Republic of Serbia
Road Traffic Safety Agency

UNECE

Regional Workshop on Advancing Road Safety:
Road Safety Audit and Road Safety Inspection implementation practices

Practical Guide for Road Safety Auditors and Inspectors

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BACKGROUND

Practical Guide is based on actual traffic situations identified as typical road safety deficiencies during audit/inspection and best international practice (initially PIARC) with proposals for improvement (treatment) …

Tailor made for each country and training course …

DEVELOPMENT

Based on:

- **Analysed worldwide literature**
- **Collected experience of the team of authors in RSA/RSI**
- **PIARC initial RSA/RSI research**

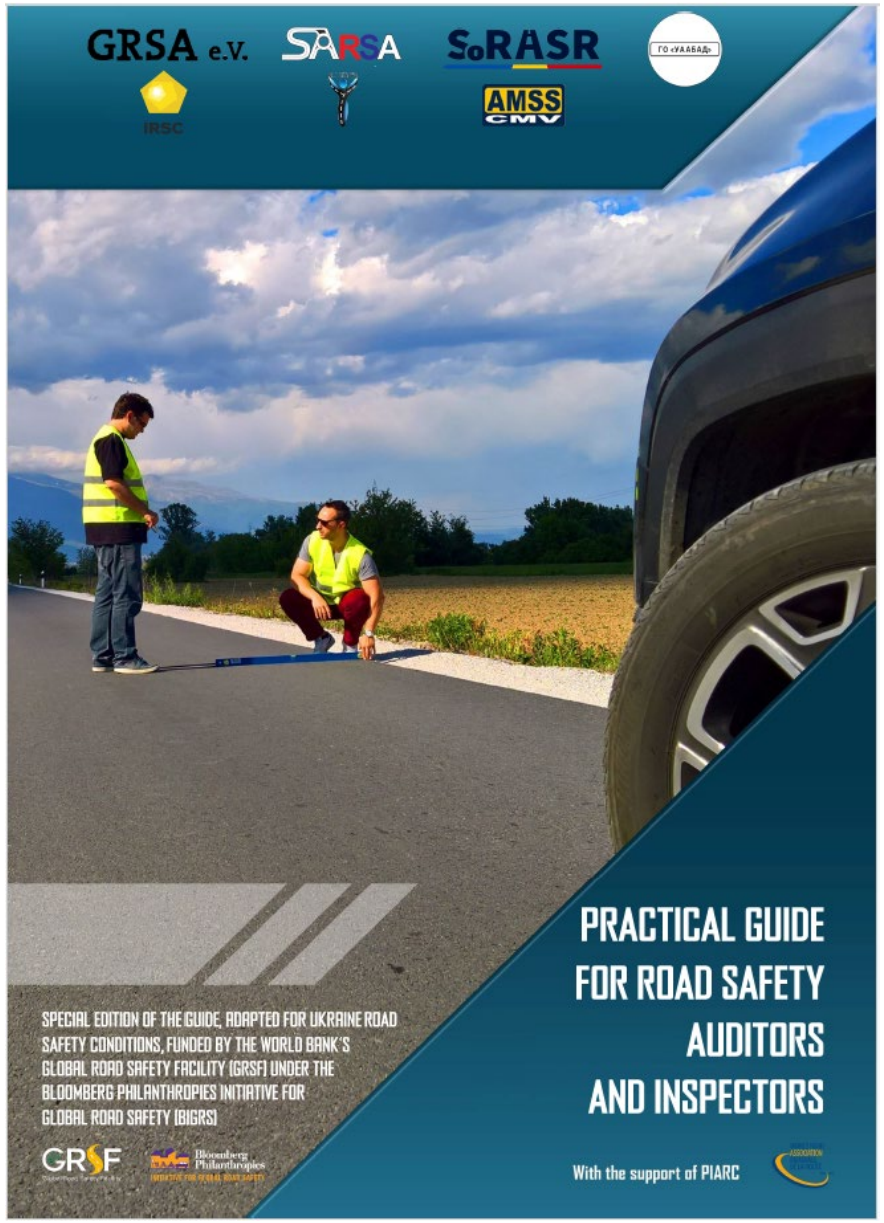
- Supported by PIARC and GRSF/Blumberg

- Guide was localised and translated into several languages

(English, Serbian, Russian, Romanian, Ukrainian) +

- Next review was planned in 2024…

CONTENT



CONCEPT

Guide Left side:

- **Selected Chapter +**
- Background and possible RS problems
- Examples of unsafe designs
- Typical accidents in accordance with CADaS:

1 ROAD FUNCTION:

1.1 ROADS WITH MIXED FUNCTION (LINEAR SETTLEMENTS)

Background and possible problems

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 especially in Low and Medium-Income Countries (LMICs). This is a typical problem in countries where the development of linear communities along a major road can rapidly cause unsafe conditions and reduce the effectiveness of a nationally or regionally significant route as a result of the local traffic activities and needs conflicting with 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 the existence of by-pass), can it keep its geometry unchanged? Can it be called International/Regional/National road, or does it become a "street" for that section? This, simple planning (designing) and access control mistake of road administrations, can cause tremendous problems in road safety. Once intense development has been allowed to occur, it is then very difficult to achieve safety improvements without major reconstruction on a new alignment.

Often even when a bypass has been built, the village, over time, may extends out across to the new road. This is mainly an issue of ensuring effective access control (See Chapter 1.2).

Examples of unsafe designs

1+1 road with mixed function

2+2 road with mixed function

Typical accidents in accordance with CADaS:

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 another vehicle

CADaS: Common Accident Data Set (EU Protocol), presented within Chapter 10.

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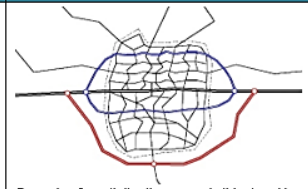
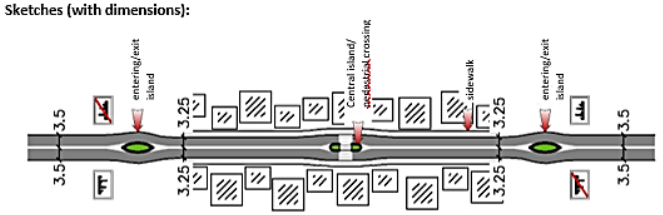
Possible countermeasures with expected costs (EC) and crash reductions (CR):

Countermeasure with (EC)	CR	Illustrations
1. Separation of slow and fast traffic by small distributor roads either between the main road and house or behind those ($$-$$$) - Construction of by-pass Best but expensive solution with the high possibility that one-day a new by-pass will be needed ($$$) If building a bypass, the opportunity should be taken to downgrade the old road by narrowing it, widening footpaths etc. to deter through traffic using it. The number of connections between the bypass and the new road should be kept low.	8 - 30 % 16 - 33 % (these figures include crashes on old road network and by-pass)	 Example of small distributor roads (blue) and by-pass (red) around the built-up area
2. Grade separation of long distance and local traffic - Full space separation of fast moving vehicles and local transport. Fast road with access control (grade separated intersections, acceleration/ deceleration lanes, etc.) ($$$) - Separation of pedestrians (pedestrian bridges or underpasses with ramps and no steps) ($$)	20 - 57 % 13 - 44 % (including all crashes)	
3. Changing character of road (from mobility to accessibility) – so it acts as a street. The primary task is to "kill" the speed - Building of entering/exit islands or roundabouts ($$) - Narrowing of the road ($) - Implementation of different traffic calming measures ($)	11 - 47 % 2 - 10 % 5 - 12 % (including road narrowing)	 Example of speed reducing entering/exit island to/from the built-up areas

$-Small amount of investment (mostly short-term measures);
$$-Medium amount of investment (usually midterm measures);
$$$-Significant amount of investment (mostly long-term measures)

Sketches (with dimensions):



Example of road elements within the built-up areas

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Guide Right side:

- Possible countermeasures
- Expected Costs
- Expected Crash Reduction
- Illustrations
- Sketches

2 CROSS SECTION:

2.1 TYPES OF CROSS PROFILES (WIDTH OF THE ROAD)

Background and possible problems

A cross section will normally consist of the carriageway, shoulders or kerbs, drainage features, and earthwork profiles. It may also include in built-up areas facilities for pedestrians, cyclists, or other special road user groups. There is some evidence to suggest that widening lane or carriageway width or widening shoulders up to a certain extent (1 m) is beneficial in reducing certain types of crashes. However, beyond a certain point (1 m) it can have negative effects (users will start using extended width as a regular lane). Dangerous cross sections of express roads and highways are still used in. For example, a four lane road without a crash barrier or two lane road with wide hard shoulders. Drivers can sometimes misuse a road with a wide hard shoulder, as a very narrow four lane road, with disastrous results and severe crashes.

The road surface performance must ensure adequate grip for tires and should be a stable driving surface. In the case of a run-off the carriageway the shoulder must also be stable enough to keep the car in an acceptable position and to make it possible for the driver to guide the car back to the carriageway. That means the difference of bearing capacity of these adjacent areas should be taken into consideration. In several countries, for that reason, gravel stabilised, shoulders are in use as a cost-effective and functional solution. This stabilised shoulder strip is also stable enough to carry trucks. On the other hand, this kind of surface is not "attractive" as (illegal) driving space.

Cross sections, particularly on roads through built-up areas, are often not uniform or consistent. Local developments may encroach onto the carriageway because of the lack of effective planning control. In rural conditions, cross sections may be reduced at drainage structures causing sudden changes in width. Maintenance of the road in full profile affects the safety situation. If a pavement width reduces due to the lack of maintenance (water on the pavement, sand, gravel, debris, etc.) or pavement breaking at the edges effectively narrowing the road width, head on collisions or loss of control over a vehicle can occur.

Steep side slopes, introduced for drainage purposes, do not allow a driver time/space to recover in situations where he leaves the carriageway, and thereby add to the likelihood of a crash. Open channel drains can also increase the probability that if a driver error occurs, vehicle wheels may go into the drain and cause vehicle to crash.

Examples of unsafe designs

Too wide traffic lanes

1+1 road with wide hard shoulders

Typical accidents:

At least two vehicles - head-on collision in general

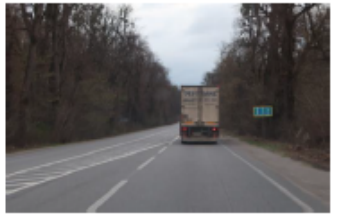
Hitting parked vehicles on the right (left) side of the road

At least two vehicles - same direction - rear end collisions

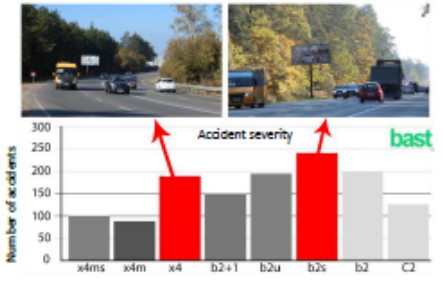
Pedestrian crossing street outside a junction

Pedestrian in the road

Possible countermeasures with expected costs (EC) and crash reductions (CR):

Countermeasure with (EC)	CR	Illustrations
1. Reconstruction of cross section - Changing into one of the safest solutions (motorway cross profile) ($$$) - Introducing of the 2+1 cross-section with the marked median area, where each direction periodically and alternatively is given two lanes. This gives the opportunity of safe overtaking along 40% of the road length for traffic volumes up to 20.000 vehicles per day) ($$) - New median barrier for 4-lane roads without barrier ($$)	10 – 80 %	
2. Road improvements (Rehabilitation) - Installation of medians ($$$) - Reducing the lane width (in built-up areas) - Improving slopes – flattening side slopes ($$) - Gravel stabilised shoulder	7 – 24 % 15 – 37 % 18 – 46 %	 
3. Better signing and marking - Improved signing – usage of warning signs, speed limit signs and VMS. Use of high reflective and raised markings ($) - Improved markings – usage of central hatching, rumble strips, "ghost" islands, etc. ($)	10 – 62 % 11 – 35 %	

Sketches:



X4ms = 4x (3.00 to 3.75) metre wide lanes + median + 1,5 emergency lane
X4m = 4x (3.00 to 3.75) metre wide lanes + median
X4 = 4x (3.00 to 3.75) metre wide lanes No median!
b2 = 2 x 3.50-metre wide lanes
C2 = 2x 3.25-metre wide lanes + speed limit
b2s = 2x 3.50-metre wide lanes + 2.5m emergency lane: used as four lane roads
b2+1 = 2x 3.50 metre wide lanes + an overtaking lane alternatively used (regulated by markings, plastic poles, or barriers)

Example of cross section influence on crash severity
(BASt – Federal Highway Research Institute in Germany with example of dangerous cross sections)

3.2 SIGHT DISTANCE (VISIBILITY)

Background and possible problems

In general, the visibility offered to drivers should be sufficient to identify any necessary course of action and then to perform that action safely. A usual critical requirement is that the driver can stop safely, and this requires the understanding of speeds, reaction times and deceleration rates. Sight distance requirements are thus related to geometric design and speed controls and are inherent in all design standards. Visibility may relate to another road user, or to an object such as a road sign.

The following types of sight are taken into consideration:

a. **Stopping sight distance**–to be mandatory along the whole road section,
b. **Orientation sight distance**–this parameter is not included in every national design guideline. However, since decades is it well known, that the orientation sight has very good advantages for the road safety. In German interurban road design guidelines it is recommended to the designer that he should have an orientation site distance in most subsections of the amount of the stopping sight + 30 %. The auditor should advise on that direction in his report.
c. **Passing sight distance** – for two-lane roads. In the most national design guidelines, there is a demand of 20% passing possibility in each direction. Nevertheless, in the most cases, this demand is not easy to ensure, e.g. because of limited sight in curves. For important highways, an additional passing lane (alternate in both directions) could be the safe and economical solution.
d. **Sight distance at junctions**

Pedestrians also need to see and be seen, and crossing movements are often concentrated at or near junctions. From human factors research, drivers need 4-6 seconds to respond to a new situation; this means 300 m ahead if the speed limit is 100 km/h or 200m for 80 km/h.
Warning and information signs may sometimes be so sited that they have poor conspicuity, and the detailing of the road may not provide sufficient additional clues as to the hazard or decision ahead.

Examples of unsafe designs

Insufficient orientation site distance at intersection

Insufficient stopping site distance in curve

Typical accidents:

Single vehicle accidents in a bend - going either side of the road

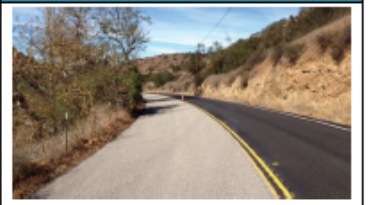
At least two vehicles - different roads - turning left (right) into traffic from the right (left) side

At least two vehicles - crossing (no turning) - different

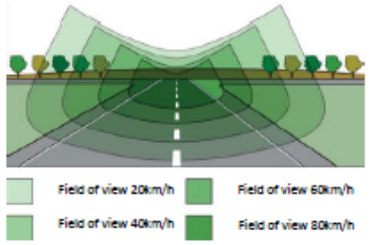
At least two vehicles - head-on collision in general

At least two vehicles - same direction - rear end collisions

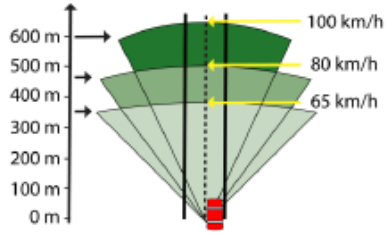
Possible countermeasures with expected costs (EC) and crash reductions (CR):

Countermeasure with (EC)	CR	Illustrations
1. Reconstruction of the curve, intersection, pedestrian crossings, etc. - Improved radius and visibility ($$$)	8 – 55 %	 Example of improved radius of horizontal curve and visibility in curve
2. Provide sufficient sight distances for adequate driver reaction - Opening of visibility (see sketch at the end of page) ($$) - Enable proper orientation for drivers (e.g. adding of trees at secondary roads which shows that there is intersection ahead) ($) - Breaking the sightline of the driver is important to show that the road is not continuing ahead.	20 – 38 % No reliable data No reliable data	
3. Improved signing and marking - improved signing (usage of high-class reflectivity materials for traffic signs, adding of chevron signs in sharp and hidden curves, using of flash beacons on approach to the pedestrian crossing, etc.) ($) - improving markings (usage of reflective glass beads, usage of nonstandard markings, etc.) ($)	10 – 33 % 11 – 35 %	

Sketches (with dimensions):



Example of speed and peripheral vision



Example of speed and focus point

Conclusion: The faster we drive the further we need to look ahead and vice versa in order to be able to read, understand and react in time to a hazard ahead.

SPECIFICS

- **Extension of PIARC approach to RSA/RSI with Work Zones**
- **First time usage of CADaS pictograms in RSA/RSI in world practice**
- **Collections of crash reductions from different treatments**
- **Real cases/pictures from different countries (can be localised)**
- **Periodically improved with latest case studies and experiences**
- **USER FRIENDLY AND PRACTICAL HANDBOOK**
- **SHARED AUTHORSHIP**
- **FREE USAGE (non for profit publication)**

(https://www.roadsafetyfacility.org/publications/practical-guide-road-safety-auditors-and-inspectors-ukraine)

INSTEAD OF CONCLUSION
- INVITATION FOR COOPERATION

- **Please share your experience with us - become a part of next generation of Practical Guide**