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InfRO@D
EUROPEAN DIGITAL EDUCATION IN RIM

WP3 – Development of techniques for the implementation of the remote teaching and training process with the use of support tools

IO.5 Development of a methodology for conducting fieldwork classes with the use of communication tools

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1 ABOUT THE INFRO@D PROJECT

The COVID-19 pandemic has forced a departure from the current functioning of society in many aspects of the economy, travel, work and education, not excluding higher education. The necessity of remote education is one of the ways to maintain social distancing and protect our health and life.

A preliminary assessment of the situation at universities in European countries indicates that academic staff were not sufficiently prepared to conduct attractive and practical classes in a remote format.

The necessity to conduct classes remotely involves developing a dedicated didactic and training process project, considering the specific requirements of interdisciplinary engineering knowledge. Transferring this knowledge in remote education, due to its large scope, requires various didactic tools (lectures, fieldwork, design, practicals, laboratories, student assignments and assessment of the progress and knowledge of students and trainees).

The measurable expected final results are:

- Development of a remote learning methodology for Road Infrastructure Management (RIM) as a model solution to provide a basis for extending the methodology to include further aspects of civil engineering and transport.
- Developing an e-handbook for academic staff supporting the remote learning process.
- Development of model digital teaching and training materials dedicated to technical colleges and training for road management staff on RIM:
  - Road safety audit,
  - Roadside safety management,
  - Safety management of vulnerable road users,
  - Road pavement management.
- Developing an e-learning platform with access to project products.
- Appointment of a panel of experts in road infrastructure management.

The InfRO@D 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 RIM activities, including staff who conduct training in various RIM 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 RIM 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 a methodology for conducting fieldwork classes with the use of communication tools
- **Work package:** The task falls under WP3 – Development of techniques for the implementation of the remote teaching and training process with the use of support tools.
- **Target Groups:**
  Research and teaching staff from institutions involved in the project and other European institutions.

2 INTRODUCTION TO FIELDWORK LESSONS

2.1 Element of the learning system

Field activities should be an integral part of the Road Infrastructure Management curriculum. Fieldwork (field activities) plays a pivotal role in the education of future road infrastructure engineers and managers. It allows students and road authority staff to bridge the gap between theoretical knowledge gained in classrooms and the real-world challenges they will face in their future work. It is safe to say that there will not be a good engineer without a detailed knowledge of the issue in reality, i.e. in the field. Here are some additional points to emphasise its significance:

1) Practical Application: Fieldwork allows students, and road authority staff to apply what they have learned in the classroom directly. It offers hands-on experience in assessing, diagnosing, and managing road infrastructure, which is invaluable for their professional development.
2) Problem-Solving Skills: Field activities often involve unexpected challenges, which require students to think on their feet, problem-solve, and make decisions. These skills are vital in the dynamic field of road infrastructure management.
3) Collaborative Learning: Working in the field encourages collaboration among students, and road authority staff. They learn to work as a team, share responsibilities, and communicate effectively—a crucial skill set in the industry.
4) Real-World Challenges: Road infrastructure management involves numerous real-world challenges, from addressing safety concerns to optimising traffic flow, recognising hazards on different road infrastructure elements, etc. Fieldwork exposes students, and road authority staff to these challenges, allowing them to develop practical solutions.

The teacher also needs to be much better prepared for the field activities. They can expect to be asked problem questions that go beyond the topic under discussion. It should be noted that being together makes such contact much easier and shortens the teacher-student road authority staff distance, making it easier for them to ask questions.

2.2 COVID-19 restrictions

Movement restrictions due to the restrictions put in place during COVID-19 made the process of delivering classes in the field much more difficult or completely impossible. Consequently, the teachers of these classes had the choice of abandoning such classes altogether or using modern technology to deliver IT remotely. The absence of such classes in Road Infrastructure Management would have significantly reduced the quality of teaching and resulted in the non-fulfilment of an essential element in the teaching process. The present methodology will respond to the preparation of materials in the second way, i.e. using IT tools.

Unfortunately, such limitations will result in a much greater workload for the teacher who must prepare and carry out these activities.

2.3 Expected result

The developed methodology includes defining didactic scenarios enabling students to prepare and receive remote support for independent field research. The scope of the research involves identifying and assessing hazards and their sources in road traffic, diagnosing and evaluating road surface conditions, identifying damages, and collecting input data in the form of section characteristics and geometry.

The discussion on effective teaching methods emphasised the importance of creating clear and practical guides. These guides may include multimedia elements, such as videos and step-by-step tutorials that help learners understand by example. Additionally, teachers should provide instruction on how to create video materials that demonstrate the correct performance of field research. Modern technologies, support tools, and cloud collaboration tools can also help students communicate effectively and receive remote assistance in teacher assistance classes. Additionally, photo and video coverage can be used to present field research results remotely.

2.4 Types of field activities

Field activities can vary based on specific needs, tasks, or duration. They may also be restricted for safety reasons. In Road Infrastructure Management, such issues frequently arise. For example, there can be a lot of risk in conducting classes at motorway junctions, so a method needs to be devised to deliver them safely and effectively. So, the teacher has to anticipate things that sometimes seem irrational.

Field activities related to Road Infrastructure Management issues can be divided, by type of activity, into:

- filed lectures,
- collecting input data in the form of section characteristics and geometry,
- identifying and assessing hazards and their sources in road traffic, vulnerable users,
- diagnosing and assessing road surface conditions,

Transferring field lectures to the virtual classroom is straightforward, but preparing teaching materials for other classes is more time-consuming. Field activities related to Road Infrastructure Management can be categorised based on their duration into the following:

- Single-day classes,
- Multi-day classes.

One-day classes are short, typically lasting no more than 8 hours. They may take place throughout the academic year on the premises of the university, in the city where the university is located. Attention should only be paid to the weather outside, which may make it impossible to hold them (e.g. heavy snow, rain). Multi-day classes involve travel to another city. These activities require planning a longer stay, which also involves additional costs.

3 SOFTWARE, HARDWARE

Using supporting tools, software, and hardware will be an essential element to help implement such activities.

3.1 Software

The COVID-19 pandemic has spurred the rapid development of IT tools to facilitate communication and the preparation of remote classes. A description of exemplary software is provided in section IO.16. It's important to note that the evolution of these tools is ongoing, and it's likely that other software options will emerge in the future. Among the fundamental software solutions, we can highlight the following:

- for remote communication, e.g. Zoom, MS Teams,
- for creating multimedia presentations, e.g. ActivePresenter (Figure 1), Lectora,
- for video processing, e.g. CapCut, VLC, Movavi Video Converter,
- for picture, maps processing, e.g. GIMP,
- for Geographic Information System analysis, e.g. Qgis,
- Management of the teaching process, e.g. Google Classroom.

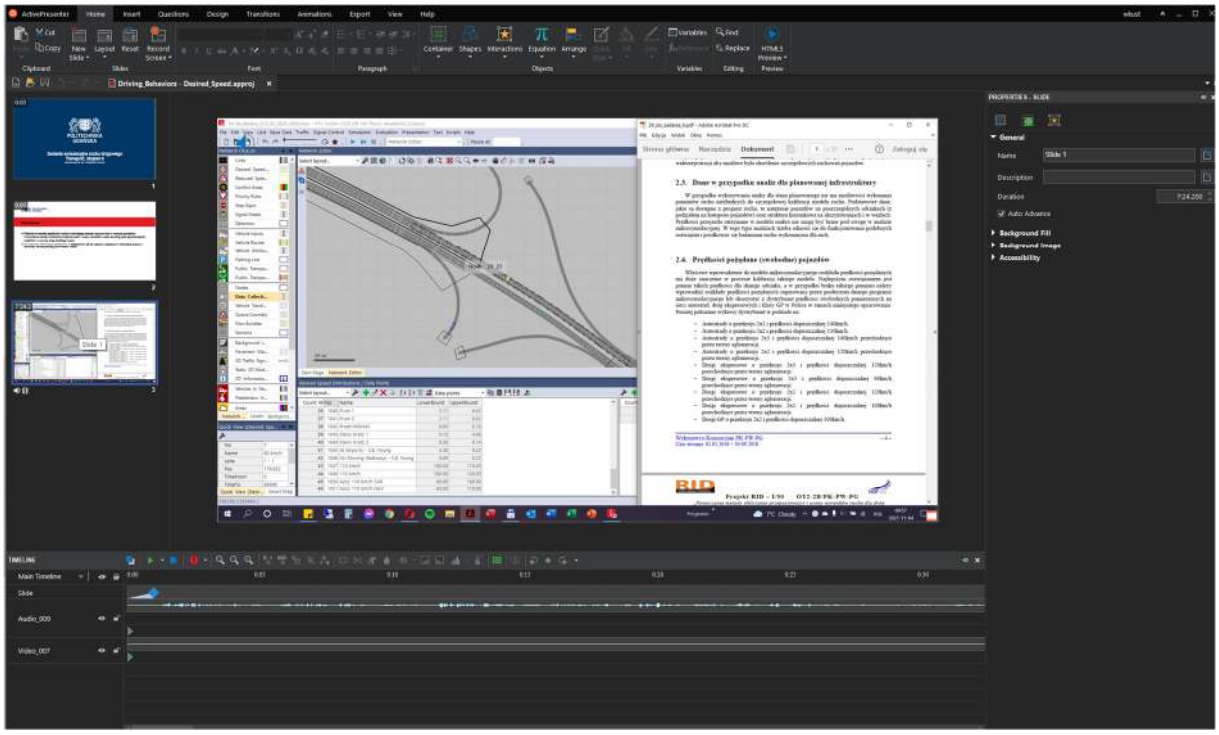

Figure 1. View the prepared presentation using the ActivePresenter software

Efforts were made to select software with open-source or free licences for educational use.

3.2 Hardware

When developing the methodology for fieldwork, our primary consideration was to make it cost-effective for both the academic staff and students. We aimed to utilise relatively affordable equipment for most of the tasks (Figure 2):

- Dash camera with single, multiple cameras,
- GoPro-type video camera,
- Mobile phone,
- Gimbal.

Source: https://gopro.com

Source: https://70mai.pl

Figure 2. Examples of recording devices

In the initial project proposal, we considered incorporating the VR method. Regrettably, its implementation has proven challenging and time-consuming, primarily due to the absence of dedicated software capable of seamlessly translating field research into virtual reality. Consequently, we have decided not to use this method for fieldwork.

4 METHODOLOGY FOR FIELDWORK

4.1 Assumptions

We aimed to conduct one-day field classes with a maximum implementation time of one working day. As part of our methodology preparation, we developed the following scenarios for teaching these classes:

A. Sign materials prepared by the teacher, and RS specialist.
B. Using materials created by students or road authority staff.

These scenarios incorporate various materials and methods, including:

1) Teaching selected infrastructure elements using video files.
2) Instructing on selected infrastructure elements using online digital maps.
3) Providing lessons on selected infrastructure elements in the field.

The two types of scenarios can be combined to create six scenarios: A1, A2, A3, B1, B2, and B3. While most of the scenarios in group B can generally be implemented, selected scenarios will not be recommended for safety reasons.

It's essential to highlight that, in the case of scenario B3, the paramount concern is ensuring the safety of all participants. This involves implementing hazard information procedures and conducting a brief training session led by the teacher.

All scenarios will be discussed using the examples of four selected subjects:

- Road Safety Audit.
- Roadside Safety Management.
- Safety management of vulnerable road users.
- Road Pavement Management.

4.2 Road safety audit

Road Infrastructure Safety Management (RISM) is a process that involves various inspection activities, such as road safety audits. Identifying and rectifying any deficiencies during the planning, design, and construction stages is crucial to ensure road infrastructure solutions that do not pose any risks to road users' lives and health. Road safety Audit (RSA) is a collaborative effort; to facilitate this, additional techniques will be provided to allow group remote work under the guidance of a teacher.

The field activities can be implemented using the following scenarios, according to Table 1.

Table 1 Road Safety Audit recommended conduct field activities scenarios

Type of road elements	Scenario recommended
Single carriageways	A1, B1
Motorways, expressways, dual carriageways	A1, B1*
Interchanges	A1 + A2
Intersection, Roundabouts	A2, A3, B2, B3
Elements of VRU	A1, A2, A3, B1, B2, B3

* only if there are such road grades near the student's., road authority staff's residence and video recording is possible.

For all scenarios, work should be carried out in groups of two. This will make it possible to develop future cooperation and monitor and check each other's work.

4.2.1 Teacher preparation

The teacher's preparation for the fieldwork is an important element in the teaching process. If the teacher prepares the materials, the following are recommended:

- Review of all road sections, Interchanges, Intersection, Roundabouts, Elements of VRU,
- Initial Road Safety Audit using checklists.
- Consultation of evaluation results with other RS Auditors or Specialists.

4.2.2 Single carriageways

The most effective way to conduct lessons on this type of road will be to use video technology (Scenarios A1, B1). Using a car video recorder, you should record a section of the road in good weather and lighting conditions. Utilising a camera with two integrated cameras (recording from the front and rear of the vehicle) will be preferable. Registering the road section during the night is a good idea.

Preparation of materials for RSA - Single carriageways (Figure 3 - Figure 5):

- Preparation of road sections with minimum lengths of 10-15 km. Estimated driving time: approximately 15 minutes.
- Completion of files with distance, coordinates, and location.
- Preparation of road mileage using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the Street View tool.
- Prepared a dedicated control question list for the relevant stage (Preliminary Design, Building stage, etc.).

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.
- Completion of the last three years of crash data.

Figure 3. View the prepared video recording – single carriageway, front camera

Figure 4. View the prepared video recording – single carriageway, rear camera

#	Accident time	Settlement	Street	House number	Road number	Section	Crossing street	Cross. public road	GPS_LAT_DI	GPS_LON_DI	Outcome	Died	Seriously injured	Slightly injured
225	2018-01-02 17:25	Győr			83	67+177			47.6272472222	17.5913861111	fatal	1	0	0
226	2018-01-10 07:16	Tét	Győri		83	52+350	Gyömörei	8306	47.5159444444	17.5167472222	serious injury	0	1	0
227	2018-01-13 14:16	Győrszemere			83	63+486			47.5963166667	17.5879638889	serious injury	0	1	0
228	2018-01-14 10:48	Győrszemere			83	63+380			47.5955555556	17.5871361111	slight ijury	0	0	1
229	2018-01-20 13:30	Győrszemere			83	48+900		94000	47.4889972222	17.4955527778	serious injury	0	1	0
230	2018-01-31 19:35	Győr			83	63+387			47.5956111111	17.5871666667	serious injury	0	1	0
231	2018-02-07 09:00	Tét			83	50+977			47.5049222222	17.5097916667	serious injury	0	1	0
232	2018-02-10 07:45	Győr			83	68+720		8311	47.6382777778	17.6033583333	serious injury	0	1	0
233	2018-02-10 11:45	Győrszemere			83	61+600		83132	47.5649166667	17.5794972222	slight ijury	0	0	2
234	2018-02-18 09:57	Győrszemere			83	63+438			47.5959416667	17.5875805556	slight ijury	0	0	4
235	2018-04-14 19:45	Farkasgyepű			83	7+515			47.2106388889	17.6223055556	slight ijury	0	0	1
236	2018-04-20 10:45	Pápa			83	21+202			47.2900555556	17.5131388889	serious injury	0	1	0
237	2018-04-29 04:56	Tét			83	50+120			47.4983361111	17.5039055556	slight ijury	0	0	2
238	2018-05-01 07:45	Gyarmat	Fő	4	83	45+271			47.4584722222	17.4855383333	slight ijury	0	0	1
239	2018-05-14 15:20	Takácsi	Petőfi		83	38+705	Rákóczi	94000	47.4020555556	17.4676083333	slight ijury	0	0	1
240	2018-06-02 06:20	Pápa			83	29+225			47.3305555556	17.4313027778	slight ijury	0	0	1
241	2018-06-02 20:26	Farkasgyepű			83	6+360			47.1979411111	17.6393306556	slight ijury	0	0	1
242	2018-06-10 20:43	Tét	Pápai		83	48+720			47.4877472222	17.4947750000	serious injury	0	1	0
243	2018-06-22 05:55	Tét	Győri		83	52+194			47.5146388889	17.5158583333	slight ijury	0	0	1
244	2018-07-02 05:52	Tét	Győri		83	52+232			47.5150944444	17.5161833333	serious injury	0	1	0
245	2018-07-06 18:45	Pápa	Tapolcafői	134	83	20+795			47.2870833333	17.5163888889	serious injury	0	1	0
246	2018-07-11 09:25	Takácsi			83	39+400			47.4054861111	17.4709805556	slight ijury	0	0	1
247	2018-07-20 11:30	Pápa			83	25+775			47.3104694444	17.4657222222	fatal	1	0	0
248	2018-08-03 09:51	Gyarmat			83	43+510			47.4427777778	17.4819416667	slight ijury	0	0	1
249	2018-08-18 08:40	Gyarmat	Fő		83	45+400			47.4595833333	17.4857750000	serious injury	0	1	0
250	2018-08-21 06:22	Győr			83	68+760			47.6386083333	17.6036361111	slight ijury	0	0	1
251	2018-08-25 08:05	Győr			83	63+463			47.5961388889	17.5877472222	slight ijury	0	0	1
252	2018-08-26 12:50	Gyarmat			83	42+311			47.4323583333	17.4784694444	serious injury	0	1	1
253	2018-08-31 12:15	Győr	Nagy Imre		83	73+161		96549	47.6659694444	17.6446916667	slight ijury	0	0	1
254	2018-09-07 13:15	Győr			83	61+337			47.5783055556	17.5803305556	slight ijury	0	0	2
255	2018-09-08 11:44	Győr			83	62+420			47.5875611111	17.5824083333	slight ijury	0	0	2
256	2018-09-23 11:05	Győr			83	66+469		8418	47.6212777778	17.5906638889	slight ijury	0	0	3
257	2018-09-23 22:30	Győrszemere			83	56+650			47.4983055556	17.5604416667	serious injury	0	3	0
258	2018-09-30 10:30	Győrszemere			83	59+150			47.5610555556	17.5724416667	serious injury	0	2	0

Figure 5. Example of crash data – single carriageway

4.2.3 Motorways, expressways, dual carriageways

The most effective way to conduct lessons on this type of road will be to use video technology (Scenario A1). Using a car video recorder, it would be best if you recorded a section of the road in good weather and lighting conditions. Registering the road section during the night is a good idea.

Preparation of materials for RSA - Motorways, expressways, and dual carriageways (Figure 3Figure 6 - Figure 8):

- Preparation of road sections with minimum lengths of about 20 km. Estimated driving time: approximately 10 minutes.
- Completion of files with distance, coordinates, and location.
- Preparation of road mileage using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the StreetView tool.
- Prepared a dedicated checklist (control question list) for the relevant stage (Preliminary Design, Building stage, etc.).

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.
- Completion of the last three years of crash data.

Figure 6. View the prepared maps – motorway

Figure 7. View the prepared video recording – motorway

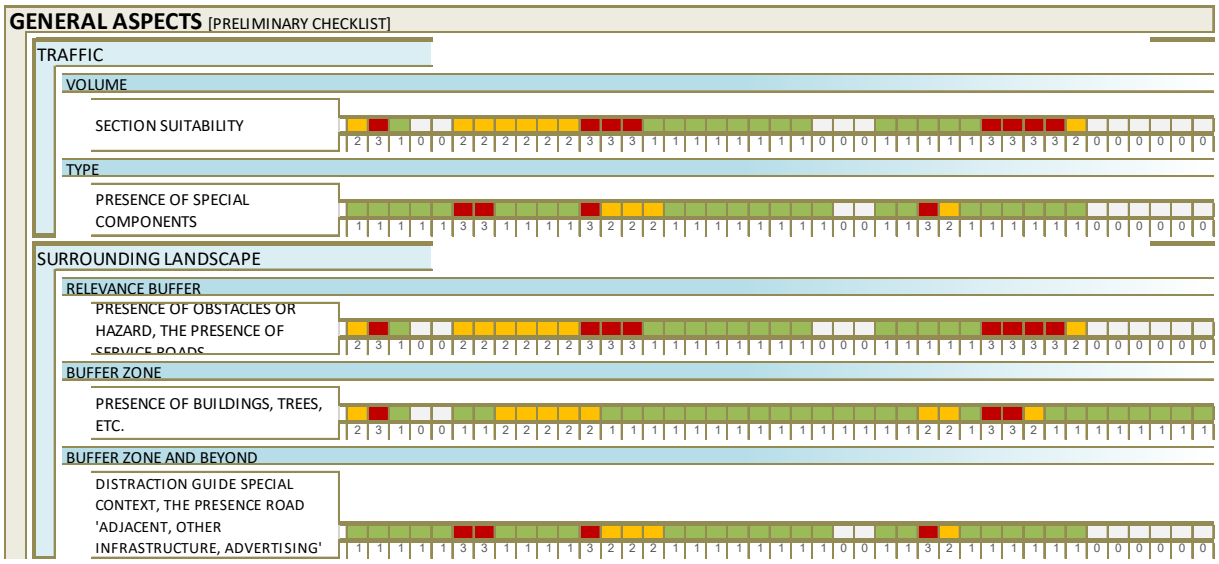

Figure 8. List of checklist – Italian guide

4.2.4 Interchanges

The most effective way to conduct interchange lessons is to use video technology (Scenarios A1+A2). It is not recommended to use any other scenarios. Using a car video recorder, the teacher should record the whole interchange in good weather and lighting conditions. It is a good idea to record the interchange with two cameras: front and side.

Preparation of materials for RSA - Interchanges (Figure 9 - Figure 11, Table 2):

- Preparation of whole interchanges. The video should cover all elements: main roads, exit and entry areas, waving areas and others if are occurred: intersections, signalisation, pedestrian, cycle crossing, and pedestrian, cycle path.
- Completion of files with coordinates, location and type.
- Prepared a dedicated checklist (control question list) for the relevant stage (Preliminary Design, Construction design, pre-opening, and one year after opening).

Additional elements:

- Completion of Annual Average Daily Traffic on both crossing roads with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.
- Completion of the last three years of crash data.
- Calculated capacity of exit entry and weaving area.
- Intersection calculated capacity.

Table 2 Table with name, coordinates, types of interchanges

ID	Name	X-coor	Y-coor	Type
1	Motorway A1 – RR226, Rusocin interchange	18.60875	54.23529	Partial cloverleaf
2	Motorway A1 – RR224, Stanislawie interchange	18.69228	54.10261	Trumpet
3	Motorway A1 – NR22, Swarozyn interchange	18.67144	54.03771	Trumpet
4	Expressway S7 – NR89, Gdansk North interchange	18.70524	54.3195	Trumpet
5	Expressway S7 – RR226, Gdansk East interchange	18.74808	54.31687	Partial cloverleaf
6	Expressway S7 – RR227, Cedry Male interchange	18.87961	54.27208	Partial cloverleaf
7	Expressway S7 – LR2232G, Zulawy West interchange	18.81838	54.29629	Trumpet
8	Expressway S7 – LR2328G, Dworek interchange	18.95183	54.25648	Partial cloverleaf
9	Expressway S7 – RR502, Nowy Dwor interchange	19.1029	54.21283	Partial cloverleaf
10	Expressway S6 – RR224, Szemud interchange	18.20981	54.49607	Partial cloverleaf
11	Expressway S6 – LR151012G, Koleczkowo interchange	18.34224	54.47512	Partial cloverleaf

Figure 9. View the prepared video recording – Interchange (front camera and side camera)

Figure 10. Interchange – Google Maps street view

List of auxiliary control questions when performing Road Safety Audit - Stage 1 Preliminary Design

Problem	Nb	Follow-up questions
1. Function, technical class, design speed, road accessibility	1	Are the basic technical assumptions for the road compliant with the road safety requirements for motorway
	2	Are the adopted assumptions regarding accessibility (distances of interchanges, intersections and entries to passenger service areas) correct with regard to road safety requirements?
	3	Is the design and reliable speed correctly established for: elements of the road plan and longitudinal profile of the road?
	4	Is the design and reliable speed correctly established for: elements of intersections (e.g. additional lanes at intersections) and traffic light parameters?
	5	Is the design and reliable speed correctly established for: determining the necessary visibility?
	6	Is the design and reliable speed correctly established for ramp design?
	7	Are the design solutions well adjusted to the adopted traffic volumes and other characteristics of traffic flows, including the atypical share of heavy goods vehicles, cyclists and pedestrians?

Figure 11. List of control questions – Stage 1 Preliminary Design – Polish guide

4.2.5 Intersection/roundabouts

The most effective way to conduct lessons on this type of intersection will be to use digital maps or visit a particular place (Scenarios A2, B2, A3, B3). Teachers should prepare localisation of intersections with coordinates. If the students or road authority staffs would like to choose an intersection themselves, the teacher must approve their choice. Side visiting can help prepare inventory and observation of road infrastructure and road users' behaviours in real-life conditions. Scenario B3 is recommended for field activities.

Preparation of materials for RSA - Intersection (Figure 12)

- Completion of files with coordinates, location and type of intersection.
- Prepared a dedicated checklist (control question list) for the relevant stage (Preliminary Design, Construction design, pre-opening, and one year after opening).

Additional elements:

- Completion of Annual Average Daily Traffic on both crossing roads with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.
- Completion of the last three years of crash data.
- Intersection calculated capacity.

Example of prepared Important issues for evaluation:

- Vehicle speed and comparison with design assumptions.
- Readability and understandability of designs in various traffic and lighting conditions
- Road user behaviour at intersections.
- Correctness of the selection of traffic organisation at the entrances compliance with the parameters of exclusive traffic lanes with the observed needs.
- Evaluation of control programs due to existing traffic volumes.
- Conflicts when using public transport means.

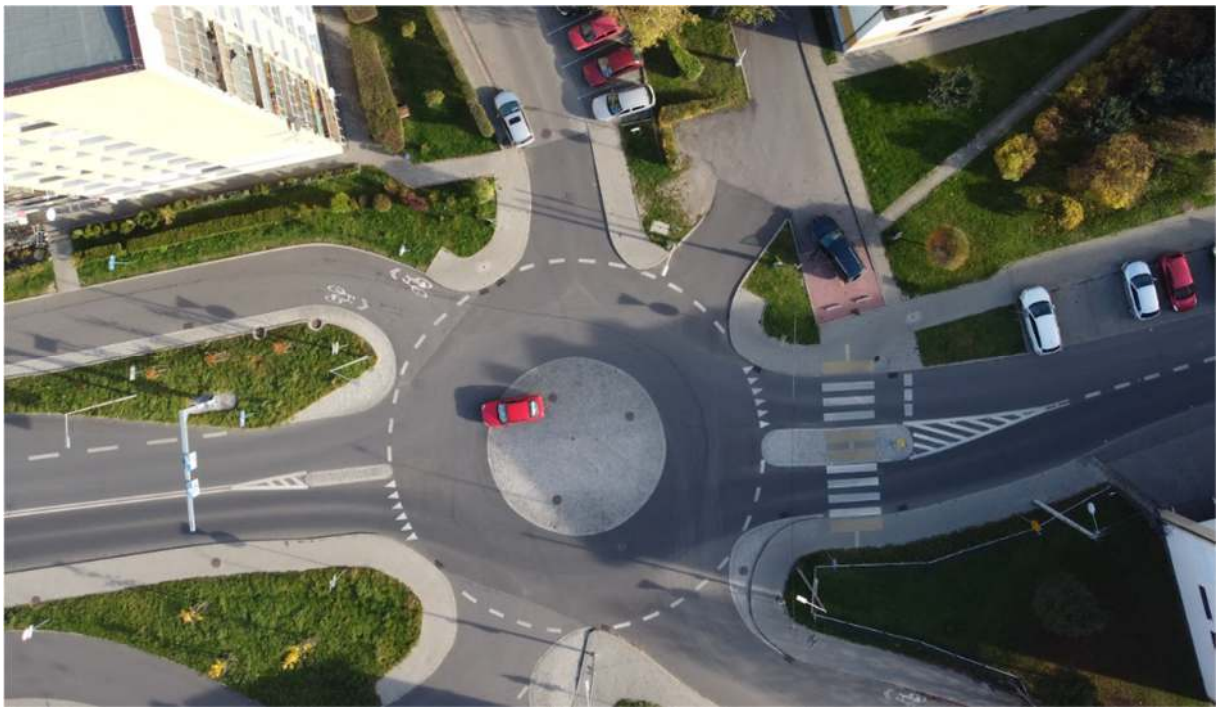

Figure 12. Intersection – Google Maps view

4.2.6 Elements of VRU

When performing Road Safety Audit for vulnerable road users, the choice of scenario will depend on the length of analysing road sections. If the length is longer than 2 km, scenarios A1 and B1 will be best. In another case, the best scenario will be A3, B3. If the analysing elements of road infrastructure will be a pedestrian crossing or intersection, the recommended scenario will be B3. In the case of using digital maps (scenarios A2 and B2), it is essential to check that the maps are actual. Side visiting can help prepare the inventory and observe road

infrastructure and user behaviours in real-life conditions. Scenario B3 is recommended for field activities.

Scenarios A1, B1 - Preparation of materials for RSA – VRU road sections (Table 3 - Table 4, Figure 13 - Figure 14)

- Preparation of road sections with minimum lengths of 2-4 km (the section should cover min. 500 m before and end of the village.
- Completion of files with distance, coordinates, and location.
- Preparation of road mileage using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the Street View tool.
- Prepared a dedicated control question list for the relevant stage (Preliminary Design, Building stage, etc.).

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.
- Completing the last three years of crash data, including accidents with VRU.

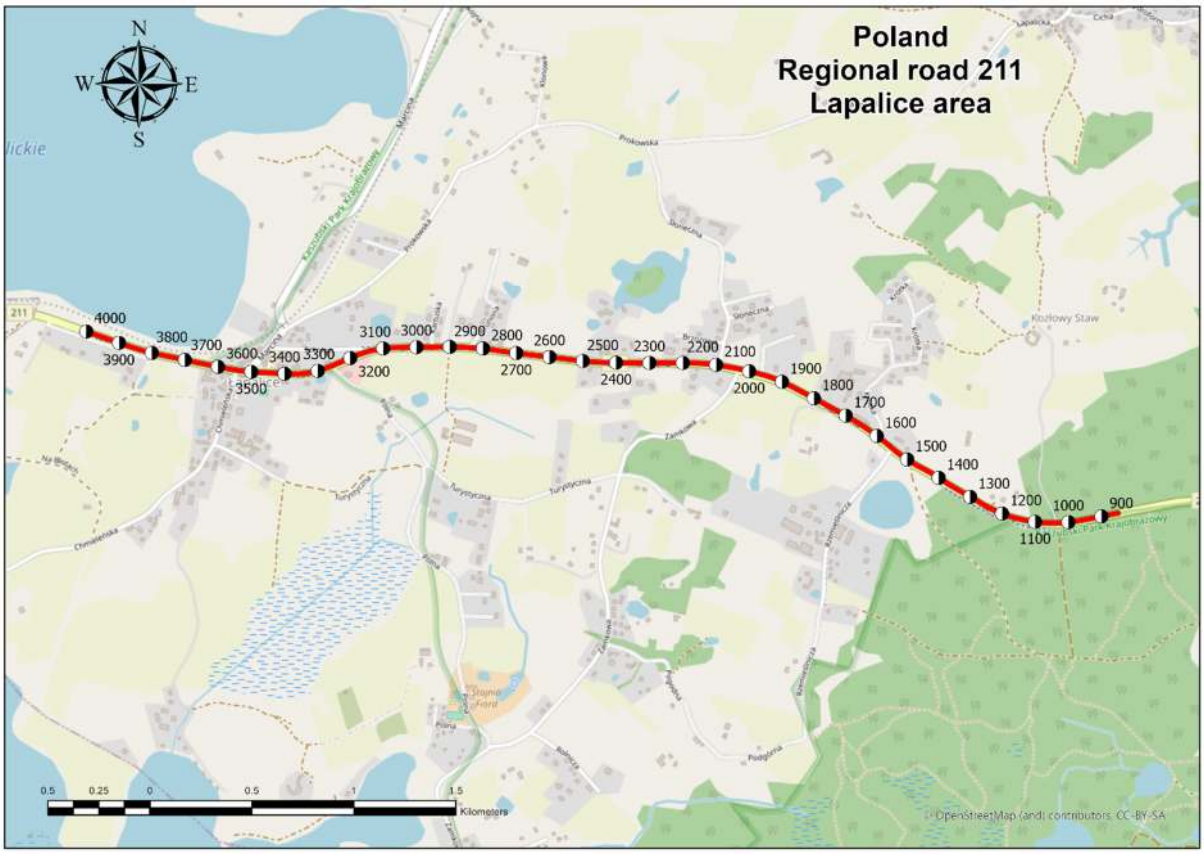

Figure 13. View the prepared maps – VRU road section

Table 3 Table with the name of the village, section, number of roads, cross-section and length of section

ID	Road nb	Section name	Section nb	cross section	From [m]	To [m]	Length [m]	Vilage name
1	211	Sierakowice - Garcz	1	1x2	850	4000	3150	Lapalice
2	211	Sierakowice - Garcz	1	1x2	7400	9270	1870	Cieszenie
3	218	RR218 - Koleczkowo	1	1x2	3330	6170	2840	Nowy Dwor Wejherowski
4	221	Trzepowo - Czapielsk	2	1x2	11760	13500	1740	Jodlowo
5	221	Czapielsk - Jankowo Gdanskie	3	1x2	3700	6700	3000	Przywidz
6	224	Szemud - Wejherowo	1	1x2	3370	6210	2840	Przetoczno
7	244	Jastrzebie - Tryszczyn	1	1x2	2420	5900	3480	Zoledowo
8	408	Lany Wielkie - Kotlarnia	1	1x2	6370	10320	3950	Sierakowice
9	521	Kwidzyn - Prabuty	1	1x2	4330	7450	3120	Rakowiec
10	726	Rawa Mazowiecka - Rzeczyca	1	1x2	11520	13180	1660	Sadykierz

Table 4 Table with AADT

ID point	Road	Section				AADT	Vehicle compositon					
		Picketage		Length	Name		M	PC	DV	LTV	HTV	B
		from	to									
1	2	3	4	5	6	7	8	9	10	11	12	13
Regional road 211, Sierakowice - Garcz, section 2												
22402	211	41.326	51.007	9.681	SIERAKOWICE /DW214/ - MIECHUCINO	7529	72	6240	740	187	216	65
22403	211	51.007	61.558	10.551	MIECHUCINO - KARTUZY /GR. MIASTA/	10808	138	8812	1335	186	245	81
Regional road 218, RR218 - Koleczkowo, section 1												
22623	218	13.562	26.192	12.63	KOLECZKOWO - GNIEWOWO /DW224/	5955	78	5070	514	140	120	31
Regional road 221, Trzepowo - Czapielsk, section 2												
22302	221	13.621	39.408	25.787	KOLBUDY - NOWA KARCZMA /DW224/	7464	91	6223	701	127	277	37
Regional road 221, Czapielsk - Jankowo Gdanskie, section 3												
22316	221	6	13.621	7.621	W. GDAŃSK-ORUNIA /S7/ - KOLBUDY	14173	101	12213	1161	234	379	75
Regional road 224, Szemud - Wejherowo, section 1												
22627	224	0	11.21	11.21	GNIEWOWO /DW218/ - SZEMUD	3640	20	2950	386	59	167	43

Figure 14. View the prepared video recording – VRU section

Example list of tasks for teacher preparation field activities at pedestrian crossings.

1) Initially select about ten pedestrian crossings using a map of the city/region with the assumption that they will be crossings of varying characteristics:

- On the subordinate inlet of an intersection
- On the superior inlet of an intersection
- Between intersections
- On a dual-carriageway road
- On the inlet of a roundabout

The search for crossings is recommended to start with higher-speed roads and then, in the vicinity, identify crossings with lower hazards (e.g., speed limit zones). It is important to remember during classes with students in the field. You need to visit all 4-5 crossings and perform an audit of them. Therefore, the pedestrian crossings should be as close to each other as possible.

2) *Collect data on traffic volumes of vulnerable road users and vehicles at crossings, data on traffic incidents, actual speed of vehicles
3) Self-audit on the day of all selected pedestrian crossings by the teacher (preferably with an assistant to take accurate measurements), take photos of the crossings and complete the control question list. Needed tools:

- Rangefinder.
- *Speedometer.

4) At the office, the teacher performs a full audit of the pedestrian crossing (a minimum of 4-5 from the pre-indicated ones selected for the students' classes).

4.3 Roadside Safety Management

Road Infrastructure Safety Management (RISM) is a process that involves various inspection activities, such as Roadside Safety Management (RSM). The primary objective of RISM is to identify and rectify any deficiencies in existing road sections to reduce risk for all groups of users. RSM is a collaborative effort, and to facilitate this, additional techniques will be provided to allow group members to work remotely under the guidance of a teacher. This procedure shall cover single carriageways.

The field activities can be implemented using the following scenarios, according to Table 5.

Table 5 Roadside Safety Management recommended conducting field activities scenarios

Class of roads	Scenario recommended
National roads	A1, B1
Regional roads	A1, B1
Local roads	A1, A2, B1, B2

For all scenarios, work should be carried out in groups of two. This will make it possible to develop future cooperation and monitor and check each other's work.

4.3.1 Teacher preparation

The teacher's preparation for the fieldwork is an important element in the teaching process. If the teacher prepares the materials, the following are recommended:

- Review of all road sections.
- Initial RSM using hazard identification and classification sheet.
- Consultation of evaluation results with other RS Auditors or Specialists.

4.3.2 Road sections

The most effective way to conduct lessons on this type of road will be to use video technology (Scenarios A1, B1). Using a car video recorder, you should record a section of the road in good weather and lighting conditions. Utilising a camera with two integrated cameras (recording from the front and right side of the vehicle) will be preferable. The short section with a maximum length of 2 km can be used for digital maps (Scenarios A2, B2).

Preparation of materials for RSM - Single carriageways (Table 6 - Table 9, Figure 15 - Figure 17):

- Preparation of road sections with minimum lengths of 15 km for national and regional roads and 8 km for local roads.
- Completion of files with distance, coordinates, and location.
- Preparation of road mileage using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the Street View tool.
- Prepared a hazard identification and classification sheet, with the length of analysing road section of 100 m.

Figure 15. View the prepared video recording – local road, front camera

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses) data.

- Completion of the last three years of crash data.

Table 6 Table with the name, number of the road section, cross-section and length of section

ID	Road nb	Section name	Section nb	cross section	Length	ID	Road nb	Section name	Section nb	cross section	Length
1	6	Nowograd - Kurniki	1	1x2	19426	11	19	Kuriany - Ryboly	1	1x2	18900
2	6	Pniewo - Goscinko	2	1x2	19233	12	19	Lubartów - Lublin	2	1x2	15647
3	6	Slupsk - Poganice	3	1x2/2x2	22756	13	22	Starogard Gdanski - Kaliska	1	1x2	16778
4	6	Lebork - Keblowo	4	1x2	20027	14	29	Krosno Odrzanskie - Cybinka	1	1x2	20318
5	7	Miechow - Wodzislaw	1	1x2	19325	15	50	Mszczonow - Przeslawice	1	1x2	20511
6	12	Radom - Zwolen	1	1x2	19350	16	50	Wiskitki - Mszczonow	2	1x2	17544
7	12	Zwolen - Bronowice	2	1x2	22671	17	50	Ruszki - Rebowo	3	1x2	18061

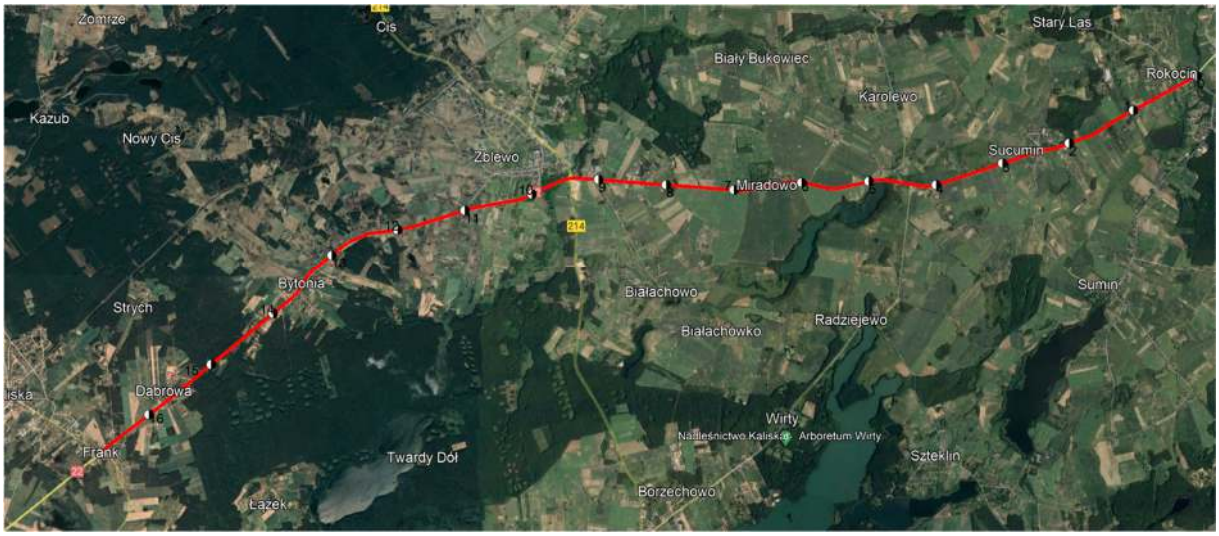

Figure 16. View the prepared maps – Google Earth

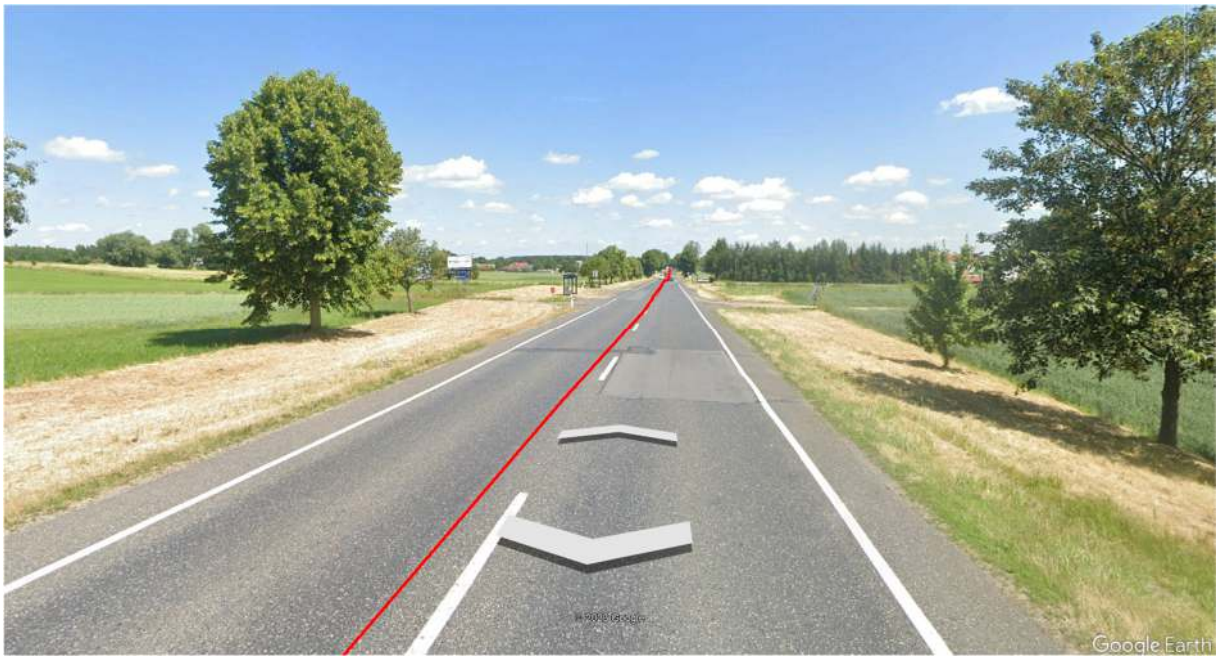

Figure 17. View the prepared maps – Google Street View

Table 7 Roadside management – Hazard identification and classification sheet – general information about road sections

COUNTRY			NAME, SURNAME	
REGION				
AREA	rural			
NUMBER OF ROAD			DATE	
TYPE OF ROAD				
LENGTH [km]	20.0		SCHEDULE	
KM FROM	0		BEGINNING	END
KM TO	20			
GPS COORDINATES	X	Y	Number of investigation sections	
			200	

Table 8 Roadside management – Hazard identification and classification sheet – collected detailed information about road hazard

ID	Hazard group/name	Investigation sections 1 (0 - 100)		2 (101 - 200)		3 (201 - 300)	
		Risk level	Risk severity level	Risk level	Risk severity level	Risk level	Risk severity level
Speed limit							
A	**Greenery**	2	Moderate – high	1	Minimal - moderate	1	Minimal - moderate
A.1	A single tree	1	Minimal - moderate				
A.2	A group of trees	2	Moderate – high	1	Minimal - moderate	1	Minimal - moderate
A.3	Vegetation limiting visibility.	3	High – very high	1	Minimal - moderate	1	Minimal - moderate
B	**Supporting structures**	2.3	Moderate – high	3	High – very high	3	High – very high
B.1	Unprotected metal poles with a cross-sectional dimension> 70 mm.						
B.2	Unprotected gantries.	1	Minimal - moderate				
B.3	Unprotected concrete poles, regardless of their diameter.						
B.4	Unprotected metal poles with cross-sectional dimensions≤ 70 mm	3	High – very high	3	High – very high	3	High – very high
B.5	Unprotected traffic barrier pole	3	High – very high	3	High – very high	3	High – very high
B.6	Unprotected wooden or plastic poles with the smallest cross-sectional dimension> 100 mm						
C	**Engineering facilities**						
C.1	Unprotected structures of road noise barriers						

Table 9 Roadside management – Risk hazard matrix

Speed [km/h]	Distance [m] 0 - 3,0	3 - 6	6-9	9-12
≤ 50	1	0	0	0
60 - 70	2	1	0	0
70 - 80	3	2	1	0
> 80	3	3	2	1

4.4 Safety management of vulnerable road users

Road Infrastructure Safety Management (RISM) is a process that involves various inspection activities, such as Safety management of vulnerable road users (SMVRU). The primary objective of RISM is to identify and rectify any deficiencies in existing road sections to reduce the risk for VRU. SMVRU is a collaborative effort, and to facilitate this, additional techniques will be provided to allow group members to work remotely under the guidance of a teacher. This procedure shall cover single carriageways.

Road Infrastructure Safety Management (RISM) is a systematic process encompassing various inspection activities, focusing on the Safety Management of other Vulnerable Road Users (SMVRU). The primary goal of RISM is to identify and address any deficiencies in existing road sections to enhance safety and reduce risks for Vulnerable Road Users (VRU). SMVRU is a collaborative effort to improve road safety for cyclists and motorcyclists, who are more susceptible to accidents on the road.

To facilitate SMVRU and RISM, additional techniques are provided to enable group members to work remotely, allowing them to collaborate effectively under the guidance of a teacher or facilitator. This approach enhances the efficiency and effectiveness of the safety management process, ensuring that road infrastructure is as safe as possible for all users.

It's important to note that this procedure is designed explicitly for single-carriageways, which are road sections with a single traffic lane in each direction. The focus on single-carriageways recognises that different classes of roads(national, regional, local) may have varying safety needs, and addressing vulnerabilities in these sections is crucial for overall road safety management.

The field activities can be implemented using the following scenarios, according to Table 10.

Table 10 Safety management of vulnerable road users recommended conducting field activities scenarios

Class of roads	Scenario recommended
National roads	A1, B1
Regional roads	A1, B1
Local roads	A1, A2, B1, B2

For all scenarios, work should be carried out in groups of two. This will make it possible to develop future cooperation and monitor and check each other's work.

4.4.1 Teacher preparation

The teacher's preparation for the fieldwork is an important element in the teaching process. If the teacher prepares the materials, the following are recommended:

- Review of all road sections.
- Initial RSM using hazard identification and classification sheet.
- Consultation of evaluation results with other RS Auditors or Specialists.

4.4.2 Road sections

The most effective way to conduct lessons on this type of road will be to use video technology (Scenarios A1, B1). Using a car video recorder, you should record a section of the road in good weather and lighting conditions. The short section with a maximum length of 2 km can be used for digital maps (Scenarios A2, B2) only for local roads.

Preparation of materials for SMVRU - Single carriageways (Table 3, Figure 15 - Figure 17):

- Preparation of road sections should cover a minimum section within one village with 1000 m. the section before and at the end of the border of the village. A much better solution will be a neighbouring two villages. It will then be possible to observe the facilities for VRUs between them.
- Completion of files with distance, coordinates, and location.
- Preparation of road mileage using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the Street View tool.
- Prepared control questions.

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses, Bicycles) data.
- Completion of a number of pedestrians bicycles moving between villages.
- Completing the last three years of crash data, including incidents with VRU.

List of control questions

1. Have speed limits been implemented in areas with potential pedestrian presence, such as residential and commercial areas?
2. Is there infrastructure for vulnerable road users, such as pedestrians and cyclists, in the villages along the road?
3. Does the infrastructure for vulnerable road users meet the requirements for
   - continuity,
   - safe and functional width,
   - and lighting?
4. Is there safe infrastructure for vulnerable road users between villages or at least 1 km from village boundaries in case of long distances?
5. How has cycling traffic been organised on the analysed road sections?
6. Is the designed infrastructure safe for all users?
7. Has a safe speed limit of 50 km/h or less been enforced at the entrance and height of the crossing?
8. Does the location of the pedestrian crossing ensure its visibility?
9. Is visibility ensured at the crossing?
10. If not, what factors may limit pedestrian and driver visibility?
11. Are ramps and textured tiles for blind people utilised at pedestrian crossings?

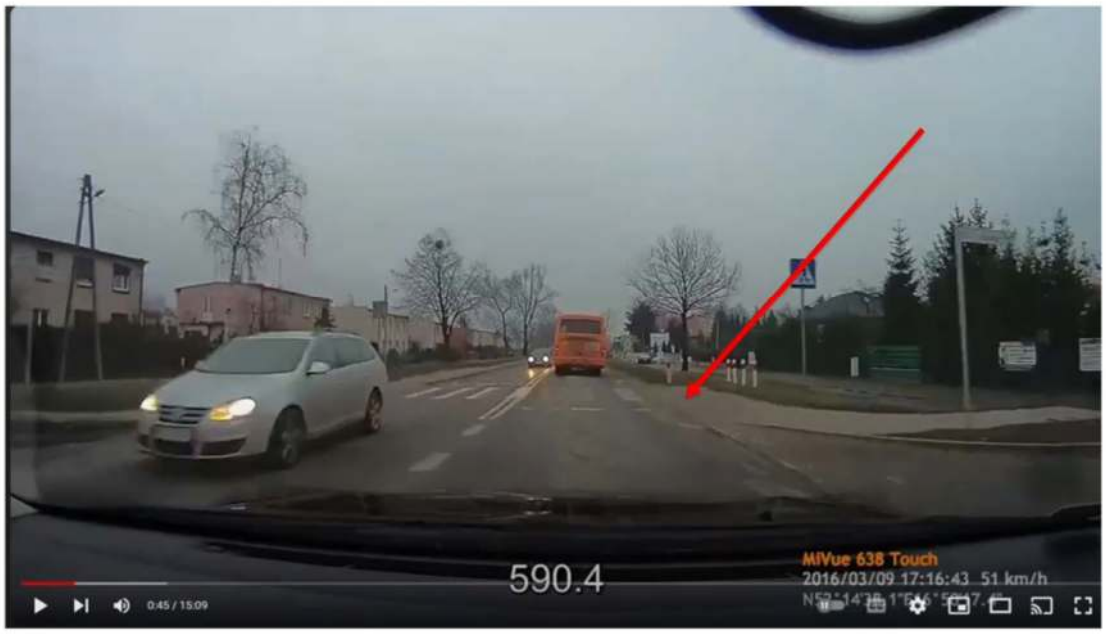

Figure 18. Video tutorial for VRU

4.5 Road pavement management

Field research within the domain of road pavement management primarily involves analysing pavement conditions. It is imperative to conduct a comprehensive assessment of road damages, taking into account various factors like frequency, size, severity, and potential causes. This assessment is critical for gaining insights into the state of road infrastructure. The fieldwork can be categorised into the following key steps:

1) Collecting damage data through field inspections and visual assessments.
2) Evaluating the frequency and locations of damages on roads and streets.
3) Assessing the extent and severity of these damages.
4) Classifying road sections using a four-grade scale to determine pavement damage class.

By following these steps, road authorities and maintenance teams can make informed decisions regarding necessary repairs, maintenance priorities, and overall infrastructure management.

The field activities can be implemented using the following scenarios, according to Table 11.

Table 11 Road pavement management recommended conducting field activities scenarios

Class of roads	Scenario recommended
Local roads	A2, B2, A3, B3
Urban streets	A2, B2, A3, B3

For all scenarios, work should be carried out for each student by himself.

4.5.1 Teacher preparation

The teacher's preparation for the fieldwork is an important element in the teaching process. If the teacher prepares the materials, the following are recommended:

- Pavement analysis of all road sections, and urban street.
- Consultation of evaluation results with other road construction specialists.

4.5.2 Local road sections, urban streets

The most effective way to conduct lessons on this type of roads/streets will be to use digital maps (Scenarios A2, B2). The maximum length of the section should be 2000 m. When carrying out such fieldwork (Scenarios A3, B3), for safety reasons, road/street sections should be selected where the volume will not exceed 1000 P/24h.

Preparation of materials for RSM - Single carriageways (Table 12, Figure 19- Figure 20):

- Preparation of road sections/streets should be a maxof imum 2000 m.
- Completion of files with distance, coordinates, and location.
- Preparation of road data using GIS: shapefiles, kml files (map format used by Google Maps), enabling the road section to be checked using the Street View tool.
- Prepared checklists.

Additional elements:

- Completion of Annual Average Daily Traffic with structure of vehicle (motorcycles, passenger cars, delivery cars, trucks without trailers, track with trailers, Buses, Bicycles) data.

Example of control checklist:

1) Determination of the **values of pavement condition parameters**.
2) Performing of **normalisation** of condition parameter values to a scale of 0-100.
3) Determination of the pavement **condition class for each condition parameter** (classes A, B, C, D).
4) Determination of the **dominant parameters** in each group of condition parameters and the collective parameter for all condition parameters.
5) Determination of pavement **condition classes** in each condition parameter group and the collective **condition level** for all parameters.
6) Determination of pavement **condition levels** in each condition parameter group and the **collective condition level** for all condition parameters

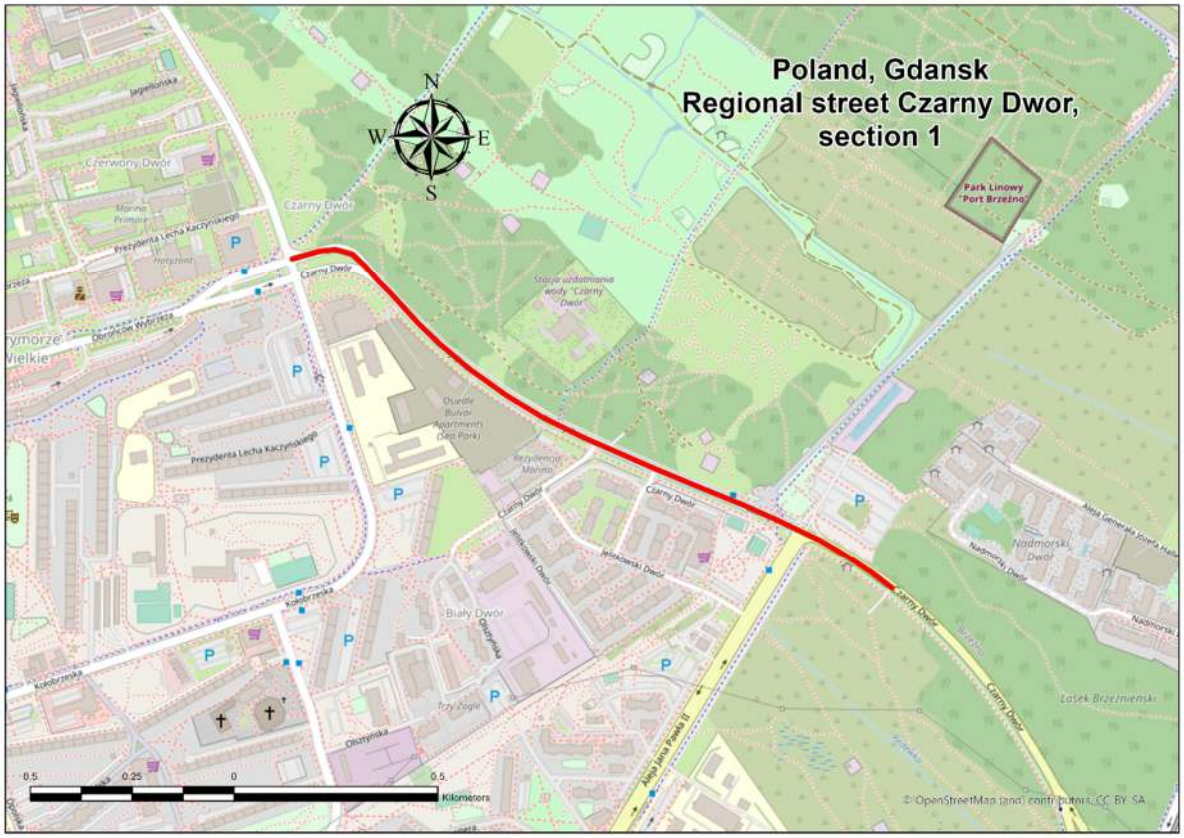

Figure 19. View the prepared maps – Road pavement management

Figure 20. View the prepared maps – Google Street View

Table 12 Road pavement management - levels of pavement condition

Condition class	Condition level
A	**Desired level** (in good condition)
B	
C	**Warning level** (in unsatisfactory condition)
D	**Critical level** (in bad condition)

5 SUMMARY\

The methodology outlined here offers insights into preparing field classes on Road Infrastructure Management. This methodology covers class types and essential tools and software for enhancing the quality of teaching materials significantly.

The methodology includes scenarios for conducting classes using materials prepared by teachers, civil and transportation engineering students, and road authority staff at national, local, and regional levels.