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EuroS@P
EUROPEAN ROAD SAFETY PARTNERSHIP

WP3. Teaching materials development related to the road infrastructure safety inspection

IO.5 Development of road safety inspection methodology

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1 ABOUT THE EUROS@P PROJECT

The main objective of the EuroS@P project is to promote the best education solutions in the area of RISM directive, with an increase of awareness and knowledge of road safety, by:
1) Developing an e-learning platform with access to project products,
2) The development of teaching and training materials dedicated to conducting classes at universities and training courses for RISM staff,
3) Raising competencies and skills in RISM by changing curricula at universities and equipping students and staff with didactic materials based on innovative RISM methods and tools,
4) Creating the foundations for Road Safety Professional Certification (RSP),
5) The development of a lasting relationship and the continuation of active international cooperation between project partners with the possibility of its extension to other institutions.

The EuroS@P project targets the following groups:
1) Students, researchers, and academic teachers at universities.
2) Road authority staff at national, regional and local levels.
3) Experts, specialists, and practitioners involved in RS activities, including staff who conduct training in various RS courses.
4) All users of road infrastructure, as an indirect target group, for whom the risk of road accidents will ultimately be reduced by increasing the effectiveness and efficiency of RISM activities.

The project is also supported by a group of associates who will cooperate with project partners to consult and evaluate the results. They will implement final products and promote the dissemination and accessibility of the project results.

ABOUT OUTPUT IO.5

- **Objective:** Development of road safety inspection methodology.
- **Work package:** 3 Teaching materials development related to the road infrastructure safety inspection.
- **Target Groups:**
  - 1. Research and teaching staff from institutions involved in the project.
  - Civil engineering and transportation engineering students.
  - National, local, and regional road authority staff.

2 PRELIMINARY PART

2.1 Directive 2019/1936/EC

The teaching materials include a prepared PowerPoint-Lecture on the directive 2019/1936/EC. In the course of the lecture, the learners will be familiarized with the main idea, the structure (articles and annexes) of the directive, and its main ideas. The text corpus of the articles is presented to the learners in small selected sections, which are presented side-by-side with a summary of the main contents and also comments. A special focus is put on Annex IIa regarding the targeted inspection, highlighting and presenting the indicative elements mentioned in the Annex. The lecture closes with a discussion round, which should be first conducted in small groups, then in the whole class, on questions of the implementation of the directive and its scope and contents.

After the lecture, the learners are familiar with the main ideas of the directive, can describe where it is applicable, can name the different procedures and have an overview of the elements to consider during a road safety inspection.

2.2 RSI procedures

2.3 Road network classification

The teaching materials include a prepared PowerPoint-Lecture on different types of roads and their functions with a focus on contexts and users. The lecture includes a case study on road types in Germany.

After the lecture, the learners know the different categories of roads, what they are used for and who uses them. They also have an overview about the road network classification in Germany.

2.4 Accident analysis and statistics

2.4.1 Accident data and Accident type

Road accident data and the categorization of road accident types are fundamental in understanding and improving road safety. These datasets are typically collected and maintained by government agencies, such as the National Highway Traffic Safety Administration (NHTSA) in the United States, and play a vital role in shaping traffic policies and interventions. Road accident data encompass a wide range of information, including the number of vehicles involved, road conditions, weather, and contributing factors like speeding or impaired driving.

Categorizing road accidents into distinct types is essential for identifying common patterns and risk factors. Common road accident types include collisions (rear-end, head-on, side-impact), single-vehicle accidents (such as rollovers or crashes into fixed objects), pedestrian and cyclist accidents, and multi-vehicle accidents:

- Collisions: As mentioned earlier, collisions are a significant category. NHTSA's Traffic Safety Facts report provides in-depth analysis of different collision types, contributing factors, and trends, aiding in the development of countermeasures.
- Single-Vehicle Accidents: The European Road Safety Observatory (ERSO) categorizes single-vehicle accidents further into run-off-road, head-on, and side-impact crashes, offering insights into the impact of road design and driver behavior.
- Pedestrian and Cyclist Accidents: The World Health Organization (WHO) offers a global perspective on pedestrian and cyclist accidents, including data on vulnerable road users.
- Multi-Vehicle accidents: The National Transportation Safety Board (NTSB) in the United States investigates and reports on multi-vehicle pile-up accidents, often issuing safety recommendations to prevent future incidents.
- By categorizing accidents in this manner, safety experts can pinpoint areas of concern, develop targeted safety measures, and assess the effectiveness of interventions. Additionally, this approach allows for a more nuanced understanding of the factors contributing to specific accident types, which is crucial for designing educational campaigns and engineering improvements aimed at reducing the incidence and severity of road accidents.

2.4.2 Accident causation and risk assessment

Understanding the multifaceted causes of road accidents is a complex process that relies on insights from various fields of study. Key factors contributing to accidents include human behavior, vehicle-related issues, and environmental conditions. Human behavior is a primary contributor to road accidents, with distracted driving, impaired driving, and fatigue being significant concerns. The National Highway Traffic Safety Administration (NHTSA) conducts extensive research into human factors, exploring topics such as the impact of mobile device usage, substance impairment, and drowsy driving on accident rates. NHTSA's research informs strategies to address these factors, including public awareness campaigns and law enforcement efforts. Vehicle-related issues can also lead to accidents, often stemming from mechanical failures or inadequate maintenance. The National Transportation Safety Board (NTSB) investigates accidents involving vehicle defects and maintenance problems, aiming to identify root causes and recommend improvements in vehicle safety standards. Their thorough analysis assists in preventing similar accidents in the future. Roadway design and environmental conditions can significantly influence accident rates. The Federal Highway Administration (FHWA) conducts research into the impact of road infrastructure and conditions on road safety. This research encompasses road design improvements, traffic control measures, and the assessment of environmental factors like adverse weather conditions and visibility issues. FHWA's findings help guide infrastructure improvements and safety enhancements.

Road risk assessment is a comprehensive and multidimensional process that plays a pivotal role in traffic safety management. At its core, it involves the systematic identification, analysis, and mitigation of potential hazards and risks on roadways. The primary objective is to proactively prevent accidents and reduce their severity, thereby safeguarding the lives of road users and minimizing property damage.

The components of Road Risk Assessment are:

- Identification of Hazards: The initial phase of road risk assessment revolves around the meticulous identification of potential hazards. These hazards encompass a wide spectrum, ranging from road conditions and infrastructure design to traffic patterns, human behavior, and environmental factors such as weather and lighting conditions. This stage relies heavily on the collection and analysis of accident data, near-miss reports, and on-site assessments. By pinpointing these hazards, authorities gain valuable insights into areas that require closer scrutiny.
- Risk Estimation: Following hazard identification, risk estimation becomes a critical undertaking. Here, quantitative models and statistical analyses are often employed to assess the likelihood and severity of accidents or incidents associated with each identified hazard. These models factor in variables such as historical accident data, traffic volumes, road geometry, and prevailing weather conditions, providing a quantitative basis for evaluating potential risks.
- Risk Evaluation: Risk evaluation involves gauging the significance of each identified risk. This assessment considers various factors, including the number of potential casualties, property damage estimates, economic costs, and societal impacts. By assigning weights to these factors, decision-makers can prioritize risks based on their potential consequences, helping to allocate resources efficiently and effectively.
- Risk Mitigation: Armed with a comprehensive understanding of identified risks, road authorities and safety experts proceed to develop and implement risk mitigation strategies. These strategies are tailored to address the specific hazards identified during the assessment. Mitigation measures encompass a wide range of solutions, from engineering interventions such as road improvements and signage enhancements to changes in traffic management and regulations, stricter law enforcement, and targeted public education campaigns.
- Monitoring and Review: Road risk assessment is an ongoing process that requires continuous monitoring and review. Regular assessments ensure that implemented risk mitigation measures remain effective and adaptive to evolving road conditions and traffic patterns. Periodic evaluations provide the opportunity to fine-tune safety strategies, respond to emerging hazards, and incorporate lessons learned from past incidents.

Road risk assessment is not merely a theoretical exercise but a dynamic and proactive approach to traffic safety. Its significance lies in several key areas:

1) Accident Prevention: Road risk assessment serves as a potent tool for preventing accidents and minimizing their severity, ultimately saving lives and reducing injuries.
2) Resource Allocation: By systematically prioritizing resources and investments in road safety initiatives, risk assessment enables authorities to focus their efforts on addressing the most significant risks, thereby optimizing the utilization of available resources.
3) Data-Driven Decision Making: Rooted in data and evidence-based analysis, road risk assessment provides a robust foundation for policy and decision-making processes in traffic safety management.
4) Continuous Improvement: Through regular monitoring and review, road risk assessment facilitates the maintenance and enhancement of road safety over time. It

ensures that safety measures remain effective and adaptable to changing conditions, helping to sustain and further improve road safety in the long run.

In conclusion, road risk assessment is a multifaceted and data-driven approach to identifying, evaluating, and mitigating potential hazards and risks on roadways. It represents a cornerstone of modern traffic safety management, contributing to safer roads, reduced accidents, and overall improved road safety outcomes for communities and nations alike.

2.4.3 How collect and manage data

Collecting and managing road accident data is a fundamental aspect of modern traffic safety management. Accurate and comprehensive data is essential for understanding accident patterns, identifying high-risk areas, and developing evidence-based strategies to reduce accidents and improve road safety. This process involves a range of methodologies, technologies, and organizational efforts. Let's explore how road accident data is collected, managed, and its importance, with references to authoritative sources:

1. Data Collection Methods:

a) Police Reports: Law enforcement agencies play a central role in collecting accident data. When accidents occur, they generate police reports that detail the circumstances, involved parties, vehicles, injuries, and potential contributing factors. These reports serve as primary sources of accident data. The National Highway Traffic Safety Administration (NHTSA) in the United States provides guidelines for standardized crash reporting and data collection. Reference: NHTSA - Traffic Records

b) Hospital Records: Healthcare institutions maintain records of accident-related injuries and treatments, contributing valuable data on the severity and nature of injuries resulting from accidents. Collaboration between healthcare providers and traffic safety agencies helps capture this information.

c) Eyewitness Accounts and Traffic Cameras: Eyewitness accounts and traffic camera footage can provide additional insights into accident dynamics and factors. Technologies such as dashcams and surveillance cameras are increasingly valuable sources of data.

d) Traffic Monitoring Systems: Advanced traffic monitoring systems, including sensors embedded in roadways and intersections, capture real-time traffic flow data and can also detect incidents such as accidents. This data aids in both accident detection and post-accident analysis.

2. Data Management:

a) Data Repositories: Road accident data is typically centralized in comprehensive databases managed by governmental agencies responsible for traffic safety. These repositories facilitate data access, analysis, and reporting by various stakeholders, including researchers, policymakers, and law enforcement.

b) Data Standardization: Standardized data formats and coding systems ensure consistency and interoperability among various data sources and jurisdictions. The Global Reporting and Analysis of Traffic Crashes (GRASP) is an example of an international effort to standardize accident data for comparative analysis. Reference: GRASP

c) Data Quality Control: Rigorous data quality control procedures, including data validation and verification, help ensure the accuracy and reliability of accident data. These processes help eliminate errors and inconsistencies in the data.
d) Geospatial Mapping: Geographic Information Systems (GIS) are used to map accident locations, helping to identify accident-prone areas and inform targeted interventions.

3. Importance of Road Accident Data:

a) Evidence-Based Decision Making: Accurate accident data is the foundation for evidence-based decision making in traffic safety management. It informs the development of targeted interventions, policy changes, and enforcement strategies.
b) Identification of Trends: Analysis of accident data reveals trends and patterns, such as seasonal variations, high-risk intersections, and common contributing factors (e.g., speeding or impaired driving). This information guides resource allocation and intervention strategies.
c) Performance Monitoring: Ongoing data collection and analysis allow for the monitoring of road safety performance over time. Agencies can assess the effectiveness of safety initiatives and adjust strategies accordingly.
d) Public Awareness and Education: Accident data can be used to raise public awareness about road safety issues and support educational campaigns aimed at changing driver behavior.

In conclusion, collecting and managing road accident data is a multifaceted process that involves various data sources, standardized methods, and quality control procedures. Accurate data is essential for evidence-based decision making, trend identification, performance monitoring, and public awareness efforts in the pursuit of improved road safety. It is a collaborative effort involving government agencies, healthcare institutions, and technology providers to ensure that the data collected is of the highest quality and serves the goal of reducing accidents and saving lives on the roads.

2.4.4 Surrogate Measures of Safety

In the realm of traffic safety analysis, surrogate measures play a pivotal role in assessing and improving road safety. These measures serve as indicators or proxies for safety outcomes, offering valuable insights into potential hazards and risk factors. This chapter explores the concept of surrogate measures of safety, their types, applications, and significance in enhancing traffic safety.

Surrogate measures of safety are quantitative indicators that serve as substitutes for actual safety outcomes, such as accidents or injuries. They are particularly useful in situations where it is challenging to collect comprehensive accident data or where policymakers and safety experts seek early warning signs of potential safety issues. Surrogate measures provide a way to proactively identify high-risk areas and prioritize safety interventions.

Surrogate measures encompass a diverse range of indicators, each offering unique insights into different aspects of road safety:

a) Traffic Violations: Surrogate measures may include the frequency and type of traffic violations, such as speeding, running red lights, and improper lane changes. An increase in violations can indicate a higher risk of accidents.

b) Near-Miss Events: Near-miss incidents, where a collision is narrowly avoided, are strong indicators of potential safety issues. Analyzing near-miss data can reveal hazardous locations or behaviors.
c) Roadway Geometry: Characteristics such as sharp curves, inadequate sight distance, and suboptimal road design can be surrogate measures, highlighting areas where accidents are more likely to occur.
d) Traffic Density and Flow: Congested traffic conditions and irregular traffic flow can indicate increased safety risks. Surrogate measures like traffic density help identify areas prone to congestion-related incidents.
e) Driver Behavior: Monitoring driver behavior through metrics like aggressive driving, lane departure, and following distance violations can offer insights into potential safety concerns.
f) Vehicle Speed: Speed is a critical factor in road safety. Surrogate measures related to speed include average speeds, speed variance, and the prevalence of speeding.

Surrogate measures of safety find applications across various domains:
a) Intersection Safety: Surrogate measures like red-light running and near-miss events are used to assess intersection safety. Traffic engineers can use this data to optimize signal timings and enhance safety at intersections.
b) Work Zone Safety: In work zones, surrogate measures help identify potential safety hazards due to temporary changes in road conditions and traffic patterns. This data informs the implementation of safety measures and traffic control strategies.
c) Pedestrian and Cyclist Safety: Surrogate measures are used to assess pedestrian and cyclist safety, including factors like crosswalk violations, close calls with vehicles, and unsafe infrastructure.
d) Freight and Commercial Vehicle Safety: Surrogate measures can highlight risky behaviors among commercial vehicle operators, such as unsafe lane changes and tailgating, contributing to targeted enforcement efforts and training programs.

Surrogate measures of safety offer several advantages in traffic safety management:
a) Early Warning: They provide early warning signs of potential safety issues, allowing authorities to take proactive measures before accidents occur.
b) Data Availability: Surrogate measures can be easier and less costly to collect than accident data, making them valuable in areas with limited resources or data infrastructure.
c) Targeted Interventions: Surrogate measures pinpoint specific safety concerns, enabling focused interventions and resource allocation.
d) Performance Evaluation: They help assess the effectiveness of safety improvements by tracking changes in surrogate measures over time.
e) Research and Analysis: Surrogate measures are valuable for research and analysis, providing insights into the relationships between various factors and safety outcomes.

While surrogate measures of safety offer numerous benefits, they are not without challenges:
a) Validation: Ensuring that surrogate measures accurately reflect safety outcomes requires validation against actual accident data.

b) Data Quality: The reliability of surrogate measures depends on data quality, which may vary.
c) Context Sensitivity: Surrogate measures may not capture all safety aspects and should be used in conjunction with other safety data sources.
d) Ethical and Privacy Concerns: Collecting data related to driver behavior and vehicle movements raises ethical and privacy considerations that must be addressed.

Surrogate measures of safety are valuable tools in the pursuit of improved traffic safety. They provide insights into potential hazards, guide targeted interventions, and contribute to data-driven decision-making. By continuously refining and expanding the use of surrogate measures, traffic safety experts can work toward safer roadways and reduced accidents, ultimately saving lives and minimizing injuries on the roads.

3 ROAD SAFETY FUNDAMENTALS

3.1 Characteristics and requirements of different road users

The teaching materials include a prepared PowerPoint-Lecture on different types of transport modes and road users. The different road users are presented to the learners and their main characteristics are discussed. A special focus is put on vulnerable road users.
After the lecture, the learners are aware of different transport modes, road users and their need and can draw insight to traffic safety of those groups.

3.2 Road Alignment and Cross Section

3.3 Intersections and interchanges

The teaching materials include a prepared PowerPoint-Lecture on the main requirements of junctions and interchanges and specific information on the junctions and interchanges of different road types. The learners are introduced to different interchange geometries and are presented a case study on Germany.

After the lecture, the learners know which intersection and junction types exist and which are best suited to which cases.

3.4 Roadside hazard

3.5 Signs, markings, pavement and lighting

The teaching materials include a prepared PowerPoint-Lecture on the main pricinciples of traffic signage, markings, pavement and lighting. The lecture materials gives several examples of different local implementations of traffic signs and markings and familiarizes learners with different approaches to the topic, present in different countries. For the section on lighting and pavement, learners are familiarzised with the basic requirements road users have towards those elements of infrastructure.

After the lecture, the learners are aware of the differences in road signage and marking present in different European countries. The learners know about the basic principles in regards to pavements and lighting.

4 ROAD SAFETY INSPECTION

4.1 Two lane rural road/single carriageway

4.1.1 Procedure

The general characteristics of the road have been understood from the preliminary inspection, that interest various segments of road although it should not normally exceed a total extension of more than 100 km. During the preliminary inspection each road is run in both directions, at normal speed, that is the prevailing traffic speed, with the aim of investigating the ways in which the road environment is perceived and interpreted by its users. The analysis focuses not only on the road, but also on the surrounding environment with which it interacts and on the users themselves.

In the general inspection, the aim is to obtain the most important information regarding specific aspects, while referencing their position along the segment.

The road is run at low speed (about 30 km/h), compatibly with traffic conditions, in such a way as to allow the inspectors to record the information on the checklist. During the inspection each road is run in both directions. A single inspection can cover more than one road segment, covering a total distance normally not more than 30 km.

At least three reviewers are needed: the driver, the reviewer in front seat and the reviewer in back seat. A video of the road segment is performed during the trip and the checklists must be filled for both runs in both directions. They are differentiated according to the position of the inspector: in the front or back seat.

Safety issues are ranked as high-level problem and low-level problem and for each problem the inspector can insert a tick against different levels. If no problem exists, then no sign is inserted.

The checklist evaluations are recorded for each 200 m segment (every 24 s at a speed of 30 km/h). This interval is a compromise between the possibility of easily expressing a reliable evaluation, which requires observation periods of limited length, and of having enough time available to compile the checklist, which requires periods that are not too short.

The tasks of the front-seat and back-seat inspectors were separated to distribute the effort for the completion of the checklists, also bearing in mind that the road environment is perceived differently according to their positions inside the car:

- the front-seat inspector is interested in aspects linked to roadside, alignment and accesses (Table 1).
- the back-seat inspector is interested in the aspects linked to cross-section, pavement delineation, road signs and road markings (Table 2).

The checklists are divided into two parts (A, B):

- Part A contains elements that must be completed during the inspection to have a correct evaluation;
- Part B contains elements that can also be evaluated in the office using the video recording.

Part B must be completed in the office when the complexity and number of problems is such that it is difficult to complete the form during the run.

Table 1 Preliminary inspection checklist: module for the front-seat inspector

	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
PART A										
Roadside										
Embankments										
Bridges										
Dangerous terminals and transitions										
Trees, utility poles and rigid obstacles										
Ditches										
Alignment										
Inadequate sight distance on horizontal curve										
Inadequate sight distance on vertical curve										
PART B										
Accesses										
Dangerous accesses										
Presence of accesses										

Table 2 Preliminary inspection checklist: module for the back-seat inspector

	0.2	0.4	0.6	0.8	1.0	1.2	1.4	1.6	1.8	2.0
PART A										
Cross section										
Lane width										
Shoulder width										
Pavement										
Friction										
Unevenness										
Delineation										
Chevrons										
Guideposts and barrier reflectors										
PART B										
Signs										
Warning signs, regulation signs										
Markings										
Edge lines										
Center line										

4.2 Road Alignment and Cross Section

4.2.1 Cross section

4.2.1.1 Lane

A lane width of less than 2.75 m should be considered as a **high-level problem**, while a width of between 2.75 m and 3.25 m is a **low-level problem**.

In the same way excessive lane width can also constitute a safety problem. A lane width of more than 4.50 m should be considered as a **high-level problem**, while a width of between 3.75m and 4.50 m constitutes a **low-level problem**. This recommendation should in no way be considered binding in the case of hair-pin bends and road widening on curves.

<u>No problem: Example</u>

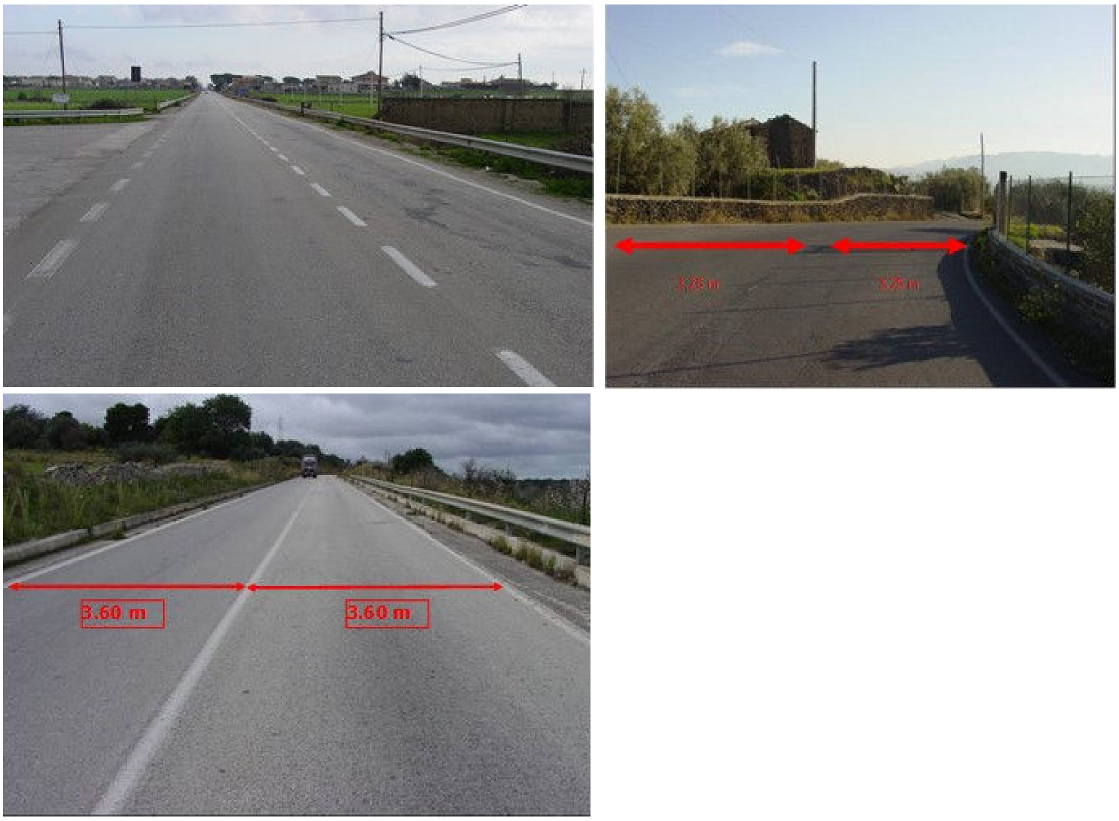

Figure 1 Examples of corrected lane width

High level problem: Example

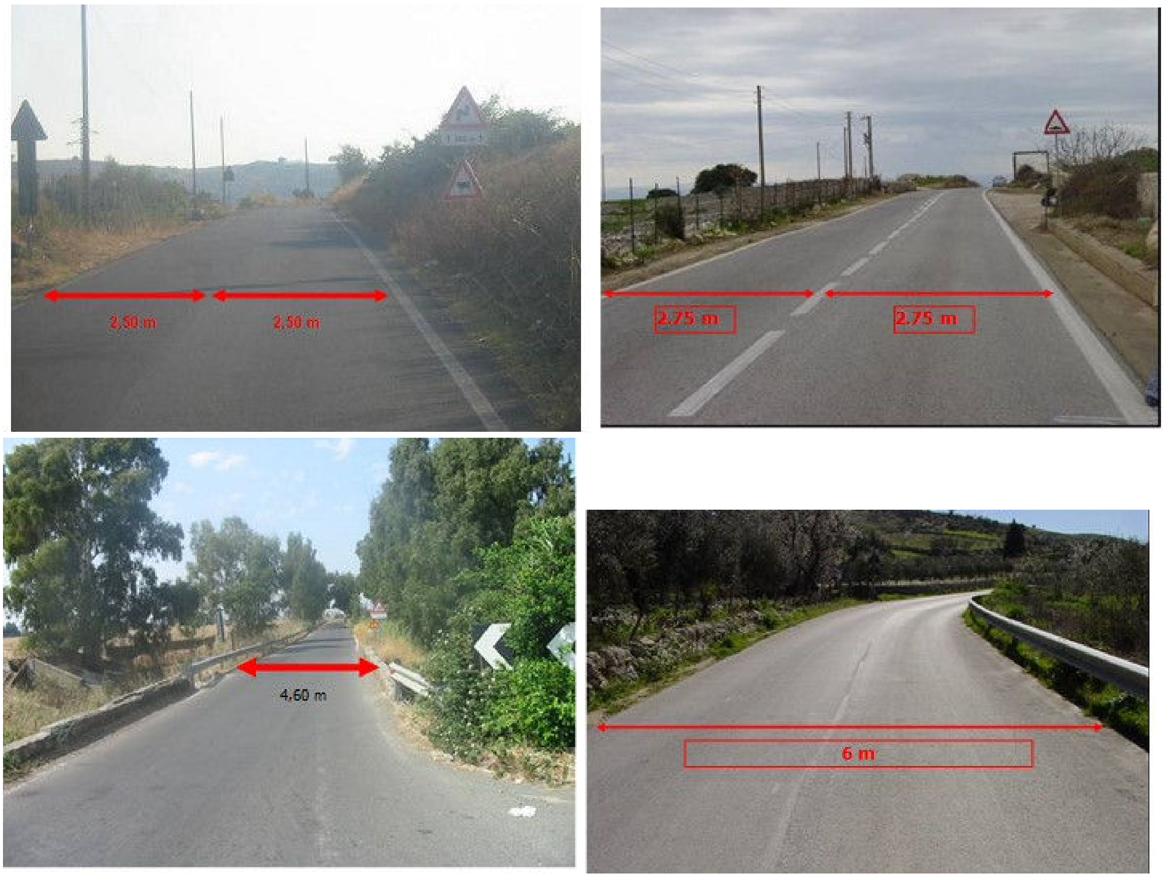

Figure 2 Examples of high level problem for lane width

Low level problem: Example

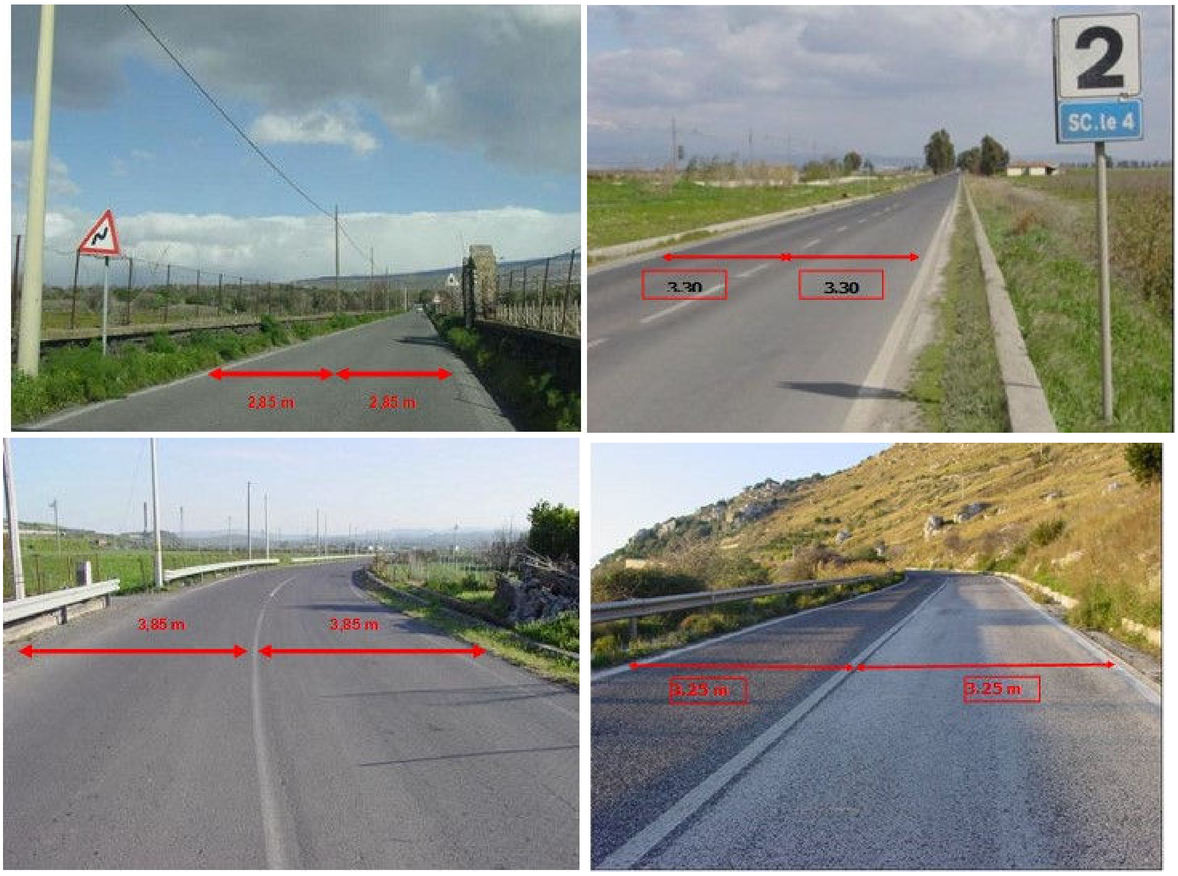

Figure 3 Examples of low level problem for lane width

4.2.1.2 Right shoulder

A shoulder width of less than 0.30 m should be considered as a **high-level problem**, while a width of between 0.30 m and 1.00 m should be considered as a **low-level problem**.

High level problem: Example

Figure 4 Examples of high level problem for shoulder width

<u>Low level problem: Example</u>

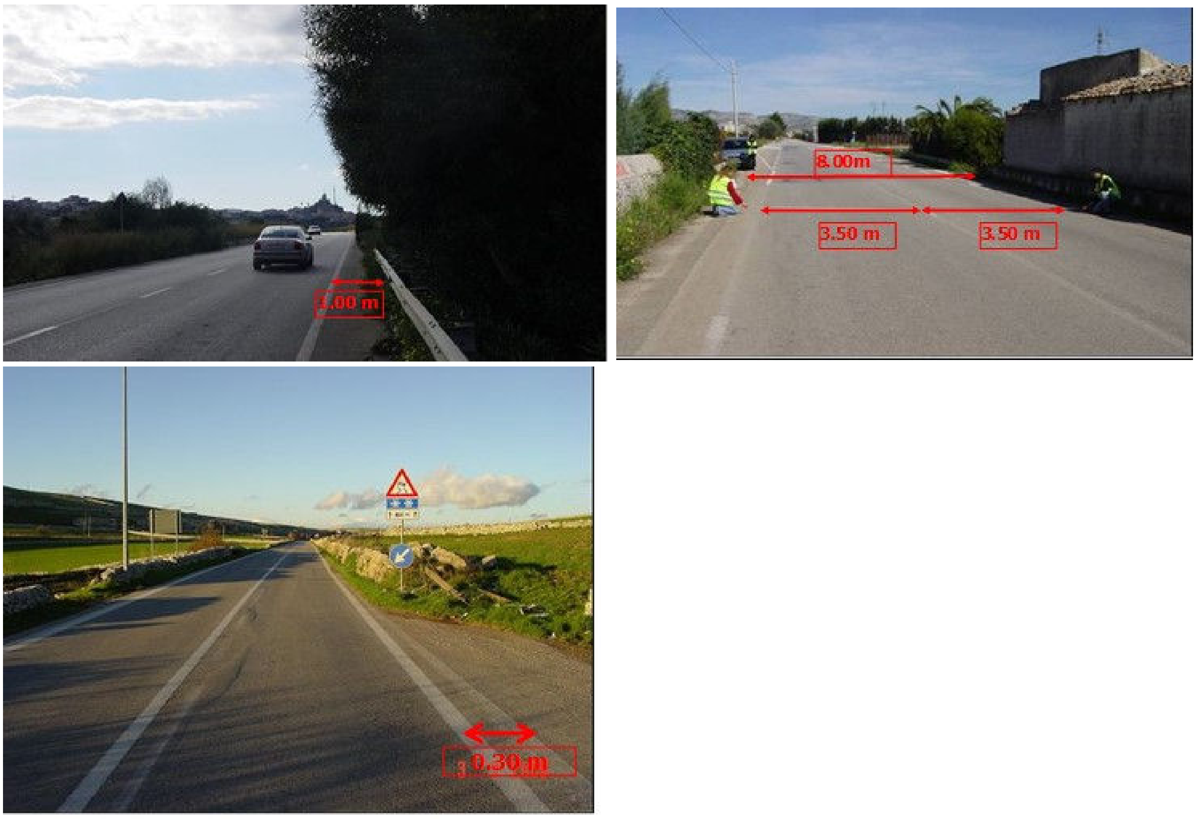

Figure 5 Examples of low level problem for shoulder width

4.2.2 Alignment

4.2.2.1 Vertical

The situation in which it is advisable to report a **<u>high-level problem</u>** of inadequate sight distance on vertical curves is the following:

- presence of a crest with available sight distance of less than 50 m.

The situation in which it is advisable to report a **<u>low-level problem</u>** of inadequate sight distance on vertical curves is the following:

- available sight distance greater than 50 m but smaller than Stopping Sight Distance or inadequate to give the correct road perception.

<u>High level problem: Example</u>

Figure 6 Examples of high level problem for vertical alignment

<u>Low level problem: Example</u>

Figure 7 Examples of low level problem for vertical alignment

4.2.2.2 Visibility and sight distance

The situation in which it is advisable to report a **<u>high-level problem</u>** of inadequate sight distance on horizontal curves is the following:

- available sight distance less than about 50 m due to the presence of obstacles along the whole inside of the curve.

The situations in which it is advisable to report a **<u>low-level problem</u>** of inadequate sight distance on horizontal curves are the following:

- available sight distance greater than 50 m but smaller than Stopping Sight Distance or inadequate to give the correct road perception;
- presence of discontinuous obstructions to visibility on the inside of the curve (for example, isolated trees).

<u>High level problem: Example</u>

Figure 8 Examples of high level problem for horizontal sight distance

Low level problem: Example

Figure 9 Examples of low level problem for horizontal sight distance

4.3 Access

Accesses are driveways from private areas or buildings onto public roadways, or rather the points where private roads lead onto public roads and vice-versa. The checklist specifies two aspects: the presence of accesses and dangerous accesses.

4.3.1.1 Dangerous accesses

The positioning and configuration of accesses must be such as to respect the same distance of unrestricted visibility as required for junctions.
The most common situations in which it is advisable to report a **high-level problem** with dangerous accesses are the following:

- accesses located on horizontal curves;
- accesses located on crest curves;
- accesses located on sites with poor visibility;
- accesses located close to intersections;
- accesses less than 30 m from intersections (distance measured between the access axis and the junction axis).

The most common situations in which it is advisable to report a **low-level problem** with dangerous accesses are the following:

- narrow accesses;
- accesses with no road markings;
- accesses with no delineators;
- unpaved accesses.

High level problem: Example

Figure 10 Examples of high level problem for dangerous accesses

Low level problem: Example

Figure 11 Examples of low level problem for dangerous accesses

4.3.1.2 Presence of accesses

The situation in which it is advisable to report a **high-level problem** with the presence of accesses is the following:

- high number of accesses (> three accesses over a 200 m segment).

The situation in which it is advisable to report a **low-level problem** with accesses is when there are one or two accesses over the 200m segment under review.

High level problem: Example

Figure 12 Examples of high level problem for presences of accesses

Low level problem: Example

Figure 13 Examples of low level problem for presences of accesses

4.3.2 Signs

4.3.2.1 Warning signs

The situations in which it is advisable to report a **high-level problem** with signs are the following:

- missing or not visible warning sign for severe curve;
- missing or not visible warning sign for crest curve;
- missing or not visible warning sign in dangerous situations.

The situations in which it is advisable to report a **low-level problem** with signs are the following:

- curve warning sign faded or with low visibility.

High level problem: Example

Figure 14 Examples of high level problem for warning signs

Low level problem: Example

Figure 15 Examples of low level problem for warning signs

4.3.2.2 Yield/Stop signs

The situations in which it is advisable to report a **low-level problem** with signs is the following:

- yield sign missing, faded or with low visibility.

Low level problem: Example

Figure 16 Examples of low level problem for yeld/stop signs

4.3.2.3 Indication signs

The situations in which it is advisable to report a **low-level problem** with signs is the following:

- indication signs incomplete, with low legibility or in wrong position.

-

Figure 17 Examples of low level problem for indications signs

4.3.2.4 Advisory speed

The situations in which it is advisable to report a **low-level problem** with signs is the following:

- speed limits not consistent with road features.

Figure 18 Examples of low level problem for advisory speed

4.3.3 Marking

4.3.3.1 Centrelines

The situations in which it is advisable to report a **high-level problem** with the centre line are the following:

- missing centre line;
- very faded centre line;
- discontinuous line with no overtaking sight distance

The situation in which it is advisable to report a **low-level problem** with the centre line is the following:

- low faded centre line

High level problem: Example

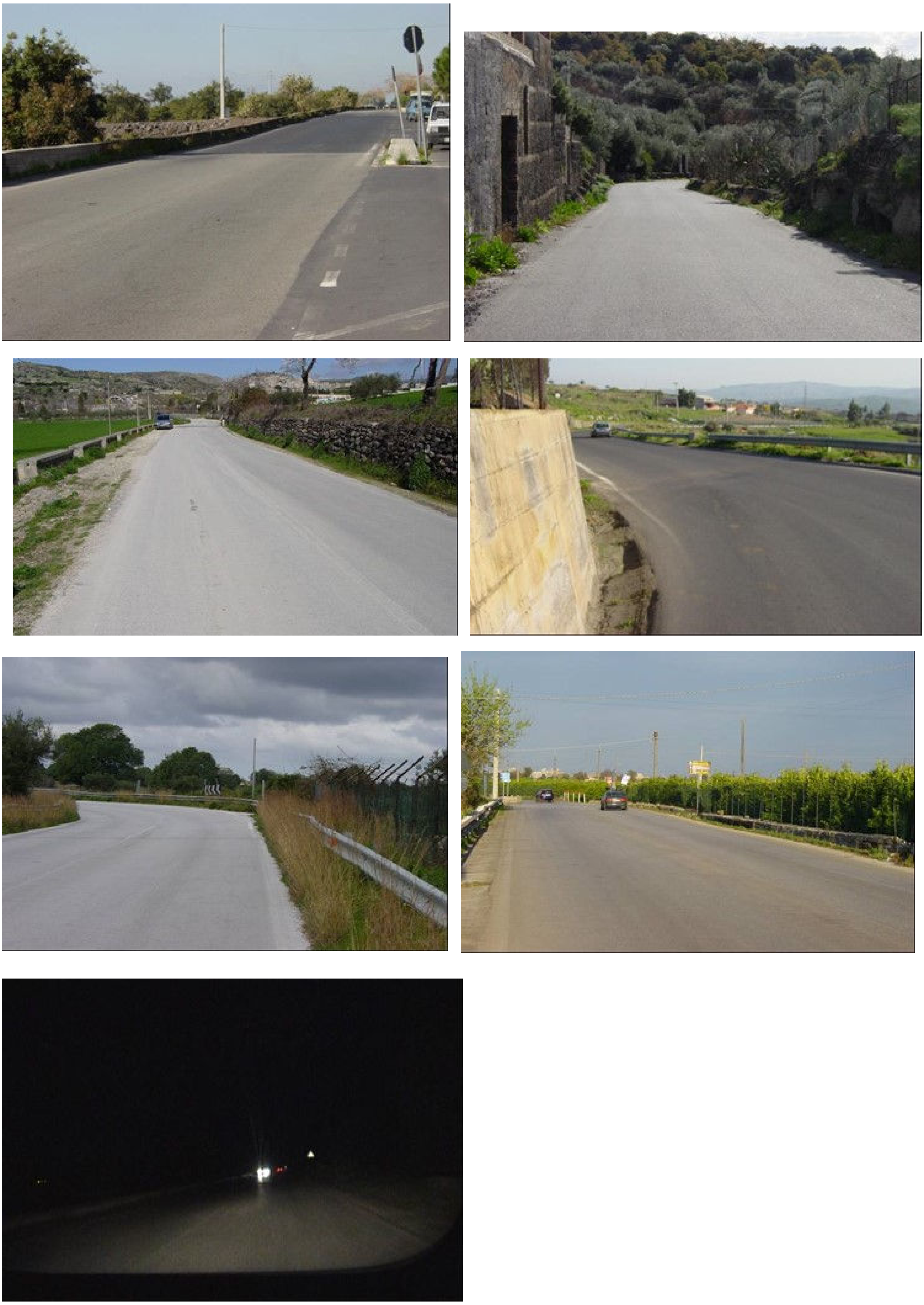

Figure 19 Examples of high level problem for centrelines marking

Low level problem: Example

Figure 20 Examples of low level problem for centrelines marking

4.3.3.2 Edgelines

The situations in which it is advisable to report a **high-level problem** with the edge lines are the following:

- missing edge lines;
- very faded edge lines

The situation in which it is advisable to report a **low-level problem** with the edge line is the following:

- low faded edge line

<u>High level problem: Example</u>

Figure 21 Examples of high level problem for edgelines marking

<u>Low level problem: Example</u>

Figure 22 Examples of low level problem for edgelines marking

4.3.4 Delineation

4.3.4.1 Chevrons

In Italy chevrons must be placed in series composed of several elements to delineate the outside of curves having a radius of more than 30m when it is necessary to improve the sight distance of the curve. The maximum longitudinal spacing of the delineators must therefore be such as to always allow at least three chevrons to be visible. Chevrons must be placed on curves with a radius of less than 30m and with a lack of visibility.

The most common situations in which it is advisable to report a **high-level problem** with chevrons are the following:

- Missing chevrons on severe curves;
- Chevrons number inadequate to give correct perception of the total length of the curve;
- chevrons placed in only one direction;
- ineffective chevrons due to a high-level of deterioration;
- not reflective chevrons;
- chevrons with directional arrows in the wrong direction;
- chevrons obscured by vegetation.

The most common situations in which it is advisable to report a **low-level problem** with chevrons are the following:

- low reflective chevrons due to dirt or slight deterioration;
- missing chevrons on moderate curves;
- local discontinuity of chevrons;
- chevrons spacing inadequate to give correct perception of the curve;
- chevrons do not continue along the whole of the curve;
- sharp bend warning chevrons installed instead of chevrons of normal type (or vice-versa);
- chevrons partially obscured by vegetation.

High level problem: Example















Figure 23 Examples of high level problem for chevron

<u>Low level problem: Example</u>

Figure 24 Examples of low level problem for chevron

4.3.4.2 Guidepost

Roadside guideposts must be placed in those places, outside built-up areas, where it is necessary to provide visibility of road alignment. Discontinuous placing must be avoided and on uniform road segments, there must be an unbroken installation of the same kind of delineator. The spacing intervals of the guideposts must be as uniform as possible along the same road segment and reduced on curves.

The most common situation in which it is advisable to report a **high-level problem** with the roadside delineators are the following:

- missing guideposts along the roadside;
- dangerous placement (e.g., inside ditches).

The most common situations in which it is advisable to report a **low-level problem** with the roadside delineators are the following:

- local discontinuity in guideposts placing;
- excessive spacing between guideposts.

<u>High level problem: Example</u>

Figure 25 Examples of high level problem for guidepost

<u>Low level problem: Example</u>

Figure 26 Examples of low level problem for guidepost

1.1.1.1 Reflectors

When there are safety barriers, walls, parapets or other obstacles, the guideposts can be substituted by reflective elements positioned on the fixtures, placed either in the wave of the guard-rail or above it; it is advisable for the reflectors to be placed at the same height above the ground as those on the normal guideposts (the upper edge positioned between 70 and 110 cm).

The most common situation in which it is advisable to report a **high-level problem** with the roadside delineators are the following:

- missing reflectors on roadside safety barriers;
- missing reflectors on walls or in other situations;
- missing or ineffective reflectors.

The most common situations in which it is advisable to report a **low-level problem** with the roadside delineators are the following:

- variable height of reflectors along the road;
- low reflectivity reflectors due to inadequate maintenance.

High level problem: Example

Figure 27 Examples of high level problem for reflectors

<u>Low level problem: Example</u>

Figure 28 Examples of low level problem for reflectors

4.4 PAVEMENT

Pavement inspection aims only at identifying safety problems and is not therefore carried out identifying the type and degree of deterioration which is necessary for the drawing up of the maintenance programme.

4.4.1 Friction

Since a correct evaluation of the pavement friction conditions requires instrumental measurements, a solely visual inspection does not differentiate the degree of seriousness of the problem.

The situations in which it is advisable to report a problem with friction are the following:

- Polished aggregate;
- Bleeding;
- Low macrotexture;
- Ravelling;
- Ponding, water drainage

Figure 29 Polished aggregate

Figure 30 Bleeding

Figure 31 Low macrotexture

Figure 32 Raveling

Figure 33 Ponding

4.4.2 Unevenness

The presence of pavement unevenness (cracking, shoving, potholes, rutting, etc.) leads to safety problems in that it can induce risky driving behaviour (sharp decelerations, sudden change of direction, lane axis deviations), suspension vibrations (increase in braking distance, driver tiredness) and inadequate drainage. It is therefore necessary to evaluate not only the seriousness and extent of the problems, but also their precise location on the road (curves, tangents, intersections).

The situations in which it is advisable to report a **high-level problem** with unevenness are the following:

- Steel grates in the roadway, raised manhole covers;
- Disrupted bridge joints;
- Potholes on curves or near intersections;
- Deep potholes on tangents;
- Shoving on curves or near intersections;
- High shoving on tangents;
- Rutting on curves;
- Patches on curves.

Figure 34 Disrupted bridge joints: high level problem for unevenness

Figure 35 Disrupted bridge joints: high level problem for unevenness

Figure 36 Deep potholes on tangents: high level problem for unevenness

Figure 37 Shoving on curves: high level problem for unevenness

The situation in which it is advisable to report a low level problem with unevenness are the following:

- Low shoving on tangent;
- Shallow potholes on tangent;
- Rutting on tangent;
- Patches on tangent.

Figure 38 Shallow potholes on tangent: low level problem for unevenness

Figure 39 Patches on tangent: low level problem for unevenness

Figure 40 Rutting on tangent: low level problem for unevenness

4.5 ROADSIDE

4.5.1 Embankments

The situations in which it is advisable to report a **high-level problem** with embankments are the following:

- Embankments with height more than 5 m unshielded or shielded with ineffective barriers;
- Embankments with height more than 3 m and steep slopes unshielded or shielded with ineffective barriers;

- Embankments with height more than 3 m and steep slopes unshielded by low containment safety barriers, when there are dangerous obstacles at the foot of the embankment.

Figure 41 Embankments with height more than 5 m unshielded or shielded with ineffective barriers: high level problem for roadside

Figure 42 Embankments with height more than 3 m shielded with ineffective barriers: high level problem for roadside

Figure 43 Embankments with height more than 3 m and steep slopes unshielded: high level problem for roadside

The situations in which it is advisable to report a **low-level problem** with embankments are the following:

- Unshielded embankments with height between 1 and 3 m and steep slopes or shielded with ineffective barriers;
- Embankments with height more than 3 m but less than 5 m shielded by low containment safety barriers, if there is a high level of commercial – vehicle traffic;
- Embankments with height more than 3 m and less than 5 m shielded with discontinuous barriers.

Figure 44 Embankments with height more than 3 m but less than 5 m shielded by low containment safety barriers: low level problem for roadside

1.1.2 Bridges

The situations in which it is advisable to report a **high-level problem** with bridges are the following:

- Unshielded bridges or bridges shielded with ineffective barriers;
- Bridges with low containment safety barriers if there is a high level of commercial – vehicle traffic.

 

Figure 45 Bridges shielded with ineffective barriers: high level problem for roadside

The situations in which it is advisable to report a **low-level problem** with bridges are the following:

- Bridge barriers incorrectly installed;
- Medium containment safety barriers if the bridge goes over roads, railways or built-up areas.

4.5.2 Terminals and transitions

The situations in which it is advisable to report a **high-level problem** with terminals and transitions are the following:

- Roadside barriers with no breakaway terminals;
- Bridge barriers with no breakaway terminals;
- Terminals buried in the ground;
- Roadside barriers not connected to concrete walls;
- Roadside barriers not connected to stone walls;
- Roadside barriers not connected to bridge barriers;
- Roadside and bridge barriers connected without transitions;
- Unconnected roadside barriers.


3 3 2006


14 9 2004

Figure 46 Roadside barriers with no breakaway terminals: high level problem for roadside

Figure 47 Roadside barriers not connected to concrete walls: high level problem for roadside

Figure 48 Bridge barriers with no breakaway terminals: high level problem for roadside

Figure 49 Roadside and bridge barriers connected without transitions: high level problem for roadside

The situations in which it is advisable to report a **low-level problem** with terminals and transitions are the following:

- Inadequate transitions connecting steel barriers of different types.

4.5.3 Trees, utility poles and other obstacles

The situations in which it is advisable to report a **high-level problem** with trees, utility poles and other obstacles are the following:

- High diameter trees less the 3 m from the roadway;
- Rows of trees;
- Concrete utility poles than 3 m from the roadway;
- High diameter utility poles less the 3 m from the roadway;
- Rigid obstacles with exposed front face or corner less than 3 m the roadway.

Figure 50 Concrete utility poles than 3 m from the roadway: high level problem for roadside

Figure 51 Rigid obstacles with exposed front face or corner less than 3 m the roadway: high level problem for roadside

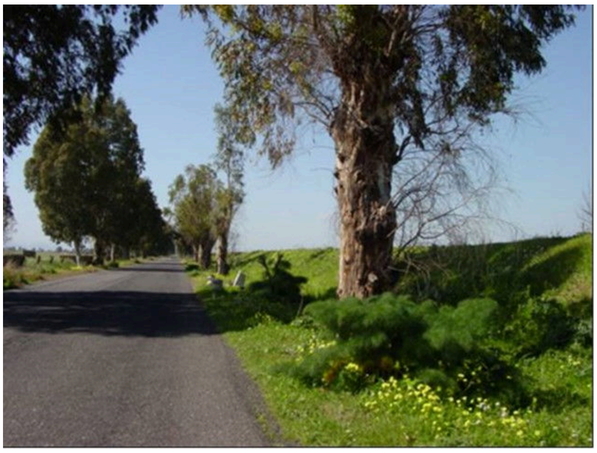

Figure 52 Rows of trees: high level problem for roadside

The situations in which it is advisable to report a **low-level problem** with trees, utility poles and other obstacles are the following:

- High diameter trees between 3 and 8 m from the roadway;
- Low diameter trees less than 3 m from the roadway;
- Concrete poles between 3 and 8 m from roadway;
- High diameter metal poles between 3 and 8 m from the roadway;
- Low diameter metal poles less than 3 m from the roadway;
- Rigid obstacles with exposed front face or corner between 3 and 8 m from the roadway;
- Isolated trees or obstacles.

4.5.4 Rectangular and trapezoidal ditches

The situations in which it is advisable to report a **high-level problem** with rectangular and trapezoidal ditches are the following:

- Rectangular and trapezoidal ditches less than 3 m from the roadway.

Figure 53 Rectangular and trapezoidal ditches less than 3 m from the roadway: high level problem for roadside

The situations in which it is advisable to report a **low-level problem** with rectangular and trapezoidal ditches are the following:

- Rectangular and trapezoidal ditches between 3 and 5 m from the roadway.

4.6 Motorways, interchanges

4.6.1 Legislation

For the motorway, the Decreto Ministeriale n. 137 of 02/05/2012 “Linee guida per la gestione della sicurezza delle infrastrutture stradali ai sensi dell’art. 8 del decreto legislativo 15 marzo 2011, n. 35” is reported.
According to Directive 2008/96/EC (D.L. n.35 of 15/03/2011) it applies to the roads they make part of the trans-European network, whether they are in the planning stage, in construction or already open to traffic. Four of the nine TEN-T Corridors involve Italy:

- the Mediterranean Corridor crosses Northern Italy from West to East, joining Turin, Milan, Verona, Venice, Trieste, Bologna and Ravenna;
- the Reno-Alps Corridor passes through the Domodossola and Chiasso passes and reaches the port of Genoa;
- the Baltic Adriatic Corridor connects Austria and Slovenia to the Northern Adriatic ports of Trieste, Venice and Ravenna, passing through Udine, Padua and Bologna;
- the Scandinavian-Mediterranean Corridor starts from the Brenner pass and connects Trento, Verona, Bologna, Florence, Livorno and Rome with the main urban centers in the south such as Naples, Bari, Catanzaro, Messina and Palermo.

With effect from 1 January 2016, the regulations contained in the D.L. n.35 of 15/03/2011 also applies to roads belonging to the network of national interest, identified by the legislative decree 29 October 1999, n. 461, and subsequent amendments, not included in the trans-European road network, whether, at that date, in the phase of planning, design, under construction or already open to traffic.

The inspection types of procedures are three:

1) PRELIMINARY INSPECTION, day and night, to understand the general problems and characteristics of the road section in relation to the entire network, morphology and land use. The road must be travelled at a speed appropriate to the geometric characteristics, and therefore contained in the design speed range, to evaluate the ways in which the road environment is perceived and interpreted by users. At this stage, the inspector fills in the first part of the check list form, i.e. the one in which, in addition to the references of the road section, the notes of a global nature, representative of the entire homogeneous road section, must be reported and focuses on the aspects that will be the subject of greater attention in the subsequent general inspection. A preliminary night inspection must be carried out in which potential further criticalities of the road section that had not emerged in the presence of natural lighting may be highlighted.

Figure 54 Italian TEN-T network

(source: https://www.stradeanas.it/it/anas-europa-la-rete-stradale-ten-t)

2) GENERAL INSPECTION, day and night, to examine in more detail the safety problems distributed throughout the road section. The road is travelled at low speed, therefore reduced compared to that of the preliminary inspection (about 80-60 km/h on type A and B roads and about 40-30 km/h on type C and F roads), compatibly with traffic conditions and any operational indications provided by the managing body for safety

reasons and in order to allow the inspector the time necessary to record the information contained in the inspection check list. The inspector at this stage, by the awareness, for that type of road, of the severity of the critical issues in absolute terms of the different parameters observed, and about the indicators, attributes a degree of adequacy/inadequacy to the road section in a way sufficiently objective. The opinions on the check list are inserted for variable length sections (e.g. 500 meters for motorways and main suburban roads, 200 meters for secondary and local rural roads). During the general inspection, in addition to viewing and collecting information relating to the road geometric-functional characteristics, all the singular points of the route are also observed, understood as intersections, accesses to service areas, other interferences important (tunnels, viaducts, etc.), for which specific punctual inspections will be conducted, using the relative punctual sheets. In conclusion, a general night inspection must be carried out, using the same daytime check list, in which any further critical issues not found during the daytime inspection regarding specific aspects (signs, street lighting, etc.) must be reported.

3) DETAILED INSPECTION, day and night-time, where appropriate, must be combined with other inspections to be able to examine safety problems located at specific sites where a considerable number of accidents in proportion to the flow of traffic, or in other sites that, although they have not yet recorded incidental phenomena, during the widespread inspection highlight critical aspects to be examined in detail.

The Competent Body carries out periodic road safety inspections with enough frequency to ensure adequate levels of safety for the road infrastructure subject to application of D.L. 213/2021, in any case, at least every five years.

During the road safety inspections, RSI team used data collected to fill the check list. Data about traffic volume and accident are provided by the Road manager.

As a priority, the Competent body, for the activity of road safety control on the projects, makes use of internal personnel, included in the list referred to in Article 4, c.7 of Legislative Decree no. 35/11. In the absence or unavailability of internal professionalism, the Competent body provides to entrust the activity of control over projects to "personnel not belonging to the Competent Body", according to the indications identified in art. 4, c.7.

For each project, the Competent body identifies a single controller or several controllers depending on the importance, complexity, size and specificity of the project and, consequently, the burdensomeness and peculiarities of the audits. It is possible to use, in the case of identification of a single inspector, collaborators for the performance of support activities for inspection functions, remaining in any case in the hands of the inspector the full responsibility for the activity.

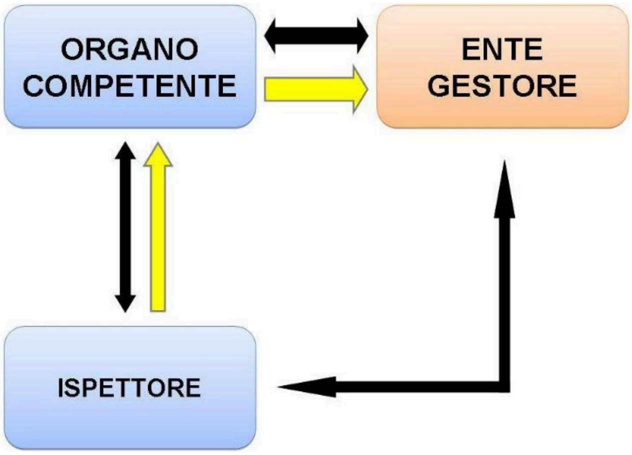

Figure 55 Functional relationships between inspection actors

The inspection should be made in day-nighttime condition. No indications have been done for day of week or weather condition.

During the inspections, photographic surveys and video footage can be carried out, which will be of assistance, during the preparation of the final report, as evidence of the annotations that the inspector records on the inspection checklist. To facilitate the management of all the information collected, the georeferencing of the data must be envisaged, with the support of the managing body, and therefore it would be desirable to carry out surveys and measurements, using a special vehicle equipped with adequate technological systems (localization system with module GPS, digital camcorders, computers capable of recording and processing the detected images).

The check-list depends on four elements:
- Type of project: new or existing infrastructure;
- Level of inspection: preliminary, general, detailed, for road work.
- Area: rural or urban;
- Type of road: single or double carriageway.

The check list includes the following elements:
- Traffic (suitability of the section with respect to traffic volumes; type of traffic);
- Surrounding landscape
- Speed;
- Plano-altimetric characteristics of the road;
- Road section;
- Road safety restrain;
- Road marking and signs;
- Accesses;
- Lighting.

In the check list it is required to indicate one for each micro-item synthetic quantitative assessment of the risk of danger by filling with a value, from 1 to 3, the related field. This value represents both the recurrence (frequency) and the severity level of the parameter per base unit of treats, and will take on the following meanings (the value 0 will indicate the undetectable quantity):

- 1: minimal - moderate risk
- 2: moderate – high risk
- 3: high – very high risk

The hazard assessment depends on Inspector's subjective assessment.
The activity of the inspector/s is concretized and formalized in the control reports which contain a list of recommendations of solving problem, that is transmitted to the Competent Body.
The final report must be divided into:

- prescriptions: solutions to serious deficiencies related to non-compliance with primary design and management standards, which must be adopted and implemented;
- recommendations: solutions that contribute effectively to the improvement of safety;
- indications: suggestions that are easy to implement by the managing body.

The inspection report must be delivered to the competence body, dated and signed by the person in charge of the inspection, within the deadline indicated in the assignment of the assignment and must contain:

- information relating to inspections (dates of inspections) and associated fiches;
- the identification of requirements/recommendations/indications in order to eliminate or mitigate potential hazard factors, with an explanation of the type of benefits achievable through their implementation (e.g. reduction in the number of accidents of a particular type, reduction of the severity of accidents, reduction of traffic volumes of conflicting currents, etc.);
- any photographic documentation ;
- a summary, also in tabular form, of the problems and their solutions, including alternative ones, divided into prescriptions, recommendations and indications.

The following table, by way of example, shows a series of problems and criticalities, both in the extra-urban and urban areas, with the relative possible solutions, and which must be specifically indicated in the inspection report with reference to the location of the criticality found.

The Competent body, having taken the indications from the inspector, after sharing and relative assumption of responsibility, imposes them on the managing body.

Table 3 Example summary of solutions to critical issues found in inspections

	PROBLEM	***PRESCRIPTION***	***RECOMMENDATION***	***INDICATION***
1	*sign not visible at night*		*reconstruction and adaptation of signs*	
2	*intersection immediately after a curve*	*speed reduction*	*adaptation of warning signs*	
3	*narrowing of the track due to reduced overpass light*	*speed reduction*	*overpass makeover*	
4	*incorrect positioning pedestrian crossing with respect to bus stop*		*moving pedestrian crossing and/or moving bus stop*	
5	*inadequate channeling branch access intersection*			*elimination of the parking for the insertion of the lane for the right turn*

4.6.2 CHECKLIST

The checklists have been structured by providing a series of elements to be observed continuously along the road section to be inspected and distinguished according to the following hierarchical logic:

- macro item;
- item;
- parameter;
- indicator.

The macro-voice and voice are the elements that remain constant, within the same urban or extra-urban environment, while the parameters are variable depending on the type of road.
The first part of the checklist contains partially fillable data before the start of the preliminary inspection (name, number and type of road, length of the road section to be inspected, direction of travel of the section, GPS coordinates of start and end of section, date, time, inspector name, etc.) and other data to be filled in during the preliminary inspection regarding the global attributes of the homogeneous section.

ROAD SECTION			BEGINNING	END
NAME AND NUMBER OF ROAD	A10	PROGRESSIVE KM AMN	35.531	55.531
ROAD TYPE (art. 2 of the Highway Code)	A-Highway	SITE/INTERSECTION	Sant'Eusebio	Priscilla
LENGTH SECTION (km)	20	GPS COORDINATES	41.87194-12.56738	41.87194-12.56738

DAYTIME AND NIGHT TIME INSPECTION	DIRECTION RIGHT	DIRECTION LEFT	DATE	SCHEDULE BEGINNING	SCHEDULE END	IDENTIFICATION INSPECTION
	•		08/05/2019	07:30	19:30	
INSPECTOR / SHEET	CODE	NAME ING.				CODE SHEET
	036	JOHN MASTROGIACOMO				IG-A10-AND-DX (34.715-54.715) 2019-046-1

Figure 56 General information

The part of the sheet relating to the general inspection is structured for the observation of the variable elements in a continuous way along the development of the road axis that must be evaluated by the inspector every 500 meters, through the judgment of severity for each indicator, which can be graphed, as shown below by way of example, with a different coloring for the minimal - moderate risk average judgment (green), moderate – high risk judgment (yellow) and high – very high risk judgment (red).

For the item “<u>TRAFFIC</u>” two parameters are analyzed:

1) Parameter: VOLUME
   Cross section adequacy: based on the expected traffic volumes, based on the data provided by the competence body, for the day and time of the inspection, the inspector finds any deviation and above all the insufficiency of the cross section;
2) parameter: TYPE
   Presence of particular components: the possible presence of particular traffic components (e.g. percentage of commercial vehicles)

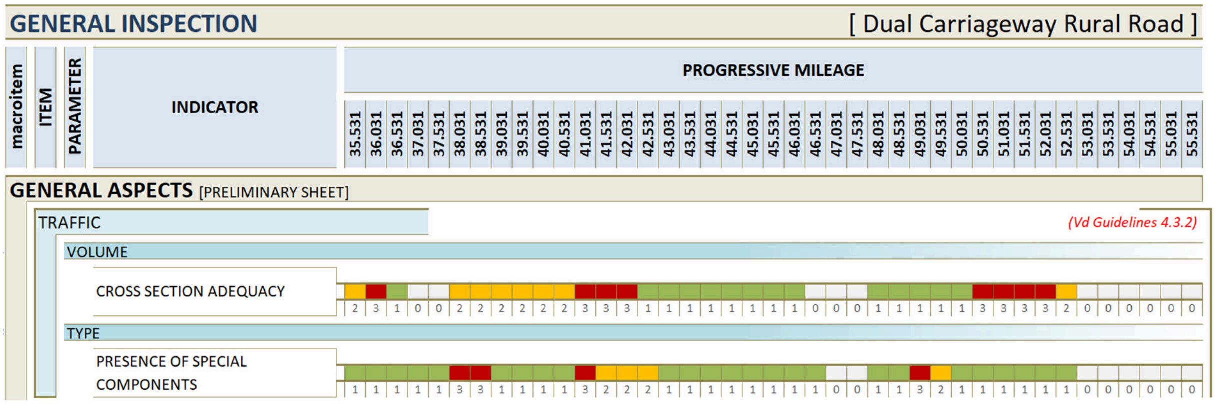

Figure 57 General aspect - Traffic

For the item "<u>SURROUNDING LANDSCAPE</u>" three parameters are analyzed:

1) Parameter: RELEVANCE BANDS
   presence of obstacles or hazard, presence of service roads: the presence, within the band of relevance, of functional elements or not to the road, which may constitute an obstacle or danger in the event of a vehicle spillage, but above all reduce visibility, as well as the presence of a service road and in particular if bidirectional with consequent potential glare phenomena
2) Parameter: BANDS OF RESPECT
   presence of buildings, trees, etc.: their presence in buffer zones must be signaled in particular when it reduces visibility both when cornering and at junctions
3) Parameter: BANDS OF RESPECT AND BEYOND
   distraction driving for particular contexts, presence of adjacent roads, other infrastructures, advertising: the presence of natural elements of the landscape and above all artificial that can be a reason for distraction in driving, such as advertising in sight from the road, adjacent roads, the presence of isolated or contiguous commercial and/or industrial buildings with the relative operating signs

SURROUNDING LANDSCAPE (Vd Guidelines 4.3.2)

RELEVANCE BANDS																																									
PRESENCE OF OBSTACLES OR HAZARD, THE PRESENCE OF SERVICE ROADS	2	3	1	0	0	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	3	3	3	3	2	0	0	0	0	0	0
BANDS OF RESPECT																																									
PRESENCE OF BUILDINGS, TREES, ETC.	1	1	1	1	1	3	3	1	1	1	1	3	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1	3	2	1	1	1	1	1	1	0	0	0	0	0	0
BANDS OF RESPECT AND BEYOND																																									
DISTRACTION GUIDE FOR SPECIAL CONTEXT, THE PRESENCE OF ADJACENT ROAD, OTHER INFRASTRUCTURE, ADVERTISING	2	3	1	0	0	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	3	3	3	3	2	0	0	0	0	0	0

Figure 58 General aspect – Surrounding landscape

For the item "SPEED" the following parameters are reported:

1) parameter: DESIGN SPEED - MAXIMUM SPEED ALLOWED
   excessive difference: from the comparison between the design speed and the maximum allowable speed, imposed on the homogeneous section through the vertical signs, the criticality of an excessive difference both positive and negative could emerge. This results in a loss of credibility of the signs, in behaviors only formally illegal, but also and above all in insecure driving behaviors.
2) parameter: MAXIMUM SPEED ALLOWED - OPERATING SPEED
   excessive difference: if the comparison between the maximum permissible speed and the operating speed, i.e. the travel speed under normal conditions of runoff, results in an excessive difference, this should be noted by the inspector as a strong criticality.

SPEED (Vd Guidelines 4.3.2)

SPEED DATA (IF AVAILABLE)														
DESIGN SPEED	60	130	130	130	130	130	20	130	130	130	130		130	130
MAXIMUM SPEED	110	130	130	130	130	130	130	130	150	130	130	130	130	130
OPERATING SPEED	200	130	20	150	300	30		130	150	130	130	130	130	130
DIFFERENCE DES / MAX (+/-)	50	0	0	0	0	0	110	0	20	0	0		0	0
	3	0	0	0	0	0	3	0	2	0	0	0	0	0
DIFFERENCE MAX / OPER (+/-)	90	0	-110	20	170	-100		0	0	0	0	0	0	0
	3	0	3	2	3	3	0	0	0	0	0	0	0	0

Figure 59 General aspect – Speed

For the item “GEOMETRY” the critical issue about planimetric and altimetric design is detected, in terms of incorrected visibility and loss of track. With reference to the provisions of Italian guidelines about the road project, the coordination between the planimetric and altimetric elements for the entire route must be verified so that a correct perspective vision is guaranteed and a loss of track is not possible.

GEOMETRY

PLANIMETRIC AND ALTIMETRIC DESIGN																																									
CRITICAL ISSUES	1	1	1	1	1	3	3	1	1	1	1	3	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1	3	2	1	1	1	1	1	1	0	0	0	0	0	0

Figure 60 General aspect – Geometry

For the item “PLATFORM, ROADSIDE AND RELEVANCE BANDS” the following parameters related to platform are analysed:

1) Right shoulder
   Width suitable or absence
   Reduction in correspondence of bridge/tunnel
2) Emergency lane
   Width suitable or absence
3) Lane/Overtaking lane
   Width suitable
   Excess width
4) Right shoulder
   Width suitable or absence

PLATFORM, ROADSIDE AND RELEVANCE BANDS																																									
RIGHT SHOULDER																																									
WIDTH SUITABLE OR ABSENCE	2	3	1	0	0	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	3	3	3	3	2	0	0	0	0	0	0
REDUCTION IN CORRESPONDENCE OF BRIDGE/TUNNEL	1	1	1	1	1	3	3	1	1	1	1	3	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1	3	2	1	1	1	1	1	1	0	0	0	0	0	0
EMERGENCY LANE																																									
WIDTH SUITABLE OR ABSENCE	2	3	1	0	0	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	3	3	3	3	2	0	0	0	0	0	0
TRAVEL/OVERTAKING LANE																																									
WIDTH SUITABLE	1	1	1	1	1	3	3	1	1	1	1	3	2	2	2	1	1	1	1	1	1	1	1	0	0	1	1	3	2	1	1	1	1	1	1	0	0	0	0	0	0
EXCESS WIDTH	2	3	1	0	0	2	2	2	2	2	2	3	3	3	1	1	1	1	1	1	1	1	0	0	0	1	1	1	1	1	3	3	3	3	2	0	0	0	0	0	0
LEFT SHOULDER																																									
WIDTH SUITABLE OR ABSENCE	2	3	1	0	0	1	1	2	2	2	2	2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	1	3	3	2	1	1	1	1	1	1	1	1

Figure 61 Platform judgement

For the item “PLATFORM, ROADSIDE AND RELEVANCE BANDS” the following parameters related to roadside and relevance bands are analysed:

1) Median
   Adequacy
   Effects on visibility
2) Road Safety barrier
   Absence
   Adequacy type
   Adequacy transitions and terminals
   Adequacy median gap
   Correctness of installation conditions
   Presence of obstacles not protected
3) Embankments
   Efficient building maintenance
   Protection hazards
4) Drainage
   Maintenance
5) Fencing
   Maintenance

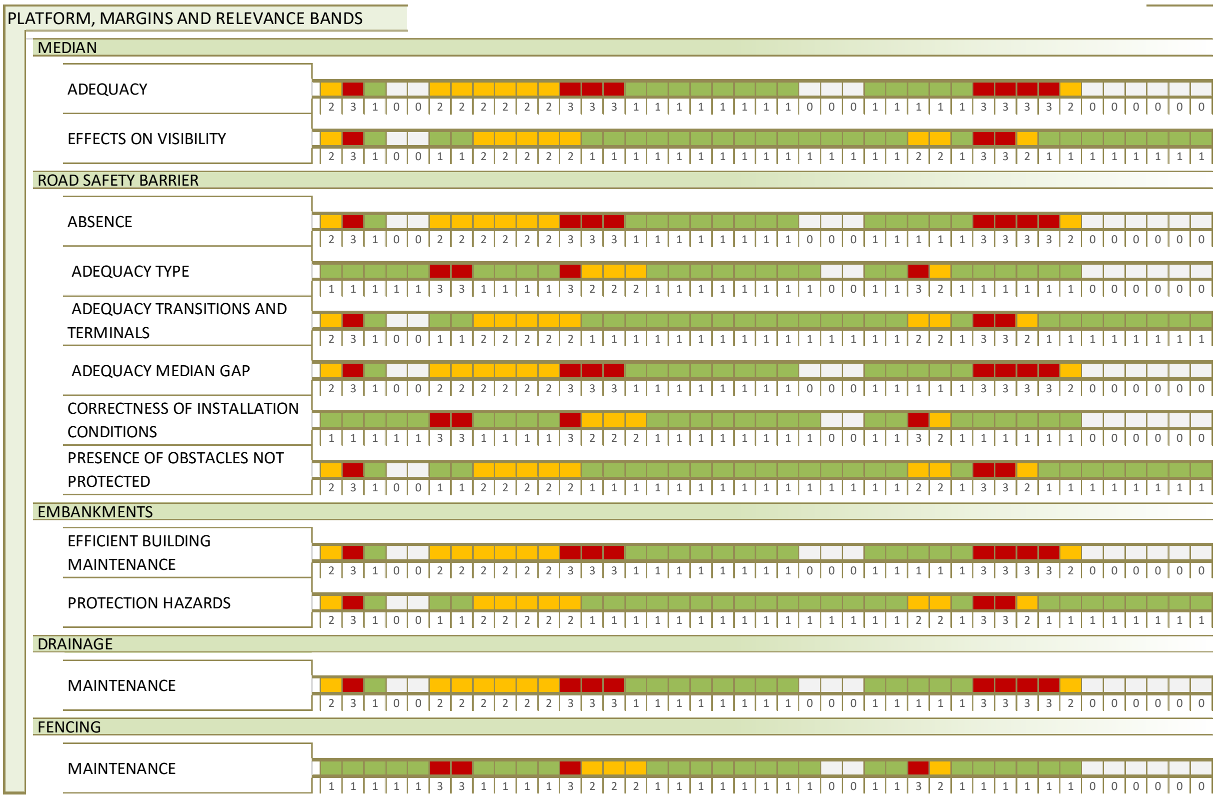

Figure 62 Roadside and relevance bands judgement

The macro item “SIGN” is divided in “ROAD MARKING”, “SIGNS”, “TRAFFIC LIGHT SIGNALS” and “ADDITIONAL SIGNALS”.

For the item “ROAD MARKING”, the visibility of edge and centre line in daytime and night-time must be analysed.

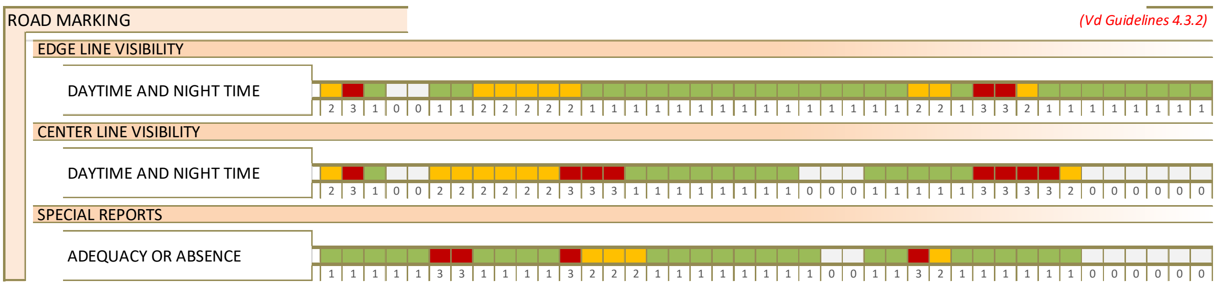

Figure 63 Road marking judgement

For the item “SIGN”, the warning signs, the regulation signs and indication sign are evaluated in terms of visibility, legibility and intelligibility. Visibility is about the capability of a sign being seen and read by the driver; the legibility is linked to being easy to read, or the degree to which something is easy to read; the intelligibility is linked to how the sign quality is possible to understand.

For the speed limit, a detailed analysis is requested in terms of positioning accuracy or absence, the adequacy with respect to the design and the operating speed.

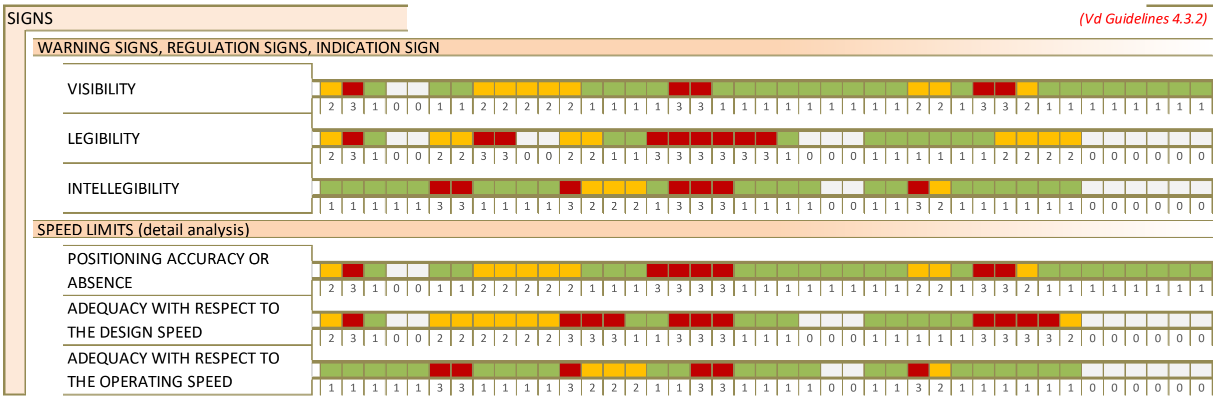

Figure 64 Sign judgement

For the item “ADDITIONAL SIGNALS” the adequacy or absence of chevrons and roadside guideposts is analysed.

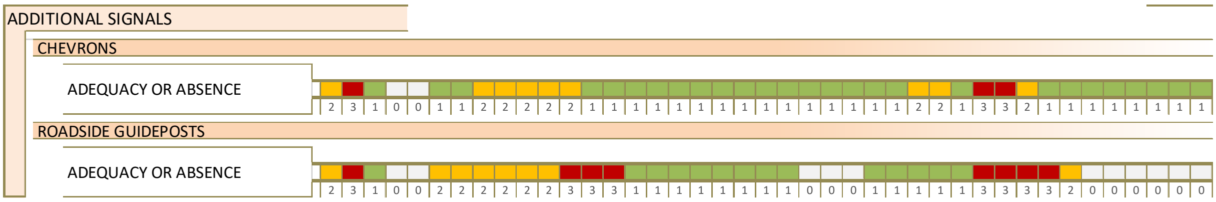

Figure 65 Additional signals judgement

For the item “ACCESS AND ROAD BRANCH”, it is necessary to give a judgment to the adequacy of the coordination, of the visibility and of the location of service and parking area.

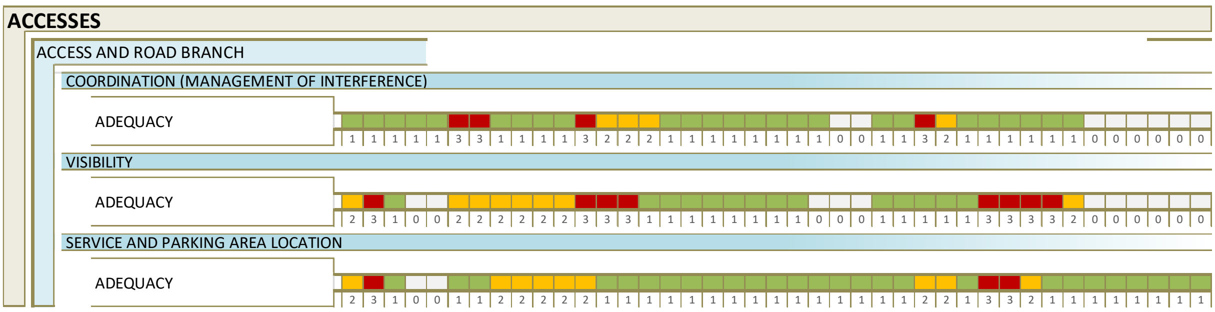

Figure 66 Accesses judgement

The macro item “ROAD PAVEMENT” is divided into two different item “SURFACE” and “JOINT”. For the first, in the checklist it is important to give a judgment to the presence of unevenness, the maintenance of the drainage and the adequacy of the friction. For the joint, the checklists are referred to the adequacy in terms of discontinuity (longitudinal and transversal).

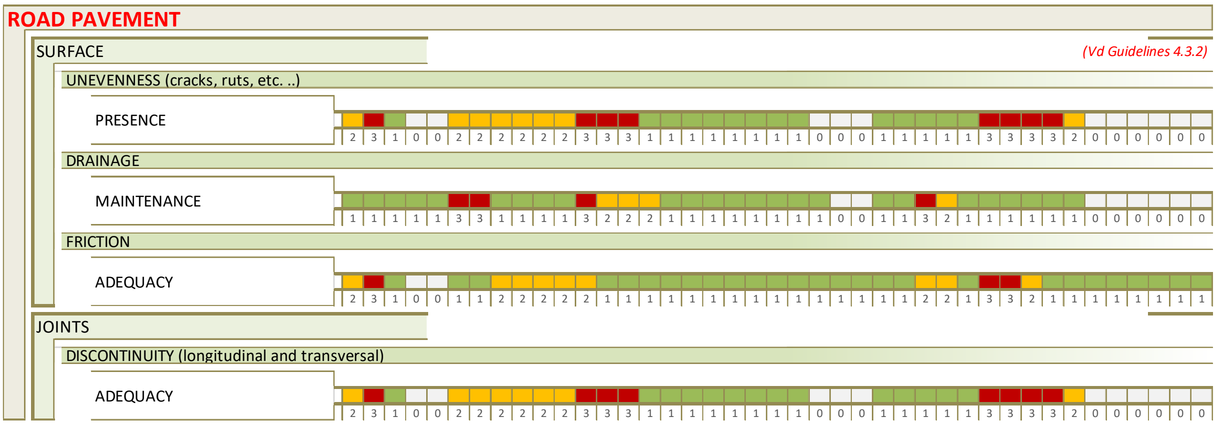

Figure 67 Road pavement judgement

The macro item “LIGHTING” is divided for singular points (like junctions, acceleration and deceleration lanes and entry/exit from toll station) and for tunnels (entrance and entire development). For each item the parameters analysed are “ADEQUACY OR ABSENCE” and “MAINTENANCE”.

Figure 68 Lighting judgement

4.7 INTERSECTIONS/ROUNDABOUTS

4.7.1 Lecturing guidelines for Intersections/roundabouts

Teaching Road Safety Inspection (RSI) at intersections is crucial for developing the next generation of traffic engineers and urban planners. The essence is to equip the students with a balanced blend of theoretical knowledge and practical skills, emphasizing real-world application to prepare them for the professional world.

The theoretical sessions are pivotal, serving as the bedrock of the learning process. Here, professors should utilize premade multimedia presentations to elucidate the fundamental concepts of road safety inspections. The topics should encompass road geometry, the dynamics of traffic flow, the consideration for vulnerable road users, and the intricacies of signal timings. By addressing these, students can grasp the theoretical foundations needed to analyse various road safety scenarios effectively.

Implementing case studies is also essential, and the Rovinj example can serve as a practical illustration of road safety inspection in a real-world context. This example allows students to walk through the meticulous process of conducting a road safety inspection, aiding them in identifying potential safety issues and devising feasible recommendations. This, coupled with group discussions about specific intersections or diverse road safety situations, fosters an environment where students can delve into a comprehensive understanding of the subject matter.

Following the theoretical sessions, practical application of the learned concepts is paramount. This can be executed by simulating field inspections where students, using the Rovinj example, can scrutinize the data, discern safety concerns, and contrive appropriate solutions. Encouraging students to utilize the provided tools and data to assess various road safety elements such as sight distances, pedestrian facilities, and traffic signal timings ensures the transference of theoretical knowledge to practical applications.

Interactive learning activities are integral components of the learning process. Incorporating quizzes regularly will assist in gauging student understanding, covering both theoretical knowledge and application of practical examples. Moreover, orchestrating group projects and providing diverse intersection scenarios for assessment enable students to refine their analytical skills. The Rovinj case can serve as a benchmark, guiding the students in their evaluations and subsequent reporting.

Assessment and constructive feedback are pivotal for student development. After the completion of simulated field inspections, students should be tasked with preparing detailed reports. Professors should meticulously assess these, focusing on their observational, analytical, and evaluative skills. Offering feedback sessions, wherein the students receive constructive criticism, plays a crucial role in highlighting areas necessitating improvement and reinforcing areas of strength.

Promoting continuous learning is essential in ensuring students stay abreast of the latest developments and best practices in road safety. Professors should continually share an array of resources such as articles, research papers, and case studies pertinent to road safety. Encouraging active participation in discussions, online forums, and webinars allows students to acquire diverse perspectives and expand their knowledge base.

4.7.2 The inspection process

A road safety inspection (RSI) involves the systematic assessment of an existing road to identify safety issues.

Intersections and roundabouts represent crucial points in a traffic network. Their complexity arises from the intertwining pathways of different traffic streams. Consequently, safety at these junctures is paramount. The risk of collisions increases in these zones due to the varied and potentially conflicting movements. Ensuring a clear understanding and consistent management of these areas not only decreases collision risks but also enhances traffic flow efficiency.

Procedure for Setting Up the Inspection:
1) **Define Objective:** Clearly state the reason and scope of the inspection.
2) **Assemble Team:** Gather a multidisciplinary team including traffic engineers, safety experts, and local authorities.
3) **Gather Preliminary Data:** Acquire initial data on the intersection/roundabout, including past reports, traffic counts, and historical accident data.
4) Good Examples:
   - An intersection assessment initiated after community feedback on safety concerns.
   - A team that consists of traffic engineers, local community representatives, and safety experts.
   - A clear mandate to improve pedestrian safety at a busy intersection, backed by municipal support.
5) Bad Examples
   - Undertaking a roundabout assessment with no clear objectives or reasons.
   - A team that has no road safety experts with no on-ground experience.
   - An inspection initiated merely as a formality, with no real intent to implement changes.

4.8 Preliminary Steps

Before diving into the specifics of infrastructure checks, a solid foundation of understanding the existing conditions is essential. Comprehensive data collection provides a backdrop against which anomalies or issues can be detected. It's not just about identifying problems; it's about recognizing patterns that contribute to them. Site familiarization, on the other hand, adds a qualitative layer to the quantitative data, giving inspectors an intuitive sense of the site dynamics. This holistic approach of combining hard data with on-ground observations creates a comprehensive picture of the prevailing conditions.

1) Procedure for Preliminary Analysis:

a) Data Collection:
   - Obtain accident reports from the local police.
   - Source traffic count data from transportation agencies.

- Retrieve past safety reports, if available.

b) Site Familiarization:

- Schedule visits during various times (peak/off-peak, different weather conditions).
- Document initial observations using photographs and notes.
- Engage with locals for insights and typical concerns.

2) Good Examples:

- Incorporating accident reports, eyewitness accounts, and traffic camera footage for a comprehensive data collection.
- Conducting site visits at varying times including school rush hours, weekends, and late nights.
- Engaging with school representatives near an intersection to understand children's crossing patterns.

3) Bad Examples:

- Only considering data from the last two months for an intersection that's been in existence for decades.
- Visiting the site just once on a quiet weekday morning and assuming it represents typical conditions.
- Ignoring feedback from regular users of the intersection, like nearby shopkeepers.

4.9 Infrastructure checks of intersections and roundabouts

The core of any road safety inspection lies in evaluating the physical infrastructure. Road users—whether drivers, pedestrians, or cyclists—interact directly with this infrastructure. Inadequate or deteriorating infrastructure not only poses direct hazards (like a pothole causing a vehicle to lose control) but can also introduce confusion or misjudgement in decision-making. For instance, faded road markings might lead to lane indiscipline, and poor lighting can obscure pedestrian movements. A thorough assessment ensures that the built environment actively supports and guides safe road user behaviours.

1) Elements which need to be checked, and the guidelines, are as follows:

a) Sight Distance:

- Measure the available sight distance using appropriate tools.
- Compare against standard requirements.

b) Road Markings & Signs:

- Document the state of existing road markings.
- Check the visibility and condition of signs.

c) Road Surface:

- Inspect for irregularities like potholes, cracks, and rutting.
- Assess water drainage effectiveness.

d) Lighting:

- Check the operational status of each light.
- Measure illumination levels and ensure they meet required standards.

e) Pedestrian & Cyclist Facilities:

- Walk the entire length of pedestrian paths, noting obstructions or discontinuities.
- Ride or walk along cycle paths, ensuring they're safe and clear.

f) Traffic Signals & Control:
- Verify the operational status of all signals.
- Ensure synchronization, where applicable.

g) Geometry & Layout:
- Measure the radius of curves.
- Check the width and alignment of lanes.

h) Traffic Islands & Medians:
- Document their size and condition.
- Check for and note any visible damage.

i) Barriers & Guardrails:
- Inspect their condition, alignment, and anchoring.
- Ensure ends are treated or protected.

2) Good Examples:
- A roundabout where vegetation is regularly trimmed to maintain clear sightlines.
- Clear and reflective road markings which are repainted biannually.
- Adaptive lighting that increases brightness during peak hours or low visibility conditions.

3) Bad Examples:
- Overgrown trees at an intersection's corner, obscuring the view of oncoming traffic.
- Faded pedestrian crossings that haven't been repainted for years.
- A roundabout with lights that have been malfunctioning for months.

4.10 Vulnerable Road Users checks of intersections and roundabouts

While motorized vehicles can pose significant threats in collisions, it's the non-motorized users—pedestrians and cyclists—who are most vulnerable. Unlike vehicle occupants, these users lack a protective shell, making them more susceptible to severe injuries in accidents. Moreover, their movement patterns and needs differ significantly from those of vehicles. Addressing their safety is not just an ethical imperative but also supports broader urban goals of promoting sustainable and active transportation. An infrastructure designed with vulnerable road users in mind is typically safer for all users.

1) Procedure for Assessing Vulnerable User Safety:
- **Observation:** Spend time specifically observing pedestrian and cyclist behavior.
- **Facilities Check:** Inspect pedestrian crossings, cyclist lanes, and refuge areas.
- **Engage:** Discuss with pedestrians and cyclists about their perceived safety concerns.

2) Good Examples:
- A pedestrian crossing with a refuge island in the middle, ensuring safety during multi-stage crossing.
- Tactile paving leading up to the pedestrian crossing, aiding visually impaired individuals.
- A clearly marked bicycle lane with periodic safety barriers, separating cyclists from vehicular traffic.

3) Bad Examples:
- Crossings placed at high-speed sections of the road without any speed-calming measures.
- Lack of any shade or seating for elderly pedestrians at wide intersections.

- Bicycle lanes that suddenly merge with main traffic, without any warning signs.

4.11 Post-Inspection checks of intersections and roundabouts

The post-inspection phase is where insights turn into action. A meticulous report is more than just a record; it serves as a blueprint for remedial measures. Engaging stakeholders is equally critical. First, it ensures transparency and public trust in the road management process. Second, stakeholders, especially local residents, often have unique insights and feedback that can enhance the effectiveness of proposed solutions. Lastly, without monitoring and review, there's no feedback loop to gauge the effectiveness of interventions, making it essential for iterative improvements.

1) Procedure for Post-Inspection Activities:

a) Report Compilation:

- Organize findings by priority.
- Incorporate photographs and diagrams.
- Draft actionable recommendations.

b) Stakeholder Engagement:

- Organize feedback sessions with local authorities and residents.
- Present findings and gather feedback.

c) Monitoring & Review:

- Set up periodic re-inspections.
- Install monitoring equipment, if possible, to gather real-time data.
- Analyse data periodically to gauge the effectiveness of implemented measures.

2) Good Examples:

- A detailed report that uses both quantitative data and qualitative observations, supported by photographs.
- Organizing a town hall meeting where the findings are discussed, and community feedback is actively sought.
- Implementing short-term measures immediately, like repainting crossings, while planning for long-term changes.

3) Bad Examples:

- A brief report with generic statements like "improve safety" without specific actions or justifications.
- Sending a summary of findings via mail to stakeholders without any follow-up or engagement.
- No plan in place for reviewing the effectiveness of implemented changes.

4.12 Concluding the inspection

Wrapping up a road safety inspection isn't merely an end; it's the beginning of a continuous process. The overarching goal is dynamic safety, adapting to changing conditions, traffic patterns, and urban needs. Theories and practices in road safety evolve, as do the challenges posed by growing urban areas and changing transportation modalities. Concluding an inspection provides an opportunity to reflect, learn, and set the stage for future endeavors in the realm of road safety.

1) Procedure for Concluding the Inspection:
- **Summarize Key Findings:** Highlight the most pressing issues and commendable areas.
- **Propose Next Steps:** Suggest immediate, medium-term, and long-term interventions.
- **Document Lessons Learned:** For internal use, note what went well and areas for improvement for future inspections.

2) Good Examples:
- A summary that highlights both the critical issues and the strengths of the current setup.
- Recommendations grouped by immediacy and impact, helping prioritize actions.
- A commitment to re-evaluate the site after a year with a clear date set.

3) Bad Examples:
- A vague conclusion without any clear takeaways or next steps.
- Merely listing problems without suggesting potential solutions.
- A conclusion that doesn't consider feedback or suggestions from stakeholders during the inspection process.

4.13 Complete checklist for roundabouts and intersections RSI procedure

In the check list it is required to indicate quantitative assessment of the risk of danger by filling with a value, from 1 to 3, the related field. This value represents both the recurrence (frequency) and the severity level of the parameter per base unit of treats, and will take on the following meanings (the value 0 will indicate the undetectable quantity):
- 1: minimal - moderate risk
- 2: moderate – high risk
- 3: high – very high risk

The hazard assessment depends on the Inspector's subjective assessment.
Examples of elements per level or risk are:

1) Minimal - Moderate Risk
- Wear and tear on roads showing early signs of degradation but not causing immediate hazards.
- Faded lane markings that are still somewhat visible.
- Slightly misaligned signage or those with minimal wear.
- Street lighting that provides adequate visibility during low-light conditions but might be less effective in adverse weather.
- Vegetation that's starting to obstruct views but hasn't completely blocked sightlines.
- Areas with some pedestrian activity but equipped with proper crosswalks and signals.
- Bike lanes that are marked but might not be separated from the main roadway.
- School zones that have some safety measures in place but could benefit from enhancements like speed bumps or flashing lights.

2) Moderate – High Risk
- Potholes or cracks that can impact vehicle stability but aren't gaping.
- Lane markings that have largely faded, leading to possible confusion.
- Signage showing signs of significant wear, making them harder to decipher.
- Inadequate street lighting that results in visibility issues during evening hours or in bad weather.
- Vegetation that significantly obstructs views at intersections or roundabouts.

- Busy pedestrian areas lacking proper crosswalks or signal systems.
- Bike lanes that are frequently blocked by parked cars or other obstructions.
- School zones with high child pedestrian activity but lacking necessary safety measures.
- Public transportation stops located near high-speed areas without sufficient safety barriers.

3) High – Very High Risk

- Major road damages, such as large potholes or sections of missing pavement, which can cause serious accidents.
- Virtually non-existent or entirely faded lane markings.
- Signage that's either missing or so degraded that it's unreadable.
- Complete absence of street lighting in areas that require them, resulting in pitch-dark conditions during the night.
- Overgrown vegetation completely blocking views, especially around intersections, merges, or curves.
- Extremely busy intersections with heavy pedestrian traffic but no safety measures in place.
- Absence of bike lanes in areas with a high concentration of cyclists.
- School zones with no safety measures, situated on or near high-speed roads.
- Elderly or disabled individuals' facilities near busy streets without any safety buffers.

Table 4 Checklist for the entire Intersection/roundabout RSI procedure

Sections	**Checklist Items**	***Level or risk***	**Checked**
Pre-inspection			
	Define the objective	n/a	[ ]
	Assemble a multidisciplinary team	n/a	[ ]
	Gather preliminary data	n/a	[ ]
Preliminary Steps			
	Obtain accident reports	n/a	[ ]
	Source traffic count data	n/a	[ ]
	Retrieve past safety reports	n/a	[ ]
	Schedule visits (peak/off-peak times)	n/a	[ ]
	Document initial observations	n/a	[ ]
	Engage with local community	n/a	[ ]

Sections	Checklist Items	Level or risk	Checked
Infrastructure Checks	Measure and compare sight distance	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect road markings	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Check road signs' visibility	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect road surface irregularities	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Assess water drainage efficiency	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect pedestrian & cyclist facilities	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Verify traffic signal operation	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Check intersection/roundabout geometry	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect traffic islands & medians	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Examine barriers & guardrails	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
Vulnerable Road Users	Observe pedestrian and cyclist behavior	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect pedestrian crossings	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Inspect cyclist lanes and refuge areas	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
	Obtain feedback from pedestrians & cyclists	1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	[ ]
Post-Inspection	Compile a report with findings	n/a	[ ]
	Incorporate photographs & diagrams	n/a	[ ]
	Organize a stakeholder feedback session	n/a	[ ]

Sections	Checklist Items	*Level or risk*	Checked
	List short-term & long-term measures	n/a	[ ]
	Set up a monitoring & review mechanism	n/a	[ ]

4.14 Composition of a Road Safety Inspection Report for Roundabouts and Intersections

In ensuring the utmost clarity and utility of a Road Safety Inspection Report, meticulous attention should be paid to its structure, details, and presentation of technical content. This chapter delineates the essential elements to be incorporated.

1) **Executive Summary**
- **Purpose of the Inspection:** Clearly state the reasons leading to the inspection, including any notable incidents or community feedback.
- **Key Findings:** A concise summary of the most critical observations and concerns.
- **Recommendations Overview:** A brief outline of the main suggestions derived from the inspection.

2) **Introduction**
- **Scope:** Describe the specific roundabouts and intersections under consideration, with geographical and jurisdictional information.
- **Team Composition:** Enumerate the roles and expertise of the inspection team members, emphasizing their qualifications in technical areas.
- **Data Sources:** List out preliminary datasets, traffic studies, and prior reports that provided a foundation for the inspection.

3) **Methodology**
- **Inspection Approach:** Elaborate on whether inspections were carried out during specific times, different weather conditions, and traffic scenarios.
- **Tools & Equipment:** Detail any special tools, software, or equipment used to gather data or measure specific parameters, e.g., lux meters for lighting or devices for distance measurements.
- **Engagement Strategy:** Describe the methodology of engaging with stakeholders, including local residents, regular users, and nearby establishments.

4) **Infrastructure Analysis**
- **Sight Distance:** Report the measured sight distances at various points of the roundabouts and intersections. Compare these to accepted standards or benchmarks.
- **Road Markings & Signs:** Detailed findings on the condition, visibility, and appropriateness of road markings and signs. Include specifics like dimensions, materials, and reflective qualities.
- **Surface Conditions:** Analyze the roundabout and intersection pavements. Highlight any concerns such as potholes, rutting, skid resistance, and surface material composition.
- **Drainage:** Report on the effectiveness of water drainage systems. Mention gradients, gutter placements, and any areas of water pooling.
- **Lighting:** Include measurements of illumination levels at different parts of the intersection or roundabout. Discuss uniformity, shadows, and potential glare.

- **Traffic Signal & Control Devices:** Analyze the status, placement, and synchronization of traffic signals. Evaluate the need for additional control mechanisms.
- **Geometry & Layout:** Offer an in-depth analysis of the geometric design, including lane widths, curvature radii, entry and exit angles, and any potential conflict points.
- **Islands, Medians, and Barriers:** Detail their size, placement, and condition. Emphasize their effectiveness in traffic management and pedestrian safety.

5) **Vulnerable Road User Analysis**

- **Pedestrian & Cyclist Movements:** Map and discuss the typical paths taken by pedestrians and cyclists. Highlight any potential conflict zones with vehicular traffic.
- **Facilities' Condition:** Report on the state of pedestrian crossings, refuge islands, and bicycle lanes. Evaluate their adequacy, placement, and visibility.
- **Feedback & Concerns:** Include insights gathered from vulnerable road users during the inspection phase.

6) **Technical Annexes**

- **Photographic Evidence:** Include clear, well-labeled photographs that support observations. Utilize before-after shots where applicable.
- **Data Sheets:** Attach detailed datasets used or gathered during the inspection, such as traffic counts, accident reports, or sight distance measurements.
- **Diagrams & Maps:** Provide detailed schematics or maps that give a spatial context to the findings. Highlight areas of concern.

7) **Risk analysis**

- **Categorized Proposals:** Structure recommendations based on urgency and impact. This can range from immediate actions to long-term infrastructural changes.
- **Final Summary:** Conclude with a synthesis of the key findings and reiterate the importance of swift action to mitigate identified risks.
- **Conduct safety analysis:** Use the following table to elaborate the categories, findings, risk level and recommendations.

Aspect (Category)	**Findings (Detailed Observations)**	**Risk Level (Based on Criteria)**	**Aspect (Category)**
Description of the specific element or category under inspection. e.g., Sight Distance, Road Markings, etc.	Detail the specific observations made during the inspection related to the aspect. What was observed? How does it deviate from the standard or expectation?	Based on the findings, classify the risk level using the provided criteria: 1: minimal - moderate risk 2: moderate – high risk 3: high – very high risk	Description of the specific element or category under inspection. e.g., Sight Distance, Road Markings, etc.

- **Aspect (Category):** Begin by categorizing the specific element or area of the infrastructure you're inspecting. This should provide a general idea about what the following details will pertain to. For example, 'Sight Distance' indicates you're focusing on visibility issues.
- **Findings (Detailed Observations):** In this column, you should provide detailed observations of the current state of the infrastructure in relation to the aspect. Describe

the current condition, noting any deviations from standards, and if possible, provide specific measurements or data to quantify the issue.

- **Risk Level (Based on Criteria):** Based on your findings, determine the risk level. This should be a judgment based on potential dangers, the volume of affected users, and the severity of the deviation from the standard. Use the provided risk criteria to classify the risk.
- **Recommendations (Actionable Steps):** In this section, propose potential solutions to address the issues observed. These can be both short-term fixes and long-term strategies. Be specific: for example, instead of saying "Improve lighting," you might suggest "Install LED streetlights at 50-meter intervals."

4.15 Example Road Safety Inspection Report for *Rovinj, Croatia*

Road Safety Inspection Report Location: Intersection of Istarska ul (East), Ul. Vijenac Brace Lorenzetto (North and South), and Ul. Giosue Carduccia (West), Rovinj, Croatia.

Figure 69 Scope of Inspection

1) Executive Summary

- **Purpose of the Inspection:** Due to raised concerns from Rovinj residents and recent traffic incident data, this inspection concentrated on the intersection of Istarska ul, Ul. Vijenac Brace Lorenzetto (both North and South), and Ul. Giosue Carduccia.
- **Key Findings:** The main challenges identified were deteriorated road markings on Istarska ul, limited visibility at certain points of the intersection, and problematic pedestrian crossing facilities.
- **Recommendations Overview:** Prioritized action includes the refreshing of road markings on Istarska ul, enhancements to improve intersection visibility, and pedestrian facilities overhaul.

2) **Scope**

- **Scope:** The intersection, central to the daily activities of both tourists and locals, connects key pathways in Rovinj. It plays a crucial role in ensuring the smooth flow of traffic and pedestrian safety.
- **Team Composition:** Anđelo Marunica and Leonid Ljubotina (road safety specialists), Irena Ivandić (spatial planner), and two field assistants, Klara Rusan and David Gruhonjić.
- **Data Sources:** Rovinj City Council's 2022 Traffic Report, Istria Regional Police accident reports, and feedback gathered from nearby businesses and residents.

3) **Methodology**

- **Inspection Approach:** Observations spanned four days, capturing various scenarios including weekday traffic, weekend congestion, morning hours, and late evenings.
- **Tools & Equipment:** Usage of advanced instruments like speed cameras, laser distance measurers, and drones to capture accurate data and imagery.
- **Engagement Strategy:** Informal interviews with local shopkeepers, residents, and tourists to collate firsthand experience. A temporary feedback box was also placed near the intersection.

4) **Infrastructure Analysis**

- **Sight Distance:** Due to parked vehicles and some street infrastructure, sight distance was notably limited at certain vantage points of the intersection.

Figure 70 Limited sight distance from W to E direction (for VRU users, namely Cyclists).

- **Road Markings & Signs:** Road markings on Istarska ul showed significant wear. Additionally, several directional signs around the intersection were either obscured or faded.

Figure 71. Faded centerline and no edgelines present on Istarska ul.

- **Surface Conditions:** Istarska ul exhibited minor surface inconsistencies, perhaps from frequent traffic and occasional heavy loads.

Figure 72 Surface inconsistencies noted on Istarska ul.

- **Drainage:** Notable water stagnation indication was observed post-rainfall on Ul. Vijenac Brace Lorenzetto, indicating drainage challenges.

Figure 73 Leaves on an incline indicating possible water stagnation on southern intersection end.

- **Lighting:** Some street lamps around the intersection, particularly near Ul. Giosue Carduccia, were non-standardised.

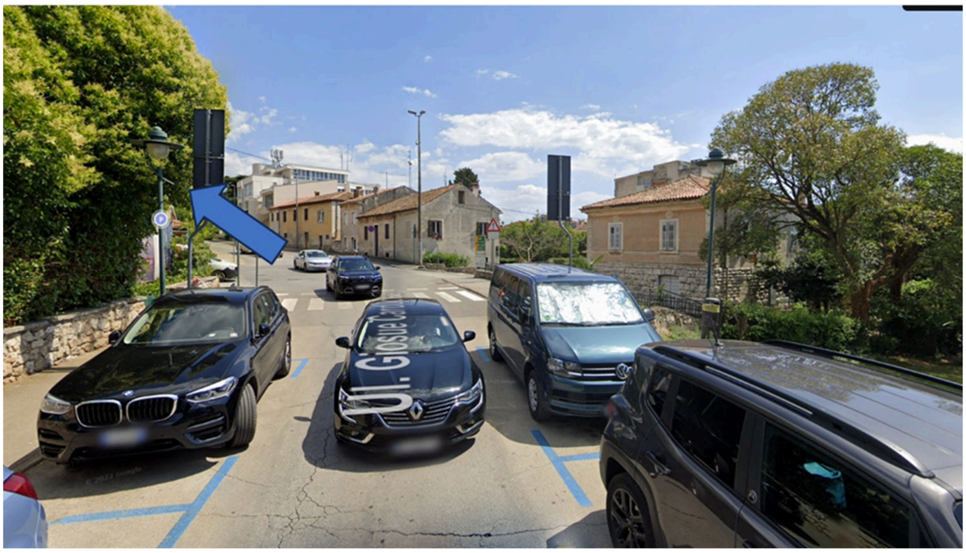

Figure 74. Non-standardised traffic lamp

5) Vulnerable Road User Analysis

- **Pedestrian & Cyclist Movements:** High pedestrian volume was noted, especially along Istarska ul and Ul. Giosue Carduccia. The existing crosswalks seemed faded, and there was a lack of clear cyclist pathways.

Figure 75 Faded pedestrian Crossing next to intersection

- **Feedback & Concerns:** Residents and visitors frequently mentioned the need for clearer pedestrian pathways and better-lit crosswalks for evening hours.

4.16 Risk analysis

The intersection of Istarska ul,uUl. Vijenac Brace Lorenzetto, and ul. Giosue Carduccia stands as a crucial juncture in Rovinj, facilitating movement of both residents and tourists. Addressing its challenges will not only improve the safety and efficiency of this vital intersection but also elevate the overall experience for everyone utilizing it. The combination of history, aesthetics, and modern-day requirements presents a unique challenge. Implementing the recommendations in this report will harmonize these elements, aligning with Rovinj's stature as a blend of historic charm and contemporary life. Risk analysis for the intersection is shown within the following table 5

Table 5 4.16 Risk analysis – Intersection of Istarska ul,uUl. Vijenac Brace Lorenzetto, and ul. Giosue Carduccia

Aspect	Findings	Risk Level	Recommendations
Sight Distance	Parked vehicles and street infrastructure have notably limited sight distance at various vantage points.	2: moderate – high risk	Implement parking restrictions at critical zones.Reevaluate street infrastructure placement.
Road Markings & Signs	Road markings on Istarska ul are worn. Directional signs are obscured or faded.	2: moderate – high risk	Repaint road markings on Istarska ul. Replace or refurbish faded signs.
Surface Conditions	Istarska ul shows minor surface inconsistencies from frequent traffic and heavy loads.	1: minimal - moderate risk	Schedule regular road maintenance. Investigate road reinforcement in areas with heavy loads.
Drainage	Water stagnation post-rainfall on Ul. Vijenac Brace Lorenzetto.	2: moderate – high risk	Survey area for drainage causes. Redesign or unblock existing drainage systems.
Lighting	Non-standardized street lamps near Ul. Giosue Carduccia.	1: minimal - moderate risk	Replace or retrofit non-standardized lamps. Add more light poles in dim areas.
Pedestrian & Cyclist Movements	High pedestrian traffic on Istarska ul and Ul. Giosue Carduccia. Faded crosswalks and unclear cyclist pathways.	3: high – very high risk	Repaint pedestrian crosswalks. Designate and mark cyclist lanes or shared paths.
Feedback & Concerns	Need for clearer pedestrian pathways and better-lit crosswalks during evening hours.	2: moderate – high risk	Engage with the community. Introduce LED illuminated pedestrian crossings or reflective markers.