ASSESING THE PERFORMANCE OF SAFETY ASSETS

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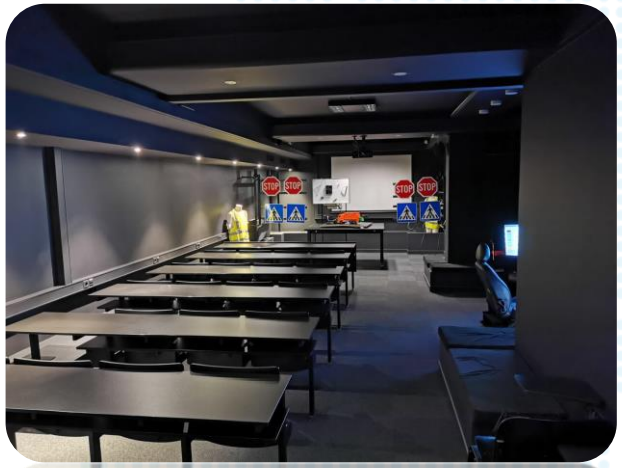
General Data of the Department for Traffic Signalization

- Department for Traffic Signalization established in year 2000.

- The structure of the Department:
  - ***Head of Department:***
    Prof. Anđelko Ščukanec, Ph. D.
  - ***Permanent staff:***
    Assoc. prof. Darko Babić, Ph.D.
    Dario Babić, Ph.D.
    Mario Fiolić, Ph.D.
    Marko Ružić, mag. ing. traff.
    Valentina Šnajder, mag. ing. traff.
    Maja Modrić, mag. ing. traff.
- In the work of the department are engaged also ***STUDENTS (9)***, who through various forms of cooperation acquire scientific and technical knowledge in the field of traffic signalization.

DEPARTMENT FOR TRAFFIC SIGNALIZATION - *WORKING ENVIRONMENT*



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BULGARIAN BRANCH ASSOCIATION ROAD SAFETY

Projects of the Department for Traffic Signalization includes the following tasks:

- Research and testing of new materials and technology in traffic signalization
- Measuring of retroreflection (Road Markings and Traffic Signs) – ***CORE JOB***
- Testing of dry film thickness of road markings
- Review of transport and traffic projects and their monitoring
- Projects for Temporary signalization
- Projects for “guiding” signalization
- Projects for Tourist signalization
- Participates in the development of basic, applied and developmental research projects co-financed by the Ministry of Science and Technology
- Cooperation with business entities and academic institutions at home and abroad





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ACCREDITATION

- Testing Laboratory is in accordance with ISO 17025 and ISO 9001 standards.
- **Road markings accreditation:**
  - EN 1436:2007+A1:2008 - Measurement method for the luminance coefficient under diffuse illumination Qd
  - EN 1436:2007+A1:2008 - Measurement method for the coefficient of retroreflected luminance RL
- **Traffic signs accreditation:**
  - EN12899-1:2008 - Fixed, vertical road traffic signs - Part 1: Fixed signs
    tč./art. 4.1.1.4. - 4.1.1.4 Coefficient of retroreflection RA class RA1 and RA2
    CIE 054.2-2001
- **Coating thickness:**
  - HRN EN ISO 2360:2004 - Measurement of coating thickness - Amplitude-sensitive eddy current method (ISO 2360:2003; EN ISO 2360:2003)
  - HRN EN ISO 2808:2008 - Paints and varnishes - Determination of film thickness (ISO 2808:2007; EN ISO 2808:2007)
  - HRN EN ISO 2178:1999 - Measurement of coating thickness - Magnetic method (ISO 2178:1982; EN ISO 2178:1995)

Why we measure road markings quality?

Road markings quality control

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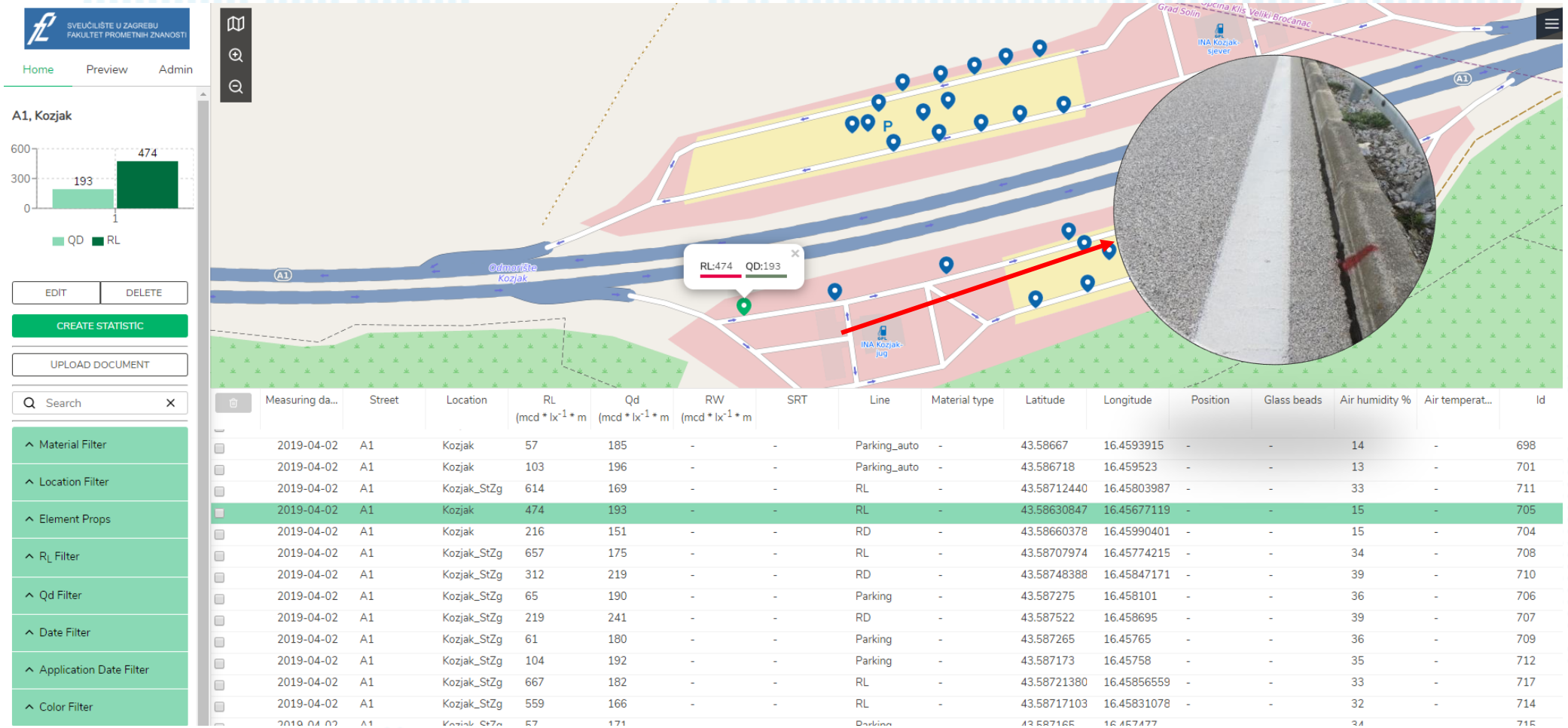
Retroreflectivity measurement

- Zehntner ZRM 6013 and ZRM 6014 are used for the measuring day and night visibility of road markings (horizontal signalization).

Retroreflectivity measurement

- (*https://staticretro.smartview.hr/*)



Measuring da...	Street	Location	RL (mcd * lx^{-1} * m	Qd (mcd * lx^{-1} * m	RW (mcd * lx^{-1} * m	SRT	Line	Material type	Latitude	Longitude	Position	Glass beads	Air humidity %	Air temperat...	Id
2019-04-02	A1	Kozjak	57	185	-	-	Parking_auto	-	43.58667	16.4593915	-	-	14	-	698
2019-04-02	A1	Kozjak	103	196	-	-	Parking_auto	-	43.586718	16.459523	-	-	13	-	701
2019-04-02	A1	Kozjak_StZg	614	169	-	-	RL	-	43.58712440	16.45803987	-	-	33	-	711
2019-04-02	A1	Kozjak	474	193	-	-	RL	-	43.58630847	16.45677119	-	-	15	-	705
2019-04-02	A1	Kozjak	216	151	-	-	RD	-	43.58660378	16.45990401	-	-	15	-	704
2019-04-02	A1	Kozjak_StZg	657	175	-	-	RL	-	43.58707974	16.45774215	-	-	34	-	708
2019-04-02	A1	Kozjak_StZg	312	219	-	-	RD	-	43.58748388	16.45847171	-	-	39	-	710
2019-04-02	A1	Kozjak_StZg	65	190	-	-	Parking	-	43.587275	16.458101	-	-	36	-	706
2019-04-02	A1	Kozjak_StZg	219	241	-	-	RD	-	43.587522	16.458695	-	-	39	-	707
2019-04-02	A1	Kozjak_StZg	61	180	-	-	Parking	-	43.587265	16.45765	-	-	36	-	709
2019-04-02	A1	Kozjak_StZg	104	192	-	-	Parking	-	43.587173	16.45758	-	-	35	-	712
2019-04-02	A1	Kozjak_StZg	667	182	-	-	RL	-	43.58721380	16.45856559	-	-	33	-	717
2019-04-02	A1	Kozjak_StZg	559	166	-	-	RL	-	43.58717103	16.45831078	-	-	32	-	714

Retroreflectivity measurement - DYNAMIC

- Zehntner ZDR 6020 (mounted on vehicle) is used for dynamic measuring of night visibility (retroreflection) of road markings (horizontal signalization). The ZDR 6020 is a dynamic measuring system for the fast and precise recording of the night visibility and important ambient data of long distances or large areas.

Retroreflectivity measurement - DYNAMIC

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Dynamic retroreflection measurement of longitudinal road markings on Second Level Roads in Croatia 2010 - 2021

- **Period 2010. – 2011.** measured 14.096 km of lines
- **Period 2011. – 2013.** measured 17.918 km of lines
- **Period 2013. – 2014.** measured 13.591 km of lines
- **Period 2015. – 2016.** measured 23.377 km of lines
- **Period 2017. – 2018.** measured 10.453 km of lines
- **Period 2018. – 2019.** measured 10.043 km of lines
- **Period 2019. – 2020.** measured 10.368 km of lines
- **Period 2020. – 2021.** measured 9.633 km of lines

In TOTAL: 109.479 km (end 2021.)

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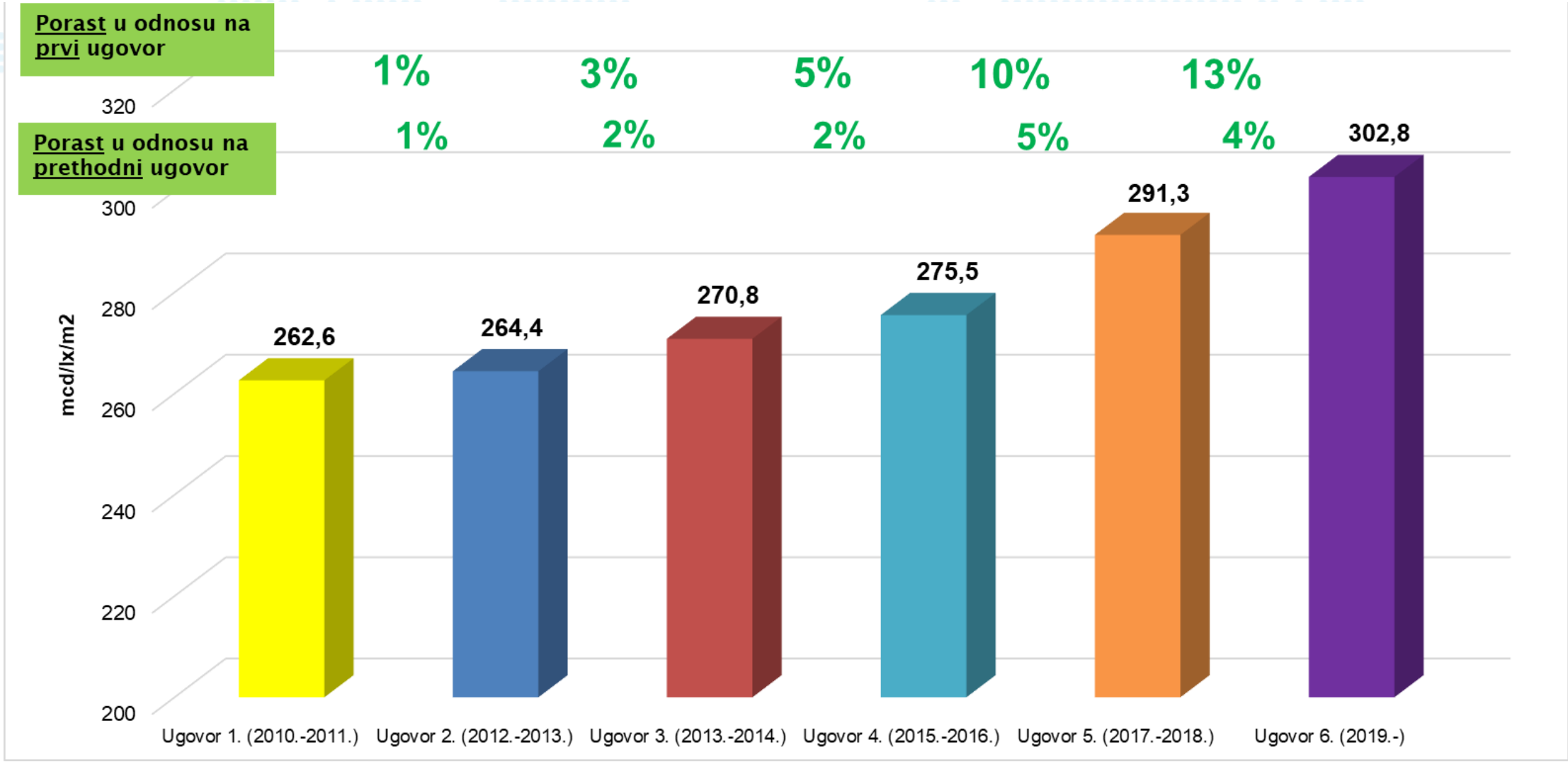
Average retroreflection value (RL) on second level roads in Croatia 2010 - 2021



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Dynamic retroreflection measurement of longitudinal road markings on Highways in Croatia 2019 - 2021

Key:

BINA istra	In service	145 km
	In service	780 km
	In construction	
AZM	In service	60 km
	In service	178 km
	Total in service: 1163 km	

1/11/2007

- **Highway network – 1.300 km full profile**
- **We provide measurements every year**
- **Maintenance plan is made based on our results**

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Why we measure traffic signs quality?

Retroreflectivity measurement

- Zehntner ZRS 6060 is device used for measuring retroreflection of traffic signs (vertical signalization). Zehntner ZRS 6060 uses LED lighting and a 3.5 " high-resolution color touch screen with adjustable angle. Device is used for all types and colors of retroreflective material and automatically detects the color of retroreflective material. Device stores GPS coordinates and measurements can be evaluated with the included mapping and data analysis software “MappingTools”.

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Colorimetry measurement

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CASE STUDY: Traffic signs retroreflection measurement on Croatia second level roads

- With retroreflection coefficient, on all traffic signs we collected info about all others relevant informations for traffic signs:
  - Number of the state road and road section
  - Chainage (road kilometer position of sign)
  - GPS coordinate of the sign
  - Traffic signs code according to the legislation
  - Direction of sign
  - Class of retroreflection material
  - Dimensions
  - Shape
  - Name of the manufacturer
  - Year of manufacture
  - Mounting characteristics and Plate thickness
  - Height of traffic signs
  - Distance from the edge of the pavement
  - Digital photography of traffic sign

HRVATSKE CESTE

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CASE STUDY: Traffic signs retroreflection measurement on Croatia second level roads

BASIC FACTS

- Project was realized 2015-2017
- Within this Project we measured and registered **150 000** traffic signs
- After establishing “point Zero“ we continued measurement till today on “critical“ traffic signs

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CASE STUDY: Traffic signs retroreflection measurement on Croatia second level roads

Redni broj ispitivanja: 1

Cesta:	**DC58**
Dionica:	**Šibenik (luka) - Boraja (g.ž.)**
Smjer:	**SMJ**
Pozicija:	**Desno**
Stacionaža:	**002/9,993**
Datum ispitivanja:	**30. 06. 2020.**
Ispitivao:	**Zavod za prometnu signalizaciju Fakulteta prometnih znanosti**

Podaci o prometnom znaku

Šifra:	**A05-3**	Postava:			
Dimenzije:	**120*120*120 cm**	način:	**Samostojeći stup**		
Oblik:	**Trokut**	visina:	**-**		
Proizvođač:	**Pismorad (2015-04)**	udaljenost od ruba:	**66 cm**		
Debljina lima:	**2,1 mm**	CE broj:	**Ne**	Zaštitna ograda:	**Da**
Napomena:	**-**				

Podaci o retroreflektirajućoj foliji

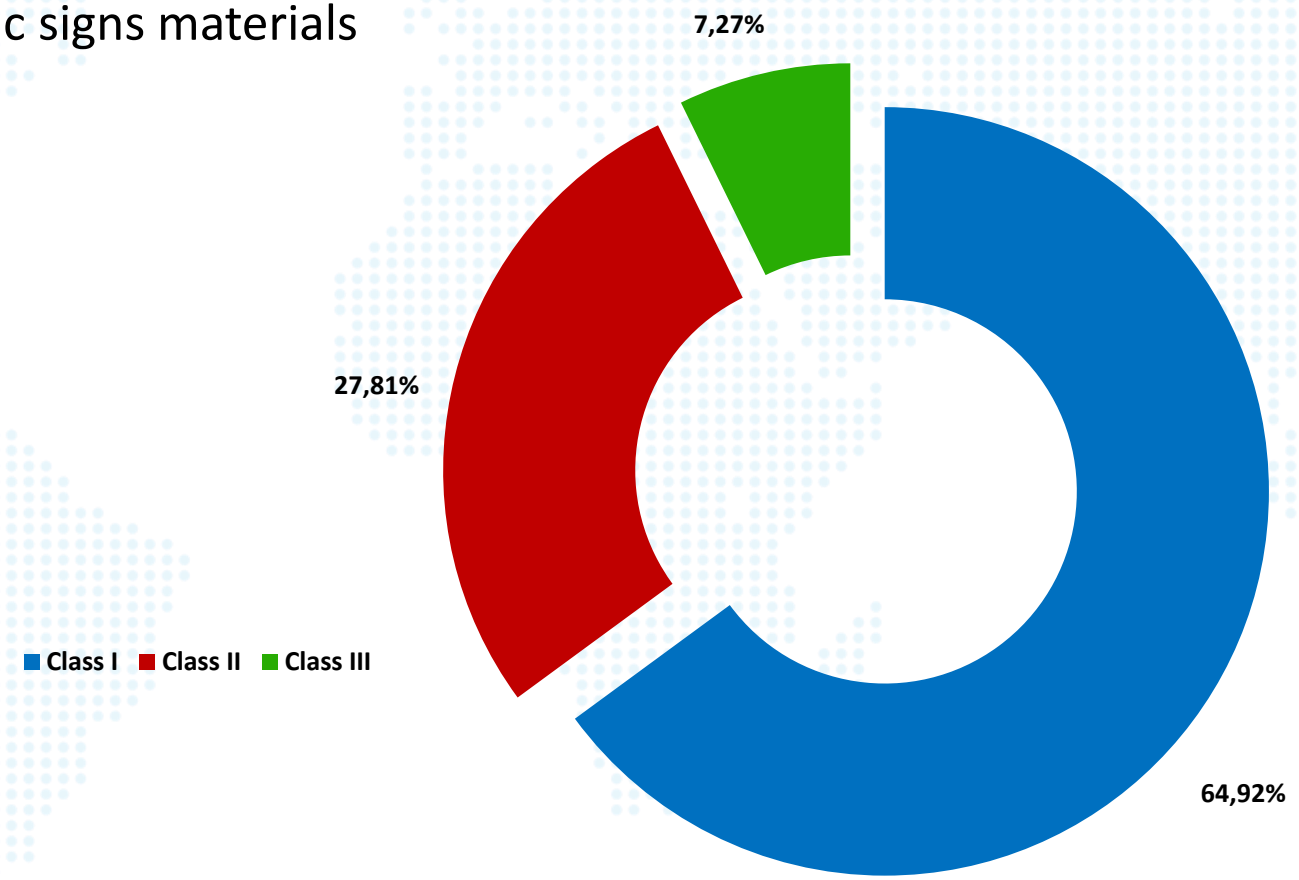
Klasa:	**Klasa I**	Vrsta retrorefleksije:	**Prizmatična**

Vrijednosti koeficijenata retrorefleksije [$cd \cdot lx^{-1} \cdot m^{-2}$]

Boja	Minimalna vrijednost	Izmjerena vrijednost	Ocjena
Bijela	**50,0**	**129,7**	✔
Crvena	**7,0**	**51,88**	✔

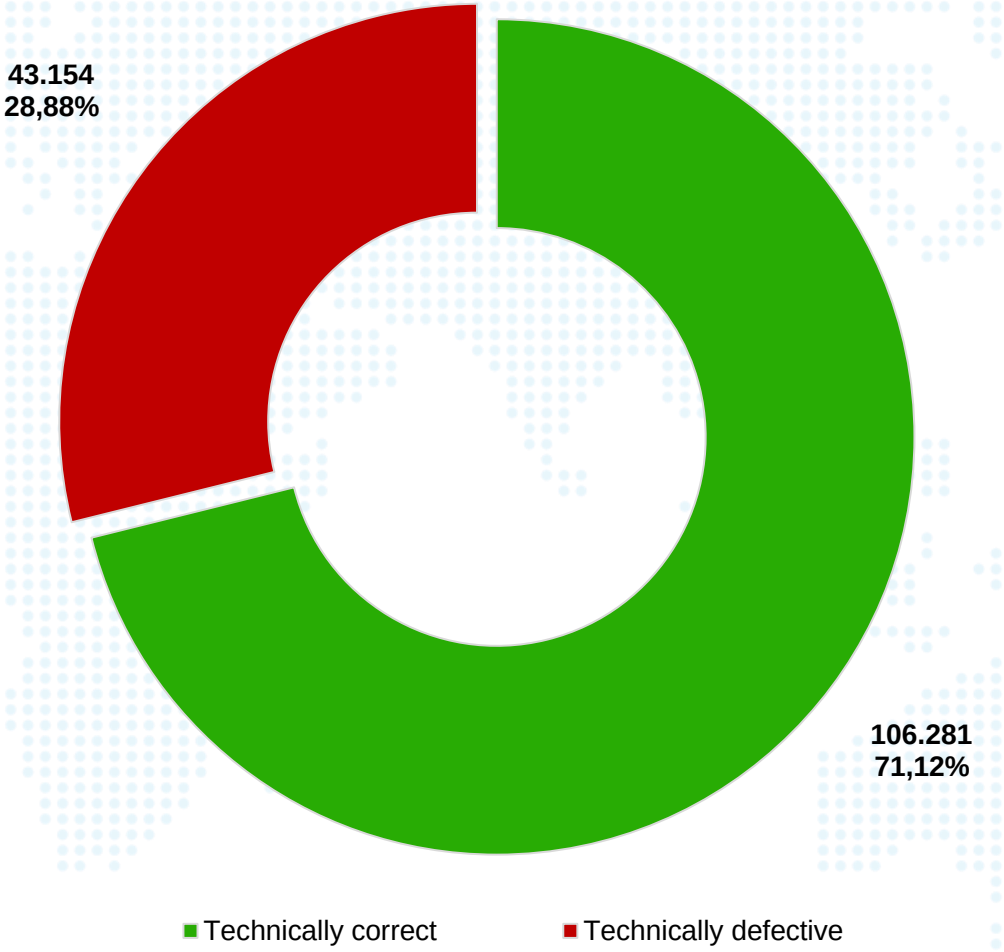
CASE STUDY: Traffic signs retroreflection measurement on Croatia second level roads

Percentage share of traffic signs materials



CASE STUDY: Traffic signs retroreflection measurement on Croatia second level roads

- Percentage share of traffic signs that meet and do not meet the technical requirements
- Average age of “good“ signs is **6,34 years**
- Average age of “bad“ signs is **11,54 years**



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CASE STUDY: Traffic signs retroreflection measurement on Croatia Highways

BASIC FACTS

- Project was realized 2020-2021
- Within this Project we measured and registered **16.764** traffic signs

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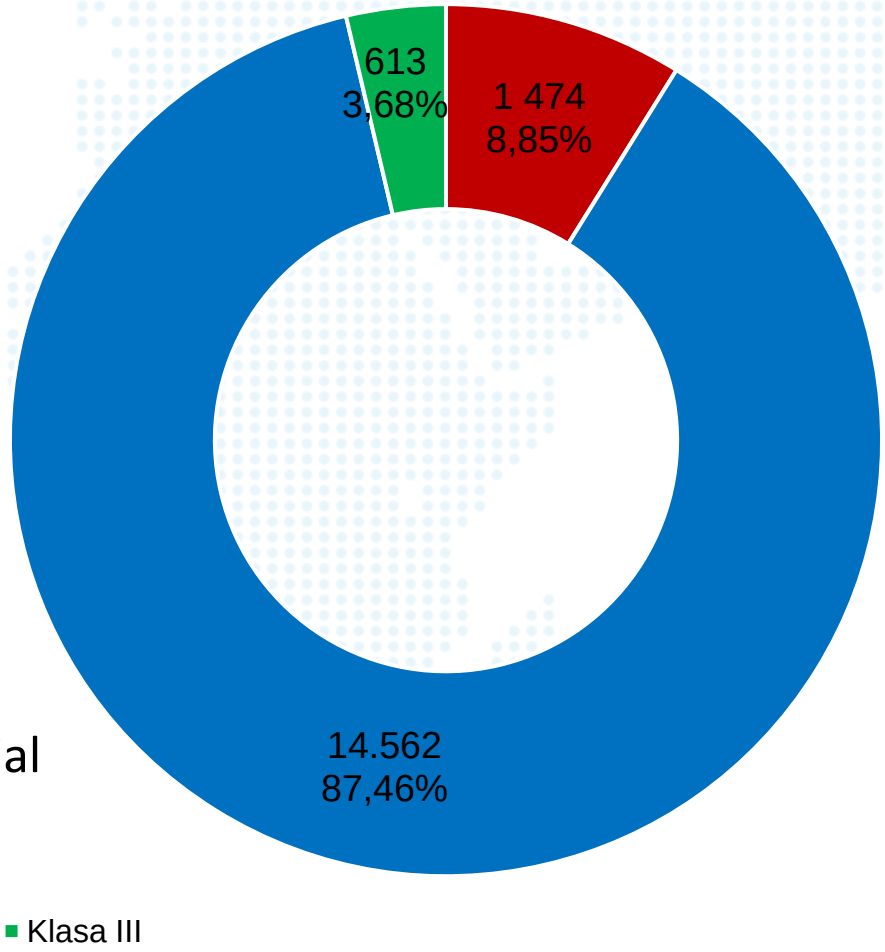
CASE STUDY: Traffic signs retroreflection measurement on Croatia Highways

Percentage share of traffic signs materials

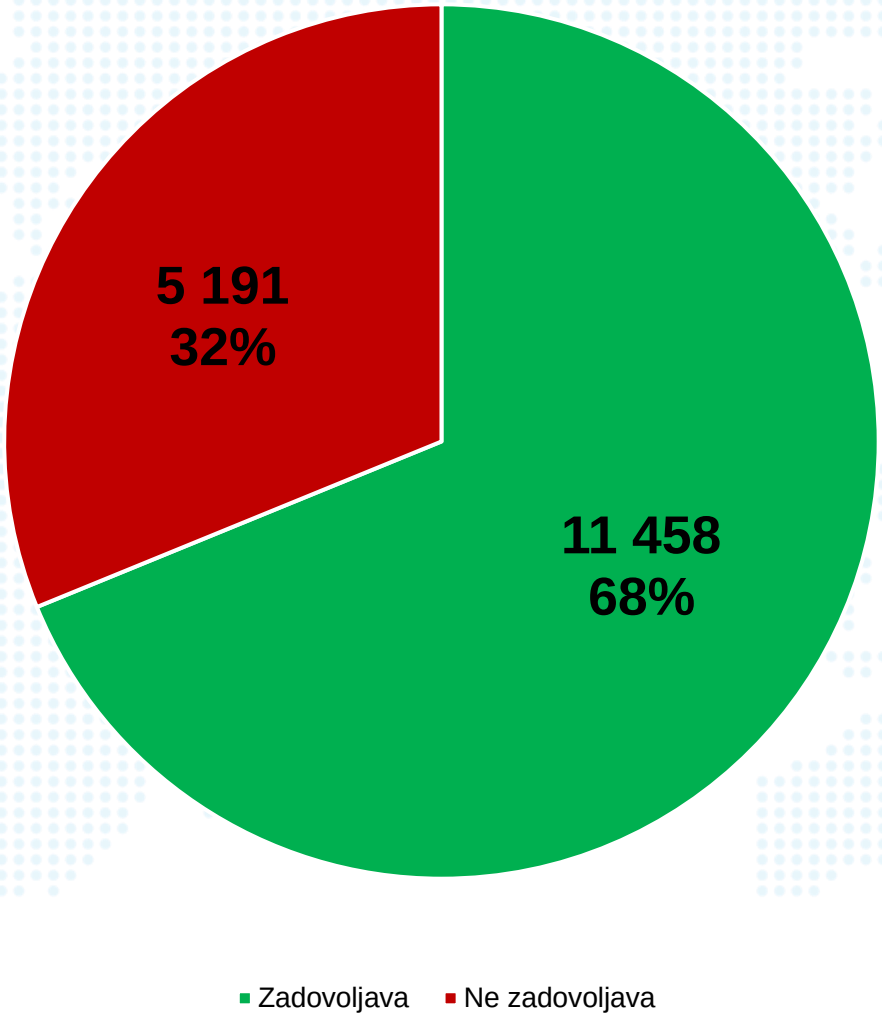


New regulation in Croatia from 2019:

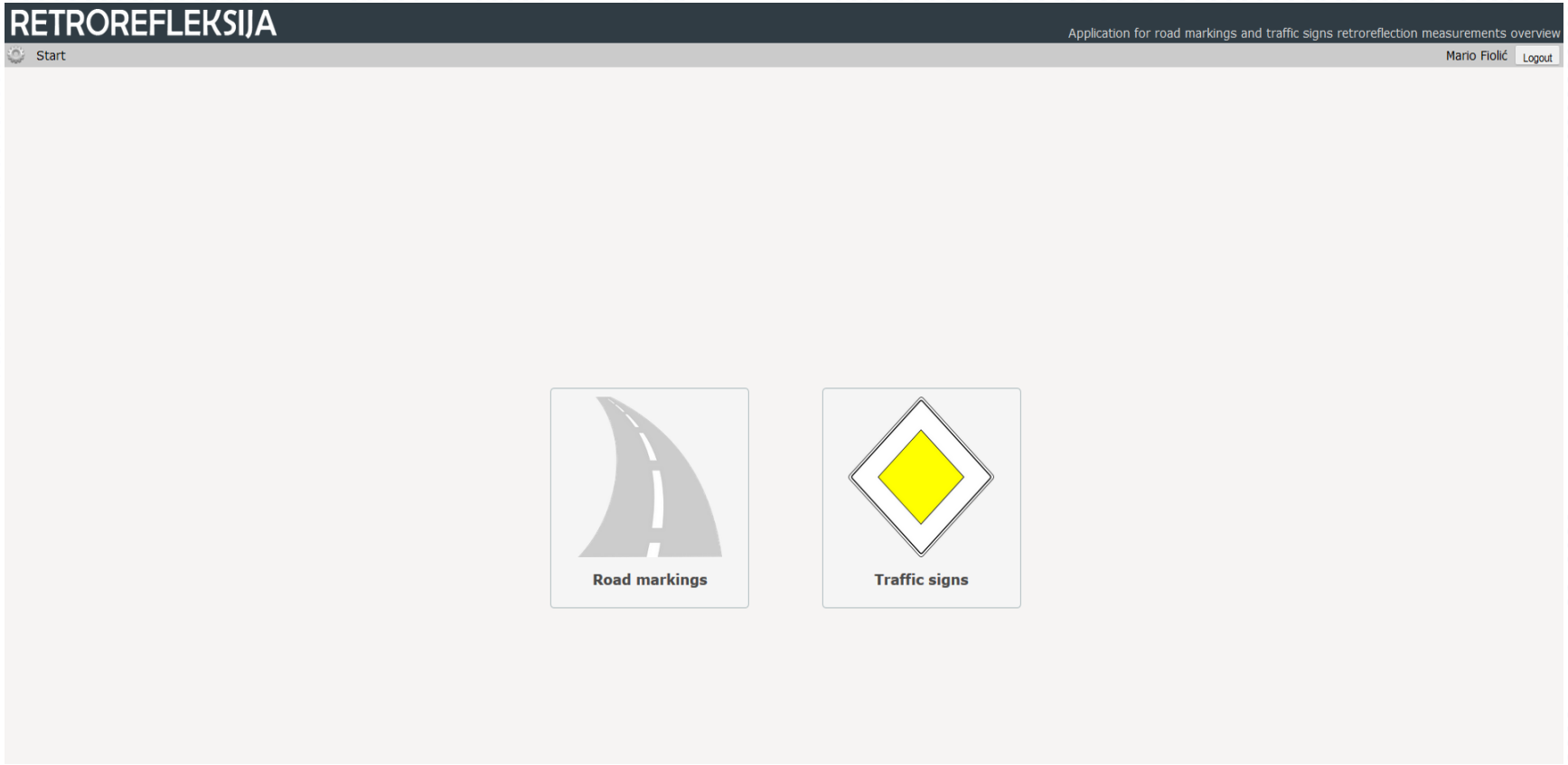
- on Highways is minimum Class 2 material

CASE STUDY: Traffic signs retroreflection measurement on Croatia Highways

- Percentage share of traffic signs that meet and do not meet the technical requirements
- Average age of “good“ signs is **10,40 years**
- Average age of “bad“ signs is **15,70 years**

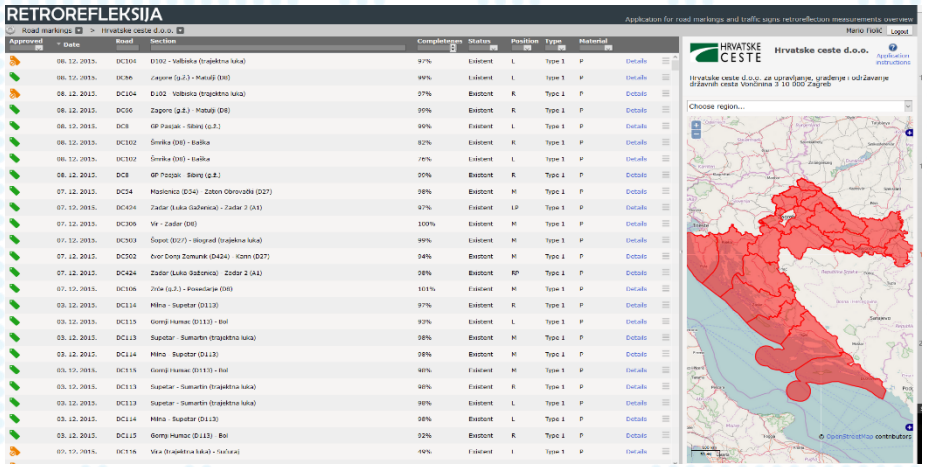


SPECIALIZED SOFTWARE PACKAGE – Developed by Department of Traffic Signalization



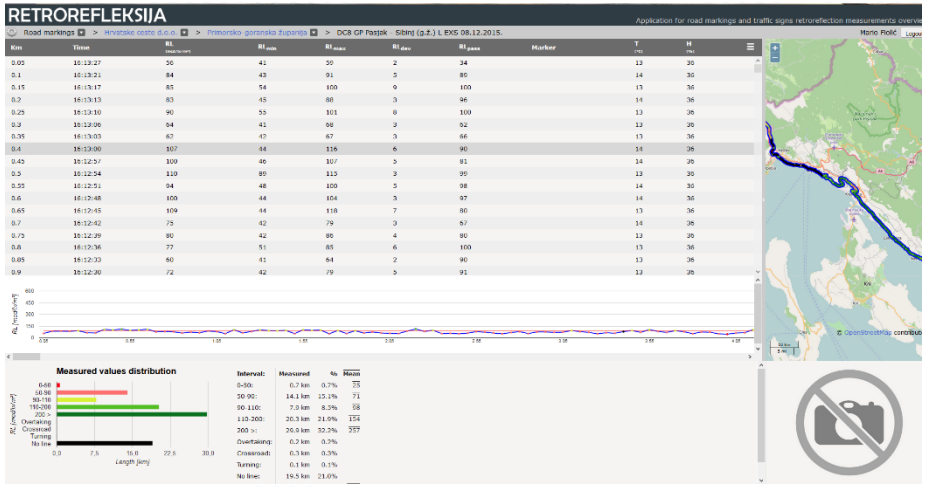
- The Software developed by Department for Traffic Signalization is used to view the test results of night visibility (retroreflection) of road markings and traffic signs. It provided a detailed data analysis for further research, automatic generation of report for each test (vertical or horizontal signalization) and preparation of databases for tested traffic signs.

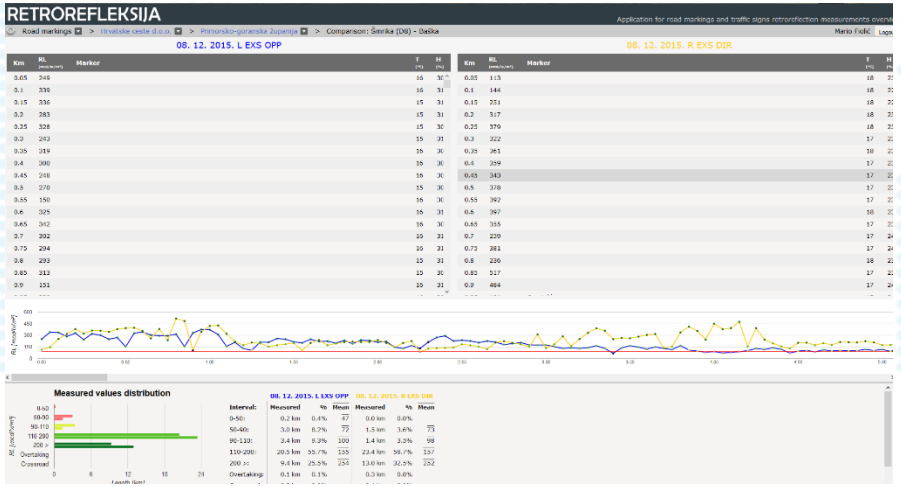
ROAD MARKINGS MODUL



FEATURES:

- Fast upload
- Measurement data review
- Measurement GPS coordinates and picture
- Data analysis
- Comparison data
- Full report





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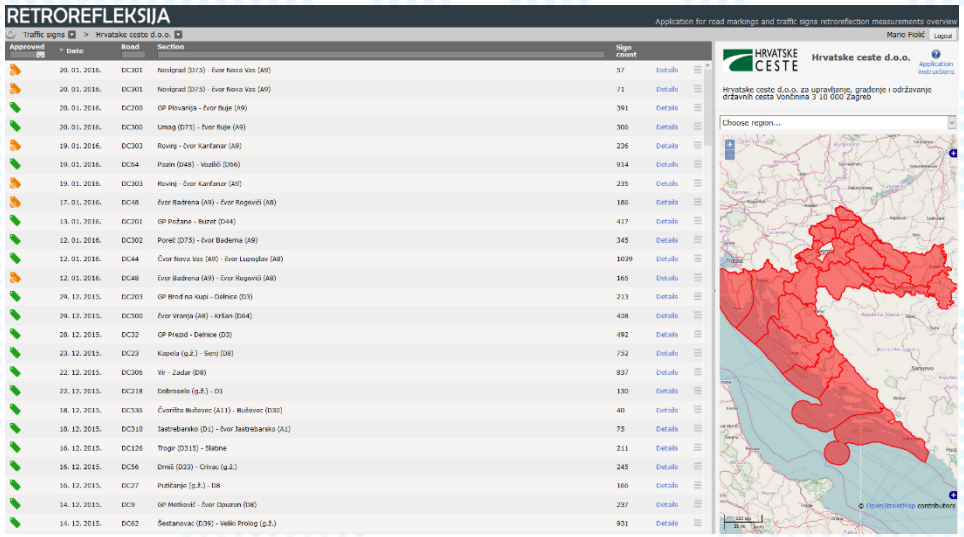
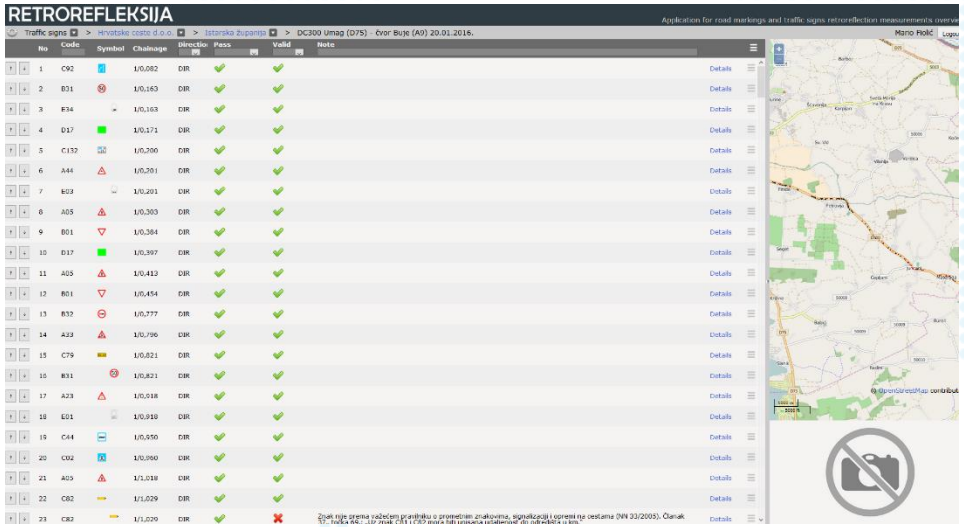
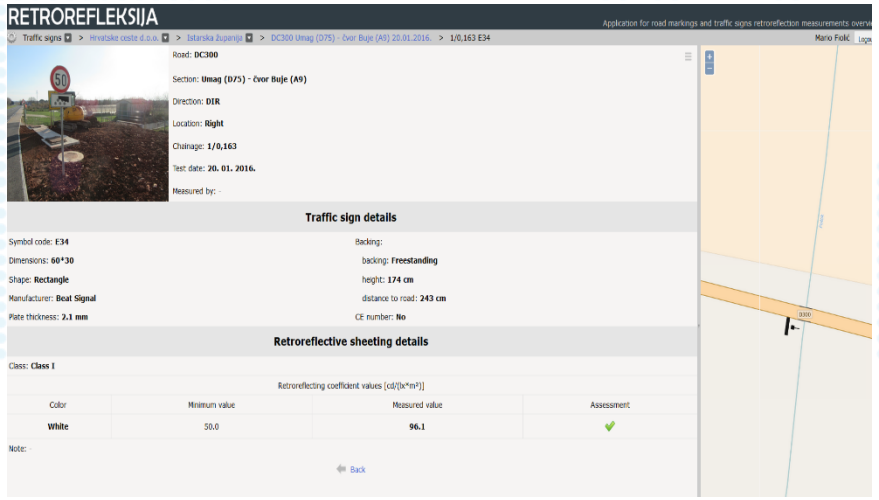
TRAFFIC SIGNS MODUL



FEATURES:

- Fast measurement data review
- GPS coordinate and road kilometer position of each traffic sign
- Data analysis
- Full report





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