

RSA/RSI TC

**TYPICAL ROAD SAFETY
ENGINEERING PROBLEMS
IN SEETO AND TRACECA REGIONS:**

A Practical Guide for Road Safety Auditors

**Banja Luka, 16.09.2016
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About

Practical Guide for Road Safety Auditors

- Why do we need unified approach to RSA/RSI?
- SEETO RRW/RSA Project 2008/2009
- All SEETO/TRACECA countries have experience with RSA
- ...
- Practical Guide for Road Safety Auditors is based on actual traffic situations identified as road safety deficiencies and best international practice and proposals for improvement (treatment).
- There are plenty of illustrations from SEETO/TRACECA Regions which will help users to easily understand typical road safety deficiencies and to select appropriate treatments.
- ...

About

Practical Guide for Road Safety Auditors

Typical Road Safety Engineering Deficiencies: Practical Guide for Road Safety Auditors in TRACECA Region

1 ROAD FUNCTION:

1.1 ROADS WITH MIXED FUNCTION (LINEAR SETTLEMENTS)

Problem

Mixture of road functions (usage of the road as fast distributors for fast longer distance motorized traffic and as a route for slow local traffic) causes one of the major road safety problems especially in low and medium income countries (LMIC), such as in most of TRACECA Region.

This is one of the common problems in almost all of TRACECA countries where the rate of expansion of isolated communities along a road can rapidly reduce the effectiveness of a nationally or regionally important route as a result of the local traffic activities overwhelming the through route function of the road.

In such cases, the role of the road in the road hierarchy becomes confused. While the road is passing through settlements (without existence of by-pass) can it keep its geometry unchanged? Can it be called International/Regional/National road, or does it become a street? This, simple planning (designing) mistake of local administrations, can cause tremendous problems in road safety. Once intense development has been allowed it is very difficult to achieve improvements without major reconstruction on a new alignment. Often even when a bypass has been built, the village often over time extends out across to the new road. This is mainly an issue of access control (See Ch. 1.2).

Examples of unsafe designs from TRACECA Region



Armenia: 3+3 road with median



Uzbekistan: 3+3 road with median



Kyrgyzstan: Wide road without median



Turkmenistan: Wide road without median

Typical accidents:

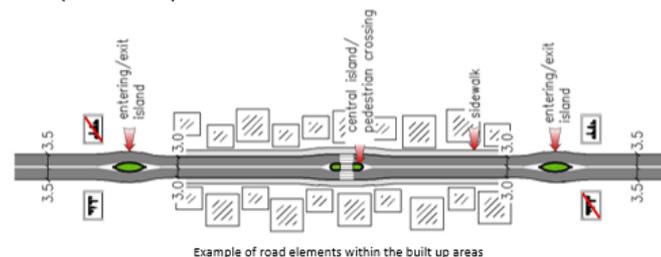
Pedestrian crossing street outside a junction	Pedestrian in the road	At least two vehicles - same direction - rear end collisions	At least two vehicles - head on collision in general	At least two vehicles - same road - opposite direction - turning left (right) in front of other vehicle

Typical Road Safety Engineering Deficiencies: Practical Guide for Road Safety Auditors in TRACECA Region

Possible countermeasures with expected costs (EC) and accident reductions (AR):

Countermeasure with (EC)	AR	Illustrations
<ol style="list-style-type: none"> Separation of slow and fast traffic by small distributor roads either between the main road and house or behind those (SS) Construction of by-pass Best but expensive solution with high possibility that one-day a new by-pass will be needed (SSS) If building a bypass, the opportunity should be taken down grade the old road by narrowing it, widening footpaths etc. to deter through traffic using it. 	<p>8 - 30 %</p> <p>16 - 33 % (these figures include accidents on old road network and on by-pass)</p>	<p>Example of small distributor roads (blue) and by-pass (red) around the built up area</p>
<ol style="list-style-type: none"> Grade separation of long distance and local traffic - Full space separation of fast moving vehicles and local transport. Fast road with access control (grade separated intersections, acceleration/ deceleration lanes, etc.) (SS) 	20 - 57 %	<p>Armenia</p>
<ol style="list-style-type: none"> Separation of pedestrians (pedestrian bridges or underpasses with ramps and no steps) (SS) 	13 - 44 % (including all accidents, with pedestrians and with vehicles)	<p>Tajikistan</p>
<ol style="list-style-type: none"> Changing character of road (from mobility to accessibility) – so it act as a street. Main task is to “kill” the speed - Building of entering/exit islands or roundabouts (SS) - Narrowing of the road (S) - Implementation of different traffic calming measures (S) 	<p>11 - 47 %</p> <p>2 - 10% 5 - 12 % (including narrowing of the road)</p>	<p>Example of speed reducing entering/exit island to/from the built up areas</p>

Sketches (with dimensions):



Structure of Road Safety Deficiencies (Problems)

An accordance with World Road Association (PIARC) and developed Regional Road Safety Audit Manual for SEETO and TRACECA countries, road safety deficiencies (problems) are collected and categorized into following groups:

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

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REFERENCES

Authors Pen Portraits

Typical Road Safety Problems

1. Function

Typical Problems:

- Mixture of road functions (usage of the road as fast distributors for fast longer distance motorized traffic and as a location of slow local traffic) causes one of the major road safety problems especially in Low and Medium Income Countries (LMICs)
- The role of the road in the road hierarchy becomes eroded / confused. While the road is passing through settlements (without existence of bypass) can it keep its geometry unchanged?
- Can it still be called International/Regional/National road, or does it then become a street? This, simple planning (designing) error of local administrations, can cause tremendous problems in road safety.
- Once intense development has been allowed it is very difficult to achieve improvements without major reconstruction on a new alignment.
- Often even when a bypass has been built, the village often over time extends out across to the new road. This is mainly an issue of access and development control and relevant authorities need to apply such measure.

Typical Road Safety Problems in SEETO

1. Function



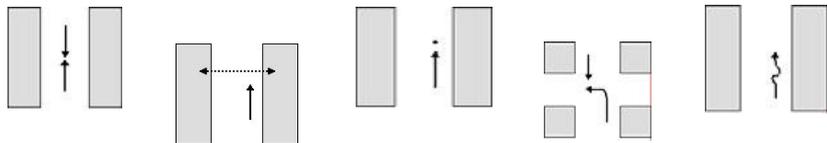
Bosnia and Herzegovina

2+2 Road without median

Serbia

2+2 Road without median

Typical accidents:



Typical Road Safety Problems in TRACECA

1. Function

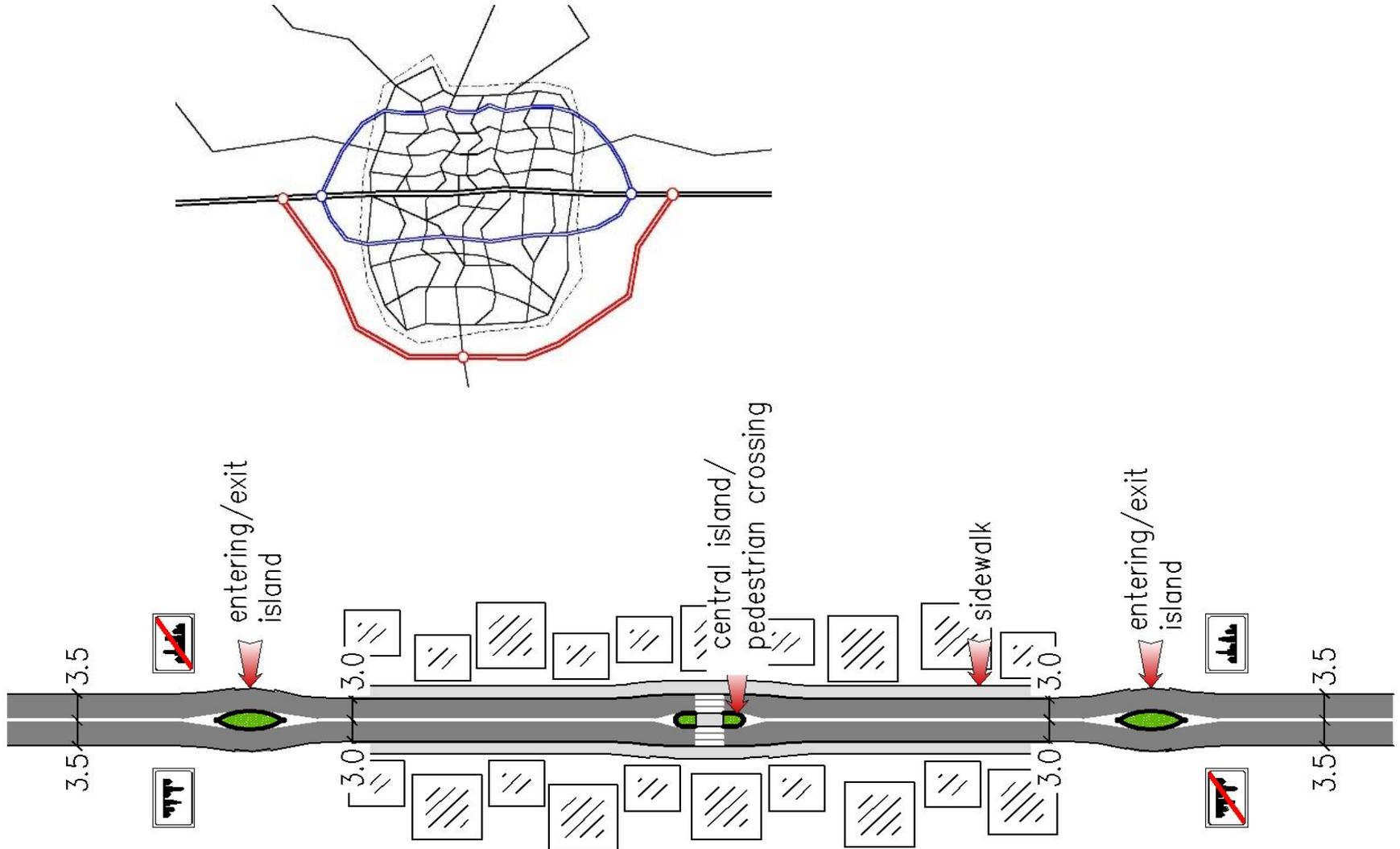


Kyrgyzstan:
Wide road without median

Turkmenistan:
Wide road without median



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Example of road elements within the built up areas

Typical Road Safety Problems

2. Cross Section

Typical Problems:

There is some evidence to suggest that widening lane or carriageway width or widening shoulders up to a certain extent is beneficial in reducing certain types of accidents. However, beyond a certain point it can have negative effects on road safety (users will start using extended width as a regular lane).

Dangerous cross sections of express roads and highways are frequently being used in SEETO/TRACECA region. 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.

Typical Road Safety Problems in SEETO

2. Cross Section



Serbia

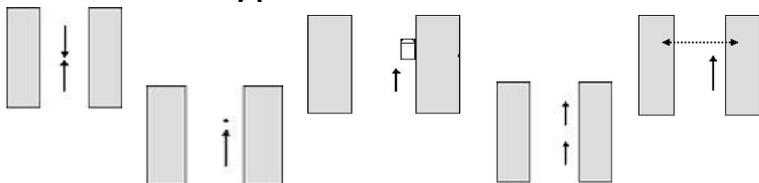
Too narrow acceleration lane



Croatia

1+1 With wide hard shoulders

Typical accidents:



Typical Road Safety Problems in TRACECA

2. Cross Section



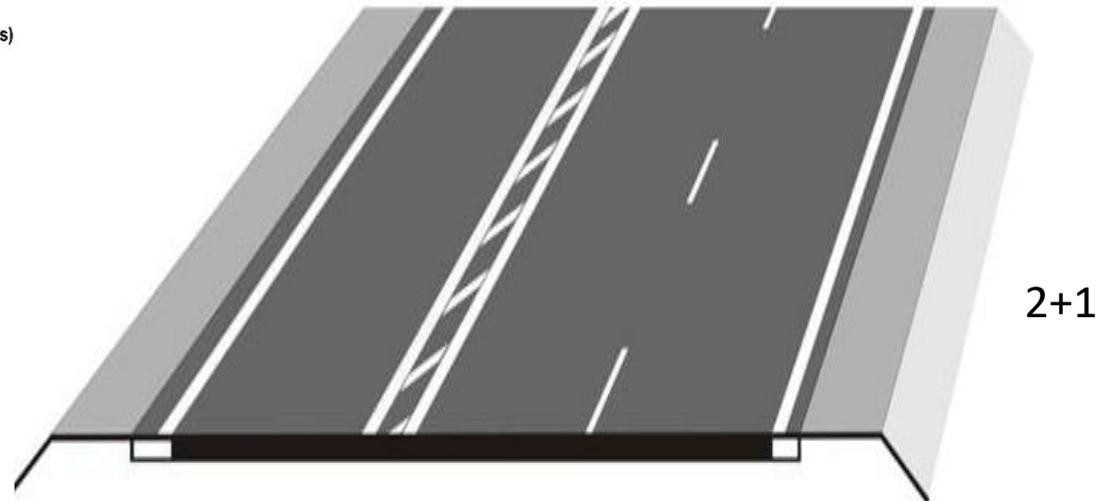
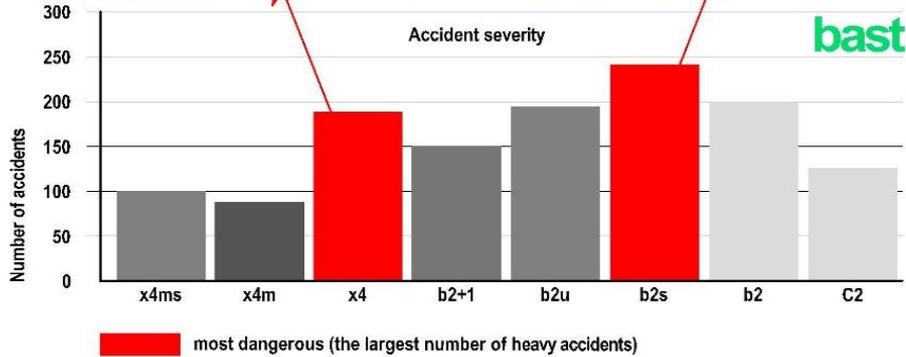
Azerbaijan

2+2 Road without median

Kazakhstan
Drainage problems



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Typical Road Safety Problems

3. Alignment

Typical Problems:

Unexpectedly tight horizontal curves can lead to accidents as drivers try to drive through them at too high a speed. A similar situation may occur on horizontal curves in other similar hazardous situations, such as steep gradient or after a long straight section where driver is encouraged or misled (by the approach geometry) to think that he can drive at higher speed than is safe for that location. The sight distances associated with larger curve radii may also encourage driver to overtake in unsafe conditions.

Poor co-ordination of the horizontal and vertical alignments can result in visual effects which contribute to the accidents and are detrimental to the road appearance. Unsafe combinations of horizontal and vertical curvature are likely to be misinterpreted by a driver and may result when horizontal and vertical curves of different length occur at the same location.

Typical Road Safety Problems in SEETO

3. Alignment

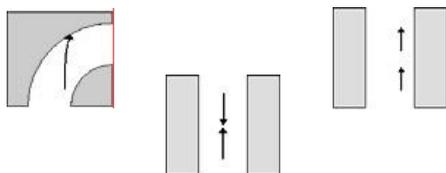


The Former Yugoslav Republic of Macedonia
Sharp curve



Serbia
Sharp curve

Typical accidents:



Typical Road Safety Problems in TRACECA

3. Alignment



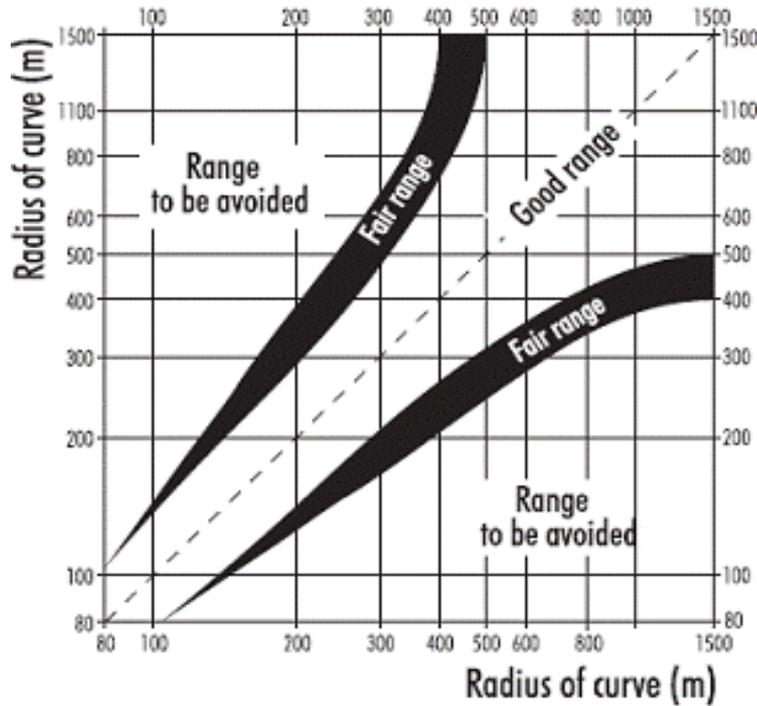
Moldova

U-turn at vertical curve

Georgia
Sharp curve



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Typical Road Safety Problems

4. Intersections

Typical Problems:

Channelization is a useful tool in traffic management. It should be applied to all junctions on high speed roads. Channelization guides the driver through the conflict points, provides safe areas for him to stop while making a manoeuvre and reduces conflicts between different flows.

- Traffic islands have the added benefit of providing a refuge for pedestrians crossing the road. They also provide a convenient location for street furniture such as signs, street lighting and drainage covers.

Typical Road Safety Problems in SEETO

4. Intersections



Kosovo *

Confusion for drivers leads to mistakes

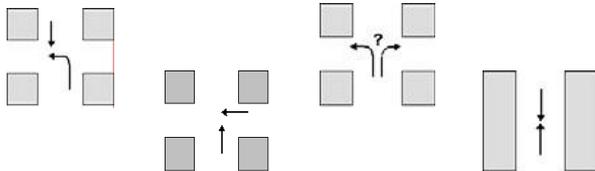
** This designation is without prejudice to positions on status, and in line with UNSCR 1244 and the ICJ Opinion on the Kosovo declaration of independence*



Serbia

Unsafe "Y" turn

Typical accidents:



Typical Road Safety Problems in TRACECA

4. Intersections



Kazakhstan
missing signing/markings

Tajikistan
complex intersection



Typical Road Safety Problems

5. Public and Private Services

Typical Problems:

- Roadside facilities (rest places and petrol stations) are necessary to serve the long distance traffic between regions and towns (villages). Drivers need to rest at least once every 2 or 3 hours in order to maintain their concentration when driving. It is useful to combine rest areas with petrol and/or service stations at 30 – 50 km distances.
- Entrances and exits to and from Service and Rest areas can cause a disruption to traffic on the main carriageway if they are not separated well, and special attention should be given to design and maintenance of deceleration and acceleration lanes. Such rest areas may be used for selling goods by local farmers to minimize such activity along the roads. Farmers should reach the areas from minor roads behind the service area.
- In SEETO, and more specifically in TRACECA Region there are a lot of examples where roads are encroached upon by unacceptable commercial services or there are unsuitable rest areas. This is dangerous for all road users, because of huge speed differences and mixture of different categories of road users (sudden vehicle stops and entering the traffic stream, as well as presence of unprotected pedestrians on high speed roads).

Typical Road Safety Problems in SEETO

5. Public and Private Services



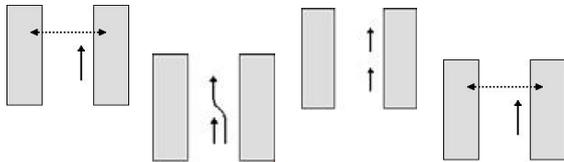
Kosovo*

Rest area along a link section,
lack of separation,
no regular exit and



Serbia
Unsafe
Bus stop

Typical accidents:



Typical Road Safety Problems in TRACECA

5. Public and Private Services



Uzbekistan
Selling of goods

Tajikistan
Services along road



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Typical Road Safety Problems

6. Vulnerable Road Users

Typical Problems:

Pedestrians should not have to walk at all along interurban roads. Hard shoulders are not intended for vulnerable road users but for emergency use by vehicles only. With the exception of roundabouts, pedestrian crossings should ideally be grade separated on major roads if large numbers of vulnerable road users are expected. At-grade pedestrian crossing on dual carriageways or multi-lane roads should be forbidden unless traffic signals are provided.

To enable pedestrians to cross safely the crossings facilities should be provided as underpasses or overbridges with ramps, not stairs. Any other solution significantly increases risks of with pedestrian accidents. Even though this is not in accordance with any road standards/norms in the world, even the ones used in SEETO/TRACECA Region, there are many such examples where pedestrian crossings are placed at grade on busy international roads.

The provision of underpasses or overbridges however may be too expensive and may not be well used. Designers and the road authority need to provide crossings which the pedestrians will willingly use.

Typical Road Safety Problems in SEETO

6. Vulnerable Road Users

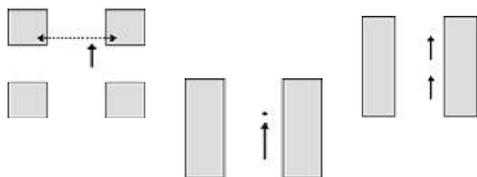


Kosovo*
unsafe pedestrian
crossings



Serbia
unsafe
pedestrian
crossings

Typical accidents:



Typical Road Safety Problems in TRACECA

6. Vulnerable Road Users



Ukraine
unsafe pedestrian crossings

Uzbekistan
unsafe pedestrian crossings



Typical Road Safety Problems

7. Traffic Signing, Markings and Lighting

Typical Problems:

Warning signs and warning markings are used to give advance notice of a potential hazard ahead or of any unexpected feature of the road geometry. The signs are used in specific situations when there is a change in the road, such as in a bend, on high speed road or on the approach to junction.

The location of signs is very important because they should provide adequate warning or information at sufficient distance, however they should not obscure important road features. Of great importance for the visibility of the signs is that they be located in positions where overgrown vegetation cannot obscure the visibility of the sign. Signs must be visible at all times, so reflective materials should be used for night-time visibility and urban signs may require to be lit internally or externally. In some SEETO and more specifically in TRACECA countries, it is common practice for the signs to be missing (even at potentially dangerous locations), not properly positioned, without reflectivity, non-standardized or even not uniform in compliance with International UN Conventions.

Too many signs can detract from their objective by overloading the driver with too much information too quickly, which leads to confusion or to a situation where the driver ignores certain signs.

Typical Road Safety Problems in SEETO

7. Traffic Signing, Markings and Lighting

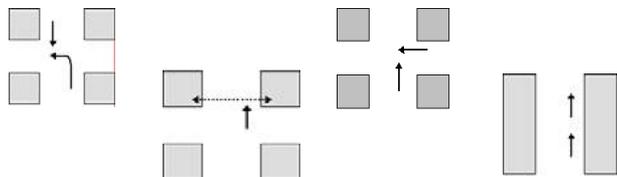


The Former Yugoslav Republic of Macedonia
Hidden sign



Croatia
Hidden traffic light

Typical accidents:



Typical Road Safety Problems in TRACECA

7. Traffic Signing, Markings and Lighting

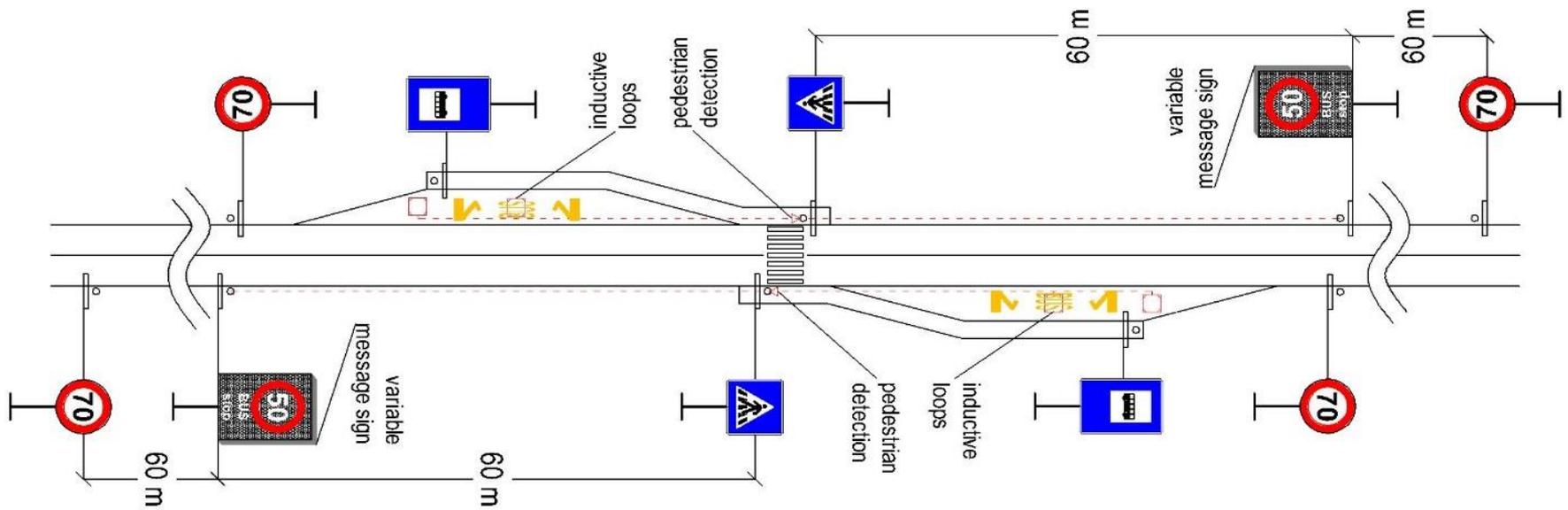


Georgia
Too many signs

Kyrgyzstan
Hidden sign



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Typical Road Safety Problems

8. Roadside Features

Typical Problems:

The presence of roadside obstacles, street furniture (for example, road signs and lighting columns) advertising signs and trees has two safety implications. The first is the potential danger of collision, and the second is their obstruction of visibility.

Visibility is important not only for the driver, but also to other road users.

Obstructions caused by trees, for example, may result in a pedestrian making an unwise decision.

Great care should be taken concerning the positioning of roadside features which may either obstruct visibility, lead to accidents or increase accident severity. Where it is impractical to remove obstructions which contribute to hazardous situations, consideration should be given to their replacement with equipment designed to collapse on impact, re-alignment of the road, or the introduction of barriers. Once a road is completed, care must be taken to ensure that obstacles are not introduced by other institutions subsequently, such as telephone or electricity authorities.

Vegetation should be trimmed regularly and planning controls should be enforced to prevent stalls and structures being too close to the road edge.

In some SEETO/TRACECA countries, trees are often planted adjacent to roads in order to provide shade for pedestrians, animals and parked vehicles and in other countries to prevent the wind from bringing snow onto the road.

Typical Road Safety Problems in SEETO

8. Roadside Features

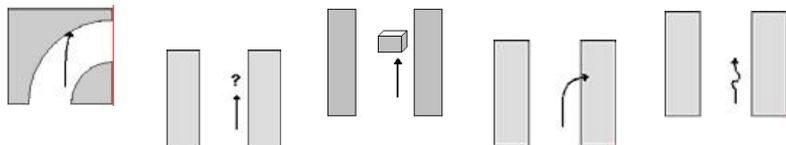


Montenegro
No guardrails at sharp curve



Albania
Dangerous beginning of guardrail

Typical accidents:



Typical Road Safety Problems in TRACECA

8. Roadside Features

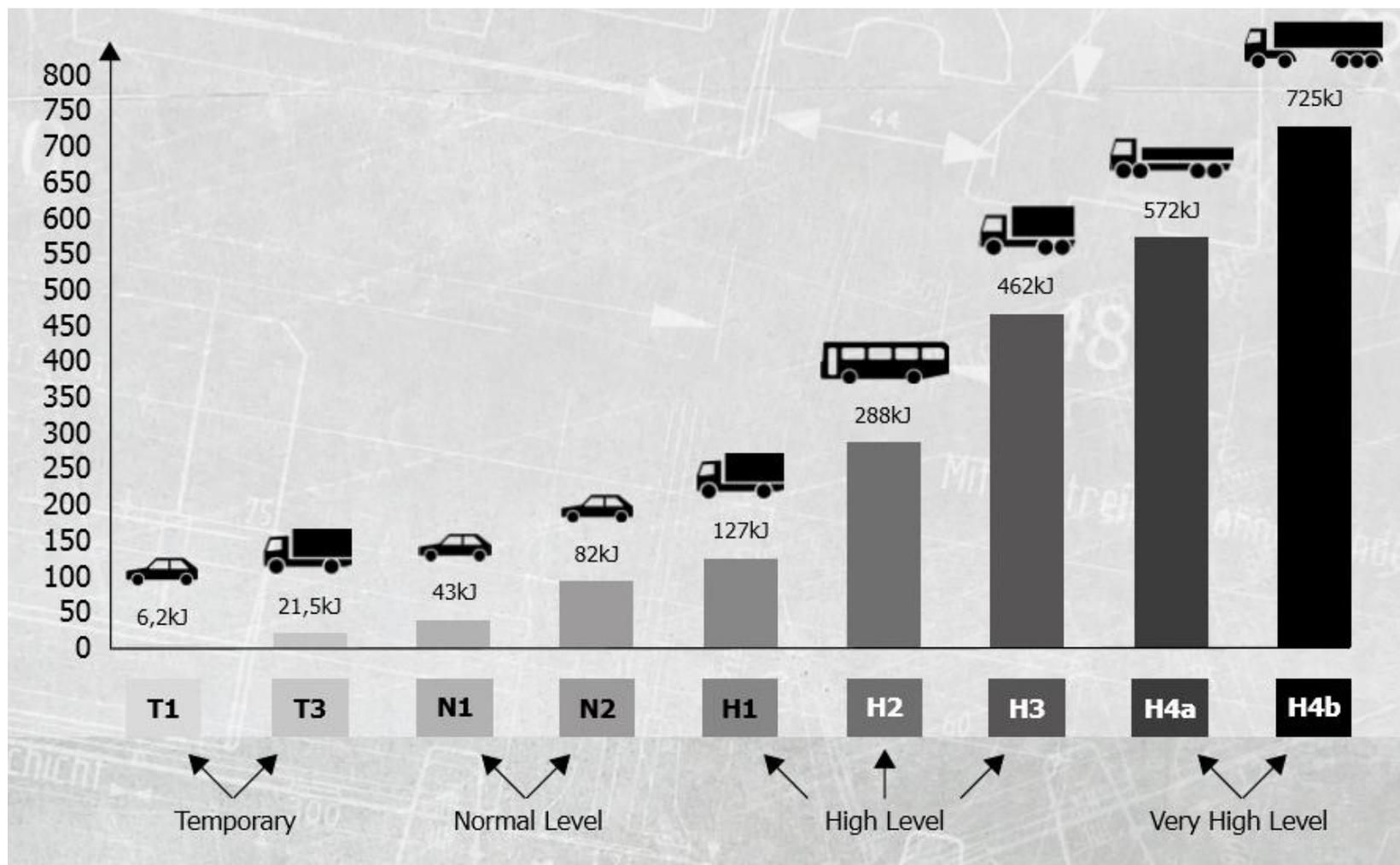


Azerbaijan
Trees near by road

Kazakhstan
Dangerous beginning of barrier



Possible countermeasures with expected costs (EC) and accident reductions (AR)



9. Temporary signing and marking at Work Zone

Introduction:

Work zones are zones on the road with higher risk of accidents for both road users (vehicle occupants and vulnerable categories) and workers.

A Traffic Management Plan (TMP) of good quality should be made and followed so that all participants in traffic are protected against risk of a traffic accident.

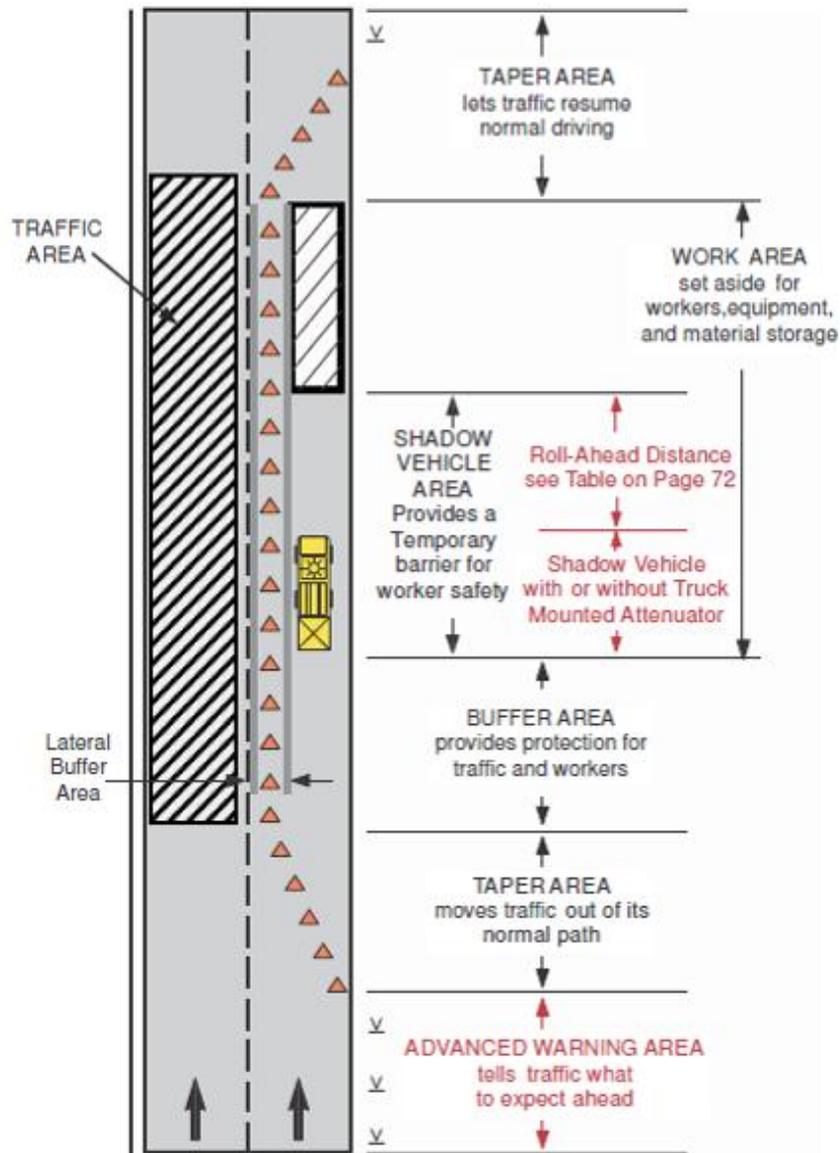
To minimize the problems and increase safety, work zone layout (marking and signing) requires special consideration for the following reasons:

- Work zone is a section of road where, most often, geometrical characteristics of the road and the traffic conditions are temporarily changed to poorer conditions (less safe).
- Employees in work zones spend most of their working hours directly exposed to traffic. In accidents, happening in work zones, these employees are often the victims, and often at as much at risk as the road users.

9. Temporary signing and marking at Work Zone



Possible countermeasures with expected costs (EC) and accident reductions (AR)



Speed limit (km/h)	Minimum buffer area (m)	
	Lateral	Longitudinal
40	0.5	30
50	0.5	35
60	0.5	40
80	0.5	60
100	1.0	100
120	1.0	100

10. Accident type sketches

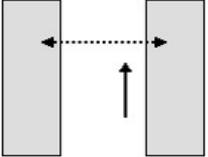
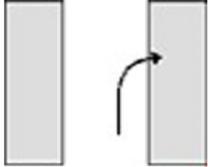
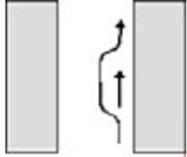
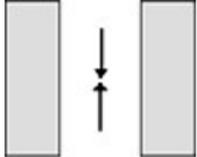
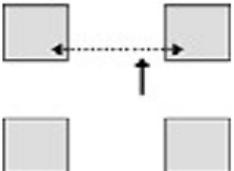
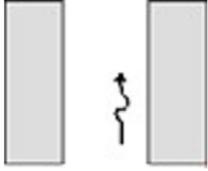
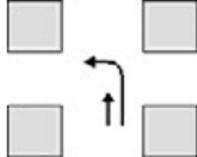
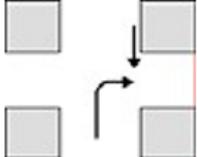
Introduction:

European Union countries have a long history in collecting accident data via different national collection systems. At European level, road accident data are also available since 1991 in disaggregate level in CARE (Community database on road accidents resulting in death or injury). The purpose of CARE system is to provide a powerful tool which would make it possible to identify and quantify road safety problems throughout the European roads, evaluate the efficiency of road safety measures, determine the relevance of Community actions and facilitate the exchange of experience in this field. It also allows countries to benchmark themselves against other countries to assess areas where they need to do more.

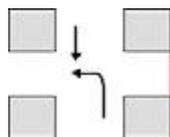
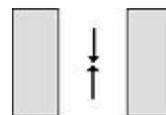
Due to differences in accident data collecting between EU countries, new recommendations have been agreed for a Common Accident Data Set (CADaS) consisting of a minimum set of standardized data elements, which will allow comparable road accident data to be available throughout Europe. In this way, more variables and values with a common definition will be added to those already contained in the previous models of the CARE database. They will maximize the potential of CARE database allowing more detailed and reliable analyses at European level.

10. Accident type sketches

Common Accident Type Sketches

<p>Pedestrian crossing street outside a junction</p> 	<p>Single vehicle accident - Leaving straight road - either side of the road</p> 	<p>At least two vehicles - same direction - overtaking</p> 	<p>At least two vehicles - head on collision in general</p> 
<p>Pedestrian crossing street at a junction</p> 	<p>Single vehicle accidents on the road</p> 	<p>At least two vehicles - turning or crossing - same road - same direction - turning left (right)</p> 	<p>At least two vehicles - same road - opposite direction - turning right (left) in front of other vehicle</p> 

Examples of real accidents and respective accidents and its sketches



11. Potential crash reduction

Introduction:

For any kind of countermeasure proposal, it is necessary to know the crash reduction potential. Therefore, a list is proposed of the most usual low cost countermeasures with their expected effects.

The following table is collated from results of different international research projects and case studies and can be use for understanding the potential crash savings after implementation of different countermeasures.

Table 11.1 presents each different proposed countermeasure (treatment) and its range potential crash reduction effects as a percentage. (Usually, minimum and maximum effects are presented).

Treatment	Potential crash reduction [%] (different sources/research)
Road Standard	
Improve to higher standard	19-33
Increase number of lanes	22-32
Lane widening 0,3 – 0,6 m	5-12
Paved shoulder widening 0,3 - 1 m	4-12
Add median strip	40
Bridge widened or modified	25

Conclusion

Education and training of the auditors/inspectors is probably one of the weakest points in the entire RSA/RSI chain within the SEETO and TRACECA Region. This is exacerbated by the frequent reluctance of roads authorities to implement RSA recommendations even where RSAs are done. The reasons for this are the relatively short history of RSA, lack of understanding of RSA methodology and procedures and lack of RSA literature in local languages.

This is why the team of safety engineering specialists, who are knowledgeable and familiar with SEETO and TRACECA Region, prepared the Practical Guide for Road Safety Auditors in SEETO and TRACECA Region to help present and future auditors in their work.

Acknowledgements

The Practical Guide for road safety auditors which builds to a large extent on international best practice, direct experience of the authors in SEETO/TRACECA countries/participants and draws upon detailed guidance and concepts in the 3 key publications indicated below:

- “Towards safer roads in developing countries”, a guide for planners and engineers, developed by TRL, Ross Silcock Partnership and ODA in 1991,
- “Catalogue of design safety problems and practical countermeasures”, developed by World Road Association (PIARC) in 2009 and
- “The handbook of road safety measures”, written by Rune Elvik and Truls Vaa, in 2004.

The above 3 documents provide much more detailed guidance on all key aspects of safety engineering and authors recommend that road engineers should use these in planning and operation of roads to ensure safer road networks.

This Practical Guide document is aimed specially at the needs of safety auditors in SEETO/TRACECA Regions and has addressed only the main issues of relevance to them and their tasks in preparing safety audit reports.

The Authors of this paper are grateful and wish to acknowledge the contributions of our fellow authors of the Practical Guide:

- Hans-Joachim Vollpracht,
- Rajko Branković and
- Filip Trajković.

All photographs used as illustration of the problems, or as best practices are provided by authors.

THANK YOU !