Geometric parameters in railroad crossing based reconstruction of Iliantsi-Curilo and Curilo-Rebrovo

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Abstract: *Railroad crossings are a point of conflict between rail and road transport. Failure to abide by the rules and their malfunctioning leads to human casualties. The solution is to improve transport infrastructure. In the course of renewal of the railways in the form of rehabilitation, reconstruction, emergency repairs, new construction and more, it is inevitably necessary to intersect road infrastructure. This is done by crossing at one or two levels. During the construction of the main railway lines in Bulgaria, the safety requirements, the load of the road infrastructure, the current speeds, the financial possibilities and other factors led to the construction of many railroad crossings 757 [1]. They are on the secondary and major railway lines, especially outside the large settlements.*

Of course, with the construction of new routes, intersections at two levels are envisaged and constructed [2, 3], but at the same time the railroad crossings on the rest of the railway network requiring higher safety criteria have to be maintained. This necessitates the replacement of many elements of the railway and the pavement [4], which in turn leads to a change in the conditions for the reconstruction of the railroad crossings. The report examines a specific case of construction practice - reconstruction of railroad crossings along the second railway line in the area of Iskar Gorge [5], but the conclusions it requires are valid for most existing railroad crossings.

Keywords*: DESIGN OF RAILWAY LINES, RAILROAD CROSSING, INTEROPERABILITY OF EU RAILWAYS*

1. Introduction

There are 757 pcs in the network of the National railway infrastructure company [1]. Railway infrastructure reviews shows, of which 677 are protected and fully secured. There have changed the EU average by this indicator - we have 17.5% for Bulgaria, against 47% for Germany, 49% for Hungary and 53% for Slovakia. Of these with automatic electrical or manual barriers are related: Bulgaria - 49%, Germany - 46%, Hungary - 20%, Slovakia - 28%, with alarms: Bulgaria - 34%, Germany - 7%, Hungary - 31%, Slovakia - 19%. In fact, they indicate that NRIC is the EU's leader in security screening and that this should be Bulgaria second after Slovakia, with the most incidents of railway crossings.

The long-standing lack of investment in railway transport has led to strong depreciation and inactivity of the elements that must be linked to the need for manufacturers of safety workshops to operate on it and the precision of road infrastructure. They deal with the general case with a dramatic improvement in speed and, in the rare case, with traffic (mostly represented by social and strategic forces along the railway lines). In this part of the budgets, it is recommended to find emergency repairs for the purposes of: maintaining the speed of movement, seeking safety and the continuous availability of information on certain documents and interoperability with the European railway network.

The most common railroad crossing violations are related to the passage of road vehicles at lowered barriers or regularly triggered signage indicating a train approaching, as well as breaking or striking barrier beams [5, 6]. Every incident of a railroad crossing, with the exception of material damage and inconvenience - broken barriers, damaged signaling devices, slowing down or blocking the movement of trains or delays in the timetable for trains running, carries a risk to the life and health of the offenders.

2. Problems and solutions

The reconstruction of external lines outside the scope of European programs is drawned on the basis of a quantitative inventory database by review of expert evaluation, without making a design project [7]. This is leads to many changes in the construction process, which may change the quantities offered.

For reconstruction it is supposed:

- Mix the existing, wooden pavement on the railroad crossing with the new rubber [4];
- Change the construction of rail track with new ballast, CT6 sleepers, type 60E1 rails;
- To reconstruction the rails track along the axis and level to maintain the design speed.

Following the development of design projects, the following difficulties are encountered in the construction process:

- Due to the replacement of the rail track of wooden sleepers or reinforce concrete sleepers ST4 with rails 49E1 with reinforce concrete ST6 sleepers with rails 60E1 is obtained lift leveling with 7-8 cm Figure 1.

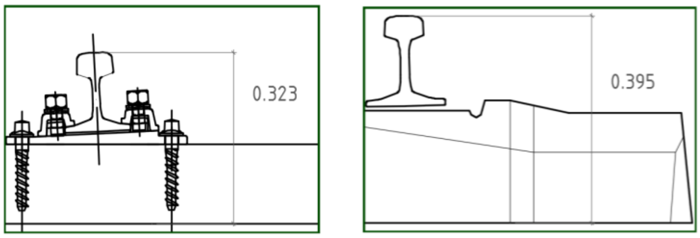

Fig. 1 *Rail track fastening ПАК 68И and SKL14*

- Changing the level of the railway requires a change in the level of road approaches to the crossing.

3. Problems with the height of the railway track

The level of the railway at existing railway lines is determined by the level of the solid points in the railway. When reconstructing railway lines, it is not the traditional elevation level that is used but the elevation of the rail head [8]. The accuracy of the calculations is up to 1 mm. The presence of steel bridges without a ballast bed, open culverts, bridges with a minimum height above the high water level, railroad crossings and stations with intersection of several directions and available industrial branches, determine the level of the new level.

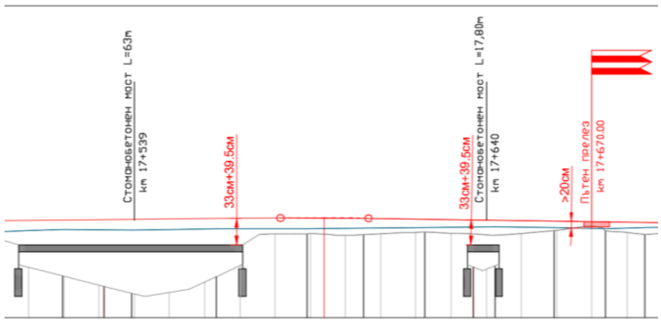

Fig. 2 *Railroad crossing near to reinforced concrete bridge*

Removing the level of the track in the presence of concrete bridges is impossible if the crossing is within walking distance (in this case 20 m). These reinforced concrete bridges require the presence of 33 cm of ballast over waterproofing and protection and another 7-8 cm of elevation due to alteration of the upper railway track structure. This requires a total of about 24 cm of leveling in comparison to the existing figure 2.

Keeping the level causes problems with the railroad crossing. The approaches of the motor road to the crossing, defined in Ordinances 55 and 58 [9, 10], are changing. The situation is even more difficult if the bridge is steel without a ballast bed.

3. Problems in the situation

When the railroad crossing is in a horizontal curve for the railway, a cant is required in the curve. For small radii the excess is maximum cant. A concrete example is a railroad crossing, which is located in a horizontal curve with a small radius of 298 m and a height of 150 mm - Fig.3.

The Iliyantsi – Kurilo and Kurilo - Ribrovo railway is two-road railways. The cant of both roads is the maximum possible for design speed. This leads to a decrease in the comfort of car traffic, albeit within the capabilities of the rolling stock.

The solution is to reduce the speed of travel. In terms of safety it is good, but reducing the speed of vehicles nervous drivers.

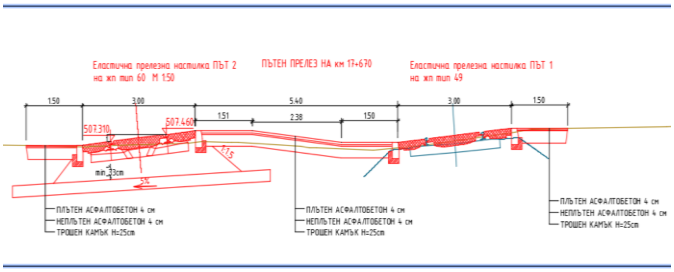

***Fig. 3** Maximum cants of both roads at small radius*

Although not laid down in the assignment, raising the level of the road, new approaches to the crossing would solve the problem - figure 4. If the railway line was one road, the level of the motor road could be changed.

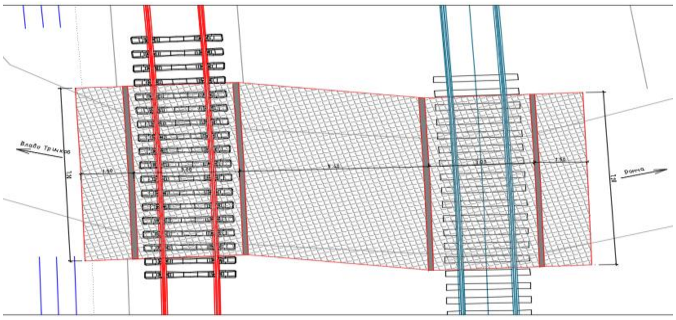

Fig. 4 Changing the straightness of the railroad crossing

The Ordinance on the railroad crossing and the existing Ordinance 55 [10] give the railroad crossing device at a perpendicular and inclined at a certain constant angle the intersection of the railway and the road.

In two line railway, the two pavements may not be parallel. This causes the straightness of the road to be disturbed and the speed of the cars restricted. With existing railroad crossings [11, 12] this is not fatal, although it seriously disrupts safety.

In the two-road railway, the railroad crossing is fully dependent on the levels of the two roads to ensure smooth and trouble-free passage of vehicles through it. In cases where the geometric parameters are not properly selected, there is a violation of the pavement of long wheelbase cars and vehicles and increases the risk of accidents caused by damaged or stuck vehicles.

The design decision of the two-road railway and intersection should be complex, covering the two railway tracks and the asphalt road passing through them.

The solution for changing the level of the two railway tracks and road approaches is the best option figure 5.

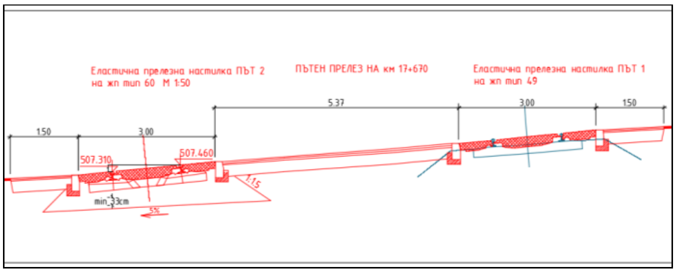

Fig. 5 Synchronization of the levels of the two-road railway

This variant necessitates a change in the levels of Route 1 within about one kilometer, around the railroad crossing. On the one hand, this is not included in the assignment and the quantitative account of the works contract. On the other hand, it is difficult because of the existence of solid points along the railway, which also alter the necessary activities. These can be railway station platforms - requiring height adjustment, bridges - requiring repair of the walls or ballasts or complete replacement of the facility, tunnels, contact network requiring replacement of the pillars, etc. The changed load on rolling stock and road traffic is also irrelevant [13]. In the construction of the motor road more ten years ago, the axle load was one, and now it has changed (increased).

At km 17 + 670, lifting of road 1 is practically impossible due to the presence of a steel bridge with wooden sleepers and without ballast bed 15 m before it, and nailing the level at the crossing to the nearest 1 millimeter. Changing the level of the steel bridge is only possible with major reconstruction of the facility or its replacement.

At the railroad crossing at Novi Iskar railway station on road 1 immediately before the crossing there is a platform, the change of which is also not within the scope of construction works. The height of the platform is a constant relative to the level of the rail head. This defines a solid point for the leveling line.

4. Decisions with a reduction of the cant in railway curve

This decision provides good compromise geometry of the crossing of road vehicles but increases operating costs for track and reduces passenger comfort on it.

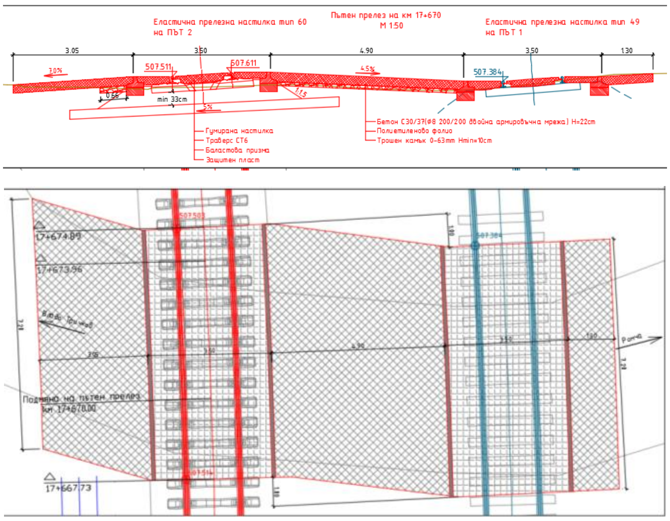

Fig. 6 Compromise reduction of the cant

The decrease of the cant in the crossing zone leads to the appearance of excess and shortage of cant. Normally, in mixed traffic, freight trains experience an excess of cant and passenger trains shortages of cant. The compromise of reducing the required overrun leads to additional checks on the minimum unslaked acceleration for passing trains.

3. References

Restrictive conditions predetermine the railroad crossing of the track in the presence of any compromises. Therefore, it is necessary to look for complex design solutions to balance the situation with regard to road vehicles and, accordingly, to improve it with regard to the railway infrastructure as well, in all cases the safety of the intersection comes first.

The options for solving the problems are:

- Situation analysis;
- Finding working solutions;
- Assessment of the damage and benefits of a decision and economic justification.

The findings and conclusions lead to:

- Making an analysis of possible solutions;
- Economic justification for the options;
- Preventive problem solving;
- Reduction of risks when crossing junctions are needed;
- Preliminary projects and studies to properly assess the need and scope of a repair contract.

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