REPUBLIC OF SERBIA
CENTER FOR INVESTIGATION OF ACCIDENTS IN TRANSPORT
SECTOR FOR INVESTIGATION OF ACCIDENTS IN RAILWAY TRAFFIC
NEMANJINA 11, 11000 BELGRADE

No.: ŽS - 04/20

No.: 340-03-1/2020-02-3-42

Date: 22.11.2021.

FINAL REPORT ON SERIOUS ACCIDENT INVESTIGATION

Accident type:	Serious accident on the level crossing
Train No.:	Train No. 6431
Accident location:	City of Subotica, Municipality of Bajmok, distance between the stations Bajmok - Aleksa Šantić
Date:	02.12.2020.
Time:	08:15

This Report presents the results of investigation of serious accident, overtaking of the train No. 6431(railway undertaking “Srbija Voz”a.d.) on the road passenger vehicle, which occurred on 02.12.2020. at 08:15 on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), on the level crossing secured with half barriers with light traffic signs and traffic signs on the road, which is located in the area of the village Bajmok.

Director of the Center for Investigation of Accidents in Transport of the Republic of Serbia established the Working Group for the investigation of this serious accident by the Decision No. 340-03-1/2020-02-3-8 of 09.12.2020.

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 the Council of EU (Railway Safety Directive), Center for Investigation of Accidents in Transport 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 Investigations of Accidents in Railway Traffic carries out tasks within the competence of the 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 railways 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
RS	.....	Republic of Serbia
US	.....	Constitutional Court
a.d.	.....	Joint stock company
d.o.o.	.....	Ltd.
MUP	.....	Ministry of Interior
OJT	.....	Basic Public Prosecutor
JP	.....	Public Enterprise
PU	.....	Police Department
SPI	.....	Traffic police station
SS	.....	Safety- signalling
OJ	.....	Organizational Unit
ZOVS	.....	For rolling stock maintenance
ZOP	.....	For track maintenance
ETP	.....	Electro technical affairs
TT	.....	Telephone-telegraph
TK	.....	Telecommand

C O N T E N T:

1. Summary

1.1. Short description of the serious accident

On 02.12.2020. at 08:15 on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), on the level crossing at km 102+890, secured with automatic half barriers with light traffic signs and traffic signs on the road, there occurred an overtaking of the train No. 6431 (railway undertaking "Srbija Voz"a.d.) on the road passenger vehicle of brand Volkswagen Golf, license plate KI 045-DK.

The road passenger vehicle of brand Volkswagen Golf, license plate KI 045-DK, was moving along the state road 1B rank, marking 12: Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja) from the direction of Sombor to Bajmok. Upon encountering the level crossing at km 102+890, whose automatic device was defective, having in mind that the half-barriers were raised, the road passenger vehicle did not stop in front of the level crossing, but continued driving and entered the track profile in the area of the level crossing, just before the arrival of train No. 6431.

Train No. 6431 was moving from the direction of Bajmok station in the direction of Aleksa Šantić station. Train No. 6431 consisted of DMV 711-033/034. In DMV 711-033/034, in addition to the train driver, there were also two conductors, all employees of the railway undertaking "Srbija Voz"a.d. Upon encountering the level crossing at km 102+890, there occurred overtaking of the train No. 6431 with a road passenger vehicle, which entered the track profile immediately before the train arrived. The collision occurred when the right part of the forehead DMV 711-034 (front right buffer) hit the central left part of the side of the road passenger vehicle (seen in the direction of train No. 6431 movement, ie road passenger vehicle).

In this serious accident, 1 (one) person was fatally injured. The fatally injured person was in a road passenger vehicle. Material damage exists on DMV 711-033/034.

At the time of occurrence of this serious accident, the automatic device at the level crossing was faulty and the half-barriers at the level crossing (on both sides) were raised.

1.2. The causes of the serious accident determined by investigation

The direct cause of the occurrence of the serious accident in question is that upon encountering the level crossing at km 102+890, which automatic device was faulty, the train No. 6431 did not stop in front of the level crossing, in accordance with the aspect of a signal 55: "Level crossing device faulty" which showed the control signal KS 2, which is contrary to the provisions of Article 63, item 5 of the Rulebook 2, Traffic Rulebook ("Official Gazette of ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03), while the road passenger vehicle was on the track just before the train arrived, thus creating a dangerous situation related to the occurrence of this serious accident. Having in mind that the half-barriers were raised and that the traffic light did not announce the arrival of the train, the road passenger vehicle did not stop in front of the level crossing, but continued driving and entered the track profile in the area of the level crossing just before train No. 6431 arrived.

In accordance with the provisions of Article 63, item 5 of the Rulebook 2, Traffic Rulebook ("Official Gazette of ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03), the train driver of the train No. 6431 was obliged to stop the train in front of the level crossing in question, which was faulty, to let all the road vehicles pass and only after he ensures that there are no other vehicles in the vicinity

and that crossing over the level crossing is safe, to undertake the activities for safe crossing. When the traction vehicle crosses the crossing, it may continue driving at regular speed.

Pursuant to Article 160 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), when approaching a level crossing, the train driver is obliged to give an aspect of a signal 67: "Watch out", and pursuant to Article 143 of the same Rulebook, the train driver is obliged to give aspect of a signal 67: "Watch out", when approaching the faulty level crossing. Giving this aspect of a signal on the section of the line from the control signal to the level crossing, informs the participants in road traffic that the train is approaching the level crossing. Failure to act in this way could have contributed to the occurrence of a serious accident.

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

Aiming to improve safety on the railway and prevent occurrence of the new accidents, CINS has issued the following safety recommendations:

To the Directorate for Railways recommendations SR_26/21, SR_27/21, SR_28/21, SR_29/21, SR_30/21 and SR_31/21 are issued:

SR_26/21 "IŽS"a.d., to revise the technical documentation and diagnostic software for the road crossing device PZZ-EA, and to consider the need for their supplementation and correction in terms of correct and clear translation into Serbian with the use of precise and professional terms. This primarily refers to the documentation for the operation and maintenance of the device, so that the content of the mentioned documentation is clear to the employees of the maintenance service (see point 4.2.1.1.).

SR_27/21 "IŽS"a.d., to continuously during the regular training of workers employed in the regular maintenance of SS devices, analyse the operation of available software tools for diagnosing the operation of electronic devices of level crossings. During corrective maintenance of the electronic level crossing device, on those devices where it is applicable, by using electronic diagnostic devices to accurately determine the cause of the fault and enter it into the appropriate records kept in "IŽS"a.d. (see point 4.2.1.2.).

SR_28/21 "IŽS"a.d., in the Rulebook on organization and work positions systematization of "IŽS"a.d., Belgrade, to consider the adequacy of the existing ones and consider the possibility to predict the appropriate number of executors in the electro technical affairs (worker on SS devices and facilities maintenance) both on the section of the railway on which the serious accident occurred and on the entire network in order to reduce the time of starting the process of elimination of the fault to a measure that is in accordance with the Rulebook on maintenance of signalling and safety devices ("Official Gazette RS", No. 41/18), thus minimizing the time in which SS devices are in the state of fault, all in order to ensure the safe conduct of railway traffic (see points

3.4.1. and 4.3.4.).

SR_29/21 "IŽS"a.d., to carry out activities on obtaining a use permit issued by the Ministry of Construction, Transport and Infrastructure for level crossing at km 102+890, in accordance with the Article 158 of the Law on Planning and Construction ("Official Gazette of RS", No. 72/2009, 81/2009 - amended, 64/2010 – US decision, 24/2011, 121/2012, 42/2013 - US decision, 50/2013 - US decision, 98/2013 - US decision, 132/2014, 145/2014, 83/2018, 31/2019, 37/2019 - other law, 9/2020 and 52/2021) (see points 2.2.3, 3.3.4 and 4.2.5).

SR_30/21 "Srbija Voz"a.d., to perform extraordinary training of traction vehicle staff regarding the procedure in front of the road crossing equipped with control signals, pursuant to Article 143, paragraph 2 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), and Article 61, item 12 and Article 63, item 5 of the Rulebook 2, Traffic Rulebook ("Official Gazette of the ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03) (see points 3.3.8 and 4.1).

SR_31/21 "Srbija Voz"a.d., to perform extraordinary training of traction vehicle staff in terms of proper application of the aspect of signal 67: "Watch out", in accordance with the Article 160 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), in order to properly apply railway regulations with the aim of preventing the circumstances that could contribute to the occurrence of new similar accidents and increase safety in railway traffic (see points 3.3.7, 3.3.11. and 4.1.).

To the Ministry of Construction, Traffic and Infrastructure the recommendation SR_32/21 is issued:

SR_32/21 The Ministry of Construction, Traffic and Infrastructure to harmonize the Article 2, item 11 and Annex 2 of the Rulebook on the manner of crossing the railway and 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) with Annex 2 of the Rulebook on technical conditions for signalling-safety devices ("Official Gazette of RS", No. 18/2016 and 89/2016) regarding the definition of the border of the dangerous zone of the road crossing, that is, the border of the free profile (see points 3.3.6, 3.3.9 and 4.3.4).

2. Direct facts about the serious accident

2.1. Basic data on the serious accident

2.1.1. Date, time and place of the serious accident

The serious accident occurred on 02.12.2020. at 08:15 in the area of the city of Subotica, on the territory of the municipality Bajmok, on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), on the level crossing at km 102+890, secured with automatic half barriers with light traffic signs and traffic signs on the road.

The view of the serious accident site is shown in Figure 2.1.1.1.

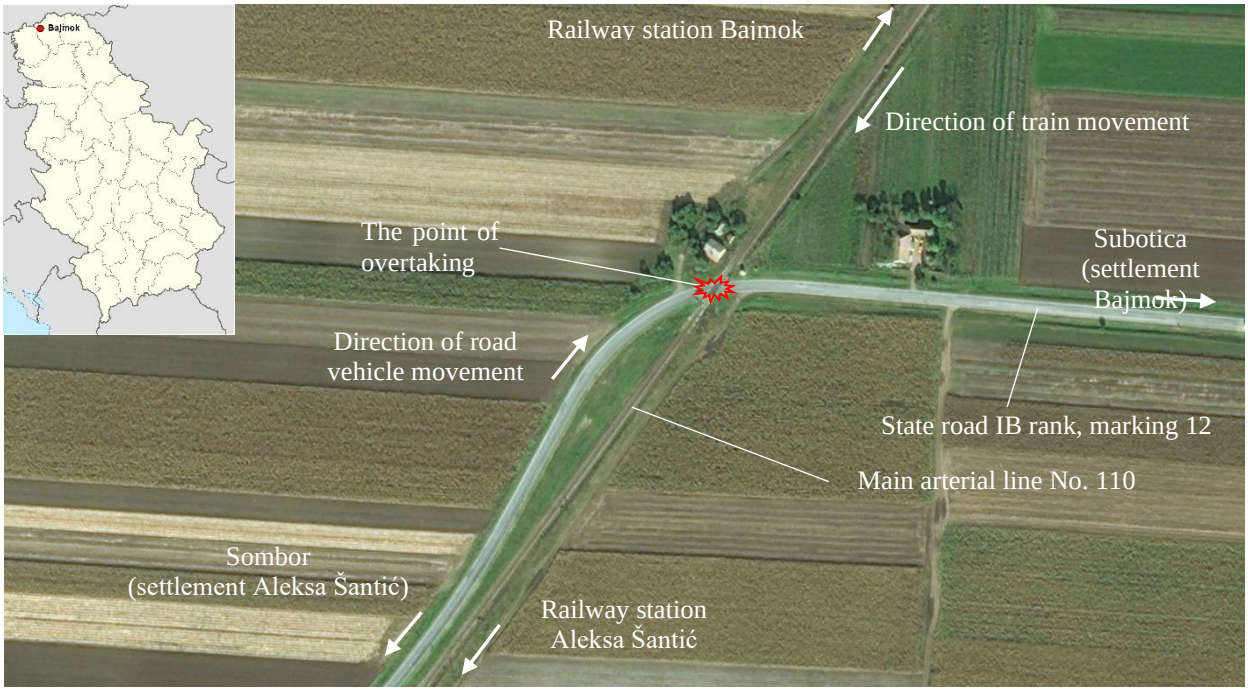


Figure 2.1.1.1: The view of the serious accident site area (source: Bing maps)

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

The level crossing is located in the area of the city of Subotica, on the state road 1B rank, marking 12: Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja), on the section of the state road on the exit from the settlement Bajmok in the direction to the settlement Aleksa Šantić, that is, on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut). It is secured with automatic level crossing device. At the time of occurrence of the serious accident in question, automatic level crossing device was not in function (half barriers were raised and traffic lights regulating the crossing of the road over the railway line were turned off).

The road passenger vehicle of the brand Volkswagen Golf, license plates KI 045-DK, was moving the state road 1B rank, marking 12: Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja) from

the direction of Sombor to Bajmok. Upon encountering the level crossing at km 102+890, which automatic device was faulty, having in mind that the half-barriers were raised and that the traffic lights were turned off (they did not announce the train arrival), the road passenger vehicle did not stop in front of the level crossing, but continued driving and in the area of the level crossing it entered the track profile, just before the arrival of the train No. 6431.

Train No. 6431 was moving on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), from the direction of Bajmok station in the direction of Aleksa Šantić station. After operating at the Bajmok station due to the needs of passengers, train No. 6431 was started from the third main passing track of the Bajmok station in the direction of the Aleksa Šantić station. Upon encountering the level crossing at km 102+890, there occurred overtaking of the train No. 6431 with a road passenger vehicle, which entered the track profile immediately before the train arrived. Overtaking occurred when the right part of the DMV 711-034 head (front right buffer) hit the central part of the left side of the road passenger vehicle (seen in the direction of train No. 6431 movement, ie the road passenger vehicle).

After overtaking, train No. 6431 continued its movement in the length of 165 m, after which it stopped. Due to the force of the impact, the road passenger vehicle crawled under the DMV 711-034 head (driver's cab), ie it remained stuck in the part between the DMV buffer and the track. On that occasion, the entire front part of the road passenger vehicle was significantly damaged.

In Figures 2.1.2.1. and 2.1.2.2. the appearance of the train No. 6431 and the road passenger vehicle is shown, after the serious accident.

Figure 2.1.2.1: Appearance of DMV 711-033/034 from the train No. 6431 and the road passenger vehicle after the serious accident (view from the free space between the railway line and the road, source:"IŽS"a.d.)

Figure 2.1.2.2: Appearance of the road passenger vehicle after the serious accident (view from the railway line, in the direction opposite from the direction of train movement, source:"IŽS"a.d.)

In this serious accident, one person was fatally injured (a person who was in the driver's seat in a road passenger vehicle).

Due to this accident, the members of MUP RS, PU in Subotica, members of MUP RS, Emergency Situations Sector, Department for Emergency Situations in Subotica (fire and rescue unit from Subotica), members of the Voluntary Fire Brigade Bajmok, members of OJT Subotica and members of the Emergency Medical Service of the Health Center Subotica.

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

CINS has been informed immediately upon the occurrence of the serious accident. Main Investigator for Railway Traffic received the first notification of the accident occurred on 02.12.2020. at 08:55 via telephone by the Main Dispatcher of the Central Operations Department of "Srbija Voz"a.d., and then also via telephone at 09:51 by the Head of Central Operations Department of "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 accident in question 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 accident is determined by Decision No. 340-03-1/2020-02-3-8 of 09.12.2020. 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 two conductors employed by the railway undertaking "Srbija Voz"a.d. participated in the serious accident in question.

The driver of the road passenger vehicle of brand Volkswagen Golf, license plates KI 045-DK, also participated in this serious accident.

2.2.2. The train No. 6431 and the road passenger vehicle that participated in the serious accident and their composition

In the serious accident in question the train No. 6431 and the road passenger vehicle of brand Volkswagen Golf, license plates KI 045-DK, participated.

The train No. 6431 consisted of DMV 711-033/034.

The road passenger vehicle of brand Volkswagen Golf is a small family car of approximate dimensions: length 4.3 m, width 1.8m and height 1.5 m.

2.2.3. Infrastructure and safety-signalling system

The main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Bajmok and Aleksa Šantić is one-track, unelectrified. According to the Timetable Booklet 4.2., the stopping path on the main arterial line in question is 700 m, the maximum allowed speed on that section between the stations Bajmok and Aleksa Šantić is 80 km/h for DMV, and 60 km/h for all other trains. Maximum speed for the train No. 6431 is 80 km/h.

In the zone of the level crossing in question (the level crossing at km 102+890), the railway line is in direction (from km 100+838 to km 111+019), while the slope (rise, viewed in direction of the train movement) is 4.5‰ (viewed in the direction of decreasing stationing, from km 103+900 to km 103+500, the slope amounts to 3,3‰, while from km 103+500 to km 102+800, the slope amounts to 4.5‰ and from km 102+800 to km 102+175, the slope is 3,0‰). On the mentioned distance between the stations there are no speed limits and no restricted speed runnings.

On the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), the traffic of trains is regulated with a station distance, according to Provision of the Article 39, Rulebook 2, Traffic Rulebook ("Official Gazette of the ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03). On the section of the line in question, the traffic of trains is regulated by the station dispatchers of the occupied official points Bajmok and Sombor (the station Aleksa Šantić, according to the valid Timetable Booklet, is unoccupied by traffic staff). At the time when the station Bajmok was unoccupied (from 17:00 to 05:20), the traffic is regulated by the train dispatchers of the occupied station Subotica and Sombor.

The level crossing at km 102+890 (stationing given according to the data submitted by the construction service of "IŽS"a.d.) represents the point of crossing at the level of the main arterial line No. 110: Subotica - Bogojevo - state border - (Erdut), and the state road 1B rank, marking 12:Subotica - Sombor - Odžaci -Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja).

Marking for the railway line was taken according to the Regulation on the categorization of railways belonging to the public railway infrastructure ("Official Gazette of RS", No. 92 of 29.06.2020), which was valid at the time of occurrence of the serious accident in question, and the marking for the road according to the Letter of JP "Putevi Srbije", Sector for maintenance of state roads of I and II rank, No. 953-877 of 14.01.2021. and the Regulation on the categorization of state roads ("Official Gazette RS" No. 105/2013, 119/2013 and 93/2015).

The track and the road intersect at an angle of 60°. The state road is built of asphalt pavement. Near the level crossing, the road gauge is 7.8 m in part towards Sombor, that is, 7.6 m in part towards the settlement of Bajmok. In the zone of the level crossing, the road has an asphalt surface of the road, while rubber panels have been set at the level crossing.

The condition of the asphalt pavement near the level crossing is in order, without any noticeable damage. The state road in question is at the point of intersection with the railway in a curve with a radius of 110 m. The road at the level crossing is horizontal.

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

Figure 2.2.3.1: The view of the level crossing (view from direction of Sombor)

Figure 2.2.3.2: The view of the level crossing (view from direction of Bajmok)

Sketch of the serious accident is shown in Fig. 2.2.3.3.

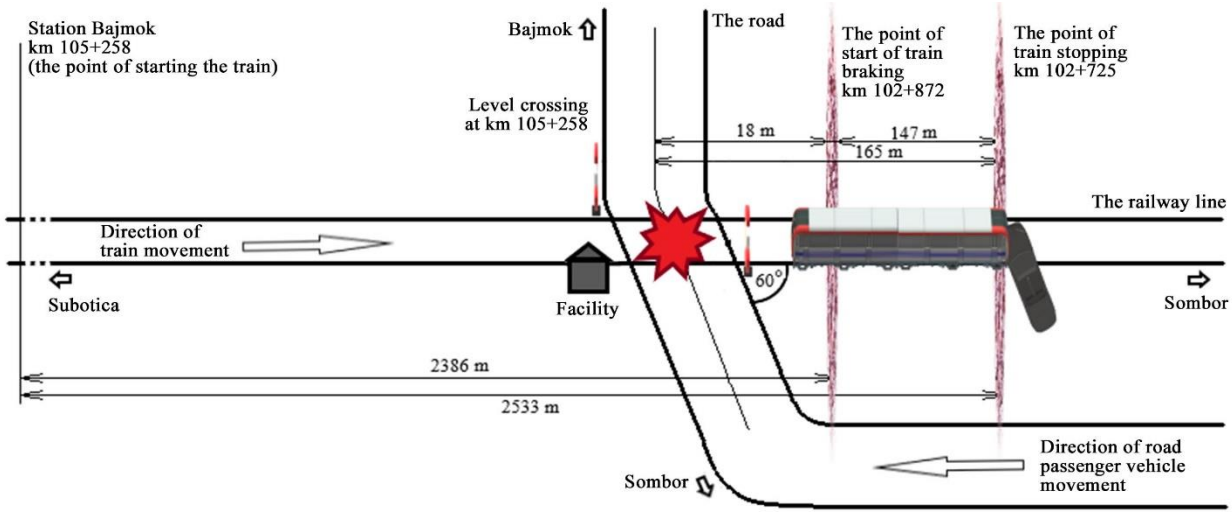


Figure 2.2.3.3: Serious accident sketch

On the state road in question, before encountering the level crossing from the direction of Sombor to the settlement of Bajmok, on the supporters located on the left and right side of the road next to the roadway and from the level crossing are approximately 240 m away, the following traffic signs are placed: I-32: "Crossing of a road with a railway with barriers or half-barriers" and I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.4.). On the supporters, located on the left and right side of the road next to the roadway and from the level crossing are approximately 160 m away, the following traffic signs are placed: I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.5.) On the supporters, located on the left and right side of the road next to the roadway and from the level crossing are approximately 80 m away, the traffic signs are placed: I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.6.). On the supporter, located on the right side of the road next to the roadway and is 8.2 m away from the level crossing (start of the rubber panel), the traffic sign: "Saltire" is placed, on the supporter located on the right side of the road, next to the roadway and is 5.3. m away from the level crossing (start of the rubber panel), the traffic lights IV-9, regulating the crossing of the road over the railway line at the same level, are placed (serving for announcing the train approaching and announcing of the half-barrier lowering), while the half-barrier supporter is placed on the right side of the road next to the roadway and is 4 m away from the level crossing (Figure 2.2.3.7.)

Figure 2.2.3.4: The view of traffic signalization (view from direction of Sombor)

Figure 2.2.3.5: The view of traffic signalization (view from direction of Sombor)

Figure 2.2.3.6: The view of traffic signalization (view from direction of Sombor)

Figure 2.2.3.7: The view of traffic signalization (view from direction of Sombor)

Figure 2.2.3.8: The view of traffic signalization (view from direction of Sombor)

Apart from the mentioned traffic signs, on this section of the state road from the direction of Sombor to the settlement Bajmok, the following traffic sign is set: II-30: "Speed limit" (placed on the supporter on the right side of the road next to the roadway and is approximately190 m away from the level crossing, Figure 2.2.3.8.). Other traffic signs on this section of the road are not set.

On the state road in question, before encountering the level crossing from the direction of the settlement Bajmok, towards Sombor, on the supporters, located on the left and the right side of the road next to the roadway, on the supporters located on the left and right side of the road next to the roadway and from the level crossing are approximately 240 m away, the following traffic signs are placed: I-32: "Crossing of a road with a railway with barriers or half-barriers" and I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.9.). On the supporters, located on the left and right side of the road next to the roadway and from the level crossing are approximately 160 m away, the following identical traffic signs are placed: I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.10.) On the supporters, located on the left and right side of the road next to the roadway and from the level crossing are approximately 80 m away, the identical traffic signs are placed: I-35: "Approaching the place of crossing of the road and the railway" (Figure 2.2.3.11.). On the supporter, located on the right side of the road next to the roadway and is 5.5 m away from the level crossing (start of the rubber panel), the traffic sign: "Saltire" is placed, on the supporter located on the right side of the road, next to the roadway and is 3.8 m away from the level crossing (start of the rubber panel), the traffic lights IV-9, regulating the crossing of the road over the railway line at the same level, are placed (serving for announcing the train approaching and announcing of the half-barrier lowering), while the half-barrier supporter is placed on the right side of the road next to the roadway and is 2.4 m away from the level crossing (Figure 2.2.3.12.)

Figure 2.2.3.9: The view of traffic signalization (view from direction of Bajmok)

Figure 2.2.3.10: The view of traffic signalization (view from direction of Bajmok)

Figure 2.2.3.11: The view of traffic signalization (view from direction of Bajmok)

Figure 2.2.3.12: The view of traffic signalization (view from direction of Bajmok)

Apart from the mentioned traffic signs, on this section of the state road from the direction of Bajmok to the direction of the level crossing, the following traffic signs are placed: I-2:"Double curve or more than two consecutive curves, the first of which is on the left" and II-28:"Overtaking ban for motor vehicles" (placed on the same supporter, which is located on the right side of the road, next to the roadway and is approximately 210 m away from the level crossing, Figure 2.2.3.13.) and the traffic sign II-30: "Speed limit" (placed on the supporter on the right side of the road next to the roadway and is approximately 115 m away from the level crossing, Figure 2.2.3.14.). Other traffic signs on this section of the road are not set.

Figure 2.2.3.13: The view of traffic signalization (view from direction of Bajmok)

Figure 2.2.3.14: The view of traffic signalization (view from direction of Bajmok)

The level crossing (stationing given according to the data obtained from "IŽS"a.d.) is a place of crossing at the level of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut) and section of the state road 1 B rank, marking No. 12: Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (Srpska Crnja border crossing).

On the level crossing at km 102+890 of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), securing of traffic is carried out by automatic half-barriers with light traffic signs, to which sound signals and traffic signs on the road are added, by which the traffic participants are directly announced on the railway vehicles encountering and warned to adjust the speed so that they must unconditionally stop in front of the road crossing because the railway vehicle is

about to pass. On the level crossing in question the SS device for level crossings is set (device for securing traffic at the road crossing) of the PZZA-EA type by "AŽD" Praha s.r.o. manufacturer. On this level crossing, SS device functions automatically with encountering of a railway vehicle via on or off devices-sensors, and there is also a possibility of direct handling of control device on the spot, in the level crossing house.

On the main arterial line, before encountering the level crossing in question, from the direction of the station Bajmok to the station Sombor, at km 103+866, the switching point signal is set, aspect of a signal 57: "Switching point, expect control signal", and at km 103+587 the control light signal KS 2 is set (Figures 2.2.3.15. and 2.2.3.16.). The mentioned signals are placed on the right side of the track, viewed in the direction of decreasing stationing, that is, in the direction of the train No. 6431 movement.

Figure 2.2.3.15: The view of the switching point signal on the main arterial line (view from direction of station Bajmok)

Figure 2.2.3.16: The view of KS 2 control signal (view from direction of station Bajmok)

On the main arterial line, before encountering the level crossing in question, from the direction of the station Sombor to the station Bajmok, at km 101+909 the switching point signal is set, the aspect of a signal 57: "Switching point, expect control signal", and at km 102+187, control light signal KS 1 is set (Figures 2.2.3.17. and 2.2.3.18.) The mentioned signals are placed on the right side of the track, viewed in the direction of increasing stationing.

Figure 2.2.3.17: The view of the switching point signal on the main arterial line (view from direction of station Aleksa Šantić)

Figure 2.2.3.18: The view of the control signal KS 1 (view from direction of station Aleksa Šantić)

The signals stationing is determined according to the signalling marks 227:"Kilometer and hectometer mark", placed on the spot next to the track.

To secure the level crossing at km 102+890 of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), an electronic SS device of the road crossing type PZZ-EA, manufactured by "AŽD" Praha s.r.o. from the Czech Republic is used.

Works on the reconstruction and raising the level of securing of the road crossing in question were performed on the basis of the following Investment-technical documentation:

- The main project of reconstruction and raising the level of securing at the road crossing at km 102+890 of the railway line Subotica - Bogojevo - Croatian border, Book 1. - Traffic-technological part, made by the Traffic Institute "CIP"d.o.o. from Belgrade, Nemanjina Street no. 6/IV, registered under No. 388-10/06 dated 17.07.2006.;
- The main project of reconstruction and raising the level of securing at the road crossing at km 102+890 of the line Subotica - Bogojevo - Croatian border, Book 2. - Construction arrangement, made by the Traffic Institute "CIP"d.o.o. from Belgrade, Nemanjina Street no. 6/IV, registered under No. 388-9/06 dated 10.07.2006.;
- Main project of reconstruction and raising the level of insurance at the road crossing in km 102+890 of the line Subotica - Bogojevo - Croatian border, Book 3. - Securing of the road crossing, made by the Traffic Institute "CIP"d.o.o. from Belgrade, Nemanjina Street no. 6/IV, registered under No. 388-6/06 dated 22.06.2006.

Approval for the execution of works on the reconstruction and raising the level of insurance of the road crossing at km 102+890 of the railway line Subotica - Bogojevo - border with the Republic of Croatia, was given by the Decision on construction permit No. 351-02-131/2006-11 from 21.09.2006., which was issued by the Ministry of Capital Investments.

In the mentioned Decision on the construction permit, it is stated that the technical control of the technical documentation of the Main Project, performed by the Institute "KIRILO SAVIĆ"a.d. from Belgrade, Vojvode Stepe Street No. 51, on the basis of which a certificate of acceptance of all the above books of the project was issued. Also, the Decision on the construction permit states that the books of the Main Project were revised by the Railway Audit Commission, the Sector for

Strategy and Development of the JP "Železnice Srbije", which confirmed that the main project in accordance with laws, standards, terms of reference, and it is accepted and certified by the Investor.

By "IŽS"a.d., as an attachment to the letter No. 1/2021-935 from 29.04.2021., the letter of the Investment Sector No. 27/21-430 from 29.04.2021 was submitted, in which it is stated that the competent Ministry of Infrastructure by Decision No. 351-02-879/2007-11 of 17.10.2007. approved the trial use of the reconstructed facility - road crossing at km 102+890 of the railway line Subotica - Bogojevo - state border - (Erdut), as well as that there is no additional information that the Ministry has issued a Use Permit.

According to provision of the Rulebook on the manner of crossing the railway and 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), Article 10, with the aforementioned device traffic at the road crossings is secured via automatic half-barriers with light traffic signs and traffic signs on the road. The internal device of the road crossing is located in a typical concrete house at km 109+885 on the right side of the railway line.

There is a difference in the stationing of the railway used in the documents of securing of the SS device in relation to the stationing that can be found in other documentation of the investigative material. This difference does not affect the course of the investigative procedure, because only the relative values of the mutual distances of the SS elements are important.

The warning to the participants in the road traffic and the ban on the crossing of the road vehicles over the railway line in front of the approaching railway vehicle is given by the light road signals, the loud ringing and the half-barriers. The level crossing device is activated automatically when the railway vehicle encounters the switching points.

The correct operation of the automatic road crossing device and its parts is controlled by control track signals on the railway line, which warn the driver that the road crossing device is correct and activated.

According to the Technical description of the device provided by the manufacturer, in the document "Safety device of the PZZ-EA road crossing in the application for securing the road crossing on the line with the control of the state by means of a control signal according to Part IV of Instruction 412", No. T 80 100-RS/T-SB of 12.09.2006., the electronic SS device for securing traffic at road crossings type PZZ-EA consists of the following basic elements:

- PZZ-E-B command computer,
- command computer power supply,
- device for voltage control of the state of road light signals,
- switch on - off elements,
- class I relay for performing safety functions,
- electronic light control device - EOS,
- power supply,
- road light signals,
- electromechanical mounting devices with half-barriers,
- control signals,
- microprocessor time unit CJ.

According to the manufacturer's description of the PZZ-EA device, three operating states of the device can be defined in relation to the signaling state:

- Basic (initial) condition - open crossing. The level crossing device does not give a light and sound warning of an oncoming train, the road crossing half-barriers are raised, and the control signals show aspects of a signal 55: “The level crossing device is defective”.
- Crossing closed - the crossing device gives a light and sound warning of the train approaching, the crossings half-barriers are lowered (lowered after the pre-ringing time), and the control signal from the direction of train movement shows aspect of a signal 56: “The level crossing device is correct”. The indications of the control signals depend on the state of readiness of the crossing and can be set to a delay in relation to the moment of the beginning of the pre-ringing.
- Device status after switching off the crossing until it returns to the basic state - the crossing is open. After trampling the switch-off point, the level crossing device does not give a light and sound warning of the approach of the train, the half-barriers of the level crossing are raised to the upper position, and the control signals show aspect of a signal 55: “The level crossing device is defective”. As long as the train that crossed the road crossing does not leave the included section from the opposite direction, the road crossing device is in this state. Only after leaving the second switching section, the crossing device returns to its basic state.

The white flashing light on the control signal switches off after 60 s from the moment of activation of the switching element, after this time the device forcibly stops giving the aspect of a signal which allows the oncoming train to drive over the road crossing without restrictions.

2.2.3.1. PZZ-E-B command computer at PZZ-EA type road crossings

The heart of the PZZ-EA road crossing device is the PZZ-E-B command computer, which uses a micro-controller with one SAB80C537 processor core, and two software channels, which make the system redundant. The processor unit consists of a micro-controller and a diagnostic board that uses EEPROM memory to archive the performed functions and other data important for the diagnostics of the device operation. The processor micro-controller is designed so that no changes or modifications can be made to it. Due to the mentioned feature, no maintenance is performed on this part of the device.

2.2.3.2. Road crossing diagnostic device

All changes in the state of external elements, faults and malfunctions are recorded in the memory together with the date and time of their occurrence.

There are two types of records in EEPROM memory - short and long. A long record is a seven-digit series of two-digit numbers that contain complete information about the time of the event (the first six segments) in the format year, month, day, hour, minute, second, and a seventh segment that represents the code of a defined state or event. The short record, in order to save memory space, uses a series of three two-digit numbers that contain information about the minute and second of the event, as well as the code of the event itself.

The long record is entered when the data transfer key is pressed, after the command computer is restarted by the maintenance service employee and during the first event archiving after the start of the whole hour, while the short record is entered in all other cases. The number

of records in memory ranges from 2048 states (long records) to 5461 states (short records). The actual number of archived records depends on the configuration of the road crossing itself, the intensity of railway traffic as well as the total number of trains runs over the road crossing.

Archived records can be downloaded and processed using a special application that is exclusively intended for that purpose and that is delivered together with the security device.

In the case of a road crossing at km 102+890, in the regular mode of operation, when one train runs during the switching on and off of the road crossing device, 48 (forty-eight) different events are recorded in the memory. Based on that, it can be estimated that the device records data on the operation of the device for a little more than 100 (one hundred) last train runs. Considering the intensity of railway traffic and the daily number from 8 (eight) to 12 (twelve) trains over this road crossing, we can expect that data up to 10 (ten) days ago will be archived in the memory.

2.2.3.3. Switching on and off points

Siemens-Frauscher AzF axle counters are used as switching devices for controlling the road crossing safety device. Electronic sensors type RSR180/K AzF are used as track on and off contacts. Two times two on and off contacts are installed, as follows:

- switching point K1/11 at km 101+909, ie axle counter sensor No.1 - at this point a command is given for switching on the road crossing for trains coming from the direction of Sombor,

- switching point K1/11 at km 101+909, ie axle counter sensor No.1 - at this point a command is given for switching on the road crossing for trains coming from the direction of Sombor,
- switch-off point K31/131 at km 102+887, ie axle counter sensor No.2 - at this point a command is given to switch off the road crossing for trains coming from the direction of Bajmok,
- switch-off point K32/132 at km 102+897, ie axle counter sensor No.3 - at this point a command is given for switching off the road crossing for trains coming from the direction of Sombor,
- switching point K2/12 at km 103+865, ie sensor of axle counter No.4 - at this point a command is given for switching on the road crossing for trains coming from the direction of Bajmok.

Appropriate counting sections are formed between these counting points, the switching section AJ1 between the axle counter sensors No.1 and No.3, and the switching section VJ1 between the axle counter sensors No.4 and No.2 (Figure 2.2.3.3.1.).

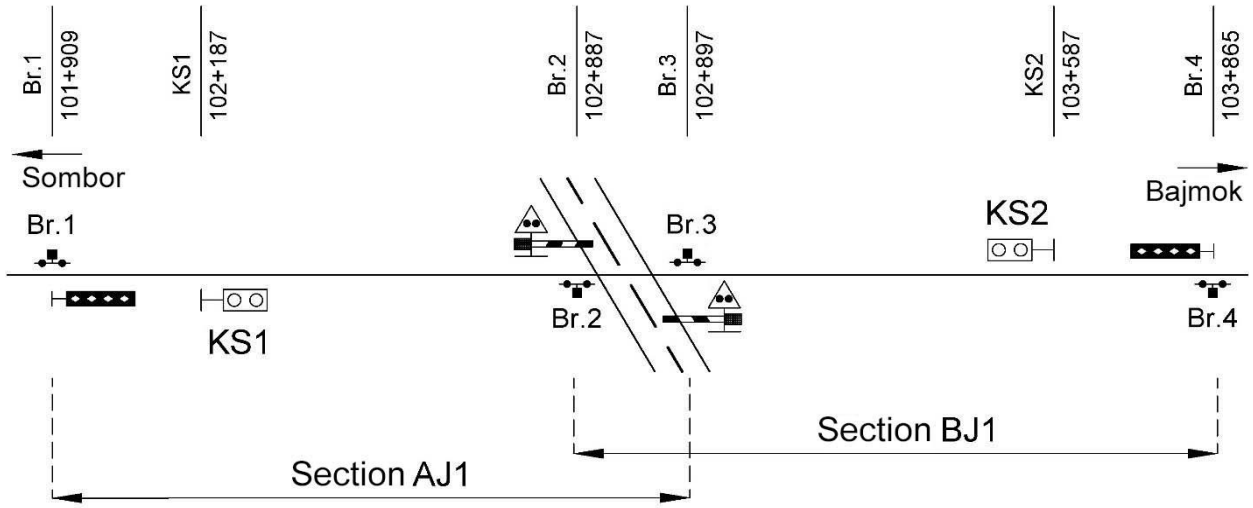


Figure 2.2.3.3.1: Block diagram of inclusive sections and disposition of external elements

2.2.4. Means of communication

Communication at this section of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Bajmok and Sombor, takes place via telephones connected to the public network (Telekom Srbija operator). The PTT telephone used by the train dispatcher of the Sombor station is connected to the registration device located in the Sombor station. At the time of the serious accident in question, the means for communication between the train dispatchers of Bajmok and Sombor stations were correct and their communication was recorded on a recording device.

2.2.5. Works executed on or near the serious accident site

In the vicinity of the serious accident site no works have been executed.

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

Railway undertaking "Srbija Voz"a.d. immediately after the occurrence of the serious accident, has informed CINS, i.e. the main investigator for railway traffic, and then the infrastructure manager "IŽS"a.d. did the same. Infrastructure Manager "IŽS"a.d. and the railway undertaking "Srbija Voz"a.d., formed a joint investigation committee which conducted the investigation of the accident in accordance with the applicable regulations. Upon completion of the investigation, Investigation Report U-362/20 was prepared.

According to the data submitted in the attachment to the letter "Srbija Voz"a.d. No. 1/2021-43 of 14.01.2021. and statements given in the premises of CINS, the train driver informed the authorities in "Srbija Voz"a.d. about the accident, by mobile phone, by calling through the network of mobile telephony operators, while the policeman who was present in the train No. 6431 informed the MUP. Members of MUP informed the ambulance. Immediately after the accident, the driver and the conductor went outside and saw that the car was stuck under the driver's cab and that it was impossible to access the driver. According to the Report on irregularities-deficiencies during operation (K-91) No. 32/20-I-3-948 from 04.12.2020., the conductors of train

No. 6431 state that they informed the passengers about the situation after which the passengers left the train.

According to the data submitted in the attachment to the letter No. 15/2021-31 from 13.01.2021. of the Sector for Traffic Affairs, "IŽS"a.d., the train dispatcher on duty at the Bajmok station received the first notification of the accident at 08:35, from the traffic dispatcher of the station Bajmok, who emphasized that the police, the Emergency Medical Service and commission for the investigation of the accident was informed, but he also contacted the police in Bajmok and the train dispatchers on duty at the first occupied stations in Sombor and Subotica. The scene of the accident was secured by a traffic police patrol, and the funeral service took away the body of the fatally injured person.

After the investigative operations by the police, OJT and the joint investigative committee of the infrastructure manager and the railway undertaking, removal of the road vehicle from the track profile and the change of train driver, the train No. 6431 was launched at 12:50 from the scene, in the direction of Bajmok station.

Regular traffic was established at 13:07, by starting the train No. 5410 from the Sombor station.,

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

Due to this serious accident, members of the MUP RS, PU in Subotica, the Traffic Police Department in Subotica, the Traffic Police Office in Subotica, members of the MUP RS, the Emergency Situations Sector, the Emergency Situations Department in Subotica, the Subotica Fire and Rescue Battalion and members of the Voluntary fire brigade Bajmok, representatives of OJT Subotica and members of the Emergency Medical Service of the Health Center Subotica were engaged.

By the letter of the Health Center Subotica, Emergency Medical Service Subotica No. 01-5917 from 28.12.2020., data were submitted that on 02.12.2020. at 08:42, at the scene of the accident - the Bajmok railway crossing, the emergency team of the Subotica Emergency Medical Service intervened. Upon arrival, they found a female person on the spot who was trapped in the driver's seat of a passenger car (with extensive head injuries). The person was showing signs of life (agonal breathing). The fire brigade tried to release the injured person and at one point the injured person stopped breathing.

By the letter of the MUP RS, Sector for Emergency Situations, Department for Emergency Situations in Subotica, No. 217-154/21-1 dated 5.01.2021., data were submitted that on 02.12.2020. at 08:29, the Subotica Fire and Rescue Unit received a report from the Emergency Medical Service that an accident in question had occurred. 2 (two) vehicles with 6 (six) firefighters were sent to the intervention.

After the departure of the fire brigade of the Fire and Rescue Battalion Subotica to the scene, the Voluntary Fire Brigade Bajmok was informed about the accident. Arriving at the scene at 08:51, members of the Subotica Fire and Rescue Battalion established that the train hit a passenger car and pushed it about 200 m from the road crossing in the direction of the settlement of Aleksa Šantić, as well as that there was a trapped driver in the car who was difficult to reach due to the breakdown of the vehicle. With the help of a hydraulic demolition tool, a space was made and the driver was pulled out of the car with the help of a spinal board, with the assistance of Emergency Medical Service workers. After that, the equipment was collected and the members of the Subotica

Fire and Rescue Unit returned to the fire brigade. The Traffic Police with 2 (two) vehicles and 6 (six) members, the Emergency Medical Service with 3 (three) workers and the Bajmok Voluntary Fire Brigade with 1 (one) vehicle and 4 (four) firefighters were present at the scene.

By letter of the Voluntary Fire Brigade Bajmok No. 1/21 dated 19.01.2021., data were submitted that on 02.12.2020. at 08:25 Voluntary Fire Brigade Bajmok was notified of the accident by a professional fire brigade Subotica. The intervention involved 1 (one) vehicle and 4 (four) firefighters. Upon arrival at the scene, they found the Emergency Medical Service and the Traffic Patrol. During the intervention, firefighters tried to open the door of the passenger vehicle that was stuck under the train, which failed, and in the meantime, firefighters from the professional fire brigade of Subotica arrived and took over the action. By joint work and tools for cutting the car, the vehicle was cut and the victim was taken out by the workers of the Emergency Medical Service.

By Letter from OJT in Subotica, No. Ktn.1110/20 of 01.02.2021., data were submitted that OJT in Subotica on a traffic accident, which occurred on 02.12.2020. at 08:15 on the state road 1B rank, marking No. 12, was notified by the duty inspector of PU Subotica for investigations at 08:21, and at 09:03 was notified by the Head of the Traffic Police Department in Subotica who was on the spot, that the injured person from the passenger vehicle died, which was stated by the doctor of the Emergency Medical Service. Deputy prosecutor from OJT Subotica came to the site at 10:00 and took over the investigation which started at 09:00 by the investigative team - police officers of the Traffic Police Station Subotica.

By Letter of MUP RS, PU in Subotica, Traffic Police Department, Traffic Police Station, 03/38/4-2 No. 221-31447/20 of 29.12.2020. it was confirmed that the investigation of this traffic accident was performed by the Deputy Prosecutor of the OJT from Subotica, with the assistance of the police officers of the Traffic Police Station Subotica.

2.3. Dead, injured and the material damage

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

In this serious accident, from the total of 1 (one) person in the road passenger vehicle, 1 (one person) was fatally injured (the road passenger vehicle driver).

Among the passengers and railway workers in train No. 6431, there were no injured nor fatally injured.

Table 2.3.1.1: Review of fatally injured and injured persons

	Passengers	The railway staff	Third persons	Total
Fatally injured	-	-	1	1
Seriously injured	-	-	-	-
Lightly injured	-	-	-	-

Data on the fatally injured were submitted by OJT Subotica (Letter No. Ktn.1110/20 of 01.02.2021.).

2.3.2. Goods, luggage and other assets

There was no damage to the luggage in train No. 6431 in this serious accident. There exists a damage to the road passenger vehicle. CINS does not have data on the assessment of damage to a road passenger vehicle.

2.3.3. Railway vehicles, infrastructure and the environment

In the serious accident in question, the railway vehicle (DMV 711-033/034) was damaged. On the infrastructure there were no damages.

The structure of the material damage is given according to the following:

On DMV 711-033/034:	1 148 100.00	RSD
Total direct material damage:	**1 148 100.00**	**RSD**

The damage is stated in the official currency of the RS (Dinar - RSD).

According to the official middle exchange rate of the National Bank of Serbia on 02.12.2020., which amounted to 1 EUR (Euro) = 117.5725 RSD (Dinara), the total material damage caused by the serious accident in question is 9 765.04 EUR (Euro).

Material damage to railway vehicles is shown on the basis of documents confirming the stated amounts of damage, which were submitted by “Srbija Voz”a.d. (Minutes EV-67 dated 3.12.2020, “Srbija Voz”a.d., ZOVS Sombor Section).

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 city of Subotica in the municipality of Bajmok, on the main arterial line which is located on the geographical plain terrain.

The geographical coordinates of the accident site are: 45º 57 '37.02' 'N and 19º 23' 44.3 " E.

The section of the track on which the road crossing is located is in the direction and in fall of 4.5 ‰ in the direction of the descending stationing, ie in the direction of the train movement.

By the letter of the Republic Hydrometeorological Institute No. 925-1-390/2020 from 12.01.2021., data were submitted that, based on measurements and observations at the Meteorological Station Palić, which is climatologically representative of the area of Bajmok, on 02.12.2020., the maximum air temperature was -0.7°C, and the minimum temperature was -4.5°C. It was an icy day (a day when the maximum temperature is less than 0°C). There was no precipitation during the day. From 00:00 to 06:00 it was clear, from 07:00 to 13:00 fog. The following meteorological phenomena were observed: fog (from 00:00 to 01:30 and from 13:10 to 17:30), salt (from 00:00 to 24:00) and fog (from 01:30 to 13:10), when the meteorological visibility was 100 m.

At 07:00 the air temperature was -4.3°C, air pressure 1010.6 mb, relative humidity 96% and visibility 200 m.

At 08:00 the air temperature was -4.4°C, air pressure 1010.6 mb, relative humidity 96% and visibility 100 m.

At 09:00 the air temperature was -3.91°C, air pressure 1010.9 mb, relative humidity 96% and visibility 100 m.

Meteorological visibility is the horizontal transparency of the atmosphere, which is expressed with the greatest distance at which the observer of normal vision can recognize objects known to him in the environment, when observing during the day, and light sources when observing at night.

At the time of the investigation of the serious accident in question by the CINS investigative team, it was day. The weather was partly cloudy, windy and without precipitation. Visibility was good. The air temperature was approximately -4°C.

3. Minutes on investigations 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 Voz"a.d.;
- material submitted by OJT in Subotica and
- material submitted by the road manager of the JP "Putevi Srbije".

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

Members of the MUP RS, PU Subotica, the Traffic Police Department in Subotica and members of the OJT Subotica conducted an on-site investigation.

3.1. Summary of testimonies

The CINS working group has on 18.02. 2021. in the premises of CINS, interrogated the train driver employed by the railway undertaking "Srbija Voz"a.d., who participated in the serious accident in question. The questioned train driver was on duty at train No. 6431 at the time of this serious accident.

From "Srbija Voz"a.d. Records on the interrogation of employees who were on duty at the train No. 6431 (train driver and conductors) as well as the Report of the conductor on irregularities - malfunctions (K-91) No. 32/20-I-3-948 from 04.12.2020 were obtained. Also, from "Srbija Voz"a.d., as an attachment to the letter 1/2021-43 from 14.01. 2021., the document "Statement of train drivers OJ for traction of trains Subotica, the state of the road crossing on the line Subotica - Sombor - Bogojevo - state border at km 102+890" was submitted.

From "IŽS"a.d. attached to the letter No. 1/2021-97 from 20.01.2021., the Report of the train dispatcher on irregularities during work (SP-9) No. 0048674 from 02.12.2020 was submitted.

issued by the train dispatcher of the Bajmok station, who was on duty at the time of the serious accident in question, and the Minutes of the hearing of the train dispatcher of the Bajmok station who was on duty at the Bajmok station at the time of the serious accident, as well as the train dispatcher in service at the time of the malfunction at the road crossing.

The summary of the testimony for the train driver who was on duty at train No. 6431 was given according to the hearing conducted by the CINS Working Group

3.1.1. The railway staff

The train driver stated that after the train left Bajmok station, he started to accelerate the train, when he came to the switching point he was giving the aspect of a signal "Watch out", and when he came across the control signal KS 2, it showed the aspect of a signal "Device at the road crossing correct". When he reached a certain speed according to the Timetable booklet, considering the reduced visibility, he reduced his speed and on his left side he noticed a car that was bright orange and on the right side he could not see the road, due to the guard. He noticed that the car was accelerating and that it would probably not stop, so he introduced fast braking at a distance of approximately 60 m from the level crossing because he thought he was going to hit that car. However, at that moment, a vehicle came from the right side, he had hit it and stopped approximately 150 m from the level crossing. At the moment of crashing, he was not completely sure whether the half-barriers were raised, only after stopping did he see that the poles were raised. He notes that there was poor visibility, thick fog and that when he came to the switching point, he could not notice the control signal and that he noticed it from a distance of 50 to 70 m.

3.1.2. Other witnesses

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

3.2. Safety management system

3.2.1. Organizational frame and manner of issuing and executing orders

The infrastructure manager "IŽS"a.d. and the railway undertaking "Srbija Voz"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 accident in question. By completion of investigation, Report on Investigation No. U-362/20 was drafted.

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 Voz"a.d. has informed CINS on the serious accident occurred.

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

"Srbija Voz"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 question in which the train driver and conductors was involved, employee of "Srbija Voz"a.d., all activities related to professional training, competence and work time planning were carried out in accordance with applicable regulations.

"IŽS"a.d. as the infrastructure manager has through the Rulebook of the safety management system (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.

3.2.3. Procedures for internal audits and controls and their results

"Srbija Voz"a.d. has, as the railway undertaking, established Rulebook of the safety management system. The general purpose of safety management system (SMS) is, to secure that "Srbija Voz"a.d. achieves its business goals in a safe way.

Rolling stock be must maintained in the prescribed technical level of correctness and must follow the maintenance plans (EV-62) and their 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 an integral part of the Safety management system Manual "Srbija Voz"a.d.

Regarding the serious accident in question, regular and corrective maintenance of the railway vehicle (DMV 711-033/034) in the period from 30.10.2019. to 13.11.2020. at certain time intervals, was not performed in accordance with the applicable regulations. For example, between the control repairs of P1 rank, carried out between 09.01. and 26.02., 48 days have passed, between repairs carried out between 12.03. and 08.05.2020., 57 days have passed, between repairs carried out between 08.05. and 15.06.2020., 38 days have passed, while between the repairs carried out between 10.09. and 20.10.2020. 40 days have passed, contrary to the Article 5, Paragraph 6 and 7 of the Instruction for Rolling stock maintenance No. 4/2016-16-4 of 23.02.2016. The aforementioned did not affect the occurrence of the serious accident in question.

"IŽS"a.d. as a management infrastructure has a business Safety Management System Rulebook. Safety management system includes organization and all processes and procedures set 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 line part) and railway vehicles used for maintenance by "IŽS"a.d., 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.

Regarding the serious accident in question, regular maintenance of the level crossing was performed in accordance with the applicable regulations (see section 4.2.1.3.) Corrective maintenance regarding the prescribed deadline in which troubleshooting of a defect was not performed according to applicable regulations (see sections 3.3.10. and 4.2.2.).

3.3. Relevant international and national regulations

3.3.1. 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, 87/2018 and 23/2019)

IV Traffic rules

...

1. General provisions

...

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

Article 100

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

A driver who approaches a railway 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, ie he can stop the vehicle before it steps on the railroad.

...

VII Traffic signalization

1. General provisions

Article 132 (excerpt)

...

Traffic participants are obliged to adapt their movement to the danger signs that these signs warn of in places, ie sections of the road that are marked with danger signs.

...

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

Article 153 (excerpt)

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

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

...

XI Drivers

5. Psychophysical conditions for driving a motor vehicle

Article 187

A driver who is incapable of safe driving, ie so tired or ill, or is in such a mental state that he is not able to drive safely, must not drive 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, ie a person for whom the analysis of an appropriate blood sample determines the alcohol content 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 (breathalyzer, etc.), with blood alcohol content greater than 0.20 mg/ml.

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

III Calculation of access prices and allocation of railway infrastructure capacity

...

8. Road crossings, reconstruction and road crossings maintenance

Article 62 (excerpt)

At the road crossing, the railway infrastructure and railway traffic are managed by the railway infrastructure manager (infrastructure manager, service facility operator, owner, ie authorized industrial track manager who is part of the railway infrastructure), and the 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 place of intersection on the infrastructure he manages.

...

Article 67 (excerpt)

The railway infrastructure manager and the road infrastructure manager are obliged to conclude an agreement which regulates the mutual relations in terms of road 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 road crossing., the method of payment of expenses and regulate other issues from these relations.

The agreement 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 agreement referred to in paragraph 1 of this Article must be signed no later than December 31st of the current year for the upcoming year.

...

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 road crossing and to maintain the road 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 manager of the railway infrastructure takes care of maintaining the part of the road crossing, as well as ensuring safe and undisturbed traffic at the road crossing, with the provison

that the roadway at the road crossing must be maintained so that safe and undisturbed road traffic can be performed over it.

...

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

II Railway vehicles

1. Technical conditions

...

Traction vehicle devices and equipment

Article 51 (excerpt)

Locomotive must possess:

...

8) sound signaling device;

XIII Crossing of the railway lines and the roads

...

Article 96 (excerpt)

...

Traffic at road crossings is provided with traffic signs for participants in road traffic. On the railway line, in front of the road crossing, the prescribed aspects of a signal must be placed to inform the train staff about the approach of the train to the road crossing. The train has the right of priority in relation to participants in road traffic.

...

Conditions for crossing a railway line and a 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 at the road crossings depend on the traffic density, visibility of the railway, driving speed on the railway and the road and local conditions.

...

3.3.4. Law on Planning and Construction ("Official Gazette RS" No. 72/2009, 81/2009 – amend., 64/2010 – decision US, 24/2011, 121/2012, 42/2013 - decision US, 50/2013 - decision US, 98/2013 - decision US, 132/2014, 145/2014, 83/2018, 31/2019, 37/2019 – other law, 9/2020 and 52/2021)

VIII Operating permit

Technical inspection of the facility

...

1.2. Probation period

Article 157

If, in order to determine the suitability of the facility for use, preliminary tests and checks of installations, devices, plants, stability or safety of the facility, devices and installations for environmental protection, fire protection devices or other tests must be performed, or if provided by technical documentation, the technical inspection commission, ie the company or other legal entity entrusted with the technical inspection may approve the commissioning of the facility, provided that it determines that the conditions are met, and notify the competent authority without delay.

The probation period may last for a maximum of one year. It is the obligation of the investor to monitor the results of the probation work.

During the probation operation of the facility, the Technical Inspection Commission, ie the company or other legal entity entrusted with the technical inspection, checks the fulfillment of the conditions for issuing the use permit and submits a report to the investor.

2. Issuance of the operating permit

Article 158 (excerpt)

The facility for which the issuance of a construction permit is envisaged in accordance with this Law may be used according to the previously obtained use permit. The body that issued the construction permit shall issue a decision on the use permit, within five working days from the day of submitting the request for issuing the use permit.

...

3.3.5. Traffic Signallization Rulebook ("Official Gazette RS" No. 85/17 и 14/21)

Note: During the investigative procedure, amendments to this Rulebook (Rulebook on Amendments to the Traffic Signalization Rulebook No. 110-00-00012/2021-03 of 09.02.2021 ("Official Gazette of RS" No. 14 of 17.02.2021)), which did not affect the serious accident in question.

1. Traffic signs

...

1.1. Danger signs

Article 17

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

Article 18 (excerpt)

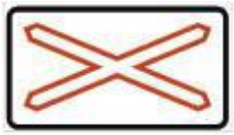
Danger signs are:

...

27) sign “crossing of the road with the railway line with barriers or half-barriers” (I-32), denotes encountering the crossing of the road with the railway line at the level, provided with barriers or half-barriers;

I-32

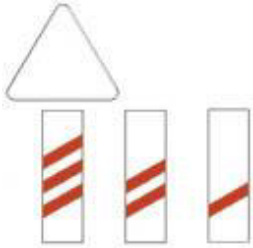
29) sign “Saltire”, denotes encountering the crossing of the road with the railway line at the level with one track (I-34), i.e., with two or more tracks (I-34.1);



I-34

I-34.1

30) 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 23

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.

...

3. Traffic lights

Article 71.

Traffic lights are used to regulate the traffic and to denote the works and obstacles on the road.

Traffic lights are used to regulate:
1. vehicle movements;
2. pedestrian movements;
3. tram movements;
4. bicycle movements;
5. level crossing over the railway line;
6. vehicle access.

Traffic lights emit light traffic signs, ie, red, yellow, green or white lights.

Traffic lights can also be with a graphic symbol, which further explains its meaning, ie defines which category of users the term refers to.

...

3.5. Traffic lights for regulating the crossing of the road over the railway line at the same level

Article 81

Traffic lights that regulate the crossing of the road over the railway at the same level (VI-9), are used to announce the approach of the train and the announcement of the lowering of the barriers, ie the semi-barriers.

It is placed at the crossings of the road over the railway at the level, with or without barriers, ie, semi-barriers.

Light traffic signs are given by alternately turning on two red flashing lights in the shape of a circle, and sound devices can be added to inform traffic participants that a light traffic sign has been given, announcing the approach of a train.

The lights referred to in paragraph 3 of this Article are located next to each other on the horizontal axis, on a board that has the shape of an equilateral triangle with the top facing upwards, whose characteristics correspond to the danger signs.

VI-9

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 RS" No. 89/2016)

I. INTRODUCTORY PROVISIONS

...

Article 2 (excerpt)

Certain terms used in this Rulebook have the following meaning:

...

11) dangerous area at the road crossing is a part of the road located 3 m before the first rail on the side of the road vehicle approaching the road crossing at the level of the track and 2 m after the last rail on the side of the leaving the road crossing, where the load profiles of road vehicles and railway vehicles overlap or touch;

...

III. Measures to ensure safe traffic at road crossings

Article 10 (excerpt)

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

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

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 road crossing and special measures, and

6) protective fences and traffic signs or bypasses and traffic signs at road crossings for pedestrians and cyclists.

...

Article 35 (excerpt)

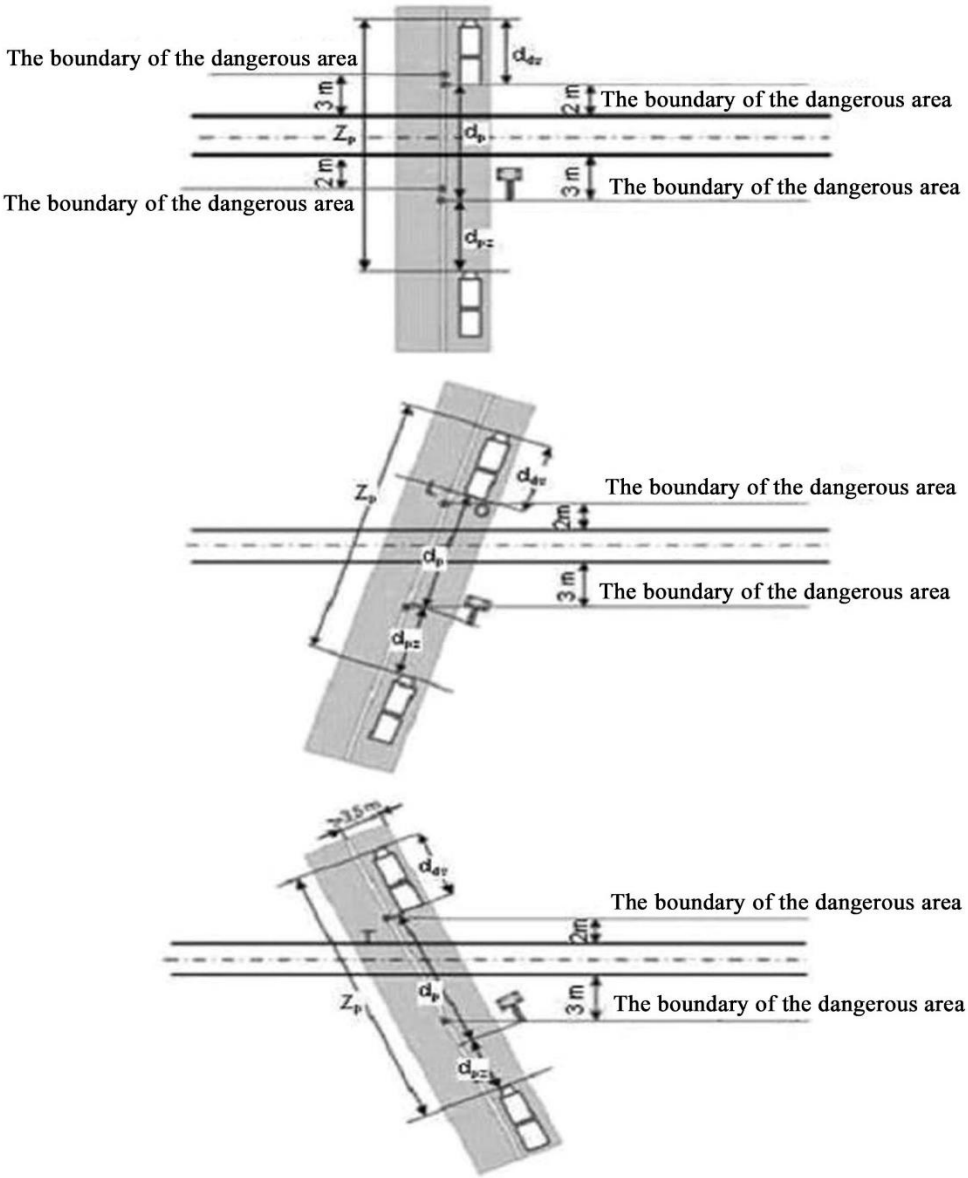
If there is a malfunction or temporary inability to use the signal-safety device at the road crossing, the traffic at the road crossing is provided by applying one of the following special measures:

...

3) the railway vehicle is stopped in front of the road crossing with the aspect of signal prescribed in Article 17 of this Rulebook, and when it is ensured that the road vehicles stopped in front of the road crossing at the aspect of a signal indicating the place of crossing the road over the railway, the railway vehicle continues slowly and carefully, and road vehicles continue driving after leaving the railway vehicle, ie the last vehicle in the train in the area of the road crossing.

...

Appendix 2: Level crossing at the place of intersection of the railway line and the road



Wherein:

d_{pz} - length of stopping the road vehicle;

d_p - length of the level crossing;

L - a line opposite to the right edge of the road belt;

O - the point of intersection of the right edge of the road belt and the boundaries of the danger area;

T - the point of intersection of the invisible line, opposite the right edge of the road belt and the invisible line, parallel to the right edge of the road belt at a distance of 3.5 m, if the lane is narrower than 3.5 m, and from the left edge of the roadway if the lane is wider than 3.5 m.

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

III. PERMANENT SIGNALS

…

10. Signals for automatic devices at road crossings

General provisions on signals for automatic devices at road crossings

Article 132.

The correctness of automatic devices for providing traffic at road crossings at the same level including the oncoming train is controlled in two ways:

1) control devices installed in one of the adjacent continuously occupied official points (remote control);

2) control light signals installed at a certain distance in front of the road crossing.

If the traffic at road crossings is provided in the manner referred to in paragraph 1, item 1) of this Article, only signals indicating the beginning of the stopping road in front of the road crossing shall be installed on the line in front of the road crossing. the switching point is, exceptionally, located at a greater or lesser distance from the stopping distance.

If the traffic at the road crossings is provided in the manner referred to in paragraph 1, item 2) of this Article, the following shall be installed on the line in front of the road crossing:

1) control light signals;

2) auxiliary control light signals, if necessary;

3) switching point signals.

The control and auxiliary control light poles are painted on the front with oblique black and white stripes of equal width.

The switching point signals and the signal of the beginning of the stopping road in front of the road crossing are not illuminated at night.

a) Control and auxiliary control light signals

Place of installation and distance of visibility

Article 133

Control light signals shall be installed in front of the road crossing at a stopping distance or at a greater distance, but up to a maximum of 1.5 stopping lengths.

The control light signal must be visible from the place where the switching-on signal is installed in front of the road crossing control signal.

An auxiliary control light signal shall be installed between the control light signal and the road crossing on that part of the track where the train has a delay between the control light signal and the road crossing, and then continue driving in the direction of the road crossing.

Aspects of a signal of control and auxiliary control signals

Article 134

Aspects of a signal of control and auxiliary signals are:

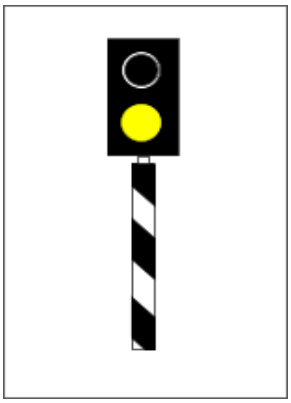
1) Aspect of a signal 55: “Device at the level crossing defective”

2) Aspect of a signal 56: “Device at the level crossing correct”.

Aspect of a signal 55: “Device at the level crossing defective”

Article 135.

The shape and colour of the aspect of a signal 55: “Device at the level crossing defective” is given in Fig.70.



day and night sign:

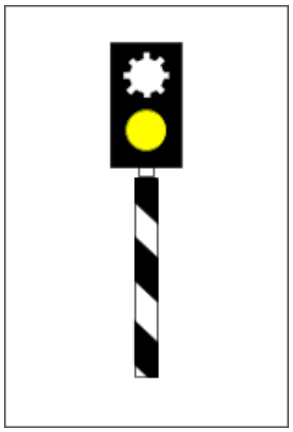
one yellow calm light towards the train

Figure 70

Aspect of a signal 56: “Device at the level crossing correct”

Article 136.

The shape and colour of the aspect of a signal 56: “Device at the level crossing correct” is given in Fig.71.



day and night sign:

one yellow calm and above it one white flashing light towards the train

Figure 71

The white flashing light turns on and off in the rhythm of the road traffic sign in front of the road crossing.

б) Switching point signals

The point of placing and the distance of visibility

Article 137 (excerpt)

Switching point signals that show aspect of a signal 57: “Switch-on point, expect the control signal” are installed next to the switching point signal (which is on the track) before the control light signal, and on the same side where the control light signal is placed.

...

The distance of visibility for pre-signals prescribed in Article 29 of this Rulebook also applies to the signals of the switching point.

Aspects of a signal of the switching point signal

Article 138 (excerpt)

Aspects of a signal of the switching point signal are:

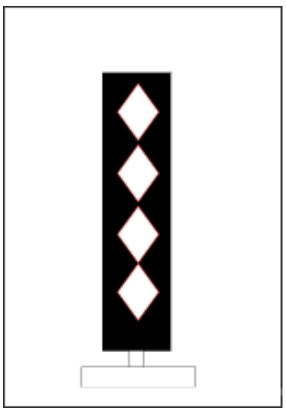
1) aspect of a signal 57: “Switch-on point, expect the control signal”

...

Aspect of a signal 57: “Switch-on point, expect the control signal”

Article 139.

The shape and colour aspect of a signal 57: “Switch-on point, expect the control signal” are given in Figure 73.



day and night sign:

a rectangular black board with four white rhombuses placed one below the other

Figure 73

Procedures for railway workers regarding the display of aspects of a signal for automatic devices at level crossings

Article 143 (excerpt)

...

If after passing the aspect of a signal 57: “Switch-on point, expect control signal”, the control light signal shows the aspect of a signal 55 “Device at the level crossing defective”, the train driver reduces the speed of the train, several times he gives an aspect of a signal 67 “Watch out” and the

train stops in front of the level crossing. The procedure for further drive is given in the Traffic Rulebook.

...

Section V: Aspects of a signals of the traction vehicle staff

Basic provisions on aspects of a signal

Article 158 (excerpt)

With the aspects of a signals of the traction vehicle staff, the traction vehicle staff gives the necessary orders and warnings to the train, station and railway staff, and in certain cases to other persons.

...

The aspects of a signals of the traction vehicle staff are given by a train driver with a traction vehicle siren.

...

Aspects of a signals of the traction vehicle staff

Article 29 (excerpt):

A. Basic provisions. Aspects of a signal

1. With the aspects of a signals of the traction vehicle staff, the traction vehicle staff gives the necessary orders and warnings to the train, station and railway staff, and in certain cases to other persons.

...

2. The aspects of a signals of the traction vehicle staff are given by a train driver with a traction vehicle siren.

...

Article 159 (excerpt)

The aspects of a signals of the traction vehicle staff are:

1. aspect of a signal 67: “Watch out”, one long sound: ————

...

Aspect of a signal 67: “Watch out”

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”,

...

(5) in front of road crossings whose safety devices are faulty but not occupied, or whose devices are not handled at the time of train passage due to interruption of service,

...

(8) in case of reduced visibility due to bad weather, more often,

…

(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;

...

3.3.8. Rulebook 2, Traffic Rulebook (“Official Gazette of ZJŽ” No. 3/94, 4/94, 5/94, 4/96 and 6/03)

Section VI: Organization of traffic

Article 34 (excerpt):

Informing train staff about train traffic and safety measures

...

29. By general order it is regularly informed and ordered that

...

the procedure when the barrier or automatic device at the road crossing is defective, i.e. when the road crossing is unsecured;

...

Section XIII: Irregularities during the drive on the open track

Article 63 (excerpt):

Exceptional stopping of the train on the open track

...

5. In front of the road crossing the train driver must stop the train in the following cases:

...

- when the control light signal in front of the road crossing does not show the aspect of a signal 55: “Device at the road crossing correct”;

...

In all these cases, the road crossing is considered unsecured.

...

After the train driver ensures that at the level crossing and in the immediate vicinity there are no vehicles, pedestrians or cattle, the train will cautiously continue its drive until the traction vehicle crosses over the railway line, and further with the prescribed speed.

3.3.9. Rulebook on technical conditions for safety-signalling devices ("Official Gazette RS" No. 18/2016 and 89/2016)

1. Introductory provisions

...

Safety-signalling devices

Article 2 (excerpt)

Safety-signalling devices (hereinafter: SS devices), in terms of this Rulebook, are:

...

4) Devices for securing the level crossings (hereinafter: PP devices);

...

SS devices parts

Article 3 (excerpt)

Parts of SS devices, in terms of this Rulebook, are:

...

7) axle counters (hereinafter: BO);
8) barrier mounting devices on PP;
9) transit light signals

...

2. Technical conditions for SS devices

Article 5 (excerpt)

General technical conditions that SS devices must meet

...

3) SS device is constructed in such a way that in case of individual failure or interruption of any assembly or part of the device, it prevents the occurrence of conditions in which the safety of railway traffic could be endangered, such as

(1) incorrect signal indication,

...

(9) report of non-switching on or premature switching off of the PP device;

...

5) to ensure the safe flow of traffic at the intersections of railway and road traffic;

...

3. Technical conditions for SS devices parts

Permanent light signals

Article 10 (excerpt)

...

Control and auxiliary control signals must meet the following technical requirements:

...

1) the duration of the white flashing light on the control or auxiliary control signal, which works in the rhythm of the lamps on the transit light signals, is limited in time to 30 to 90 seconds from the moment of the first appearance of that light. The time circuit used for this purpose does not have to be doubled. If the time limit has not expired, the flashing light is extinguished by the arrival of the rail vehicle at the exclusive points of the road crossing;

...

2) if the PP device is defective, the white flashing light must not come on either on the control signal or on the auxiliary control signal;

...

Appendix 2 (excerpt)

Basic elements for the calculation of the length of the train approaching the road crossing, ie the length of the inclusive section

...

Length of the level crossing zone is:

Lz=Lzp+Lpv+d (m)

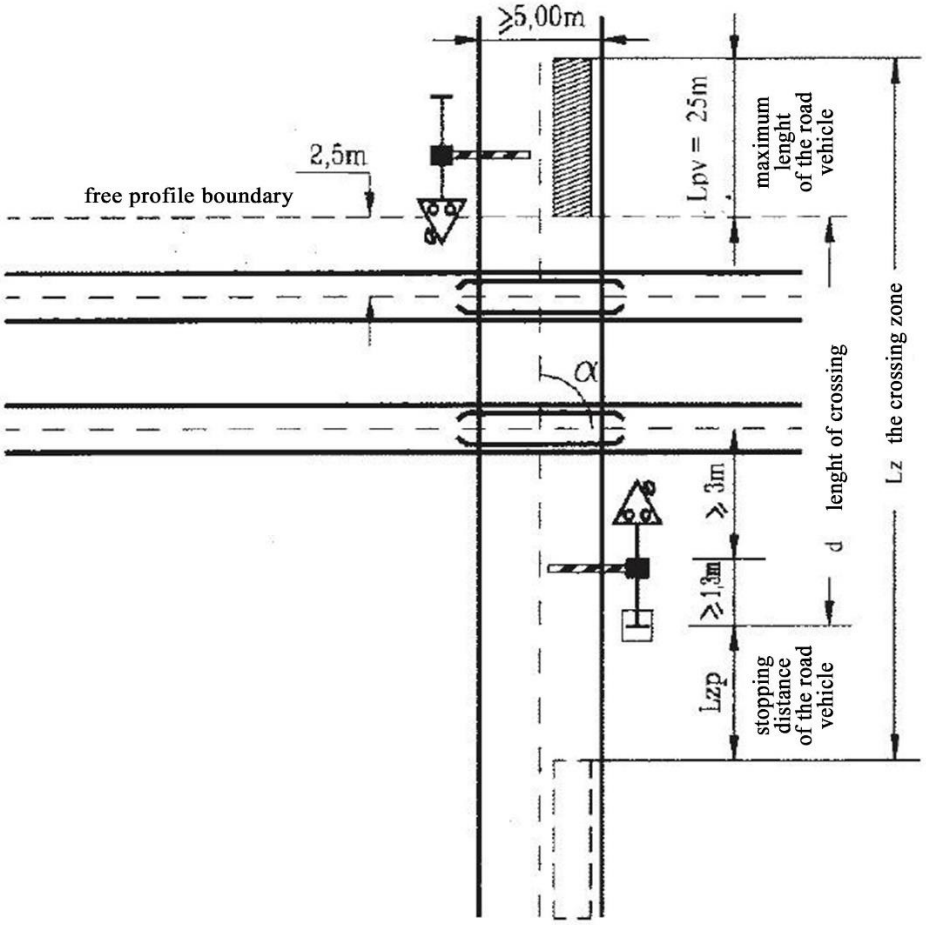
where:

...

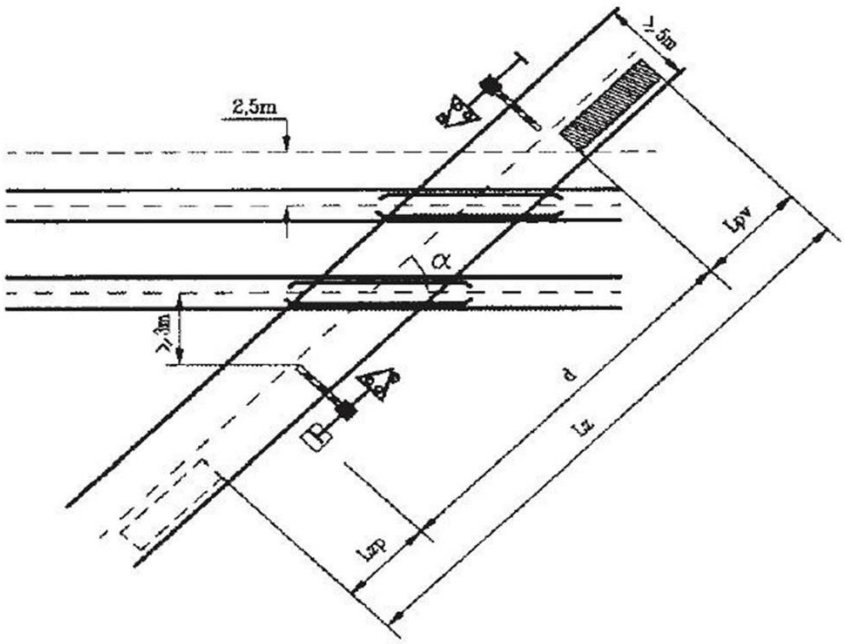
d – length of crossing according to the Figure 1.

...

Figure 1: Basic manner of crossing of the railway line and the road and determining the location of the securing elements



Crossing at right angle (α = 90°)



Crossing at sharp angle (α < 90°)

3.3.10. Rulebook on safety-signalling devices maintenance ("Official Gazette RS", No. 41/18)

II General provisions on the maintenance of SS devices

...

Corrective maintenance

Article 9

Corrective maintenance has priority over regular maintenance of the device.

Maintenance workers shall proceed to rectify the fault or malfunction of the signaling and safety device within two hours of receiving notification of the fault or malfunction.

Notwithstanding from 2 of this Article, in the case of hard-to-reach places, bad weather conditions and the like, the time to access the troubleshooting of malfunction may be up to four hours from the receipt of the notification of the fault or malfunction.

Regular maintenance of the device for securing the level crossings

Article 33

Regular maintenance of the device for securing the level crossings includes:

1) maintenance of barriers and their components;

2) maintenance of road light signals at the road crossing;

3) maintenance of switch on/off elements of the road crossing;

4) maintenance of control light signals on the track;

5) maintenance of the command-control and power supply part of the device.

3.3.11. Instruction for operation of devices for securing the automatic traffic at the level crossing at km 102+890 of the railway (ERDUT-HŽ) - km 41+074, state border - Bogojevo - Subotica (case number 08/2007-265 of 21.08.2007, registration No. 9)

1. INTRODUCTORY PROVISIONS

1.1. Introductory remarks

1.1.1. At *km* 102+890 of the railway (ERDUT-HŽ) - km 41+074, state border - Bogojevo - Subotica on the open track of the distance between the stations between official points Aleksa Šantić and Bajmok, the device for automatic securing the traffic has been installed.

1.1.2. The road crossing device is with road crossing barriers, light and sound road signalization with control signals. It is switched on and off automatically by the train, and there is also the possibility of operating the crossing device on the spot.

...

1.1.3. As the Bajmok station is in charge of this level crossing, all works related to this level crossing is performed at the Bajmok station.

...

1.3. General provisions

1.3.3. This Instruction must be supplied to executive units and professional services of traffic, construction and electrical activities, units of traction and maintenance of vehicles in the Subotica junction, as well as organizational parts of companies that are superior to these organizational units.

This Instruction must be an Annex to the Bajmok Station Business Rules.

...

2. TECHNICAL – OPERATIONAL CHARCTERISTICS OF THE DEVICE

2.1. Basic data on level crossing device

...

2.1.2. The automatic road crossing device with control signals of the PZZ-EA type is a product of AŽD companies from the Czech Republic.

Switching on and off the road crossing device is done automatically, by crossing the train or rail vehicle via on or off devices - sensors, and there is also the possibility of direct handling of the device on the spot.

...

2.1.4. The device of the road crossing at the place of the road crossing includes light vertical signalization of road traffic, installation devices with road crossing barriers which prohibit crossing of the railway at the time when the device of the road crossing is switched on, loud bell which warns road traffic participants.

In addition, external plants and devices include on or off sensors and other equipment that connect all external elements in the functioning of the crossing device.

...

3. HANDLING THE LEVEL CROSSING DEVICE

3.1. Regular device functioning

3.1.1. This level crossing device is not handled regularly, but the level crossing device is switched on and off automatically when a train or rail vehicle encounters the appropriate on and off sensors.

...

3.1.3. When the device at the level crossing is correct, after the train passes the signal of the switching point, the control signals start to show an aspect of a signal 56: “Device at the level crossing correct”, and when the device at the level crossing is defective, the control signals show an aspect of a signal 55: “Device at a road crossing defective”. Upon encountering these signals, the train driver or the driver of the railway vehicle acts according to the aspects of a signal.

3.1.4. The regular condition of the device is that it does not secure traffic at the crossing, ie that the crossing device is switched off and then the control signals show aspect of a signal 55: “Device at the crossing defective”, and after crossing the first axle over the switching point, that is, switching on of the level crossing device, if the level crossing device is correct and if it has been switched on, the aspect of a signal 56 “Device at the level crossing correct” starts to show, which means that further driving is allowed.

3.1.5. In the event that the level crossing device is not switched on after crossing the switch-on point due to a fault or any other reason, the control signals still show the aspect of a signal 55: "Device at the crossing point defective". In these cases, the train driver or the driver of the railway vehicle is obliged to act in the manner prescribed for the case when the road crossing is unsecured, ie to act in accordance with the provisions of Art. 61 item 12 or Art. 63 points 5 of the Rulebook 2. When encountering a road crossing, the driver is obliged to give an aspect of a signal 67 several times: "Watch out".

...

4. INTERFERENCES AND FAULTS OF THE ROAD CROSSING DEVICE

...

4.2. Procedures in the event of faults

4.2.1. In the event that there is an operational disturbance that endangers traffic safety, the road crossing device goes into a state of "failure" and in that state, the road crossing device does not secure traffic at the road crossing.

4.2.2. In these cases, when the train or rail vehicle passes over the switching sensors, the crossing device will not turn on and traffic will not be secured at the crossing, ie the control signal will still show the aspect of a signal 55: "Device at the crossing defective" so that it is train staff is obliged to act as if the traffic at the road crossing is not secured, ie to act in accordance with the provisions of Art. 61 points 12 and Art. 63 points 5 of the Regulations 2.

This activity must be recorded by the train staff in the travel document or pass in accordance with the provisions of Instruction 58.

4.2.3. After the train staff at the road crossing acted in accordance with the provisions of Art. 61 points 12 and Art. 63 points 5. of Rulebook 2, it continues to run to the first occupied official position where the train has a regular operation and in that official position the train driver is obliged to inform the train dispatcher about the malfunction at the road crossing.

This is done by entering the data in section IV "Remarks" of the travel document, and the receipt of the notification must be confirmed by the train dispatcher with his signature in the travel document below the entered text on the malfunction of the road crossing.

4.2.4. The train dispatcher who received the notification on the malfunction of the crossing device is obliged to immediately forward this notification to the Bajmok station as a phonogram that will be recorded in the TT diary (S-43).

4.2.5. On the basis of the received and recorded notification, the train dispatcher makes records in the Notebook of disturbances and malfunctions V-11 and immediately notifies the service for maintenance of signalling-safety devices about the malfunction of the road crossing device, ie acts in accordance with the provisions of Art. 39 Instruction 40.

4.2.6. In cases when there is a malfunction at the road crossing device, the train staff is not informed about the malfunction of the road crossing device, that is, the traffic at the road crossing is not secured, but the train staff is informed about it via a control signal.

...

3.4. Functioning of the railway vehicles and technical installations

3.4.1. Control, command and signalling

On the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), SS device at the level crossing at km 102+890, secured with automatic half barriers with light traffic signs and traffic signs on the road, was defective.

According to the data submitted in the attachment to the letter from "IŽS"a.d. No. 1/2021-97 of 20.01.2021. and the letter "Srbija Voz"a.d. No. 1/2021-43 of 14.01.2021., the failure of the device at the road crossing was first noticed on 01.12.2020. by the train driver No. 6435, which he entered in section IV of the travel document and reported to the train dispatcher of the station Sombor, which is 01.12.2020. at 20:48 via TT diary (S-15) informed the Subotica station about the failure of the SS device, whose SS section maintains the device at the road crossing in question. At 21:45, the train dispatcher at the Subotica station reported a device failure at the road crossing at km 102+890 to the SS dispatcher and he recorded the failure in in V-11 Interference Notebook. The same malfunction was reported on three more occasions by the train driver (by entering in section IV of the travel document and reporting to the train dispatcher) on 01.12.2020. at 23:07 in the station Subotica by the train driver No. 5412, on 02.12.2020. at 06:19 in the Bajmok station by the train driver No. 5420 (the fault was entered in the Notebook of disturbances of the V-11 station Bajmok at 06:20 and the fault was reported to the SS dispatcher) and 02.12.2020. at 07:00 in the station Sombor by the train driver of the train No. 5411.

By "IŽS"a.d. information was submitted (letter from the Sector for ETP No. 21/2021-26 dated 12.01.2021) that the mechanic on duty who worked alone in the night shift on 01/02.12.2020., was informed about the failure at the road crossing in question, but that due to interventions at other interferences and failures, he did not manage to eliminate the reported failure. Attached to the same letter, a tabular presentation of records of failures and disturbances at the road crossing at km 102+890 in the last five years was submitted, where it can be seen that, among others, a failure at the road crossing was reported on 01.12.2020. at 21:50, checked out on 02.12.2020. at 00:50 with the explanation: "device was reset", re-registered on 02.12.2020. at 06:30 and checked out on 04.12.2020. at 14:40.

The failure in question was rectified on 04.12.2020. at 14:40, after the occurrence of the serious accident in question, which was entered in the V-11 Interference Notebook at the Bajmok station.

3.4.2. Infrastructure

The condition of the infrastructure (in terms of the condition of the tracks and facilities) on the main line 110: Subotica - Bogojevo - state - border - (Erdut), between the official points Bajmok and Aleksa Šantić was in order and in that sense, there were no irregularities that could negatively affect the occurrence of the serious accident in question.

According to point 5.2. of the Business order of Bajmok station part I (case number 15/9-2632 dated 16.12.2018), at the level crossing at km 102+890 on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between stations Aleksa Šantić and Bajmok, an automatic road crossing has been installed, which is secured with control aspects of signal.

According to the data from "IŽS"a.d. (the letter from "IŽS"a.d. No. 1/2021-97 of 20.01.2021. with Appendices) works on reconstruction and raising the level of insurance at the level crossing at km 102+890 on the line Subotica - Bogojevo - state border with the Republic of Croatia have been approved by the Decision of the Republic of Serbia, Ministry for Capital Investments, Sector for Railways and Intermodal Transport No. 351-02-131/2006-11 of 21.09.2006. Data on commissioning after the reconstruction and raising the level of insurance and the use permit for the road crossing in question were not submitted by the said letter by the railway infrastructure manager "IŽS"a.d. However, at the repeated request of CINS, attached to the letter No. 1/2021-935 dated 29.04.2021. "IŽS"a.d. letter No. 27/21-430 dated 29 .04.2021 a Letter 27/21-430 of 29.04.2021. was submitted of the Sector for Investments in which it was stated that

"IŽS"a.d. has no additional information that the competent ministry has issued a use permit. "IŽS"a.d. possesses only Decision No. 351-02-879/2007-11 from 17.10.2007. of the Ministry of Infrastructure approving the trial use in traffic (trial operation) of the reconstructed facility - road crossing "Bajmok" at km 102+890 of the railway Subotica - Bogojevo - state border - (Erdut) under the following conditions that the duration of the trial operation is no longer than 17.01.2008 (three months). The mentioned Decision specifies the conditions to be met by the investor and the contractor, and that before the expiration of the trial period, the investor ("IŽS"a.d.) submits the documentation with the results of the trial work to the Ministry of Infrastructure with a proposal on the suitability of the facility for issuing use permit.

At the time of this serious accident, the SS device was not working at this road crossing. The failure of the SS road crossing device was first recorded on 01.12.2020. at 20:48.

On the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), before the level crossing in question, from both direction signals have been installed in accordance with the provision from the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20) relating to the level crossing with automatic device (see point 2.2.3.)

An on-site inspection carried out by the CINS investigative team established that the control light signals KS1 (installed at km 102+187) and KS 2 (installed at km 103+582) showed aspect of a signal 55: "Device at the road crossing defective" (See point 2.2.3). During the investigation, while driving the train No. 36433 from the direction of Bajmok station in the direction of Sombor station, it was noticed on the spot that the control signal KS 2 has, all the time during the train approaching the switching point, crossing the switching point, driving between switching point and control signal , driving between the control signal and the level crossing and upon crossing the level crossing, showed an aspect of a signal 55: "Device at the road crossing defective".

Between Joint Stock Company "Železnice Srbije" Beograd, in the terms of railway infrastructure manager, and JP "Putevi Srbije" Beograd, in terms of road infrastructure manager, an Agreement on maintenance of road crossing at the state roads of I and II rank at the territory of the Republic of Serbia has been concluded ("ŽS"a.d. No. 300/2015-810 of 09.06.2015. and JP "Putevi Srbije" 454-718 of 04.07.2015.) which has, by the Agreement on Assignment of the Agreement on maintenance of road crossing at the state roads of I and II rank at the territory of the Republic of Serbia, been taken over and is in application in "IŽS"a.d. ("IŽS"a.d. No. 1/2015-985 of 09.10.2015. and in "ŽS" 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 work of railway workers who perform works at road crossings, the method of payment of those costs and else.

An on-site inspection conducted by the CINS investigative team determined that the traffic signals at the road crossing at km 102+890 were not installed in accordance with the Rulebook on Traffic Signals ("Official Gazette of RS" No. 85/17). Traffic signs I-34: "Saltire" are not placed on a common supporter above the traffic lights: IV-9 which regulates the crossing of the road over the railway at the same level as defined in Article 23, paragraph 1, under 6) Rulebook on traffic signalization ("Official Gazette RS" No. 85/17), are already placed on special supporters located in front of the supporter on which the traffic lights are placed IV-9 (seen for the respective direction of movement of road vehicles), at a distance of 2.9 m, seen from the direction of Sombor in the direction of Bajmok, ie at a distance of 1.7 m, seen from the direction of Bajmok in the direction of Sombor (see point 2.2.3).

An on-site inspection carried out by the CINS investigative team established that the supporter on which the IV-9 traffic light was placed, which is located in front of the road crossing from the direction of Sombor, does not stand vertically (90 °) in relation to the roadway, but at an angle of approximately 70 °, inclined forwards, in the direction of the road towards Bajmok and slightly to the right. There is damage on the supporter and the foundation on which the supporter is placed, most likely caused by the impact of the road vehicle, while no damage was noticed on the traffic light itself. A certain amount of small broken safety (tempered) glass used on road vehicles was observed on the half-barrier supporter (Figures 3.4.2.1 and 3.4.2.2). The shape and location of the observed damages to the supporter and the base of the traffic light supporter and the shape, size and position of the broken glass indicate that the damages did not occur in the serious accident in question.

Figure 3.4.2.1: Appearance of the traffic lights (view from direction of Sombor)

Figure 3.4.2.2: Appearance of traffic light details (view from direction of Sombor)

3.4.3. Communication tools

At the time of occurrence of the serious accident in question, on the section of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Bajmok and Sombor,

the means of communication were correct and in function. No disturbances or malfunctions were recorded on the means of communication.

3.4.4. Railway vehicles

At the time of occurrence of the serious accident in question, the train No. 6431 was moving in the direction from the station Bajmok (Subotica) to the station Aleksa Šantić (Sombor), in the direction of decreasing stationing.

Train No. 6431 consisted of DMV series 711-033/034, owned by "Srbija Voz"a.d.

DMV 711-033/034 was released on 10.03. 2016. and until 30.11.2020., he ran 605,596 km and it had a license for use in traffic issued by the Directorate for Railways I-02-2 No. 340-166-3/2016 of 07.03.2016.

DMV series 711 of manufacturer "Metrovagonmaš"a.d. from Mitiščije, Russia, is intended for the transport of passengers on 1435 mm wide gauge railways, equipped with low platforms. It works as an independent (autonomous) transport vehicle. The DMV is composed of two motor wagons, driven by a powertrain (diesel engine and hydraulic power transmission). The interior is connected into one spatial unit with comfortable seats of the second class (a total of 120 seats) and a space provided for standing (a total of 126 seats according to the criterion of 4 passengers/m^2). The passenger compartment is fully air-conditioned and equipped with security video surveillance. In accordance with Article 51 of the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018), the DMV series 711-033/034 is equipped with a device for giving sound signals (siren).

Based on documentation from "Srbija Voz"a.d. it has been noticed that the periods between regular repair have been longer than the prescribed time interval (for example, between the control repairs of P1 rank, carried out in January and February 2020., 48 days have passed, between repairs of P48 rank carried out in March 2020., 57 days have passed, etc.) In all other aspects, regular and corrective maintenance of DMV 711-033/034 in the period from 30.10.2019. to 02.12.2020. was carried out in accordance with the Rulebook on maintenance of railway vehicles ("Official Gazette of RS", No. 101/2015, 24/2016, 36/2017) which was valid at the time of the serious accident and the Instruction for maintenance of traction vehicles "Srbija Voz"a.d. No. 4/2016-16-4 of 23.02.2016.

Review of DMV 711-033/034 performed by professional services of "Srbija Voz"a.d. after the serious accident on the spot, and then in the workshop of ZOVS in Sombor (document of the Section of ZOVS Sombor: Report on the factual situation of train No. 6431 determined by on-site inspection and Report on the condition of DMV 711-033/034 after the accident determined in the review in workshop ZOVS in Sombor No. 51/2020-268 from 29.12.2020, submitted by "Srbija Voz"a.d.), apart from the damages caused in the serious accident in question, on DMV 711-033/034 no defects, malfunctions or damages that could have affected the occurrence of a serious accident, were noted.

On DMV 711-033/034 a device for measuring and registering speed type TELOC 1500 manufacturer Hasler Rail, from Bern, serial No. 15094809 with instruments for indicating speed serial No. 13081760 and 13081755 and speed sensor serial No.15091818, were installed.

For the mentioned device, from "Srbija Voz"a.d. the Report and Certificate on testing and checking the correctness of the device for measuring and registering the speed TELOC 1500 No. 4/02-2020 dated 09.03.2020 was delivered, which confirms that the electronic speedometer is

of brand TELOC 1500, serial No. 15094809 correct and in accordance with Annex 6 of Instruction 230.

By processing the data taken from the memory of the electronic speedometer DMV 711-033/034 (document Data from the records of speedometer Teloc 1500 No. 39/2021-20 from 05.12.2020 submitted by "Srbija Voz"a.d.) it was determined that the train No. 6431 departs from the station Subotica at 07:30:48 and stops at Bajmok station at 08:10:37 On the route Subotica - Bajmok, it was registered that the total number of stops of the train No. 6431 was nine (five times in official points according to the Timetable Booklet 4.2 and four times in front road crossings according to the received General Order). On this section of the line, two times the registered speed was higher than the maximum allowed speed for the train No. 6431 according to the Timetable Book No. 4.2 (83.3 km/h between the official points Subotica Suburbs and Šebešić and 82 km/h between the official points Tavankut and Skenderevo) and the use of a siren was registered three times (at 1593 m, 2250 m and 2334 m from the departure from the Subotica station). From the station Bajmok train No. 6431 started at 08:11:13 and accelerates. At 08:11:48, after 746 m, it reaches a speed of 30 km/h. The train continues to accelerate and after 1338 m from the start from the Bajmok station it reaches a speed of 78.9 km/h, after which the speed decreases and at 08:14:14, after 2386 m from the start from the Bajmok station, the train speed is 73.53 m/h. At that moment, the traction was interrupted and the braking started by activating the "danger" button. The speed of the train decreases and at 08:14:17 (2434 m from the start from the station Bajmok) it is 59.56 km/h. At that moment, in the interval of 0.02 s, the speed of the train decreases from 59.56 km/h to 52.92 km/h. The train continues to slow down and stops at 08:14:31 after 2533 m from the departure from Bajmok station.

3.5. Traffic regulation and management

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

At the station Subotica, the employees of "IŽS"a.d. have given to the train staff a General Order I (S-20) No. 14 of 02.12.2020., in which it was stated that between the stations Subotica and Sombor the following road crossing at km 127+135, 126+741, 123+486, 118+542, 115+163, 111+828, 97+266, 95+859, 84+584 and 83+570 were unsecured, and that in front of them one should stop, drive cautiously over them and continue the drive with the prescribed speed. The train No. 6431 was started from the station Subotica at 07:30, as predicted in the Timetable Booklet 4.2.

The traffic of the train No. 6431 between the stations Bajmok and Sombor took place at at station distance, with the regulation of traffic by the train dispatcher of the occupied official points Bajmok and Sombor. The train No. 6431 entered into the third track of the station Bajmok at 08:06 and was dispatched at 08:07 after manipulation of passenger was completed, regularly (by aspects of signal of train dispatcher and by the exit aspects of a signal), in accordance with the permission given (permission was given at 08:05) by the train dispatcher of the station Sombor.

At the stations Subotica and Bajmok, the General Order I (S-20) for informing the train staff on the failure of the level crossing device at km 102+890 was not submitted, bearing in mind that the train staff is notified on this via control signal, in accordance with the point 4.2.6. of the Instruction for operation of the device for automatic insurance of traffic at the level crossing at km 102+890 of the line (ERDUT-ŽŽ)- km 41+074, state border - Bogojevo - Subotica (case No. 08/2007-265 of 21.08.2007., registration No. 9)

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

Immediately before occurrence of the serious accident in question, there was a verbal communication between the staff of the station Subotica, from which the train started and the staff of "Srbija Voz"a.d. which was in the train No. 6431, during which the train driver was given the accompanying travel documents. From the dispatch of the train from the station Subotica to the occurrence of the serious accident in question, there was no communication between the staff in the train No. 6431 and the staff that regulates the traffic.

Direct communication between the staff regulating the traffic (the train dispatcher of the occupied official points on the line in question) and the train staff of the train No. 6431 was not achieved not even after the occurrence of the serious accident in question, but with the purpose of informing on the serious accident occurred, with a telephone call via a network of mobile telephony operator, the communication between the train staff (the train driver and conductor) with the competent services of "Srbija Voz"a.d. was achieved. The train dispatcher of the station Bajmok was given the information on the serious accident occurred by the Senior traffic dispatcher of "IŽS"a.d. and forwarded the information to the train dispatcher of the station Sombor.

3.5.3. Measures taken to protect and secure the place of the accident

After the occurrence of a serious accident, DMV 711-033/034 of train No. 6431, under whose driver's cab (711-034) a road passenger vehicle was stuck, remained on the part of the track outside the road crossing, so that there was no interruption of traffic on the state road, while on the section of the main railway line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Bajmok and Sombor, the traffic was interrupted.

Securing and protection of the serious accident site (providing conditions for the work of emergency and rescue services that created conditions for retrieving the injured person from the road passenger vehicle and provided security and protection of evidence) was performed by members of the PU in Subotica.)

No other measures have been taken to secure the site of the serious accident.

3.6. Interface between the people, machines and organization

3.6.1. Working hours of the staff involved

For the staff of "Srbija Voz"a.d. data was submitted that show that the train driver and the conductors of the train No. 6431 had a legally stipulated rest before coming to work and that they did not spend at work more than the maximum prescribed time determined by the Law.

3.6.2. Health-related and personal circumstances that have effects on the serious accident, including the presence of physical or mental stress

For the staff of "Srbija Voz"a.d. data was submitted that show that the train driver and the conductors of the train No. 6431 were professionally trained and medically fit to perform the work. The train driver of the train No. 6431 has a License for operating a traction vehicle

No. RS 71 2017 0371, issued by the Directorate for Railways on 01.01.2017. with a validity period until 18.09.2022.

After the occurrence of the serious accident, the train driver was breathalysed on the spot by the traffic police patrol and the result of the alcotest was negative. The train driver, on the order of the Deputy Public Prosecutor from the OJT in Subotica, was instructed to give a blood sample for analysis for the presence of alcohol. Based on the data obtained from the OJT in Subotica (letter Kt. No. 570/21 dated 18 .05.2021), the presence of <0.10 mg/ml of alcohol was determined in a blood sample taken from the driver, by analysis performed at the General Hospital in Subotica.

According to the data submitted by OJT in Subotica (The report on alcohol expertise, which is an integral part of the Autopsy Report No. SP 784/20 of the Clinical Center of Vojvodina, submitted in the attachment to the letter from OJT Kt. No. 570/21 of 18.05.2021.), the presence of 0.01 mg/ml of alcohol in the blood was determined in the driver of the road vehicle, while the presence of alcohol was not determined in the urine, muscles and stomach contents.)

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

The main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Sombor and Bajmok is designed in such a manner that it satisfies all the criteria for safe operation of train with the speeds prescribed by the Timetable Booklet. According to the designed state, the main arterial line is one-track, on which the traffic of trains is regulated at a station distance. On the section in question, the traffic was regulated by the train dispatcher of the official points Sombor and Bajmok.

For the purpose of traffic regulation, on the section of the line between the stations Aleksa Šantić and Bajmok, control light signals for automatic devices at road crossings and switching points for activating and deactivating devices at the road crossing have been installed.

On the section of the railway between the stations Sombor and Bajmok, for communication between the staff that regulates the traffic on the railway and the staff of the traction vehicle, there is no manner of communication provided by the TT service of "IŽS"a.d. Only mobile operator lines are available for this purpose.

The DMV of the 711 series is controlled by the train driver via controls from the driver cab, designed during DMV production. DMV 711-033/034 did not register any objections or irregularities observed on the control systems and devices.

3.7. Previous accidents of the similar character

Based on the data obtained by "IŽS"a.d. (a Letter of the Traffic affairs Sector No. 15/2021-31 of 13.01.2021.) for the period from 01.01.2006. to 02.12.2020., on the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), at the level crossing at km 102+890, two accidents and one incident occurred. The review of the accidents and incidents occurred at the level crossing in question is given in Table 3.7.1.

Table 3.7.1: Review of accidents and incidents occurred at the level crossing between the stations Bajmok and Aleksa Šantić at *km* 102+890, in the period from 01.01.2006. to 02.12.2020.

Serial No.	Date	Time	Short description	Fatally injured	Injured
1.	13.09.2007.	06:12	The road crossing was not provided for the passage of train No. 6430; the train driver stopped the train in front of the road crossing. Cause: The crossing keeper did not lower the barriers.	-	-
2.	16.06.2009.	15:10	Overtaking of the train No. 6437 on a road vehicle (van). Cause: The driver of the road vehicle bypassed the lowered barrier poles.	-	1
3.	28.07.2009.	18:33	Overtaking of the train 6438 on a road passenger vehicle. Cause: the driver of the road vehicle did not stop in front of the lowered half-barrier pole, but broke it and entered the track profile.	1	1

4. Analyses and conclusions

4.1. Final review of the course of events and making conclusion on the event based on the facts determined during investigation and examination

On 02.12.2020. at 08:15 on the main line 110: Subotica - Bogojevo - state border - (Erdut), at the road crossing at the level of km 102+890, secured by automatic barriers with light traffic signs and traffic signs on the road, there occured an overtaking of the train No. 6431 on a Volkswagen Golf road passenger vehicle with registration plates KI-045-DK. There were no other persons in the road vehicle, except the driver, while in the train, at the time of the serious accident, next to the train driver who was driving the train, there were two officials who performed the duties of conductors and six passengers.

Train No. 6431 consisted of DMV 711-033/034. DMV 711-033/034 did not show any defects or malfunctions that could have an impact on the occurrence of this serious accident (see points 3.2.3, 3.4.4 and 3.6.3).

In accordance with Article 51 of the Law on Railway Traffic Safety ("Official Gazette of RS" No. 41/2018), DMV 711-033/034 is equipped with a device for giving sound signals (siren).

The train staff of the train No. 6431 has, via a General Order I (S-20) No. 14 of 02.12.2020., submitted by the train dispatcher of the station Subotica, given notification on unsecured level crossings between the stations Subotica and Sombor, as well as the procedure of the train staff in front of the unsecured level crossing. By the issued General Order no notifications were given on the failure of the device at the level crossing at km 102+890.

The train dispatcher of the Subotica station was informed on 01.12. 2020. at 20:48 via TT diary (S-15) on the failure of the device at the road crossing at km 102+890, by the train dispatcher of the Sombor station, as well as on 01.12.2020. at 23:07 through section IV of the travel document, by the train driver of the train No. 5412. The train dispatcher of the station Bajmok was informed about the failure of the device at the road crossing on 02.12.2020. at 06:19 by the train driver of the train No. 5420 (fault registered in the Notebook of interference V-11) (see point 3.4.1.).

Train No. 6431 arrived on the third track of Bajmok station at 08:06 and was dispatched at 08:07 after the manipulation of passengers was completed, in accordance with the permission obtained (permission given at 08:05) by the train dispatcher at Sombor station.

The roadway is a state road Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja). The road crossing is located on the part of the mentioned state road between Sombor and Bajmok, in the immediate vicinity of the settlement of Bajmok (outside the settlement). The state road is built of asphalt pavement and intersects with the main line at an angle of 60 °, which is in accordance with Article 7 of the Rulebook on the manner of crossing the railway and 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*)*. The road has two lanes (one for each direction). The road at the road crossing itself is built of well-fitted and levelled rubber panels for heavy traffic. Drive ramps on one and the other side of the road are covered with asphalt. Near the road crossing, the width of the road is 7.8 m in part towards Sombor, or 7.6 m in part towards the settlement of Bajmok. The width of the installed rubber panels is 11.0 m, and the length is 2.7 m, seen in the direction of the road. The condition of the asphalt pavement near the road crossing is in order, without any noticeable damage.

At the time of the serious accident, the road was dry. No ice was observed on the road. Daily visibility conditions applied.

According to the data obtained from the Republic Hydrometeorological Institute, based on data from meteorological stations relevant for the Bajmok area, fog was observed at the time of this serious accident, and the air temperature was between -4.4°C and -3.91°C. Visibility was 100 m.

At the level crossing in question, traffic is provided by automatic half-barriers with light traffic signs to which sound signals and traffic signs on the road are added.

On the main arterial line, before encountering the level crossing from the direction of Bajmok station to Sombor station, on the right side of the track there are properly placed: aspect of a signal 57: "Switching point, expect a control signal" (at km 103+866, 976 m in front of the level crossing) and a control light signal KS 2 was installed (at km 103+582, 692 m in front of the level crossing).

On the subject state road, before encountering the road crossing from the direction of Sombor to the settlement of Bajmok, and vice versa, the road traffic signalization is set in accordance with the bylaw (see point 3.3.6.), Except in the part related to the traffic sign: I -34: "Saltire" and traffic light IV-9 which regulates the crossing of the road over the railway at the same level, which are placed on separate supporters instead of on the same supporter (see point 2.2.3.).

Based on the analysis of data from the computer memory of the automatic device at the crossing, taken on 02.12.2020. with the help of diagnostic software and in the presence of officials of the Subotica PU (letter from the Sector for ETP No. 21/2021-26 dated 12.01.2021), the fault occurred on the SS device of the level crossing in question on 01.12.2020. at 17:50:19 with the indication "pole fracture or failure to lower the barrier". The SS mechanic of the Subotica section reported the malfunction on 02.12.2020. at 00:50, without going out on the spot (analysis of the diagnostic record of the PHC-EA device). According to his own statement, the train driver of train No. 5420 received information from the train dispatcher of the Sombor station that the road crossing in question has failed, which he himself was assured of when crossing it. Upon arrival at the Bajmok station, he reported the malfunction at the level crossing at km 102+890 to the train dispatcher, who registered it in the V-11 Interference Notebook. The failure lasted until the occurrence of the serious accident in question, which occurred on 02.12. 2020. at 8:15 a.m. at the

level crossing in question. At the time of the serious accident in question, the SS device of the road crossing was out of order for more than 14 hours.

The road passenger vehicle was moving the state road of 1B rank, marking 12: Subotica - Sombor - Odžaci - Bačka Palanka - Novi Sad - Zrenjanin - Žitište - Nova Crnja - state border with Romania (border crossing Srpska Crnja) from the direction of Sombor to Bajmok and was approaching the train from its right side. The train No. 6431 was moving from the direction of the station Bajmok to the station Aleksa Šantić and was approaching the road passenger vehicle on the left side.

Based on the analysis of data from the computer memory of the speedometer device of DMV 711-033/034 (submitted on 05.12.2020. from "Srbija Voz"a.d.), it can be stated that upon dispatch from the station Bajmok, the train No. 6431 was moving the maximum speed of 78.9 km/h, while just before activating the "Danger" button (the start of the braking process) that is, the occurrence of the serious accident in question, the speed of the train was 73.53 km/h. According to his own statement, the train driver of the train No. 6431 (DMV 711-033/034) when approaching the level crossing was giving the aspect of a signal 67: "Watch out" with the siren of DMV. Based on the data from the computer memory of the speedometer device of DMV, there was no use of siren registered between the station Bajmok and the level crossing in question.

When encountering the level crossing at km 102+890 of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), the train driver did not stop in front of the level crossing, ie, he did not act in accordance with the aspect of a signal of control light signal KS 2 (installed at km 103+582), which showed the aspect of a signal 55 "Device at the level crossing defective", but he continued his drive and in the area of the level crossing it came to overtaking of the train No. 6431 on the road passenger vehicle. The collision occurred when the right part of the front of the DMV 711-034 (front right buffer) hit the central part of the left side of the road passenger vehicle (seen in the direction of train No. 6431 movement, ie the road passenger vehicle). An on-site inspection carried out by the CINS investigative team established that the control light signals KS 1 (installed at km 102+187) and KS 2 (installed at km 103+582) showed an aspect of a signal 55: "Device at the road crossing defective" (see point 2.2.3).

In this serious accident, one person was fatally injured. The fatally injured person was in a road passenger vehicle. After the occurrence of a serious accident, DMV 711-033/034 from train No. 6431, under the driver cab under which 711-034 a road passenger vehicle was stuck, remained on the part of the track outside the road crossing, so that there was no traffic interruption on the state road, while on the section of the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), between the stations Bajmok and Sombor, the traffic was interrupted. There were damages to the DMV (faucets, hoses with half-couplings, steel pipes with half-couplings, throat, rail cleaners, sand tank with sandblasting valves, formwork, tug carrier), while there was no damage to the infrastructure. On the road passenger vehicle there are signs of damage. CINS does not have a data on damage assessment on the road passenger vehicle.

On the main arterial line 110: Subotica - Bogojevo - state border - (Erdut), from the station Bajmok there is a control signal KS 2 at km 103+587 (697 m in front of the level crossing), aspect of a signal 57: "Switching point, expect control signal", installed at km 103+865 (278 m in front of the control signal KS2), which is in accordance with the Rulebook on types of signals, aspects of signal and signal marks on the line ("Official Gazette RS", No. 51/20).

4.2. Discussion - analysis of the facts established during the investigation and examination with the aim of drawing conclusions regarding the causes of the accident and the effect of the rescue services

4.2.1. Analysis of work of the automatic device for securing the level crossing

4.2.1.1. Analysis of diagnostic record data

By "IŽS"a.d., as an attachment to the Letter No. 1/2021-97 of 20.01.2021., a CD with the appropriate application "DiagSrbsko.exe", version 3.0, was submitted for analysis and processing of the diagnostic record from the device PZZ-EA. Also, attached to the mentioned letter, log files from the device of the road crossing at km 102+890, taken during the previous period, were submitted, including the log file read after the serious accident in question on 02.12. 2021. at 14:17.

With the help of the submitted application, the analysis of the operation of the level crossing device in the period from 22.1.1.020 was performed. from 12:03 until the moment of taking over the record after the occurrence of a serious accident. This file contains 5251 records. As an illustration, Figure 4.2.1.1.1 shows the appearance of the work window of the application for data processing of the diagnostic record of the PZZ-EA road crossing device.

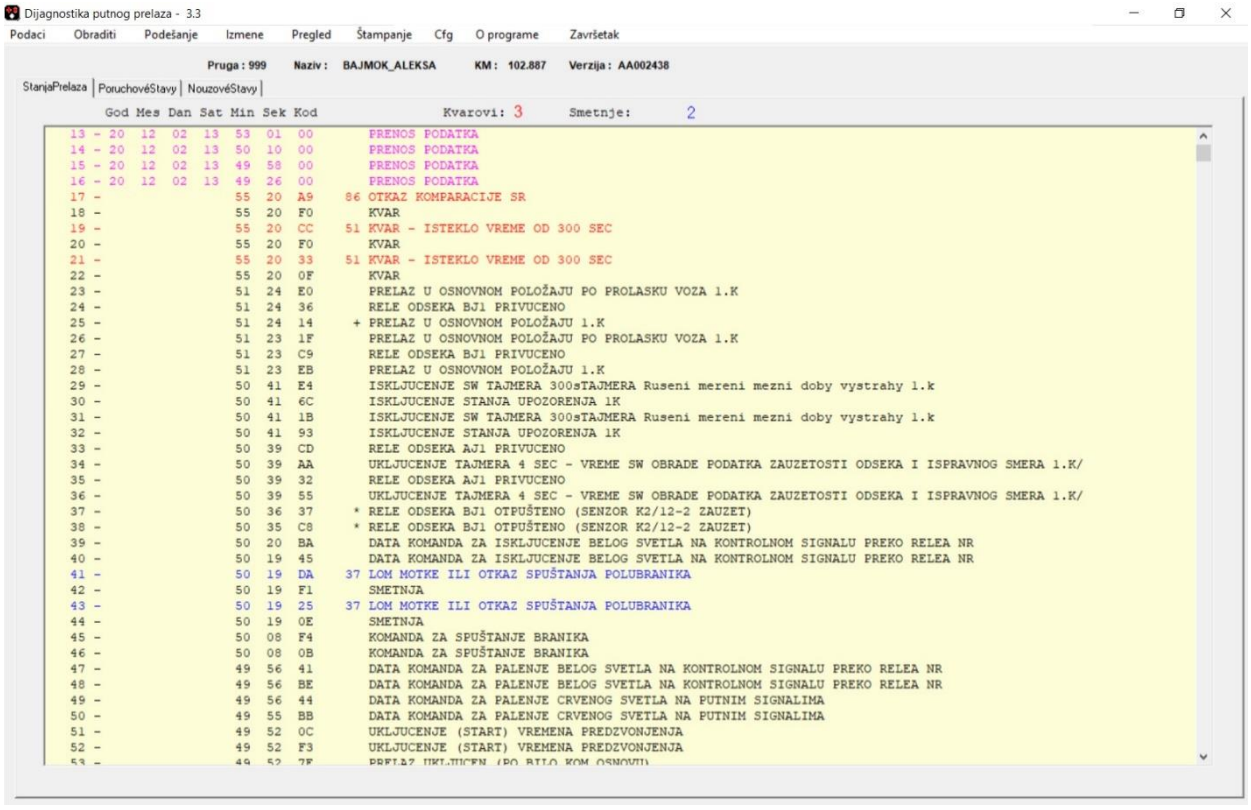


Figure 4.2.1.1.1: Appearance of the work window of the application for data processing of diagnostic record PZZ-EA

As mentioned above, an archived record contains the time when the event occurred, as well as the code of the event that occurred at that time. Since the logical comparison of states in this

device is performed using two different softwares, all events that are archived in memory are duplicated. One record was recorded using the first software channel (hereinafter SW1), while the second record was recorded using the second software channel (hereinafter SW2). The meanings of the individual codes in the diagnostic record are given in the document Safety device of the PZZ-EA road crossing (U 80 100-RS/T dated 20.03.2007) marked Maintenance instructions in Annex 3.

Considering that in the original log file the new record is archived above the previous one (the order of events in the log file is from the newest to the oldest), as well as that the time data are given in "short" form together with the event code, for easier analysis operation of the road crossing device before the occurrence of the serious accident in question, the processed data with the chronological order of events and complete information on the time of occurrence of each individual event will be presented below. Also, for easier analysis of the data in the attached tables, the events written in the memory based on the second software channel are shaded in blue, while the entries recorded in the memory based on the first software channel are shaded in orange.

Table 4.2.1.1.1 shows the archived events during the automatic switching on and off of the road crossing on 29.11.2020. for train No. 6433, which operated on the route Subotica - Sombor. For this train, the automatic road crossing device at km 102+890 received the command to turn on after the train arrived at the switching point, correctly transferred it to the external elements to warn road traffic participants of the approach of the train, and after crossing the switching point, and releasing the switching point section on the opposite side, correctly moved to the basic position.

Table 4.2.1.1.1: Diagnostic record of the road crossing device for train No. 6433 of 29.11.2020.

	Time	Label	Decoded event description
1.	12:04:31	code 87	Warning status
2.	12:04:31	code 37	Section BJ1 relay released (sensor K2/12-2 occupied)
3.	12:04:31	code 78	Warning status
4.	12:04:31	code C8	Section BJ1 relay released (sensor K2/12-2 occupied)
5.	12:04:31	code 19	Activation of SW timer for 300 s. Alarm timer start.
6.	12:04:31	code 91	Crossing activated automatically per 1 track based on SW2 operation
7.	12:04:31	code 81	Crossing activated (on any basis)
8.	12:04:31	code 0C	Activation (start) of the pre-ringing time
9.	12:04:31	code E6	Activation of SW timer for 300 s. Alarm timer start.
10.	12:04:31	code 6E	Crossing activated automatically per 1 track based on SW1 operation
11.	12:04:31	code 7E	Crossing activated (on any basis)
12.	12:04:31	code F3	Activation (start) of the pre-ringing time
13.	12:04:32	code 0C	Activation (start) of the pre-ringing time
14.	12:04:35	code BB	A command given to turn on the red light on the traffic signals
15.	12:04:35	code 44	A command given to turn on the red light on the traffic signals
16.	12:04:35	code BE	A command given to turn on the white light on the control signal
17.	12:04:35	code 41	A command given to turn on the white light on the control signal
18.	12:04:47	code F4	Barriers lowering command
19.	12:04:48	code 0B	Barriers lowering command
20.	12:04:56	code F9	Barriers lowered on time
21.	12:04:56	code 06	Barriers lowered on time
22.	12:05:15	code 45	A command given to turn off the white light on the control signal

23.	12:05:15	code 33	Section AJ1 relay released (sensor K1/11 occupied)
24.	12:05:16	code BA	A command given to turn off the white light on the control signal
25.	12:05:16	code CC	Section AJ1 relay released (sensor K1/11 occupied)
26.	12:05:19	code AA	Activation of timer 4 s - SW processing of section occupancy data and correct direction
27.	12:05:19	code C9	Relay section BJ1 drawn
28.	12:05:19	code 55	Activation of timer 4 s - SW processing of section occupancy data and correct direction
29.	12:05:19	code 36	Relay section BJ1 drawn
30.	12:05:21	code 6C	Deactivation of warning status 1k
31.	12:05:21	code E4	Deactivation of SW timer 300 s
32.	12:05:21	code 78	Warning status
33.	12:05:21	code F2	Barriers lifting command
34.	12:05:21	code 93	Turn off of the warning status1к
35.	12:05:21	code 1B	Deactivation of SW timer 300 s
36.	12:05:21	code 87	Warning status
37.	12:05:21	code 0D	Barriers lifting command
38.	12:05:21	code F2	Barriers lifting command
39.	12:05:26	code 07	Barriers lifted on time
40.	12:05:26	code F8	Barriers lifted on time
41.	12:06:00	code 14	Crossing in a basic position 1.к
42.	12:06:00	code 80	Condition regular
43.	12:06:00	code 32	Relay section AJ1 drawn
44.	12:06:00	code E0	Crossing in a basic position after the train passes 1.к
45.	12:06:00	code EB	Crossing in a basic position 1.к
46.	12:06:00	code 7F	Condition regular
47.	12:06:01	code CD	Relay section AJ1 drawn
48.	12:06:01	code 1F	Crossing in a basic position after the train passes 1.к

In Table 4.2.1.1.2. an overview of archived event is given by the example of automatic switch on of the road crossing on 01.12.2020. at 17:49 for train No. 6432, which operated on the route Sombor - Subotica. For this train of automatic regulation of road crossing at km 102+890, a command was obtained to turn on the occupation of the switch on section AJ1 after the train came to the switching point K1/11, that is, axle counter sensor ST4. After receiving the command to turn on, the crossing device correctly transmitted the received command to the external elements for warning the road traffic users - turning on the loud bell and light road signals, as well as giving the command to lower the barrier after 16 s from giving the pre-ring command. Also, a command was given to turn on the white flashing light on the control signal KS 1, after which it showed aspect of a signal 56: “The device at the road crossing correct”.

During the lowering of the half-barriers, after 11 s from the moment of giving the command for their lowering, the device detected a fault “lowering the barriers”. Immediately after diagnosing the fault, the road crossing device gives a forced command to turn off the white flashing light on the control signal, whereby the control signal KS 1 passes to show an aspect of a signal 55: “Device at the road crossing defective”. After the train passes through the switch-off points and the switch-off section AJ1 is released, the road crossing device, after checking the correct direction of train movement, switches off the warning state for road traffic participants.

After the release and the switching section from the opposite direction BJ1, the crossing returns to the basic position. After 300 s from the moment of indication of "failure of lowering of the half-barrier", the device of the road crossing archives the event with the description 51. Fault - the time of 300 s has expired. According to the technical description of the manufacturer, after reporting a fault with this code, the road crossing device is forcibly shut down, and to switch the device to a fault-free state after its elimination, it is necessary to reset the PZZ-E-B command computer of PZZ-EA device.

After the mentioned forced disconnection from the operation of the road crossing device on 01.12.2020. at 17:55, the device did not register other commands to turn on or off, nor was it registered to read the diagnostics or reset the device by the maintenance services of "IŽS"a.d. until the occurrence of the serious accident. The first next archived record after a serious accident is 02.12.2020. at 13:49, when the record was taken from the diagnostics of the device for the needs of the investigation.

Табела 4.2.1.1.2: Diagnostic record of the level crossing device for the train No. 6432 of 01.12.2020.

Serial No.	Time	Label	Decoded event description
1.	17:49:51	code 87	Warning status
2.	17:49:51	code 33	Section AJ1 relay released (sensor K1/11 occupied)
3.	17:49:51	code 78	Warning status
4.	17:49:51	code CC	Section AJ1 relay released (sensor K1/11 occupied)
5.	17:49:52	code 19	Activation of SW timer for 300 s. Alarm timer start.
6.	17:49:52	code 91	Crossing activated automatically per 1 track based on SW2 operation
7.	17:49:52	code 81	Crossing activated (on any basis)
8.	17:49:52	code 0C	Activation (start) of the pre-ringing time
9.	17:49:52	code E6	Activation of SW timer for 300 s. Alarm timer start.
10.	17:49:52	code 6E	Crossing activated automatically per 1 track based on SW1 operation
11.	17:49:52	code 7E	Crossing activated (on any basis)
12.	17:49:52	code F3	Activation (start) of the pre-ringing time
13.	17:49:52	code 0C	Activation (start) of the pre-ringing time
14.	17:49:55	BB	A command given to turn on the red light on the traffic signals
15.	17:49:56	44	A command given to turn on the red light on the traffic signals
16.	17:49:56	BE	A command given to turn on the white light on the control signal
17.	17:49:56	41	A command given to turn on the white light on the control signal
18.	17:50:08	0B	Barriers lowering command
19.	17:50:08	F4	Barriers lowering command
20.	17:50:19	0E	Interference
21.	17:50:19	25	**Fault 37:** Break of the pole or failure of the lowering of the half-barrier
22.	17:50:19	F1	Interference
23.	17:50:19	DA	**Fault 37:** Break of the pole or failure of the lowering of the half-barrier
24.	17:50:19	45	A command given to turn off the white light on the control signal
25.	17:50:20	BA	A command given to turn off the white light on the control signal
26.	17:50:35	C8	Section BJ1 relay released (sensor K2/12-2 occupied)
27.	17:50:36	37	Section BJ1 relay released (sensor K2/12-2 occupied)
28.	17:50:39	55	Activation of timer 4 s - SW processing of section occupancy data and correct direction

29.	17:50:39	32	Section AJ1 relay drawn
30.	17:50:39	AA	Activation of timer 4 s - SW processing of section occupancy data and correct direction
31.	17:50:39	CD	Section AJ1 relay drawn
32.	17:50:41	93	Deactivation of warning state 1k
33.	17:50:41	1B	Deactivation of SW timer 300 s
34.	17:50:41	6C	Deactivation of warning state 1k
35.	17:50:41	E4	Deactivation of SW timer 300 s
36.	17:51:23	EB	Crossing in the basic position 1.к
37.	17:51:23	C9	Section *BJ1* relay drawn
38.	17:51:23	1F	Crossing in a basic position after the train passes 1.к
39.	17:51:24	14	Crossing in a basic position 1.к
40.	17:51:24	36	Section BJ1 relay drawn
41.	17:51:24	E0	Crossing in a basic position after the train passes 1.к
42.	17:55:20	0F	Fault
43.	17:55:20	33	**Fault 51:** 300 *s* elapsed
44.	17:55:20	F0	Fault
45.	17:55:20	CC	Fault **51:** 300 *s* elapsed
46.	17:55:20	F0	Fault
47.	17:55:20	A9	Comparison cancellation 86

In the diagnostic application for the event with the code “25” ie “YES”, the explanation is given: “37 - Break of the pole or failure of lowering the half-barrier”. Attached to the letter No. 1/2021-97 from 20.01.2021. submitted by “IŽS”a.d., in the technical documentation of the manufacturer of automatic road crossing device, in the document Road crossing safety device PZZ-EA (U 80 100-RS/T dated 20.03.2007) in the Maintenance Manual -Appendix 3 has no explanation of these codes is given. In the mentioned Instruction in appendix 1 - faults condition, explanation 37 - failure of lowering the half-barrier, is given. The meaning of the fault condition “37 - Barrier lowering fault” is not precisely explained. Also, in the mentioned Instruction in Annex 3, the meanings of the codes “F0” and “A9” are not stated, for which the explanations “Fault” and “Comparison failure 86” are given in the diagnostic application.

By comparing the description of event codes displayed within the application “DiagSrbsko.exe” and the description of codes given in the Maintenance Manual in Annex 3 in the document Road crossing safety device PZZ-EA (U 80 100-RS/T dated 20.03.2007) , it can be concluded that these descriptions are not identical. For example: code 44 in the application is decoded as “COMMAND FOR RED LIGHT ACTIVATION ON TRAFFIC SIGNALS GIVEN”, while in the mentioned documentation the meaning of this code is “Setting the CS output (positive result of traffic light signals activation control)”. Based on the above, it is not clear whether the mentioned code really refers to giving the command to turn on the red lights on the road signal or to receive feedback from the relay confirming the correct operation of the red lights on the road light signal.

In addition to the mentioned discrepancies, it can be noticed that the text was not clearly translated into Serbian with the use of correct and professional terminology. In addition to the above, there are many such examples of unclear meaning of individual codes, as well as inconsistent meaning of individual codes in the diagnostic application and in the technical description document.

4.2.1.2. Analysis of disturbances and failures recorded at the workplace of the technical SS dispatcher

Based on the data submitted by "IŽS"a.d. it can be stated that during the period of one year before the occurrence of the serious accident in question, ie in the period from 02.12.2019. until 02.12.2020., on the device of the automatic road crossing at km 102+890 at the workplace of the technical SS dispatcher in the TK Center in Makiš (station Belgrade Marshalling Yard) a total of 52 failures were recorded. The average duration of a fault from its occurrence to its elimination is 372 minutes.

Out of 52 recorded failures, the cause of 9 failures (17.31%) is an error in the operation of the axle counter, also 9 failures (17.31%) are caused by breaking the control insert of the barrier (most often due to passing of the road vehicles under the lowered barriers or barriers being lowered at that moment), the cause of 2 faults (3.85%) is the bulb burnout on the road signal, 3 failures (5.77%) were caused by disturbances in the power supply part of the device, while one recorded failure each was related with the following: the bulb burnout on the control signal, damage on the local cable network, loss of network power supply of the device, failure of the micro-switch in the power plant, damages to the equipment after the lightning strike, damage to the external equipment after the ignition of the grass. For the other 23 recorded failures (44.23%), no clear cause of the transition of the road crossing device to the state of failure was stated. After the fault has been rectified, a "Reset Device" is simply entered when the reported fault is resolved. The term "reset device" cannot be accepted as an expert explanation of the cause of the failure, but only as a way in which the device is returned to its original state. Such deregistration of disturbances on electronic devices for traffic insurance at road crossings is unacceptable, considering that this type of device has diagnostics from which it is easy to determine the cause of the failure and then eliminate it.

4.2.1.3. Review of SS device maintenance documentation

By "IŽS"a.d., attached to the letter No. 1/2021-935 dated 29.04.2021. the letter of the Sector for ETP No. 21/2021-535 dated 29.04.2021 was submitted with attachments or copies of issued work orders for regular maintenance of OJ for SS Subotica on SS devices in the station Bajmok, for the period from 01.06.2020. until the occurrence of the serious accident in question.

The Head of OJ for SS Subotica issued work orders for regular maintenance of the road crossing device at km 102+890, as follows:

- Work order No. 58/07 from 29/30.07.2020., on the basis of which works were performed on the lubrication of road crossings barriers and movable parts in the installation devices,
- Work order No.60/07 from 30/31.07.2020., on the basis of which works were performed to check the correctness of sound and light signalling, as well as the operation of control signals,
- Work order No.19/08 from 10.08.2020., on the basis of which works were performed on lubrication of movable parts in the installation devices of road crossings and cleaned contacts of light bulbs of road and control signals, checking the correctness of sound and light signals as well as the operation of control signals. During these works, the interference on the device of the road crossing in question was removed. The mentioned disturbance

was recorded in the electronic records of disturbances and failures on SS devices in the TC Center in Makiš (Belgrade Marshalling Yard),

- Work order No.05/09 from 03.09.2020., on the basis of which works on regular maintenance of installation devices, road signals and control signals were performed,
- Work order No.41/09 from 21.09.2020., on the basis of which works on regular maintenance of installation devices, road signals and control signals were performed,
- Work order No.59/11 from 30.11.2020., on the basis of which works were performed on lubrication of movable parts in the installation devices of road crossings and checking the correctness of sound and light road signalization, as well as the operation of control signals.

From the submitted work orders of OJ for SS Subotica, it can be concluded that the works on regular maintenance of the level crossing device at km 102+890 and its parts were performed according to the provisions of Article 33 of the Rulebook on maintenance of signalling and safety devices ("Official Gazette of RS" No. 80/2015).

Also, from the submitted work orders of OJ for SS Subotica, it can be concluded that according to the needs, ie after the occurrence of disturbances and failures on the devices, works were performed on corrective maintenance of the level crossing device at km 102+890 and its parts according to Article 9 paragraph 1 of the Rulebook on maintenance of signalling and safety devices ("Official Gazette of RS", No. 80/2015). Also, it was noted that during one working day, the same workers performed regular and corrective maintenance work and that they entered those works on the same work order. It cannot be concluded from the submitted work orders whether the elimination of disturbances or malfunctions was approached within the deadline prescribed in Article 9, Paragraph 2 of the Rulebook on maintenance of signalling and safety devices ("Official Gazette of RS", No. 80/2015).

4.2.2. Analysis of documentation on recording the failure of the automatic road crossing device

In this part, the documentation that "IŽS"a.d. submitted in the attachment to the letter No. 1/2021-97 dated 20.01.2021. which refers to keeping official records at the workplaces of train dispatchers at Sombor, Bajmok and Subotica stations, at the workplace of the technical SS dispatcher at the TK Center in Makiš (Belgrade Marshalling Yard), as well as at the Records on hearing of the train dispatchers.

In the Record on hearing of the train dispatcher, who worked at the Sombor station during the night shift on 01/02.12.2020., it is stated that a failure on the device of the road crossing at km 102+890 was reported to the train dispatcher of the Sombor station by the train driver of the train No. 6435, after the train arrival at the station, via the Travel document (S-1). After receiving this notification, since the device of the road crossing in question belongs to the maintenance section of OJ Subotica, a phonogram was given to the station Subotica with the following content "Inform the SS section Subotica of automatic road crossing at km 102+890", which was recorded in the Notebook on sent and received telegrams (S-15) of the Sombor station on 01.12. 2020. at 20:48 This phonogram of the Sombor station was recorded in the S-15 of the station of Subotica at the same time.

The train dispatcher of the Subotica station recorded in the Notebook of disturbances (V-11) of the Subotica station the information about the failure at the road crossing at 21:45, after which

he notified the technical dispatcher at TK Center Makiš (Belgrade station Marshalling Yard), who recorded the failure at 21:50 and notified the competent maintenance section.

From the above, it can be stated that the train dispatcher of the Subotica station informed the technical SS dispatcher about the failure 57 minutes after he received the phonogram (information) about the failure of the road crossing device. This event could not have affected the occurrence of the serious accident in question, but it certainly represents a disorder in the keeping of official records and the performance of the work of train dispatchers.

According to the electronic records of disturbances and failures on SS devices in the TK Center in Makiš (Belgrade Marshalling yard station), the failure of the automatic road crossing at km 102+890, which was recorded on 01.12.2020. at 21:50 was removed on 02.12.2020. at 0:50, with the description "Reset device". However, based on the data submitted by "IŽS"a.d. on-duty mechanic who worked alone in the night shift 01/02.12.2020. (although it is planned that two mechanics will work in shifts), was informed about the failure at the road crossing, but he did not manage to eliminate the reported failure due to interventions at other faults and malfunctions. Having in mind the size of the section and the scope of work (according to the number of SS devices), that the SS device of the road crossing was out of order for more than 14 hours, as well as that corrective maintenance has priority over regular device maintenance, it can be stated that due to insufficient number of executors, the on-duty mechanic failed to rectify the fault within the prescribed period of two hours (bearing in mind that the terrain is accessible), which is contrary to Article 9 of the Rulebook on maintenance of signalling and safety devices ("Official Gazette of RS", No. 41/18).

Also, from the analysis of the diagnostic record of the PZZ-EA device, it was determined that the workers of the maintenance service of the OJ for SS Subotica did not reset the device after the failure of the automatic road crossing device in the period from 01.12.2020. at 17:55 until the occurrence of the serious accident in question.

The observed inconsistency of the submitted data cannot be the cause of the serious accident in question, considering that the control signal KS 2 of the automatic road crossing device is from the moment of the occurrence of the fault on 01.12.2020. at 17:55 continuously showed an aspect of a signal 55: "Device at the road crossing defective". The noticed inconsistency of information in the submitted documentation represents the unscrupulous work of the workers of the maintenance service of the devices OJ for SS Subotica. Since this disorder did not affect the occurrence of the serious accident in question, it will not be analysed any further.

4.2.3. Analysis of observations of train drivers of OJ for traction of trains Subotica

This part analyzes the possibility of occurrence of irregularities described in the document "Statement of train drivers of OJ for traction Subotica, the state of the road crossing on the line Subotica - Sombor - Bogojevo - state border at km 102+890", submitted in the attachment to letter No. 1/2021-43 from 14.01.2021. by the railway undertaking "Srbija Voz"a.d.

The statement, signed by 22 (twenty-two) train drivers of the OJ for traction of trains Subotica, states the following: "The control light signal that protects the automatic road crossing on the line Subotica - Sombor - Bogojevo - state border at km 102+890 has, until 02.12. 2020 after crossing the switching point from Bajmok, only after the train had approached it, on less than halfway from the switching point to the control signal KS 2, began to show the aspect of a signal 56: "Device at the road crossing correct", so that from the placement of the aspect of a signal 56 until the crossing next to the control signal KS2, the white flashing light flashed only 3-

4 times. From 02.12.2020. until 04.12.2020., the control signal KS 2, which protects the road crossing at km 102+890, was turned off (it did not show the aspect of a signal 55: "Device at the road crossing defective" or aspect of a signal 56: "Device at the road crossing correct"), and we were notified on the failure by a General order in the previously occupied stations in accordance with Article 34, item 29 of the Traffic Rulebook".

By analysing the data read from the diagnostic device of the road crossing, which contains archived events for the crossing of 109 trains over the road crossing in question in the period from 22.11.2020. at 12:03 until the occurrence of the serious accident, it can be concluded that the average time from the moment of trampling the switching point, or from the moment of receiving the command to turn on the automatic road crossing, to the moment of flashing the white flashing light on the control signal is between 4 and 5 s.

Taking into account that the speed of passenger trains in the DMV 711 composition, according to the Timetable Booklet 4.2, on this section of the line is 80 km/h, it can be calculated that during this time from 4 to 5 s, the train travels between 88 m and 111 m. The distance of the control signal from the switching point at the road crossing in question is 278 m, for both control signals. Thus, the control signal starts to show the aspect of a signal 56: "Device at the road crossing correct" at the moment when the oncoming train is in front of the control signal at a distance between 167 m and 190 m. Taking into account again the train speed according to the Timetable Booklet 4.2 of 80 km/h, it can be calculated that a train needs between 7.5 and 8.5 s to cross the distance between 167 m and 190 m. The submitted technical documentation of the manufacturer of the road crossing equipment states that the frequency of the white flashing light is 1 Hz and that their operation is controlled by the command computer of the road crossing device PZZ-EA.

Based on the above, it can be concluded that for a train traveling at speed according to the Timetable Booklet 4.2, after trampling the switching points, a white flashing light on the control signal appears after 4 to 5 s. During the time required for the train to reach the location of the control signal from the moment of the start of appearing the aspect of a signal 56: "Device at the level crossing correct", the white lamp on the control signal goes through 7 to 8 cycles of consecutive switching on and off.

4.2.4. Analysis of the train No. 6431 and the road vehicle movement

According to the "Network Statement 2020" and the Timetable Booklet 4.2. "IŽS"a.d., which were valid at the time of occurrence of the serious accident in question, the maximum permitted speed for DMV on the section of the main arterial line between the station Bajmok and Sombor was 80 km/h. According to the letter No. 20/2021-24 from 06.01.2021. at the time of occurrence of this serious accident, there were no traffic restrictions for train No. 6431 on the section of the ine, the main line between Bajmok station and the level crossing at km 102+890.

By analysing the data taken from the memory of the electronic speedometer DMV 711-033/034 (document Data from the records of speedometer Teloc 1500 No. 39/2021-20 from 05.12.2020 submitted by "Srbija Voz"a.d.), it can be concluded:

- Train No. 6431 was launched from Bajmok station at 8:11:13. This time differs from the time recorded in the Traffic Log (S-9) of the Bajmok station;
- The train reaches a speed of 30 km/h at 8:11:48, after passing 746 m from the moment of departure from Bajmok station towards Sombor;

- Acceleration of the train continues and the speed of 78.9 km/h is reached after 1338 m from the moment of starting from the station Bajmok;
- After reaching a speed of 78.9 km/h, the speed starts to decrease and at 8:14:14 it was 73.53 km/h;
- At 8:14:14 the speedometer device records the interruption of traction and the beginning of braking by activating the danger button;
- At 8:14:17 the train speed decreases to 59.56 km/h, after crossed 2434 m from the moment of departure from Bajmok station;
- The train continues to slow down at 8:14:31 and after crossed 2533 m, from the moment of starting from the station Bajmok, it stops;
- The maximum speed that the train reached from the moment of starting from the Bajmok station until the occurrence of the serious accident in question is 78.9 km/h and indicates the fact that the maximum allowed speed on the section Bajmok - Sombor was not exceeded.

CINS does not have data on the speed of the road passenger vehicle that participated in this serious accident, just before its occurrence. Based on the photographs taken immediately after the occurrence of the serious accident in question and which are part of the investigative documentation, it can be seen that there are no traces of braking of the passenger vehicle before the occurrence of the serious accident. However, in Figure 4.2.4.1. it can be seen that the traces that have been made immediately after the train hit the passenger vehicle, and which originate from the liquid from the passenger vehicle caused by the force of the impact, begin in the roadway lane of the 1B rank road of the marking 12, for the direction towards Bajmok. This fact indicates that the passenger vehicle was in the correct lane at the time of the serious accident in question and that the barriers of the automatic device of the road crossing in question were raised at the time of the collision between the train and the passenger vehicle. This fact indicates that the passenger vehicle was in the correct lane at the time of occurrence of the serious accident in question and that the automatic device barriers of the level crossing in question were raised at the time of the collision between the train and the passenger vehicle.

Figure 4.2.4.1: The position of the serious accident site and the traces in relation to the roadway

4.2.5. Construction and use permit

According to the data obtained from "IŽS"a.d. (letter "IŽS"a.d. No. 1/2021-97 dated 20.01.2021 with attachments), works on reconstruction and raising the level of security of the level crossing at km 102+890 on the line Subotica - Bogojevo - border with the Republic Croatia were approved by the Decision of the Republic of Serbia, Ministry of Capital Investments, Sector for Railways and Intermodal Transport No. 351-02-131/2006-11 dated 21 .09. 2006. Attached to the letter No. 1/2021-935 dated 29.04.2021. "IŽS"a.d. letter No. 27/21-430 dated 29.04.2021 was submitted, from the Sector for Investments in which it is stated that "IŽS"a.d. has no additional information that the competent Ministry has issued a use permit. "IŽS"a.d possesses only Decision No. 351-02-879/2007-11 from 17.10.2007. of the Ministry of Infrastructure approving the trial use in traffic (trial operation) of the reconstructed facility - level crossing "Bajmok" at km 102+890 of the railway line Subotica - Bogojevo - state border - (Erdut) under the following conditions that the duration of the trial operation is no longer than 17.01.2008 (three months). The mentioned Decision specifies the conditions to be met by the investor and the contractor, and that before the expiration of the trial period, the investor ("IŽS"a.d.) submits the documentation with the results of the trial work to the Ministry of Infrastructure with a proposal on the suitability of the facility for issuing use permit.

4.2.6. Rescue service performance analysis

In order to hel the injured person in this serious accident members of MUP RS, Emergency Situations Sector, Department for Emergency Situations in Subotica (fire and rescue unit from Subotica), members of the Voluntary Fire Brigade Bajmok and members of the Emergency Medical Service of the Health Center Subotica went to the scene.

An emergency team from the Subotica Emergency Medical Service of the Health Center Subotica intervened at the scene of the serious accident. Upon arrival, they found a female victim on the spot, who was trapped in the driver's seat of a passenger car (with extensive head injuries), and who was showing signs of life (agonal breathing) and who could not be accessed to provide assistance. During the attempt to be released by the members of the fire brigade, the injured person stopped breathing, while access was still impossible.

The fire and rescue unit from Subotica sent 2 (two) vehicles with 6 (six) firefighters to the intervention. Upon arrival at the scene, they determined that there was a trapped driver in the car, who was difficult to reach due to the vehicle's breakdown. With the help of a hydraulic demolition tool, a space was made and the driver was pulled out of the car with the help of a spinal board, with the assistance of the workers of the Emergency Medical Service.

From Voluntary Fire Brigade Bajmok 1 (one) vehicle and 4 (four) firefighters were sent for intervention. During the intervention, firefighters tried to open the door of the passenger vehicle that was stuck under the train, which failed, and in the meantime, firefighters from the professional fire unit of Subotica arrived and took over the lead in the action. By working together and using a car cutting tool, the vehicle was cut and the driver was pulled out of the road vehicle.

4.3. Conclusion on the serious accident causes

4.3.1. Direct and immediate cause of the serious accident

The direct cause of the occurrence of the serious accident in question is that when the train No. 6431 approached the level crossing at km 102+890, whose automatic device was faulty, it did not stop in front of the level crossing, in accordance with aspect of a signal 55: "Device on the road crossing defective" which was showing the control signal KS 2, which is contrary to the provisions of Article 63, item 5 of the Rulebook 2, Traffic Rulebook ("Official Gazette of ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03), and the road passenger vehicle was on the track just before the train arrived, which created a dangerous situation related to the occurrence of this serious accident. Having in mind that the half-barriers were raised and that the traffic light did not announce the arrival of the train, the road passenger vehicle did not stop in front of the level crossing, but continued driving and entered the track profile in the area of the level crossing just before the train No. 6431 arrived.

4.3.2. Basic causes arising from skills, procedures and maintenance

Pursuant to Article 63, item 5 of Rulebook 2, Traffic Rulebook ("Official Gazette of ZJZ" No. 3/94, 4/94, 5/94, 4/96 and 6/03), the train driver of the train No. 6431 was obliged to stop the train in front of the level crossing in question, which was faulty, to let all road vehicles pass and only when he is convinced that there are no other vehicles in the immediate vicinity and that the crossing over the level crossing is safe, to undertake activities for careful crossing. When the traction vehicle crosses the level crossing, he may continue driving at regular speed.

Pursuant to Article 160 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), when approaching a road crossing, the driver is obliged to give an aspect of a signal 67: "Watch out", and pursuant to Article 143 of the same Rulebook, the train driver is obliged to give aspect of a signal 67: "Watch out", during the approach to the faulty road crossing. Giving this aspect of a signal on the section of the line from the control signal to the level crossing, informs the participants in road traffic that the train is approaching the level crossing. Failure to act in this way could have contributed to the occurrence of a serious accident.

4.3.3. The main causes of the serious accident deriving from conditions established by the legal framework and the safety management system application

N/A.

4.3.4. Additional remarks on the shortcomings and flaws identified during the investigation, but not relevant to the conclusions on the causes

Based on the data submitted by "IŽS"a.d., the mechanic on duty in the section OJ for SS Subotica worked alone in the night shift on 01/02.12.2020., although it is planned that two mechanics will work in a shift. As stated, this is a frequent case due to the lack of staff in the OJ section for SS Subotica. The mechanic on duty was informed about the failure at the level crossing,

but did not manage to troubleshoot the failure, as well as rectify the reported failure due to interventions at other faults and breakdowns (see point 3.4.1.).

By comparing the descriptions of event codes shown within the diagnostic application and the descriptions of codes given in Annex 2 of the manufacturer's documentation "Technical description of the device -safety road crossing device PZZ-EA", it can be concluded that these descriptions are not identical. In addition to the mentioned discrepancies, it can be noticed that the text was not clearly translated into Serbian with the use of correct and professional terminology. There are many such examples of unclear meaning of individual codes, as well as inconsistent meaning of individual codes in the diagnostic application and in the technical description document. (ee point 4.2.1.1.).

In the period from 02.12.2019. until 02.12.2020., on the device of the automatic road crossing at km 102+890, at the workplace of the technical SS dispatcher in the TK Center in Makiš (Belgrade Marshalling Yard), 52 failures were recorded. For 23 recorded failures, the clear cause of the transition of the road crossing device to the state of failure was not stated, but the remark "Reset device" was entered when the fault was resolved. Such deregistration of faults on electronic traffic safety devices at road crossings that have diagnostics from which it is easy to determine the cause of the fault is unacceptable and contrary to the prescribed form of the Fault Log (V-11) (see point 4.2.1.2.).

According to the electronic records of disturbances and failures on SS devices in the TK Center in Makiš (Belgrade Marshalling Yard),), as well as the records of handover of the service of on-duty SS mechanics in the section OJ for SS Subotica, it is recorded that the disturbance, which occurred on 01.12.2020. at 17:50, was removed on 02.12.2020. at 00:50 with the explanation "Reset" while the analysis of the diagnostic record of the device PZZ-EA determined that the workers of the maintenance service OJ for SS Subotica did not reset the device after a malfunction on the device of the automatic road crossing in the period from 01.12.2020. at 17:55 until the occurrence of the serious accident in question (see point 4.2.2.).

Article 2, item 11 of the Rulebook on the manner of crossing the railway and 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), defines a dangerous area, while Annex 2 defines the area that represents the boundary of the dangerous area.

Annex 2 of the Rulebook on technical conditions for signaling and safety devices ("Official Gazette of RS", No. 18/2016 and 89/2016) defines the space that represents the limit of the free profile in a different way, compared to the definitions in Annex 1 and Annex 2 of the Rulebook on the manner of crossing the railway and 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). Also, the term and borders of the free profile are defined by the Rulebook on technical conditions and maintenance of the railway line superstructure ("Official Gazette of RS" No. 39/2016 and 74/2016) in a similar way as defined in Annex 2 of the Rulebook on technical conditions for signaling and safety devices ("Official Gazette of RS", No. 18/2016 and 89/2016). Bearing in mind that both formulations are used in the context of safe leaving the crossing zone, as well as the fact that in Article 14 of the Rulebook on the manner of crossing the railway and road, pedestrian or bicycle path, the place where the crossing can be made and measures to ensure safe traffic, within the explanation of the time t_{pdv}, also the formulation leaving the boundary of the free profile is mentioned, there is a discrepancy in determining the distance of this boundary from the axis of the track.

5. Measures taken

The level crossing device was returned from the state of failure to the regular state on 04.12.2020. at 14:40.

No other measures have been taken.

6. Safety recommendations

Aiming to improve safety on the railway and prevent occurrence of the new accidents, CINS has issued the following safety recommendations:

To the Directorate for Railways recommendations SR_26/21, SR_27/21, SR_28/21, SR_29/21, SR_30/21 and SR_31/21 are issued:

SR_26/21 "IŽS"a.d., to revise the technical documentation and diagnostic software for the road crossing device PZZ-EA, and to consider the need for their supplementation and correction in terms of correct and clear translation into Serbian with the use of precise and professional terms. This primarily refers to the documentation for the operation and maintenance of the device, so that the content of the mentioned documentation is clear to the employees of the maintenance service (see point 4.2.1.1.).

SR_27/21 "IŽS"a.d., to continuously during the regular training of workers employed in the regular maintenance of SS devices, analyse the operation of available software tools for diagnosing the operation of electronic devices of level crossings. During corrective maintenance of the electronic level crossing device, on those devices where it is applicable, by using electronic diagnostic devices to accurately determine the cause of the fault and enter it into the appropriate records kept in "IŽS"a.d. (see point 4.2.1.2.).

SR_28/21 "IŽS"a.d., in the Rulebook on organization and work positions systematization of "IŽS"a.d., Belgrade, to consider the adequacy of the existing ones and consider the possibility to predict the appropriate number of executors in the electro technical affairs (worker on SS devices and facilities maintenance) both on the section of the railway on which the serious accident occurred and on the entire network in order to reduce the time of starting the process of elimination of the fault to a measure that is in accordance with the Rulebook on maintenance of signaling and safety devices ("Official Gazette RS", No. 41/18), thus minimizing the time in which SS devices are in the state of fault, all in order to ensure the safe conduct of railway traffic (see points 3.4.1. and 4.3.4.).

SR_29/21 "IŽS"a.d., to carry out activities on obtaining a use permit issued by the Ministry of Construction, Transport and Infrastructure for level crossing at km 102+890, in accordance with the Article 158 of the Law on Planning and Construction ("Official Gazette of RS", No. 72/2009, 81/2009 - amended, 64/2010 – US decision, 24/2011, 121/2012, 42/2013 - US decision, 50/2013 - US decision, 98/2013 - US decision, 132/2014, 145/2014, 83/2018, 31/2019, 37/2019 - other law, 9/2020 and 52/2021) (see points 2.2.3, 3.3.4 and 4.2.5).

SR_30/21 "Srbija Voz"a.d., to perform extraordinary training of traction vehicle staff regarding the procedure in front of the road crossing equipped with control signals, pursuant to Article 143, paragraph 2 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), and Article 61, item 12 and Article 63, item 5 of the Rulebook 2, Traffic Rulebook ("Official Gazette of the ZJŽ" No. 3/94, 4/94, 5/94, 4/96 and 6/03) (see points 3.3.8 and 4.1).

SR_31/21 "Srbija Voz"a.d., to perform extraordinary training of traction vehicle staff in terms of proper application of the aspect of signal 67: "Watch out", in accordance with the Article 160 of the Rulebook on the types of signals, signalling marks and markings on the railway line ("Official Gazette RS", No. 51/20), in order to properly apply railway regulations with the aim of preventing the circumstances that could contribute to the occurrence of new similar accidents and increase safety in railway traffic (see points 3.3.7, 3.3.11. and 4.1.).

To the Ministry of Construction, Traffic and Infrastructure the recommendation SR_32/21 is issued:

SR_32/21 The Ministry of Construction, Traffic and Infrastructure to harmonize the Article 2, item 11 and Annex 2 of the Rulebook on the manner of crossing the railway and 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) with Annex 2 of the Rulebook on technical conditions for signaling-safety devices ("Official Gazette of RS", No. 18/2016 and 89/2016) regarding the definition of the border of the dangerous zone of the road crossing, that is, the border of the free profile (see points 3.3 .6, 3.3.9 and 4.3.4).