

Accidents and safety at level crossings

Period 2024 - 2025

Study

REPORT VERSION TABLE

<u>Version number</u>	<u>Subject of revision</u>	<u>Date</u>
1.0	First version	17/03/2026

For ease of reading, the masculine form is used to refer to certain roles, but these terms apply to all people.

Any use of this report with a different aim than of accident prevention - for example in order to attribute liability - individual or collective blame in particular - would be a complete distortion of the aims of this notice, the methods used to assemble it, the selection of facts collected, the nature of questions posed and the ideas organising it, to which the notion of liability is unknown. The conclusions which could be deduced from this would therefore be abusive in the literal sense of the term.

In case of contradiction between certain words and terms, it is necessary to refer to the Dutch version.

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GLOSSARY

BE	Belgium
CSI	Common Safety Indicators
DGSMRP	Directorate-General for Sustainable Mobility and Rail Policy
ERA	The European Union Agency for Railways
EU	European Union
FPS	Federal Public Service
IM	Infrastructure manager
KM	Kilometre
LC	Level Crossing
NIB	National Investigation Body
NSA	National Safety Authority
RAIU	Rail Accident and Incident Investigation Unit
TSI	Technical Specifications for Interoperability

FOREWORD

This study into accidents at level crossings is being conducted by the Railway Accident and Incident Investigation Unit (RAIU), with the goal of better understanding and identifying the risks and underlying causes of accidents at level crossings. We would like to thank the infrastructure manager and the Directorate General for Sustainable Mobility and Rail Policy of the FPS Mobility and Transport for sharing their knowledge, experiences and data, which made an important contribution towards this study.



1. INTRODUCTION

Belgium has a dense rail network with many level crossings, which is the result of spatial planning that has evolved over time. Despite significant technological improvements, these crossings remain a weak link in railway safety (VRT NWS, 2024a; FPS Mobility and Transport, 2025a). On average, there is still one accident per week at a level crossing, resulting in around one fatality per month. The majority of accidents can be attributed to human behaviour, in particular ignoring red lights or closed barriers and crossing the tracks without due care (Infrabel, undated, -f; RTBF, 2025).

The consequences of such accidents are often serious, both for road users and train traffic. Collisions not only cause human casualties, but also significant damage to rolling stock and rail infrastructure. Accidents and incidents at level crossings also cause delays on a daily basis: in 2024, these caused an average of more than two hours and twenty minutes of delay per day on the Belgian rail network (Infrabel, 2024a; Bruzz, 2024).

Despite the increase in safety systems and the reduction in the number of level crossings, the risk of accidents remains. After all, level crossings are not only physical intersections between road and rail, but also meeting points where different actors cross and their responsibilities converge.

The study starts by sketching the context and explaining the legal framework concerning level crossings and accidents, the data, sources and methodology used. Chapter 3 contains the analysis. Subchapter 3.1 discusses the situation in Belgium in terms of infrastructure, accidents, victims and risk factors, before placing that situation in a European context in subchapter 3.2. Subchapter 3.3 takes a closer look at the infrastructure, focusing on the road layout, level crossing visibility, possible abnormal functioning, and inspections of level crossings. Subchapter 3.4 focuses on the level crossing user and his/her behaviour. Chapter 4 discusses initiatives and measures aimed at improving safety at level crossings, including infrastructure interventions, enforcement, awareness, and the removal of level crossings. The study concludes with a summary of the key findings.



2. THE STUDY AND ITS CONTEXT

2.1. LEGISLATIVE FRAMEWORK

In Belgium, level crossings form an integral part of the rail infrastructure and are managed by the infrastructure manager Infrabel. Infrabel is an autonomous public company. Since 2005, it has been responsible for the acquisition, design, construction, renewal, maintenance and management of railway infrastructure, including level crossings, signalling, switches and catenaries. Infrabel's legal status as infrastructure manager is defined in the management contract with the federal state, in accordance with the Act of 21 March 1991 on the reform of certain public economic enterprises, and railway matters fall within the remit of the federal government (Belgian Official Gazette, 1991; Infrabel, undated, -e; Belgian State & Infrabel, 2014).

Unlike railways, roads are administered on a regional or municipal level. The three regions are responsible for the construction, management and maintenance of regional roads. Municipal roads are the responsibility of the respective municipalities. This means that the road on which a level crossing is located may be managed by the region or by the municipality, depending on the type of road.

2.1.1. ACCIDENTS AT LEVEL CROSSINGS

The Common Safety Indicators (CSIs) provide a standardised framework for measuring and reporting safety-related parameters in the railway sector in Europe. They are laid down in Directive (EU) 2016/798 on railway safety and serve as a tool for assessing the safety performance of railway operators and infrastructure managers. The CSIs encompass several categories of safety-related data, including the number and nature of significant railway accidents, such as collisions, derailments, accidents at level crossings, accidents to persons caused by rolling stock in motion, fires and other accidents¹. In addition, fatalities and serious injuries are recorded by type of accident; suicides are recorded separately and are not counted as accidents. In addition to this human impact, the indicators include material damage to rolling stock, infrastructure and the environment, as well as the financial consequences of accidents. Furthermore, the impact on the operational performance of the railway system is taken into account by measuring delays resulting from accidents (European Parliament, Council of the European Union, 2016). The articles relating to the CSIs from Directive (EU) 2016/798 have been transposed into Belgian law in Annex 4 to the Railway Code.

A significant accident is “any accident involving at least one moving railway vehicle in which at least one person has been killed² or seriously injured³, or which has caused significant damage to equipment, tracks, other installations or the environment or has caused serious disruption to traffic, with the exception of accidents in workshops, warehouses and storage areas” (free translation) (Belgian Official Gazette, 2013, p. 97). In this context, significant damage to equipment, rails, other installations or the environment means damage equivalent to at least €150,000. Furthermore, severe disruption to traffic means that train services on a main rail line are interrupted for at least six hours (Belgian Official Gazette, 2013).

A level crossing accident is defined as, “any accident at a level crossing involving at least one rail vehicle and one or more crossing vehicles, other crossing users, such as pedestrians, or other objects temporarily present on or near the track, in the event that they were lost by a crossing vehicle or user” (free translation) (Belgian Official Gazette, 2013, p. 97). A user of a level crossing, hereinafter referred to as a ‘level crossing user’ is defined in the Railway Code as: “any person who uses a level crossing to cross the tracks on foot or on board a means of transport” (free translation) (Belgian Official Gazette, 2013, p. 97).

¹ Other accidents are understood to refer to accidents due to falling objects, accidents due to infrastructure collapse, accidents due to contact with electrical installations or accidents due to extreme weather conditions.

² A fatality is “any person who is killed in an accident or dies from its consequences within 30 days thereafter, excluding persons who have committed suicide” (free translation) (Belgian Official Gazette, 2013, p. 97).

³ A person is seriously injured if they “were injured in an accident and hospitalised for more than twenty-four hours as a result of the accident, excluding persons who attempted suicide” (free translation) (Belgian Official Gazette, 2013, p. 97).

2.1.2. TYPES OF LEVEL CROSSING

A level crossing is defined in the Railway Code as: “a crossing of a road or passageway and a railway at the same level that is recognised by the infrastructure manager and accessible to public or private users. This does not include passageways between platforms in a station, nor does it include passageways over tracks intended exclusively for use by employees” (free translation) (Belgian Official Gazette, 2013, p. 99). Similar definitions are included in the Road Traffic Code and the Royal Decree on Safety Devices at Level Crossings on Railways.

2.1.2.1. ACTIVE OR PASSIVE SIGNALLING

Level crossings are classified as having either active signalling or passive signalling. A level crossing with active signalling warns the user of the approach or passage of a train. This takes place by means of two traffic signs A45 or A47 (depending on the number of tracks), better known as a ‘St. Andrew’s Cross’ (see Figure 1 and Figure 2), and two traffic lights prohibiting traffic from crossing, or traffic lights such as three-colour, two-colour or orange-yellow flashing lights. The road signs and traffic lights prohibiting crossing are positioned on both sides and to the right of the level crossing.



Figure 1: Road sign A45: Single-track level crossing



Figure 2: Road sign A47: Level crossing for two or more tracks

Furthermore, a level crossing with active signalling may be equipped with one or more additional A45 or A47 traffic signs, a full or partial closure system (full or half barriers, respectively), additional closure systems for pedestrians and cyclists, one or more acoustic signals announcing the arrival of a train, and additional traffic lights prohibiting and permitting traffic to cross (Belgian Official Gazette, 2011). If a closure system is present, the acoustic signals announcing the arrival of a train will sound before and while the barrier system is moving into the closed position and will stop as soon as it has finished moving. At level crossings without a closure system, the acoustic signal will sound for the entire duration that the red lights are flashing. The traffic lights prohibiting crossing are activated when a train approaches and will not be extinguished until the train has completely passed the crossing. In addition, when a level crossing with active signalling is equipped with a closure system, the traffic lights prohibiting crossing must be activated before that system starts moving into the closed position and must not be extinguished until the closure system has fully opened. Traffic lights permitting traffic to cross must never be in operation at the same time as a traffic light prohibiting traffic from crossing (Belgian Official Gazette, 2017).

A level crossing with passive signalling does not warn the user of the approach or passage of a train. It will only be equipped on both sides with one A45 or A47 traffic sign warning road users of a level crossing, and may additionally be equipped with one or more A45 or A47 traffic signs (Belgian Official Gazette, 2011). Also, a level crossing will be announced with an A41 danger sign (level crossing with barriers, see Figure 3) or a danger sign A43 (level crossing without barriers, see Figure 4). These signs must be located approximately 150 metres from the level crossing, unless a secondary sign underneath the main sign indicates a different distance (Belgian Official Gazette, 1975, p. 69).



Figure 3: Road sign A41: Level crossing with barriers



Figure 4: Road sign A43: Level crossing without barriers

2.1.2.2. DISTINCTION BETWEEN PUBLIC AND PRIVATE LEVEL CROSSINGS

Level crossings are classified according to their use: public or private. Public level crossings include full or partial crossings of public roads with one or more tracks constructed outside the roadway, at the same level. Private level crossings consist of an intersection of a public or private road with one or more tracks located outside the roadway, constructed to serve private interests. The regulations for private level crossings are generally less stringent, taking into account the limited amount of traffic and the desire not to impose disproportionate burdens on private citizens relative to reasonable safety goals. Private level crossings must be equipped with active or passive signalling, which may be supplemented by a full closure system. On both sides of a private level crossing, a sign is posted with the designation 'Private level crossing' (see Figure 5) (Belgian Official Gazette, 2011).



Figure 5: Traffic sign indicating a private level crossing in Dutch (L) and in French (R)

If a private level crossing is equipped with a closure system, it must be closed and locked by the authorised private citizen after each use. A closure system of this type will ensure that unauthorised persons do not have access to the level crossing. This is achieved by using a lock or similar security feature, for example (Belgian Official Gazette, 2011).

Finally, different legal rules apply to level crossings in sea and river ports and in industrial zones. Because these locations are mainly used for freight traffic and trains move slowly there, safety devices are not compulsory in those locations. However, the minister can intervene and still impose safety devices whenever warranted by local conditions (Belgian Official Gazette, 2011).

2.1.3. GUARANTEEING THE SAFETY OF LEVEL CROSSING USERS

To ensure safety at and near level crossings, both the Railway Police Act and the Highway Code contain a number of articles applicable to road users.

For example, Article 5 of the Railway Police Act states that it is forbidden “to obstruct, hinder, delay or endanger rail traffic and, in general, to interfere with rail operations in any way.” In addition, leaving vehicles stationary or placing objects in a location where they “are obstructing the easy passage of railway vehicles or the normal operation of the railway infrastructure, or obstruct the view of railway signals,” is prohibited, unless authorised by the infrastructure manager (free translation) (Belgian Official Gazette, 2018, p. 3). Violations of these provisions are considered category 4 offences under Article 31, §4 and may result in administrative fines of €300 to €500, depending on recurrence within a one-year period (Belgian Official Gazette, 2018, p. 9).

The Highway Code contains additional rules that apply specifically to the behaviour of road users on and around level crossings:

- Article 12.1 requires road users to give way to rail vehicles and to clear the tracks as quickly as possible.
- Article 17.2 prohibits passing on the left at a level crossing, with certain exceptions.
- Article 20.1 prohibits “any traffic on tracks located outside the traffic lane”.
- Article 20.2 requires road users approaching a level crossing without active safety devices to take extra precautions and only cross the level crossing once they have ensured that no rail vehicle is approaching.
- Article 20.3 prohibits accessing a level crossing “1° when the barriers are moving or closed; 2° when the red flashing lights are on; 3° when the acoustic signal is sounding”.
- Article 20.4 stipulates that a driver must not drive onto a level crossing “when traffic is obstructed to such an extent that he is likely to have to stop on that level crossing”.
- Article 24 3° prohibits stopping or parking a vehicle on level crossings.
- Article 25.1 prohibits parking in places where the passage of railway vehicles is obstructed.
- Article 77.8 prohibits stopping and parking on chequered markings at level crossings (Belgian Official Gazette, 1975).

Under Article 29 of the Highway Code, violations of these provisions are classified into different categories, with the specific classification being determined by Royal Decree. This classification also determines the severity of the penalties:

- Offences under Articles 20.3 and 24 3° are classified as category 4 offences and are punishable by a fine of €40 to €500 and a possible disqualification from driving a motor vehicle for a period of eight days to five years. In certain cases, for example where there are aggravating circumstances, additional criminal penalties may be imposed, including a fine of at least €208 after the application of surcharges.
- Offences under Article 17.2 are classified as category 3 offences and are punishable by a fine of €30 to €500.
- Offences under Articles 20.4, 12.1 and 25.1 are classified as category 2 offences and are punishable by a fine of €20 to €250.
- Offences under Articles 20.1, 20.2 and 77.8 are classified as category 1 offences and are punishable by a fine of €10 to €250 (Belgian Official Gazette, 1968).

Finally, Article 64.2 and Article 64.3 of the Highway Code clarify the meaning of warning lights at level crossings: “Two alternately flashing red lights mean that all road users are forbidden to pass the stop line, or, if there is no stop line, to drive or walk past the traffic light itself” and “A moon-white flashing light placed at a level crossing means that road users may drive or walk past the warning sign” (free translation) (Belgian Official Gazette, 1975, p. 61).

2.2. DATA AND METHODOLOGY

2.2.1. QUANTITATIVE DATA

The quantitative data for this study came from the CSI dataset of the European Union Agency for Railways (ERA) and data from the Rail Accident and Incident Investigation Unit (RAIIU) database. The datasets were compared and validated to ensure consistency and accuracy.

The data relating to CSIs for both Belgium and other Member States were taken from the ERA database. The dataset is updated every two years and contains data on various safety indicators from all Member States from 2006 through 2023. The ERA includes all Member States of the European Union with a railway system (including the United Kingdom up to and including 2020), Norway, Switzerland and the Channel Tunnel⁴ (hereinafter: European countries). The figures in this dataset come from the annual reports of the National Safety Authorities (NSAs), which are responsible for collecting all information on all CSIs. The quality of the data depends on the accuracy and completeness of reporting by each country to the ERA. Although data collection has improved over the years, data from earlier years in particular should be interpreted with caution because of possible inconsistencies and missing information.

For Belgium, additional information was obtained from the RAIU database. This database is populated by railway undertakings and the infrastructure manager, who record all accidents and incidents on the Belgian railway network. The dataset provides detailed information about each accident, such as the status of the barriers, weather conditions, visibility and specific location characteristics of level crossings. This specificity makes it possible to take an in-depth look at the characteristics of accidents at level crossings and to analyse individual incidents. The CSI data from this dataset were compared with those from the ERA database to ensure consistency. It is important to note that the accuracy of the data in the RAIU database depends on correct input by the railway undertakings and the infrastructure manager involved. In the early years, there were deficiencies and inconsistencies in data reporting. As time went on, the reliability of the data improved, categories were more clearly defined, and the database became more comprehensive. Nevertheless, the data must be considered with a certain margin of error, and some data are missing in individual cases. For example, information on the status of the barriers, on the category of the level crossing, on the functioning of the level crossing, on the status of the road surface and on the position of the sun at the time of the accident is missing.

For this study, we chose to analyse data from 2010 through 2023. This choice was made because the data prior to 2010 varied widely by country. Another reason for choosing that period is because no new countries joined ERA from 2010 onwards, which means that the comparability of the data is greater. The year 2023 was chosen as the end point because it is the most recent year for which complete data are available in the ERA database. Using a uniform end date for all datasets strengthens the consistency of the analyses. A total of 690 cases were analysed for Belgium, of which 208 were classified as CSI accidents and 482 as non-CSI accidents. Until 2020, the ERA dataset included data from 29 countries and from 2021 onwards, from 28 countries, including Belgium.

Combining and validating these datasets provided a robust foundation for analysing accidents at level crossings, with a focus on both European trends and specific national characteristics.

⁴ The Channel Tunnel has no level crossings and therefore no accidents at level crossings.

2.2.2. QUALITATIVE DATA

The qualitative data in this study primarily originate from existing reports, scientific literature and from research conducted in the past, such as Infrabel's Railspect study. Semi-structured interviews were also conducted with relevant representatives of Infrabel and of the relevant departments within the Federal Public Service (FPS) Mobility and Transport. These interviews combined open-ended questions with prepared presentations by the interlocutors. For privacy reasons, the reports of these interviews are not publicly available. Furthermore, questions were posed on an informal basis to the National Investigation Bodies (NIBs) from other European countries in order to provide a framework for comparison. This inquiry was entirely voluntary and was separate from any formal or legal proceedings. Reports from the RAIU and relevant legislation were also consulted.

The documents used were collected by carrying out an extensive online search of news sites, of the websites of ERA, of other research bodies and Infrabel, of the Belgian Official Gazette and of scientific databases.

A side note to the qualitative data is that much of the information comes from Infrabel. Since Infrabel owns virtually all level crossings on the Belgian rail network, it is understandable that this source plays a central role. Furthermore, the relevance and reliability of the sources were assessed solely by the author. Triangulation with other sources and carrying out interviews enabled the information to be validated, thereby reducing the risk of one-sidedness and of missing important information.

3. THE ANALYSIS

3.1. THE SITUATION IN BELGIUM

3.1.1. INFRASTRUCTURE

Belgium has a densely populated rail network. In 2023, the Belgian railway network included a total length of 8,311 kilometres (Infrabel, undated, -c), on which a total distance of 98,634,989.59 kilometres was travelled that the same year (Infrabel, undated, -b). This network contains a significant number of level crossings. On 31 December 2023, the Belgian railway network had 1,621 level crossings, of which 1,191 were located in Flanders, 427 in Wallonia, and 3 in the Brussels-Capital Region. The majority, namely 1359, of these level crossings are public crossings with active signalling. In addition, there were 141 private level crossings with passive signalling, 62 public level crossings with passive signalling and 59 private level crossings with active signalling (Infrabel, undated, -a). Figure 6 shows the distribution of level crossings by region and by type of signalling.

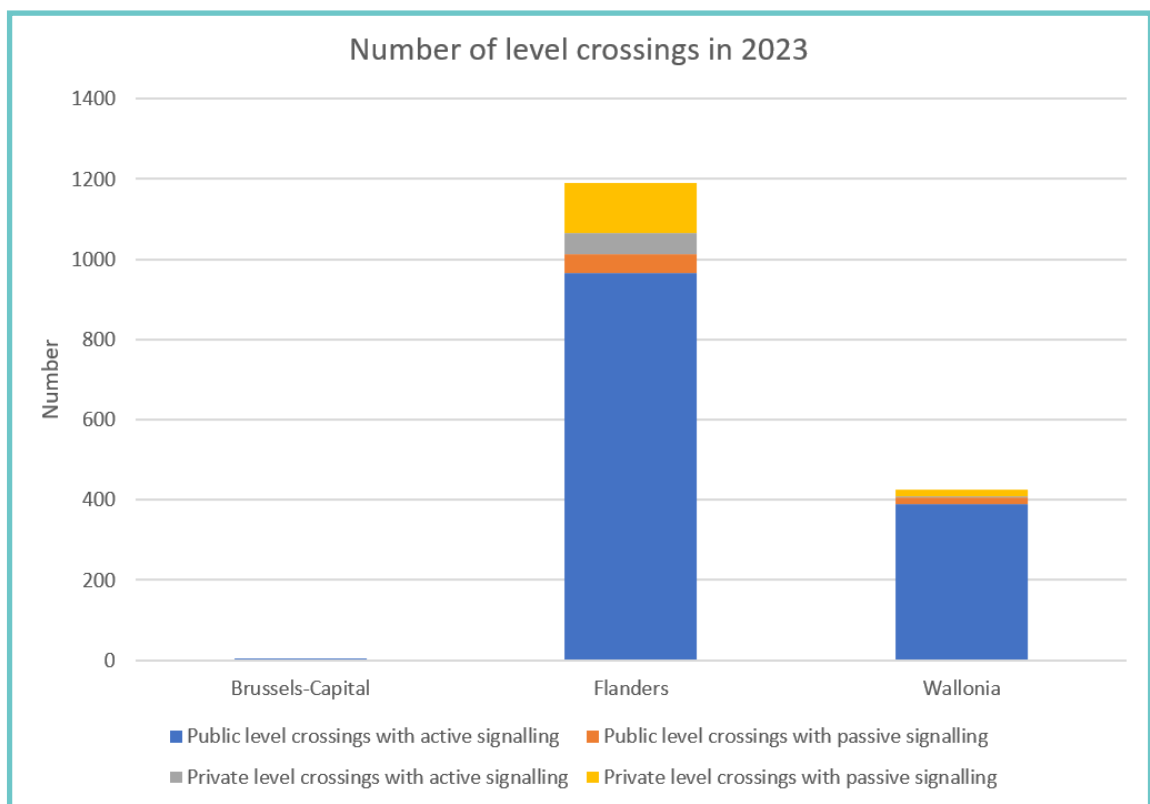


Figure 6: Number of level crossings in Belgium and their distribution by type and region in 2023

Since its inception in 2005, Infrabel has removed 442 level crossings to improve safety (Infrabel, undated, -f). Figure 7 shows the decreasing trend from 1,902 level crossings in 2010 to 1,621 in 2023 (figures refer to the number of level crossings on 31 December of the respective year).

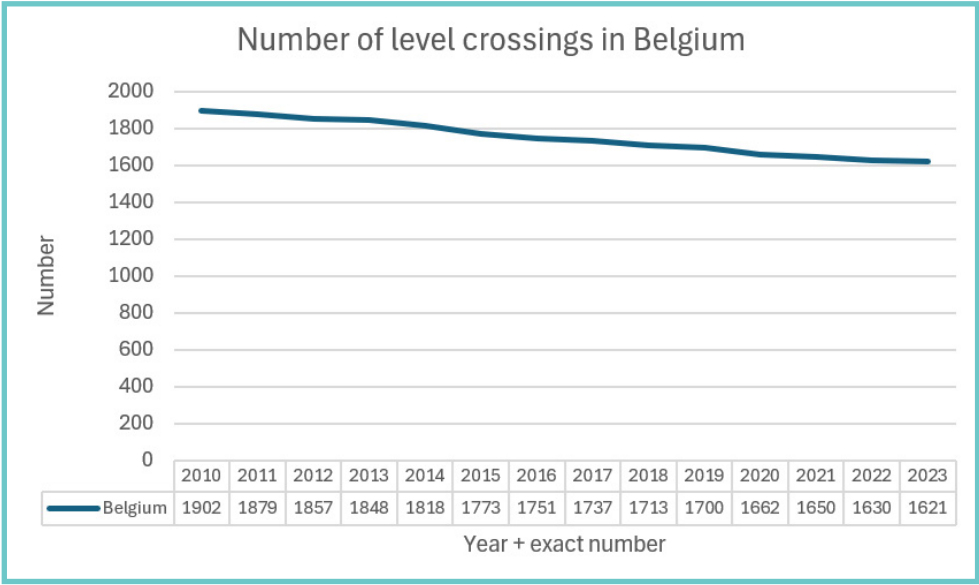


Figure 7: Decrease in the number of level crossings in Belgium, 2010 – 2023

Finding: Belgium had 1,621 level crossings in 2023, most of which have active signalling; the number of level crossings has been steadily decreasing since 2010.

3.1.2. ACCIDENTS AT LEVEL CROSSINGS IN BELGIUM

From the data, we can see that the total number of accidents at level crossings in Belgium underwent a slight downward trend between 2010 and 2023 (see Figure 8). Within this overall decrease, however, a distinction remains visible between CSI accidents and non-CSI accidents. CSI accidents show a relatively stable pattern with limited fluctuations. Non-CSI accidents, on the other hand, fluctuate more sharply, with a notable decline in 2020 and a subsequent peak in 2021.

The reduction in the number of level crossings potentially contributes to the reduction in the overall number of accidents, as fewer physical crossings between rail and road traffic result in fewer potential points of conflict. However, the relatively stable rates of CSI accidents suggest that these significant incidents are less directly affected by the number of level crossings. Factors such as increased road and rail traffic, human error, failure to obey traffic rules, weather conditions and visibility probably play a larger role in the occurrence of CSI accidents. Moreover, CSI accidents are by definition more serious and can be the result of several, mutually reinforcing factors and are not simply eliminated by reducing the number of level crossings.

The notable decrease in non-CSI accidents in 2020 can be partially attributed to the COVID-19 pandemic, which led to reduced road and rail traffic due to lockdown measures such as mandatory working from home (Infrabel, 2021). This resulted in fewer interactions at level crossings and a lower number of accidents. The subsequent increase in 2021 can possibly be explained by the resumption of normal traffic patterns following the relaxation of measures. The overall figures for traffic accidents in Belgium reflect this sharp decrease in 2020, however, it is noteworthy that the total number of traffic accidents in 2021 actually remained below the 2019 level (StatBel, 2022).

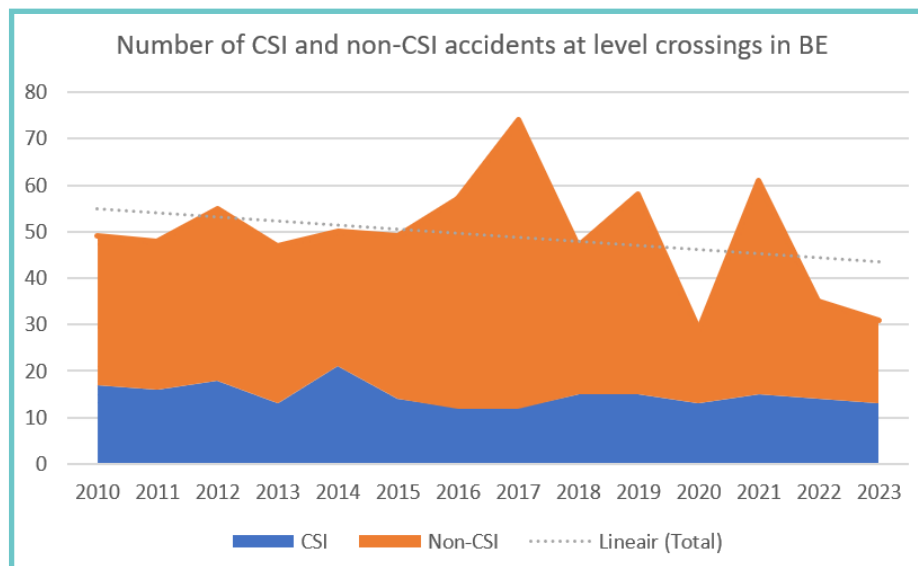


Figure 8: Total number of CSI and non-CSI accidents at level crossings in Belgium, 2010 – 2023

Finding: Although the total number of accidents at level crossings has declined slightly since 2010, CSI accidents remain relatively stable.

3.1.2.1. PERSONS SERIOUSLY INJURED DURING ACCIDENTS AT LEVEL CROSSINGS

Although the total number of accidents at level crossings in Belgium⁵ has shown a declining trend since 2010 (see Figure 8), with a notable peak in 2021, the number of persons seriously injured in a level crossing accident continues to fluctuate significantly. Figure 9 shows that the number of persons seriously injured in accidents at level crossings varies between 2 and 11 per year. The maximum figures recorded in earlier years are no longer being reached in the later years and there is a downward trend. However, the numbers involved are low, which makes it difficult to assess how significant such a trend is. Furthermore, the number of persons seriously injured in 2023 (5) is about the same as in 2010 (4).

The impact of the COVID-19 pandemic in 2020 is less evident in the number of persons seriously injured during accidents at level crossings. This may indicate that the severity of the accidents that did occur did not decrease, despite the lower number of accidents.

In comparison, a total of 3,762 people were seriously injured in road accidents in Belgium in 2023, including victims of accidents at level crossings. The proportion of persons seriously injured from accidents at level crossings is only 0.15%. The total number of people seriously injured in traffic accidents ranged from 3,762 in 2017 to 2,978 in 2020. The decreasing trend that can be observed in the case of serious injuries at level crossings is also reflected in the total number of persons seriously injured in traffic accidents (StatBel, 2025).

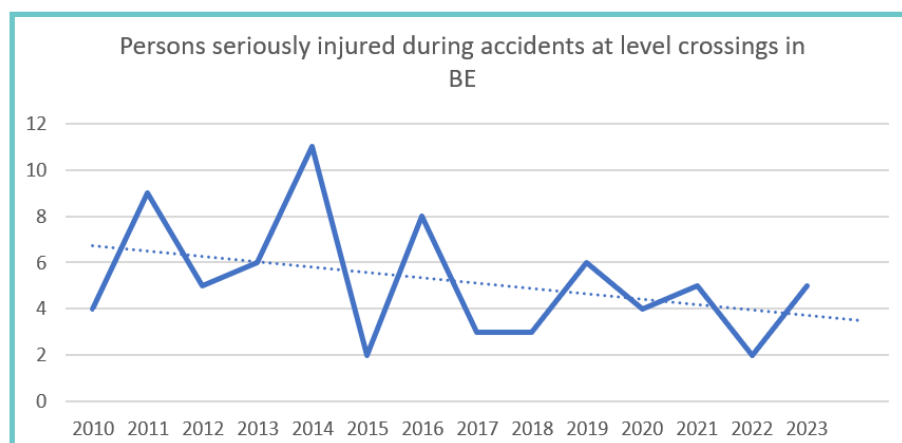


Figure 9: Persons seriously injured during accidents at level crossings in Belgium, 2010 – 2023

Finding: The number of persons seriously injured in accidents at level crossings fluctuates widely, but has been showing a downward trend since 2010.

⁵ The total number of accidents at level crossings includes the total number of non-CSI accidents and CSI accidents throughout Belgium.

3.1.2.2. FATALITIES DURING ACCIDENTS AT LEVEL CROSSINGS

In contrast to the declining trend in the overall number of accidents at level crossings (see Figure 8), the number of fatalities shows a less uniform pattern (Figure 10). Annual variations are significant, from a maximum of 13 deaths in 2012 to a minimum of 4 in 2016. Since 2016, only 2022 has seen the number of fatalities rise above 10 again. In 2023, however, we can observe a marked decrease from previous years, with 6 fatalities.

An important factor that may explain these fluctuations is the randomness of the severity of individual accidents. Although the overall number of accidents is experiencing a relatively stable decline, the outcome of each individual accident remains difficult to predict. Whether an accident results in a fatality depends on several factors, including the speed of the train, the angle of impact and the physical vulnerability of the victim. The same reasoning applies to the number of persons seriously injured, which also varies greatly from year to year. Also, the number of fatalities and the number of persons seriously injured are relatively low compared to the total number of accidents at level crossings, so an increase of only a few cases can already lead to a notable spike in the statistics.

By comparison, in 2023 there were a total of 501 traffic fatalities in Belgium (including fatalities in accidents at level crossings). This means that 1.2% of traffic fatalities occurred in accidents at level crossings. Interestingly, the spike in total traffic fatalities in 2019 (644) is not reflected in fatalities in accidents at level crossings, nor is the decline in 2020 (499) reflected in the number of fatalities in accidents at level crossings (StatBel, 2025).

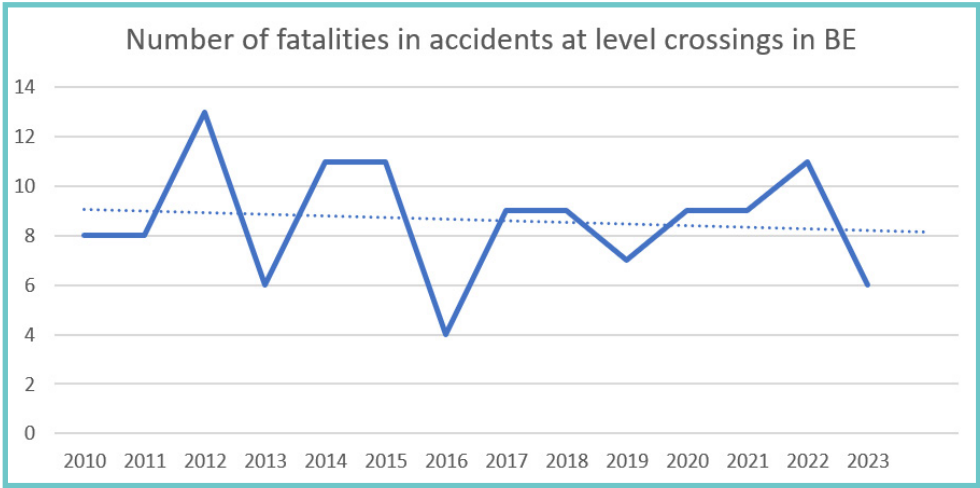


Figure 10: Fatalities in accidents at level crossings in Belgium, 2010 – 2023

Finding: The number of fatalities in accidents at level crossings varies greatly from year to year and shows only a slight downward trend.

3.1.2.3. ACCIDENTS AT LEVEL CROSSINGS

Figure 11 shows the total number of accidents at level crossings from 2010 through 2023 by type of level crossing. Most accidents at level crossings occur at level crossings with active signalling and half barriers (59.6%). In addition, 34.3% of accidents occur at level crossings with active signalling but no barriers. Level crossings with passive signalling, where no active warning systems are present, account for 5.6% of accidents. Only 0.5% of accidents occur at level crossings with full barriers.

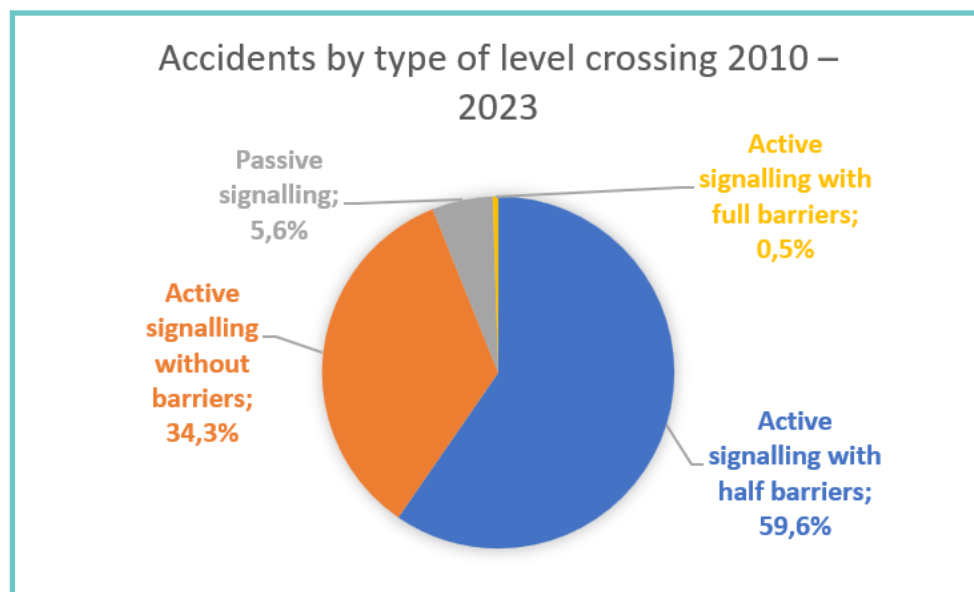


Figure 11: shows the total number of accidents at level crossings in Belgium from 2010 to 2023 by type of level crossing

Figure 12 shows the percentage share of accidents at level crossings, broken down by type of level crossing, for the period 2010 through 2023. This graph provides an insight into the annual trend with regard to the distribution of accidents among the different types of level crossings and allows the average share by type of crossing over the entire period to be compared with outliers in specific years. It is notable that the distribution in 2023 is very different from the trends in previous years. Whether this deviation indicates the beginning of a structural shift in the distribution of accidents by type of level crossing, or is the result of a random fluctuation, cannot be determined with certainty at this time.

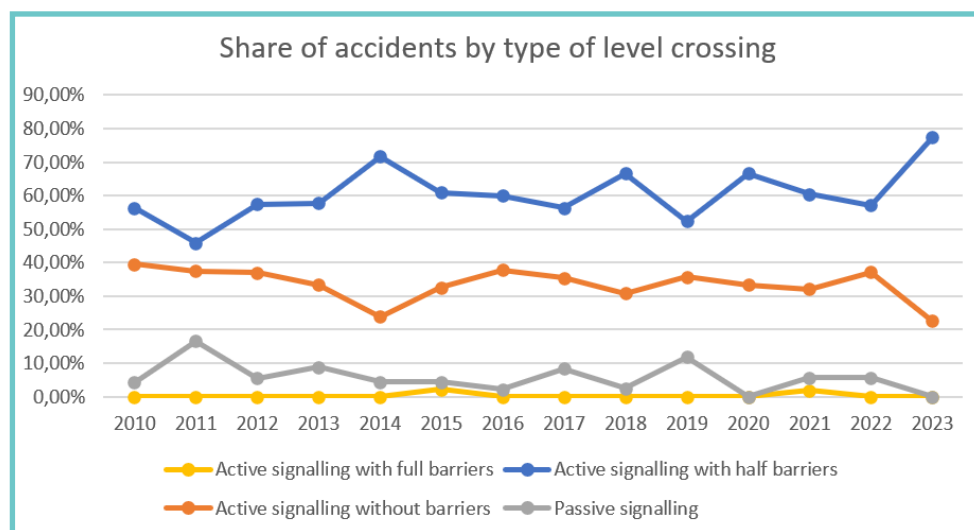


Figure 12: shows the share of accidents at level crossings in Belgium from 2010 to 2023 by type of level crossing

Figure 13 complements the above analysis by comparing, for 2023, the share of accidents by type of level crossing to the share of that type within the total number of level crossings. This makes it possible to identify potential differences in the risks that apply to each type. For example, level crossings with active signalling and half barriers appear to suffer relatively few accidents relative to their number. However, the differences are limited, and because the analysis is only available for 2023, it is premature to state that there is a causal relationship, even though there are strong indications.

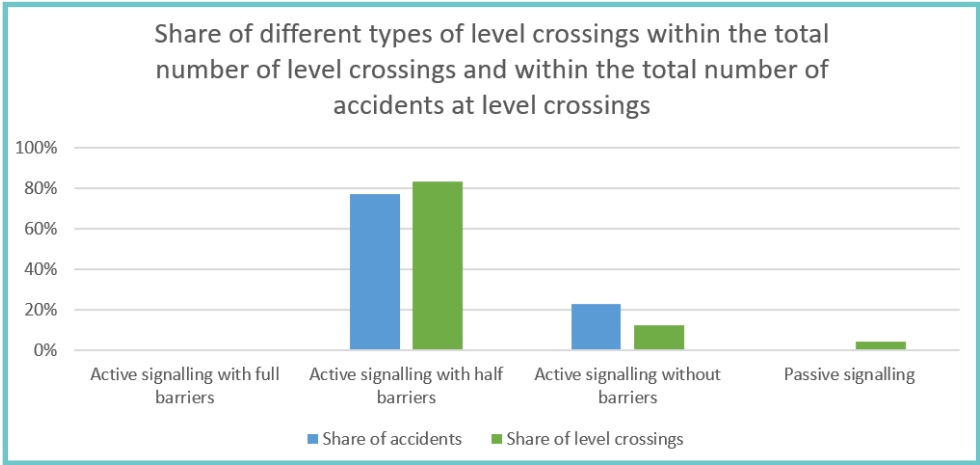


Figure 13: Share of different types of level crossings within the total number of level crossings and within the total number of accidents at level crossings in Belgium, 2023

Based on the combined analysis of both figures, it has been found that level crossings with active signalling and half barriers account for 60-70% of accidents annually, peaking at 77% in 2023. Based on the assumption that their share in the total number of level crossings has remained relatively stable over the years, this type of level crossing seems rather under-represented in the number of accidents compared to their share within the total number of level crossings. In contrast, level crossings with active signalling without barriers account for 30-40% of accidents each year, while accounting for only 12% of public level crossings. In turn, this seems to indicate that this type of level crossing is over-represented within the total number of accidents. The finding that active level crossings without barriers are proportionally more likely to be involved in accidents is consistent with the literature. For example, the Australian Transport Safety Bureau (2024) states that in order to stop in time, road users must first recognise by means of a safety system that they are approaching a level crossing. Passive level crossings require road users themselves to actively visually check whether a train is approaching, without assistance from warning signals. If an approaching train goes unnoticed, remedial measures to avoid a collision are lacking. In contrast, active level crossings have visual and auditory signals that draw attention to an approaching train and the presence of a level crossing. Combined with half barriers, it also creates a physical barrier between the road user and the track. This barrier acts as an additional visual measure and, in the case of vulnerable road users, as a remedial measure whenever the road user has missed the visual and acoustic signals. The barrier significantly reduces the likelihood of a collision by actively preventing the road user from crossing the level crossing.

Since private level crossings are not included in the percentage calculation by type of crossing, the figures may give a slightly distorted view of the distribution. In the most extreme scenario, in which all private level crossings belong to the active signalling type without barriers, the share of this type would be underestimated in Figure 13. Yet even in this extreme situation, it has been found that this type of level crossing is still over-represented within the total number of accidents. This reinforces the assumption that level crossings with active signalling but without barriers have a higher risk of accidents compared to level crossings with half or full barriers. This also reinforces the assumption that level crossings with passive signalling are overrepresented in accident statistics. To confirm these hypotheses, a more in-depth analysis over a longer period is necessary.

The status of the barriers at the time of the accident, see Figure 14, shows that, in most (93.7%) of the accidents at level crossings in the 2010 - 2023 period, the barriers were closed. This is not unexpected: after all, the barriers are in the down position for a longer period of time than the amount of time it takes them to move into position, and at the time the train actually arrives, they are in the closed position. The cases in which the barriers were in motion (2.6%) involved level crossing users who crossed the level crossing while the barriers were going down and then got stuck on the level crossing. In 2.9% of cases, the barriers were still open. This usually involves level crossing users who are still on the level crossing when the level crossing system activates and then do not leave the level crossing in time. An important note on the status of barriers is that these data are based on investigation by railway undertakings and by the infrastructure manager. This involves analysing camera footage if

available, collecting witness statements and recording statements from both the train driver and the victim (if possible). Furthermore, these are not just collisions involving people. In many cases, they involve vehicles without occupants that are involved in collisions at level crossings.

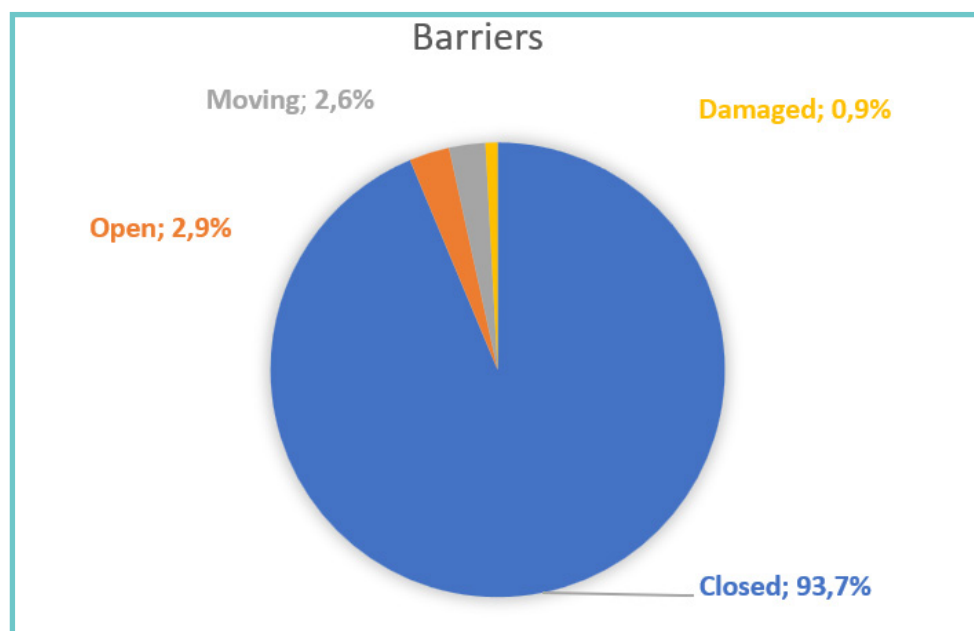


Figure 14: Total number of accidents at level crossings in Belgium from 2010 to 2023 according to the status of the barriers

The functioning of the level crossing at the time of the accident was reported as normal in 99.5% of the cases. In only 0.5% of the accidents was there an anomaly. This confirms the fact that technical failures play hardly any role at all in accidents at level crossings.

Figure 15 and Figure 16 show the distribution of weather conditions and the position of the sun at the time of the accident, respectively. The analysis of weather conditions shows that 77.2% of accidents occurred on a road surface that was dry. In 15.9% of cases, the road surface was wet, while slippery conditions due to ice or snow played a role in only 2% of accidents. This suggests that weather conditions play only a limited role in accidents at level crossings. The influence of light shows that 27.6% of accidents occurred in cloudy weather and 25.6% during the night, in which case visibility is more limited. Fewer visual cues are available during the night, especially at level crossings with passive signalling, which increases the risk of an accident (Australian Transport Safety Bureau, 2024). At night, level crossing users are also more likely to be experiencing fatigue. This is related to the circadian rhythm, which shows a peak in sleep requirements between 2 a.m. and 6 a.m., during which alertness is at its lowest. Moreover, circadian rhythms are affected by light, which is also in limited supply during the night (RAIB, 2016). The location of the sun low down in the sky was noted in 15.2% of cases. This can make it difficult to perceive the signalling, for example, when the sun is in the direct line of sight of the level crossing user and is low in the sky, when it shines on the lights making them less visible, or when it shines into a road user's eyes through their mirrors. The RAIU investigates these conditions by going on site at the time of the accident or on another day at the same time with the same weather conditions and when the sun is in the same position.

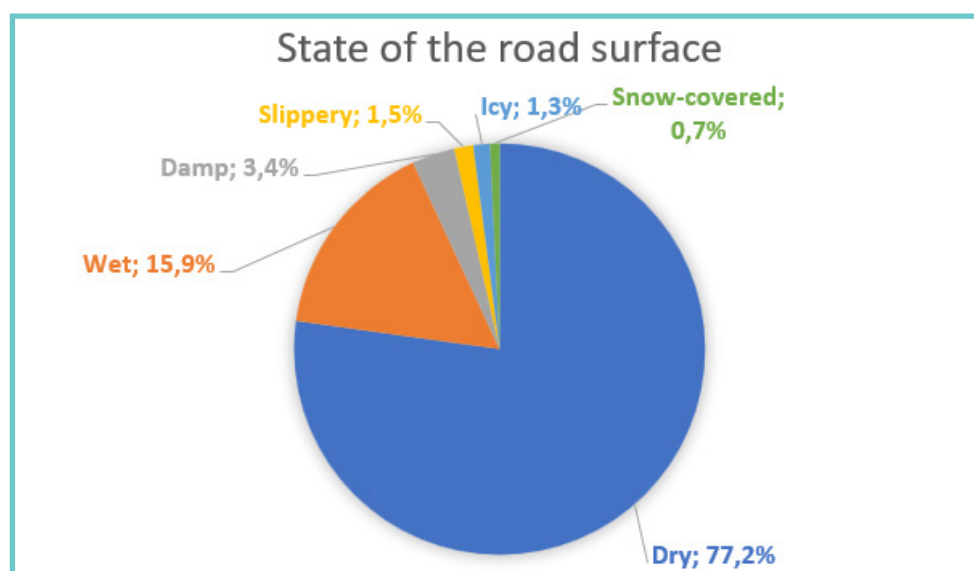


Figure 15: Total number of accidents on level crossings in Belgium by state of the road surface, 2010 – 2023

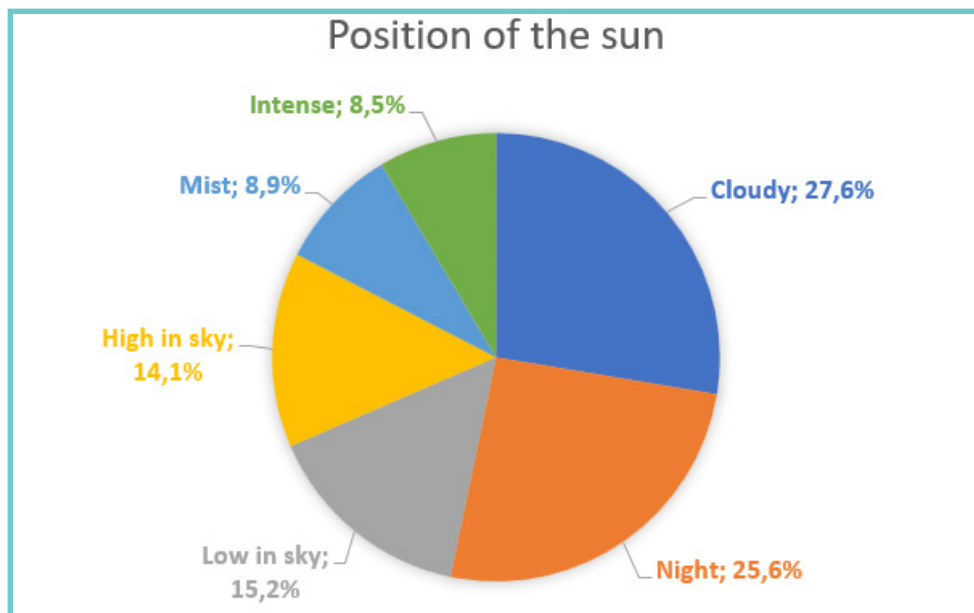


Figure 16: Total number of accidents on level crossings in Belgium by position of the sun, 2010 – 2023

Finding: Proportionally speaking, the majority of accidents occur at level crossings with active signal-lingactive level crossings without barriers. In most accidents at level crossings with barriers, the barriers were closed and the level crossing was functioning properly. External factors play only a limited role.

3.2. BELGIUM COMPARED TO EUROPE

To put the number of accidents at level crossings in Belgium into perspective, a comparison is made with the average and median⁶ of countries in Europe. By means of this comparison, both absolute differences and broader trends within the European rail industry can be identified. The use of these measures provides a nuanced picture: the average gives a general indication of the European situation, while the median is less sensitive to outliers and vastly different national contexts. The analysis focuses exclusively on CSI accidents.

3.2.1. INFRASTRUCTURE

To better understand the context of this comparison, it is essential to also consider the number of level crossings. The number of level crossings by country varies widely, from 112 level crossings in Luxembourg (2023) to 14,225 level crossings in France (2023).

The total number of kilometres of track⁷ also varies considerably from country to country. Figure 17 shows the level crossing density expressed as the number of level crossings per kilometre of track for Belgium, the European average and the median over the period 2010 - 2023. The graph shows that Belgium has structurally fewer level crossings per kilometre of track than the European average and the median. This difference remains consistent over the years, and the graph also shows that the number of level crossings per kilometre of track is declining. In 2010, the number of level crossings per kilometre of track in Belgium was still around 0.3, while the average and median were around 0.35 and 0.31, respectively. The Belgian figure is falling steadily, approaching 0.25 by 2023, while the European average and median remain slightly higher, 0.31 and 0.28, respectively. These figures indicate that Belgium has a relatively low density of level crossings compared to other European countries.

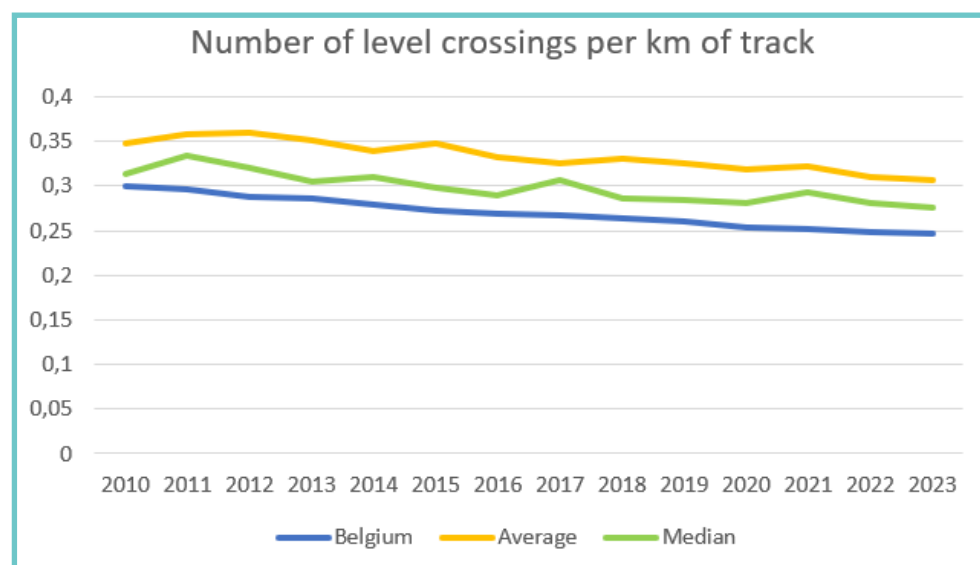


Figure 17: Number of level crossings per kilometre of track for Belgium and the average and median of European countries, 2010 – 2023

The type of level crossing is also important to consider. In the EU, active level crossings are divided into three types: manually operated, automatic with warnings for road users, and fully protected with train control. There are also passive level crossings. The share of each type of level crossing varies greatly from country to country, as shown in Figure 18 (European Commission, 2021). By 2022, 43% of all European level crossings were equipped with active signalling, such as barriers and warning lights. For Belgium, that figure is significantly higher, at 72%. In addition, 40% of the total number of level crossings in Europe are passive level crossings, whilst in Belgium, only 12.5% of level crossings are passive (European Union Agency for Railways (ERA), 2024). Passive level crossings are generally considered less safe than active level crossings because, without warning signals, road users must make their own judgements about whether it is safe to cross (Australian Transport Safety Bureau, 2024).

⁶ The median is the middle of the observations when the observations are ranked by size.

⁷ "Kilometres of track" means the length, measured in kilometres, of the railway network of Member States, the scope of which is defined in Article 2. Each track of a multi-track railway is counted (European Parliament, Council of the European Union, 2016, p. 53).

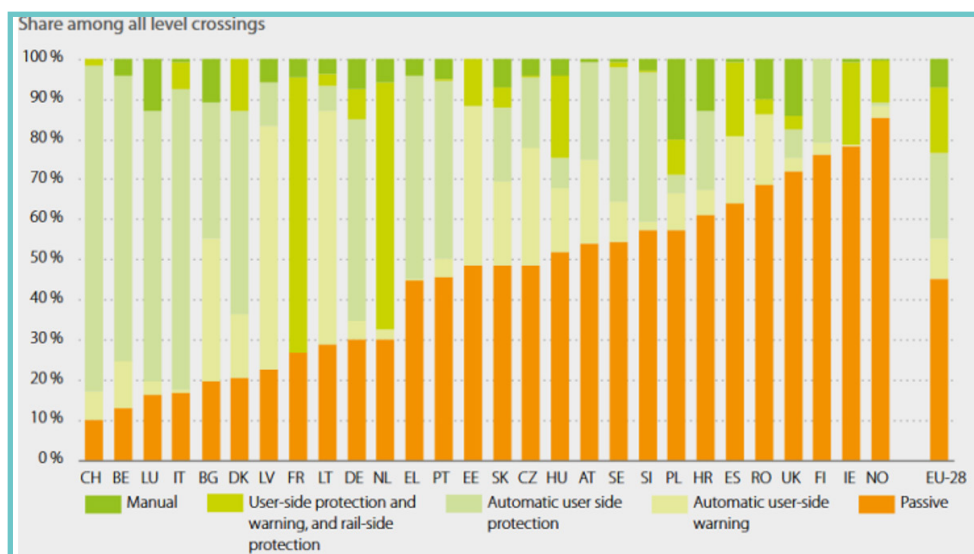


Figure 18: Level crossings by type of protection by country. Source: (European Commission, 2021)

Finding: Belgium has fewer level crossings per kilometre of track than the European average and the number of level crossings with active signalling in Belgium is higher than the average.

3.2.2. ACCIDENTS AT LEVEL CROSSINGS

Since the number of level crossings varies greatly from country to country, the number of accidents at level crossings is considered in relation to the number of level crossings in the country, per year.

Figure 19 shows the evolution in the number of accidents at level crossings per level crossing in Belgium, compared to the median and average of the countries. Belgium shows a fluctuating pattern, while the European median and mean, on the other hand, are gradually declining. In 2010, Belgium was just above the European average, but since then, the figures show a gradient with both sharp peaks (2012, 2014) and declines (2013, 2015, 2016). In contrast, the median shows a gradual decrease, indicating that most European countries are achieving a steady improvement in the number of accidents at level crossings relative to the number of level crossings. The European average is also falling, but shows slight fluctuations, suggesting that a few countries with exceptionally high or low rates are influencing the trend. According to the ERA's *Report on Railway Safety and Interoperability in the EU*, the countries with the fewest level crossing accidents tend to have comprehensive strategies and only a small number of level crossings with little or no protection. Countries with high accident rates at level crossings tend to have low population densities and limited train traffic, so the need for comprehensive safety management for level crossings seems less (European Union Agency for Railways (ERA), 2024).

The temporary decrease in the number of accidents in Belgium in 2020, caused by the lockdown measures during the COVID-19 pandemic, is also reflected in both the European average and the median.

In 2023, Belgium remains well above the median (0.0045) and the average (0.0054) with 0.0080 CSI accidents per level crossing.

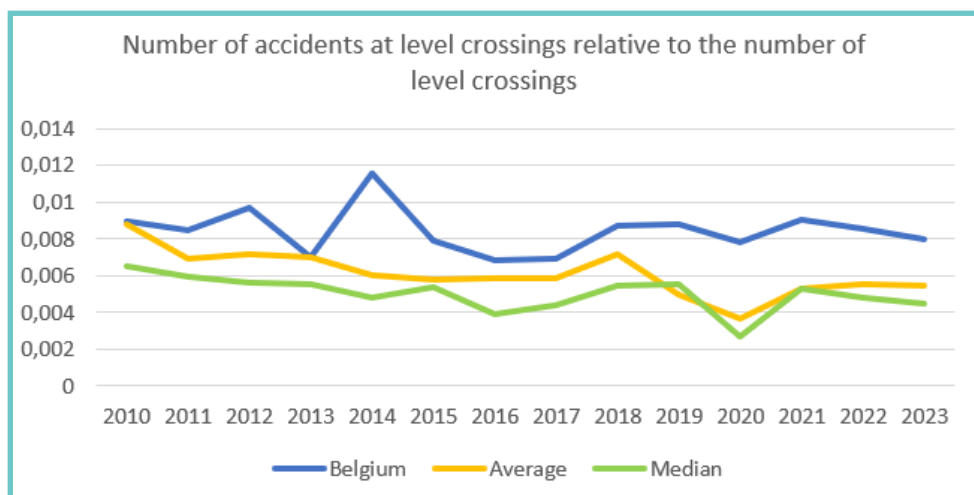


Figure 19: The number of accidents at level crossings relative to the number of level crossings in the country concerned for Belgium and the average and median of European countries, 2010 – 2023

3.2.2.1. PERSONS SERIOUSLY INJURED DURING ACCIDENTS AT LEVEL CROSSINGS

Figure 20 shows that the number of persons seriously injured per level crossing in Belgium follows a highly fluctuating pattern that deviates from both the median and the European average over a period of several years. In contrast to the steady decline seen in most European countries, Belgium shows several sharp peaks, such as in 2011 (0.0048), 2014 (0.0061) and 2016 (0.0046).

In 2023, Belgium (0.0031) is again above the median (0.0015) and the mean (0.0024), meaning that the risk of serious injuries in accidents at level crossings is still higher than in most European countries. This points to the fact that Belgium not only has more accidents per level crossing than the European average, but that these accidents are also more likely to result in serious injuries.

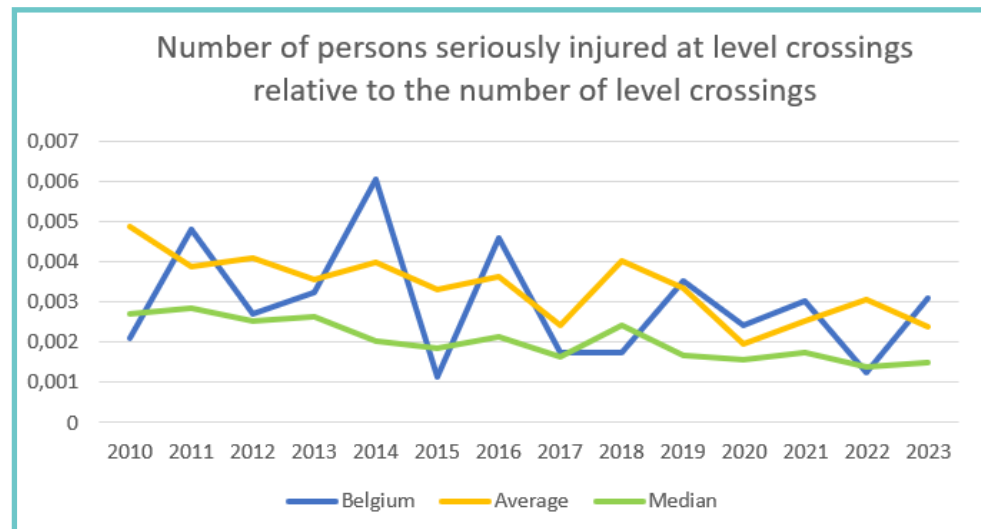


Figure 20: Number of level crossings per kilometre of track for Belgium and the average and median of European countries, 2010 – 2023

3.2.2.2. FATALITIES DURING ACCIDENTS AT LEVEL CROSSINGS

Figure 21 shows the evolution in the number of fatalities in accidents at level crossings in Belgium in relation to the total number of level crossings and compares it with the European median and average. Between 2010 and 2023, Belgium shows a fluctuating pattern, with some outliers over the course of the years. In the first years of the observation period, the Belgian figure is close to the European average, but from 2012 onwards, significant fluctuations become apparent. In contrast, the European median and average show a downward trend. This indicates that, despite a general decline in fatal accidents in Europe, Belgium has years in which the number of fatalities is relatively high. Notable declines can be seen in 2013 and 2016, during which Belgium temporarily falls below the European average. In subsequent years, however, the Belgian value rises again and remains well above both the median and the average.

Unlike the total number of accidents, we cannot see any pronounced decrease in fatalities in 2020 as a result of the reduced traffic volume during the COVID-19 pandemic. Whereas in many other countries a decrease is visible, the number of fatalities per level crossing remains relatively high in Belgium and is even increasing from 2019. This implies that reduced the traffic intensity during the pandemic had less impact on the number of fatal accidents at level crossings in Belgium than elsewhere in Europe.

In 2023, the number of fatalities per level crossing in Belgium was 0.0037, which is significantly higher than the European median (0.0020) and the average (0.0025). This suggests that Belgium had an increased risk in 2023 compared to most other European countries.

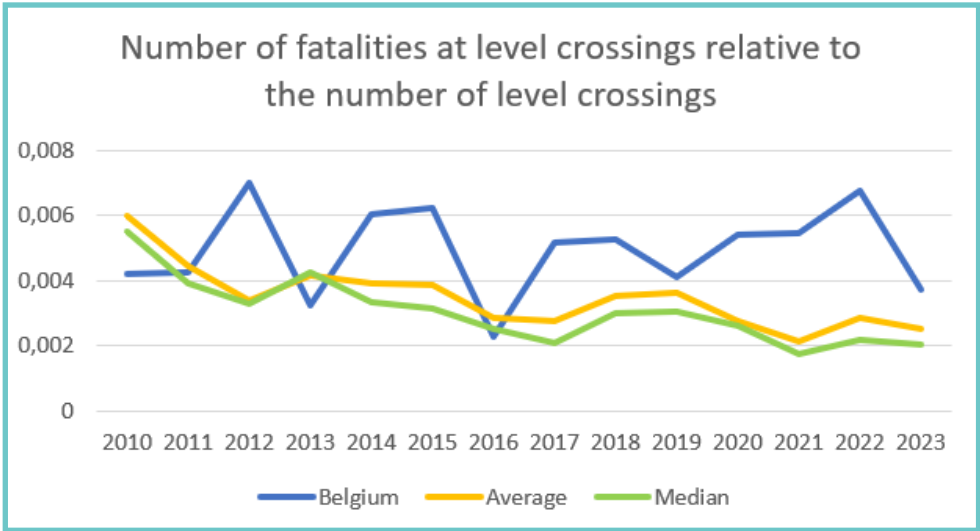


Figure 21: Number of fatalities at level crossings in Belgium and the average and median of European countries, 2010 – 2023

Finding: Belgium has more accidents and fatalities per level crossing than the European average and median, and the number of seriously injured per level crossing fluctuates widely; these figures remain higher than the European average and median in 2023.

3.3. ROAD AND RAIL INFRASTRUCTURE

3.3.1. ROAD LAYOUT

The road layout around level crossings is critical to road and rail safety. The task of driving requires drivers to pay constant attention to their surroundings, which becomes particularly challenging in complex traffic situations. Whenever drivers face an environment in which multiple visual and cognitive stimuli are present, such as intersections, road signs or other road users, their ability to notice essential information in a timely manner is reduced. This may cause them to be less likely to detect an approaching train or an activated level crossing, thereby increasing the risk of an accident (Rudin-Brown, George, & Stuart, 2014). Furthermore, observations inside the driver's cabs of lorries show that drivers are sometimes distracted by elements in the immediate vicinity of the level crossing, such as poor road surface, which can further limit their attention (Australian Transport Safety Bureau, 2024).

An additional important aspect of road layout is the risk of traffic queues being formed, also known as *blocking back*. This occurs when a traffic jam forms downstream of the level crossing and extends up to the crossing itself. This can cause a vehicle entering the level crossing to become trapped and being unable to exit the crossing because stationary vehicles are blocking the way ahead. This can create a stationary or slow-moving line of vehicles blocking the railway line. Such situations pose significant safety risks, especially at level crossings with active signalling with or without half barriers and at level crossings with passive signalling, since they are not equipped with obstacle detection. At level crossings with active signalling and full barriers, blocking back is primarily an operational inconvenience, as some train traffic will be stopped. In accordance with Belgian legislation, such level crossings are required to be equipped with an obstacle detection system (Belgian Official Gazette, 2011; Delmonte & Tong, 2008). Blocking back can be both the consequence and a contributing factor of traffic delays. Whenever long queues form in front of a closed level crossing, there is a risk that after the crossing is opened and when it is closed again, the queue will not have been resolved completely. This may result in vehicles still being on the level crossing when it is activated once again. Moreover, in such circumstances, drivers are more likely to violate the level crossing rules, for example by rushing onto the crossing, as the traffic jam makes the actual waiting time feel longer than the level crossing's actual closure time. In addition, heavy traffic on both sides of the level crossing can further increase the likelihood of blocking back, especially when vehicles need to turn left after the crossing and are prevented from doing so by oncoming traffic. Such situations slow down the traffic flow and can lead to traffic jams that are difficult to clear when the level crossing closes again (Delmonte & Tong, 2008).

In Belgium, there are no specific regulations defining the minimum distance between a level crossing and a nearby intersection or roundabout. This can be partly explained by the division of powers in Belgium (see section 2.1), whereby rail and road infrastructure fall under the remit of different levels of government. In other countries, the minimum distance is regulated differently:

- Czech Republic: a minimum distance of thirty metres applies.
- Croatia: the required distance varies between four and eight metres, depending on the type of road.
- Italy: distance requirements apply between level crossings and intersections.
- Germany: the so-called "25-metre principle" is applied, in which road users must have at least 25 metres of clear lane after passing a level crossing, so that even the longest vehicle has sufficient space.
- Finland and the Netherlands: specific design standards set by the infrastructure manager regarding minimum distances between level crossings and nearby intersections or roundabouts are used.
- Ireland: guidelines rather than binding rules and orders are given, for example, to provide full barriers at level crossings near intersections.
- Spain: no distance rules apply by law, but the Spanish NIB *Comisión de Investigación de Accidentes Ferroviarios* has recommended avoiding the construction of roundabouts or intersections close to level crossings (see Annex A. NIB Questions and Answers).

Complicated road layout

On 28 May 2024, at about 3:30 p.m., an accident occurred at a level crossing in the centre of Jambes (Province of Namur), in which a car was hit by a passenger train. The level crossing, which was equipped with active signalling and half barriers, is located at a roundabout where six streets converge. Due to the proximity of the railway station and the high intensity of train traffic, the level crossing may be closed frequently and for extended periods of time. There is a school, a church, various shops and bus stops in the immediate vicinity, which add to the complexity of the traffic situation and the potential for distraction among road users.

The level crossing ranks in first position in Infrabel's top 100 most dangerous level crossings in Belgium. Eight collisions and five near collisions have occurred there since 2009. The combination of a busy roundabout, frequent crossing closures and a complicated road layout increases the risk of blocking back, errors, distraction and risk-taking behaviour (RAIU, 2024).



Source of image: Google Maps

Finding: The road layout around level crossings affects safety: complex traffic situations and blocking back increase the risk of accidents. Belgium has no specific rules governing the distance between a level crossing and an intersection or roundabout.

3.3.2. VISIBILITY OF THE LEVEL CROSSING

Good level crossing visibility is fundamental in order to ensure safe interaction between road users and rail traffic. Limited visibility can significantly hinder perception of both the level crossing itself and of the approaching train, thereby increasing the risk of accidents. Several factors can limit the visibility of a level crossing. Bends in the road, nearby buildings and dense vegetation can make it difficult to see the level crossing or the approaching train. In addition, vehicle features, such as wide window pillars or large mirrors, can restrict a driver's field of vision. This is especially a problem in the case of large vehicles, such as lorries or buses (Rudin-Brown, George, & Stuart, 2014).

In Belgium, there are no specific rules governing how visible a level crossing must be. The legislation refers only in general terms to the importance of visibility. For example, Article 9 of the Royal Decree on Safety Devices at Level Crossings on Railways states that road users must comply with the signage and/or signalling as soon as it is "sufficiently visible" (Belgian Official Gazette, 2011). A similar provision is found in Article 5 of the Highway Code, which states that traffic lights and signs must be complied with if they are "sufficiently visible" and are correctly placed (Belgian Official Gazette, 1975). Both rules emphasise the behaviour of road users, but not the responsibility of the road or infrastructure manager to ensure that signage and signalling remain effectively visible.

Obstacles in the vicinity of level crossings, such as buildings or vegetation, are only referred to in a number of general provisions. Buildings or works must not be erected within five metres of the track axis or embankment without permission from the infrastructure manager. As for vegetation, overgrowth should be at least one and a half metres shorter than the distance between the base of the plant and the nearest rail. In addition, the infrastructure manager can prohibit all non-herbaceous vegetation within eight metres of the track if it endangers the safety of train traffic (Belgian Official Gazette, 2018).

It is important to note that Infrabel's risk model for level crossings does take into account the visibility of the level crossing and its signalling, including vegetation and obstacles.

In some European countries, the visibility of level crossings and the presence of obstacles such as vegetation and buildings are more strictly regulated than in Belgium. Examples of visibility requirements include::

- France: the sight distance is linked to the speed of road traffic: from 27 metres at 30 km/h to 152 metres at 90 km/h, with 100 metres as a guide value for the risk of congestion.
- Lithuania: sight distances for both drivers and train operators are set by law at 1,200 metres on new or modernised lines.
- Poland: a mandatory sight triangle is used that must remain clear of obstacles such as trees, buildings or advertising signs.
- Finland and the Czech Republic: there are binding technical guidelines that precisely define curves, slopes and sightlines.
- Germany: the visibility triangle is defined based on the speed of the train and the driver's reaction time.
- Italy: regular pruning of vegetation around level crossings and mitigation of visual obstacles are mandatory.
- Sweden: requirements have been adjusted according to the type of safety installation and stricter conditions apply in the case of level crossings with passive signalling.
- Norway: visibility requirements apply in the case of level crossings with passive signalling.
- The Netherlands: minimum viewing distances are set by law and additional standards for sightlines are applied.
- Estonia: the law requires that traffic signs and signals should not be obstructed by vegetation or buildings (see Annex A. NIB Questions and Answers).

Finding: The visibility of level crossings is crucial for safety, but Belgian regulations contain only general provisions; other European countries often have detailed standards with regard to sight distances and obstacles. No European standards have been established.

3.3.3. ABNORMAL FUNCTIONING OF A LEVEL CROSSING

Although the infrastructure of a level crossing is in principle designed to ensure maximum safety, the system may function abnormally in certain circumstances. This means that the level crossing system is not functioning as intended. Possible malfunctions include:

- the improper functioning of light or acoustic signals;
- barriers moving jerkily or non-synchronously;
- a level crossing that activates too early, too late, or not at all;
- a level crossing that remains closed without a train passing.

The causes of such malfunctions are varied and may include wear and tear, faulty electronic components, power failure or cable theft.

When a level crossing functions abnormally, it is automatically indicated at the respective signal box as a minor alarm or a major alarm, depending on the severity of the malfunction (RAIILU, 2015). A minor alarm refers to relatively minor malfunctions, such as one (out of two) extinguished red or white light, batteries not charging, a lack of power supply, or a malfunction that has no impact on the normal operation of the level crossing. In contrast, a major alarm indicates larger defects, such as when both red lights are extinguished, when at least one barrier does not close or fails to close within the scheduled time, when the level crossing remains closed for more than ten minutes, or when a malfunction has occurred (Infrabel, 2025a). In the event of a major alarm, the barriers will close to ensure safety and trains in the area must reduce their speed and give audible warnings as they approach the level crossing. Once the control centre has established that there is no (or no longer any) malfunction, train traffic can resume as normal (Infrabel, undated, -f).

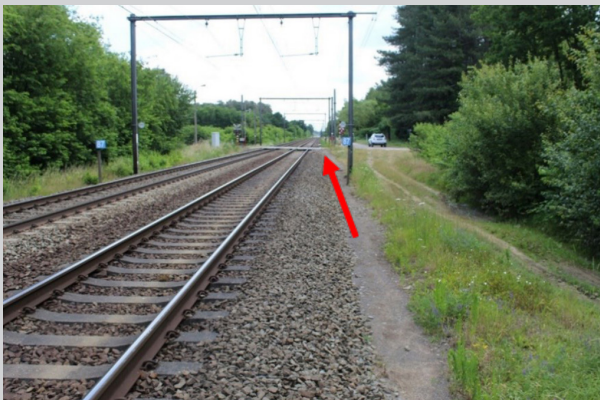
Specific obligations also exist for road users. Article 9, §3 of the Royal Decree on Safety Devices at Level Crossings on Railways states that in the event of a malfunctioning of the active signalling, orders given by railway personnel must be followed in order to prevent dangerous situations or accidents (Belgian Official Gazette, 2011).

The Investigation Unit's dataset shows that between 2010 and 2023, only 3 of the 690 accidents recorded at Belgian level crossings occurred at a level crossing that was functioning abnormally. This indicates that though not exceptionally rare, abnormalities in the functioning of level crossing installations rarely lead directly to an accident. During the same period, there were 1,295 reports of abnormal functioning, which is a very low number when compared to the total number of level crossings. However, these figures should be interpreted with some caution, as abnormal functioning is not consistently recorded in all cases and details regarding 125 cases are missing.

Furthermore, situations exist in which the level crossing system is functioning normally, yet an anomalous situation arises, as described in the example below.

Abnormal situation at the time of an accident at a level crossing

At about 10:24 p.m. on 20 June 2019, an accident occurred at a level crossing in Langdorp (Aarschot), in which a car was hit by a freight train which was being removed along the opposite track after a breakdown. Because that section of track was still occupied, the direction of travel could not be changed. As a result, the level crossing did not work as intended: the system was detected only 65 metres before the crossing, so the warning signal did not activate until two seconds before the train arrived and the barriers did not have sufficient time to start closing (RAIILU, 2021)..



View of level crossing in the direction of travel of the freight train (about 65 metres). Source of image: (RAIILU, 2021)

Finding: Level crossings functioning abnormally are infrequent and rarely result in accidents; however, malfunctions are recorded and are addressed by implementing safety measures.

3.3.4. INSPECTIONS OF LEVEL CROSSINGS

The inspection of level crossings is laid down by law in Article 14 of the Royal Decree on Safety Devices at Level Crossings on Railways. That article stipulates that the FPS Mobility and Transport and the infrastructure manager must jointly conduct periodic inspections of all level crossings. These checks must consist of a visual verification that the safety devices comply with the legal requirements and of a written report being prepared. In addition to the scheduled inspections, the FPS Mobility and Transport can carry out additional inspections at any time, for example in response to incidents, accidents or complaints. In such situations, a written report is also drawn up, and the infrastructure manager receives an overview of the findings and the deadline within which the necessary measures must be taken (Belgian Official Gazette, 2011).

In practice, these inspections are carried out by inspectors from the Level Crossings Team, part of the Safety Department within the Directorate General for Sustainable Mobility and Rail Policy (DGSMRP) of the FPS Mobility and Transport, in cooperation with the level crossing manager, which is usually Infrabel. The department is in charge of drafting ministerial decrees regarding safety devices for each level crossing and carries out both periodic and ad hoc inspections (FPS Mobility and Transport, 2025c).

Priorities for inspection are established in consultation with the level crossing manager. The highest priority is given to level crossings at which an accident or incident has occurred recently. Next, level crossings where recent infrastructure works or signalling modifications have been carried out are inspected so that the ministerial decree can be updated. The next priority concerns level crossings that are installed or removed, and finally, periodic inspections of level crossings that are included within the ten-year inspection cycle (FPS Mobility and Transport, 2025b).

Before each inspection, relevant plans, technical documents and the ministerial decree are consulted. On this basis, the inspector prepares a preliminary report, which is compared with the actual condition on site during the inspection. The inspection consists of a visual check of the conformity of safety devices and an assessment of their adequacy, for example, at pedestrian crossings, new roads, bus stops and roundabouts. **The inspection does not include auditory checks and focuses only on the safety devices laid down by law. Elements such as announcement signs, LED signalling or warning boxes, lie beyond the scope of these inspections** (FPS Mobility and Transport, 2025b).

Whenever discrepancies or nonconformities are found during an inspection, they are recorded in the joint report. Afterwards, the inspector supplements the report with photographs and additional observations. This complete report is delivered to the level crossing manager, who must sign it. In principle, the report is not automatically forwarded to the appropriate minister unless explicitly requested. If the on-site situation differs from the regulations and the ministerial decree, a report will be prepared with an updated sketch of the level crossing. Generally, Infrabel is very quick to make the necessary adjustments to correct the discrepancies identified and to bring the level crossing back into compliance. If actions to bring the level crossing back into compliance fail, the FPS Mobility and Transport can file a complaint with the police. If the actual situation on site is found to be safer than the provisions of the ministerial decree, that decree will be amended. In the case of private level crossings, additional technical advice is sought from Infrabel, in order to make use of their specific expertise and knowledge of the infrastructure (FPS Mobility and Transport, 2025b).

Finding: Inspections of level crossings are established by law and are carried out periodically and on an ad hoc basis by the FPS Mobility and Transport and Infrabel; any anomalies detected are usually corrected quickly. The NSA is not involved.

3.4. THE LEVEL CROSSING USER

Railway safety is based on the principle that a train should always have a clear path. After all, trains cannot swerve and usually have a long braking distance, which in most cases means that taking action in an emergency is impossible. This differs fundamentally from road traffic, as in many cases, road users can still respond to other people's mistakes by braking or swerving. At a level crossing, these two systems meet. Safety heavily depends on the proper behaviour of road users, who must make appropriate adjustments whenever a train is passing (Safety Investigation Board, 2018).

It is no surprise that accidents at level crossings are largely the result of human behaviour. Although technological safety installations such as barriers, traffic lights and acoustic signals are intended to protect level crossing users, in practice they do not always prove sufficient. The majority of accidents at level crossings are the result of choices made by level crossing users, such as ignoring traffic rules or engaging in risky behaviour, either intentionally or unintentionally (Belgian State & Infrabel, 2023; Fonverne, 2020).

3.4.1. LITERATURE REVIEW

The behaviour of road users at and near level crossings is influenced by a complex interaction of factors. Two main categories of human factors determine whether a driver⁸ stops at a level crossing and the likelihood of an accident: sensory (or perceptual) factors, which relate to the ability to perceive an approaching train, and cognitive factors, which are related to decision-making and risk perception (Rudin-Brown, George, & Stuart, 2014).

3.4.1.1. SENSORY FACTORS

The infrastructure and visibility of a level crossing have already been discussed in subchapter 3.3: Road and rail infrastructure. Yet other problems of perception remain relevant, including on a sensory level. A fundamental problem at level crossings is the visual perception of an approaching train. When a train is approaching from the side, the vehicle causes hardly any visual movement on the retina of the road driver, making it difficult to perceive the train unless looking at it directly. Even if a train is spotted, estimating its speed and at what moment it will arrive at the level crossing proves particularly difficult, which can lead to erroneous decisions to still cross the crossing (Rudin-Brown, George, & Stuart, 2014).

3.4.1.2. COGNITIVE FACTORS

In addition to sensory factors, cognitive factors play a determining role in the behaviour of road users at and near level crossings. These factors include mental processes involved in the interpretation of information, decision-making, risk assessment and the choice of behaviour.

A first common cognitive error is the so-called 'looked-but-failed-to-see' error. This involves a driver looking in the right direction but not recognising the danger as such. Errors of this type especially occur in visually complex environments where information processing is limited and selective attention or misperception causes crucial information to be overlooked (Rudin-Brown, George, & Stuart, 2014).

The mental models or schemas that drivers develop based on previous experiences also play an important role in their behaviour at and near level crossings. These may be previous experiences of the same level crossing (familiarity) or of other level crossings (association). When a driver repeatedly experiences that no train is passing at a level crossing, a mental model of 'no train' may develop (Pickett & Grayson, 1996; Rudin-Brown, George, & Stuart, 2014). According to Reason (1990), mental models of that type are efficient in daily functioning, but are a major source of error when they do not correspond to the actual situation. Drivers not expecting a train tend to ignore or misinterpret warning signals, such as flashing lights or descending barriers, especially when they are under time pressure or are distracted. Moreover, drivers familiar with a specific crossing may tend to base their decision to cross an activated level crossing on the train timetable (Delmonte & Tong, 2008). Even when confronted by a level crossing they have never seen before, they may be less vigilant as a result of generalising their previous experiences (Pickett & Grayson, 1996).

⁸ The majority of studies are based on drivers of vehicles, mostly cars; pedestrians are generally not considered. That is the reason why the word 'driver', as opposed to 'level crossing user', is used.

According to the Australian Transport Safety Bureau (2024), the low expectation that a train will be approaching fundamentally undermines safe behaviour, especially at level crossings with passive signalling. After all, expectations influence not only our conscious behaviour but also our unconscious processes of perception. Anyone who is not expecting a train is less active in scanning the surroundings and may potentially overlook an approaching train. This increases the risk of accidents, especially in environments where trains operate rarely or where breaking rules rarely has negative consequences (Reason, 1990; Yeh & Multer, 2008).

Not all factors are unconscious. Some drivers deliberately choose to ignore the rules. Beanland et al. (2017) demonstrated that rural drivers sometimes ignore stop signs at level crossings because they believe they have adequate visibility or are not expecting a train. Pickett and Grayson (1996) argue that some drivers make a cost-benefit trade-off: in other words, the time saved by crossing an activated level crossing is weighed up against the perceived small risk and low likelihood of a penalty. In such cases, drivers also often overestimate their own skill and control, and underestimate the true danger. For example, they assume that they can still cross quickly, without considering the speed and braking ability of a train (RAIU, 2021).

Distraction also plays an important role in the occurrence of errors. Internal or external distractors – such as telephoning, eating, wandering thoughts, advertising signs – can interfere with drivers' sensory scanning patterns, leading to a failure to notice warning signals or even approaching trains (Rudin-Brown, George, & Stuart, 2014; Australian Transport Safety Bureau, 2024). Errors of this type mostly occur during routine operations. For frequent users of level crossings, crossing them is often an automatic act, during which conscious control is reduced. As a result, unexpected elements, such as a level crossing getting activated or the approach of a train, are sometimes not processed (Reason, 1990; Australian Transport Safety Bureau, 2024).

Errors also arise in the decision-making process itself. At level crossings with passive signalling, the driver needs to process sensory information, assess risks and then act. This decision chain can fail due to incomplete or erroneous information, as a result of incorrectly estimating one's own speed or the speed of the train, or due to an impulsive decision to proceed in the absence of clear signals (Rudin-Brown, George, & Stuart, 2014).

Furthermore, it has been found that some drivers are influenced by the behaviour of others. According to the Australian Transport Safety Bureau (2024), 30% of respondents said they would break the rules if they saw others doing the same, especially when no train was visible at first glance.

It was also found that drivers do not always accurately estimate the amount of time spent waiting at level crossings and are more likely to show signs of impatience when faced with longer delays. These impatient reactions are amplified in cases where they are accustomed to shorter waiting times at other level crossings. A distorted perception of the waiting time may therefore contribute towards an increased propensity for risky behaviour, such as crossing a level crossing while it is active (Delmonte & Tong, 2008).

Finally, an impaired ability to drive caused by alcohol, drugs or fatigue can contribute to the occurrence of accidents on level crossings. Such states hamper perception, slow reaction times and undermine decision-making, making drivers more vulnerable to error and distraction (Rudin-Brown, George, & Stuart, 2014).

Finding: Human factors such as limited perception, misjudgement and cognitive biases influence the behaviour of road users at level crossings and increase the risk of accidents.

3.4.2. THE RAILSPECT STUDY BY INFRABEL

To gain a better understanding of behaviour at and near level crossings, Infrabel conducted a behavioural study in early 2019 involving 1,000 respondents in Belgium, who were sent a survey via the GfK-panel⁹ between 16 November 2018 and 3 December 2018. The random sample included a geographical spread (58% in Flanders, 32% in Wallonia, 10% in Brussels); the gender distribution was balanced (49% female, 51% male) and respondents represented different age groups and occupational groups (see Figure 22 and Figure 23).

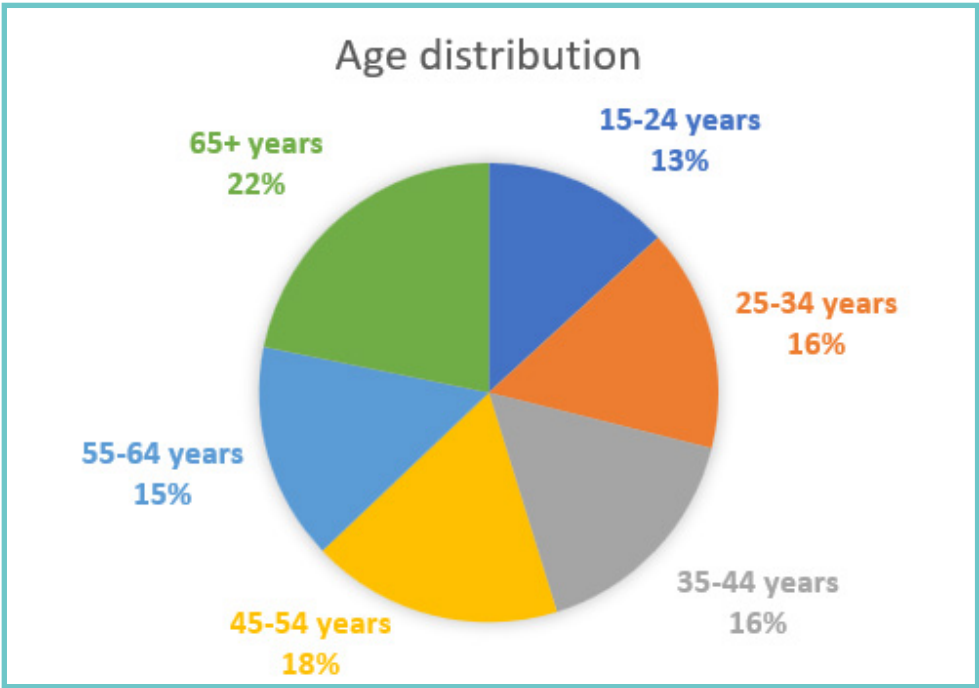


Figure 22: Age distribution of Railspect data

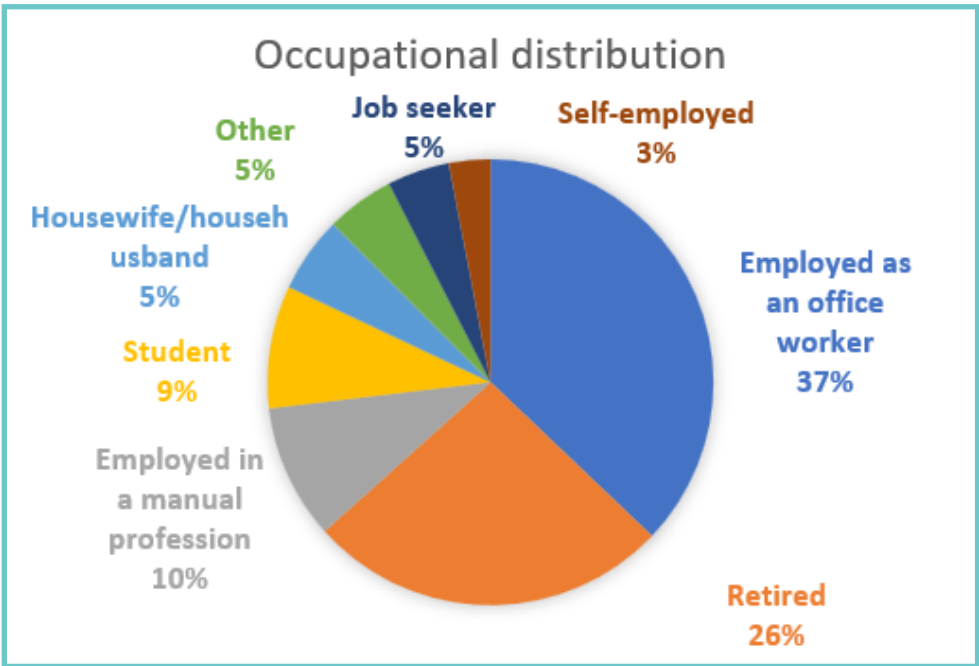


Figure 23: Occupational distribution of Railspect data

⁹ GfK-panel is an online platform where people can give their opinions on various topics, such as products, services and media. The panel is a representative reflection of the total population living in Belgium.

The study focuses, among other things, on how individuals interact with level crossings and what attitudes they exhibit in doing so. It does that by inquiring about risk behaviours, such as crossing a level crossing when the red lights are flashing and the barriers are completely closed, crossing a level crossing without looking closely at the signage and signalling, and using a smartphone while in traffic. Based on the results, four profiles of level crossing users were identified:

- dangerous doers;
- unconscious crossers;
- opportunistic crossers;
- risk avoiders.

These four profiles differ not only in their behaviour, but also in their perception of risk, their motivation and their level of awareness.

3.4.2.1. THE DANGEROUS DOERS

The dangerous doers represent 17% of respondents to the survey (174 people) and are characterised by a clear propensity for risky behaviour at and near level crossings. Figure 24 shows the demographic distribution of dangerous doers.

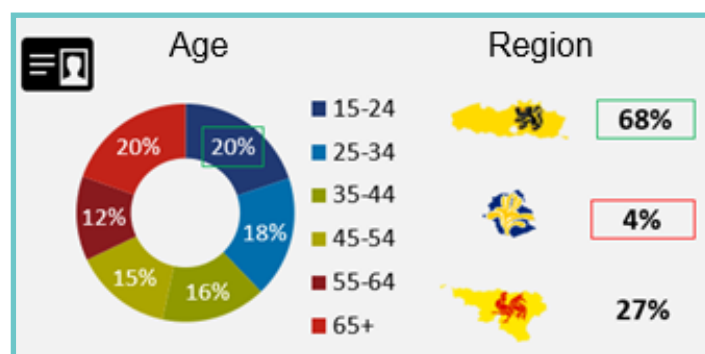


Figure 24: The demographics of 'Dangerous doers'

Dangerous doers are especially inclined to minimise risk in situations that they themselves consider mundane or manageable. Whereas they mostly avoid explicitly prohibited behaviour (such as crossing a fully closed level crossing), or commit such behaviour in error, the real risk for this group lies in routinely committing actions that fall below the perception threshold of danger (such as driving with impaired hearing or while using a smartphone). This is consistent with findings from the literature: Reason (1990) points to routine violations in contexts with no obvious negative consequences; Pickett and Grayson (1996) point to the fact that a false sense of safety is created due to previous experiences with no negative consequences, and the Australian Transport Safety Bureau (2024) points to the deliberate violation of rules because no train is expected. Distraction and habit formation further reinforce this behaviour.

3.4.2.2. THE UNCONSCIOUS CROSSERS

About one in four respondents can be classified as an unconscious crosser (245 people). Figure 25 shows the demographic distribution within this group.

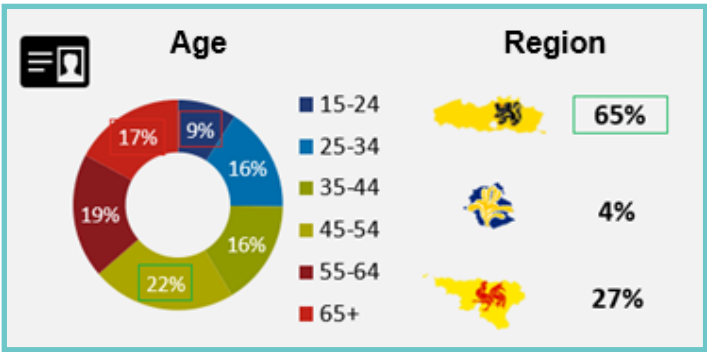


Figure 25: The demographics of 'Unconscious crossers'

Unconscious crossers do not necessarily consciously violate the rules, but act primarily out of inattention, routine and/or an underestimation of the danger. They are usually familiar with the rules that apply at level crossings, but exhibit unsafe behaviours determined mostly by automatic actions: crossing with only limited vision or hearing, using a smartphone in traffic as a driver or as a pedestrian near a crossing. Their behaviour especially illustrates the importance of sensory and cognitive restrictions. For example, the 'looked-but-failed-to-see' error plays a role: level crossing users look but do not recognise the danger of their behaviours (Rudin-Brown, George, & Stuart, 2014). These errors are exacerbated by complex visual environments, limited attention and the automatic way in which routine tasks such as driving are often performed. Mental models based on previous experiences of 'no train' result in warning signals not always being processed consciously (Reason, 1990; Pickett & Grayson, 1996).

3.4.2.3. THE OPPORTUNISTIC CROSSERS

Opportunistic crossers make up 35% of the respondents (350 people). Figure 26 shows the demographic distribution of this group.

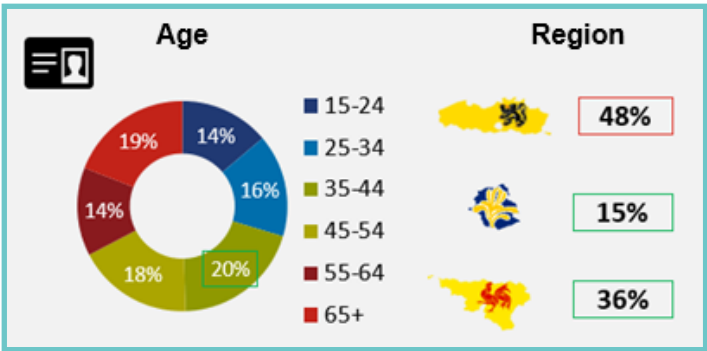


Figure 26: The demographics of 'Opportunistic crossers'

Opportunistic crossers generally follow the rules, but are tempted to engage in risky behaviour in certain circumstances. They are mostly guided by what suits them at the time: when they think they can save time, when they see others doing it too, or when they think there is no immediate danger. Their behaviour illustrates how cognitive decision-making is influenced by a cost-benefit trade-off: the amount of time gained outweighs the assessed risk (Pickett & Grayson, 1996). In the Railspect study, these respondents often indicated that they thought they had 'enough time' or that the behaviour was 'not really dangerous'. In the literature, such beliefs are linked to an overestimation of one's own skills and to erroneous perceptions of risk caused by habit formation or experiences with delays (Delmonte & Tong, 2008; RAILU, 2021).

3.4.2.4. THE RISK AVOIDERS

The risk avoiders represent 23% of the total number of respondents (231 people). Figure 27 shows the demographic distribution of this group.

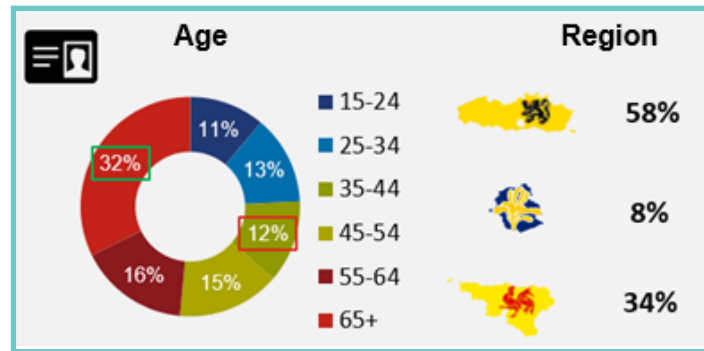


Figure 27: The demographics of 'Risk avoiders'

Risk avoiders are characterised by a pronounced tendency to actively avoid risky behaviour. They value rule-compliant behaviour and generally adhere strictly to the law. Their behaviour is driven by a realistic perception of risk, whereby the severity of a potential accident or their responsibility towards other road users outweighs any sense of time pressure or convenience. This attitude reflects a cognitive cost-benefit trade-off, in which the potential costs are perceived as far outweighing the benefits. In the literature, this behaviour is supported by the insight that road users with heightened risk perception are less likely to engage in routine behaviour that deviates from the rules (Reason, 1990). Social factors, such as role model behaviour or social norms, also seem to be a guiding factor for this group to a greater extent than for the other profiles (Australian Transport Safety Bureau, 2024).

3.4.2.5. CAVEATS

The Railspect study provides valuable insights into how different groups of road users behave at level crossings. At the same time, there are some points to bear in mind that help put the results in the correct context. For example, some of the response options leave room for interpretation, as a result of which certain reasons underlying people's behaviour are expressed in less detail. In addition, the survey was based on a limited time period and on behaviour that was self-reported by respondents, which always remains susceptible to variation in memory or estimation. Furthermore, while the sample size of 1,000 respondents is sufficient at first glance, it appears to be very limited for some analyses, making it difficult to draw broader conclusions concerning underlying motivation. For some questions, moreover, it is conceivable that additional nuance or additional response categories would provide a more complete picture.

Nevertheless, the study remains a useful starting point. It makes it clear that road users have different profiles, each of which has its own attitudes towards risk and its own way of acting at level crossings. Future questionnaires may benefit from a more detailed and transparent structure. It is recommended that the response categories distinguish between “rarely” and “never” and allow respondents to indicate multiple legal sanctions simultaneously whenever realistic. Moreover, a longer survey period and a broader time horizon would make it possible to capture structural patterns of behaviour more effectively. However, it is recognised that these recommendations present additional challenges, including administrative, financial, and data processing and data storage challenges.

Finding: The Railspect study identifies four profiles of level crossing users with varying attitudes and risk behaviours; compliance with rules and motivation vary by profile, but results are limited by methodological caveats

4. ACTIONS TO IMPROVE SAFETY AT AND AROUND LEVEL CROSSINGS

4.1. INFRASTRUCTURE INTERVENTIONS AT AND IN THE VICINITY OF LEVEL CROSSINGS

Infrabel strives to make level crossings as safe as possible and is investing in the renovation and modification of level crossings.

In 2024, Infrabel invested €17.4 million in modernising level crossings, part of which came from EU subsidies (Infrabel, 2025d).

4.1.1. LEGAL FRAMEWORK

The Royal Decree on Safety Devices at Level Crossings on Railways states that the federal minister responsible for rail transport determines, at the request of the infrastructure manager, which safety devices must be installed at a level crossing. This results in a ministerial decision for each level crossing. A safety device is “any element intended to prevent the risk of collision or accident at a level crossing and whose application has been imposed by legal or regulatory provisions or provisions with individual scope, including signalling” (free translation) (Belgian Official Gazette, 2011, p. 42880). These include the A45 and A47 traffic signs, the ‘private level crossing’ sign, the red traffic light prohibiting road users from crossing, the white traffic light permitting them to cross, the acoustic signals, a partial or full closure system (whereby systems with full closure must be fitted with an obstacle detection system), additional closure systems for pedestrians and cyclists, and closure systems with a locking mechanism (Belgian Official Gazette, 2011).

According to Article 12, §1, whenever any construction, modification or abolition of a safety device on a public or private level crossing is proposed, the infrastructure manager must submit a file to the Minister of Mobility. This file should be complete and be sufficiently substantiated. As stipulated in Article 12, §2, it must include, among other things, an outline of the locality and all information that is necessary to enable a thorough analysis and an informed decision (Belgian Official Gazette, 2011).

The infrastructure manager is also obliged to inform other interested parties about planned changes in a timely manner. Article 13, §1 states that the manager of the public road or private road must be notified before any modification to the safety devices is implemented. According to Article 13, §2, if works are planned that may temporarily obstruct traffic, this must be communicated to the road manager or private individual concerned at least five weeks in advance and that communication must include the anticipated duration of the obstruction (Belgian Official Gazette, 2011).

Finding: The Royal Decree defines which safety devices are mandatory and optional, and how changes must be approved. Submitting files and communicating with affected parties are required by law.

4.1.2. INFRADEL'S PRIORITIES ARE BASED ON RISK ANALYSIS

Infrabel's risk model plays an important role in the decision to carry out level crossing modifications. The model quantitatively maps the risks of level crossings and aims to classify level crossings outside the port zones according to their degree of risk. This classification can be used to determine which level crossings are prioritised for additional safety measures such as barriers, checkerboard markings or LED lighting on barriers (Infrabel, 2025c).

The model calculates a risk score for each level crossing that refers to the probability or frequency of an accident multiplied by its severity or impact (Infrabel, 2025c). The risk score is based on three factors:

- The exposure factor shows the extent to which road users are exposed to the risks arising from crossing the level crossing. This factor is calculated by adding together the daily traffic volume of trains, vehicles and vulnerable road users (pedestrians and cyclists). Based on accident figures from 2007 through 2022, different classes of traffic intensity were linked to the risks of accidents, showing that higher traffic flows systematically involve a higher risk factor (Infrabel, 2025c).
- The infrastructure factor includes a set of parameters that describe the physical and environmental characteristics of the level crossing. These parameters are grouped into three categories:
 - Road-related parameters: the presence of parallel roads, the type of road (e.g. national roads), visibility at fifty metres, the presence of a median strip and the risk of blocking back.
 - Track-related parameters: the width of the level crossing, the number of tracks to be crossed, the profile of the crossing (the angle of the slope and the crossing angle) and the average waiting time.
 - Environmental parameters: proximity to stations, the number of passengers, the number of schools within a five-hundred-metre radius and the total number of pupils in those schools.

Based on the accident figures from 2007 through 2022, weighted coefficients were determined for each of these parameters. In particular, factors such as waiting time, the presence of a median strip, proximity to a station, the number of school pupils in the area and the presence of a cycle lane were found to be most strongly related to an increased risk of accidents (Infrabel, 2025c).

- The equipment coefficient takes into account the level of safety at the level crossing. A distinction is made between passive and active signalling, the presence of barriers, warning lights and acoustic signals. The analysis of accident figures from 2007 through 2022 shows that level crossings with a lower level of safety have significantly more accidents per exposure to risk than level crossings that are more effectively safeguarded (Infrabel, 2025c).

The final risk score for each crossing is calculated by multiplying the exposure factor by the infrastructure factor and by the equipment coefficient. Infrabel compiled a list of all public level crossings based on the final scores, resulting in a "Top 100" of level crossings with the highest risk scores. These locations are considered priorities for the implementation of additional safety measures (Infrabel, 2025c).

The current risk analysis relates solely to level crossings outside the ports. However, Infrabel is working to expand the model to include level crossings at ports, based on the same methodology. A ranking of the level crossings with the greatest risks will also be drawn up in relation to those, so that targeted safety measures can be proposed on that basis (Infrabel, 2025c).

Finding: Level crossings are prioritised using a risk model that combines exposure, infrastructure and equipment. The "Top 100" with the highest risk scores will be prioritised for additional measures.

4.1.3. MODIFICATIONS TO THE LEVEL CROSSING ITSELF

4.1.3.1. ADDITIONAL SAFETY DEVICES

Additional safety devices at level crossings play an important role in reducing the risk of accidents. Level crossings with no safety installations remain the most vulnerable because road users receive no warnings and no physical barrier is present. Although level crossings with safety installations already provide a basic level of protection, targeted modifications can further enhance safety (Safety Research Council, 2018).

In Belgium, many level crossings are equipped with half barriers; this was a deliberate choice. By law, full barriers require obstacle detection, which keeps the level crossing closed for longer. Experience shows that longer closing times lead to more red-light violations (VRT NWS, 2024a).

Infrabel is continually adding further safety devices to level crossings. In 2023, half barriers were installed at two level crossings with active signalling, a level crossing with passive signalling was converted into a level crossing with active signalling with half barriers, and another level crossing with passive signalling was converted into a level crossing with active signalling without barriers (Infrabel, 2024d). In 2024, one level crossing with active signalling without barriers was equipped with barriers (Infrabel, 2025d). Each year, additional St. Andrew's crosses with road light signals and short barriers for pedestrians and cyclists are also being added to improve visibility and safety.

4.1.3.2. IDENTIFICATION STICKERS AND 1711 STICKERS

The identification stickers on level crossings play an important role in reporting incidents quickly and correctly. Each sticker lists the unique number of the level crossing, the railway line on which it is located, as well as the street name and the municipality involved. This information allows road users to immediately communicate the correct location when making an emergency call and enables rapid and targeted intervention (Infrabel, 2025d; Infrabel, 2025c).

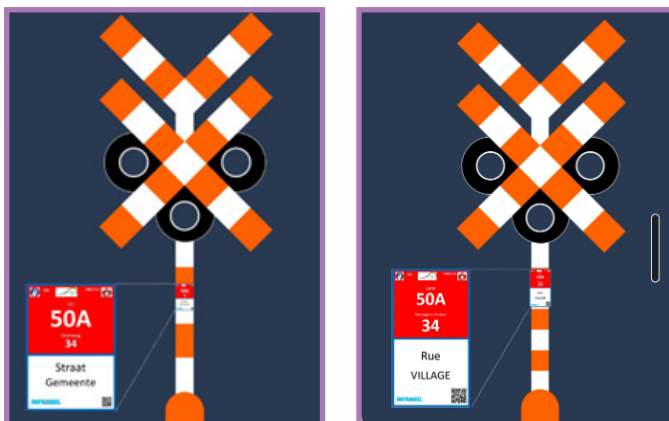


Figure 28: Identification sticker in Dutch (L) and in French (R). Source: (Infrabel, 2025d)

In addition to these identification stickers, Infrabel recently introduced a new sticker that lists the call number 1711, which allows road users to contact Infrabel traffic control directly whenever a dangerous situation occurs on or near the tracks. The number was designed to be an easily accessible hotline so that potential incidents can be notified more quickly. This allows operational teams to take immediate action, such as halting train traffic or intervening on the ground whenever necessary. The introduction of the 1711 sticker is therefore an important addition to the existing safety measures around level crossings (Infrabel, undated, -i; Infrabel, 2025c).



Figure 29: 1711 stickers. Source: (Infrabel, 2025d)

4.1.3.3. LED LIGHTING ON BARRIERS

Infrabel conducted a pilot project to increase visibility and safety at level crossings by installing red flashing LED lights on barriers. These lights are meant to ensure that road users notice the barriers sooner and adjust their speed in time (Infrabel, 2024d; Infrabel, 2025c).

The pilot project, conducted at about 20 level crossings, clearly shows that LED lighting reduces barrier collisions. In addition, field research by the Vias institute shows that road users, especially motorists, brake more gently and less abruptly when approaching a level crossing with LED-lit barriers. This confirms that the additional lighting improves visibility and has a positive effect on driving behaviour (Infrabel, 2024d; Infrabel, 2025c).

Based on these results, the FPS Mobility and Transport authorised the further rollout of the technology from 2024 onwards on level crossings with a large number of incidents or high traffic volumes (Infrabel, 2024d; Infrabel, 2025c). Additional safety features were added in 2025: level crossings now switch to a minor alarm in the event of a failure of all LED lights, and the lights now flash in synchronisation with the red warning lights on the St. Andrew's crosses. Although not all level crossings are yet equipped with barriers, analyses of the test sites confirm a clear improvement in the behaviour of road users (Infrabel, 2025c; Infrabel, 2025d).



Figure 30: Barriers with LED lighting. Source: (Infrabel, 2024d)

4.1.3.4. WARNING BOX

A warning box is a mobile device that activates an audible alarm whenever someone tries to cross a closed level crossing. As soon as the barriers descend, an infrared LED beam is activated between transmitter and receiver. When a level crossing user interrupts this beam, a short alarm signal sounds that immediately warns of the approaching danger. Targeted at cyclists and pedestrians, the warning box is designed as an on-the-spot deterrent and is intended to help bring about sustainable behavioural change in the longer term. Evaluations show that the number of pedestrian violations decreased markedly after activation. A wider rollout to fifteen additional level crossings followed between 2024 and 2025 (Infrabel, 2025d; Infrabel, 2025c).

The warning box has several practical advantages: the device does not interfere with train traffic, requires no modifications to existing installations, is easily movable and causes only limited noise pollution because the alarm sounds only for a few seconds. The system is also relatively inexpensive. However, monitoring does in fact show that effectiveness decreases over time as road users become accustomed to the alarm signal (Infrabel, 2025d; Infrabel, 2025c).



Figure 31: Warning box. Source: (Infrabel, 2025c)

4.1.3.5. CAMERAS WITH OBSTACLE DETECTION

Cameras with obstacle detection increase safety at level crossings by using artificial intelligence to detect stationary people, vehicles or other objects. When an object remains on an unactivated level crossing for more than 15 to 30 seconds, the camera automatically generates an alarm at the relevant signal box. During that process, the traffic controller is shown live images and, if necessary, can immediately stop train traffic in the area (Bruzz, 2024; Infrabel, 2024a; VRT NWS, 2024d; Infrabel, 2025c).

Initial tests recorded an average of 20 valid detections each month, with no false positives. Based on these results, Infrabel selected 70 high-risk level crossings, most of which are locations where congestion occurs regularly. By April 2025, 56 level crossings were equipped with cameras, mainly in locations with a high risk of blocking back or a large number of previous incidents (Bruzz, 2024; Infrabel, 2024a; VRT NWS, 2024d; Infrabel, 2025c).

An additional element is that these cameras utilise obstacle detection based on a deep learning model. This means that the system is able to continuously improve itself by analysing new examples, making the recognition of people, vehicles and other objects increasingly accurate (Bruzz, 2024; Infrabel, 2024a; VRT NWS, 2024d; Infrabel, 2025c).

Finding: Infrabel is carrying out a variety of modifications to the infrastructure of level crossings. These interventions focus on visibility, the ability to report incidents and risk detection.

4.1.4. MODIFICATIONS TO ROAD INFRASTRUCTURE

4.1.4.1. CHECKERBOARD MARKINGS

Checkerboard markings are white squares on the road that delineate areas where stopping and parking are prohibited, including at level crossings (Belgian Official Gazette, 1968). Infrabel rolled out the markings at various locations from 2024 onwards, in order to improve the visibility of level crossings and to encourage drivers to keep the danger zone clear, with the aim of increasing road safety (Infrabel, 2025c).



Figure 32: Checkerboard markings Source: (Infrabel, 2025c)

4.1.4.2. BLOCKING-BACK SIGNS

Blocking-back signs are placed at level crossings where congestion occurs regularly, for example, due to nearby traffic lights, bus stops or roundabouts. They remind drivers to enter a level crossing only when enough space is available to exit the crossing immediately, so that vehicles do not remain stationary on the tracks (Infrabel, 2020).

Infrabel has been renewing the original sign design since early 2025. The new model will be systematically introduced from 2026 onwards at other level crossings identified as high risk (Infrabel, 2020; Infrabel, 2025c).

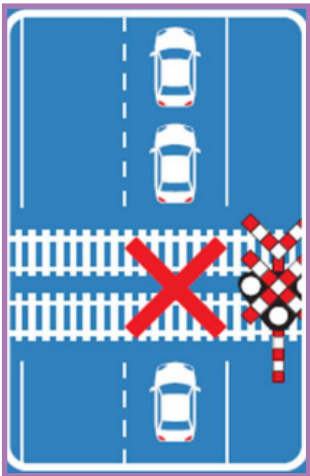


Figure 33: Blocking-back sign. Source: (Infrabel, 2025c)

Finding: Checkerboard markings and blocking-back signs improve the visibility of the level crossing and can prevent vehicles stopping on the tracks.

4.2. IN-VEHICLE WARNINGS

In-vehicle warnings are an additional measure to prevent accidents at level crossings, especially at passive level crossings where road users depend entirely on their own perception. Such systems warn drivers that they are approaching a level crossing (Australian Transport Safety Bureau, 2024). Providing a warning with a pop-up window or an audible signal, for example, gives the driver a clear instruction to stop that is hard to ignore. The EU project *SAFER-LC*¹⁰ shows that in-vehicle warnings can potentially prevent 4% to 15% of accidents (European Commission, 2021).

In Belgium, this mostly takes place by means of navigation apps. Since 2020, Waze has been showing a specific icon whenever a user approaches a level crossing, based on open data from Infrabel. In the case of level crossings without barriers or that are less visible, an audible warning is also given, which is intended to make the driver extra alert (Waze, 2020). By making open data available for about 1,200 level crossings, Infrabel is among the first European infrastructure managers to support this form of digital safety enhancement (Infrabel, undated, -h).

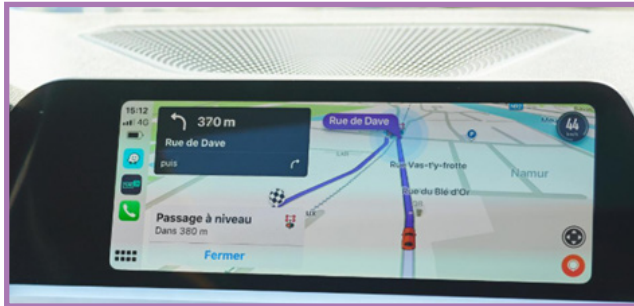


Figure 34: Level crossings on Waze. Source: (Infrabel, undated, -h)

At the same time, several studies point to possible side effects. Drivers may become accustomed to the presence of alerts, which may cause them to pay less attention to conventional safety devices. Research carried out in simulators shows that drivers with a visual warning system disregarded rules more often whenever no train was approaching, maintained higher speeds and looked at the railway line less often. These effects were less pronounced whenever an acoustic warning was used. A key risk is overreliance: when drivers rely too heavily on in-vehicle warnings, an error or the absence of a warning can lead to dangerous situations (Australian Transport Safety Bureau, 2024).

Finding: Infrabel is strengthening safety at level crossings by making open data available that is used by navigation apps such as Waze. This gives drivers a warning whenever they are approaching a level crossing.

¹⁰ The EU *SAFER-LC* project is a project coordinated by the International Union of Railways (UIC) and is co-funded by the EU. Its purpose is to ensure safer level crossings by integrating and optimising the management and design of road and rail infrastructure. The project ran from 1 May 2017 to 1 May 2020 (Safer-LC, undated).

4.3. ENFORCEMENT AND CHECKS

Enforcing traffic regulations at level crossings is a crucial part of safety policy. As cited in subchapter 2.1.3. Ensuring Safety for Level Crossing Users, entering a level crossing when it is not clear is prohibited; entering an activated level crossing is prohibited, and stopping or parking on a level crossing is prohibited. These offences are punishable by a fine and the temporary revocation of the person's driving licence (Belgian Official Gazette, 1968). Moreover, violators may also be liable to pay compensation for damages incurred and for the number of minutes of delay caused to train traffic (VRT NWS, 2025b).

Infrabel works closely with the Railway Police, the local police and Securail to ensure repressive enforcement. These partners regularly carry out enhanced enforcement checks at level crossings, during which penalties are handed out for any violations (Infrabel, undated, -g). In addition to these checks, Infrabel is continuing to develop alternative enforcement mechanisms. Since 2024, a mediation process has been proposed to minors caught committing risky behaviour at level crossings, as an alternative to a police report (Infrabel, 2024a). This approach is specifically targeting young people and seeks to prevent repeated risky behaviours by means of education and promotion of responsibility.

Research shows that a combination of police presence and the imposing fines virtually eliminates violations at level crossings. However, police forces are unable to ensure permanent enforcement and it is not financially feasible (European Commission, 2021). That is why technological means are taking an increasingly important role in targeted controls. According to the United Nations Economic Commission for Europe (UNECE) Group of Experts on Improving Safety at Level Crossings (2016), although many infrastructure operators possess detection technology, they remain largely dependent on police surveillance. As a result, road users perceive that the likelihood of being caught is low at many level crossings, which in turn undermines compliance with rules. Technology can partially address this problem by enabling continuous and consistent detection.

A concrete example of such technological support is red light cameras. These cameras record violations in which vehicles ignore a red light and therefore cross a level crossing while it is closed. The cameras are intended for level crossings with a high number of violations. The cameras include automatic number plate recognition that enables road users to be detected and fines to be issued (Infrabel, 2025d; Infrabel, 2025c). Research has shown that red light cameras at level crossings clearly reduce violations and save costs, due to the fact that fines are issued (European Commission, 2021). A pilot project was launched in Belgium in 2021, and the end of the pilot project was scheduled for 2025 (Infrabel, 2025d; Infrabel, 2025c).

Finding: Enforcement by means of targeted checks and penalties remains essential in order to reduce violations at level crossings. An integrated approach that includes raising awareness and the use of technological tools is necessary to achieve sustainable changes in behaviour.

4.4. RAISING AWARENESS

4.4.1. INFRABEL CAMPAIGNS

In the *Action Plan to Make Level Crossings Safer*, the Belgian State and Infrabel emphasise the fact that awareness is an essential part of safety policy. Infrabel therefore continually invests in campaigns and educational initiatives aimed at diverse audiences, such as the general public, schools, local authorities and professional drivers (Belgian State & Infrabel, 2023). The intention of these campaigns is to contribute towards sustainable behavioural change by focusing on awareness, clear communication and education.

In 2024, investments in awareness-raising and educational projects amounted to €461,659 (Infrabel, 2025d).

The overview list in this chapter does not contain a complete inventory, but highlights the most recent and relevant campaigns.

4.4.1.1. PUBLIC CAMPAIGNS

Don't delay, dial 1711 straight away

As explained in Section 4.1.3.2. Identification stickers and 1711 stickers; the emergency number 1711 provides a direct connection to Infrabel traffic control for situations that may require an immediate shutdown of train traffic. To encourage the use of this number and raise public awareness of its importance, Infrabel launched the awareness campaign *Panic at the level crossing? Don't delay, dial 1711 straight away*. The campaign consisted of a video clip and various online and offline communication materials distributed via the website, social media and in the press. In addition, targeted communications were made to specific audiences such as lorry drivers, farmers and industrial partners (Infrabel, undated, -i; Infrabel, 2025d).

The results for 2024 show that the emergency number provided a tangible safety gain and helped avoid at least 20 dangerous situations at level crossings (Infrabel, 2025d). To further increase awareness of the number, Infrabel organised additional campaigns in December 2024, targeted at bus drivers of De Lijn, TEC and STIB-MIVB, and to farmers, among others. A second round of communication on social media followed in late 2025 (Infrabel, 2025c).



Figure 35: The 1711 campaign in Dutch (L) and in French (R). Source: (Infrabel, undated, -i)

Testimonies of those left behind

The online campaign *Testimonies of those left behind* ran from February to the end of September 2024. With this campaign, Infrabel wanted to confront the public with the dangers of track walking and ignoring traffic rules at level crossings. The core of the message was conveyed using five short videos in which that same number of witnesses shared their personal, often profound experiences following a railway accident. By focusing on the emotional and human impact, the campaign aimed to create a deeper awareness of the potential consequences of risky behaviour (Infrabel, 2024b).

The videos were disseminated via Infrabel's website and social media channels and were additionally included in educational materials used in schools and other educational contexts (Infrabel, 2024b). Their wide distribution led to significant reach: the campaign was viewed more than six million times (Infrabel, 2024a).

The Saint Nicholas campaign

The Saint Nicholas campaign is organised every year and is a low-threshold awareness campaign to draw attention to the traffic rules at level crossings. 'Saint Nicholas' stood at a level crossing in Heverlee in 2024 where several road users had committed violations a few weeks before. Children who crossed correctly received a piece of chocolate, while violators were fined. Infrabel's aim was to alert the public to the dangers of risky behaviour and therefore increase safety awareness (VRT NWS, 2024c).

Not spot

The *not spot* campaign consisted of humorous videos distributed via social media between September and December 2024. The campaign focused on combating risky behaviour near railway lines, including level crossings. By changing the term *hot spots* to *not spot*, Infrabel emphasised the fact that tracks and level crossings are not places to walk or hang out. By showing that there are many more attractive places than the areas around railway tracks, Infrabel's intention was to encourage behavioural change and make it clear that safe behaviour can save lives (Infrabel, 2024c; Infrabel, 2025d).

Campaigns for professional drivers

Infrabel is also committed to targeted efforts to raise awareness among professional drivers, with a specific focus on situations in which heavy vehicles pose an increased risk at level crossings. The *Red = Stop, anytime and anywhere* campaign (June-July 2025) focused on lorry drivers in port areas, where nine out of 30 accidents at level crossings in 2024 took place and where ignoring the red light was often a determining factor. This behaviour not only leads to life-threatening situations, but also causes significant property damage and disruption to freight traffic. Infrabel spoke with drivers on the ground in the port of Antwerp and in the port of Zeebrugge and backed this up by means of videos and information material. The campaign was then continued online via the social media channels of Infrabel and its partners, with geographically targeted messages for road users in and around the port zones. Companies were able to visit the campaign page and download flyers and video materials in multiple languages to distribute to their staff (Infrabel, 2025b).



Figure 36: Flyer campaign Red = Stop, anytime and anywhere. Source: (Infrabel, 2025b)

In addition to campaigns directed at lorry drivers, Infrabel also targeted bus drivers at De Lijn and TEC. Several Alert Chain Test (ALEX) exercises simulating a stalled bus at a level crossing took place in 2024 (Infrabel, 2025d; Infrabel, 2025c). In addition, awareness-raising initiatives for school buses were developed in 2023 and 2024 and via the Belgian Federation of Coach and Bus Operators (FBAA), focusing on correct rules of conduct at level crossings and the procedure to follow whenever incidents occur. In 2025, the procedures that apply with regard to the 1711 emergency number and its alarm procedure were re-emphasised. At the same time, a study is under way to map level crossings frequently used by De Lijn and TEC buses so that future interventions can be developed in an even more targeted way (Infrabel, 2025c).

4.4.1.2. EDUCATIONAL PROGRAMMES

Infrabel also reaches out to schools by means of a wide range of educational materials. Teachers can use various types of games and animations that make children aware of safe behaviour at level crossings (Infrabel, 2024a). Free educational programmes are available for pupils aged 6 to 18, including a game for children aged 6 to 12 that focuses, among other things, on behaviour around level crossings (Infrabel, undated, -j). For young people aged 12 to 18, there is a more extensive programme that includes *Code Rails*, an interactive escape game in which participants must solve puzzles within sixty minutes using maps and an app. This programme also includes rail safety theory and videos containing testimonies (Infrabel, undated, -k). There is also an adapted version for young people who are deaf or hard of hearing, which focuses on visual cues, practical demonstrations and educational videos (Infrabel, undated, -l).

In addition to its regular educational offerings, Infrabel is also deploying virtual reality (VR) to confront young people between the ages of 12 and 18 with the risks of crossing a level crossing when it is closed. During such sessions, students first receive a safety lesson focusing on behaviour along the tracks, at stations and at level crossings, illustrated with images of past incidents. Then, using a VR animation, they experience how a seemingly innocent moment can turn into a serious accident, as in the video in which a girl gets too close to the track while taking a picture and is grabbed by a train (Infrabel, 2025d; VRT NWS, 2025a). In doing so, Infrabel is building on previous VR awareness-raising campaigns, including *The Floor* (2019), a 360° experience in which pupils follow the perspective of a teenager who is hit by a train at a level crossing and witness the aftermath. This programme reached about two thousand pupils in 2020, but was subsequently discontinued due to the COVID-19 pandemic (Infrabel, 2021).

4.4.2. INTERNATIONAL LEVEL CROSSING AWARENESS DAY

International Level Crossing Awareness Day (ILCAD) is an annual, global campaign organised by the UIC around the beginning of June. Its aim is to raise awareness around safety at level crossings. Since 2009, about 40 countries have taken part by organising awareness-raising activities, both in physical form and online. Each year, a different country hosts the official launch, at which representatives from the rail industry, road authorities, academic institutions and other stakeholders share good practices and projects that help reduce accidents at level crossings. Belgium is a regular participant in this international campaign (ILCAD, undated).

4.4.3. THE EFFECTIVENESS OF AWARENESS RAISING

There is broad international consensus that raising awareness is an important part of level crossing safety, but that the impact is especially high when campaigns are aimed at specific audiences (Group of Experts on Improving Safety at Level Crossings, 2016). This is also true in Belgium, where Infrabel focuses on conducting campaigns targeted at professional drivers, such as lorry and bus drivers, because this group is involved in a relatively high number of serious accidents worldwide (Nelson, 2012).

Research shows that measures to raise awareness become more effective when they respond to specific risk factors. For example, combining targeted awareness-raising and enforcement leads to a sharp reduction in violations, with international studies reporting up to nearly 60% fewer illegal crossing movements (European Commission, 2021). Belgian campaigns such as *Red = Stop* and *Testimonies of those left behind* follow this principle by addressing behaviours that often precede incidents, such as ignoring traffic rules or stopping on tracks.

As people's media use changes, awareness-raising campaigns must also adapt accordingly. International recommendations stress the importance of digital tools and new media, especially when it comes to reaching young people (Nelson, 2012). This can be seen in Belgium in the form of campaigns on social media, VR simulations and interactive programs such as *Code Rails*, including adapted versions for young people who are deaf or hard of hearing. Such inclusive and modern forms of awareness-raising align directly with the call for awareness raising to evolve.

In addition, uniform safety messages in multiple languages have been shown to enhance the recognition and persuasiveness of awareness-raising (Nelson, 2012). ILCAD is expressing this in specific terms: countries, including Belgium, share the same key messages, share experience and thereby build consistency and the attention to level crossing safety around the world (Group of Experts on Improving Safety at Level Crossings, 2016).

Finding: Infrabel is reinforcing safety at and in the vicinity of level crossings by bringing together awareness-raising and targeted, up-to-date campaigns, as recommended in the literature.

4.5. REMOVING LEVEL CROSSINGS

Removing level crossings is a crucial measure to reduce the number of accidents at level crossings, since the safest level crossing is one that does not exist. By 2024, eight level crossings were removed, including six active level crossings with barriers, one active level crossing without barriers and one passive level crossing. Because two new level crossings were also built in the same year, the total number of level crossings on 1 January 2025 came to 1,612 (Infrabel, 2025d). Figure 7 shows how this structural reduction is progressing. However, removing level crossings is a complex, lengthy and cost-intensive operation. In 2024, Infrabel invested €23 million in such projects, part of which came from EU subsidies (Infrabel, 2025d).

4.5.1. LEGAL FRAMEWORK

The legal basis for the removal of level crossings located on public roads is set out in Article 19 of the Railway Police Act of 27 April 2018. However, that power cannot be exercised unilaterally; the Act provides for a mandatory consultation process with the relevant authorities, as well as a public inquiry. The Act stipulates that the decision to remove a level crossing by infrastructure manager Infrabel may only be finalised after these procedures (Belgian Official Gazette, 2018).

The concrete elaboration of the above procedure is laid down in the Royal Decree of 9 July 2024, which specifies the steps, deadlines and responsibilities of each party. Infrabel must transmit a draft removal decision to the municipality concerned, accompanied by a situation plan and contact details of the competent technical departments. The municipality must then organise a public inquiry¹¹ to be announced with a poster on each side of the level crossing and lasting 30 days. During that period, any interested party can submit comments or objections. These comments and objections will be conveyed to Infrabel after the public inquiry by the municipality has been completed. Furthermore, the municipality still has 30 days to provide advice. Infrabel must review the comments and objections and the opinion of the municipality before making a final decision. Furthermore, the Royal Decree requires that the decision to remove the level crossing must be notified to the public by means of a poster at the level crossing itself and, if possible, via the municipality's website (Belgian Official Gazette, 2024).

The performance contract between the Belgian State and Infrabel emphasises that the removal of a level crossing is regarded as a safety measure that must be duly justified, taking into account the criteria set out in the legal framework. Infrabel is required to conduct a thorough impact analysis mapping the effects of the removal on rail, road, bicycle and pedestrian traffic. In addition, the analysis should include the impact on the public environment, if necessary beyond the boundaries of the municipality in question. The financial implications of the proposed action also form an integral part of the assessment. Infrabel carries out this analysis in close consultation with the road managers and local authorities concerned (Belgian State & Infrabel, 2023).

Finding: The removal of a level crossing is a strictly regulated decision that can only be made after a formal advisory process, a public inquiry and a thorough impact assessment. This decision should be carefully justified and communicated in a timely manner to all interested parties and the public.

¹¹ This public enquiry can be incorporated into the public enquiry for the application for a permit to construct, alter or remove a municipal road, so that no separate public enquiry is required.

4.5.2. INFRABEL'S PRIORITISATION MODEL

In addition to the risk model, Infrabel developed the prioritisation model for the removal of level crossings. This model aims to determine which level crossings should be considered for removal in the first instance, taking not only safety but also operational and social criteria into account. The model provides a framework for a decision-making process that is more transparent in the eyes of the public and supports closer collaboration with municipalities when planning projects to remove level crossings.

The prioritisation model for removing level crossings brings together several criteria to form a system that underpins decision-making. First, the importance of removing a level crossing is considered. This takes into account five factors: the risk score from the aforementioned risk model, the impact on punctuality, the capacity for rail traffic, the impact on mobility for road traffic and historical accident and incident data.

After that, the social benefits of the removal project¹² will be examined. The importance of removing a level crossing is considered, as well as the total estimated cost and possible co-financing by third parties, such as municipalities, regions or other partners. Based on this information, removal projects are classified into different priority levels. Two additional criteria are important here: the category of rail line and the agreement in principle from the municipality concerned.

Projects on mass transit lines and on connecting, local or industrial lines with either a high social return, or with at least one level crossing with a high level of priority for removal, or on routes where capacity is under pressure, will be given the highest priority if there is an agreement in principle, or increased priority if there is no agreement in principle. Projects with medium social returns will be given medium priority, while projects with limited social returns are placed in the lowest category (Infrabel, 2025c; Infrabel, 2025e).

Finding: Infrabel uses a prioritisation model for removing level crossings based on their safety risk, on the operational impact, on social profitability, on the cost and on co-financing, on the line category and on agreement in principle.

¹² A removal project can involve doing away with several level crossings at once.

4.5.3. THE PROCESS WHEN REMOVING A LEVEL CROSSING

Removing level crossings is a complex and lengthy procedure that poses both technical and societal challenges. The initiative to remove a level crossing always lies with Infrabel, which launches these projects based on its desire to make the rail network safer and more efficient. The goal is clear: to completely eliminate the risk of accidents at level crossings, a measure internationally considered to be the most effective solution to ensure safety, despite the high cost and the practical limitations (Rudin-Brown, George, & Stuart, 2014; FPS Mobility and Transport, 2025a; Infrabel, 2025e).

The first step in the process is to establish a target situation for each municipality. This target situation takes the form of vision for the future in which all level crossings in the territory are considered in conjunction with local mobility plans. It includes a coarse network for motorised traffic, with bridges and tunnels, and a dense network for cyclists and pedestrians, via underpasses or pedestrian bridges. Not every level crossing will be given an alternative; some will be removed permanently to prevent traffic taking a short cut and make streets liveable again for residents. The STOP-principle (pedestrians, cyclist, public transport and cars¹³) is a key component of this target vision (Infrabel, 2025e; Infrabel, undated, -f).

After the concept phase, Infrabel presents the target situation to the municipality and requests a declaration of commitment. Detailed studies are then conducted, and cooperation agreements are concluded. Infrabel will bear the cost of the studies and the basic construction of the alternatives. Consultation is not limited to municipal authorities: provinces, the Roads and Traffic Agency, emergency services and residents are also involved through information sessions and public engagement events (Infrabel, 2025e). This participation is crucial as a way of creating public support, as the removal of a level crossing often leads to longer routes and resistance from residents (VRT NWS, 2024a; Infrabel, 2025e).

The technical implementation of a removal project varies according to local conditions. Possible infrastructure elements include routes to an adjacent level crossing, tunnels under the tracks, bridges or underpasses for cyclists and pedestrians. Simply removing the level crossing by closing off the road with barriers is cheaper, but is rarely accepted by municipalities and residents. In addition, building a bridge or tunnel requires significantly more space than a level crossing, which creates additional challenges in densely built-up areas or agricultural zones. Each structure is made to measure and will depend on the available space, natural areas and rezoned agricultural land (Infrabel, 2025e).

The process is a lengthy one. Years can pass between an initial agreement and implementation. For example, an agreement was reached regarding a level crossing in Beveren in 2016, and the initial works did not get started until 2025. This lengthy lead time can be attributed to complex procedures, land expropriations and budgetary constraints (Infrabel, 2025e).

While removing level crossings has significant benefits for safety and improves the flow of rail traffic, there are also problems. Costs are high and not every location lends itself to an alternative such as a bridge or tunnel (European Commission, 2021; Infrabel, 2025e). In addition, political long-term vision is sometimes lacking, which slows progress (Infrabel, 2025e). Creating public support remains a challenge, especially when residents are faced with longer routes, loss of direct connections to locations such as village centres, for example, and lengthy works (VRT NWS, 2024a; Infrabel, 2025e; Network Rail, 2019).

Finding: While removing level crossings is the most effective measure to prevent accidents at level crossings, implementation remains complex, costly and dependent on widespread public and political support.

4.6. INTERNATIONAL INSIGHTS AND BEST PRACTICES

International experience shows that improving safety at and around level crossings requires a multifaceted approach in which technical measures, education, enforcement and organisational reforms complement each other. Many countries apply the principle that the safest level crossing is one that no longer exists. Consequently, the drive to reduce the number of level crossings is widely shared: Norway has completely banned new level crossings, while countries such as Spain, Portugal and Bulgaria ban such crossings on lines with speeds above 140 to 160 km/h. Finland and the Netherlands also systematically discourage the installation of new level crossings and promote grade-separated crossings. Belgium partially follows this trend by no longer allowing new level crossings, other than in exceptional cases, and by explicitly banning level crossings on high-speed lines (Annex A. NIB Questions and Answers).

In addition to preventative measures, some countries have clear legal “triggers” for the mandatory removal of existing level crossings. Portugal and Spain specify removal whenever risk thresholds are exceeded, such as in the case of high traffic volumes or speeds above 160 km/h. Italy requires extensive safety studies before a removal can take place (Annex A. NIB Questions and Answers). Objective criteria of this type provide transparency and speed up decision-making.

On an organisational level, it is notable that countries with an integrated infrastructure manager, such as Sweden and Finland, have a more streamlined decision-making process. In those countries, one agency manages both rail and road components, which reduces coordination losses and administrative barriers (Nelson, 2012).

Technical innovations also play a crucial role. In the United Kingdom, voice warnings such as “Another train coming” have been introduced at level crossings used by large numbers of pedestrians (Network Rail, 2019). Other countries are improving the visibility of approaching trains by installing flashing lights on locomotives, a measure that can prevent up to 30% of accidents and is proving economically viable. Reducing the closing times of level crossings near stations, by closing the level crossing only when the train is ready to depart, also reduces the amount of risky behaviour by road users (European Commission, 2021).

Education and awareness remain a pillar of international strategies. Experts argue for the inclusion of specific modules on level crossing safety in driver training and for the effectiveness of campaigns to be measured, ideally in an international context where experiences and successes can be shared and refined (Group of Experts on Improving Safety at Level Crossings, 2016).

Finding: International examples provide a variety of ideas and approaches to improve safety at level crossings, ranging from technical innovations to education and enforcement.

5. CONCLUSION

This study confirms that accidents at level crossings in Belgium are a persistent and multifactorial safety problem. Despite a dense rail network with a high proportion of level crossings with active signalling and years of investment in infrastructure and safety, the number of serious accidents and fatalities remains high compared to other European countries. This shows that technological and infrastructural measures are necessary but not sufficient to fundamentally manage the risk.

The analysis confirms that human behaviour plays a decisive role in the onset of accidents. In most cases, the level crossings function correctly and external conditions such as weather conditions or technical failures are not a primary cause. The fact that accidents often occur while barriers are closed or while red lights are flashing underscores the importance of risk perception, compliance with rules and context-dependent behaviour. The distinct user profiles make it clear that violations can be both conscious and unconscious and stem from a variety of motivations, ranging from underestimating the risk and routine behaviour to intentionally weighing up the risks and benefits and deviation from the rules.

In addition, the broader traffic context around level crossings significantly influences the risk. Factors such as complex road layouts, limited visibility, and proximity to intersections or roundabouts can adversely affect the perception and decision-making of road users. Although inspections and monitoring play a part in ensuring that the basic infrastructure remains safe, Belgium lacks clear and binding design guidelines for level crossings and their surroundings in certain respects, which can lead to situations of increased risk. This is linked to the Belgian institutional context, in which rail and road infrastructure fall under the remit of different levels of government and actors, which can make coordination regarding level crossings more difficult. Although this cannot be seen as the sole explanation, it highlights the importance of a more integrated approach and cooperation between the parties involved.

Belgium is committed to a broad mix of measures: infrastructural improvements, technological solutions, enforcement and awareness raising. These efforts are necessary and have an impact, but they cannot fully solve the problem as long as a portion of road users systematically underestimates the risks or deliberately ignores the rules. Removing level crossings remains the most effective measure but is a slow and complex process that is not everywhere spatially or socially feasible.

5.1. WHAT SHOULD YOU AND CAN YOU DO YOURSELF AS A ROAD USER?

This study underlines the fact that further progress not only depends on policy, technology and monitoring, but also on the behaviour of individual road users.

Every road user must strictly obey the traffic rules. This means stopping as soon as the red light flashes, always staying behind the barriers and proceeding to cross only when you are certain you can clear the level crossing completely and without stopping. Attention and alertness are crucial in this regard. Any type of distraction reduces the perception of visual and acoustic signals and significantly increases the risk.

In addition, tracks should be crossed only via the infrastructure provided, such as protected level crossings, bridges or underpasses. Trespassing or crossing a level crossing when it's in operation remains dangerous, even when no train appears to be approaching. Trains approach faster than many road users estimate.

Finally, acting correctly in the event of an incident is of vital importance. Anyone in an emergency situation at a level crossing should immediately leave the tracks and notify Infrabel's traffic control centre by calling the emergency number 1711. The information on the level crossing post allows train traffic to be stopped quickly and in a targeted way.

With that, this study concludes with a clear observation: technical measures and regulations are a necessary foundation, but safe behaviour by road users is still indispensable. Only once every road user takes responsibility can the risk of accidents at level crossings truly be reduced.

ANNEX

A. NIB QUESTIONS AND ANSWERS

The enquiries sent to investigation bodies in other European countries were of an open nature and were independent of any formal or legal proceedings. The investigation bodies contacted were entirely free to choose whether or not to respond, and to do so to the extent and in the manner they deemed appropriate. Within the network of National Investigation Bodies (NIB), it is customary to exchange knowledge and experiences on an informal and voluntary basis. The responses received were provided in this spirit. Thanks are extended to the investigation bodies concerned for their willing cooperation.

Which authority is responsible for the construction, modification, and removal of level crossings (LC) in your country and what is the procedure for removing or modifying the infrastructure (so not the signage)?

Belgium	The responsibility for LCs is shared among several entities: • The IM is responsible for the LCs, including the construction, modification, and removal. • The Federal Public Service of Transport and Mobility oversees general railway and road regulations and compliance and inspects LCs. • Roads, road signs and markings are either the responsibility of the region (roads are federalised) or the municipality, depending on the ownership of the road. Roads are not the responsibility of the federal state, but the federal state does outline the LC signage. The procedure is as follows: • The IM asks the municipality where the LC is located for advice. The advice includes a reasoned draft decision to remove/modify the LC, a situation plan which identifies the LC and contact details of the service where technical information on the file can be obtained. • According to federal law, a public enquiry must be held about the removal of the LC, announced with posters at the LC. At the same time, according to regional law, a public enquiry must be held about the construction, modification or closure of the road. So: there can be two separate public enquiries about the same LC and with the same questions, however, it's possible to integrate those two inquiries in one. • The municipality sends the results of the public enquiries to the IM. • The IM drafts the definite decision. The IM sends the definite decision to the municipality and notifies the public with posters at the LC.
Bulgaria	The responsibility for LCs is shared between the following entities: • The final decision on the construction, modification and removal of a LC is made by the Ministry of Transport and Communications (MTC) after a coordinated agreement with the IM, the Road Infrastructure Agency (RIA), the police and the local authorities (municipality). • Responsibility for roads, road signs and markings are divided between the IM, the RIA and the municipality. • The IM is responsible for the technical condition of the LC, including the railway, equipment, signalling and LC signs (warning cross and stop). • The RIA bodies and municipalities, depending on the location, make decisions on the placement of other road signs related to the LC (balises), maintenance is carried out by the same persons. • In the event of reconstructions and modernizations of the railway infrastructure and the issue of removing a LC arises, decisions are made by the interested state structures. • Regulation No. 4 of 1997 on LCs established that newly built railway lines with a speed of over 160 km/h should not have LCs.

<i>Croatia</i>	The design, construction, modernization, renovation and maintenance of railway infrastructure shall be carried out in such a way as to meet the requirements that ensure technical and technological unity and the requirements of the law, including the technical conditions for railway infrastructure and technical conditions for railway infrastructure subsystems and their maintenance, and directly applicable EU regulations, in particular the TSIs for infrastructure subsystems, in accordance with their implementation plans. The IM shall adopt detailed rules, technical specifications and conditions for the design, construction, modernization, renovation, and maintenance of railway infrastructure. At the request of the investor, with the prior consent of the IM, the legal entity managing the road, the competent police administration and the regional or local self-government unit (local self-government units are municipalities and cities, and regional self-government units are counties), the Croatian NSA shall issue an approval for the opening of a newly constructed permanent or temporary LC or PC (pedestrian LC). In the approval process, the NSA checks whether the conditions for opening a newly constructed permanent or temporary LC or PC are met and whether the planned method of ensuring traffic at the LC is in accordance with the prescribed technical conditions. The NSA publishes the decision on opening a newly constructed permanent or temporary LC or PC in the Official Gazette. At the request of the IM, the NSA decides on closing existing LC and PC in accordance with the solution program of the Ministry of the Sea, Transport and Infrastructure LC and PC (current program for the period 2023-2027) and publishes it in the Official Gazette. This program establishes a list of priorities for resolving LCs and PCs across the railway line. The program covers LCs that are in the resolution process, then LCs that are within the scope of project applications for which funds have been secured, as well as those that are not within the scope of existing investment programs and that need to be secured.
<i>Czech Republic</i>	The responsibility for LCs is shared among the following entities: • Final decision about the construction, modification, and removal of LC is made by the NSA after the cooperation and agreement with IM, police and local authorities (municipality). • By regulation it is set that at newly built railways with speed over 140 km/h there must not be any LCs. • Responsibility for roads, road signs and markings are divided between IM, Road administration authority and Road maintenance. IM is responsible for condition of LC including road right in the LC and signing of LC (warning cross sign). Road administration authority decides about installation and position of other road signs concerning LC and Road maintenance installs and cares about these signs directly on the spot. There aren't any public consultations regarding removal of LC.
<i>Denmark</i>	Did not receive answers to questions but heard via Task Force meeting that if there are more than 100 users per day on an LC, barriers are mandatory.
<i>Estonia</i>	The IM orders a project for the construction of a LC. On the roadside, it must comply with the Ministerial Regulation "Road Design Requirements". On the railway side, the LC must also meet specific requirements established by ministerial regulation. The closure of the LC is initiated by the IM. This must be coordinated with the NSA, the police and the road owner. The IM must submit a traffic management project for the time of the LC closure. The client or the contractor of all these works is IM; therefore, it is also responsible.
<i>Finland</i>	The IM of track network is primarily in charge of all things related to LCs. If a LC needs to be modified or removed, the IM must communicate this with the entity who owns the road (city/company/state etc.) too. The NSA oversees that all changes to existing infrastructure comply to current regulations and new LCs fulfil all regulations. When a section of track is being modernised, the IM must make a detailed plan on how the LCs and risks associated with them are considered. This plan must be approved by the NSA before work is started. Recommendation is that all LCs should be removed or equipped with barriers and warning devices in these types of projects.
<i>France</i>	Any creation or removal of a LC, as well as any change or installation of equipment for an existing LC, is authorized by a prefectural decree. The road network manager is consulted by the IM before, which is responsible for the studies and procedure regarding any modification. In case of some, a prefectural consultation is organised, and especially for the removal of a LC a declaration of public utility is compulsory, taken following a public inquiry, conducted under the responsibility of the prefectural service. The road network manager and the IM are involved. The authority responsible for road traffic police may issue a closure order in the event of an incident, pending the completion of repair work.

<i>Germany</i>	The German Act on crossings of railways and roads: It states for LCs in §14 EBKrG: • The IM's obligation to maintain the railway equipment. This is defined as the section of the LC itself (limited to 2,25m beside the centre of the track), all equipment directly relevant for the safety of the LC such as the Andreas cross, barriers, lights, and the technical safety installation belonging to. • The road construction and traffic authority's obligation to maintain the road equipment. This is defined as the necessary visual space ("sight triangle", esp. relevant for LC only guarded by road user's attention, without barriers or lights) and all other road equipment/ traffic signs relevant for the LC. All maintenance must be done by these players. They are legally obligated to tolerate the other player's measures. If there is the interest of modernisation or removing by bridges, the relevant authorities for authorisation (railway, road) must be involved. This aspect is a little bit complicated due to German Federalism. The responsibility and the concept for financing varies for federal roads, state roads and municipal roads. An interest of modernisation or removing can be raised by each player and affects the others. The EBKrG states the relevant issues like associated responsibilities, values and financing.
<i>Ireland</i>	The situation is broadly like Belgium. Road signage is defined in the Traffic Signs Manual published by the Department of Transport. Roads on which LCs are to be found e.g. not motorways and trunk roads are the responsibility of councils/ local authorities. The NSA (in this case the CRR) has published guidance a https://www.crr.ie/assets/files/pdf/crr-g-006-c.pdf which includes guidance on closing LCs. • See CRR Guidance Section 5 (5.1.4) from the CRR Guidance above: LCs should be closed where possible and practicable, and the introduction of new LCs resisted. Closure of a LC should be possible when the land on both sides is no longer in common ownership and Iarnród Éireann progress such closures while complying with all legal requirements. Where it is possible to reach an agreement with a local authority to close a public road LC (OP type) this opportunity should be pursued with the relevant authority. The local authority can exercise their statutory function under Section 73 of the Roads Act 1993 (to extinguish any public right of way over the road) and thus facilitate the closure of the OP type LCs. See this document for the www.irishrail.ie/Admin/IrishRail/media/Imported/CLLC-Screening-Scoping-Report.pdf for further details of a LC closure programme.
<i>Italy</i>	The entity responsible for the construction, modification, and removal of LCs is the IM — for the national network, this is Rete Ferroviaria Italiana (RFI). The procedure is regulated by DPR 11 luglio 1980, n. 753, which governs safety and construction standards for railways and other guided transport systems. Any modification or removal of a LC entails: • A technical assessment conducted by the IM, often in agreement with the road authority (such as municipalities, provinces, or ANAS). • Submission of a project proposal to the Ministry of Infrastructure and Transport, particularly when the intervention has broader safety implications. • Execution of safety and traffic impact studies in accordance with national standards. • Approval from the relevant road authority if public roads are affected. Once all administrative and safety approvals are obtained, the IM carries out the works.
<i>Latvia</i>	The entity responsible for the construction, modification, and removal of LCs is the IM. The IM is obliged to ensure the safe functioning of railway traffic and to cooperate with road administrators concerning the technical conditions of LCs.

Lithuania	According to Railway Transport Code of the Republic of Lithuania, LCs are installed: • When a new railway track is constructed – at the intersection of the railway track with existing state roads, streets, bicycle and/or pedestrian paths, using funds from the entities constructing the railway track; • When new state roads are constructed – at the intersection of those roads with existing railway tracks, using funds from the entities constructing the roads; • When the railway track already exists – using the funds of natural and/or legal persons interested in the installation of a LC, pedestrian crossing (if the IM agrees to the installation), culvert, overpass or tunnel for road transport and/or pedestrian traffic. At the intersection of local roads, streets, bicycle and/or pedestrian paths with a railway track, LC or pedestrian crossings, as well as culverts, overpasses or tunnels for road transport and/or pedestrian traffic on local roads, LC are installed and maintained by the interested natural or legal persons at their own expense, in coordination with the IM. Therefore, the responsibility of the decision to install a new LC is shared between the Ministry (which administers the nation funds) and municipalities (which administer the municipality funds) or even private entity. However, the permit to install a LC shall be issued by the IM, taking into account the technical possibilities and the special land use conditions provided in the Law on Special Land Use Conditions in the protection zones of railway tracks and their facilities, as well as railway greenery. By mutual agreement between interested natural or legal persons and the IM, existing LCs may be relocated, closed, or removed. The relocation, closure, or removal shall be carried out at the expense of the person requesting such a change (once again that could be the state, the municipality or private person). The building of LCs as of the structure (the building) is regulated by the Law on Construction of the Republic of Lithuania.
Netherlands	The IM is responsible for the construction, modification and removal of LCs. The road manager (like municipalities and private individuals) is responsible for the accessibility of the road. The Ministry of Infrastructure and Water Management has two programmes on LC safety. Both programmes are aimed to reduce the number of LCs on the mixed railway network, for example by constructing tunnels. The policy is that no new LCs will be constructed, stand still principle. If transport flows change, it may be decided to improve the security of LCs. Both the road and railway IMs have a role in risk reducing measurements. There is a procedure for modifying and removing LCs, which involves all above-mentioned parties. Often there is a difference of opinion on the type of change and the funding. In some cases, the IM can expropriate land to remove a LC, which is a long procedure.
Norway	The IM (Bane NOR SF) is responsible for the national railway infrastructure, including LCs. Bane NOR is therefore responsible for the installation and maintenance of safety equipment at LCs on public roads, including removal or modification. Any type of work near the railway (30m) must be reported to and approved by Bane NOR. Modifications of LCs can occur in connection with planning processes and after dialogue with affected stakeholders. It's important to note that it is forbidden to construct new LCs in Norway, only removal or enhancing the safety level of existing is allowed. • In a previous NIB NO report (https://nsia.no/Railway/Investigations/20-415) we highlighted an unclear division of responsibility between Bane NOR and the road owner (in this case the municipality) regarding the design of the road over the LC, as changes to the road infrastructure near LCs may require coordination between these entities. As a conclusion from this investigation, it became clear that the road owner has the overall responsibility for traffic safety on its roads, but it requires cooperation and involvement from the IM.
Poland	The entity responsible for the construction, modification, and removal of LCs is primarily the IM – usually the railway IM (e.g. PKP Polskie Linie Kolejowe S.A.) in cooperation with the road manager (such as local, regional, or national road authorities). This is regulated under the Rail Transport Act of 28 March 2003 (Ustawa o transporcie kolejowym, Dz.U. 2023 poz. 861). According to Article 28 of this Act, the IM is obliged to ensure the safe functioning of railway traffic and to cooperate with road administrators concerning the technical conditions of LCs. Modifications or removal of LCs must comply with the provisions of the Construction Law (Prawo budowlane, Dz.U. 2023 poz. 682) and require obtaining the necessary administrative permits, including a building permit if the changes concern the railway infrastructure. The detailed technical requirements are set out in the Regulation of the Minister of Infrastructure of 20 October 2015 on the technical conditions to be met by LCs and their location (Rozporządzenie Ministra Infrastruktury z dnia 20 października 2015 r. w sprawie warunków technicznych, jakim powinny odpowiadać skrzyżowania linii kolejowych z drogami publicznymi oraz ich usytuowanie, Dz.U. 2015 poz. 1744).

<i>Portugal</i>	The specific regulation governing LCs does not allow for the construction of any new LC, except in special circumstances for a temporary and well-defined delay and situation. The responsibility is shared among the IM and the road IM, which can be also the IM (in Portugal the rail network and the national importance roads network are managed by the same entity) or the municipality (for most cases). The legislation states that any LC within 700m of another one, with the possibility of establishing an alternative link between both roads, should be removed. Also, if there is any urban development project that will increase the use of a LC, licensing should only be granted if it includes replacement of the LC by an underground or overhead passage. This legal requirement has seldomly been enforced. The responsibility for LCs is shared among several entities: • The IM is responsible for the LCs, including modification and removal. It is mandatory that it inspects LCs at least every 5 years to assess the traffic moment indicator and revise the protection system accordingly (LC protection systems depend on the rank in traffic moment). • The National Institute for Mobility (a state entity, which is also the NSA) oversees general railway and road regulations, including road and LC signage. Regarding road regulations it is responsible to ensure compliance on national roads, but it does not have powers on municipal roads. It should inspect, but it does not. • Roads (including the road pavement in the rail domain – which in our opinion is wrong), road signs and markings are the responsibility of the road IM, which can be the (rail) IM (on national roads) or the municipality. Please note that the signage immediately at the LC is always the responsibility of the rail IM. Only the approach signage is the responsibility of the road IM. Unfortunately, rarely there is coordination between both, even in the case when they are both the same entity (on national roads). For modifications or removal, the road and rail IMs must coordinate the actions. I am not aware of any example where there was a public consultation as described for Belgium and would be surprised if it ever happened. There are no LCs on lines where the rail speed is above 140 km/h. If there is a major modernization to the rail infrastructure that involves increasing the number of tracks, then the LC must be removed, at the rail IM expense. If there is an important upgrade to the road, then the LC must be removed at the expense of the road owner. The national law provides that any LC where there were more than 2 accidents over a 5 year period, or has a traffic moment over 24.000, or where the road has an average daily traffic over 2000, or where there are more than 2 running tracks, must be included in a removal plan, with costs to be shared by the rail and road IMs. However, the law does not define a timeline for the removal to happen, so this provision does not produce significant practical results.
<i>Romania</i>	The law gives the possibility to both parties (IM or roads manager) to build a new LC or to remove or change an old one. As a rule, the entity who carries out modernisation works for railway or roads can initiate the procedure. If the IM is the initiator, it must obtain the approval from the road infrastructure company and vice versa. The company that carries out the works must be authorised by the Romanian Railway Authority and the Romanian Road Authority. The reception of the works is done by a mixed commission composed by the IM, road IM and the police.
<i>Slovakia</i>	The entity responsible for the construction, modification, and removal of LCs is the IM. The IM is obliged to ensure the safe functioning of railway traffic. It also technically manages and, if necessary, repairs LCs, including the relevant part of the road.

<i>Spain</i>	The IMs are responsible for the LCs, including the construction, modification, and removal. Roads, road signs and markings are the responsibility of the road owner (municipality, region or state). The NSA oversees LC management by IMs, and every change (modifications or removal) must be communicated to the NSA. About the procedure for removing or modifying LCs: • The IM must remove the LC if it wants to duplicate the track, to increase the speed of trains above 160 km/h or increase the traffic in such way that (number of daily trains) x (number of daily cars) > 1500. • About the threshold of 160 km/h, we have to point out that many lines have been improved by increasing the speed of the trains up to 155 km/h – we have a proverb that says “once you have invented the law, you invent the tricks”. • Out of those cases, the Ministry for Transport can take the initiative to remove any LC or to set rules for removal, commissioning the IM for that. Municipalities and regions can also subscribe agreements with the IM for LCs removal or safety improving (beyond what is required by law), but legislation allows for a wide scope of action on a case-by-case basis (especially regarding who has to pay for it, which is usually the core of the problem).
<i>Sweden</i>	For the state-owned roads, the road authority is the same government authority that also is the Swedish largest IM (Trafikverket, The Swedish Transport Administration), which make things a little bit easier for us. For the municipal roads, or private owned roads, The Swedish Transport Administration has written a guidance. Regarding LCs, all other IMs use the same procedures as Trafikverket in the role as an IM.

Which entities oversee the legal control of level crossings?

<i>Belgium</i>	A department within the Federal Public Service of Transport and Mobility oversees the legal control of the construction, removal and modification of safety devices of LCs, they inspect if the safety devices of the LC match with the laws, which is mandatory at least once every 10 years, when accidents happen, when something changes to the LC. The IM doesn't need to be present for every inspection, but generally always is. IM also inspects LCs.
<i>Bulgaria</i>	The Ministry of Transport and Communications and the Ministry of the Interior, through the issued joint Regulation No. 4, carry out control of LCs. The National Road Safety Authority carries out control over the LCs. Every year, each LC is inspected jointly by the IM, the police, the RIA and the local authorities (municipalities).
<i>Croatia</i>	The NSA performs supervision and inspection tasks with the aim of ensuring continuous compliance with the requirements for the safety of the railway system. The IM must maintain the existing infrastructure subsystems in a proper functional condition in accordance with the designed solutions, in order to constantly meet the essential requirements, set out in the TSI and national technical rules, in accordance with the technical conditions for maintenance. Maintenance includes the implementation of systematic measures, condition monitoring, regular and periodic inspections, control of the correct operation of infrastructure subsystems and their parts, carrying out works on renovation (repair) and replacement of components of infrastructure subsystems, removal of trees, plantations, devices and other, while maintaining compliance with location conditions. Public road inspection services are performed by the road inspection of the Ministry of the Sea, Transport and Infrastructure, and supervision is carried out by the road inspector.
<i>Czech Republic</i>	The Ministry of Transport issues and oversees general railway and road regulations. Top state supervision on LCs is performed by the NSA. On each LC an annual inspection is performed together by the IM, police and local authorities (municipality).
<i>Estonia</i>	NSA. However, regular LC inspection committees must be held at least every three years. The IM invites representatives of the NSA, local government, police and road administration, as well as other persons with a justified interest or competence, to the committee.
<i>Finland</i>	NSA (Traficom) oversees the legal control but does not inspect them in practice. Inspections of LCs are done by IM's.

<i>France</i>	Each LC is defined by an order from the Prefect of the department (the departmental representative of the State) which indicates in particular the equipment from which it benefits. Each LC is inspected every five years by a pair of inspectors, one working for the road IM and one working for the rail IM. The purpose of these inspections is to identify safety issues (visibility, legibility, alignment, traffic, etc.) and to provide suggestions for improvement. These inspections are mandatory as they are enshrined in law and regulatory texts. National inspection grids have been defined. In addition, the IM carries out regular safety inspections at least once a year. During this inspection, the manager checks that the LC's safety equipment, such as traffic lights and bells, is working properly. Moreover, the visibility on the road signs and LC red lights is checked. The railway network manager has common technical rules for all the LCs linked to the national rail network.
<i>Germany</i>	Each player has its own supervision authorities. For the involved IM, it is the NSA on federal railways, or the railway authority of the state for non-federal IMs. The responsible entity/ authority for the road at the LC may have some internal service supervision as well. Defined by road administration policy, in Germany the instrument called "Bahnübergangsschau" has been established: All 2 to 4 years, all road entities/ authorities, the police (if decided relevant by themselves), the IM and the railway supervision authority involved in a certain LC hold a concerted inspection at the LC. In that process, all technical and operational aspects concerning road/ rail safety are observed and relevant information and measures to take are assigned.
<i>Ireland</i>	In Ireland the Department of Transport grants legal orders for an LC. For example : https://www.irishstatutebook.ie/eli/1984/si/144/made/en/print https://www.irishrail.ie/en-ie/railwayorders/corklinelevelcrossing .
<i>Italy</i>	The legal oversight of LCs involves multiple entities: • RFI (or the relevant IM) ensures compliance with technical and operational standards. • ANSFISA (Agenzia Nazionale per la Sicurezza delle Ferrovie e delle Infrastrutture Stradali e Autostradali) oversees safety across the railway and road networks, including LCs. • Local road authorities (municipalities, provinces, or ANAS for state roads) are responsible for the road elements intersecting the railway. • Law enforcement (e.g., Polizia Stradale, Carabinieri) may be involved in monitoring road safety compliance at LCs.
<i>Latvia</i>	The NSA monitors compliance with railway safety regulations and can conduct inspections and issue administrative decisions. The IM is responsible for the technical maintenance of the LC and controls, the road manager is responsible for the road part of the LC and could also performs controls, the NIB has the right to do inspections of LCs during investigations.
<i>Lithuania</i>	Public LCs are maintained by the IM. Private LCs, upon coordination with the IM, are installed and maintained by interested natural or legal persons at their own expense. According to the Law on Construction a LC is a railway structure (building) whose technical maintenance is supervised (inspected) by the Lithuanian Transport Safety Administration (NSA). The majority of LCs are managed and maintained by LTG Infra (IM).
<i>Netherlands</i>	The NSA supervises the implementation of LCs on a risk-based basis. In practice, this means that the NSA only assesses whether the LC meets the requirements set in response to accidents. The IM itself supervises its contractors who maintain the LCs. The maintenance requirements for LCs are also included in the contracts with the contractor and relate to, among other things, the operation of the LC and its condition.
<i>Norway</i>	The Norwegian NSA (Statens jernbanetilsyn) oversees the legal control of the LC infrastructure. The Norwegian Public Roads Administration (Statens vegvesen) set standards for public roads, but these have few specific details regarding LCs.
<i>Poland</i>	The legal supervision over the safety and condition of LCs is carried out by several entities: • The President of the NSA Poland - Office of Rail Transport (Prezes Urzędu Transportu Kolejowego – UTK), as the NSA, monitors compliance with railway safety regulations and can conduct inspections and issue administrative decisions (pursuant to the Rail Transport Act, Article 13 and 14), • The IM is responsible for the technical maintenance of the LC and controls, • The road manager is responsible for the road part of the LC and could also performs controls, • The NIB has the right to inspect LCs during investigations, • Additionally, the police and the Road Transport Inspection may also control road traffic safety elements, including at LCs.
<i>Portugal</i>	The National Institute for Mobility (a state entity, which is also the NSA) has a general obligation regarding legal control of roads and rail. However, it does not inspect them, except sometimes when there are serious accidents, within its functions as NSA.

<i>Romania</i>	The IM and NSA for the railway part and road IM and police for roads and signage.
<i>Slovakia</i>	The NSA monitors compliance with railway safety regulations and can conduct inspections and issue administrative decisions. The IM is responsible for the technical maintenance of the LC and controls. The police carry out traffic controls at LCs (including fines).
<i>Spain</i>	The NSA, although not directly: the IM must certify to the NSA that the CSM requirements regarding LCs are met, and that they have adopted the necessary safety measures. The inspection onsite is made regularly by the IM, and they must keep an updated inventory of the LCs, their traffic parameters, and their equipment (they also have to keep the NSA informed about all the updates).
<i>Sweden</i>	The IM has the legal control of the LC, but not for the roads that are connected to the LC, that depends on the owner of the road.

Are there specific regulations regarding the minimum distance from intersections and roundabouts, vegetation, and visual obstacles (such as billboards)?

<i>Belgium</i>	There aren't any specific regulations regarding the minimum distance from intersections or roundabouts, nor for visual obstacles. For vegetation, there aren't any specific regulations for LCs in Belgium, only for railway in general.
<i>Bulgaria</i>	Bulgarian legislation, specifically Regulation No. 55, lists all the requirements for new construction of LCs and their distances from facilities, as well as the overview of visibility for each type of LC.
<i>Croatia</i>	In the protective railway belt, it is permitted, in accordance with general and special conditions, to build buildings, construct and install lines, facilities and equipment, and plant trees and plantations that do not constitute railway infrastructure and infrastructure subsystems, provided that the safety of the railway system is not endangered. The distance between the railway line and a parallel road or pedestrian or bicycle path must not be less than 8m, measured from the axis of the nearest track to the nearest point of the upper structure of the road or path. The distance between the railway line and a road that does not have the status of a motorway may be from 4m to 8m, provided that their free profiles do not touch and that there is sufficient space between them for railway infrastructure devices and facilities, and provided that the upper edge of the nearest rail on the railway line is at least 1m above the upper surface of the road pavement. If the upper edge of the nearest rail on a railway line is not at least 1m above the upper surface of the road or track, the legal entity maintaining the road is responsible, subject to the conditions of the IM, for the installation and maintenance of a guardrail.
<i>Czech Republic</i>	There are specific regulations regarding the minimum distance from intersections or roundabouts. It is set by binding standard, where it is determined that the shortest distance from intersection or roundabouts is 30m. In the Law about railways there are general conditions for all obstacles in the protection zone of railways, in the binding standards there are set rules for visibility conditions for each kind of LC.
<i>Estonia</i>	Traffic signs must be visible to road users and must not be obscured by vegetation, buildings, billboards or any other object.
<i>Finland</i>	The visibility in LCs is defined in Ministry of Transport and Communications' regulation 65/2011. The IM of the state-owned network (Finnish transport infrastructure agency) has made very detailed instructions on all specifications for LCs. These instructions include for example minimum distances between intersections, curves, roundabouts etc. and LCs.
<i>France</i>	Natural or artificial visibility marks are examined during the inspection visit. To do this, the inspector stands at a height of between 1.5 and 2m and ensures that the red lights at the LC are properly lit. The distance of visibility depends on the speed of road users, between 27m at 30 km/h to 152m at 90 km/h. The presence of an intersection, a bus stop, a pedestrian LC, near a LC is an element that is examined during inspection visits, because of the risk of traffic jams that it can cause. The distance of 100m is an average value to determine the risk. For some LC, especially those near a roundabout, a specific detection equipment is installed in the road coupled with a traffic light which, depending on the number of vehicles coming up, will stop the flow upstream of the LC.

<i>Germany</i>	Yes, concerning intersections, there is a certain principle established: After crossing a LC, the road user must have free lane for 25m. That means, that the road with must guarantee two lanes for each direction (even relevant for dirt roads/ farm tracks). This is even relevant in front of intersections. In the past, this has led to changes of the right of way at the intersection or caused technical interfaces between LC protection systems and intersection traffic lights, if the 25m-principle could not be realized. The 25m-principle is based on the longest road vehicles (trailers / lorries or agricultural machines), which not need and exemption to operate on the road. Yes, concerning vegetation and visual objects, there are principles in place how the sight triangle is defined (done by the IM in accordance with the speed of the train and affected operation like acoustic warning by train driver). These rules are maintained by the IMs. They pay attention to them concerning their own property. And the IMs transmit these principles (individual data for each LC) with the road authorities responsible for their tasks. This also includes private property next to the road, which may lead to additional legally defined consequences to other ownership.
<i>Ireland</i>	No legislation appears to specifically define distance from roundabouts, but CRR does give guidance on LC type selection – where ‘blocking back’ is a risk by road traffic, then a full barrier and signal protected LC is likely to be the only option that will receive approval. Historically, LC orders did define how the LC must be presented to the user (e.g. barriers, lights to be displayed etc). Visibility requirements for LC warning equipment are contained in the CRR guidance 5.18.1.
<i>Italy</i>	Yes. The Codice della Strada (Italian Highway Code) and DPR 753/1980 include specific provisions regarding the visibility and positioning of elements near LCs: • There are minimum distance requirements between LCs and nearby intersections or roundabouts to ensure adequate visibility. • Vegetation near the LC must be regularly trimmed to avoid obstructing the view of the tracks and the signalling system. • Visual obstacles, including advertising billboards, are subject to restrictions in proximity to LCs to avoid driver distraction or obstruction of sight lines. The enforcement of these norms is the responsibility of the road authority and the IM, each for their respective domains.
<i>Latvia</i>	LCs must comply with the Cabinet of Ministers Regulations No. 392 Regulations on the Construction, Equipment, Maintenance and Closure of Railway Crossings and Crossings. There are no specific regulations regarding the minimum distance from intersections and roundabouts.
<i>Lithuania</i>	There aren't any specific regulations regarding the minimum distance from intersections or roundabouts, nor for visual obstacles such as billboards. For vegetation, there aren't any specific regulations for LCs, only for railway infrastructure in general. However, there are “visibility requirements”: at existing LCs on railway lines, a train approaching from either direction, depending on its speed, must be visible to drivers of road vehicles positioned at road sign "STOP", or, if the sign is absent, within 50m or closer to the outer rail, as well as to pedestrians standing at the informational sign "Railway crossing", from no less than the following distances: • 121–160 km/h: 500m • 81–120 km/h: 400m • 41–80 km/h: 250m • 26–40 km/h: 150m • 25 km/h and below: 100m Also, on existing railway lines, the train driver must be able to see the centre of the LC from no less than 1000m. On newly constructed or reconstructed railway lines, a train approaching the LC must be visible to drivers of road vehicles positioned at road "STOP", or, if the sign is absent, within 50m or closer to the outer rail, from no less than 500m, regardless of train speed. The train driver must be able to see the centre of the LC from 1200m.
<i>Netherlands</i>	The IM has, for the design of the LC, distances to intersections, priority rules, sight lines of the LC (obstacles that obstruct the view) and the location of new stations at LCs. In addition, there are legal requirements concerning the minimum viewing distance from road to track and vice versa.

Norway	Regarding vegetation and other visual obstacles, Bane NOR's technical regulations include detailed requirements for visibility conditions at unsecured LCs. The focus is on ensuring sufficient visibility for road users to detect approaching trains. For secured LCs (barriers, light, sound) there are no visibility requirements, and they can lie quite close to e.g. intersections.
Poland	Yes. The Regulation of the Minister of Infrastructure of 20 October 2015 (Dz.U. 2015 poz. 1744) defines the technical requirements and spatial conditions for LCs, including visibility parameters. According to § 8 and § 9 of the regulation: • The visibility triangle (free from obstacles such as vegetation or billboards) must be maintained to ensure the driver of a road vehicle has a clear view of approaching trains. • The location of LCs must consider the distance from nearby road intersections and roundabouts to ensure that vehicles do not stop on tracks due to congestion or traffic lights. Furthermore, general provisions of the Act on Public Roads (Ustawa o drogach publicznych, Dz.U. 2023 poz. 645) and Road Traffic Law (Prawo o ruchu drogowym, Dz.U. 2023 poz. 1047) apply, especially regarding the prohibition of placing visual obstacles near roads and LCs.
Portugal	There are no specific regulations regarding the minimum distance from intersections and roundabouts. There is a good practice manual issued by the National Institute for Mobility recommending the signage to apply. The LC regulation defines a "minimum visibility polygon" for vegetation and visual obstacles only for the cases of passive LCs, where the ability to observe a train approaching at a sufficient distance is a requirement to use the LC as safely as possible.
Romania	There is a norm that regulates the minimum distances that must be respected by the buildings and other obstacles and the visibility but did not contain any provisions related the distance from intersections and roundabouts.
Slovakia	There are no specific regulations regarding the minimum distance from intersections and roundabouts.
Spain	There are no specific regulations about distances to intersections, roundabouts or obstacles, although we have made some recommendations on that: we have recommended to the IM and the Ministry to review LCs to ensure there is a "clear" approaching for cars (and pedestrians), with no intersections nor roundabouts in a certain distance to the railway, as they divide the attention of car drivers (and to adopt additional protection measures in case this "distractors" cannot be suppressed). The LC regulation regulates the "distance of visibility" and the "technical visibility". "Distance of visibility" is the distance from which an approaching train can be spotted by an LC-user from a certain distance to the nearest rail (5m for cars, 1m for pedestrians), and its measured onsite, considering all existing visual obstacles. The "technical visibility" is the distance that a passing train needs to reach the LC in the time a LC-user crosses it, and it's calculated considering the train's speed, the user's speed, and the LC width. Depending on which one is bigger different measures must be adopted.
Sweden	There are different rules depending on the protection for the LC, for example barriers, and also depending on the vehicle depot at the LC.

When a level crossing accident occurs and your organisation investigates it, is there any collaboration with a road accident investigation body or another relevant entity?

Belgium	No, there isn't any collaboration, except in some cases when, for example, a bus company is an involved party.
Bulgaria	Yes, if necessary, we cooperate with the police, RIA or municipality.
Croatia	There isn't a road accidents investigation body. When a LC accident occurs, we collaborate with the Police Department, the NSA, the IM, the railway undertaking and other parties involved in the accident.
Czech Republic	Yes, in the case of need we collaborate with the police and road administration authority.
Estonia	Cooperation is being carried out with everyone who is somehow connected to the case. In doing so, the NIB will ask for materials related to the case that they are required to submit by law. The NIB will decide how and whether to use these materials at all.

<i>Finland</i>	Most LC accidents are investigated by road accident investigation teams that investigate all fatal road and off-road traffic accidents in Finland. Investigation is regulated by legislation on the investigation of road and off-road traffic accidents (Act on the investigation of road and off-road traffic accidents, 1512/2016). The Finnish Crash Data Institute (OTI) coordinates the work of road accident investigation teams but does not intervene in the independent working of the teams. The NIB investigates only the most serious LC accidents or if there are fatalities, injuries, or severe material damages in train. In these cases, we normally have close co-operation with road accident investigation teams in on-site investigation, but the rest of the investigation process is totally independent.
<i>France</i>	The NIB owns two divisions for investigations: rail and road. For an accident on a LC, the road division takes the lead of the investigation, and a pair of investigators (one from road division and one from rail division) is in charge. The investigation benefits from the judicial inquiry, as well as additional investigations with the person responsible for railway infrastructure, the railway company of the train, the person responsible for road infrastructure and the road transport company involved. Occasionally we would have an interaction with the police, but it would normally only be on a serious accident.
<i>Germany</i>	In case of an accident, all aspects on roadside traffic control are task of the police. Collaboration means sharing of information, if there are safety aspects on railway side or if the accident is to see as responsible violation of the road user. In past, there have been accidents on LCs, where the role of road side players were a factor, like e.g. the maintenance of the sight triangle. The "Bahnübergangsschau" can also take place accident-related, and individual problems on an LC will come up transparent then.
<i>Ireland</i>	Not normally, except where a signage issue is identified or where changes in usage and traffic has taken place.
<i>Italy</i>	Yes, collaboration occurs depending on the nature and complexity of the accident: • The NIB leads the independent safety investigation if the criteria set by EU Directive 2016/798 are met. • In case of road-related aspects, there may be collaboration with the local law enforcement (e.g., Police - Polizia Stradale). • Coordination with ANSFISA, the judicial authorities, and the IM (RFI) is also common to gather technical data and understand the systemic causes. • While the NIB is independent and focuses on safety (not liability), relevant bodies (such as municipalities, provinces, or ANAS) often provide information or participate in technical meetings when needed.
<i>Latvia</i>	The NIB is the authority responsible for investigating serious railway accidents, including those at LCs. In the case of LC accidents, especially those involving road vehicles, the NIB collaborates with: • The Police, who conduct criminal investigations, • Road managers and railway IMs, to provide technical documentation and expertise.
<i>Lithuania</i>	We do not have a body, what we know of, and it were some internal functions – NIB LT was not in collaboration. However, since 2025-01-01 NIB LT has this role "road traffic accidents" - unfortunately we do not have experience yet, the position only will be filled 2025-05-06.
<i>Netherlands</i>	The NIB does not collaborate with other investigation bodies, but it is possible to obtain and use information and reports from other bodies for our investigation. Being multi-modal, the NIB itself has a few investigators with road safety expertise.
<i>Norway</i>	Yes, we use resources from the road department as we are multimodal, but the investigation responsibility lies within in the rail department as it is considered a railway accident more than a road accident (their mandate is a bit different). Normally the police will investigate, and the internal investigators of the Norwegian Public Roads Administration will do their investigation too.
<i>Poland</i>	Yes. The State Commission for the Investigation of Railway Accidents (NIB) (Państwowa Komisja Badania Wypadków Kolejowych – PKBWK) is the authority responsible for investigating serious railway accidents, including those at LCs. In the case of LC accidents, especially those involving road vehicles, PKBWK collaborates with: • The Police, who conduct criminal investigations, • Prosecutors, where applicable on the basis of railway act and MoU, • Road accident investigation units, if relevant, • Road managers and railway IMs, to provide technical documentation and expertise. This cooperation is governed by Article 28 of the Rail Transport Act, which mandates the obligation of entities involved in rail transport to cooperate with the accident investigation body.
<i>Portugal</i>	No. There is no safety investigation body for road accidents. The police attending the site are obliged by law to send us its report within 20 days.

<i>Romania</i>	We asked some information from the road IM and police, but they are involved in the investigation.
<i>Slovakia</i>	It depends on the extent of the accident. Such accidents are investigated as a priority by the police. For accidents with minor damage and no harm to health, the railway IM. The Ministry of Transport can investigate the accident but cannot make a binding decision on guilt. The results of the Ministry's investigation serve to take measures to prevent similar accidents in the future. Cooperation of all parties involved in the investigation is common.
<i>Spain</i>	We have not any road accidents investigation body, besides traffic police. Eventually we can collaborate with them by sharing collected evidence, measures and pictures (but that happens in general in any accident investigation, not only in LCs).
<i>Sweden</i>	It depends on the art of the accident, normally we have some cooperation with the IM since the LC is a part of the railway system, for municipal or private roads there is normally not that much cooperation with the owner of the road.

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