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IRDES

Final Report

Deliverable Nr 0.2

November 2011

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Executive summary

IRDES (Improving Roadside Design to Forgive Human Errors) is a research project of the cross-border funded joint research programme "ENR SRO1 – Safety at the Heart of Road Design", which is a trans-national joint research programme that was initiated by "ERA-NET ROAD – Coordination and Implementation of Road Research in Europe" (ENR), a Coordination Action in the 6th Framework Programme of the EC. The funding partners of this cross-border funded Joint Research Programme are the National Road Administrations (NRA) of Austria, Belgium, Finland, Hungary, Germany, Ireland, Netherlands, Norway, Slovenia, Sweden and United Kingdom.

Each year 43,000 persons are fatally injured in Europe due to road accidents. The RISER project has shown that even though 10 percent of all accidents are single vehicle accidents (typically run-off-road (ROR) accidents) the rate of these events increases to 45 percent when only fatal accidents are considered. One of the key issues of this high ROR fatality rate is to be found in the design of the roadsides that are often "unforgiving". CEDR has identified the design of forgiving roads as one of the top priorities within its Strategic Work Plan. For this reason, a specific Team dealing with Forgiving Roadsides has been established within the Technical Group (TG) on Road Safety of CEDR.

A number of different studies have been conducted in recent years to design roadsides to forgive human errors, but there is still a need for:

- A practical and uniform guideline that allows the road designer to improve the forgivingness of the roadside
- A practical tool for assessing (in a quantitative manner) the effectiveness of applying a given roadside treatment

The aim of the IRDES project is to produce these two outputs with specific reference to the following set of roadside features:

- Barrier terminals
- Shoulder rumble strips
- Forgiving support structures for road equipment
- Shoulder width.

In addition a practical assessment tool was also developed for analysing the roadside treatments to be applied in high risk bends.

The project team of IRDES created the following work plan:

WP0: Coordination and Management

WP1: Collection and harmonization of studies and standards on roadside design

WP2: Assessment of Roadside Intervention Effectiveness

WP3: Production of a Roadside Design Guide

WP4: Pilot Project

WP5: Organization of Workshops and Round Tables

As a results of the activities performed in the different Work Packages the following Deliverables have been produced and are available through the IRDES Web Site (www.irdes-eranet.eu) and through the ERANET Road SRO1 web site (http://www.eranetroad.org/index.php?option=com_content&view=article&id=74&Itemid=74):

Nr.	Deliverable Name / Report Name	Partner Responsible
D0.1	Mid Term Project Assessment (internal document not available to the public)	UNIFI
D0.2	Final Project Report	UNIFI
D1	State of the art report on existing treatments for the design of forgiving roadsides	AIT
D2	Practical Guide for the Assessment of Treatment Effectiveness	CHALMERS
D3	Forgiving Roadside Design Guide	UNIFI
D4	Questionnaire on roadside safety interventions and their effectiveness	ANAS
D5.1	Proceedings of Webinar 1	IFSTTAR
D5.2	Proceedings of Webinar 2	IFSTTAR

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Abbreviations

Abbreviation	Definition
AADT	Annual average daily traffic
AASHTO	American Association of State and Highway Transportation Officials
ADT	Average Daily Traffic
CEDR	Conference of European Directors of Roads or Conférence Européenne des Directeurs des Routes
ERA-NET	European Research Area Network
IRDES	Improving Roadside Design to Forgive Human Errors
HSM	Highway Safety Manual
NCHRP	National Cooperative Highway Research Programme
PTW	Powered Two-Wheeler
RISER	Roadside Infrastructure for Safer European Roads
ROR	Run-off-road
RVS	Richtlinien und Vorschriften für das Straßenwesen
SVA	Single vehicle accident
TG	Technical Group
TRB	Transportation Research Board

1 Work Package 1 – Collection and harmonization of studies and standards on roadside design

The goal of WP1 of the IRDES project was to collect and harmonize common standards and guidelines for roadside treatments. The results of the literature review carried out in WP1 is described in detail in the deliverable D1 State of the art report on existing treatments for the design of forgiving roadsides (that is also included as Annex 1 to the Forgiving Roadside Design Guide produced in WP3) and served as the basis for the development of a uniform and practical European guideline for forgiving roadside design.

The first part of the deliverable introduces typical roadside hazards, which are the basis for appropriate counter-measures.

The main part of the report describes results and findings from relevant literature, guidelines and standards dealing with roadside treatments.

Summarizing the literature study, three categories of treatments are proposed:

1. removal or relocation of potentially dangerous roadside objects;
2. modification of roadside objects or design;
3. shielding of roadside objects.

As a conclusion of the work conducted in WP1 removing obstacles resulted as the primary strategy in most countries. Providing a so-called safety zone with a certain width allows drivers to regain control over their errant vehicle and to return to the travel lane or stop. Especially in the planning phase of a new road, safety zones should be considered. They should be free of obstacles with a flat and gently graded ground. Road operators are also encouraged to develop roadside vegetation management programs to eliminate or minimize vegetation. It is recommended to consider the safety zone width as a function of the posted speed, side slope, and traffic volume. However, some guidelines also include curve radii in their calculations. The AASHTO Roadside Design Guidelines introduces a calculation method for clear zone widths, which is the most used worldwide. It provides a useful basis for developing a uniform and practical guideline concerning forgiving roadside design, which is handled in WP3 of IRDES. Shoulders are part of the recovery areas and are therefore addressed in this report. There are several national standards regarding shoulder widths and their surface properties. A lack of standards concerning the so-called limited severity zone (the area beyond the recovery area) has been found.

In many national standards and guidelines, limit to the side slope are given. In general, the steeper the slope, the higher is the risk for drivers of errant vehicles. Slopes should thus be kept as shallow as possible. For higher traffic volumes, side slopes should be designed with a 6:1 ratio.

Ditches must be designed wide enough to provide adequate drainage and snow storage capacity. For reasons of safety, the width of the bottom should be at least one metre. Drainage features such as culvert ends or control dams need to be made crashworthy by modifying their shape. As far as there are numerous different regulations for slope ratio and ditch characteristics, they should be harmonized with respect to proper drainage as well as its forgiving nature. Shoulder treatments that promote safe recovery include shoulder widening, shoulder paving as well as the reduction of pavement edge drops. If the skid resistance of a paved shoulder is insufficient, treatments to increase surface friction should be applied. Moreover, any other hazardous surface damages such as potholes or cracks need to be eliminated from the shoulder.

There are a high number of specifications to make obstacles more forgiving. If hazardous obstacles cannot be removed from the roadside safety zone, they need to be modified in order to minimize injury or property damage at a crash. Poles or supports are commonly made passively safe and masonry structures (e.g. walls, curbs or buildings) are made crashworthy.

To prevent collisions of vehicles with obstacles, the third option is to shield them by using road restraint systems (RSS). In this deliverable, restraint systems are divided into safety barriers and impact attenuators. Safety barriers aim at preventing vehicles from passing through while limiting the severity of crashes on car passengers. In most barriers this combined effect can be achieved by allowing the barrier to deflect during the crash. For this reason, safety barriers are classified according to their deflection level in most guidelines and standards. Detailed requirements of RRS are regulated in the European Norm (EN) 1317. However, it does not give advice on which RRS to use in specific situations. This is handled in specific guidelines such as the RISER documents. Future uniform European guidelines should also include recommendations for kerb-barrier combinations as well as safe motorcycle restraint systems. Standards concerning these topics are currently under development. Impact attenuators or crash cushions (e.g. plastic boxes filled with sand or water) are restraint systems, which are used to reduce the consequences of crashes with point obstacles. The protection of terminals and transitions can also be handled with this measure. In some cases, modification of existing safety barrier terminals is necessary. If the terminals are aimed at stopping the vehicle these have to be treated as energy absorbing devices and have to be tested according to ENV 1317-4. In most reviewed guidelines, a deflection from the traffic lane towards the roadside is an appropriate measure to make terminals forgiving. The transition between two safety barriers has to ensure that vehicles slide along the barrier in a smooth way, without any interruption. It also has to be stiff enough to ensure a change.

The large number of possible treatments to make a roadside forgiving shows the large potential of those systems for increasing road safety. An harmonization would help road operators and authorities in their planning decisions to achieve safer roads. Common road planning procedures together with Road Safety Audit or Road Safety Inspections on existing roads, have to include a specific view on forgiving roadsides.

2 Work Package 2 – Assessment of Roadside Intervention

Within Work Package 2 four studies have been conducted on different approaches to analyse the effectiveness of identified treatments which are:

- the variation of shoulder width;
- the removal of unprotected barrier terminals;
- the implementation of grooved rumble strips;
- roadside treatments in high risk curves.

The results are presented in details in the deliverable D2: Guide for the Assessment of treatment Effectiveness (that is also included as Annex 2 to the Forgiving Roadside Design Guide produced in WP3) and are synthesised below.

2.1 Variations of shoulder width

Part of the study was aimed at evaluating driver behaviours before and after the treatment with a tool, called Observatory of Trajectories (OT), composed by a rangefinder and cameras. However, due to delays in the modifications of the road only measurement before the modifications could be conducted and analysed. The analysis of the measurements of the before situation concluded that:

- Measured speed and lateral position show reliable results;
- Number of measured vehicles is insufficient to analyse other parameters as required (e.g. the situation where another vehicle was approaching in the opposite lane);
- The percentage of unusable data is higher for trucks than for cars;
- The recording time needs to be increased to have more free vehicles tracked (2 minutes instead of 30 seconds);
- Measurements of the central marking in the rangefinder referential are needed to improve accurate calibration;
- two rangefinders need to be installed at different heights for the car and heavy goods vehicle measurement respectively;
- The recording period should be increased to at least two weeks to ensure a larger data sample.

2.2 Unprotected barrier terminals

The statistical analysis conducted on a typical secondary rural network in Italy shows a significant reduction of the number fatal and injury crashes when the number of unprotected terminals is reduced. A Crash Modification Factor (CMF) was derived as a function of the reduction in the number of unprotected terminals.

The equation relating the CMF with the number of unprotected terminals per km is given by:

$$CMF = e^{0.02381 \times UT}$$

The Safety Performance Function developed on the basis of the collected data resulted to be accurate. However, the effect of other roadside related variables, such as the number of obstacle and the distance from the carriageway was confounded by the cross correlation with more relevant parameters, namely the lane width and the shoulder width.

An important variable in the model resulted to be the presence of gas stations which is a variable usually not considered in Safety Performance Functions for single carriageways rural roads.

The procedure proposed, that derives CMF functions from cross sectional analyses, can be applied also to the evaluation of different roadside features.

2.3 Grooved rumble strips

To assess the effectiveness of the implementation of grooved rumble strips on dual carriageways comparisons between treated and non-treated roads were conducted by means of statistical methods. Accident data from several years with and without treatment are needed to perform the analysis.

The statistical analysis shows a significant reduction of the number of single vehicle accident on the roads where Pennsylvanian rumble strips has been implemented. It was not evaluated if the effect is evenly distributed between severe and less severe accidents.

The significant effect of the treatment for rainy weather conditions is not contradicting the lack of significance for wet roadways. The rainy weather condition is a subset of the wet roadway condition (i.e. the roadway can be wet when it is not raining). The significance of the rainy weather condition can be related to the reduced visibility rather than the road condition.

2.4 Treatments in curves

The method based on using Vehicle Infrastructure Interaction Simulation (VIIS) was tested in two case studies.

In both cases the implementation of a soft shoulder did not show any positive results. The wider shoulder reduced the probability to fall along the embankment slope, but increased the risk of skidding. The injury risk for the errant vehicle itself was reduced but, due to the fact that the errant vehicle resulted to be “uncontrolled” after running off the road, the risk for other road users that might be involved in a secondary accident is increased. The case studies showed that soft shoulder is not appropriate for speeds in excess of 90 km/h and in sharp curves.

Implementation of a hard shoulder, showed an ideal vehicle manoeuvre for the large curves but not for sharp curves. For the case with the same friction value, the shoulder acts as an extended traffic lane. This enables the vehicle to stay on its original trajectory, without strong steering or braking sequences. Therefore the consequences of the ROR were minimized in an optimal way. For the sharp curve the positive effect was only found when the shoulder had a better friction value than the traffic lane.

For both spots the implementation of a safety barrier showed positive effects. In both cases the safety barrier redirected the vehicle back onto its original trajectory, without any indications of sliding or overturning. However, the impact on the barriers caused increased accelerations and deformations on the vehicle.

Removing the trees in the near surrounding of the traffic lane or shielding with safety barriers is recommended. The deceleration of the vehicle is lower in impacts with safety barriers and this will likely decrease the risk of injuries.

The methodology shows that VIIS (Vehicle-Infrastructure Interaction Simulation) can be used as an assessment tool for estimating the effectiveness of forgiving roadside measures in a practical way. The critical point is the availability of data to create a 3D road models, since laser measurement data are not commonly used in road data bases. The interface to simulation software is not the key problem for designing that simulation tools. This methodology can be easily transferred to different software solutions.

3 Work Package 3 – Production of a Roadside Design Guide

Based on the results of WP1 and WP2 and together with an additional literature review, this WP of IRDES produced a practical guideline that, thanks to the contribution of ANAS and to the interaction with Road Administrations and Operators (through the Webinars that have been organized and through the synergy with the TG on Road safety of CEDR), can be applied in practice in road safety design projects. The different proposed interventions are linked to the potential effectiveness estimated and defined in WP2 and in other relevant literature in order to allow the user to perform cost-effectiveness evaluation before planning a specific treatment.

One of the issues has been the harmonisation of different existing standards or the identification of underlying reasons for different existing solutions for the same treatments in order to allow the user to select the optimal treatment and to properly assess its effectiveness.

The roadside features for which the IRDES design guideline has been developed are:

- Barrier terminals
- Shoulder rumble strips
- Forgiving support structures for road equipment
- Shoulder width.

Each feature is analysed in a separate section of the guideline providing:

- Introduction
- Design criteria;
- Assessment of effectiveness;
- Case studies/Examples;
- Key references.

The results of WP3 activities are presented in details in the deliverable D3: Forgiving Roadside Design Guide and are synthesised below.

3.1 Barriers terminals

Safety barrier ends are considered hazardous when the termination is not properly anchored or ramped down in the ground, or when it does not flare away from the carriageway and crashes with "unforgiving" safety barrier ends often result in a penetration of the passenger compartment and severe consequences.

Crashworthy terminals can be either flared or parallel, energy-absorbing or non-energy absorbing but in the latter case they have to be properly designed and flared to avoid front hits on the nose of the terminal.

The decision to use either an energy-absorbing terminal or a non-energy-absorbing terminal should therefore be based on the likelihood of a near end-on impact and the nature of the recovery area immediately behind and beyond the terminal. When the barrier length-of-need is properly defined and guaranteed and the terminal is therefore placed in an area where there is no need for a safety barrier protection it is unlikely that a vehicle will reach the primary shielded object after an end-on impact regardless of the terminal type selected. Therefore if the terrain beyond the terminal and immediately behind the barrier is safely traversable a flared terminal should be preferred.

If, for local constraints, the proper length of need cannot be guaranteed or if the terrain beyond the terminal and immediately behind the barrier is not safely traversable, an energy-absorbing terminal is recommended.

Turn-down terminals, or flared-degraded terminals, which have been commonly used in the last years in several counties are now often replaced in new designs by flared terminals with no degradation as the longitudinal slide that arises from the degradation to the ground can lead to an overriding of the barrier.

Additional issues to be considered in the terminals design, that are addressed in deliverable D3 are:

- The definition of the "length of need";
- The configuration of the terminals in the backfills;
- The configuration of the terminals in the medians;
- The configuration of the terminals adjacent to driveways.

In terms of effectiveness there are no before-after studies available but in WP2 of the IRDES projects a CMF to account for the number of unprotected terminals has been developed and could be used as a reference.

3.2 Shoulder rumble strips

Shoulder rumble strips have been proven to be a low cost and extremely effective treatment in reducing single vehicle run off road (SVROR) crashes and their severity.

For rural freeways the Crash Modification Factor (CMF) for the use of milled rumble strips has been estimated combining different studies in:

- 0.89 (which means potential reduction of crashes of 11%) for SVROR crashes, with a standard error of 0.1;
- 0.84 (which means potential reduction of crashes of 16%) for SVROR fatal and injury crashes, with a standard error of 0.1.

For rural two lane roads the Crash Modification Factor (CMF) for the use of milled rumble strips has been estimated combining different studies in:

- 0.85 (which means potential reduction of crashes of 15%) for SVROR crashes, with a standard error of 0.1;
- 0.71 (which means potential reduction of crashes of 29%) for SVROR fatal and injury crashes, with a standard error of 0.1.

Given the very low standard errors these results can be considered extremely reliable in estimating the potential effect of milled shoulder rumble strips on these type of roads.

For urban freeways and multilane divided highways the analysis data available do not yet allow for a statistically sound evaluation of the effectiveness. For multilane divided highways the following values can be used as a best estimate of the effects of milled shoulder rumble strips: SVROR crashes are expected to be reduced by 22% and SVROR FI crashes by 51% but more statistically sound research is needed.

Different design configurations have been proposed for milled rumble strips:

- a “more aggressive” (and more effective) configuration that can cause higher disturbance to bicycle drivers and to residents in the surrounding. This type of configuration is recommended when there are no residents in the vicinity of the road and when either a 1.2 m remaining shoulder is available or very limited or no bicycle traffic is expected;
- a “less aggressive” configuration that is more “bicycle friendly” and reduces the noise disturbance in the surrounding.

Rumble strips on “noncontrolled-access” highways should include periodic gaps of 3.7 m in length placed at periodic intervals of 12.2 m or 18.3 m to satisfy bicyclists’ need to cross the rumble strip pattern without causing them to enter the grooved area. This recommended length is sufficiently long as to permit a typical bicyclist to cross without entering the grooved area, but not so long as to permit a vehicle tire at a typical run-off-road angle of departure to cross the gap without entering the grooved area.

Shoulder rumble strips should not be placed closer than 200 m to an urban area where, if needed, rolled rumble strips could be considered as these produce less noise and do not affect bicycle handling.

3.3 Forgiving support structures for road equipment

This section of the guideline addressed the issue of identifying potential hazards in the roadside and defining the most appropriate solutions for making the hazard caused by support structures more forgiving. It is frequent to hear, amongst designers and road managers, that obstacles in the roadside NEED to be protected with safety barriers. This is a simplistic approach that should be overcome to reach a forgiving roadsides design approach as placing a barrier (with its length of need and its terminals) is not necessarily the most “forgiving” solution and it can be extremely costly as compared to the achieved benefits.

In this Guideline the procedure developed in the RISER Project has been proposed and implemented. This requires to identify if the obstacle can be considered an hazard which means if it is within the clear zone and if it has structural characteristics that can lead to injuries to an errant vehicle impacting against the obstacle. Criteria for identifying the potential hazards are given in deliverable D3.

Support structures that have been tested according to EN12767 standard are considered to be passively safe or “forgiving” but different performance classes are given in the standard and guidelines for selecting the most appropriate performance class in different situations are given in Deliverable D3.

Even though this type of structures have been in place for several years in several countries including most of the northern European counties (Norway, Finland, Sweden) and Iceland, sound statistical analyses of the effectiveness of using “passively safe” support structures in reducing the severity of crashes were not found. On the other hand several studies can be found that indicate that crashes against these type of structures rarely lead to severe consequences.

A risk assessment of the potential effect of using passively safe lighting columns and signposts has been performed in the UK by combining the likelihood of occurrence of different events that can lead to passenger injuries. The risk associated with the use of “passively safe” o “forgiving” lighting columns resulted almost 8 times lower than the risk associated to conventional unprotected columns. The solution of protecting the column with a safety barrier is still 2 times higher than the risk associated by “passively safe” columns.

3.4 Shoulder width

The width of the outer shoulder (right for most of the European countries) is commonly recognised as an important roadside safety feature as it increases the recovery zone that allows an errant driver to correct it’s trajectory without running off the road but the effect of enlarging the outer shoulder width in rural roads is clearly positive for narrow shoulders while for larger shoulders this can be more questionable or even negative. It is therefore recommended that the CMF and predictive functions given in Deliverable D3 are used for estimating the effects of having shoulder width below the national standards. For enlarging the shoulders above the national standards a specific risk assessment should be conducted and additional interventions to prevent the use of the extra width of the shoulder should be considered (such as using different colours).

For rural single carriageway two lane roads and for multilane divided and undivided highways consolidated CMF functions can be found in the recently published Highway Safety Manual while for motorways in open air the effect of the shoulder width is often not found as these road type have usually an outer shoulder width of 2.50-3.0 m that has been shown to be the value above which no effect can be seen in crash reduction. For motorways in tunnels, where shoulder are often more narrow and the confinement affects the drivers behaviour, a specific Safety Performance Function is given to estimate the effect of having a reduced shoulder width.

Given the fact the national standards usually set the criteria for defining the minimum or standard outer shoulder width a “uniform” value was not proposed but the requirements given for rural roads in Austria, France, Italy and Sweden have been compared showing that the these are very similar for Motorways with speed limits of 130 km/h (2.50-3.00 m) while more variability is found in the secondary road network with a speed limit of 90-100 km/h.

4 Work Package 4 – European Survey

Following a specific request by ERANET SRO1 Programme Executive Board (PEB) a specific Work Package (WP) has been established within the IRDES Project devoted to preparing, circulating and analysing the results of a survey among the different European Road Administrations concerning the safety interventions used to improve roadside design and their estimated effectiveness.

The questionnaire was distributed to several National Road Administrations covering all European countries mainly through the Conference of European Road Directors (CEDR) in order to reach mainly national authorities in charge of the national road network.

The results of WP4 activities are presented in details in the deliverable D4: Questionnaire roadside safety interventions and their effectiveness and are synthesised below.

The National Road Authority that answered the questionnaire are: Austria, Belgium, Estonia, Finland, France, Germany, Iceland, Ireland, Italy, Lithuania, Luxembourg, Malta, Poland, Slovenia, Sweden, The Netherlands.

The questionnaire is divided into four parts:

- General questions
- Roadside treatments
- Assessment of implemented interventions
- New solutions for roadsides

It's generally agreed that active safety involves all initiatives aimed at preventing accidents, as the run off road (ROR) of a vehicle, while passive safety involves all the measures aimed at reducing the consequences or effects of an accident which is already occurring.

Available data from the questionnaire compared and aggregated to identify similarities and differences, show a variable situation from one country to another.

The reason for variable understanding of the importance of roadside could come from different legal approaches which, in some countries, give more responsibility to driver behaviour in comparison with others. For this reason a better understanding of the influence of roadside on driving behaviour can help to find new solutions.

As an example roadsides on bridges represent the most critical situation in all countries (but they're well protected), while firstly embankments and secondly cuttings require a large improvement, which needs more research to achieve more forgiving roadsides in these road configurations.

Type and containment level of the safety barriers appeared to be of less importance: only their presence is considered to have an effect.

5 Work Package 5 – Organization of Workshops and Round Tables

During the IRDES Project 2 "webinars" have been organized to get the possible stakeholders involved in the project to gather input for achieving a "practical" guideline as a results of the IRDES activities.

Short for ***web**-based sem**inar***, a webinar is a workshop that is held over the web.

5.1 The first IRDES Webinar

The first webinar was aimed at presenting the deliverables of the IRDES Project completed at that time (D1 and D4) and also to propose an interactive discussion on how to optimise the further development of the IRDES Forgiving Roadside Design Guide, in line with stakeholders' expectations. It was opened to road laboratories, authorities, operators (including toll motorway operators) and owners, road users (fleet operators), and governmental organisations that are dealing with forgiving roadsides.

Speakers were in the same place (in Paris) while the attendees participated from their own offices with a combined phone-web connection tool. A total of 14 experts attended the webinar, 6 at the IFSTTAR and 8 in web connection, from 9 countries (Austria, Belgium, Greece, Iceland, Ireland, Italy, Norway, and Sweden).

Deliverable D5.1 describes the webinar organization and attendees, summarises the presentations offered during the webinar and the discussion that occurred with the attendees on the different topics. The full presentations offered at the webinar are included at the end of the document.

A very active discussion followed each presentation during the webinar and the attendees proposed modifications and improvements to the documents that are being prepared and specifically to the guideline structure.

The key suggestions are summarized below:

1. Include examples and case studies in the body of the document.
2. Make a clear distinction between existing roads and roads to be designed. Integrate in the process for the progressive improvement of the roads. Try to provide criteria for defining where to intervene first.
3. The problem of the balance between scientific correctness and practical applicability is always true. There is a need to have a very nice table were the user can find the different road configurations and the appropriate measures to be applied. Try to give to the practitioners answer the specific problems the he has. Lack of standards to assess safety. We have standards for design but not to assess safety.

Finally, some questions about shoulders were discussed:

- Enlarging hard shoulders can be a problem. Experiences in Ireland have shown that drivers were using the shoulder as a lane.
- Which width is ideal?

- In the introduction it has to be made clear that the road has to be forgiving and self explaining at the same time. The configuration of the roadside has an influence not only on the “forgivingness” but also the “self-explaningness”.
- Before considering any specific treatment in the roadside the designers and road authorities should consider different possible treatments that can have an effect on active safety. This issue will be treated in the introduction of the guideline.

Following the discussion the IRDES partners proposed to add a chapter in the Guideline on the overall ENRSRO1 program summarizing the other 4 projects including also the ones tackling the self-explaining roads concepts.

5.2 The second IRDES Webinar

The goal of the second Webinar was to present final results of the project IRDES to the “potential clients”: road operators and managers.

4 technical deliverables have prepared during the IRDES project:

D1	State of the art report on existing treatments for the design of forgiving roadsides
D2	Practical Guide for the Assessment of Treatment Effectiveness
D3	Forgiving Roadside Design Guide
D4	Final report on the Survey

In the Webinar the speakers have shown presentations of the D2 and D3 deliverables which have been sent in working draft to the attendees via email prior to the Webinar. Deliverable D5.2 describes the webinar organization and attendees and summarises the presentations offered during the webinar. The full presentations offered at the webinar are included at the end of the document.

Glossary

Arrester bed
An area of land adjacent to the roadway filled with a particular material to decelerate and stop errant vehicles; generally located on long steep descending gradients.

Back slope (see ditch)
A slope associated with a ditch, located opposite the roadway edge, beyond the bottom of the ditch.

Boulder
A large, rounded mass of rock lying on the surface of the ground or embedded in the soil in the roadside, normally detached from its place of origin.

Break-away support
A sign, traffic signal or luminaire support designed to yield or break when struck by a vehicle.

Abutment
The end support of a bridge deck or tunnel, usually retaining an embankment.

Vehicle parapet (on bridges)
A longitudinal safety barrier whose primary function is to prevent an errant vehicle from going over the side of the bridge structure. It can be constructed from either steel or concrete.

CCTV Masts
A mast on which a closed circuit television camera is mounted for the purpose of traffic surveillance.

Carriageway
The definition of the 'carriageway' differs slightly amongst countries. The edge of the carriageway is delineated by either the "edge line" or, if no edge line is present, the edge of the paved area.

Central reserve
An area separating the carriageways of a dual carriageway road.

Clearance
The unobstructed horizontal dimension between the front side of safety barrier(closest edge to road) and the traffic face of the.

Clear/Safety zone
The area, starting at the edge of the carriageway, that is clear of hazards. This area may consist of none or any combination of the following: a 'hard strip', a 'shoulder', a recoverable slope, a non-recoverable slope, and/or a clear run-out area. The desired width is dependent upon the traffic volumes, speeds and on the roadside geometry.

Contained vehicle
A vehicle which comes in contact with a road restraint system and does not pass beyond the limits of the safety system.

Containment level
The description of the standard of protection offered to vehicles by a road restraint system. In other words, the Containment Performance Class Requirement that the object has been manufactured and tested to (EN 1317).

Crash cushion
A road vehicle energy absorption device (road restraint system) installed in front of a rigid object to contain and redirect an impacting vehicle ("redirective crash cushion") or to contain and capture it ("non-redirective crash cushion").

Culvert
A structure to channel a water course. Can be made of concrete, steel or plastic.

Culvert end
The end of the channel or conduit, normally a concrete, steel or plastic structure.

Cut slope
The earth embankment created when a road is excavated through a hill, which slopes upwards from the level of the roadway.

Design speed
The speed which determines the layout of a new road in plan, being the speed for which the road is designed, taking into account anticipated vehicle speed on the road.

Distributed hazards
Also known as 'continuous obstacles', distributed hazards are hazards which extend along a length of the roadside, such as embankments, slopes, ditches, rock face cuttings, retaining walls, safety barriers not meeting current standard, forest and closely spaced trees.

Ditch
Ditches are drainage features that run parallel to the road. Excavated ditches are distinguished by a fore slope (between the road and the ditch bottom) and a back slope (beyond the ditch bottom and extending above the ditch bottom).

Divided roadway
Roadway where the traffic is physically divided with a central reserve and/or road restraint system. Number of travel lanes in each direction is not taken into account. See also ‘dual carriageway’.

Drainage gully
A structure to collect water running off the roadway.

Drop-off
The vertical thickness of the asphalt protruding above the ground level at the edge of the paved surface.

Dual carriageway
A divided roadway with two or more travel lanes in each direction, where traffic is physically divided with a central reserve and/or road restraint system. See also 'divided roadway'.

Edge line
Road markings that can be positioned either on the carriageway surface itself at the edge of the carriageway, or on the 'hard strip' (if present) next to the carriageway.

Embankment
A general term for all sloping roadsides, including cut (upward) slopes and fill (downward) slopes (see 'cut slope' and 'fill slope').

Encroachment
A term used to describe the situation when the vehicle leaves the carriageway and enters the roadside area.

Energy absorbing structures
Any type of structure which, when impacted by a vehicle, absorbs energy to reduce the speed of the vehicle and the severity of the impact.

Fill slope
An earth embankment created when extra material is packed to create the road bed, typically sloping downwards from the roadway.

Frangible
A structure readily or easily broken upon impact (see also 'break-away support').

Fore slope (see ditch)
The fore slope is a part of the ditch, and refers to the slope beside the roadway, before the ditch bottom.

Forgiving roadside
A forgiving roadside mitigates the consequence of the "run-off" type accidents and aims to reduce the number of fatalities and serious injuries from these events.

Guardrail
A guardrail is another name for a metal post and rail safety barrier.

Hard/Paved shoulder
An asphalt or concrete surface on the nearside of the carriageway. If a 'hard strip' is present, the hard shoulder is immediately adjacent to it, but otherwise, the shoulder is immediately adjacent to the carriageway. Shoulder pavement surface and condition as well as friction properties are intended to be as good as that on the carriageway.

Hard strip
A strip, usually not more than 1 metre wide, immediately adjacent to and abutting the nearside of the outer travel lanes of a roadway. It is constructed using the same material as the carriageway itself, and its main purposes are to provide a surface for the edge lines, and to provide lateral support for the structure of the travel lanes.

Highway
A highway is a road for long-distance traffic. Therefore, it could refer to either a motorway or a rural road.

Horizontal alignment
The projection of a road - particularly its centre line - on a horizontal plane.

Impact angle
For a longitudinal safety barrier, it is the angle between a tangent to the face of the barrier and a tangent to the vehicle’s longitudinal axis at impact. For a crash cushion, it is the angle between the axis of symmetry of the crash cushion and a tangent to the vehicle’s longitudinal axis at impact.

Impact attenuators
A roadside (passive safety) device which helps to reduce the severity of a vehicle impact with a fixed object. Impact attenuators decelerate a vehicle both by absorbing energy and by transferring energy to another medium. Impact attenuators include crash cushions and arrester beds.

Kerb (Curb)
A unit intended to separate areas of different surfacings and to provide physical delineation or containment.

Lane line
On carriageways with more than one travel lane, the road marking between the travel lanes is called the ‘lane line’.

Limited severity zone
An area beyond the recovery zone that is free of obstacles in order to minimize severity in case of a vehicle run-off.

Length of need
The total length of a longitudinal safety barrier needed to shield an area of concern.

Median
See ‘central reserve’.

Motorways
A dual carriageway road intended solely for motorized vehicles, and provides no access to any buildings or properties. On the motorways itself, only grade separated junctions are allowed at entrances and exits.

Nearside
A term used when discussing right and left hand traffic infrastructure. The side of the roadway closest to the vehicle's travelled way (not median).

Non-paved surface
A surface type that is not asphalt, surface dressing or concrete (e.g. grass, gravel, soil, etc).

Offside
A term used when discussing right and left hand traffic infrastructure. The side of the roadway closest to opposing traffic or a median.

Overpass
A structure including its approaches which allows one road to pass above another road (or an obstacle).

Paved shoulder
See 'hard shoulder'.

Pedestrian restraint system
A system installed to provide guidance for pedestrians, and classified as a group of restraint systems under 'road restraint systems'.

Pier
An intermediate support for a bridge.

Point Hazard
A narrow item on the roadside that could be struck in a collision, including trees, bridge piers, lighting poles, utility poles, and sign posts.

Recovery zone
A zone beside the travel lanes that allows avoidance and recovery manoeuvres for errant vehicles.

Rebounded vehicle
A vehicle that has struck a road restraint system and then returns to the main carriageway.

Retaining wall
A wall that is built to resist lateral pressure, particularly a wall built to support or prevent the advance of a mass of earth.

Road restraint system (RRS)
The general name for all vehicle and pedestrian restraint systems used on the road (EN 1317).

Road equipment
The general name for structures related to the operation of the road and located in the roadside.

Road furniture
See ‘road equipment’.

Roadside
The area beyond the roadway.

Roadside hazards
Roadside hazards are fixed objects or structures endangering an errant vehicle leaving its normal path. They can be continuous or punctual, natural or artificial. The risks associated with these hazards include high decelerations to the vehicle occupants or vehicle rollovers.

Roadway
The roadway includes the carriageway and, if present, the hard strips and shoulders.

Rock face cuttings
A rock face cutting is created for roads constructed through hard, rocky outcrops or hills.

Rumble strip (Shoulder rumble strips)
A thermoplastic or milled transverse marking with a low vertical profile, designed to provide an audible and/or tactile warning to the road user. Rumble strips are normally located on hard shoulders and the nearside travel lanes of the carriageway. They are intended to reduce the consequences of, or to prevent run-off road events.

Rural roads
All roads located outside urban areas, not including motorways.

Safety barrier
A road vehicle restraint system installed alongside or on the central reserve of roads.

Safety zone
See ’clear zone’.

Self-explaining road
Roads designed according to the design concept of self-explaining roads. The concept is based on the idea that roads with certain design elements or equipment can be easily interpreted and understood by road users. This delivers a safety benefit as road users have a clear understanding of the nature of the road they are travelling on, and will therefore expect certain road and traffic conditions and can adapt their driving behaviour accordingly. (Ripcord-Iserest, Report D3, 2008).

Set-back
Lateral distance between the way and an object in the roadside for clearance).

Shoulder
The part of the roadway between the carriageway (or the hard strip, if present) and the verge. Shoulders can be paved (see ‘hard shoulder’) or unpaved (see ‘soft shoulder’).
Note: the shoulder may be used for emergency stops in some countries; in these countries it comprises the hard shoulder for emergency use in the case of a road with separate carriageways.

Single carriageway
See ‘undivided roadway’.

Slope
A general term used for embankments. It can also be used as a measure of the relative steepness of the terrain expressed as a ratio or percentage. Slopes may be categorized as negative (fore slopes) or positive (back slopes) and as parallel or cross slopes in relation to the direction of traffic.

Soft/Unpaved shoulder
A soft shoulder is defined as being a gravel surface immediately adjacent to the carriageway or hard strip (if present). In some countries it is used as an alternative for hard shoulders.

Soft strip
A narrow strip of gravel surface located in the roadside, beyond the roadway (normally beyond a hard strip/shoulder).

Termination (barrier)
The end treatment for a safety barrier, also known as a terminal. It can be energy absorbing structure or designed to protect the vehicle from going behind the barrier.

Transition
A vehicle restraint system that connects two safety barriers of different designs and/or performance levels.

Travel/Traffic lane
The part of the roadway/carriageway that is travelled on by vehicles.

Treatment
A specific strategy to improve the safety of a roadside feature or hazard.

Underpass
A structure (including its approaches) which allows one road or footpath to pass under another road (or an obstacle).

Underrider
A motorcyclist protection system installed on a road restraint system, with the purpose to reduce the severity of a PTW rider impact against the road restraint system.

Undivided roadway
A roadway with no physical separation, also known as single carriageway.

Unpaved shoulder
See ‘soft shoulder’.

Vehicle restraint system
A device used to prevent a vehicle from striking objects outside of its travelled lane. This includes for example safety barriers, crash cushions, etc. These are classified as a group of restraint systems under ‘road restraint systems’.

Verge
An unpaved level strip adjacent to the shoulder. The main purpose of the verge is drainage, and in some instances can be lightly vegetated. Additionally, road equipment such as safety barriers and traffic signs are typically located on the verge.

Vertical alignment
The geometric description of the roadway within the vertical plane.