REPUBLIC OF SERBIA
CENTER FOR INVESTIGATION OF ACCIDENTS IN TRANSPORT
SECTOR FOR INVESTIGATION OF ACCIDENTS IN RAILWAY TRAFFIC
Nemanjina 11, 11000 Belgrade

No.: ŽS - 02/20

No.: 340-03-1/2020-02-2-49

Date: 03.03.2021.

FINAL REPORT ON INVESTIGATION OF A SERIOUS ACCIDENT

Accident type:	Serious accident on the level crossing
Train No.:	45403
Place:	Municipality of Šabac, settlement Petlovača, distance between the stations Štitar- Petlovača
Date:	25.07.2020.
Time:	10:55

This report presents the results of investigation of a serious accident, overtaking of the train No. 45403 on the road passenger vehcile, which occured on 25.07.2020. at 10:55 on the regional line 211: Ruma – Šabac – Junction Donja Borina – state border – (Zvornik Novi), on the level crossing, secured with traffic signs on the road and the zone of necessary visibility, located between the crossing point Štitar and the station Petlovača at km 20+647.

The Working Group for investigation of this serious accident was formed by the Director of the Center for Investigation of Accidents in Transport RS, by Decision No. 340-03-1/2020-02-2-6 of 03.08.2020.

In accordance with the Article 33 of the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18) and the Article 23 of the Directive 2004/49/EC of the European Parliament and of the Council of EU (Railway Safety Directive), the Center for Investigation of Accidents in Transport (hereinafter referred to as: CINS) drafted and published this Final Report.

In this report, all sizes and measurements are expressed in accordance with the International System of Units (SI).

The meaning of abbreviations used in the text is explained in the Glossary.

CINS has been established in accordance with the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15). The founder is the Republic of Serbia and the holder of founding rights is the Government of the Republic of Serbia.

Sector for Investigation of Railway Traffic Accidents carries out tasks within the competence of CINS in relation to rail traffic with the aim of possible improvement of safety on the railway by issuing safety recommendations. The investigative procedure in the field of railway traffic is conducted on the basis of the provisions of the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18).

CINS conducts investigations following the serious accidents on the railway system with a view to possible improvement of railway safety and the prevention of new accidents caused by the same or similar causes. Serious accident in railway traffic means any train collision or derailment of trains, resulting in the death of at least one person or serious injuries to five or more persons or extensive damage to rolling stock, the infrastructure or the environment, and any other similar accident with an obvious impact on railway safety regulation or the management of safety.

In addition to serious accidents, CINS may also investigate other accidents and incidents that could lead to a serious accident, including the technical failure of structural subsystems or interoperability constituents.

CINS has the discretion to decide whether to open an investigation of other accidents and incidents.

CINS is independent in its work and performs independent accident investigations. The aim of an investigation is to identify the causes and the possibility of improving safety on the railway and to prevent accidents by issuing safety recommendations.

Professional activities related to safety investigations are independent of judicial inquiry or any other parallel investigations which objective is to determine responsibility or the degree of guilt.

Glossary:

CINS	.....	Center for Investigation of Accidents in Transport
IŽS	.....	Serbian Railways Infrastructure
ZJŽ	.....	Community of Yugoslav Railways
ŽS	.....	Railways of Serbia
RS	.....	Republic of Serbia
CC	.....	Constitutional Court
a.d.	.....	Joint Stock Company
TT	.....	Telephone-telegraph
RDV	.....	Radio-dispatch connection
MUP	.....	Ministry of Interior
OJT	.....	Basic Public Prosecutor
DMV	.....	Diesel motor train
JP	.....	Public enterprise
ZOP	.....	For track maintenance
ŽRS	.....	Republika Srpska Railways
OJ	.....	Organizational Entity
TKP	.....	Technical wagon affairs
OC	.....	Organizational Unit
ZOVS	.....	For rolling stock maintenance

C O N T E N T:

1. Summary

1.1. Short description of the serious accident

On 25.07.2020. at 10:55 on the regional railway line 211: Ruma - Šabac - Junction Donja Borina - state border - (Zvornik Novi), at the level crossing, secured with road traffic signs and the zone of necessary visibility, located between the crossing point Štitar and the station Petlovača at km 20+647, overtaking of the train No. 45403 on the road passenger vehicle of brand Ford type Focus of license plates SM 063-DZ occurred.

1.2. The causes of the serious accident determined by investigation

Direct and immediate cause of the occurrence of the respective serious accident is that the road passenger vehicle was on track just before arrival of the train No. 45403, thus creating dangerous situation related to the occurrence of this serious accident.

Direct cause of this serious accident is noncompliance with the Provisions from the Articles 100 and 132 of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 – other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law, 87/2018 and 23/2019) by the driver of the road passenger vehicle.

The fact that the prescribed zone of necessary visibility and necessary visibility were not provided (see section 3.4.2.) does not in any way diminish the obligation of the driver of a road passenger vehicle, as he was obliged to respect traffic signs I-33: "Crossing of the road with railway line without barriers or half-barriers", I-35: "Approaching the point of crossing of the road and the railway line", I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", to adjust the speed of the road vehicle, stand in front of the level crossing and make sure that the train is approaching. In case the driver of the road passenger vehicle acted in this way, he had the opportunity to see the approaching train (see section 4.2.1.4).

The fact that on the level crossing in question the zone of necessary visibility and necessary visibility were not provided (bearing in mind the vegetation in the railway belt which is in the zone of necessary visibility, in the part of the zone of necessary visibility which includes the railway belt and in the part of the zone of necessary visibility which does not include the railway belt, see section 2.2.3.), could have contributed that the driver of the road passenger vehicle when approaching the level crossing not to notice the train in a timely manner. The zone of necessary visibility and the necessary visibility were not maintained and provided by the railway infrastructure manager and the road manager, which is contrary to Article 56 of the Law on Railways ("Official Gazette of RS" No. 41/2018) and Article 38 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law).

Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) defines that the railway infrastructure manager maintains part of the level crossing, while other parts of the road on both sides of the road, including the necessary visibility zone outside the width of the level crossing, are maintained by the road manager in a way that enables safe and undisturbed railway traffic. According to the Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) only the maintenance of the road crossing width of 3 meters from the track axis was taken into account (the width of the road crossing is defined in Article 2, paragraph 1, item 54) and the

railway belt is defined in Article 2, paragraph 1, item 52) of the Law on Railways ("Official Gazette of RS" No. 41/2018)), and not the maintenance of the part of the zone of necessary visibility next to the crossing of road and track in the zone of the railway belt width of 6 to 8 meters from the track axis, which the railway infrastructure manager is obliged to maintain in accordance with Article 56 of the Law on Railways ("Official Gazette of RS" No. 41/2018) (see item 3.3.3.). The inconsistency of Articles 56 and 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) in terms of the obligations of the railway infrastructure manager is stated. Also, Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) does not clearly define the obligation of railway infrastructure manager and road manager in terms of maintaining the necessary visibility zone (part of the necessary visibility zone which includes the railway belt and part of the required necessary zone which does not include the railway belt).

Article 68 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) defines only maintenance - arranging green areas (grass mowing, clearing shrubs and cutting of trees) in the road land. Article 68 does not define maintenance - arranging of green areas (grass mowing, clearing shrubs and cutting of trees) in the zone of necessary visibility at the points of crossing of railways and roads. Only maintenance is defined - arranging green areas (grass mowing, clearing shrubs and cutting of trees) in the road land, which is defined for the area outside the settlement in the width of 1 m next to the road, which does not include the zone of necessary visibility at the crossing of railway and road (see section 3.3.1). Article 38 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) defines the obligation to provide the zone of necessary visibility in accordance with the regulations. The inconsistency of Articles 38 and 68 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law), in terms of providing the zone of necessary visibility by the road manager, is stated.

The stated inaccuracy in the clear distribution of responsibilities for maintaining the necessary visibility zone could have affected the fact that the necessary visibility zone at this level crossing was not provided, which could have contributed to the driver of the road passenger vehicle not spotting the train on time while approaching the level crossing.

1.3. Main recommendations and information on subjects to which the Report is submitted

With the aim of possible improvement of safety on the railway and prevention of occurrence of the new accidents, CINS has issued the following safety recommendations:

To the Ministry of Construction, Transport and Infrastructure:

SR_01/21 Ministry of Construction, Transport and Infrastructure to harmonize the provisions of Article 69 with the provisions of Article 56 in the Law on Railways ("Official Gazette of RS" No. 41/2018) in terms of the obligation of railway infrastructure manager to maintain the necessary visibility zone at the crossings of the railway line and the road in terms of defining the distance from the track axis (track belt) at which the infrastructure manager has the obligation to remove vegetation (see section 4.3.3.).

SR_02/21 Ministry of Construction, Transport and Infrastructure to clearly define in the Law on Railways ("Official Gazette of RS" No. 41/2018) in Article 69 the obligations of railway infrastructure manager and road manager in terms of maintaining the necessary visibility zone (part of the necessary visibility zone which includes the railway belt and part of the necessary visibility zone which does not include the railway belt) (see section 4.3.3).

SR_03/21 Ministry of Construction, Transport and Infrastructure, in the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) in Article 68 to define (supplement) maintenance - landscaping of green areas (grass mowing, clearing shrubs and cutting of trees) in the zone of necessary visibility at the points of crossing of the railway line and the road, in accordance with Article 38, which defines the obligation to provide the zone of necessary visibility in accordance with the regulations (see section 4.3.3).

SR_04/21 Ministry of Construction, Transport and Infrastructure, to define in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette RS", No. 89/2016) the methodology (method) for determining (calculating) the elements of the zone of necessary visibility given in the Annex 9 (d_{pz} – length of stopping the road vehicle and $S_{pžv}$ – length of approaching the railway vehicle) (see sections 3.3.6. and 4.3.4.).

SR_05/21 Ministry of Construction, Transport and Infrastructure, to define in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette RS", No. 89/2016) the procedure in the case when there is the necessary visibility according to the definition from Article 2, Paragraph 1 under 12) of this Rulebook and it is not possible to provide the zone of necessary visibility. In particular, it should be borne in mind that the installation of traffic sign II-2: "Obligation of stopping" while providing the necessary visibility, allows safe passage of road vehicles over the crossing (see sections 3.3.5. and 4.3.4.).

SR_06/21 Ministry of Construction, Transport and Infrastructure, to make corrections in the expression in Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016):

$$t_v = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

so that in front of ***s*** there is a sign "-", and not the sign "+" (see section 3.4.2).

SR_07/21 Ministry of Construction, Transport and Infrastructure to harmonize, in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016), the description of the position of point B given in Article 14, Article 15 and Annex 6 (see section 4.3.4.)

SR_08/21 Ministry of Construction, Transport and Infrastructure to consider the possibility that in the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) Article 153, Paragraph 2 reformulates and harmonizes with the Article 97, Paragraph 1 of the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018) in terms of more precise provisions for the installation of traffic lights (see section 4.3.4.).

Directorate for Railways:

SR_09/21 "IŽS"a.d. to consider a change in the level of insurance (introduction of active signallization) for the level crossing in question, or solve the problem in some other way. Due to the existence of facilities near the level crossing and the curve on the railway, the necessary visibility zone is not provided, and due to the abundant vegetation in the infrastructure belt and thus in the railway belt, the necessary visibility is not provided (see sections 2.2.3 and 3.4.2.). It is also a fact that the level crossing in question is a crossing of a regional line and a state road of IIA rank (see section 2.2.3).

SR_10/21 "IŽS"a.d. to make a professionally based risk assessment at road crossings. Bearing in mind that accidents at road crossings (observing each crossing separately) are rare events, risk assessment cannot be performed only on the basis of the number of accidents that occurred at individual road crossings. Risk assessment, as a precautionary measure, should be performed collectively for all road crossings according to all relevant parameters, regardless of whether accidents have occurred at them or not.

SR_11/21 "IŽS"a.d. to make an act "Program for solving road crossings" according to the previously done risk assessment at road crossings, in order to take appropriate activities with the aim to raise the level of traffic safety.

2. Direct facts on the serious accident

2.1. Basic data on the serious accident

2.1.1. Date, time and location of the serious accident

On 25.07.2020. at 10:55 in the area of the urban setllement Petlovača (municipality Šabac) on the regional line 211: Ruma - Šabac – Junction Donja Borina – state border - (Zvornik Novi), on the track between the crossing point Štitar and the station Petlovača, at the level crossing, at km 20+647, secured with road traffic signs and the zone of necessary visibility (note: the regional line marking is taken from Regulation on the categorization of railways belonging to public railway infrastructure ("Official Gazette of RS" No. 92 of 29.06.2020.) it came to the occurence of this serious accident.

The view of the serious accident site is given in Fig. 2.1.1.1.

Figure 2.1.1.1: View of the area of the serious accident site (source: *Bing maps*)

2.1.2. Description of the serious accident and the serious accident site and work of rescue and emergency services

The level crossing is located on the open track, in the settlement Petlovača (municipality of Šabac). It is secured with the traffic signs on the road and the zone of necessary visibility.

Road passenger vehicle of the brand Ford type Focus with license plates SM 063-DZ was moving along the state road IIA rank, marking 136: Majur - Bogatić - Petlovača from the direction of the intersection with the state road IB rank, marking 26: Belgrade - Obrenovac - Šabac - Loznica - state border with Bosnia and Herzegovina (border crossing Mali Zvornik) in the direction to the

settlement Zminjak. Upon encountering the level crossing at km 20+647, the road passenger vehicle entered the track profile in the area of the level crossing just before the train arrived (note: state road markings were taken from the Regulation on categorization of state roads ("Official Gazette of RS", No. 105/2013, 119/2013 and 93/2015.)).

The train No. 45403 was moving along the regional line No. 211: Ruma - Šabac – Junction Donja Borina – state border - (Zvornik Novi), from the direction of the crossing point Štitar in the direction to the station Petlovača. The train operated on the route Ruma - Brasina – Zvornik Novi (ŽRS). The train composition consisted of the train locomotive series 661-033 and 24 empty wagons of the series *Eas*During the drive of the train No. 45403 on the open track between the crossing point Štitar and the station Petlovača, upon encountering the level crossing at *km* 20+647, it came to overtaking of the train on the road passenger vehicle, which has, just before the train arrived, entered the track profile. Overtaking occurred when the left part of the front of the train locomotive 661-033 (left buffer) hit the front right side of the road passenger vehicle (seen in the direction of the train, i.e., the road passenger vehicle).

According to the traces on the road and the rails at the level crossing observed during the on-site investigation and damages on the road passenger vehicle made due to the impact of the locomotive of the train No. 45403 (see Figure 2.1.2.1.), contact between the train and the road passenger vehicle was made at the moment when the road passenger vehicle was on the level crossing so that the part of the road passenger vehicle in which the driver's and front passenger's seats were located was at the height of the left rail of the track, and the part of the road passenger vehicle between the front wheels and the front bumper of the vehicle at the height of the right rail of the track, so that the left buffer of the train locomotive series 661-033 of the train No. 45403 had hit the place where train number 45403 hit the place where the co-driver was seated in the road passenger vehicle.

Figure 2.1.2.1: View of the traces on the road at the level crossing and damages on the road passenger vehicle

After the overtaking, the train No. 45403 continued its movement in the length of 145 m, after which it stopped, so that the front of the 661-033 series locomotive was found at km 20+792, with the longer part of the locomotive box ahead. On that occasion, no vehicle derailed out of the composition of the train No. 45403 (see Figure 2.1.2.2).

After the impact, the train threw the road passenger vehicle next to the track, to the left in relation to the direction of the train, after which the road passenger vehicle continued moving along the track for approximately 30 m, after which it stopped. The road passenger vehicle was found on the left side of the track, seen in the direction of the train, i.e. in the direction of increasing stationing of the track, in a position parallel to the track, i.e. the train, so that the front part of the road passenger vehicle was turned in the direction of the train. the passenger vehicle was 6.8 m away from the nearest track, and the rear of the road passenger vehicle was 30.1 m away from the middle of the road crossing (see Figure 2.1.2.3).

After the impact, the train threw the road passenger vehicle next to the track, to the left in relation to the direction of the train movement, after which the road passenger vehicle continued moving along the track for approximately 30 m, after which it stopped. The road passenger vehicle was found on the left side of the track, seen in the direction of the train movement, i.e., in the direction of increasing stationing of the track, in a position parallel to the track, i.e. the train, so that the front part of the road passenger vehicle was turned in the direction of the train movement, the right side of the road passenger vehicle was 6.8 m away from the nearest track, and the rear of the road passenger vehicle was 30.1 m away from the middle of the level crossing (see Figure 2.1.2.3).

Figure 2.1.2.2: View of the train No. 45403 after the serious accident
(view in direction opposite to the direction of train movement)

Figure 2.1.2.3: View of the train No. 45403 and the road passenger vehicle after the serious accident
(view in the direction of train movement)

In this serious accident, 2 (two) people were fatally injured and 2 (two) people were seriously injured. All the fatally and seriously injured people were in the road passenger vehicle.

Members of the MUP RS, the Police Administration in Šabac, the Traffic Police Department in Šabac, members of the OJT in Sabac and members of the Emergency Medical Service of the Šabac Health Center went to the serious accident site.

Due to the mentioned serious accident, the traffic between the crossing point Štitar and the station Petlovača was interrupted. The interruption of traffic lasted until 16:30, when the train traffic was normalized.

2.1.3. Decision to launch the investigation, composition of the investigative team and conducting of the investigation

CINS has been informed immediately upon the occurrence of this serious accident. Main Investigator for Railway Traffic received the first notification of the accident occurred on 25.07.2020. at 11:20 via telephone by the Main Wagon Dispatcher of "Srbija Kargo"a.d., and then also via telephone at 11:31 by Assistant Director of the Sector for Operational Affairs "IŽS"a.d.

Based on the information received and the facts that the investigative team of CINS determined by on-site investigation of the serious accident, CINS has launched the investigation of the respective serious accident in accordance with the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18).

Composition of the Working group for investigation of the serious accident is determined by Decision No. 340-03-1/2020-02-2-6 of 03.08.2020. of the Director of CINS based on the Articles 6 and 32 of the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18).

2.2. Serious accident background

2.2.1. Involved railway staff, contractors, other persons and witnesses

The train driver and the train driver assistant of the train No. 45403, employed at the railway undertaking "Srbija Kargo"a.d., Sector for traction of trains and TKP Ruma, OJ for traction of trains and TKP Ruma, participated in this serious accident.

The driver of the road passenger vehicle of the brand Ford type Focus, of license plates SM 063-DZ, and the passengers of the road passenger vehicle located at the passenger seat and at the back seat of the road passenger vehicle participated in this serious accident.

The employees of the infrastructure manager "IŽS" a.d. did not particpate in the serious accident in question.

2.2.2. The train and the road passenger vehicle that participated in the serious accident and their composition

The train No. 45403 and the road passenger vehicle of the brand Ford type Focus, of license plates SM 063-DZ, participated in the serious accident in question.

The train composition consisted of the locomotive series 661-033 NS 24 (twenty four) empty wagons of series Eas.

The road passenger vehicle of the brand Ford type Focus, of license plates SM 063-DZ, is a compact family car "C segment" with a flexible interior intended for the transport of persons and things, approximate dimensions: length 4.45 m, width 1.70 m and height 1.45 m.

2.2.3. Infrastructure and SS system

The regional line 211: Ruma - Šabac – Junction Donja Borina – state border - (Zvornik Novi), between the crossing point Štitar and the station Petlovača is a one-track, non-electrified. According to the Timetable Booklet 2.2., the stopping distance on the regional line in question is 700 m, the maximum permitted speed on the part of the line between the crossing point Štitar and the station Petlovača is 80 km/h for diesel motor trains and 60 km/h for all other trains.

In the zone of the level crossing in question (level crossing at km 20+647) the railway line is in a curve, on the part of the transition curve (from km 20+368 to km 20+672 the railway line is in the right curve, seen in the direction of train movement, i.e., in the direction of increasing stationing, and from km 20+672 to km 21+045 the railway line is in the direction), while the slope (ascent, seen in the direction of train movement, i.e., in the direction of increasing stationing) is 1.60 ‰ (from km 19+800 to km 20+100 the slope of the railway is 1.20 ‰, from km 20+100 to km 20+700 the slope of the railway is 1.60 ‰ and from km 20+700 to km 21+000 the slope of the railway is 0.83 ‰). At the stated distance between the stations, there are no limited speeds and no restricted-speed runnings.

On the regional line 211: Ruma - Šabac – Junction Donja Borina – state border - (Zvornik Novi), the traffic of trains is regulated at the station distance, in accordance with the provisions from the Article 39 of the Rulebook 2, Traffic Rulebook ("Official Gazette ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03). On the railway section in question, the traffic of trains is regulated by the train dispatchers of the occupied official places Štitar and Lešnica (according to the valid documentation of the timetable, the station Petlovača is not occupied by the traffic staff).

For the purpose of traffic regulation, the crossing point Štitar is protected by visual unambiguous input signals with one signal lever, with special pre-signals, which are operated by a mechanical device located in front of the station building, and the station Lešnica is protected by unambiguous input light signals with special pre-signals operated by the train dispatcher via a signaling box posted in the traffic office. The station Petlovača is protected by unambiguous input light signals with special pre-signals. No other main signals have been installed on the part of the railway line between the crossing point Štitar and the Lešnica station, and there are no other SS devices for traffic regulation.

The level crossing at km 20+672 (stationing given according to the data obtained from the construction service of "IŽS"a.d.) represents a point of crossing at the level of the regional railway line 211: Ruma - Šabac - Junction Donja Borina - state border - (Zvornik Novi) and the state road IIA rank, marking 136: Majur - Bogatić - Petlovača on the section ID 13602 Bogatić (Majur) - Petlovača.

Marking for the railway line is taken from the Regulation on Categorization of the railway lines which belong to the public railway infrastructure ("Official Gazette RS" No. 92 of 29.06.2020.) which was in application at the time of occurrence of the serious accident in question, and the road marking according to the letter of the JP "Putevi Srbije", Sector for maintenance of state roads of the I and II rank, Department of maintenance and protection of roads Belgrade VI No. 953-17135 / 20-3 of 11.12.2020. and the Regulation on the categorization of state roads ("Official Gazette of RS" No. 105/2013, 119/2013 and 93/2015).

The railway line and the road intersect at an angle of 90°. The state road is made of asphalt pavement. Near the road crossing, the width of the road is 6.1 m in the part towards the intersection with the state road of the IB rank, marking 26, i.e., 5.9 m in the part towards the settlement of Zminjak. In the zone and at the level crossing, the road is paved with asphalt. The width of the road, i.e. the width of the asphalt surface at the level crossing is identical to the one near the level crossing.

The condition of the asphalt road ballast near the level crossing is in order, without any unrepaired damages. The state road in question is on a slight ascent from both directions, looking towards the level crossing in question. The roadway at the level crossing itself is horizontal.

The view of the level crossing, seen from the road is shown in Figures 2.2.3.1. and 2.2.3.2.

Figure 2.2.3.1: View of the level crossing
(view from direction of the state road 1B rank, marking 26)

Figure 2.2.3.2: View of the level crossing
(view from direction of the settlement Zminjak)

On the state road IIA rank, marking 136: Majur - Bogatić - Petlovača, before encountering the level crossing from the direction of the intersection with the state road IB rank, marking 26: Belgrade - Obrenovac - Šabac - Loznica - state border with Bosnia and Herzegovina (border crossing Mali Zvornik), on the supporter located on the right side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) 59.1 m away, traffic signs are set: I-33: "Crossing of the road with the railway line without barriers or half-barriers" and I-35: "Approaching the point of crossing of a road and a railway line"; on the supporter located on the left side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) is 64.1m away, traffic signs are set: I-33: "Crossing of the road with the railway line without barriers or half-barriers" and I-35: "Approaching the point of crossing of a road and a railway line" (Figure 2.2.3.3.), on the supporter located on the right side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) is 34m away, the following traffic sign is set: I-35: "Approaching the point of crossing of a road and a railway line", on the supporter located on the left side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) is 39.2 m away, the traffic sign is set: I-35: "Approaching the point of crossing of a road and a railway line" (Figure 2.2.3.4.), on the supporter located on the right side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) is 18.7m away, the traffic sign is set: I-35: "Approaching the point of crossing of a road and a railway line", on the supporter located on the right side of the road next to the roadway and from the level crossing (from the nearest rail of the railway line) is 18.7m away, the following traffic signs are set: III-24: "Settlement" and I-35: "Approaching the point of crossing of a road and a railway line" (Figure 2.2.3.5.) and on the supporter located on the right side of the road next to the roadway and is 6.5 m away from the nearer rail of the railway line, the traffic signs are set: I-34: "St. Andrew's cross" and II-2:" Obligation of stopping" (Fig. 2.2.3.6.).

Apart from the mentioned traffic signs, no other traffic signs have been placed on this part of the state road in the specified direction (traffic sign: II-30: “Speed limit” has not been placed). The total length of the part of the state road IIA rank, marking 136 between the intersection with the state road IB rank, marking 26: Belgrade - Obrenovac – Šabac - Loznica - state border with Bosnia and Herzegovina (border crossing Mali Zvornik) and the level crossing (nearer to the railway line’s rail) is 75.3 m, viewed in the middle (axis) of the road.

Figure 2.2.3.3: The appearance of traffic signalization (view from the direction of the state road I B rank, marking 26)

Figure 2.2.3.4: The appearance of traffic signalization (view from the direction of the state road I B rank, marking 26)

Figure 2.2.3.5: The appearance of traffic signalization (view from the direction of the state road I B rank, marking 26)

Figure 2.2.3.6: The appearance of traffic signalization (view from the direction of the state road I B rank, marking 26)

On the state road IIA rank, marking 136, before encountering the level crossing from the direction of the settlement Zminjak, on the supporters located on the right and left side of the road next to the roadway and from the level crossing are approximately 210 m away, the following traffic signs are set: I-33: “Crossing of the road with the railway line without barriers or half-barriers” and I-35: “Approaching the point of crossing of a road and a railway line” (Figure 2.2.3.7.); on the supporters located on the right and left side of the road next to the roadway and from the level crossing are approximately 140 m away, the following traffic signs are set: I-35: “Approaching the point of crossing of a road and a railway line” (Figure 2.2.3.8.); on the supporters located on the right and left side of the road next to the roadway and from the level crossing are approximately 65 m away, the following traffic signs are set: I-35: “Approaching the point of crossing of a road and a railway line” (Figure 2.2.3.9.) and on the supporter located on the right side of the road next to the roadway and is 7.7 m away from the level crossing (nearer railway line’s rail), the following traffic signs are set: I-34: “St. Andrew’s cross” and II-2: ”Obligation of stopping” (Figure 2.2.3.10.).

Figure 2.2.3.7: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Figure 2.2.3.8: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Figure 2.2.3.9: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Figure 2.2.3.10: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Figure 2.2.3.11: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Figure 2.2.3.12: The appearance of traffic signalization (view from the direction of the settlement Zminjak)

Apart from the mentioned traffic signs, on this section of the state road from the direction of the settlement Zminjak in the direction of the level crossing, there are also the traffic signs II- 28: " Prohibited passing for motor vehicles" (placed on the supporter located on the right side of the road next to the roadway and is 145 m away from the level crossing, Figure 2.2.3.11.), III-201: "Intersection" (placed on the supporter located on the right side of the road next to the roadway and is 115 m away from the level crossing, Figure 2.2.3.11.) and III-23.1: "End of the populated settlement" (placed on the supporter located on the right side of the road next to the roadway and is 30 m away from the level crossing, Figure 2.2.3.12.). Other traffic signs on this section of the road are not set (traffic sign II-30:" Speed limit" is not set).

On the level crossing in question, no traffic lights were placed on either side (observed for different directions of movement of the road vehicles) announcing the approach of the train, given that it is a level crossing with a modern road ballast - asphalt, which is not in line with the Article 153 of the Law on Road Traffic Safety ("Official Gazette RS" No. 41/2009, 53/2010, 101/2011, 32/2013 – decision US, 55/2014, 96/2015 – other law, 9/2016 – decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018). This article of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) is in conflict with the railway legislation governing this issue.

On the state road IIA rank, marking 136, on the section from the intersection with the state road of IB rank, marking 26 to the level crossing, in the middle of the road there is a full dividing line, which in three places turns into an interrupted dividing line, while on the section of the mentioned state road from the settlement Zminjak in the immediate vicinity of the level crossing in the middle of the roadway there is a full dividing line in the length of 40 m. There are no other road markings (longitudinal, transversal and others). The appearance of the roadway near the level crossing is shown in Figures 2.2.3.13. and 2.2.3.14.

Figure 2.2.3.13: The appearance of the roadway in the vicinity of the level crossing (view from the direction of the state road 1B rank, marking 26)

Figure 2.2.3.14: The appearance of the roadway in the vicinity of the level crossing (view from the direction of the settlement Zminjak)

On the railway line, before encountering the road crossing in question from the direction of the Štitar crossroads towards the Petlovača station, at km 20+127, signal sign 209 was installed: "Watch out, road crossing" (Figure 2.2.3.15). The signal sign was installed on the right side of the railway, seen in the direction of increasing stationing, that is, in the direction from the Štitar crossroads to the Petlovača station, 1.9 m from the closer track of the railway track. The color on the red and white fields on the signal mark is clearly visible. The signal sign is obscured by vegetation so that it is impossible to see it from the prescribed distance (it is possible to see it from a distance of 15 m).

On the railway, before encountering the level crossing in question from the direction of the crossing point Štitar towards the Petlovača station, at km 20+127, an signaling mark 209 was set: "Watch out, the level crossing" (Figure 2.2.3.15). The signaling markwas set on the right side of the railway, viewed in the direction of increasing stationing, that is, in the direction from the crossing point Štitar to the Petlovača station, 1.9 m from the nearer track of the railway track. The color on the red and white fields on the signaling mark is clearly visible. The signaling mark is obscured by vegetation so that it is impossible to see it from the prescribed distance (it is possible to see it from a distance of 15 m).

On the railway, before encountering the level crossing in question from the direction of the crossing point Štitar towards the Petlovača station, at km 21+150, an signaling mark 209 was set: "Watch out, the level crossing" (Figure 2.2.3.16). The signaling mark was set on the left side of the railway, viewed from the direction of the station Petlovača to the crossing point Štitar, 1.7 m away from the nearer rail of the railway track. The paint on the red and white fileds on the signaling mark is clearly noticeable. The signaling mark is partially obscured by vegetation, but can be seen from the prescribed distance.

The stationing of the signaling marks is determined according to the signaling marks 227: "Kilometer and hectometer mark" placed on the site next to the roadway.

Figure 2.2.3.15: The appearance of the signaling mark209: "Watch out, the level crossing" (view from the direction of the crossing point Štitar)

Figure 2.2.3.16: The appearance of the signaling mark209: "Watch out, the level crossing" (view from the direction of the station Petlovača)

On the left side of the railway line, between the crossing point Štitar and the station Petlovača, viewed in the direction of increasing stationing, in front of the level crossing in question, there is a complex composed of more facilities built of black civil material, with sides to the railway bordered by a fence made of a wall of solid construction material, which is positioned between the railway line and the state road II A rank, marking 136, so that it extends in the legth od approxiamately 60 m along the railway line, and along the road it extends in the length of approximately 25 m. The smallest distance of the complex from the left rail of the railway line (seen in the direction of increasing stationing) is 8.8 m, and from the right edge of the roadway of the state road in question (seen from the direction of the intersection with the state road IB rank, marking 26 to the settlement Zminjak), is 23 m. The appearance of the complex is shown in Figures 2.2.3.17. and 2.2.3.18.

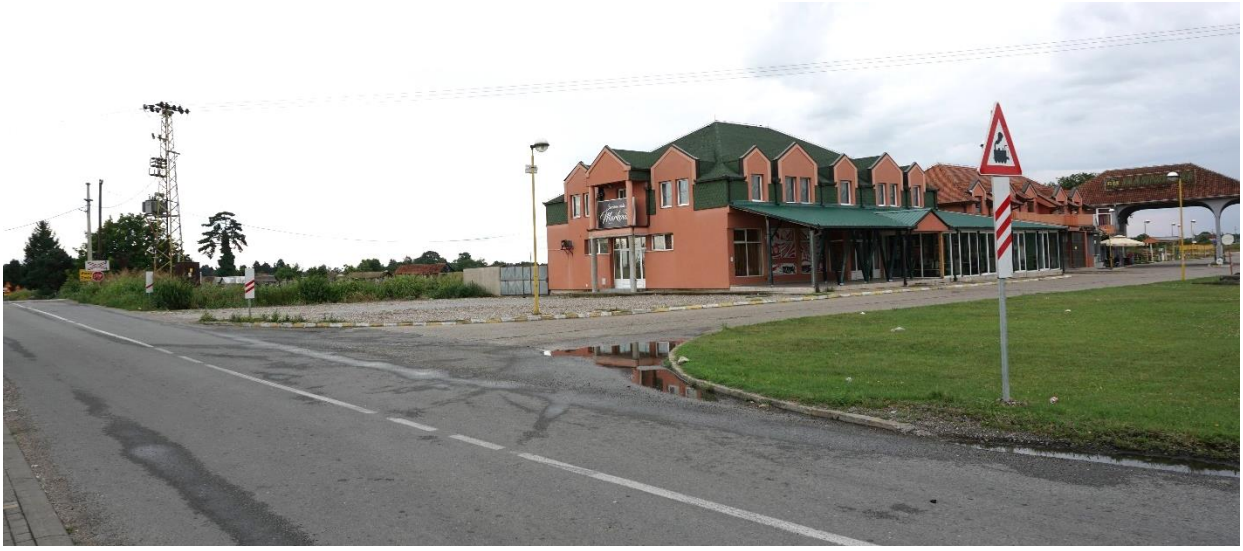


Figure 2.2.3.17: View of the complex
(view from the direction of intersection with the state road 1B rank, marking 26)

Figure 2.2.3.18: View of the complex (view from the direction of the settlement Zminjak)

On the left side of the railway line, between the crossing point Štitar and the station Petlovača, viewed in the direction of the growing stationing, behind the level crossing in question, there is a facility made of solid construction material, which is positioned between the railway line and the state road IIA rank, marking 136 so that it extends along the railway line in the length of approximately 30 m, and it extends along the road in the length of approximately 25 m. The distance of the complex from the left rail of the railway line (seen in the direction of increasing stationing) is 40 m, and from the left edge of the roadway of the state road in question (seen from the direction of the intersection with the state road IB rank, marking 26 to the settlement Zminjak), is 6 m. The appearance of the complex is shown in Figures 2.2.3.19. and 2.2.3.20.

Figure 2.2.3.19: The appearance of the facility
(view from the direction of interesection with the state road 1B rank, marking 26)

Figure 2.2.3.20: The appearance of the facility (view from the direction of the settlement Zminjak)

Between the crossing point Štitar and the station Petlovača, viewed in the direction of the growing stationing, in front of the level crossing in question, in the length of more than 600m, on the right side of the railway line extensive vegetation above 4m is noticed, which, in certain places, is located at a distance less than 2m from the nearest rail of the railway line. Also, on the same side of the railway line, 73 m in front of the level crossing and 9 m away from the nearest rail of the railway line, there is a tree, according to the estimates, over 10m high, with a branched canopy whose branches in the lower part of the tree trunk reach a distance of 5 m from the nearest rail of the railway line (see Figures 2.2.3.21, 2.2.3.22, 2.2.3.23, 2.2.3.24). The described vegetation is located in the zone of necessary visibility (in the part of the zone of necessary visibility which includes the railway belt and the part of the zone of necessary visibility which does not include the railway belt) and significantly obscures the view from the railway to the road, and view from the road to the railway line.

Figure 2.2.3.21: The appearance of vegetation next to the railway line
(view from the direction of the crossing point Štitar to the level crossing)

Figure 2.2.3.22: The appearance of vegetation next to the railway line
(view from the direction of the crossing point Štitar to the level crossing)

Figure 2.2.3.23: The appearance of vegetation next to the railway line
(view from the direction of the level crossing to the crossing point Štitar)

Figure 2.2.3.24: The appearance of vegetation next to the railway line
(view from the direction of the level crossing to the crossing point Štitar)

Between the crossing point Štitar and the station Petlovača, viewed in the direction of the growing stationing, behind the level crossing in question, in the length of more than 600 m, on the right side of the railway line an extensive vegetation is noticed of the length of more than 3 m, which in certain places is located at a distance less than 3m from the nearest rail of the railway line, while on the left side of the railway line, viewed in the direction of the growing stationing, there is no vegetation in the direct vicinity of the railway line at a distance of 300 m from the railway line, but at a distance between 300 m and 600 m there exists vegetation (see Figures 2.2.3.25, 2.2.3.26, 2.2.3.27. and 2.2.3.28.). The described vegetation is located in the zone of necessary visibility (in the part of the zone of necessary visibility which includes the railway belt and the part of the zone of necessary visibility which does not include the railway belt) and significantly obscures the view from the railway to the road, and view from the road to the railway line.

Figure 2.2.3.25: View of the vegetation next to the railway line
(view from the direction of the station Petlovača to the level crossing)

Figure 2.2.3.26: View of the vegetation next to the railway line
(view from the direction of the station Petlovača to the level crossing)

Figure 2.2.3.27: View of the vegetation next to the railway line
(view from the direction of the level crossing to the station Petlovača)

Figure 2.2.3.28: View of the vegetation next to the railway line (view from the direction of the level crossing to the station Petlovača)

2.2.4. Communication tools

On the section of the regional line 211: Ruma – Šabac – Junction Donja Borina – state border - (Zvornik Novi), between the crossing point Štitar and the station Lešnica, communication between the staff that regulates the traffic is performed via radio network , according to the Instruction for Usage of the radio-communcation system on the Ruma – Šabac – Štitar – Zvornik No. 4/2018-662-189 of 10.05.2018., consisting of 14 (fourteen) fixed radio- connections between certain official, i.e., working positions. Radio network inlcudes official positions: Šabac, Štitar, Prnjavor, Lešnica, Brasina, Junction Donja Borina and Zvornik (fixed radio station are located on the work places of train dispatchers). Radio network includes the Department for Operations in Ruma and work positions of level crossing keepers: "Prnjavor" (at km 27+764), "Šabački put" (at km 50+315), "Ilićevo II" (at km 52+714), "Navoz" (at km 58+801) and "Zejtin Vode" (at km 62+452). Radio- communication system is connected to the register device type RC3, located in the station Ruma. This type of communication is considered evidence-based communication. At

the time of occurence of the serious accident in question, Radio- communication system was working and operational.

At this railway line section there is no way of communication secured by TT service of "IŽS"a.d. between the staff that regulates the traffic and the train staff. Only mobile operator lines are available for this purpose.

2.2.5. Works performed on or near the serious accident site

In the vicinity of this serious accident no works were performed.

2.2.6. Activation of the emergency plan on the railway and sequence of events

The railway undertaking "Srbija Kargo"a.d. has, immediately after the occurrence of the serious accident in question, informed CINS, that is, the Main Investigator for Railway Traffic, and then the same was done by the infrastructure manager "IŽS"a.d. The infrastructure manager "IŽS"a.d. and the railway undertaking "Srbija Kargo"a.d. have formed a joint investigative committee which conducted investigation of the serious accident in accordance with applicable regulations. Upon completion of the investigation, the Investigation Report U-219/20 was made.

According to the data submitted in attachment of the Letter from "Srbija Kargo"a.d. No. 1/2020-3950 of 11.09.2020. and the statements given at the CINS's premises, the train driver has on the accident occurred, via mobile telephone, by calling via network of the mobile telephony operator, informed the ambulance, the police and the competent officials at "IŽS"a.d. and "Srbija Kargo"a.d. Because of personal safety, the train driver and the train driver assistant had not left the driver's cab until the police came to the site.

According to allegations from the Letter of the Sector for Traffic Affairs, "IŽS"a.d. No. 15/2020-792 of 03.09.2020., the on-duty station dispatcher of the station Lešnica received the first notification on the accident occurred by the train driver of the train No. 45403 at 11:00. Immediately after being informed, he informed the ambulance, the next occupied official position (crossing point Štitar), the assistant chief of the station Šabac and senior dispatcher in the Department for Operational Affairs Ruma. In order to secure the accident site, section of the regional railway line between the crossing point Štitar and the station Lešnica was closed for traffic at 11:20. The joint investigative committee of the infrastructure manager "IŽS"a.d. and the railway undertaking "Srbija Kargo"a.d. came to the accident site at 13:20 where the on-site investigation of the police and OJT in Šabac had already started. The accident site was secured by the traffic police patrol, the injured persons (two minor children) were transferred by ambulance car to the competent health institution, and the funeral service took away the bodies of the fatally injured persons (two adults).

After the completed investigative tasks by the police, OJT and the joint investigative committee of the infrastructure manager and the railway undertaking, train No. 45403 was launched from the site in the direction of the station Petlovača at 16:00.

After the completed inspection of the railway line in the zone of the level crossing and received check-out for the train No. 45403, the section of the railway line between the crossing point Štitar and the station Lešnica was opened for train traffic at 16:30.

2.2.7. Activation of the emergency plans of public rescue services, police and medical services and sequence of events

Due to this serious accident, members of Emergency Medical Service of the Šabac Health Center, members of MUP RS, the Police Directorate, the Police Administration in Šabac, the Šabac Traffic Police Station and members of OJT Šabac were engaged.

By the letter of MUP RS, the Police Directorate, the Police Administration in Šabac, the Šabac Traffic Police Station No.: 813/2020 of 24.08.2020., data were submitted that on 25.07.2020. the citizens informed on-duty service of the Šabac Traffic Police Station on the traffic accident and at the same time, the on-duty patrol was sent to the site.

By the letter of OJT Šabac KT No. 966/20 of 30.11.2020., data were submitted that OJT Šabac was on this specific accident informed by the police official of the Police Administration in Šabac, the Šabac Traffic Police Station at 11:26. On that occasion, Deputy Prosecutor of OJT Šabac came to the site and conducted on-site investigation, from 12:27 to 17:30. The on-site investigation was attended by two police officers from the Šabac Traffic Police Station and two criminal technicians from the Šabac Police Administration.

By the letter of the Šabac Health Center No. 01-1/966 of 23.12.2020., data were submitted that on 25.07.2020. at 10:53 an ambulance station at Prnjavor was called from two telephone numbers stating that in the settlement Zminjak a traffic incident occurred. The team from Prnjavor (driver and medical technician) immediately went to the site and informed the ambulance in Šabac. Two ambulances set off from Sabac, in which there was a complete team (a doctor, a medical technician and a driver). Four injured people, two adults and two children were found on the site. The children were conscious and two adults were without vital signs of life, after which their death was ascertained. After providing first aid on the spot, another ambulance from Šabac took the children and transported them to the Emergency Department of the General Hospital in Šabac.

2.3. Dead, injured and material damage

2.3.1. Passengers, third parties and the railway staff including contractors

In this serious accident, 2 (two) persons were fatally injured and 2 (two) persons were seriously injured. All the injured and fatally injured persons were in the road passenger vehicle.

Among the train staff of the train No. 45403 there were no injured nor fatally injured.

Table 2.3.1.1: Review of the fatally injured and injured persons

	Passengers	Railway staff	Third persons	Total
Fatally injured	-	-	2	2
Seriously injured	-	-	2	2
Lightly injured	-	-	-	-

Data on the fatally injured and injured persons were submitted by OJT Šabac (Letter KT No. 966 of 30.11.2020.).

2.3.2. Goods, luggage and other assets

In this serious accident there were no damages to the goods on the railway vehicles. On the road passenger vehicle there are damages. CINS does not own data on damage assesment on the road passenger vehicle.

2.3.3. Railway vehicles, infrastructure and the environment

There were no damages on the infrastructure and railway vehicles in the serious accident in question.

2.3.4. External conditions – weather conditions and geographical characteristics

The place of occurrence of the serious accident in question is located in the area of the populated settlement Petlovača, in the vicinity of the setllement Zminjak, on the section located on geographically plain terrain.

The geographical coordinates of the accident site are: 44º 44' 1,0" N and 19º 27' 50,5" E.

The railway line section where the level crossing is located is in the right curve of radius R=600 m, 25 m before the end of the curve, on the part of the transition curve (viewed in the direction of the train movement, that is, in the direction of growing mileage) and on the slope of 1.60‰ (rise, viewed in the direction of the train movement, that is, in the direction of growing mileage).

By the Letter of Republic Hydrometeorological Institute No. 925-1-231/2020 of 20.08.2020., data were submitted that in the area of the settlement Zminjak at 11:00 the air temeperature was 22.0°C. Atmospheric phenomena were not recorded, visibility was 10 km (meteorological visibility is the transparency of the atmosphere expressed by the greatest distance at which the observer of normal vision can recognize familiar objects in the environment, when observing during the day, and light sources when observing at night). The air pressure was 1001.3 mb, and relative humidity was 83%. The ground was moist due to the rain which was falling the previous night. In the period from 10:00 to 11:00, a moderate wind was blowing from the west, with maximum speeds from 5.5 m/s to 7.9 m/s. The data were issued on the basis of measurements and observations at the Meteorological Station Sremska Mitrovica, which is representative of the requested area.

At the time of conducting on-site investigation of the serious accident in question by the investigative team of CINS, it was day. The wather was cloudy, without wind. Occasionally the light rain was falling. The ground was moist. Visibility was good (there was no fog nor mist). The air temperature was between 26.0°*C* and 23.5°*C*.

3. Minutes on the investigation and examination

Data, facts and evidence regarding the occurrence of the serious accident in question were collected and determined on the basis of:

- On-site investigation by the investigative team of CINS;
- materials submitted by infrastructure manager “IŽS”a.d.;
- materials submitted by railway undertaking “Srbija Kargo”a.d.;
- materials submitted by railway undertaking “Srbija Voz”a.d.;

- materials submitted by the OJT Šabac and
- materials submitted by the road manager JP "Putevi Srbije".

For the serious accident in question, on-site investigation and investigation were conducted by the joint investigative committee, composed of the infrastructure manager "IŽS"a.d. and the railway undertaking "Srbija Kargo"a.d..

Members of MUP RS, Police Administration in Šabac, Traffic Police Department Šabac and members of OJT Šabac conducted on-site investigation at the serious accident site.

3.1. Summary of testimonies

The CINS working group interrogated the employees who participated in this serious accident at the CINS' premises. From the employees of "Srbija Kargo"a.d., on 15.10.2020., the train driver and train driver assistant were questioned. The questioned were, at the time this accident, on duty at the train No. 45403. From "Srbija Kargo"a.d. the Minutes on hearing of all employees that were on duty at the train No. 45403 (of the train driver and the train driver assistant) were obtained. From "IŽS"a.d. the Report of the train dispatcher on irregularities during operation (SP-9) No. 0033530 of 25.07.2020. issued by the train dispatcher of the station Lešnica, who was on duty at the time of occurrence of the serious accident in question. Summaries of testimonies for the train driver and train driver assistant, who were on duty at the train No. 45403 were given according to the hearing conducted by the Working Group of CINS.

3.1.1. Railway staff

The train driver stated that he was on the right side of the driver's cab, in the direction of train movement, that he was moving with the prescribed speed, and when approaching the level crossing he was giving an aspect of a signal "Watch out" and introduced gradual braking, and at a call of the train driver assistant "Brake, brake" he also introduced the fast braking.

He says that when he is in this position, he cannot see well the vehicles coming from the left side, that the vehicle appeared once, that it did not stop in front of the "Stop" sign, but flew under the train and because of its position in the locomotive he did not see that impact of the vehicle into the locomotive. He notes that the level crossing can be seen from 500 m, that it has a sign, that is, a pillar, of red - white colour, and that he knows that there is a level crossing, as well as that the level crossing is less noticeable on the curve, while after passing the curve it is possible to see it. When asked about the vehicles that were crossing the level crossing just before the train arrived, as well as about the road passenger vehicle that participated in the accident, he said that he did not remember how many vehicles were at the crossing at that time, that he saw some vehicles turning onto a road that crosses the railway line, but he did not see that vehicle at the time it entered the track profile. He claims that it is a matter of driver indiscipline and that he has had cases of young people running into, then stopping, looking at him and laughing. He states that immediately after the accident, around 11:05, he called the ambulance and the police, who arrived very quickly, and that he did not go to the serious accident site because he was under stress.

The train driver assistant stated that he was positioned on the left side of the locomotive and that his duty was to, from his left side, transmit aspects of signals to the train driver, as well as that the locomotive was moving with the longer end forward. He also notes that before encountering a curve in front of this level crossing, they always give an aspect of a signal "Watch out", which

they did several times this time and that they were moving at a speed of about 50 km/h, even though the limit was 60 km/h and after the train left the curve, there were no vehicles at the level crossing and then after that, at a distance of 5 to 6 meters from the train, a maximum of 10 meters, practically at a length of one locomotive, there appeared a road passenger vehicle moving with a fast speed, without stopping in front of the level crossing, without reducing the speed and without signs of braking, he shouted "Brake, brake" and the train driver introduced complete fast braking. He says that the level crossing cannot be seen before the curve from the locomotive, either because of the vegetation or the configuration of the locomotive itself, but only after the train left the curve at a distance of 50 to 70 meters from the level crossing, he noticed the level crossing. After stopping the locomotive, they looked out the window and saw a car next to the railway, which did not overturn but was obviously moving in the direction of the train movement on the meadow and stopped there and they called an ambulance and police within 5 minutes. They saw that a woman fell out of the car, which the locomotive hit directly on the head, while the man remained in the car, behind the wheel. He claims that they were not allowed to get off the locomotive because of their safety and that two ambulances and the police came to the site. He points out that his colleague train driver felt very bad.

3.1.2. Other witnesses

Witnesses to this accident (third parties) were not heard and no statements were obtained from them.

In the Record on the on-site investigation of the place KTR No. 2290/20 of 25.07.2020. of OJT Šabac, it was not ascertained whether there were eyewitnesses of this traffic accident on the spot.

3.2. Safety management system

3.2.1. Organizational frame and manner of issuing and executing orders

In accordance with the applicable Rulebook of Safety Management System, "IŽS"a.d. has informed CINS on the serious accident occurred.

In accordance with the applicable Safety Management System Manual (SMS), "Srbija Kargo"a.d. has informed CINS on the serious accident occurred.

The infrastructure manager "IŽS"a.d. and the railway undertaking "Srbija Kargo"a.d. have, in accordance with the Law on Railway Traffic Safety ("Official Gazette RS" No. 41/2008), formed the joint investigative committee which conducted the investigation of the serious accident in question. Upon completion of the investigation, Report on Investigation U-219/20 was created.

3.2.2. Requirements to be fulfilled by the railway staff and the manner they are applied

"Srbija Kargo"a.d. has, through the established Safety Management System Manual (SMS), secured competence management, that is, of the processes, that all the employees directly involved in the performance of the railway traffic, be trained and competent, as well as planning of the workload.

Regarding the serious accident in which the train driver and assistant train driver were involved, employees of "Srbija Kargo"a.d., all activities related to professional training, competence and working time planning were carried out in accordance with applicable regulations.

3.2.3. Procedures for internal audits and controls and their results

"Srbija Kargo"a.d. as a railway undertaking has the established Safety Management System Manual (SMS). The general purpose of the Safety Management System (SMS) is to secure that "Srbija Kargo"a.d. achieves its business goals of providing transportation services on the railway in the safe manner.

Rolling stock must maintain the prescribed technical level of correctness and must follow the maintenance plans (EV-62) and its cycles of control and technical inspections and regular repairs, in order to be as reliable as possible in traffic, in accordance with the Rulebook on maintenance of railway vehicles and other laws and bylaws that are integral part of the Safety Management System Manual of "Srbija Kargo"a.d.

Regarding the serious accident in question, regular and corrective maintenance of railway vehicles (locomotive 661-033) from 05.11.2019. to 20.03.2020. was performed in accordance with applicable regulations. After 20.03.2020., the first control check of the rank P1 was performed on 15.05.2020. (55 days have passed), while the first control check after 15.05.2020., performed on 01.07.2020. (46 days have passed), contrary to Article 5, paragraph 6, indent 5 of the Instruction for maintenance of traction vehicles ("Official Gazette of ŽS", No. 32/2015 and 22/2017), but the above had no impact on the occurrence of the serious accident.

"IŽS"a.d. as the infrastructure manager has established Rulebook of the safety manaagement system. The safety management system includes the organization and all procedures and processes established in "IŽS"a.d. for the safe operation of railway traffic.

Risk control related to the maintenance of railway infrastructure (subsystems infrastructure, energy, control, management and signaling - railway part) and railway vehicles that is used by "IŽS"a.d. for maintenance, is based on the implementation of defined activities of regular and corrective maintenance and their monitoring and control. Regular and corrective maintenance includes constant supervision, controls, inspections, fixings and repairs.

Requirements, standards and procedures for maintenance of "IŽS"a.d. are determined on the basis of legal regulations, general and individual acts of the company, manufacturer's instructions and standards.

In connection with the serious accident in question, regular and corrective maintenance of the level crossing was performed in accordance with the applicable regulations in the part related to the maintenance of the railway as well as taking measures to set the prescribed traffic signals on the road.

Regular and corrective maintenance of the railway belt was not performed in accordance with the applicable regulations (see section 2.2.3).

3.3. Relevant international and national regulations

3.3.1. Law on Roads ("Official Gazette RS", No. 41/2018 and 95/2018 – other law)

Definitions

Article 2 (excerpt)

Certain expressions used in this Law have the following meaning:

...

35) road land is a continuous area within the boundaries of road land;

36) the boundary of the road land is the line on both sides of the cut and embankment, at least one meter away from the lines that form the end points of the transverse profile of the road, outside the settlement, measured on the outside;

37) protective road zone is a continuous area measured from the border of the road land to the outer side, the width of which is prescribed by this Law;

...

VII Protection of public roads and emergency transport

...

Visibility of public road intersections

Article 38 (excerpt)

At the intersection of a public road with another road and crossing of a public road with a railway at the same level, the zones of necessary visibility must be provided in accordance with the regulations.

In the zones of necessary visibility, it is forbidden to erect plantations, fences and trees, leave objects and materials, set up plants and devices and build facilities, i.e. perform other actions that interfere with the visibility of the public road.

The owner, i.e. the immediate holder of the land, which is located in the zone of necessary visibility, is obliged, at the request of the public road manager, to remove plantations, fences, trees, objects, materials, plants, devices and facilities referred to in paragraph 2 of this Article, with the aim of ensuring road visibility.

...

VIII Maintenance of public roads

...

Regular maintenance of public road

Article 68 (excerpt)

Regular maintenance includes a set of activities, measures and works, which are undertaken during part or the whole calendar year, on the road network or on certain sections of the road, in order to maintain and preserve the functional correctness of public roads, road facilities, traffic signals and road equipment.

Works on regular maintenance of public roads are especially:

...

2) occasional repair of damage to the road structure and other road elements;

3) occasional surface treatment of the road ballast;

4) cleaning of roads and other road elements within the boundaries of road land;

...

9) repair, replacement, supplementation and restoration of traffic signals and equipment;

10) regular cleaning and maintenance of traffic signals and equipment;

11) replacement, supplementation and restoration of damaged or worn-out road equipment and facilities and equipment for road, traffic and environmental protection;

12) cleaning of road equipment and facilities and equipment for road, traffic and environmental protection;

13) arranging green areas in road land (mowing grass, clearing bushes and cutting trees);

...

Maintenance of certain road elements

Article 72

The manager of the state road maintains the road construction as an integral part of the state road and the traffic signalization on the state road that passes through the settlement, except for the device for giving light traffic signs and tourist signalization.

Additional elements, facilities and equipment of the state road (sidewalk, intersections for the needs of settlement, parking spaces, public lighting, light and other signalization for the needs of settlement, bicycle paths, pedestrian paths, etc.), which are built for the needs of settlement, are maintained by the units of local governments.

The unit of local government may conclude a contract with the manager of the state road, which regulates in more detail the mutual rights and obligations regarding the maintenance of additional elements, facilities and equipment of the state road from Paragraphs 1 and 2 of this Article.

Bus stops built outside the road of the state road in the settlement are maintained by the unit of local government.

The connecting ramps of the leveling intersection are maintained by the manager of the public road of a higher rank.

The public road manager maintains the road construction of the public road in the area of the border crossing in accordance with the regulations governing the protection of the state border.

3.3.2. Road Traffic Safety Law (“Official Gazette of RS” No. 41/2009, 53/2010, 101/2011, 32/2013 – decision US, 55/2014, 96/2015 – other law, 9/2016 – decision US, 24/2018, 41/2018, 41/2018 – other law, 87/2018, 23/2019 and 128/2020 – other law)

Note: On the day of entry into force of the Law on Ministries (“Official Gazette of RS”, No. 128/2020), the provision of Article 9, paragraph 1 was amended of the Road Traffic Safety Law (“Official Gazette of RS” No. 41/2009, 53/2010, 101/2011, 32/2013 – decision US, 55/2014,

96/2015 – other law, 9/2016 – decision US, 24/2018, 41/2018, 41/2018 – other law, 87/2018, 23/2019). Amendments to the law in question occurred after the occurrence of the serious accident in question and do not apply to the parts of the Law relating to the serious accident in question.

IV Traffic rules

...

23. Traffic on the crossing of the road over the railway line

Article 100

On the crossing of the road over the railway line, the driver is obliged to pass the railway vehicle moving on the railway line.

A driver approaching a level crossing with a vehicle is obliged to adjust the movement of the vehicle so that he can stop it in front of the device for closing the traffic at the crossing or in front of the device for giving signs announcing the approach of the train, i.e. to stop the vehicle before stepping on the railway line.

...

VII Traffic signalization

1. General provisions

Article 132 (excerpt)

...

Traffic participants are obliged to, at the places, that is, sections of the road marked by the danger signs, adjust their movement to the dangers that these signs warn them of.

...

6. Marking the crossing of the road over the railway line

Article 153 (excerpt)

The crossing of the road over the railway line must be marked with the prescribed traffic signalization.

At the crossing of the road with a modern road pavement (asphalt, concrete, cube, etc.) over the railway line, traffic lights announcing the approach of the train must be placed.

...

XI Drivers

...

5. Psychophysical conditions for driving a motor vehicle

Article 187

A driver who is incapable of safe driving, i.e. so tired or ill, or is sick or in such a mental state that he is not able to drive safely, must not drive a vehicle in traffic.

The driver must not drive a vehicle on the road or start driving if he is under the influence of alcohol and/or psychoactive substances.

Under the influence of alcohol is the driver, i.e. a person for whom the analysis of an appropriate blood sample determines the presence of alcohol greater than 0.20 mg/ml or if the presence of alcohol in the body is determined by appropriate means or devices for measuring alcoholism (breathalyser, etc.), which corresponds to the presence of alcohol in blood greater than 0.20 mg/ml.

...

3.3.3. Law on Railway ("Official Gazette of RS" No. 41/2018)

I Introductory provisions

...

Meaning of individual expressions

Article 2 (excerpt)

Certain expressions, in terms of this Law, have the following meaning:

...

52) railway belt is a land belt on both sides of the railway line in the width of 8 m, in a populated area 6 m, measuring from the axis of the end tracks, the land under the railway and the airspace in the height of 14 m. The railway belt also includes the land area of official positions (stations, intersections, stops, crossroads, etc.) which includes all technical-technological facilities, installations and access-fire road to the nearest public road;

...

54) a level crossing is the intersection of a railway line belonging to public railway infrastructure, an industrial railway or an industrial track and a road at the same level, which includes the intersection of these tracks with a pedestrian or bicycle path, 3 m wide from the track axis, including the space between tracks when there are several tracks at a level crossing;

...

II Railway infrastructure

...

1. Management of public railway infrastructure

...

Obligations of the infrastructure manager

Article 10 (excerpt)

The infrastructure manager is obliged to ensure safe and uninterrupted organization, regulation and management of railway traffic, uninterrupted access and use of public railway infrastructure and access to service facilities entrusted to him for management and services he provides in these facilities to all interested applicants for infrastructure capacity allocation, under equal, non - discriminatory and transparent conditions, as well as permanent, uninterrupted and quality maintenance and protection of railway infrastructure.

...

III Calculation of access prices and allocation of railway infrastructure capacity

...

6. Construction and reconstruction of railway infrastructure

...

National Public Railway Infrastructure Program

Article 48 (excerpt)

...

Based on the National Program, the infrastructure manager prepares the annual Program of construction, reconstruction and maintenance of railway infrastructure, organization and regulation of railway traffic with a projection for the next four years.

...

7. Maintenance of public railway infrastructure

Article 55 (excerpt)

Public railway infrastructure must be maintained in a condition that ensures safe and undisturbed railway traffic, as well as quality and orderly transport, in accordance with the regulations governing safety in railway traffic and technical regulations and standards.

...

Article 56

Works on regular maintenance are in particular: maintenance and replacement of elements of the superstructure of the railway (switches, tracks and track connections), with the same or other type by which the parameters of the railway are maintained at the designed level; works on the substructure of the railway line (drainage and arrangement of slopes); removal of trees, bushes and shrubs from the railway belt, replacement and renovation with the same or other materials of culverts and bridges up to 10 m in length, if their opening is not changed; replacement and supplementation of elements of signaling - safety and telecommunication devices and plants; replacement and supplementation of elements of stable electric traction plants, as well as other plants for transformation and transmission of electricity for train traction; adaptation and repair of buildings of railway official positions and other facilities at railway official places which are in the function of railway traffic which do not change their construction and external appearance; cleaning of snow and ice from tracks, plants and surfaces on station platforms, stops, etc.

...

8. Level crossings, reconstruction and level crossings maintenance

...

Article 62 (excerpt)

At the level crossing, railway infrastructure and railway traffic are managed by the railway infrastructure manager (infrastructure manager, service facility operator, owner, i.e. authorized industrial track manager who is part of the railway infrastructure), and road, street and pedestrian infrastructure and traffic are managed by the road infrastructure manager, so that each manager is obliged to create conditions for safe crossing of the crossing point on the infrastructure he manages.

...

Article 67

The railway infrastructure manager and the road infrastructure manager are obliged to conclude an agreement which, in more detail, regulates the mutual relations in terms of level crossings and within that framework determines the type and scope of road maintenance works and the time of execution of these works, the amount of costs for ensuring safe and undisturbed traffic at the level crossing, the method of payment of costs and regulate other issues from these relations.

The contract referred to in Paragraph 1 of this Article shall be concluded for a period of maximum ten years with the possibility of renewal, and the Annex to the contract referred to in Paragraph 1 of this Article must be signed no later than 31.12. of the current year for the next year.

If the railway infrastructure manager and the road infrastructure manager do not conclude the contract referred to in paragraph 1 of this Article within the period referred to in paragraph 2 of this Article, the railway infrastructure manager may, in order to maintain the road crossing in a condition that ensures safe traffic, determine that certain road maintenance works at the level crossing and carry out these works at the expense of the road infrastructure manager.

The manager of road infrastructure is obliged to pay the manager of railway infrastructure the costs referred to in paragraph 3 of this Article within 30 days from the day of receipt of the notification on the amount of costs.

Article 68 (excerpt):

The railway infrastructure manager, as well as the road manager are obliged to implement measures for safe and undisturbed traffic at the level crossing and to maintain the level crossings in a condition that ensures safe and uninterrupted traffic flow, in accordance with the laws governing railway traffic safety and road traffic safety.

...

Article 69 (excerpt):

The infrastructure manager takes care of maintaining the part of the level crossing, as well as ensuring safe and undisturbed traffic at the level crossing, with the provision that the road at the level crossing must be maintained so that safe and undisturbed road traffic can be performed over it.

Other parts of the road on both sides of the road, including the area of necessary visibility outside the width of the road crossing, are maintained by the road infrastructure manager in a way that enables safe and undisturbed railway traffic.

The zone of visibility in the gauge of the level crossing is maintained by the railway infrastructure manager.

3.3.4. Law on Railway Traffic Safety (“Official Gazette of RS” No. 41/2018)

XIII Crossing of railway lines and roads

...

Conditions for crossing of the railway line and road, pedestrian, or bicycle path

Article 97 (excerpt)

The conditions for the crossing of the railway line and the road, in terms of the place where the crossing can be made and the measures for safe traffic regulation at the level crossings, depend on the traffic density, visibility of the railway, speed on the railway and on the road and on local conditions.

...

XV Protection of railway infrastructure and vehicles

Article 100 (excerpt)

In order to conduct safe railway traffic, it is prohibited:

...

6) plant trees and other tall plants or perform works near the road crossing that reduce, prevent or in any way interfere with the visibility of the railway line or the road;

...

3.3.5. Rulebook on traffic signalization ("Official Gazette of RS" No. 85/17)

II Traffic signalization

...

1. Traffic signs

...

1.1. Danger signs

Article 17

Danger signs serve to warn participants in traffic of the danger that threatens them at a certain place, i.e. part of the road, and to inform them about the nature of the danger.

Article 18 (excerpt)

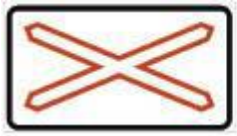
Danger signs are:

...

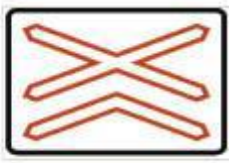
28) sign "crossing of the road with the railway line with barriers or half-barriers" (I-33), denotes encountering the crossing of the road with the railway line at the level, which is not provided with barriers or half-barriers;

I-33

29) sign “St. Andrew’s cross”, denotes encountering the crossing of the road with the railway line at the level with one track (I-34), i.e., with two or more tracks (I-34.1);

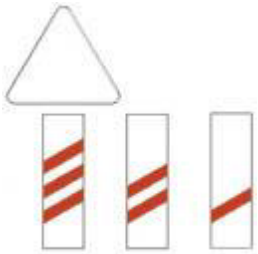


I-34



I-34.1

30) the sign “approaching the crossing of the road and the railway line” (I-35), denotes the distance to the crossing point of the road and the railway line at the level;



I-35

...

Placing the danger signs

Article 22

Danger signs are placed, at a distance from 150 m to 250 m in front of the place of danger on the road.

Notwithstanding from the paragraph 1 of this Article, on the road outside the settlement, it is allowed to place danger signs at a distance of less than 150 m, or more than 250 m, with an additional board indicating the distance to the dangerous place, with an explanation in the traffic project.

Notwithstanding from the paragraph 1 of this Article, on the road in the settlement, it is allowed to place danger signs at a distance of less than 150 m, with an explanation in the traffic project.

Article 23 (excerpt)

Notwithstanding from the Article 22, paragraph 1 of this Rulebook:

...

5) signs I-34, I-34.1 are placed at the crossings of the road and railway, at a distance of 5 m from the nearest railway track, and if the circumstances require not less than 3 m, or not more than 10 m;

6) signs I-34, I-34.1 are placed on the common supporter above the traffic lights if the level crossing over the railway line is equipped with the traffic lights;

7) sign I-35 is placed with three oblique lanes at 240 m in front of the crossing of the road and the railway line at the level, then with two oblique lanes at 160 m, and the last with one oblique

lane at 80 m in front of the crossing of the road and the railway at the level. The lower side of the oblique lanes is closer to the road. The sign I-32 or I-33 is placed above the sign with three oblique lanes.

...

1.2. Signs of explicit orders

...

Article 25 (excerpt)

Signs of explicit orders prescribing the priority of passage are:

...

2) sign ”obligation of stopping” (II-2), denotes an order to the driver that he must stop the vehicle and give priority to the passage of vehicles moving along the road he encounters;

II-2

...

Placing the signs of explicit orders

...

Article 33 (excerpt)

Notwithstanding from the Article 32 of this Rulebook:

...

2) sign II-2 shall be placed in the immediate vicinity of the crossroad, preferably at the point of visibility, where the vehicle must stop in order to give way to other vehicles moving along the road it encounters;

...

3.3.6. Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the point where the crossing can be made and measures to secure the safe traffic (“Official Gazette of RS” No. 89/2016)

I Introductory provisions

...

Article 2 (excerpt)

Certain expressions used in this Rulebook have the following meaning:

...

12) the necessary visibility from the road to the railway exists in cases when the driver of the road vehicle from the vehicle in front of the aspect of a signal indicating the place where the road crosses the railway has an unobstructed and uninterrupted view of the railway;

...

III Measures to secure the safe traffic on the level crossings

Article 10 (excerpt)

Measures to ensure safe traffic at level crossings depend on traffic density, visibility of the railway line, speed of driving on the railway and the road and local conditions in accordance with the law governing the safety and interoperability of the railway.

Traffic at level crossings referred to in paragraph 1 of this Article shall be provided with:

1) traffic signs on the road and the zone of necessary visibility;
2) light traffic signs and traffic signs on the road;
3) automatic semi-barriers with light traffic signs and traffic signs on the road;
4) barriers and traffic signs on the road;
5) direct regulation of traffic at the level crossing and special measures, and
6) protective fences and traffic signs or bypasses and traffic signs at level crossings for pedestrians and cyclists.

...

Article 11

Traffic signs on the road and the zone of necessary visibility are used to provide traffic at the intersection of the railway and the road at the level of the track, if the maximum allowed speed on the railway is up to 100 km/h, if the traffic is not provided as prescribed in Article 10, Paragraph 2 item 2) - 4) of this Rulebook.

Article 12

By providing the zone of necessary visibility referred to in Article 11 of this Rulebook, road users are allowed unobstructed and uninterrupted view of the railway on both sides of the road, pedestrian or bicycle path, in order to timely detect oncoming railway vehicles so that they can stop the road vehicle and stop movement of pedestrians or bicycles before entering the railway, i.e., in front of a traffic sign indicating the place where the road crosses the railway at the level of the track.

Article 13

The zone of necessary visibility at the crossing is measured along the axis of the railway line from its crossing with the axis of the road to one and the other side of the railway line and along the axis from its crossing with the axis of the railway line to one and the other side of the road, according to the review of determining the necessary visibility zone for road vehicles in Annex 6, which is printed with this Rulebook and forms its integral part (hereinafter: Annex 6).

The size of the zone of necessary visibility shall be determined on the basis of the maximum allowed speed on the railway line so as to ensure that road vehicles can be stopped in a timely and secure manner in front of a traffic sign signaling the point of crossing of the railway line and the road, or that road vehicles can safely start crossing the railway.

In the area of the zone of necessary visibility, facilities and plants cannot be built, items and materials left behind, and there can be no vegetation that could impede visibility, or actions that

interfere with the visibility of the railway line cannot be performed. The size of the zone of necessary visibility cannot be the reason for the reduction of the maximum allowed speed on the line.

Maintenance of the zone of necessary visibility is carried out in the part of the rail belt and in the zone of necessary visibility outside the belt.

The height of the zone of necessary visibility includes a space, between 1.0 and 2.5 m in height, measured above the track level, above the point on the road from which the road traffic participant should have an unobstructed and uninterrupted view to the point of the zone of necessary visibility on the railway line, as well as the space above the point of necessary visibility on the railway line between 1.5 and 4 m in height, measured above the upper edge of the rail of the railway line.

Article 14

The necessary visibility is determined according to the formula

$$L_{ppp} = AS = SC = t_{pdv}\frac{V_{ž}}{3{,}6} \quad [m]$$

whereas:

L_{ppp} – length of necessary visibility from the road to the railway line (m);

t_{pdv} – the total time it takes for a road vehicle of maximum length to start from point B (the point in front of the traffic sign marking the point where the road crosses the railway) and with its rear part to cross the freeway boundary of the railway line on the other side of the crossing (imaginary line l normal to axis of the road) (s);

$V_{ž}$ – the maximum allowed speed on the railway line in the zone of the level crossing (km/h).

Total time required that the road vehicle of the maximum permitted length cross over the area of the level crossing, that is, the size "t_{pdv}" is determined according to

$$t_{pdv} = t_a + t_v \quad [s]$$

wherein:

t_a – the time required that the road vehicle after starting reach V_p = 4 km/h with the supposed evenly accelerated movement (s);

t_v – the time of drive of the road vehicle from reaching V_p to crossing the line l with its rear part (s).

The time required that the road vehicle after starting to reach V_p, that is, the size "t_a" is determined according to:

$$t_a = \frac{V_p}{3{,}6 \cdot a} \quad [s]$$

wherein:

V_p = 4 km/h – the speed of the road vehicle on the level crossing;

a = 1 m/s^2 – acceleration of the road vehicle (from the moment of starting from the point B to the moment of reaching V_p).

The time of drive of the road vehicle from reaching V_p to crossing the line l with its rear part (s) that is, the size "t_v" is determined according to

$$t_a = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

m – the distance of the traffic sign presenting a point where the road crosses over the railway line from the axis of the railway line measured along the axis of the road (m);

n – the distance of the line l from the axis of the railway linemeasure along the axis of the road (m);

d – the maximum length of the road vehicle, which is 25 (m);

s – the road that the road vehicle passes from starting from the point B to reaching V_p (m);

V_p – the speed of the road vehicle on the point of the level crossing.

If, on a road crossing a railway line, the length of the road vehicle is of limited or greater length, then that limited or greater length of the road vehicle is taken as relevant for calculation.

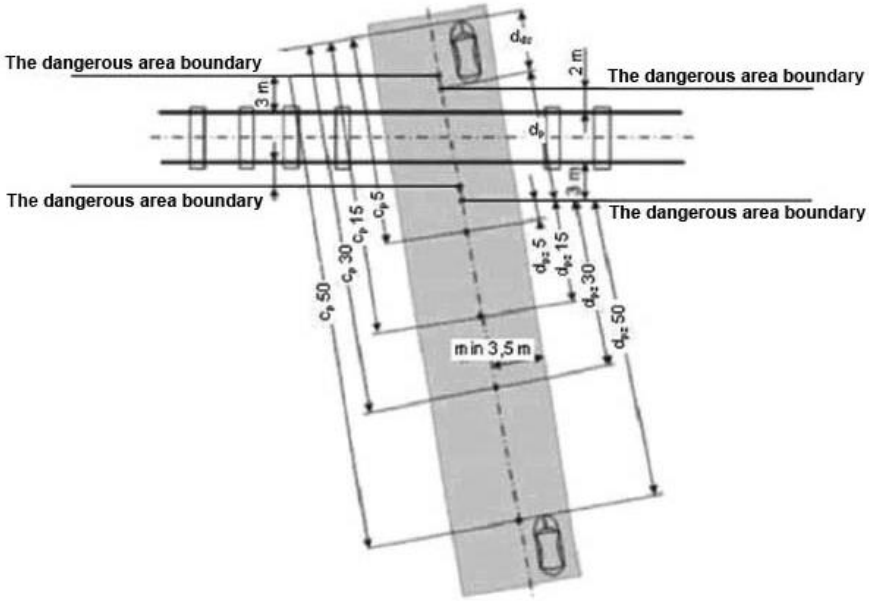
Article 15

A speed limit sign is placed on the road in front of the crossing, which is also representing the beginning of the zone of necessary visibility of the crossing zone.

The speed limit traffic sign shall be placed at the point of the road where the zone of necessary visibility (point B) begins at the distance of the stopping road of the road vehicle specified in Annex 5, Annex 6 and Annex 7, which are printed with this Rulebook and form its integral part.

...

Annex 5: The zone of crossing of the road over the railway line on the level crossing:



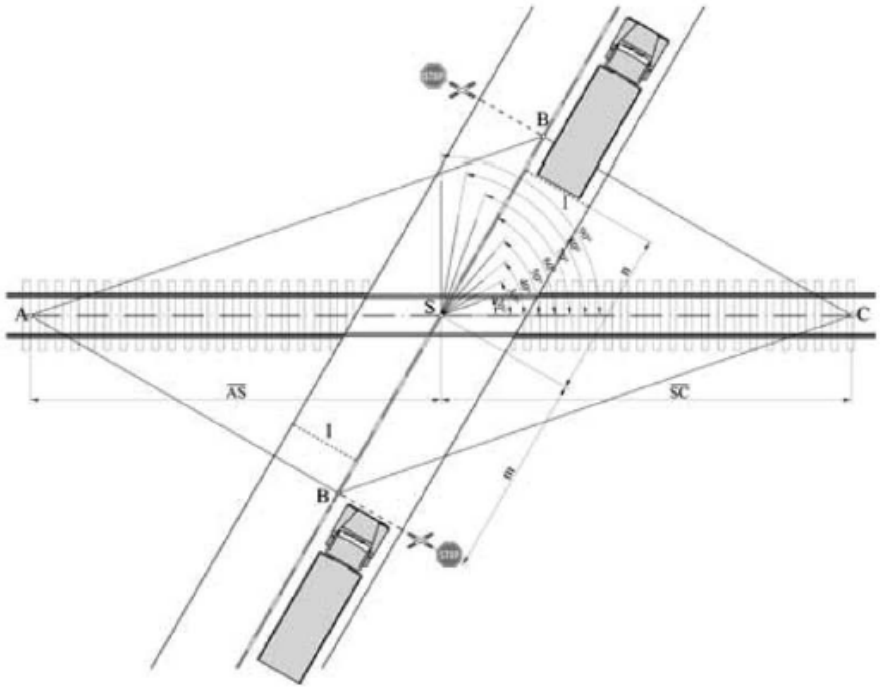
Where:

Z_p – Zone of crossing the road over the railway level crossing is a part of the way, from the point of which the driver of road vehicle should start braking so that the vehicle can safely stop before the traffic sign that indicates a place of the road crossing over the railway line, to the

place where the longest road vehicle, with the most exposed part of the rear, crosses the level of the crossing zone and leave the dangerous area boundary on the side of the departure of the level crossing, which is: $Z_p=d_{pz}+d_{dv}+d_p$ (m);

t_{zp} – the time required for a road vehicle to leave safely the zone of transition. Time "t_{zp}" is calculated on the basis of the sum of the length of the stopping distance of a road vehicle "d_{pz}", the length of the longest vehicles "d_{dv}" and the length of level crossing "d_p", with respect to the speed of road vehicles: $t_{zp}=Z_p/V_{dv}$ (s), wherein "t_{zp}" is the time of leaving the zone of the level crossing, "Z_p" zone crossing of level crossing in meters and "V_{dv}" speed of the road vehicle expressed in "m/s". The minimum time required for a road vehicle to leave safely the zone of the level crossing "t_{zp}" is calculated based on the sum of the length of the stopping of the road vehicle, which is 5 m, the length of the longest road vehicle "d_{dv}" and length of the level crossing "d_p*"* with respect to speed of road vehicle is 5 km/h (1.38 m/s): $t_{zp}=Z_p/1{,}38$ (s), wherein: "t_{zp}" is the time of leaving the zone of level crossing in seconds and "Z_p*"* the level crossing zone in meters for the speed of road vehicles 5 km/h. Indices 50, 30, 15 and 5 indicate speed of driving of the road vehicle in km/h.

Annex 6: The zone of necessary visibility on the level crossing over the railway line (level crossing):

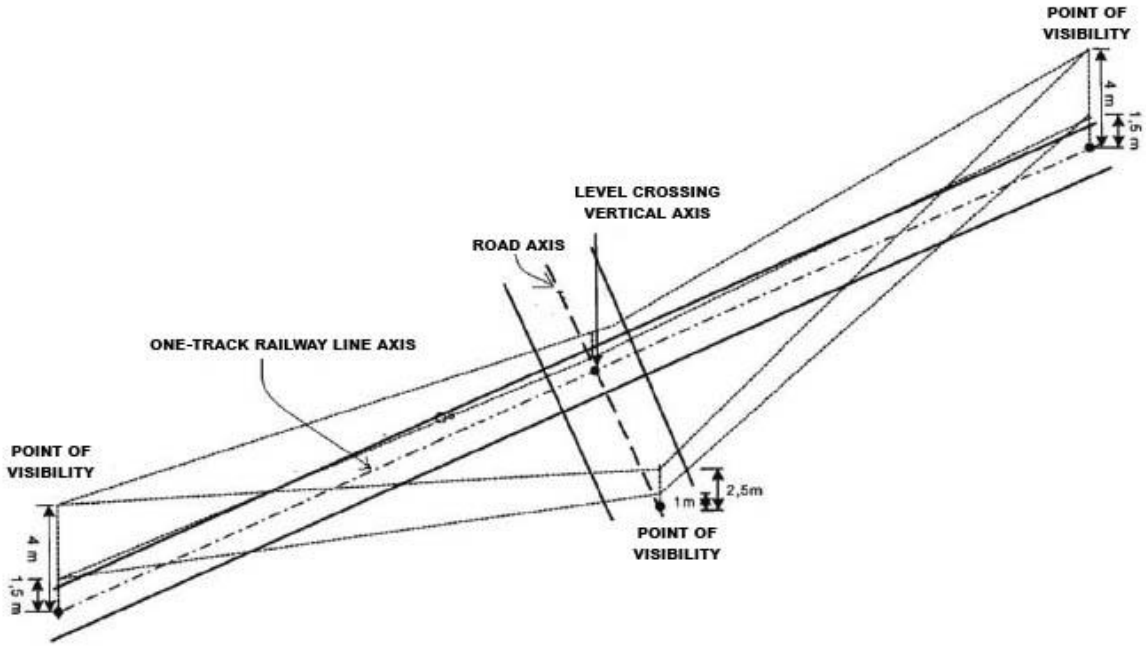


Where:

B – Place on the road from which the participant in road traffic must, when approaching the level crossing, due to the speed limit on the road, have a continuous overview to the point of visibility on the track at point A and C. Point of the visibility from the road on the railway is the length of the stopping distance of road vehicle before the traffic sign that indicates a place of crossing the road over the railway;

A and C – Point of visibility on the track away from the level crossing, at which a participant in road traffic must, from the point of visibility on the road at the point B, to have possibility to reliably see the rail vehicle coming on the track and to stop the road vehicle before the traffic sign which represents the place of crossing the road over the railway. The point of visibility is determined by calculating the road of approaching the rail vehicle.

Annex 7: Three-dimensional representation of the zone of necessary visibility on the crossing of the road over the railway line (level crossing):



3.3.7. Rulebook on the types of signals, signalling marks and markings on the railway line (*"Official Gazette RS", No. 51/20*)

Section V: Aspects of a signal of the traction train staff, station and driving staff of the trains

1. Basic provisions on aspects of a signal of traction staff

Article 158 (excerpt):

By aspect of a signal of traction vehicle staff gives traction vehicles trains the necessary orders and warnings for trains, station and service personnel and, in certain cases, other persons.

...

Aspect of a signal of the traction vehicle staff are given by the train driver with the siren of the traction vehicle.

...

Aspects of signal of the traction vehicle staff

Article 159 (excerpt):

Aspects of signal of the traction vehicle staff are:

1. Aspect of a signal 67: “Watch out”, one long sound: ▬▬▬▬

...

Article 160 (excerpt):

Aspect of signal 67: “Watch out” is given by the train driver:

1) at all the trains:

(1) in cases where it is necessary to warn about the arrival of the train or to be removed from, that is, away from the track. This also applies to the driver of each power-driven vehicle while manoeuvring.

...

(3) in front of the signaling mark “Track warning”,

...

(12) in front of every level crossing, larger notch, bridge or other larger facilities that hinder the view;

...

(14) when it is necessary in the interest of general security and warning the other persons and removing the animals of the track;

...

VIII. SIGNALLING MARKS

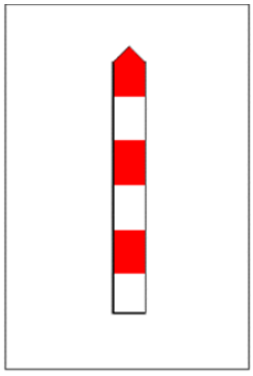
...

8. Track warnings

Signalling mark 209: “Watch out, the level crossing”

Article 226 (excerpt):

Shape and colour of the signalling mark 209: “Watch out, the level crossing” is given in Picture 163.



a pillar painted in random red and white stripes

Picture 163

Signalling mark 209: “Watch out, the level crossing” warns the train driver that at this sign he must give the aspect of a signal 67: “Watch out” and repeat it several times until arriving at the level crossing, for notifying the traffic participants that the train is approaching the level crossing.

...

Place of installation and distance of visibility of track warnings

Article 227 (excerpt):

Track warnings shall be installed in front of level crossings that are not secured with barriers, half-barriers or light signals, or in front of all road crossings in front of which control light signals or signals for the beginning of a stopping path in front of the road crossing are not installed.

Track warning is installed at the right side of the track for the direction of the relevant direction of driving.

...

Track warning is installed in front of the level crossing at the distance of 500 m on the main arterial routes and on regional railway lines, and on 200 m on the side tracks.

...

Distance of visibility of the track warning is at least 400 m on the railway lines with the stopping path of 1500 m, 300 m on the railway lines with the stopping path of 1000 m, and 200 m at the railway lines with the stopping path of 700 m.

3.3.8. Instruction of maintenance of traction vehicles ("Official Gazette of ŽS" No. 32/2015 and 22/2017)

4. Control check

Article 5 (excerpt)

Control check of traction vehicles is done for periodic check of corretness of subsystems, sets and devices of the traction vehicle according to the cycles and in the scope which is determined under this Instruction.

Depending on the traction vehicle series, the types of inspection checks and their order for a particular traction vehicle is determined, and their deadlines can not be longer than the deadlines prescribed in this Instruction.

...

The order for referral of vehicles to periodical checks is determined by the criteria of kilometers traveled or during the previous calendar days, with the criterion being the one that was first fulfilled.

Depending on the traction vehicle series, the periodic check criteria is:

...

- P1 diesel electric locomotive - at least once in 30 days or 15 000 km crossed, which can be increased by 15%;

...

3.4. Functioning of the railway vehicles and technical installations

3.4.1. Control, command and signalling

At the time of occurrence of the serious accident in question, on the railway section between the stations Lešnica and the crossing point Štitar, devices for control, conmand and signalling were correct and operational.

3.4.2. Infrastructure

The condition of the infrastructure (in terms of tracks and facilities) on the railway section between the station Lešnica, that is station Petlovača and the crossing point Štitar, was in order and in that sense there were no irregularities that could adversely affect the safety of railway traffic.

On the regional railway line from the direction of the crossing point Štitar, before the level crossing in question, a signalling mark 209 has been set: "Watch out, the level crossing" in the manner prescribed by the provisions of Article 226 of the Rulebook on types of signals, signalling marks and markings on the railway line ("Official Gazette RS, No. 51/20), but the signalling mark has been shielded by vegetation so that the prescribed distance of visibilty of 200 m (signalling mark is possible to be seen from a distance of 15 m, see section 2.2.3.)

From the direction of the station Lešnica, that is the station Petlovača, in front of the level crossing the signalling mark 209 "Watch out, the level crossing" has been installed, in the manner prescribed by the provisions of Article 226 of the Rulebook on the types of signals, aspects of signals and signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20) and for it the prescribed distance of visibility has been provided (see section 2.2.3.)

The length of the necessary visibility, according to provision of the Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016) is calculated according to the formula:

$L_{ppp} = t_{pdv} \cdot V_{ž} / 3{,}6$ [m]

$t_{pdv} = t_a + t_v$ [s]

$t_a = V_p / (3{,}6 \cdot a)$ [s]

$t_v = ((m+n+d+s)/V_p) \cdot 3{,}6$ [s]

wherein for the respective case:

1. For the direction from the intersection with the state road 1B rank, marking 26 to Zminjak:

$V_{ž} = 80$ *km/h* $\quad m = 6{,}5+0{,}8=7{,}3$ *m*
$V_p = 4$ *km/h* $\quad n = 2+0{,}8=2{,}8$ *m*
$a = 1$ *m/s*^{2} $\quad d = 25$ *m*

$t_a = 4$ *km/h* $/(3{,}6 \cdot 1$ *m/s*$^2) = 1{,}1$ *s*

$s = ((0+4)/(2$ *km/h*$\cdot 3{,}6)) \cdot 1{,}1$ *s* $= 0{,}61$ *m*

$t_v = ((7{,}3$ *m*$+2{,}8$ *m*$+25$ *m*$+0{,}61$ *m*$)/4$ *km/h*$) \cdot 3{,}6 = 32{,}1$ *s*

$t_{pdv} = 1{,}1$ *s* $+ 32{,}1$ *s* $= 33{,}2$ *s*

$L_{ppp} = 33{,}2 \cdot 80$ *km/h* $/ 3{,}6 = 737{,}8$ *m*

2. For the direction from Zminjak to the intersection with the state road 1B rank, marking 26:

$V_ž$ = 80 *km/h* m = 7,7+0,8=8,5 *m*
V_p = 4 *km/h* n = 2+0,8=2,8 *m*
a = 1 *m/s*^{2} d = 25 *m*

t_a = 4 *km/h*/(3,6·1 *m/s*^{2}) = 1,1 *s*

s = ((0+4)/(2 *km/h*·3,6))·1,1 *s* = 0,61 *m*

t_v = ((8,5 *m*+2,8 *m*+25 *m*+0,61 *m*)/4 *km/h*)·3,6 = 33,2 *s*

t_{pdv} = 1,1 *s* + 33,2 *s* = 34,3 *s*

L_{ppp} = 34,3·80 *km/h* / 3,6 = 762,2 *m*

Note: given that on the road in front of the level crossing traffic signs have been set (set on the same supporter) I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", at calculating the value m the distance of the supporter where the aforementioned traffic signs have been set is taken, from the nearer rail of the railway line.

Calculation of the necessary visibility is made according to the formula given in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016). This has been made for the reason that the Rulebook is in force and in application.

We consider that the formula for calculating t_v is not correct.

Namely, according to the provisions of Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), the formula for calculating t_v is given as follows: $t_v=((m+n+d+s)/V_p)\cdot 3,6$, where it is stated that s is the path the road vehicle crosses starting from point B to achieving a constant speed V_p, and t_v the time of driving the road vehicle from achieving a constant speed V_p to the crossing the hazardous area boundary with the rear part of the road vehicle. Therefore, it would be correct for the given formula to be -s instead of +s.

Calculation made with the corrected formula for t_v would give a shorter $L_{ppp.}$

According to the aforementioned calculation, given in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), in the event that the road vehicle stopped in front of the supporter where the traffic signs: I-34: "St. Andrew's cross" and II-2: "Obligation of stopping" have been set, it is required to secure such a necessary visibility that the driver of the road vehicle from that point must see the train that is on the railway line at a distance of 765 m from the level crossing and nearer to the level crossing.

In the direction of the state road 1B rank, marking 26 to Zminjak (the direction in which the road vehicle was moving) there is no necessary visibility in line with the provisions of the Article 2 Paragraph 1 under 12) of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No.89/2016).

Also, in the direction from the settlement Zminjak to the state road 1B rank, marking 26 there is no necessary visibility in line with the provisions of the Article 2 Paragraph 1 under 12) of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016).

Due to vegetation located in the track belt, and partly in the infrastructure belt, the driver of the road passenger vehicle who stopped in front of the supporter where the traffic signs are set I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", is not able to notice the train at the prescribed distance, that is, on the level crossing in question the necessary visibility is not provided (see section 2.2.3.)

An on-site investigation by the investigative team of CINS found that on the state road leading to Zminjak, traffic sign II-30 was not placed in front of the level crossing: "Speed limit" (see section 2.2.3.), which according to the provisions from Article 15 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bycicle path, the point where crossing can be made and the measures to secure the safe traffic ("Official Gazette RS" No. 89/2016), would represent the beginning of the zone of necessary visibility. Given the existence of the facilities described in section 2.2.3. (building and enclosed space with a wall), the zone of necessary visibility from the direction of the state road IB rank, marking 26 towards Zminjak does not exist and it is not possible to provide it without removing the mentioned facilities.

The spatial arrangement and impact on the visibility of the facilities and vegetation described in section 2.2.3, which is located next to the railway, is shown in Figures 3.4.2.1. and 3.4.2.2.

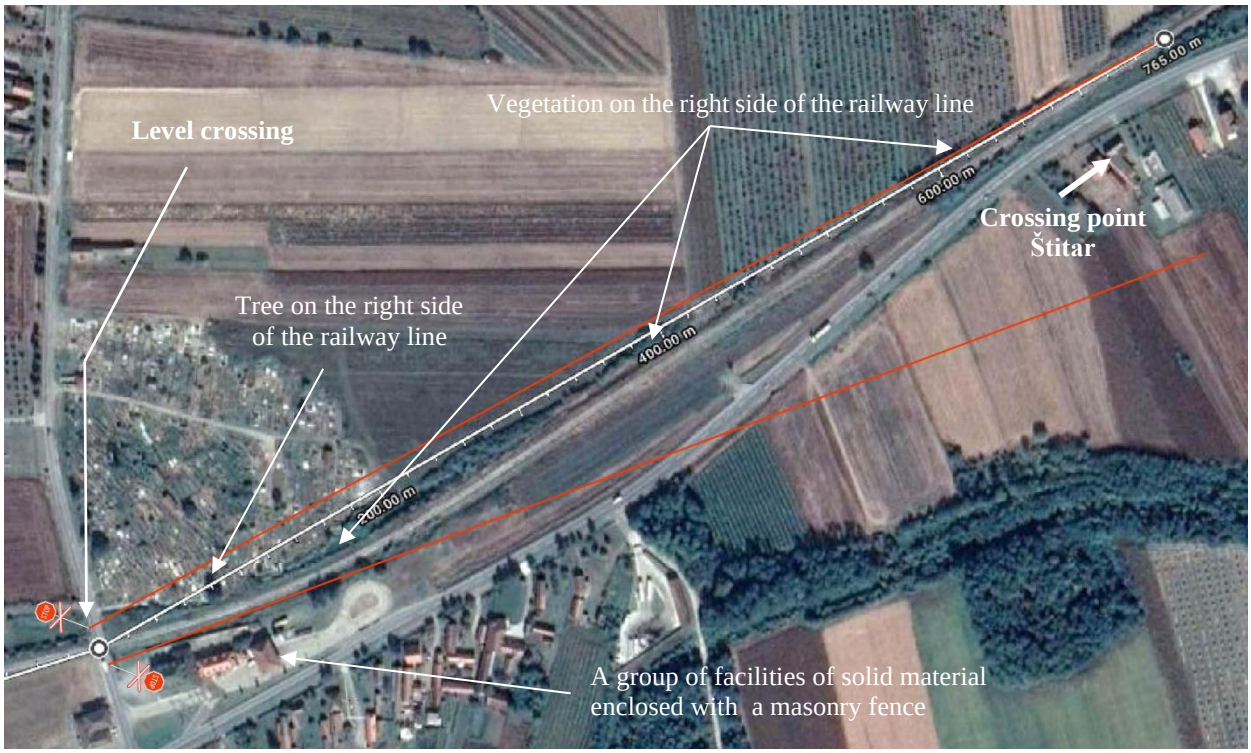


Figure 3.4.2.1: Satellite image of the level crossing area to the crossing point Štitar (source: *Google maps*)

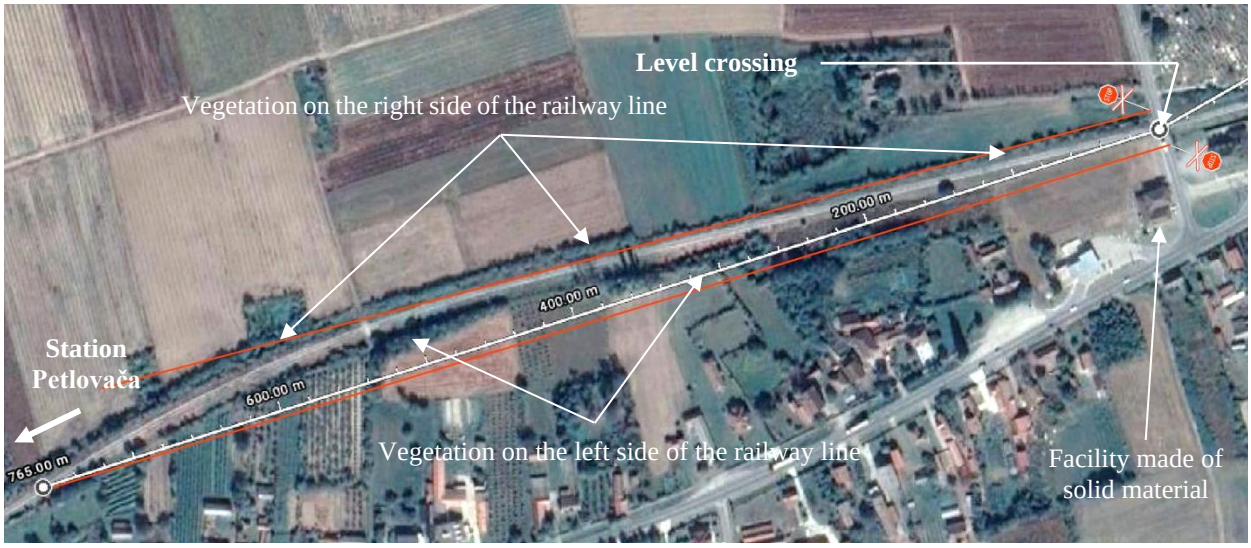


Figure 3.4.2.2: Satellite image of the level crossing area to the station Petlovača (source: *Google maps*)

From "IŽS"a.d. by Letters No. 1/2020-841 of 14.09.2020. and No. 1/2020-976 of 02.10.2020., data is submitted that in the period from 01.01.2017. to 25.07.2020. on the level crossing in question, works were conducted on mechanized destruction of vegetation on the section from the crossing point Štitar to the station Petlovača, on both sides of the track, in the width of 6 meters from the axis of the track, in August 2018, from km 10+550 to *km* 21+750 (performed works recorded in the Workbook Part II, railway section Šabac - Koviljača, OC ZOP Sremska Mitrovica, under No. 44512/209, for the period from 16.08 to 31.08.2018. Works on the maintenance of the infrastructure belt (land belt on both sides of the railway in the width of 25 meters, measured from the axis of the end tracks) were not performed in the period from 01.01.2017. until 25.07.2020. Also, the information was submitted that the works on arranging the roadway at the level crossing in question were not performed because there was no need for such works due to the fact that the road was in good condition.

Regarding the maintenance of infrastructure, at the level of "IŽS"a.d. there is no separate Program for solving the road crossings, but priorities are planned within the works on the superstructure of the railway line.

Railway Infrastructure Manager "IŽS"a.d. by Letter No. 1/2020-841 of 14.09.2020. submitted the information that in order to preserve safety, the ZOP Section Sremska Mitrovica sent a Letter No. 20/2020-1.2-788 of 16.06.2020. to the manager of road infrastructure, JP "Putevi Srbije", Sector for maintenance of roads of I and II rank, Belgrade, on the obligation to maintain the visibility of road crossings and supplement the missing traffic signals on them.

According to the Letter of JP "Putevi Srbije" No. 953-17135/20-3 of 11.12.2020., JP "Putevi Srbije" are competent for and perform only the tasks of maintaining the road structure and signalization on the state road IIA rank, marking 136, while for the maintenance of other elements, i.e. of the road belt, the local self-government is competent, i.e. the Road Company "Valjevo" a.d. (since the road crossing is located in a populated area). Based on the order of JP "Putevi Srbije" No. 953-7945/17-1 of 11.05.2017 and regarding urgency of "IŽS"a.d. No. 14-2/2017-480 of 09.05.2017., a review of the state of traffic signals at the road crossing in question was performed by the Road Company "Valjevo"a.d. in the period from 11.05.2017. until 25.05.2017., and it was stated that the condition of the asphalt ballast is satisfactory, as well as the associated signalization.

It was also stated that the visibility from Petlovača is satisfactory, while from Zminjak the visibility reduces vegetation in the railway belt. The last tour of the level crossing in question was made on 16.07.2020. by the Road Company "Valjevo"a.d., where the traffic signal was renewed or supplemented. Also, at the request of CINS to submit data on whether the road manager, before the occurrence of the serious accident in question, required the owners, i.e. the immediate holders of land, which is in the zone of necessary visibility, to remove plantations, fences, trees, objects materials, plants, devices, facilities and other in order to ensure visibility of the road (in accordance with Article 38 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law), the road manager of JP "Putevi Srbije" submitted a response that they do not have information that there were requests to the immediate owners of the land in order to ensure the visibility of the road.

Between the joint stock company "Železnice Srbije", Belgrade in the capacity of railway infrastructure manager and JP "Putevi Srbije" Belgrade, in the capacity of road infrastructure manager, an Agreement on maintenance of road crossings on state roads of I and II rank on the territory of the Republic of Serbia was concluded ("ŽS"a.d. No. 300/2015-810 of 09.06.2015 and JP "Putevi Srbije" No. 454-718 of 04.07.2015), which by the Agreement on Assignment of the Agreement on Maintenance of Road Crossings on State Roads of the 1st and 2nd rank on the territory of the Republic of Serbia, was taken over and is being used in "IŽS"a.d. ("IŽS"a.d. No. 1/2015-985 of 09.10.2015 and "ŽS"a.d. No. 300/2015-1679 of 13.10.2015). The Agreement was concluded for an indefinite period of time. The Agreement regulates the type and scope of road maintenance works, the amount of costs for ensuring safe and undisturbed traffic at road crossings, the costs of railway workers who perform work at road crossings, the manner of payment of those costs and other issues.

3.4.3. Means of communication

At the time of occurrence of the respective serious accident, in the area of the crossing point Štitar, in the area of the station Lešnica and on the section between the crossing point Štitar and the station Lešnica, the means of communication were operating and functional. On the means of communiciation no faults or interferences have been recorded.

3.4.4. Railway vehicles

At the time of occurrence of the serious accident in question, the train No. 45403 was moving in the direction from the crossing point Štitar to the station Petlovača (from the beginning to the end of the railway line, in the direction of the growing mileage).

The train composition consisted of diesel – electric locomotive of series 661-033 and 24 empty cargo wagons of series Eas.

Locomotive series 661-033 is six-axle diesel electric locomotive designed for traffic on the standard gauge railway lines of the gauge of 1435 mm, intended for traction of all types of passenger and cargo trains on all railway line categories.

At the time of occurence of the serious accident in question, locomotive 661-033 was used for traction of train No. 45403 and was moving so that the longer part of the locomotive box was located in the front part.

Locomotive series 661-033 of manufacturer General Motors – EMS from the United States of America was produced in 1960, and is owned by "ŽRS"a.d. Doboj. By the Minutes No. II-3.1 1786-3/19 of 02.09.2019. the hand-over of locomotive 661-033 was conducted between the representatives of "ŽRS"a.d. Doboj and "Srbija Kargo"a.d., and it has been leased to "Srbija Kargo"a.d., pursuant to Agreement No. 300/2003-137.

In accordance with Article 51 of the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018), the locomotive series 661-033 is equipped with a device for giving sound signals (siren).

The inspection of the locomotive 661-033 performed after the serious accident in question in the service of the ZOVS Section Belgrade (Commission report on the performed inspection was submitted in the attachment to the Letter "Srbija Kargo"a.d. No. 1/2020-3950 of 11.09.2020) established that there are no defects and damages on the locomotive, as well as that the brake is functionally correct, based on the recorded diagram of braking functionality.

On the locomotive 661-033 speeding devices of the manufacturer Hasler have been installed, as follows: register speeding device type RT9, serial No. 14055 and indicating speedometer device type A16i, serial No. N08.151 (according to the Record of hand-over No. II-3.1 1786-3/19 of 02.09.2019., submitted by "Srbija Kargo"a.d.). For the aforementioned speeding devices, from "Srbija Kargo"a.d., Certificate No. 330/2019 on the correctness of the Hasler speed measuring and registration device has been submitted, with the date of testing 27.08.2019. and Certficate No. 28/20-1254 of 21.08.2020., confirming that the registering speeding device type RT9, serial No. 14055 and indicating speedometer device type A16i, serial No. N08.151 are correct and in accordance with Instruction 230, with the validity of the Certificate until 20.08.2021.

By processing the data registered on the speedometer tape taken from the register speeding device of locomotive 661-033 (Report from the speedometer tape No. Z-525 of 21.08.2020., submitted by Letter No. 1/2020-3950 of 11.09.2020 from "Srbija Kargo"a.d.), it has been determined that the train speed in the crossing point Štitar was 43 km/h (at km 7+700 at 10:43:21). The speed then decreases and after passed 353 m it is 41 km/h. Further on, the speed increases and after passed 2799 m it is 58 km/h, and then after additionally passed 3994 m it increases on to 60 km/h. Further on, after passed 1754 m, the speed is decreased on 55 km/h, the after passed 762 m it increase on 59 km/h. After passed 2229 m, the train speed increases onto 60 km/h, and then after additionally passed 1115 m, the speed decreases onto 49 km/h. In the next 80 m, the speed decreases ont o 0 km/h and the locomotive stopps at 10:55:20. Until the removal of the speedometer tape from the speedometer device of the locomotive 661-033 (on 25.07.2020., at 14:34:30), no locomotive starts were registered. The times are given by the clock of the speedometer.

3.5. Traffic regulation and management

3.5.1. Actions taken by the staff that manages traffic regulation, control and signaling

Traffic of the train No. 45403 between the crossing point Štitar and the station Lešnica, was performed at a station distance, with the traffic regulation by the train dispatcher of the occupied official positions Štitar and Lešnica.

The train staff has, through accompanying documentation, received all the necessary orders and notifications on the traffic of trains of the given section.

3.5.2. Exchange of voice messages in relation to the serious accident

Before the occurence of the serious accident in question, there was verbal communication between the staff at the station Ruma, from where the train was dispatched, and the staff of "Srbija Kargo"a.d., which was on the train No. 45403, during which accompanying documents for the train No. 45403 were handed over to the staff of the traction vehicle. From the dispatch at the station Ruma, to the occurrence of the serious accident in question, there was no communication between the staff of the traction vehicle on the train No. 45403 and the staff that regulates the traffic.

Communication between the staff that regulates the traffic and the staff of the traction vehicle of the train No. 45403 was achieved after the occurence of the serious accident in question, with the purpose of informing on the serious accident occurred, by the train driver of the train No. 45403 by calling and informing the dispatcher of station Lešnica ("IŽS"a.d.). The dispatcher of the station Lešnica has further, on the serious accident occurred, informed the ambulance, the next official position, the Assistant Chief of the station Šabac and senior dispatcher in the Department for Operational Affairs.

3.5.3. Measures taken to secure the serious accident site

After the occurence of the serious accident in question, section of the railway line 211: Ruma-Šabac- Junction Donja Borina - state border - (Zvornik Novi), between the crossing point Štitar and the station Lešnica was closed for traffic.

Members of the Police Department of Šabac took measures to secure the accident site (providing conditions for the work of emergency and rescue services that provided assistance to the injured and the provision and protection of evidence)

Other measures to secure the serious accident site were not undertaken.

3.6. Interface between people, machines and organization

3.6.1. Working hours of the staff involved

For the railway staff, data were submitted which show that the train driver and assistant train driver of the train No. 45403 had a legally prescribed rest before starting work and that they did not spend time at work longer than the maximum prescribed by Law.

3.6.2. Health and personal characteristic that have an effect on the serious accident, involving the presence of physical or psychological stress

For the railway staff, data were submitted which show that the train driver and assistant train driver of the train No. 45403 are professionally trained and medically fit to perform the service. Train driver of the train No. 45403 has a License for driving a traction vehicle No. RS 71 2019 0578 issued by the Directorate for Railways 01.06. 2019., with a validity period until 01.06.2029.

An alcohol testing of the train driver and assistant train driver was performed on the spot by the police officers, where the presence of alcohol was not proven.

On the order of the Deputy Public Prosecutor from the OJT in Šabac, blood samples were taken from the train driver three times in the space of half an hour, for the purpose of analysis for the presence of alcohol. Based on the data obtained from the OJT in Šabac (letter KT No. 966/20 of 30.11.2020), the presence of alcohol was not proven in the blood samples taken from the driver.

3.6.3. Design of the equipment that has influence on the interface between user and machine

Regional railway line 211: Ruma - Šabac- Junction Donja Borina - state border - (Zvornik Novi), between the crossing point Štitar and the station Lešnica is designed in such a way that by all parameters satisfies the criteria for safe traffic of trains with the speeds regulated by the Timetable Booklet 2.2.

According to the designed condition, the regional line is one-track railway line on which the traffic of trains is performed at a station distance. On the railway line section in question, the traffic was regulated by the train dispatchers of the occupied official positions Štitar and Lešnica.

For the purpose of traffic regulation, entrance unambiguous mechanical semaphore signal has been installed with a special presignal (crossing point Štitar) has been installed on the section of the railway line between the crossing point Štitar and the station Lešnica, that is, entrance unambiguous light signal with a special presignal (the station Lešnica), which protect the station areas. The entrance signals and presignals of the crossing point Štitar are operated by the train dispatcher via mechanical device located in front of the station building. The entrance signals and presignals of the station Lešnica are operated by the train dispatcher via station facility.

On the railway line section between the crossing point Štitar and the station Lešnica, for communication between the staff that regulates the traffic on the railway track and the staff of the traction vehicle does not exist a manner of communication provided by the TT Service of "IŽS"a.d. For this purpose, only mobile telephony operator lines are available.

This railway line is not equipped with RDV devices. Locomotive series 661-033 is not equipped with the RDV device.

The locomotive series 661-033 is controlled by the train driver through commands from the driver's cab, designed during the production of the diesel locomotive. With the 661-033 series locomotives, no objections or irregularities were noticed on the control systems and devices.

3.7. Previous accidents of the similar character

Based on the data obtained by "IŽS"a.d. (Letter No. 1/2020-841 of 14.09.2020.) for the period from 01.01.2007. to 25.07.2020., on the regional line 211: Ruma – Šabac – Junction Donja Borina – state border – (Zvornik Novi), at the level crossing at km 20+647, there occurred 6 (six) accidents. The review of the accidents occurred on the level crossing in question is given in Table 3.7.1.

Table 3.7.1: Review of the accidents occurred on the level crossing between the crossing point Štitar and the station Petlovača at km 20+647, in the period from 01.01.2007. to 25.07.2020.

Serial No.	Date	Time	Short description	Fatally injured	Injured
1.	01.09.2009.	15:43	Overtaking of the train No. 45402 (loc. 661-001) on the road passenger vehicle	-	-
2.	27.02.2015.	00:28	Overtaking of the train No. 48452 (loc. 661-118) on the road passenger vehicle	-	-
3.	27.01.2016.	13:35	Overtaking of the train No. 45400 on the road cargo vehicle- truck	-	-
4.	29.09.2017.	17:25	Overtaking of the train No. 45403 (loc. 661-310) on the road passenger vehicle	-	1
5.	11.08.2018.	22:45	Overtaking of the train No. 48412 on the road passenger vehicle	-	1
6.	15.12.2019.	08:37	Overtaking of the train No. 920 (DMG 711-042) on the road passenger vehicle	-	1

According to the Letter No. 15/20-20-1343 of 24.08.2020. of the Department for Operational Affairs Ruma, the cause of occurrence of all the aforementioned accidents is negligence of road vehicle drivers. All the injured were located in road vehicles.

4. Analysis and conclusions

4.1. Final review of the course of events and adoption of conclusions about the occurrence based on facts determined during the investigation and interviews

On 25.07.2020. at 10:55 at the level crossing at km 20+647 of the regional raiway line 211: Ruma - Šabac - Junction Donja Borina - state border - (Zvornik Novi), it came to the overtaking of the train No. 45403 on the road vehicle of the brand Ford type Focus, license plates SM 063-DZ.

This serious accident occurred at the level crossing located between the crossing point Štitar and the station Petlovača, in the settlement Petlovača. The level crossing is secured with the traffic signs on the road and the zone of necessary visibility. The railway line is regional, one-track and unelectrified.

The road belongs to the state roads (state road IIA rank, marking 136), which connects the settlements of Majur, Bogatić and Petlovača on the territory of the municipalities of Šabac and Bogatić. The state road is made of asphalt pavement. The roadway at the crossing itself is made of asphalt. In the zone of the level crossing, from the side of the state road 1B rank, marking 26, the road gauge is 6.10 m, while from the side of Zminjak, the road gauge is 5.90 m. The condition of the asphalt road pavement near the level crossing is in order, without any noticeable damages. The aspalth roadway pavement at the level crossing (before the sign “St. Andrew’s cross”) is repaired (a layer of added asphalt is visible), but without any major damages. At the time of occurence of the serious accident, the road was clean and partly moists in places (see section 2.3.4).

On the state road in question, viewed from the direction of the state road 1B rank, marking 26, before encountering the level crossing, on the supporters located on the right side of the road next to the roadway, the following traffic signs are placed: I- 33: "Crossing of a road with the railway line with barriers or half - barriers" (at a distance of 59.1 m from the level crossing) and I-35: "Approaching the point of crossing of the road and the railway line" (at distances of 59.1 m, 34 m and 18.7 m from the level crossing), on the supporters located on the left side of the road next to the roadway, the traffic signs are placed: I-33: "Crossing of a road with the railway line with barriers or half - barriers" (at distances of 64.1 m from the level crossing) and I-35: "Approaching the point of crossing of the road and the railway line" (at distances of 64.1 m, 39.2 m and 18.7 m from the level crossing). The traffic signs in question are installed at significantly minor distance from the point of crossing of the railway line and the road than prescribed by the Rulebook on Traffic signallization ("Official Gazette RS" No. 85/17) due to insufficient space available, given that the total length of the part of the state road IIA rank, marking 136 between the intersection with the state road IB rank, marking 26 and the level crossing (nearer rail of the railway line) is 75.3 m, viewed in the middle (axis) of the road. On a special supporter located in front of the road, 6.5 m away from the nearer rail of the railway line, the traffic signs are placed: I- 34: "St. Andrew's cross" and II-2: "Obligation of stopping". From other traffic signs before encountering the level crossing from the direction of the state road 1B rank, marking 26, on the state road in question the sign "settlement" (III- 24) is set, which is placed on the left part of the roadway on the supporter of the sign I-35: "Approaching the point of crossing of the road and the railway line" (the sign with one oblique line) for the respective direction of movement.

On the railway line from the direction of the crossing point Štitar to the station Petlovača, there are properly placed signalling marks 209: "Watch out, the level crossing". However, from the direction of the crossing point Štitar, the necessary visibility of this signalling mark, which is obscured by tree branches, is not provided, which is contrary to the provisions of Article 227 of the Rulebook on the types of signals, aspects of signals and signalling marks and markings on the railway line ("Official Gazette of RS", No. 51/20). The visibility of the signalling mark in question is 15 meters (see sections 2.2.3 and 3.4.2). The railway and the road intersect at an angle of 90º.

On the state road in question, observed from the direction of the state road IB rank, marking 26, there is no speed limit sign which, according to the provisions of Article 15 of the Rulebook on the crossing of the railway line and the road, pedestrian or bicycle path, Measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016) represents the beginning of the zone of necessary visibility, but immediately in front of the level crossing there are traffic signs: I-34: "St. Andrew's cross" and II-2: "Obligation of stopping". The driver of the road passenger vehicle was obliged to stop the vehicle in front of the traffic sign II-2: "Obligation of stopping" and to make sure that the train was coming.

From the place where the aforementioned traffic sign was placed, the necessary visibility was not provided in accordance with Article 14 of the Rulebook on the manner of crossing the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016). Observing this specific serious accident, in the case of the driver of a Ford Focus road passenger vehicle, from the place where the aforementioned traffic sign was placed, the necessary visibility was not provided.

However, bearing in mind the fact that the contact between the road passenger vehicle and train No. 45403 occurred immediately after the road passenger vehicle entered the first rail of the track (traces at the site of a serious accident), that is, after 6.4 s (see section 3.4.2) from the moment of starting the road passenger vehicle (provided that the road passenger vehicle stopped), as well

as the fact that the measured time was measured on the spot (during the on-site investigation) which elapsed from the moment of spotting the passenger train No. 921 (moving at a speed of 64 km/h) from the place where the traffic sign II-2 is placed: "Obligation of stopping" for 12 s, while for the cargo train No. 45403 of 25.07.2020., which was moving at a speed of approximately 50 km/h, it needed 15.4 s, it is evident that at the time of starting the road passenger vehicle from the place where the traffic sign II-2 was set: "Obligation of stopping", the oncoming cargo train was significantly closer to the farthest point of observation by the road passenger vehicle driver, so that the driver of the road passenger vehicle had the opportunity to spot the oncoming train in a timely manner.

At the time of occurrence of the serious accident in question, the air temperature was 22^{o}C, the mild wind was blowing from the direction of west, the visibility was good.

The road passenger vehicle was moving from the direction of the state road IB rank, marking 26 in the direction of Zminjak. The train was coming from the direction of Štitar and was approaching the road passenger vehicle from the right side (viewed in the direction of the road passenger vehicle movement). According to his own statement, while approaching the road crossing, the train driver gave the aspect of a signal 67: "Watch out" and started gradual braking, and at the call of the assistant train driver "Brake, brake" (the train driver himself did not notice when the vehicle entered the track profile because he was sitting on the right side of the steering wheel), he also introduced fast braking, at a speed of approximately 50 km/h.

In the document Report of the speedometer tape No. Z-525 of 21.08.2020., submitted by "Srbija Kargo"a.d., as well as from the statements of the train driver and assistant train driver, it can be concluded that that before the occurrence of the serious accident in question, the train driver of the train No. 45403 was giving the aspect of a signal 67: "Watch out", first introduced gradual braking at the speed of 60 km/h, and then fast braking at the speed of approximately 50 km/h.

In this serious accident 2 (two) persons were fatally injured, while 2 (two) persons gained serios bodily injuries. The interruption of railway traffic to 16:30. There are no damages on the locmotive 661-033. The road passenger vehicle was wrecked and due to the condition in which it was, it was not possible to perform its technical inspection.

4.2. Discussion - Analyses of facts determined during the investigation and interviews with the view to drawing conclusions regarding the causes of the serious accident and effect of rescue services

4.2.1. Analysis of train and road vehicle movement

4.2.1.1. General data

According to the documentation submitted by "Srbija Kargo"a.d. and "IŽS"a.d., train No. 45403 was composed of a locomotive series 661-033 mass 112 t and 24 empty wagons owned by the Railways of the Federation of Bosnia and Herzegovina, series Eas, total mass 508 t (total mass of train No. 45403 was 620 t), and was dispatched on 25.07.2020. at 10:00 from the station Ruma to the station Brasina on the regional line 211: Ruma - Šabac - Junction Donja Borina - state border - (Zvornik Novi).

In the locomotive 661-033 there were the train driver and assistant train driver. According to the statement of the staff, when approaching the level crossing, the gradual braking was introduced. Document Report of speedometer tape No. Z-525 of 21.08.2020. submitted by "Srbija Kargo"a.d., it can be stated that the gradual braking was introduced at the speed of 60 km/h, and that the speed was reduced to 49 km/h. Just before the serious accident, the train driver was moving with the speed of 49 km/h, when after noticing the road passenger vehicle starting its cross over the railway line, fast braking was introduced and it came to the contact with the road passenger vehicle at 10:55. After that, the train stopped at the distance of 145 m from the level crossing. The speedometer tape record is completly in line with the statement of the traction vehicle staff.

On the locomotive 661-033, Hasler speedometer devices Hasler are installed, as follows: register speeding device type RT9i, serial No. 14055 and indicating speedometer type A16i, serial No. N08.151 (according to the Record of hand-over No. II-3.1 1786-3/19 of 02.09.2019. submitted by "Srbija Kargo"a.d.). Regarding the aforementioned, provisions of the Instruction 230 are being applied, Instruction on handling speedometer device on traction and other vehicles and processing the speedometer tape ("Official Gazette ZJŽ" No. 6/80, 8/90 и 4/05).

4.2.1.2. Basic data

The basic data duly registered on the speedometer record on the locomotive 661-033 and according to the Report of speedometer tape No. Z-525 of 21.08.2020. submitted by "Srbija Kargo"a.d. show the following condition:

- Part of the speedometer record that was observed refers to the date of 25.07.2020.,
- Part of the speedometer record that was observed, refers to the train No. 45403,
- analyzed part of the speedometer record refers to the section of the transport road from km 7+700, which corresponds to the area of the crossing point Štitar, to km 20+792, where the train stopped after hitting the road passenger vehicle. The stopping position is 145 m away from the stationing of the level crossing, which corresponds to the place determined by CINS on the spot during the on-site investigation.

4.2.1.3. Speed of the train No. 45403

On the speedometer tape of the speedometer device of the locomotive 661-033 the train speed is registered, time and distance traveled. Analysis of these data (Report of the speedometer tape No. Z-525 of 21.08.2020. submitted by "Srbija Kargo"a.d.) shows the following:

- maximum speed of train No. 45403 of 60 km/h was not exceeded when the train was moving, which was in accordance with the Timetable booklet 2.2. The maximum speed of the train was achieved in the range from 58 to 60 km/h from km 10+832 to km 14+826 and from 59 to 60 km/h from km 17+342 to km 19+571, which corresponds to the open line with the distance between stations Štitar - Petlovača;
- Approaching the road crossing, the train No. 45403 reduced its speed from 60 km/h to 49 km/h in the length of 1115 m, after which the speed of train No. 45403 began to decrease sharply and in the next 80 m it dropped to 0 km/h.

4.2.1.4. The possibility of the serious accident not occurring

The investigative team of CINS on 25.07.2020. during the on-site investigation at the site of a serious accident, and after the establishment of railway traffic, at the place in front of the traffic sign II-2: "Obligation of stopping" recorded the movement of the train for passenger transport No. 921 (railway undertaking "Srbija Voz"a.d., the first train which passed over the level crossing after the establishment of railway traffic after the serious accident in question), which was moving from the direction of the crossing point Štitar towards the station Petlovača and crossed the level crossing from the same direction as train No. 45403 which participated in this serious accident.

At the request of CINS, and for the needs of analysis within the investigation of the serious accident in question, the railway undertaking "Srbija Voz"a.d. has, in the attachment of the Letter No. 1/2020-1225 of 21.08.2020., submitted data regarding movement of the train No. 921, between the crossing point Štitar and the station Petlovača, which enabled CINS to perform comparative analysis of the obtained data and the video recordings made on the spot.

Train No. 921 regularly operated on the route Ruma - Zvornik. The train consisted of DMV 711-063/064, equipped with a speed measuring and recording device type TELOC 1500 manufactured by Hasler Rail, from Bern, serial No. 19131613. By processing the data taken from the memory of the speedometer, it was determined that train No. 921 after departure from the crossing point Štitar was engaged in the stop Dublje Mačvansko and that the train was moving at a constant speed of 64 km/h when approaching the level crossing in question and during the crossing over the level crossing in question.

Analysis of the video recording made on the spot during the passage of train No. 921 over the level crossing, it can be stated that from the moment when behind the vegetation next to the track (described in section 2.2.3.) until arrival of the front of the same train to the level crossing 12 s passed. The place where the video was made is on the road on the section of the state road IIA rank, marking 136 between the intersection with the state road IB rank, marking 26 and the level crossing, where there would be a road passenger vehicle (driver's position) stopped in front of the supporter on to which traffic signs I-34: "St. Andrew's cross" and II-2: "Obligation of stopping" were placed. From that place, the sound of a train siren is clearly heard (aspect of a signal 67: "Watch out") even before the train is spotted. From the moment when it is possible to spot the train for the first time, until the arrival of the train at the level crossing, it is possible to clearly see the movement of the train all the time. Sequences of the video of the train No. 921 approaching the level crossing are shown in Figure 4.2.1.4.1.

Figure 4.2.1.4.1: Sequences of the video recording of the train No. 921 approaching the level crossing

Comparative analysis of data obtained from the railway undertaking "Srbija Voz"a.d. and analysis of the video recording for train No. 921 for passenger transport, it can be concluded that:

- the speed of the train for passenger transport was: V_{put} =64 *km/h*,
- the time elapsed from the moment of spotting the train for passenger transport, until the arrival of the train at the road crossing: t_{put} =12 *s*,
- to calculate the distance traveled by the passenger transport train from the place where it became visible to the driver of the road passenger vehicle, provided that the road passenger vehicle is in front of the supporter on which traffic signs I-34: "St. Andrew's cross" and II-2: "Obligation of stopping" were placed, to the arrival at the level crossing, is $S=V_{put}\cdot t_{put}$=213.3 m (the calculated distance traveled is the same for any train).

The actual distance at which the driver of a road passenger vehicle moving from the direction of the state road IB rank, marking 26 in the direction of the settlement Zminjak, stopping his road passenger vehicle in front of the aupporter on which are placed the following traffic signs I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", can spot a train moving towards the level crossing from the direction of the crossing point Štitar intersection, is shown in Figure 4.2.1.4.2.

Figure 4.2.1.4.2: Actual visibility for the direction of the train No. 45403 movement and for the direction of the road passenger vehicle movement (source: *Google maps*)

Based on the above, the time of approaching of the cargo train No. 45403 from the place where the driver of the road passenger vehicle could spot the train was calculated, provided that the road passenger vehicle was (stood) in front of the supporter on which the traffic signs were placed: I-34: "St. Andrew's cross" II-2:"Obligation of stopping", until the level crossing:

- speed of the cargo train movement: V_{ter}=50 *km/h*,
- calculated distance that a cargo train pass from the place where the driver of the road passenger vehicle could spot the train, provided that the road passenger vehicle was in front of the supporter on which the traffic signs: I-34: "St. Andrew's cross" II-2: "Obligation of stopping" are placed, until encountering the level crossing is *S*=213.3 *m*,
- the calculated driving time of the cargo train from the place where the driver of the road passenger vehicle could spot the train (S=213.3 m), until the arrival at the level crossing is: $t_{ter} = S/V_{ter}$ =15,4 *s*.

Time required for the road passenger vehicle, provided that it stopped in front of the supporter on which the traffic signs were placed: I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", after starting, crosses the road from the place of stopping to the place where the contact with the train No. 45403 was made was calculated according to the formulas:

$t_{pdv} = t_a + t_v$ [*s*], where:

$t_a = V_p/(3{,}6 \cdot a)$ [*s*] and

$t_v = ((m+n+d-s)/V_p) \cdot 3{,}6$ [*s*]

Note: the formulas given in Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures to ensure safe traffic ("Official Gazette of RS", No. 89/2016) were used, except that formula for calculating $t_v = ((m+n+d+s)/V_p) \cdot 3.6$, corrected by putting -s instead of +s (s is the distance that the road vehicle travels from the moment it starts until it reaches speed of 4 km/h).

For the case in question, the following is adopted:

- *m*=6.5 *m* (the distance from the supporter on which the traffic signs are placed to the nearer rail of the railway track),

- n=1.8 m (the distance from the nearer rail of the railway track to the front bumper of the road passenger vehicle at the time of contact with the train),
- d=0 m (the time for which the road passenger vehicle reaches the nearer rail of the railway track is calculated),
- V_p = 4 km/h,
- a = 1 m/s^2.

The values of m, n and d were determined during the on-site investigation. For V_p and a, the values from the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette of RS", No. 89/2016) were taken, although for the road passenger vehicle in question these parameters are significantly higher.

t_a = 4 km/h/(3.6·1 m/s^2) = 1.1 s

s = ((0+4 km/h)/(2 3.6))·1.1 s = 0.61 m

t_v = ((6.5 m+1.8 m+0 m-0.61 m)/4 km/h)·3.6 = 6.9 s

t_{pdv} = 1.1 s + 6.9 s = 8.0 s

The driver of a road passenger vehicle that stopped in front of the supporter on which the traffic signs are placed: I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", before restarting his vehicle, observes the track to make sure that there is no train. During the observation, the following was adopted: t_0=1 s.

Therefore, the total time elapsed from the moment when the driver of the road passenger vehicle that stopped in front of the supporter on which the traffic signs were placed: I-34: "St. Andrew's cross" and II-2: "Obligation of stopping" starts observing the railway until the moment when, after starting his vehicle, he comes to the place where the contact with the train was made is:

$t_{uk} = t_0 + t_{pdv} = 1+8,0=9,0\ s$

Based on the above, it can be calculated that, at the moment when the driver of the road passenger vehicle was supposed to start monitoring the line, train No. 45403 was located at $S=V_{ter}\cdot t_{uk} = 125\ m$. The driver of the road passenger vehicle was able to see the oncoming train and did not start crossing the level crossing.

4.2.2. Analysis of the rescue service's performance

In order to provide assistance to the injured in this serious accident, members of the Emergency Medical Service of the Šabac Health Center, members of the RS Ministry of the Interior, the Police Administration in Šabac, the Šabac Traffic Police Station and members of the OJT in Šabac went to the scene.

By the letter of the Šabac Health Center No. 01-1/966 of 23.12.2020., data were submitted that on 25.07.2020. at 10:53, an ambulance was called in Prnjavor with two telephone numbers to say that a traffic accident had occurred in the settlement Zminjak. The team from Prnjavor (driver and medical technician) immediately went to the field and informed the ambulance in Šabac. Two ambulances set off from Šabac, in which there was a complete team (a doctor, a medical technician and a driver). Four injured people, two adults and two children were found on the spot. The

children were conscious and two adults were without vital signs of life, after which their death was ascertained. After providing first aid on the spot, another ambulance from Šabac took over the children and transported them to the Emergency Department of the General Hospital in Šabac.

CINS, on the basis of the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18), by Letter No. 340-03-1/2020-02-2-16 of 12.08.2020, as well as by letter of urgency No. 340-03-1/2020-02-2-33 of 29.10.2020., addressed the General Hospital in Šabac, to submit data on the number of fatally injured persons, the total number of injured persons and hospitals where the injured were taken care of, data on the health status of injured persons and all other facts and information available that could be significant for investigation.

The General Hospital in Šabac submitted a response Letter No. 09-1/1634 of 09.11.2020. in which it was stated that they did not have data on the number of fatally injured persons and for other requested data it was stated that they were not able to meet the request of CINS, although according to Article 31 of the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of RS" No. 66/15 and 83/18) CINS has the right to the requested data.

4.3. Conclusions on the causes of the serious accident

4.3.1. Direct and immediate cause of the serious accident

Direct and immediate cause of the occurrence of this serious accident is that before the occurrence of the respective serious accident the road passenger vehicle was found on the track, just before the arrival of the train No. 45403, by which the dangerous situation, related to the occurrence of this serious accident, was created.

The direct cause of a serious accident is non-compliance with the provisions of Articles 100 and 132 of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law, 87/2018 and 23/2019) by the road passenger vehicle driver.

4.3.2. Basic causes deriving from skills, procedures and maintenance

The fact that the prescribed zone of necessary visibility and necessary visibility were not provided (see section 3.4.2.) does not in any way diminish the obligation of the driver of a road passenger vehicle, as he was obliged to respect traffic signs I-33: "Crossing of the road with railway line without barriers or half-barriers", I-35: "Approaching the point of crossing of the road and the railway line", I-34: "St. Andrew's cross" and II-2: "Obligation of stopping", to adjust the speed of the road vehicle, stand in front of the level crossing and make sure that the train is approaching. In case the driver of the road passenger vehicle acted in this way, he had the opportunity to see the approaching train (see section 4.2.1.4).

The fact that on the level crossing in question the zone of necessary visibility and necessary visibility were not provided (bearing in mind the vegetation in the railway belt which is in the zone of necessary visibility, in the part of the zone of necessary visibility which includes the railway belt and in the part of the zone of necessary visibility which does not include the railway belt, see section 2.2.3.), could have contributed that the driver of the road passenger vehicle when approaching the level crossing not to notice the train in a timely manner. The zone of necessary visibility and the necessary visibility were not maintained and provided by the railway

infrastructure manager and the road manager, which is contrary to Article 56 of the Law on Railways ("Official Gazette of RS" No. 41/2018) and Article 38 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law).

4.3.3. Main causes of the serious accident deriving from legal framework and safety management system application

Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) defines that the railway infrastructure manager maintains part of the level crossing, while other parts of the road on both sides of the road, including the necessary visibility zone outside the width of the level crossing, are maintained by the road manager in a way that enables safe and undisturbed railway traffic. According to the Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) only the maintenance of the road crossing width of 3 meters from the track axis was taken into account (the width of the road crossing is defined in Article 2, paragraph 1, item 54) and the railway belt is defined in Article 2, paragraph 1, item 52) of the Law on Railways ("Official Gazette of RS" No. 41/2018)), and not the maintenance of the part of the zone of necessary visibility next to the crossing of road and track in the zone of the railway belt width of 6 to 8 meters from the track axis, which the railway infrastructure manager is obliged to maintain in accordance with Article 56 of the Law on Railways ("Official Gazette of RS" No. 41/2018) (see item 3.3.3.). The inconsistency of Articles 56 and 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) in terms of the obligations of the railway infrastructure manager is stated. Also, Article 69 of the Law on Railways ("Official Gazette of RS" No. 41/2018) does not clearly define the obligation of railway infrastructure manager and road manager in terms of maintaining the necessary visibility zone (part of the necessary visibility zone which includes the railway belt and part of the required necessary zone which does not include the railway belt).

Article 68 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) defines only maintenance - arranging green areas (mowing grass, clearing shrubs and cutting trees) in road land. Article 68 does not define the maintenance - arrangement of green areas (mowing grass, clearing shrubs and cutting trees) in the zone of necessary visibility at the intersections of the railway line and the road. Only maintenance is defined - arranging green areas (mowing grass, clearing bushes and cutting trees) in road land, which is defined for the area outside the settlement in the gauge of 1 m next to the road, which does not include the zone of necessary visibility at the intersections of the railway line and the road (see section 3.3.1.). Article 38 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) defines the obligation to provide the zone of necessary visibility in accordance with the regulations. The inconsistency of Articles 38 and 68 of the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) in terms of providing the zone of necessary visibility by the road manager is stated.

The stated inaccuracy in the clear distribution of responsibilities for maintaining the necessary visibility zone could have affected the fact that the necessary visibility zone at this level crossing was not provided, which could have contributed to the driver of the road passenger vehicle not spotting the train on time while approaching the level crossing.

4.3.4. Additional observations on deficiencies and shortcomings established during the investigation, but without relevance for conclusions about the causes

According to provisions of the Article 153, Paragraph 2 of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018), at the crossing of the road with a modern road pavement (asphalt, concrete, cube, etc.) over the railway, traffic lights must be placed announcing the approach of the train. In the case in question, the road was with an asphalt road pavement, and at the crossing of the road in question, no traffic lights were placed announcing the approach of the train.

Provision stated of the Article 153, Paragraph 2 of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018), does not exist in the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018) and in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures to secure safe traffic ("Official Gazette of RS" No. 89/2016). By Article 97, Paragraph 1 of the Law on Road Traffic Safety ("Official Gazette of RS" 41/2018) it is foreseen that the conditions for crossing of the railway line, in terms of the place where the crossing can be made and measure for ensuring safe regulation of traffic at the road crossings depend on the traffic density, visibility of the railway, the speed of driving on the railway and the road and the local conditions.

Provisions of the Article 10 and 11 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures to secure safe traffic ("Official Gazette of RS" No. 89/2016) define that measures to ensure safe traffic at road crossings depend on traffic density, visibility of the railway, speed on the track and road and local conditions in accordance with the law governing railway safety and interoperability and that traffic signs on the road and zone the necessary visibility provide the traffic at the intersection of the railway and the road at the level of the track, if the maximum allowed speed on the railway is up to 100 km/h and if the traffic is not provided at the road crossing: by light traffic signs and traffic signs on the road; automatic barriers with light traffic signs and traffic signs on the road or barriers and traffic signs on the road.

In the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures to secure safe traffic ("Official Gazette of RS" No. 89/2016), the provisions related to point B from Article 14 (point in front of the traffic sign indicating the place where the road crosses the railway) and Article 15 (place of the road where the zone of necessary visibility begins) are not in accordance with each other and with the content of Annex 6 of the same Rulebook. In the drawing in Annex 6, point B is marked next to the traffic sign indicating the place of crossing the road over the railway (traffic sign: I-34: "St. Andrew's cross") and the traffic sign: II-2: "Obligation of stopping", while in the text below the drawing it is stated that the point B is located on the length of a stopping distance of the road passenger vehicle in front of the traffic signs denoting the point of crossing of the road over the railway line (traffic sign: I-34: "St. Andrew's cross").

In the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and measures to secure safe traffic ("Official Gazette of RS" No. 89/2016), the formula is given and the methodology for calculating the value (length) of the required visibility (L_{PPP})) is precisely explained, but the methodology for determining (calculating) the elements of the required visibility zone given in Annex 9 is not

explained. 9 (d_{pz} – length of stopping of the railway vehicle and $S_{pžv}$ – length of approaching of the railway vehicle).

For the the traffic sign: II-2: "Obligation of stopping", in the Article 33, Paragraph 1, under 2) of the Rulebook on traffic signalization ("Official Gazette of RS" No. 85/17, that was valid at the time of occurrence of the serious accident in question), it is defined that it is placed in the immediate vicinity of the intersection, preferably at the point of visibility, where the vehicle must stop in order to give way to other vehicles moving on the road it encounters. According to Article 25, Paragraph 1 under 2) of the same Rulebook, traffic sign II-2: "Obligation of stopping", means an order to the driver that he must stop the vehicle and give priority to the passage of vehicles moving on the road he encounters. According to Article 25, Paragraph 1 under 2) of the same Rulebook, traffic sign II-2: "Obligation of stopping", means an order to the driver that he must stop the vehicle and give priority to the passage of vehicles moving on the road he encounters.

At the level crossing in question the traffic sign II-2: "Obligation of stopping", is place in front of the crossing of the road over the railway line at the same level on the same supporter as the traffic sign I-34: "St. Andrew's cross" (at a place behind which there is no intersection in the immediate vicinity). This placement of the aforementioned traffic sign is not in accordance with the provision of Article 33, Paragraph 1, under 2) of the Rulebook on Traffic Signalization ("Official Gazette of RS", No. 85/17, that was valid at the time of occurrence of the serious accident in question).

Fully respecting the provisions of Article 100 and Article 132, paragraph 4 of the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law, 87/2018 and 23/2019) and Article 17, Article 18, Paragraph 1 under 28), 29) and 30) and Article 23, Paragraph 1, under 5), 6) and 7) of the Rulebook on Traffic Signalization ("Official Gazette of RS" No. 85/17), we consider that at level crossings, in addition to the installation of danger signs, installation of traffic sign II-2: "Obligation of stopping" (which is one of the signs of explicit orders by which road users are made aware of prohibitions, restrictions and obligations), would positively affect the safety of both types of traffic (railway and road).

5. Measures taken

Attached to the Letter of "IŽS"a.d. No. 1/2020-976 of 02.10.2020., the Work Book II part of the railway section Šabac - Koviljača, OC ZOP Sremska Mitrovica was submitted, in which it was written that after the occurrence of the serious accident in question, on 28.07.2020. on the section of the railway from km 20+600 to km 20+800 manual destruction of vegetation (clearing of shrubs) was performed. Data on undertaking other measures were not provided.

By the Letter of JP "Putevi Srbije", Sector for maintenance of state roads of the I and II rank, Department of maintenance and protection of roads, Belgrade No. 953-17135/20-3 of 11.12.2020., data were submitted that the road manager after the occurrence of the serious accident in question did not take emergency measures other than regular maintenance of the level crossing. After the accident, the competent company for the maintenance of state roads of the I and II rank made a tour of the terrain where it was stated that all traffic signalization was provided according to the existing condition, and according to the type of the level crossing. Grass mowing in the road area has been repeated.

The Rulebook on ammendments of the Rulebook on traffic signalization No. 110-00-00012/2021-03 of 09.02.2021. (published in "Official Gazette of RS" No. 4 of 7.02.2021., that

entered into force on the eighth day from the date of publication) was adopted by the Minister for Construction, Transport and Infrastructure. Article 5 of the Rulebook on ammendments of the Rulebook on traffic signalization No. 110-00-00012/2021-03 of 09.02.2021. (published in "Official Gazette of RS" No. 4 of 7.02.2021., that entered into force on the eighth day from the date of publication) defines that the sign II-2: "Obligation of stopping" be set in the immediate vicinity of the road crossing, that is, the level crossing, if possible at the point of visibility where the vehicle must stop to give passage to another vehicles moving on the road, that is, the rail vehicles moving on the railway line, on which it encounters, and Article 3 defines that the sign II-2: "Obligation of stopping" also signifies the order to the driver that he must stop the vehicle in front of the level crossing and give passage to the rail vehicle moving on the railway line it encounters.

6. Safety recommendations

With the aim of possible improvement of safety on the railway and prevention of occurrence of the new accidents, CINS has issued the following safety recommendations:

To the Ministry of Construction, Transport and Infrastructure:

SR_01/21 Ministry of Construction, Transport and Infrastructure to harmonize the provisions of Article 69 with the provisions of Article 56 in the Law on Railways ("Official Gazette of RS" No. 41/2018) in terms of the obligation of railway infrastructure manager to maintain the necessary visibility zone at the crossings of the railway line and the road in terms of defining the distance from the track axis (track belt) at which the infrastructure manager has the obligation to remove vegetation (see section 4.3.3.).

SR_02/21 Ministry of Construction, Transport and Infrastructure to clearly define in the Law on Railways ("Official Gazette of RS" No. 41/2018) in Article 69 the obligations of railway infrastructure manager and road manager in terms of maintaining the necessary visibility zone (part of the necessary visibility zone which includes the railway belt and part of the necessary visibility zone which does not include the railway belt) (see section 4.3.3).

SR_03/21 Ministry of Construction, Transport and Infrastructure, in the Law on Roads ("Official Gazette of RS", No. 41/2018 and 95/2018 - other law) in Article 68 to define (supplement) maintenance - landscaping of green areas (grass mowing, clearing shrubs and cutting of trees) in the zone of necessary visibility at the points of crossing of the railway line and the road, in accordance with Article 38, which defines the obligation to provide the zone of necessary visibility in accordance with the regulations (see section 4.3.3).

SR_04/21 Ministry of Construction, Transport and Infrastructure, to define in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette RS", No. 89/2016) the methodology (method) for determining (calculating) the elements of the zone of necessary visibility given in the Annex 9 (d_{pz} – length of stopping the road vehicle and $S_{pžv}$ – length of approaching the railway vehicle) (see sections 3.3.6. and 4.3.4.).

SR_05/21 Ministry of Construction, Transport and Infrastructure, to define in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette RS", No. 89/2016) the procedure in the case when there is the necessary visibility according to the definition from Article 2, Paragraph 1 under 12) of this Rulebook and it is not possible to provide the zone of necessary visibility. In particular, it should be borne in mind that the installation of traffic sign II-2: "Obligation of stopping" while providing the necessary visibility, allows safe passage of road vehicles over the crossing (see sections 3.3.5. and 4.3.4.).

SR_06/21 Ministry of Construction, Transport and Infrastructure, to make corrections in the expression in Article 14 of the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016):

$$t_v = \frac{m + n + d + s}{V_p} \cdot 3{,}6 \quad [s]$$

so that in front of ***s*** there is a sign "-", and not the sign "+" (see section 3.4.2).

SR_07/21 Ministry of Construction, Transport and Infrastructure to harmonize, in the Rulebook on the manner of crossing of the railway line and the road, pedestrian or bicycle path, the place where the crossing can be made and the measures for ensuring safe traffic ("Official Gazette of RS" No. 89/2016), the description of the position of point B given in Article 14, Article 15 and Annex 6 (see section 4.3.4.)

SR_08/21 Ministry of Construction, Transport and Infrastructure to consider the possibility that in the Law on Road Traffic Safety ("Official Gazette of RS" No. 41/2009, 53/2010, 101/2011, 32/2013 - decision US, 55/2014, 96/2015 - other law, 9/2016 - decision US, 24/2018, 41/2018, 41/2018 - other law and 87/2018) Article 153, Paragraph 2 reformulates and harmonizes with the Article 97, Paragraph 1 of the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018) in terms of more precise provisions for the installation of traffic lights (see section 4.3.4.).

Directorate for Railways:

SR_09/21 "IŽS"a.d. to consider a change in the level of insurance (introduction of active signallization) for the level crossing in question, or solve the problem in some other way. Due to the existence of facilities near the level crossing and the curve on the railway, the necessary visibility zone is not provided, and due to the abundant vegetation in the infrastructure belt and thus in the railway belt, the necessary visibility is not provided (see sections 2.2.3 and 3.4.2.). It is also a fact that the level crossing in question is a crossing of a regional line and a state road of IIA rank (see section 2.2.3).

SR_10/21 "IŽS"a.d. to make a professionally based risk assessment at road crossings. Bearing in mind that accidents at road crossings (observing each crossing separately) are rare events, risk assessment cannot be performed only on the basis of the number of accidents that occurred at individual road crossings. Risk assessment, as a precautionary measure, should be performed collectively for all road crossings according to all relevant parameters, regardless of whether accidents have occurred at them or not.

SR_11/21 "IŽS"a.d. to make an act "Program for solving road crossings" according to the previously done risk assessment at road crossings, in order to take appropriate activities with the aim to raise the level of traffic safety.