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Light Barrier at Level Crossings in the Czech Republic

TRANSPORT RESEARCH CENTRE

This presentation contains mainly the results of the research project SVEZA - *Research on the applicability and effectiveness of the so-called light barrier at level crossings in the CR* (2011 – 2014), carried out in cooperation with TRAKCE, under the financial support of the Technology Agency of the CR.

Main goals: Define conditions (legal and technical) of application of the light barrier in the Czech Republic, set up 3 – 4 pilot applications at crossings with varied characteristics and using products of different producers, investigate impact of the light barrier on users‘ behavior, and carry out public acceptance research

Light barrier - essentials

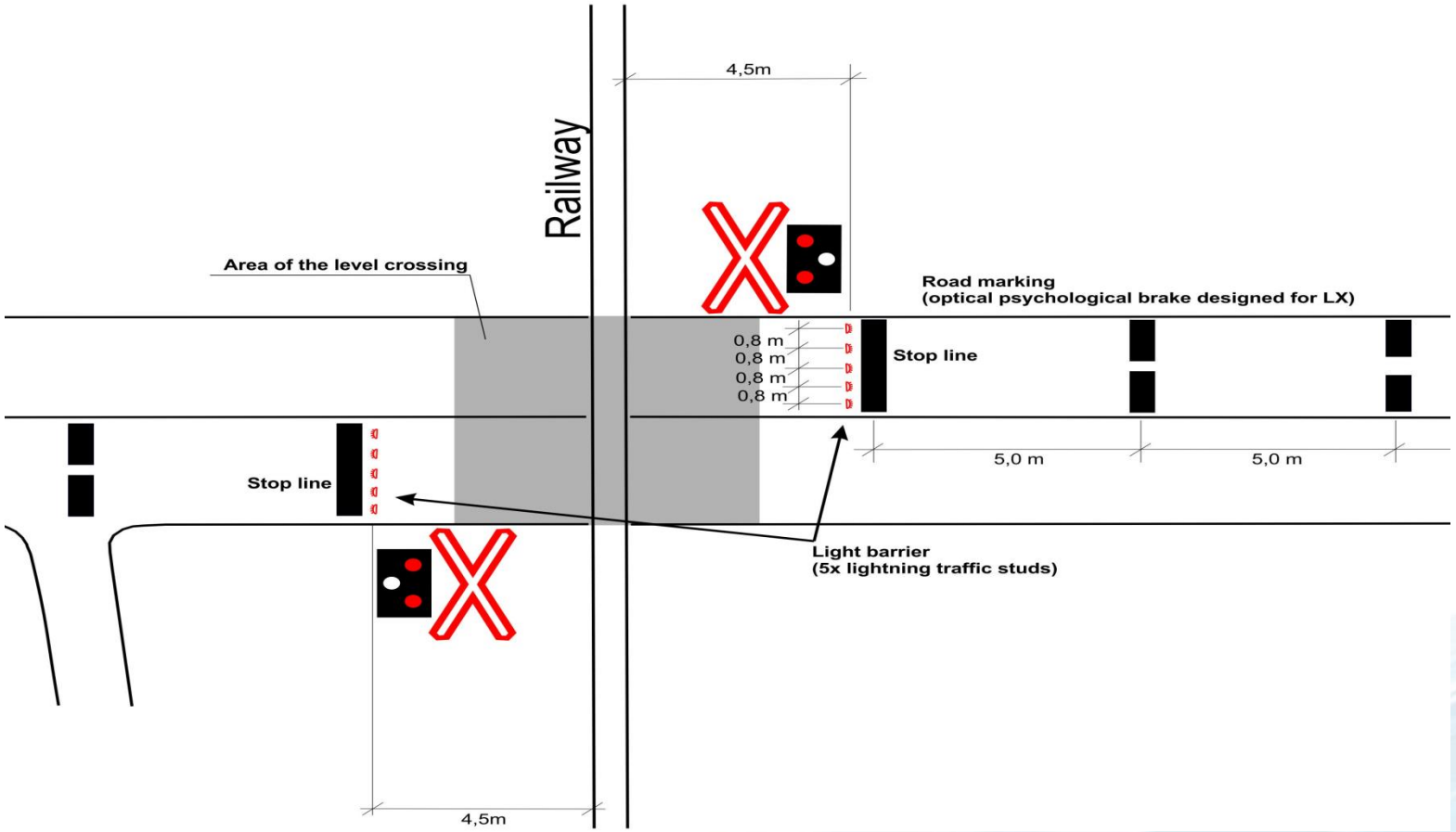
Light barrier - essentials

- Additional warning enhancing the status of basic warning on a level crossing
- Main purpose – double information given by basic warning system, and thus increase attention of driver
- Due to its position, the device is well perceived even by drivers that are stressed or not fully concentrated on driving performance; compared to basic warning lights, it is also better visible by strong daylight

Light barrier - essentials

- The device consists of the set of red traffic light studs
- Studs light up flashing red lights simultaneously with the basic warning lights, creating optical barrier
- Activated by a non-potential contact of the crossing signaling device relay; any failure must not effect basic warning light device

Light barrier - essentials



Why light barrier?

Accidents – situation in the CR

2013	number of level crossings		number of accidents		number of injuries		number of fatalities	
Andrew's cross	4298	53.5%	81	45.0%	28	32.2%	4	17.4%
Warning lights without barriers	2182	27.1%	82	45.6%	45	51.7%	12	52.2%
Warning lights with barriers	1150	14.3%	17	9.4%	14	16.1%	7	30.4%
Mechanical barriers	375	4.7%	0	0.0%	0	0.0%	0	0.0%
Other protection	36	0.4%	0	0.0%	0	0.0%	0	0.0%
Total	8041	100.0%	180	100.0%	87	100.0%	23	100.0%

Why light barrier?

Accidents – situation in the CR

2008 - 2013	number of accidents		number of injuries		number of fatalities	
Andrew's cross	591	45.2%	217	33.8%	46	21.4%
Warning lights without barriers	590	45.1%	394	61.4%	116	54.0%
Warning lights with barriers	123	9.4%	31	4.8%	51	23.7%
Mechanical barriers	3	0.2%	0	0.0%	2	0.9%
Other protection	0	0.0%	0	0.0%	0	0.0%
Total	1307	100.0%	642	100.0%	215	100.0%

Why light barrier?
Results of inspections

- In frame of AGATHA project, inspections of 60 level crossings and 10 black spots were carried out
- Wide range of safety defect was revealed, predominantly various forms of **visibility** problems (obstacles in view, view point too close to the crossing, “invisible” crossing, wrong position or poor luminance of warning lights, acute angle, optical delusion…)
- The same problems were reflected in testimonies of road users that participated in accidents

Why light barrier?

Results of analysis of testimonies

- In frame of ARIANA project, 41 testimonies of level crossing accidents survivors were analyzed, to define circumstances leading to accidents
- Only few cases were obviously caused by deliberately reckless or risky behavior
- Most often, various sorts of view problems were present (obstacles, view point too close to the crossing, invisible crossing, wrong position or poor luminance of warning lights, acute angle, optical delusion….)

Why light barrier?

Behavior of road users

- In frame of ARIANA project, extensive observation of road users at level crossings was carried out
- The observation revealed low level of compliance towards red light signal at level crossings equipped with warning lights, with or without complementary barriers
- Apart from deliberate risking, the reasons for ignorance appear to be also poor luminance or wrong position of the signaling device, and low authority of warning lights at level crossings with complementary barriers (users concentrate on barriers instead of lights)

Why light barrier?

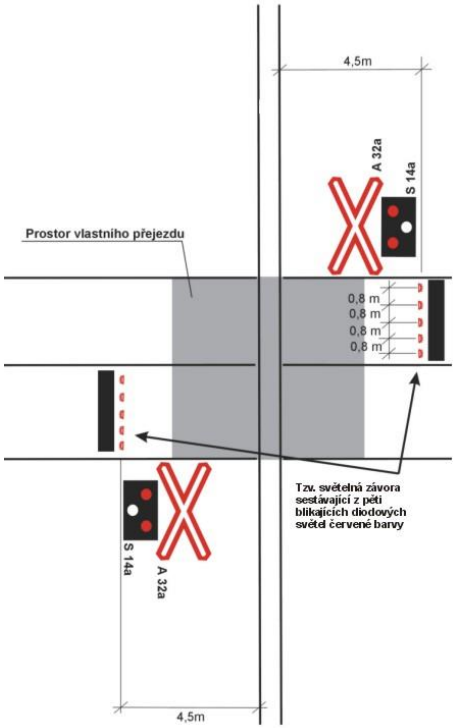
Light barrier helps to solve these safety problems:

- „Invisible“ crossing: the device improves conspicuity of the crossing in the terrain
- Insufficient luminance or inconvenient (east – west) orientation of the basic warning signal: the light barrier is well visible even by strong sunlight
- Low authority of warning lights: LB enhances the status of basic warning signal
- Stressed, inattentive, tired driver: LB increases attention; highly visible and noticeable due to its position on roadway

Light barrier in the Czech Republic

- To date, 3 pilot applications were installed in the CR : Nová Včelnice, Kamenice nad Lipou, and Otice
- Observations of road users behavior were carried out (Včelnice, Otice), surveys of public opinion (Včelnice, Kamenice), and monitoring of physical state and technical parameters (all localities)

Pilot implementation in Nová Včelnice



Pilot implementation in Nová Včelnice

(control unit EBE Solutions, GmbH)

Pilot implementation in Nová Včelnice

- Installation June 2011, in operation since July 2011
- No accidents during the testing period
- Technical checks: no functionality errors identified until now, minor damages on cover glasses of the studs and deficiency of one LED diode
- Survey of public opinion, observation of road users‘ behavior, and measurement of luminance carried out

Light barrier in Nová Včelnice

Measurement of luminance

Light barrier in Nová Včelnice

Measurement of luminance – example of results (in cd)

horizontal angle vertical angle	20º	15º	10º	5º	0º	5º	10º	15º	20º
15º		1.9	2.4	3.9	4.5	3.4	2.0	1.4	
10º	1.7	3.4	7.3	15.4	16.7	11.8	4.7	2.7	1.0
5º	2.7	8.2	23.2	66.0	79.1	51.8	16.7	5.1	1.3
2º 20´	3.1	10.6	33.5	84.0	113	69.5	25.3	5.9	1.5

Light barrier in Nová Včelnice

Observation of road users‘ behavior

- Observation of road users‘ behavior was carried out, with use of camera, 254 interactions user / warning was recorded (226 car drivers)
- No confused behavior was observed, the users evidently understand the function of the light barrier well
- Comparison with situation „before“ was not meaningful, as the level crossing was originally unprotected; therefore comparison was carried out with data from other crossings equipped with usual warning lights device (ARIANA project)

Light barrier in Nová Včelnice

Comparison of results of observation

- Among car drivers, the proportion of those who ignored red light signal was 2,2% in Nová Včelnice. At level crossings of this type, with usual warning device, the rate of ignorance is 6,4%.

Pilot implementation in Kamenice nad Lipou

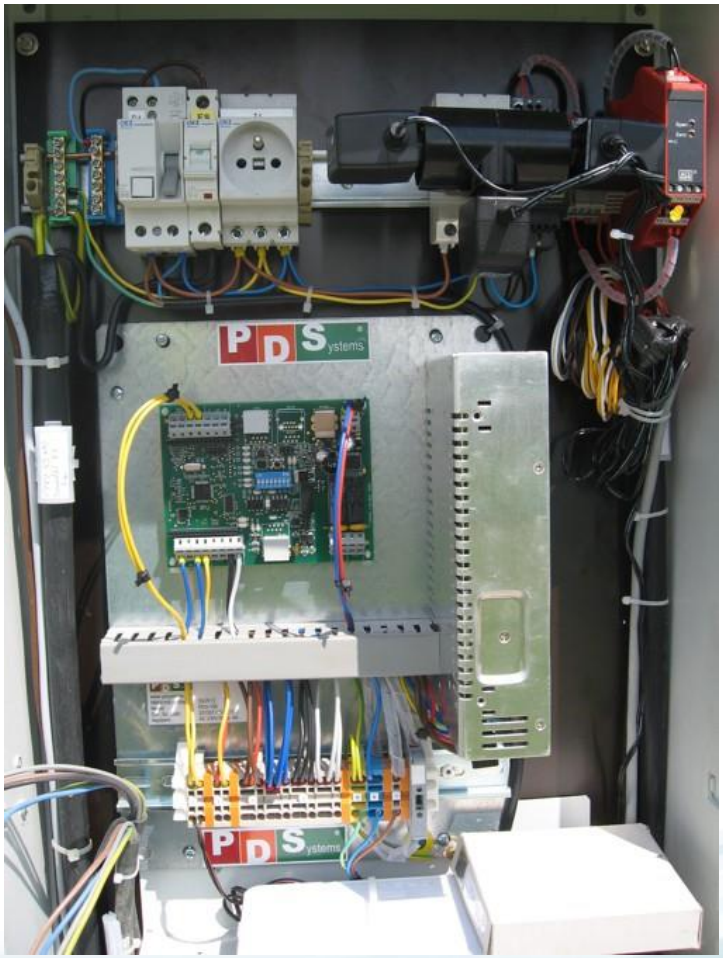
Pilot implementation in Kamenice nad Lipou

- Installation and start of operation in June 2013
- No accidents during the testing period
- Technical checks: neither functionality errors identified until now, nor technical defects
- Survey of public opinion was carried out at this site

Pilot implementation in Otice

Pilot implementation in Otice

(control unit PDSystems s.r.o.)



Pilot implementation in Otice

- Installation September 2012, start of operation June 2013; this installation required development of special convertor for plugging
- The level crossing is equipped with warning lights and complementary barriers; basic idea was to enhance the significance of the warning signal
- No malfunctions or defects until now
- Before/after observations of road users‘ behavior carried out

Pilot implementation in Otice

Results of observations

- No significant changes in compliance during the first two phases of the warning (initial phase and phase of reclined barriers)
- Substantially improved compliance in the third phase of warning (barriers going up, red light still on):

	Driver waited till the end of the warning	Driver continued with red lights still on	Total
Before	176 (70.4%)	74 (29.6%)	250 (100%)
After	139 (90.8%)	14 (9.2%)	153 (100%)

Public acceptance surveys

- Surveys were carried out in Nová Včelnice (125 respondents) and Kamenice nad Lipou (93 respondents), each of them after one year of operation of LB
- Road users in proximity of level crossings were interviewed; standardized questionnaire consisting of three questions was used
- Differences between results in both localities insignificant, so outcomes are presented here altogether

Public acceptance surveys

Results: Satisfaction with present state of the level crossing

Yes, the crossing signaling device with the light barrier in the road is a good solution	**197**	**91.2%**
Yes, but I think that warning lights would be sufficient, the light barrier is unnecessary	2	0.9%
Yes, but extra mechanical barriers would be better	9	4.2%
No, a mechanical barrier instead of the light barrier would be better	4	1.9%
It is quite unnecessary, the previous solution, Andrew's cross with "Stop sign" was sufficient	0	0%
Other	4	1.9%
Total	216	100%

Public acceptance surveys

Results: Advantages and disadvantages of the level crossing equipped with the light barrier

	Agree	Disagree	No opinion	Total
The light barrier is clearly visible, even if sun lights	155 (71.1%)	7 (3.2%)	56 (25.7%)	218 (100%)
Even to an unconcentrated person, the light barrier gives a clear signal to stop	152 (69.7%)	3 (1.4%)	63 (28.9%)	218 (100%)
Unlike with mechanical barriers, no risk of getting trapped on a crossing	64 (9.4%)	1 (0.5%)	153 (70.2%)	218 (100%)
The light barrier does not prevent crossing on a red light as reliably as mechanical barrier	43 (19.7%)	20 (9.2%)	155 (71.1%)	218 (100%)
The light barrier saves time, it turns off faster than a mechanical one rises	90 (41.3%)	4 (1.8%)	124 (56.9%)	218 (100%)
The light barrier attracts too much attention, one may overlook something important	5 (2.3%)	55 (25.2%)	158 (72.5%)	218 (100%)

Public acceptance surveys

Results: How much the light barrier prevents road users from red light crossing?

Yes, definitely	**120**	**57.7%**
Yes, partially	34	16.3%
Yes, but rather only on drivers	32	15.4%
Yes, but rather only on pedestrians	1	0.5%
No	21	9.6%
Total	208	100%

Light barrier in summary

Results of testing

- During the testing period, the device proved excellent reliability and satisfactory resistance against winter maintenance; only minor damages appeared, none of them endangering functionality; low service costs can be expected.
- Measurements proved good values of luminance, especially from position of car driver and longer distances – the barrier is well visible but there is no risk of dazzling. The visibility is good even by strong sunlight and the position of the device ensures that even inattentive drivers would notice it (unlike basic warning signal).

Light barrier in summary

Results of testing

- The light barrier has measurable effect on behavior of drivers (better compliance with the warning signal).
- The installation of the device met very good public acceptance.

Response in media:
„Even hundred years old engine is able to activate the most modern safety device!“

Light barrier in summary

Appropriate use

- **Cheaper alternative to the complementary mechanical barrier at one track level crossings:** wherever the conspicuousness of the level crossing needs to be improved, or the basic warning signal itself seems to be insufficient, but the intensity of traffic does not require mechanical barrier
- **Complement for level crossings with warning lights and mechanical barriers:** wherever the status of basic warning signal needs to be enhanced (high levels of ignorance by road users)

Thank you for your attention!

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