

## ACCIDENTS AT LEVEL CROSSINGS

Ing. Radek Pavelka

### ABSTRACT:

*The critical point of railways are the places where they cross roads, i.e. level crossings. Crossings as such have existed on the railway since its inception, but in a completely different mode. There were significantly fewer crossings and many times the number of crossings that were protected by warning crosses, previously referred to as "Unprotected". At some crossings, the only security was made up of barriers, which were operated by a barrier operator right at the crossing.*

*There are several causes of accidents at railway crossings. The presented article lists the main causes that lead to serious accidents at railway crossings in the Czech Republic. These include: poor meteorological conditions; inappropriate location of the crossing; alcohol behind the wheel; driver inattention; using mobile phones while driving; ignorance of the law; and the impact of changes in society. Driver inattention can be caused by many phenomena. According to the survey, the most common causes of inattention are using or calling on a mobile phone while driving without using a hands-free kit. and then shows options for preventing accidents. At the end, there are proposals for measures to reduce the number of accidents at crossings, which need to be incorporated into the legislation.*

**KEYWORDS:** Rail crossing; signal; gravity; statistical evaluation; critical analysis; measures to reduce accidents.

### 1 ACCIDENTS AT RAILWAY CROSSINGS

The level crossing of road traffic with an operated railway transport route is definitely one of the most risky places both for motor vehicle drivers (road traffic participants) and for rolling stock. Due to this fact, this crossing belongs to the places of frequent traffic accidents. The place where road and railway transport routes cross are railway crossings, where the above-mentioned traffic accidents occur. Less than eight thousand crossings are registered in the Czech Republic. There are many causes and factors that influence the occurrence of traffic accidents at railway crossings. Analytical processing of causes, factors and their analysis can be the basis for processing high-quality expert opinions as part of the investigation of accidents at crossings for the needs of the court, other bodies and institutions. These facts call for effective processing of all available data on traffic accidents at crossings, the result of which will be a high-quality expert opinion.

Crossings as such have existed on the railway since its inception, but in a completely different mode. There were significantly fewer crossings and many times the number of crossings that

were protected by warning crosses, previously referred to as "Unprotected". At some crossings, the only security was made up of barriers, which were operated by a barrier operator right at the crossing. It should be noted that during the development of the railway (19th century) there was a disproportionately smaller number of both trains and mainly cars. The number of passenger cars on Czech roads has increased thousands of times in 100 years. While at the beginning of the 20s of the last century there were less than 5,000 cars registered in Czechoslovakia at the time, there are currently 5.7 million.

The number of vehicles increased rapidly during the First Republic. In 1930, there were already over 100,000 cars in Czechoslovakia. At the beginning of the 1960s, it was triple. In 1989, there were 3.2 million cars and vans on the register. This follows from data from the Association of Car Importers and CTK. [6]

With the increasing number of trains, but mainly cars, there was also an increase in traffic accidents, including those at railway crossings. With this increase in accidents, questions also arose as to why such accidents actually occur and what leads the driver of a motor

vehicle to overlook the warning signs at the crossing or to generally not behave as required by Act No. 361/2000 Coll. Decree on Traffic on roads.

In view of the increasing number of accidents at railway crossings, the interest of various institutions to describe the problem in some way has naturally started to increase. From the statistics so far, it appears that the number of accidents at railway crossings almost stagnated in 2020, but in 2021 this number had an increasing tendency (Tab.2). What is the cause of this increase and what is the common cause of accidents at the level crossing? We will try to find answers to this in this post.

Accidents at railway crossings are increasing or, at best, stagnating, which is also confirmed by the results of Railway Inspection statistics. In particular, accidents with fatal consequences for participants in accidents at level crossings are increasing, and due to the increasing speed of rolling stock on the railway transport route, the consequences of collisions at level crossings are becoming more and more fatal. From a social point of view, it is necessary to recognize the most common causes of accidents at crossings and to contribute to their elimination by analyzing them. However, this in itself is not enough, and compliance with the Road Traffic Ordinance and related road regulations is an integral part of this process. There are certainly big reserves here that need to be eliminated and the behavior of drivers methodically changed

already in the process of preparing to obtain a driving license.

Despite all these aspects, accidents at crossings are statistically increasing or the numbers are stagnating, and the investigation of traffic accidents at crossings requires a very detailed processing of all available documents. Disputed cases are often resolved through court. In order to solve these cases, the courts absolutely need expert opinions of the highest quality, which are based on the processing of all available documents. The basic task is to ensure the highest quality and the most objective clarification of these accidents, and not only at railway crossings.

## 2 STATISTICS OF ACCIDENTS AT RAILWAY CROSSINGS

### 2.1 Statistics of encounters at crossings

The statistics of the Railway Inspection (see Table 1) show some fundamental facts. According to statistics for 2021 and 2022, the number of extraordinary events at railway crossings decreased on the same date, but the number of people killed increased by 6 cases. It is therefore evident that the situation in terms of accidents at railway crossings is not improving. This fact is not at all satisfactory. And as the statistics for 2020 show us compared to previous years, and finally compared to 2021, the situation is really not good.

<b>Střetnutí na železničních přejezdech</b>						
	2022			2021		
	počet MU	usmrceno	zraněno	počet MU	usmrceno	zraněno
leden	13	1	5	17	5	2
únor	9	2	4	17	0	10
březen	9	2	4	12	7	4
duben	18	4	7	9	3	2
květen	21	4	11	11	1	9
červen	11	1	5	12	0	3
červenec	15	6	15	19	2	11
srpen	15	2	10	14	0	10
září	15	2	6	9	5	2
říjen	16	6	13	16	3	7
listopad	10	2	8	10	1	3
prosinec	13	3	6	14	2	6
<b>Počet MU 1.1. - 31.12.</b>	<b>165</b>	<b>35</b>	<b>94</b>	<b>160</b>	<b>29</b>	<b>69</b>

Tab. 1 – Střetnutí na železničních přejezdech, stav k 31.12.2022 [3]

Tab. 1 – Encounters at railway crossings, status as of 31.12.2022

<b>Střetnutí na železničních přejezdech</b>						
	2021			2020		
	počet MU	usmrceno	zraněno	počet MU	usmrceno	zraněno
leden	17	5	2	11	1	6
únor	17	0	10	8	1	14
březen	12	7	4	7	2	4
duben	9	3	2	9	6	4
květen	11	1	9	11	4	5
červen	12	0	3	13	4	19
červenec	19	2	11	26	7	10
srpen	14	0	10	12	4	3
září	9	5	2	15	4	13
říjen	16	3	7	8	3	4
listopad	10	1	3	12	0	6
prosinec	14	2	6	14	3	5
<b>Počet MU 1.1. - 31.12.</b>	<b>160</b>	<b>29</b>	<b>69</b>	<b>146</b>	<b>39</b>	<b>93</b>

Tab. 2 – Střetnutí na železničních přejezdech, stav k 31.12.2021 [3]

Tab. 2 – Encounters at railway crossings, status as of 31.12.2021

## 2.2 Statistics of encounters at crossings for the year 2019

From the graph according to Table 3 (Tab.3), it can be seen that the number of extraordinary events resulting from collisions at a railway crossing is not decreasing, but quite the opposite. The table shows that the steepest increase was recorded in 2019, when the number of these accidents increased year-on-year by 11 cases.

The development in this area does not show too many changes even for 2020, although a slight

improvement is probably looming. According to table 3, in 2019 as of 31.12. recorded 181 extraordinary events resulting from a collision at a railway crossing. For the same period in 2020, 146 of these events are recorded, which is a significant improvement. 2020 was the first year in a long time in which there was a decline in this area. The causes of this decline can apparently also be seen in the year-round social development, which was significantly affected in 2020 by the pandemic situation and related measures.

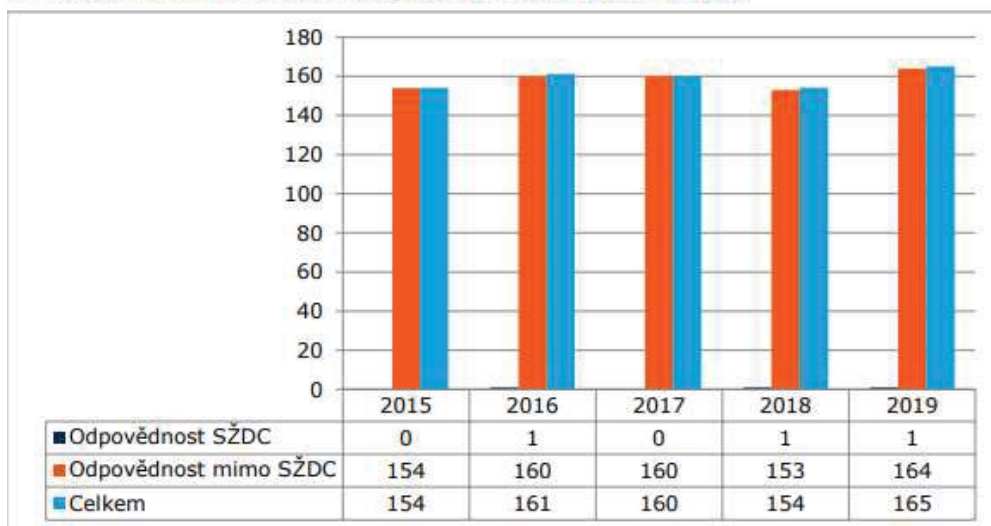
### Střetnutí na železničních přejezdech

	2020			2019		
	počet MU	usmrceno	zraněno	počet MU	usmrceno	zraněno
leden	11	1	6	22	2	3
únor	8	1	14	11	0	3
březen	7	2	4	11	2	6
duben	9	6	4	18	4	8
květen	11	4	5	18	4	3
červen	13	4	19	13	1	6
červenec	26	7	10	24	10	27
srpen	12	4	3	16	3	15
září	15	4	13	10	3	9
říjen	8	3	4	17	7	8
listopad	12	0	6	15	5	2
prosinec	14	3	5	6	2	3
<b>Počet MU 1.1. - 31.12.</b>	<b>146</b>	<b>39</b>	<b>93</b>	<b>181</b>	<b>43</b>	<b>93</b>

Tab. 3 – Střetnutí na železničních přejezdech, stav k 31.12.2020 [3]

Tab. 3 – Encounters at railway crossings, status as of 31.12.2020

### Graf střetnutí na železničních přejezdech v letech 2015 až 2019



Tab. 4 – Graf střetnutí na železničních přejezdech v letech 2015 až 2019[1]

Tab. 4 – Graph of encounters at railway crossings in the years 2015 to 2019

### 2.3 Statistics of encounters at crossings for the year 2022 according to crossing security

According to the above-mentioned table 5, it can be seen that the number of accidents at railway crossings is highest at crossings which,

although secured, are not equipped with barriers. This number is almost half of the total number of all accidents unfortunately. crossings for the monitored period. It is therefore obvious that the absence of barriers at secured crossings is of fundamental importance for the sequence of events when crossing a railway crossing with a road vehicle. Even on the basis of these

statistics, these types of crossings are not newly activated during the reconstruction of crossings in the SŽ administration, i.e. without barriers. During all reconstructions, all crossings are now equipped with barrier beams, regardless of the traffic class, i.e. also on forest and field roads that cross the railway line.

From the researches on the behavior of drivers at railway crossings, conducted for example by the CDV (Centre for Traffic Research) [4], the beam barrier appears almost like a small "miracle". Crossings equipped in this way clearly show a completely different number of accidents than at other crossings, even the lowest of all monitored, with the exception of crossings secured only mechanically, i.e. only by beam barriers.

### 3 SITUATION AT RAILWAY CROSSINGS

The current hectic time brings with it changes in the behavior of society as a whole. These changes are of course also reflected in a different perception of the surroundings. The current era and its achievements can give some individuals feelings of invulnerability and mastery of any situation. This fact can then be reflected in the behavior of drivers at level crossings. From this point of view, it is necessary to contribute to alleviating the feeling of insecurity among some drivers and contribute at least a little to changing the perception of dangerous spaces, such as a railway crossing undoubtedly is. If this can be done, even with a small group of drivers, then we will be a little bit closer to potential improvement.

So what are the most common causes of collisions between motor vehicles and trains? It can be stated with certainty that there are certainly a number of reasons.

Despite the relatively large media coverage of this problem, it is not possible to find a solution to prevent these fatal accidents.

An important task for all of us is to make the public aware that a railway crossing is a very dangerous place and road users must behave accordingly.

#### 3.1 Rail network

Relative to the area of the Czech Republic, we have the densest railway network in

Europe. This fact in itself generates a relatively high number of crossings in the Czech Republic. Here, too, it is necessary to find ways to solve the problem and perhaps even gather inspiration from the neighbors. For example, ÖBB (Austrian Federal Railways) has reduced the number of level crossings from 10,700 to 3,300 since 1960, as of 2016. As of 12/31/2023, Austrian Railways has managed to reduce this number to 2,984 crossings. [7] Every year, the railway administration invests considerable resources in increasing safety at railway crossings, acts as a preventive measure on road users with new information campaigns, and warns of the dangers of non-compliance with the rules through various actions. During reconstructions and renewals, many crossings are canceled without compensation or replaced by underpasses or overpasses. However, these are enormous financial resources and, as already mentioned, with regard to the very dense railway network in the Czech Republic, not every railway crossing can be canceled without compensation or replaced with an underpass or overpass.

#### 3.2 Mobile Phones

There can be several reasons behind the increasing trend in the number of accidents at railway crossings. First of all, it is the inattention of drivers, but this is already a generally known fact. This inattention can be caused by many things, but among the most common is certainly using or calling on a mobile phone while driving without using a hands-free kit. Using a mobile phone while driving, writing text messages and the related inattention while driving are among the most common causes of accidents on domestic roads in recent years. In 2021, 65 people died behind the wheel due to inattention accidents. This is a recent negative phenomenon when driving motor vehicles. [1]

There are hundreds of surveys conducted around the world that clearly prove that using cell phones while driving is very dangerous. And it must also be said that it is very widespread.

Talking on the phone, and especially texting while driving, is a serious problem especially among young people, but not only among them. Research has shown that drivers who use their phones while driving have a reduced awareness of their surroundings and are more likely to lose their lane. Imagine looking at your mobile for 5 seconds at a speed of 90 km/h. In that amount of time, you will drive 125 m. That's like blindly crossing the entire football field and then some. Then it's not hard to understand why phone use is such a problem and why it claims dozens of lives every year. [1]

Many may argue that they have hands-free in the car, so they can still keep a firm grip on the steering wheel with both hands while talking on the phone. But in reality, even such a conversation is problematic. The very act of conversation is in itself a distraction from concentration. If the complexity of the traffic situation requires a certain amount of concentration and at the same time you have to devote part of your brain capacity to conversation, then the brain has to prioritize one activity over another. Our brain cannot fully devote itself to any one activity. It doesn't matter so much when talking on the phone, but when driving a car it can have, and unfortunately often does, fatal consequences.

In the Czech Republic, the use of mobile phones is of course prohibited for car drivers, but just stand on the side of the road for a while and you won't have enough fingers on both hands to count the number of drivers who are talking on the phone or, worse, writing text messages. Thanks to the ban, at least they are aware that they are doing something wrong and are at risk of punishment for it.

However, if we look abroad, we can come across significantly tougher rules for using phones in cars. For example, in France, you are not allowed to use a mobile phone even if you are standing in a place that is not directly reserved for parking. So French drivers can forget, for example, about using the roadside warning lights. If caught, they can also pay a fine of up to 3,500 crowns and 3 penalty points in addition. Some countries go even further. If you are caught using your phone while driving in Trinidad and Tobago, you can spend up to 3

months in jail and be fined up to 10,000 crowns.

On the contrary, for example, Sweden does not ban the use of telephones, but the state spends a large amount of money on preventive campaigns to make people aware of the dangers of their actions.

The technology is still developing, and in the very near future, fully autonomous cars should gradually start to become part of normal traffic. This will be a welcome change for many drivers who need to make calls or text messages while driving, as they will not have to fear for their lives or endanger the lives of others. Until then, however, all drivers should be cautious and use the phone in the car really only in exceptional situations or preferably not at all.[2]

### ***3.3 Behavior of drivers***

Another cause of accidents at railway crossings is the aggressive and irresponsible behavior of drivers, especially young ones. To this can be boldly attributed the uncontrollable and everywhere present tendency to rush for no real reason. However, this can generally be stated in connection with all traffic accidents, i.e. not only those at railway crossings. The current hectic time, which is also transferred to road traffic, contributes to the current development to a large extent.

### ***3.4 Ignorance of the law***

Ignorance of Act No. 361/2000 Coll. and specifically § 29 of the aforementioned law, which clearly defines when a driver may not enter a railroad crossing. Despite this very precise definition, it is often violated. For illustration, we can use the very first indent of paragraph 1 § 29 of Act No. 361/2000 Coll. It says that the driver must not enter a railway crossing if a warning is given by two red alternating lights of the signal of the crossing security device. And this interpretation is incomprehensible to many drivers. I will give an example of the behavior of drivers who violate the above provisions of the Act. [5]

### ***3.5 Impact of changes in the company***

Another reason may be some kind of changes in society, which negatively affect the behavior of drivers. It might seem unlikely, but unfortunately it can affect some individuals.

The point is actually that the driver is not fully dedicated to driving the motor vehicle, and perhaps the reasons "Why?" are irrelevant, because the result of such actions ends very similarly.

In general, there are many reasons why drivers do not devote themselves fully to driving motor vehicles. As already described, these are mobile phones, music playback in the car (radio), navigation settings while driving, operation of additional car functions (various heating, air conditioning settings, etc.) and, last but not least, children, especially small ones. We could probably find more reasons for inattention, but this will be more than enough for our illustration.

The above-mentioned reasons, in my opinion, undoubtedly include the already mentioned changes in society. Maybe they are so-called indirect causes, but they are causes. If we take into account the behavior in today's society, you will surely agree with me that we cannot be satisfied. There is a kind of bad mood in society, and this can logically be transferred to the process of driving motor vehicles. It is clearly visible in the aggressiveness that currently prevails on our roads. It also developed through a kind of development in society. Incomprehensible rushing on the roads, which in turn leads to a traffic accident. But unfortunately, nothing else will help here, other than to keep repeating that when driving, the driver must fully devote himself to driving the motor vehicle. It's not really a phrase, but a necessity.

Accidents at level crossings are specific in many ways. One really distinctive feature is that two different modes of transport are involved in the accident. In this case, it is a big disadvantage for road transport that, from the nature of both types of transport, the railway is the dominant one. Even the consequences of these accidents speak unequivocally in favor of the railway.

Another specific feature is that the investigation of these accidents takes place along several lines. Of course, the investigation is under the responsibility of the PCR, in addition, these accidents are investigated by the railway administrator (SŽ) under its own direction, and the Railway Inspection is also part of the investigation. It might seem that the presence of several entities authorized to investigate these accidents guarantees exceptionally high-quality

investigation results. Practice shows that this may not always be the case.

#### 4 SECURING CROSSINGS

The fact that Správa železnik s.o. invests considerable funds in the modernization of crossings, but the result does not seem to have appeared. For example, in 2021, the railway administration invested around 1.1 billion crowns in the modernization of crossings and about 200 railway crossings were modernized. As part of modernization, crossings are often destroyed and then replaced by underpasses or overpasses (see the case from Blansko mentioned above). According to the current legislation, all crossings must be equipped with light, mechanical and sound warnings. Older crossings, which are not yet equipped in this way, will be supplemented by the time of their complete modernization with a barrier beam, i.e. a mechanical warning.

As can be seen, the railway administrator represented by the Railway Administration takes the circumstances of the situation at crossings very seriously and securing, increasing the security of crossings or their cancellation is one of the priorities of the Railway Administration.

Securing crossings or increasing the security of already secured ones is the right way to try to reduce the unfavorable accident statistics at level crossings. It's just a shame that many drivers, despite this effort, still do not pay enough attention to driving and driving a motor vehicle, as already mentioned in the beginning of the article.

Solutions to change the statistics of accidents at level crossings for the better can be different. One of the ways to increase the safety of railway traffic is the cancellation of level crossings between roads and railways. Although it is a relatively complex administrative process, the Railway Administration (SŽ) has already managed to reduce the number of crossings on its network by 757 since its establishment in 2003 until the end of 2021. Currently, there are 7,734. The reduction in the number of railway crossings is a long-term process. In 2017, 16 of them were canceled and in 2020 there were 26 level crossings. While two years ago there were 37 crossings and last year 52 crossings, this year the pace has accelerated further. From 7,734 at the beginning of 2022, the number of crossings on the Railway Administration's lines has

already decreased by 69. This shows the simplification of the entire process of canceling railway crossings thanks to the amended legislation effective from 2021. With the same level of security will not extend by more than five kilometers. After individual assessment and agreement with local governments and other affected entities, mainly little-used crossings on field and forest roads are removed, where the Railway Administration often also deals with alternative access to the affected land. However, it also concerns crossings with high traffic intensity, which are replaced by level crossings. [3]

Of the crossings canceled last year, in 34 cases they were level crossings protected by a warning cross, another 22 were equipped with mechanical crossing security devices. However, crossings with warning lights or barriers also disappeared, often in connection with modernization.

## 5 CONCLUSION

At the conclusion of today's contribution, it can be stated that accidents at railway crossings are a serious societal problem that deserves high attention and therefore a high priority for solving this problem. As already said, the consequences of these accidents are significantly more serious compared to other accidents. With this in mind and from a forensic engineering perspective, these accidents need to be investigated and clarified as efficiently as possible. The specification of the investigation of these accidents is quite evident, and it is therefore appropriate to develop an effort for a kind of synergy and unification of the investigation of all involved components in the investigation.

The above-mentioned problem has been and is being paid a lot of attention both in the Czech Republic and abroad. The point of view of different authors of articles, publications or entire researches differs in many respects, but we will talk about that again sometime next time.

## 6 LITERATURA

- [1] @article{HDZbbca0vRz6nUIL,  
title = {Používání mobilního telefonu za jízdy je nejčastější příčinou dopravních nehod},  
medium = {online},  
accessed = {2023-04-23},  
DOI = {http://www.finkap.cz},}
- [2] @article{Wf1VbumgMKz9eocm,  
title = {Používání mobilního telefonu při řízení},  
medium = {online},  
accessed = {2023-04-23},  
DOI = {doi:http://www.finkap.cz/},}
- [3] @misc{1QmZ2KWkXJTH7J53,  
title = {Správa železnic},  
medium = {online},  
accessed = {2023-04-23}}
- [4] @misc{FDYBBCBuu7i8sPsv,  
title = {Centrum dopravního výzkumu},  
medium = {online},  
accessed = {2023-04-23},}
- [5] @misc{s3Xah6v47zSrNBkB,  
title = {Zákon o silničním provozu (č. 361/2000 Sb.)},  
Publisher={Https://obchod.wolterskluwer.cz/kata-log?\_filter\_refine\_3=1},  
year = {2022},  
edition = {12/2022},  
ISBN = {978-80-7676-494-1},  
medium = {online},  
accessed = {2023-04-23},}
- [6] @article{fC1NsOI4x3mulkPu,  
title = {Počet aut v Česku se za století zvýšil tisíckrát},  
medium = {online},  
accessed = {2023-04-23},  
DOI =  
{doi:https://www.securitymagazin.cz/security/pocet-aut-v-cesku-se-za-stoleti-zvyzil-tisickrat-1404061240.html},}
- [7] @misc{gYztW94D7jMX38cw,  
title = {Https://www.oebb.at/de/reiseplanung-services/kundenservice},  
subtitle = {Https://www.oebb.at/de/reiseplanung-services/kundenservice},  
address = {Wien},  
medium = {online},  
accessed = {2023-04-23},  
URL = {ÖBB Kund: innenservice},}