road users, and there is a need to prevent cars from running off bridges with severe consequences. This means that there is a need for sufficient restraining systems.



8.3 Civil engineering structures

Solution/s:

- Improvements in bridge design:
 - Adding right type of guardrails,
 - Functional connection to the adjacent guardrail system,
 - Improved drainage solutions



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9. WORK ZONES

9.1 WZ

Problem:

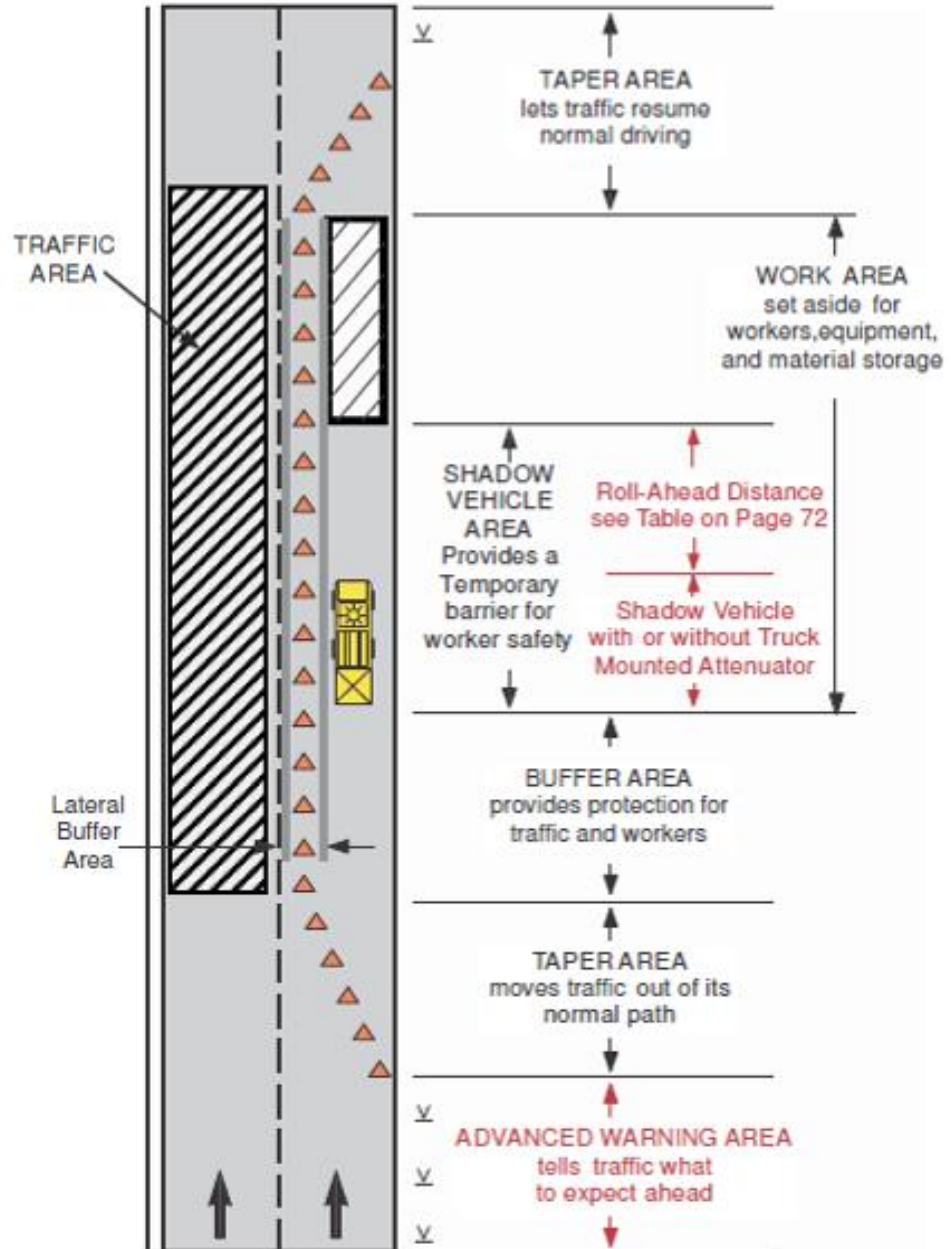
Work zones are zones on the road with a higher risk of crashes for both road users (vehicle occupants and vulnerable categories) and workers. This is sensitive topic in EaPCs...



9.2 WZ

Solution/s:

- Establishing regular **(best practice) of working zone**, the road markings in working areas should be in yellow.



Instead of conclusion

Presentation contain just **some of typical road safety deficiencies** and scope of **possible measures**.

More details about infrastructure related safety measures can be found within **freely publication** that you received or that can be downloaded from: www.sarsa.net (download section).

In the name of authors, I invite you on collaboration and improvement of Practical Guide (localisation for EaPCs)...

Please, be free to join us in cooperation for safer roads.

**THANK YOU FOR
DEDICATED TIME !**