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ИНСПЕКЦИЈА ЗА БЕЗБЕДНОСТ НА ПАТ – Некомпатибилност помеѓу функцијата на патот и типичниот пресек – белградска северна артериска тангента

ROAD SAFETY INSPECTION – Incompatibility between the function of the road and the typical cross section – Belgrade's Northern Arterian Tangent

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Апстракт

Инспекцијата за безбедност на патиштата е постапка призната низ целиот свет за идентификување на недостатоците на постоечката патна мрежа. Постапката е да се наведат точни мерки за отстранување на сите прашања кои ја засегаат безбедноста на сообраќајот. Во трудот се претставени безбедносните прашања кои произлегуваат од некомпатибилноста помеѓу типичниот пресек и основната функција на патот. Загрижувачкиот пат е белградската северна артериска тангента. При теренската посета се земени сите материјали поврзани со несоодветните елементи на патот. Исто така, трудот предлага точно преуредување на пресекот со цел да се прилагодат сообраќајните услови на моменталната и планираната улога на патот во поширокатa мрежа.

Клучни зборови

Инспекција за безбедност на патиштата, функција на патот, типичен пресек, сообраќајни незгоди, мерки за подобрување

Abstract

The Road Safety Inspection is a procedure recognized all over the world for identifying the deficiencies on an existing road network. The procedure is to purpose exact measures for eliminating all the issues affecting the traffic safety. The paper presents the safety issues emanating from the incompatibility between the typical cross section and the basic function of the road. The road in concern is Belgrade's Northern Arterial Tangent. All the materials related to the inadequate elements of the road are taken during the field visit. Also, the paper proposes exact rearrangement of the cross section in order to adjust traffic conditions to the current and planned role of the road within the broader network.

Key words

Road safety inspection, road function, typical cross section, traffic accidents, improving measures

1. INTRODUCTION

In the Terms of reference, presented by the Investor or governmental body to the Designer, among the first items stated is the function of the particular road. Consequently, one of the first steps in the design process is the adoption of the appropriate typical cross section, which must be compatible with the primary function of the road. In some cases, inadequate relationship between the typical cross section and the road function may jeopardize traffic safety.

The paper presents example of very important arterial highway, with the elements of typical cross section incompatible with its primary function. What is more, there is even inconsistency between the current and the future function of the road, further complicating selection of typical cross section elements. Also, measures to mitigate both current and future problems are proposed.

2. DESCRIPTION OF THE CASE – STUDY ROAD SECTION

The subject of this paper is the section of the road, 2200m long, situated on the left bank of the Danube river, opposite to the downtown Belgrade. The name of the road is Northern Arterial Tangent (Severna magistralna tangenta).

The section starts with the Pupin's bridge over the Danube river in the Belgrade's county of Zemun and then proceeds all the way to the east, with one more bridge planned to bring the road back to the Belgrade side in the eastern outskirts of the city. On its way, the road crosses "Veliki kanal" (Grand Channel) and roads leading to local pannonian centres of Zrenjanin and Pancevo.

The primary function of the road is to serve the long-haul traffic, diverting heavy vehicles away from the central Belgrade. For the time being, the corridor is uninhabited and land use is predominantly agricultural.

Figure 1. Location map of the road section Zemun - Borča

The paper will present the key safety issues and proposed the measures to eliminate or reduce them.

3. SPECIFIC ROAD TRAFFIC SAFETY ISSUES

3.1 Road function

For the time being, the road serves long-haul traffic and, in its nature, it is rural road. But, according to the development plans and relevant planning documentation, the road is supposed to be urban arterial, within the municipalities of Zemun and Palilula. In accordance with its planned function, the speed limit on the road is set to 50km/h. And, in accordance to such a relatively low speed, all the elements of typical cross section are selected.

However, the actual speeds on the road are much higher, with the lowest speed starting with 52km/h and reaching 126km/h. The average speed observed is around 90 km/h. Thus, all the vehicles are travelling at speeds exceeding the actual speed limit, around 88% of vehicles exceeding the limit by more than 20km/h.

The speeds registered in the field confirm the incompatibility between the planned function of the road and the parameters of the existing traffic flow.

Figure 2. Speed limit sign and typical cross section

Cosequently, increased number of traffic accidents is observed on this road in years 2018,2019 and 2020 (table 1). There were 39 traffic accidents in total, two of them with the fatalities.

Year	TA with property damage only	TA with injuries	TA with fatalities
2018	8	3	1
2019	9	5	0
2020	8	4	1

Table 1. Traffic accidents structure

The types of accidents not only expected, but acctually occuring on this section of the road, are illustrated in Figure 3:

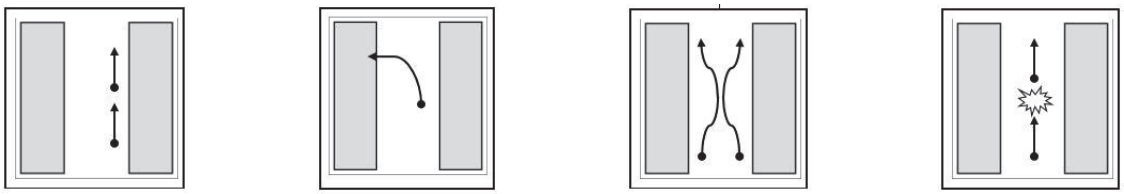

Figure 3. Expecting/occuring possible traffic accidents

Obviously, the road needs to be accommodated to serve the speeds that are much higher than the actual speed limit. There are some reserves within the typical cross section, so the elements of cross section could be rearranged to provide for higher speeds. Also, horizontal alignment of the road consists of straight sections and large radii, already enabling higher speeds (it is worth mentioning that the grades of longitudinal profile are in the order of 0.3%, thus not impeding operating speeds of any kind of vehicle).

Though there are some preconditions for reaching the speeds of 130km/h, the recommendation is to set the new speed limit of 80km/h which is compatible with the high-speed motorway in an urban environment. Intersection's interval is also compatible with the increased speed limit.

3.2 Road alignment

It is already stated that alignment of the centreline allows the speeds of 130km/h, both in plan and in longitudinal profile.

But, when it comes to details in plan projection, concerning intersections, there are some problematic spots.

At the very end of the section, at-grade intersection ("T" type) is proposed in the distant future. This future connection is to be located near the settlement of Borca. For the time being, no elements of the intersection are constructed, except the median of a variable width. Approaching the location of future intersection, the median gains width, to accommodate left turn manoeuvering lane.

Geometry of the median deviation is constructed with the parameters compatible with the operating speed of 50km/h. Practically, there is a sharp deviation of all traffic lanes within the future intersection's zone. This is the location where high-rate of traffic accidents is observed, even the accidents with the fatalities. Despite the clear horizontal marking, vehicles are crossing into the adjacent lanes, resulting in side collisions. Even the tyre marks are spotted all over the location (Figure 4).

Figure 4. Road deviation at the location of future at-grade intersection area

At this location, not only upgraded signage, but also thorough reconstruction of the roadway is recommended.

Elongating the deviation of the left turn is of utmost importance. As a result, the right edge of the pavement should be displace outwards. Fortunately, there is a space to slightly widen the pavement and to displace adjacent fill slope.

With the reconstruction of the pavement geometry considered an active measure, that actively increases the safety of the road, some passive measures are to be undertaken as well. These measures assume upgraded vertical signage and improved traffic lane marking (vibro stripes).

3.3 Typical cross section

The arterial in concern is part of un is urban road network. The cross-section is compatible with a typical urban arterial, 36m wide. It consists of 3 traffic lanes per direction, each 3.5m

wide, median 2m wide, side green belt of 1.5m, 2m wide walkway, bicycle path 1m wide, and a shoulder of 1.5m.

All along the way, the road is on an embankment with the slopes of 1:1.5. There are curbs along the edges of the pavement with inlets spaced at 20m intervals.

Midterm measure, aimed to reduce the speeds down to 80km/h and thus increasing traffic safety, is to reduce the width of traffic lanes to 3.25m. The width of the traffic lane of 3.25 m corresponds to the speed of 80 km/h. According to the regulations, the speed of 80 km/h, requires edge lane 0.35m wide.

As there is enough space for the edge lane of 0.5m, it is on the safe side to adopt that increased width. Since the current traffic flow does not justify 3 traffic lanes per direction, it is proposed to substituted outer traffic lanes with 2.5m wide stop lanes.

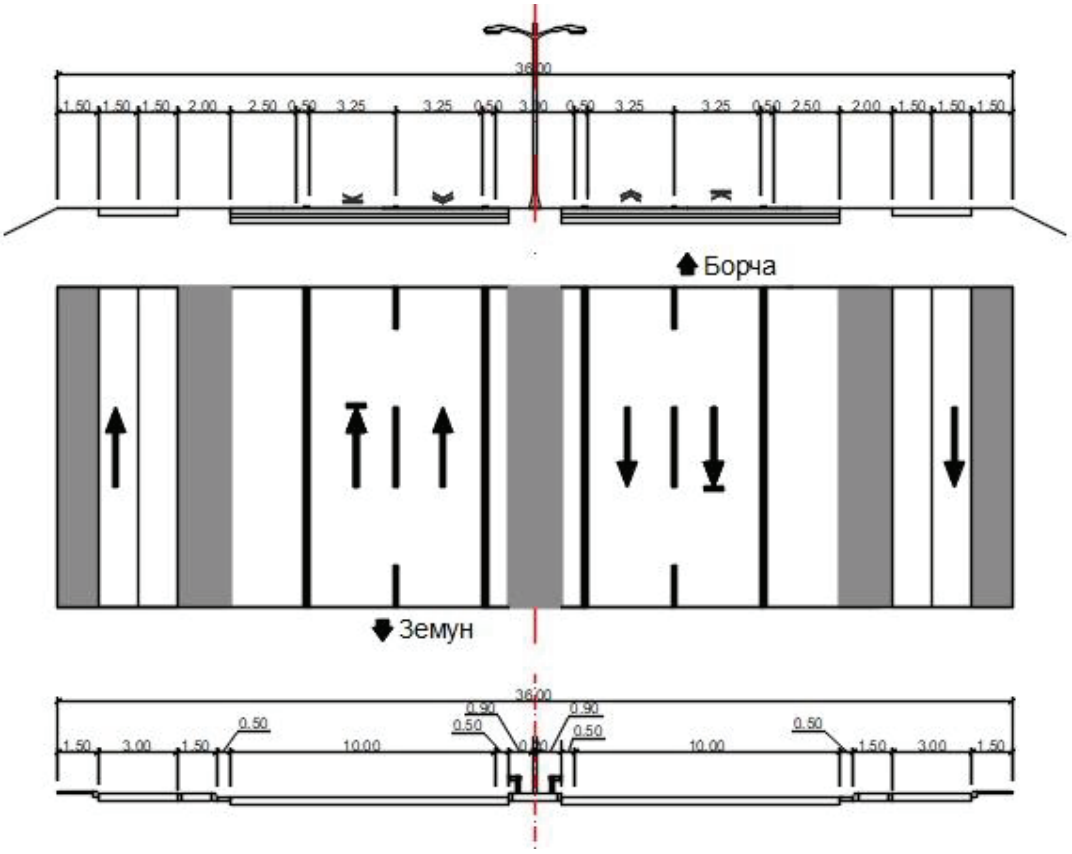

Figure 5. Typical cross section for V=80km/h

The total width of a typical cross section permits even the elements compatible with the speed of 100km/h, as a long-term measure. In this case, 3.5m traffic lanes with 2.5m wide stopping lanes, would be introduced.

The most critical element of a cross section is absolutely inadequate median width of 2m only. Even the light poles are installed in the median, with the H2W3 safety barriers on both sides. This type of safety barriers is not adequate for a speed of 100 km/h, especially taking into account crush deflection in the light pole zone.

Figure 6. Inadequate median width

The solution to this problem calles for relocating the light poles to the sides, probably in the green belts between the road pavements and walkways. According to the current design practises, this will require curbs that are lower in height (7cm) and safety barriers between the curb and the light poles.

It also apperas that the bycicle path of 1m is not enough and it has been noticed that many cyclists drive into the walkways.

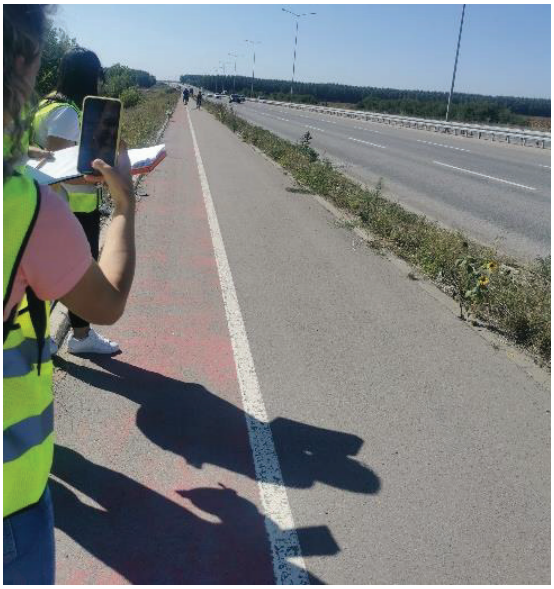

Figure 7. Inadequate bicycle path width

Therefore, it is recommended to rearrange bycicle lanes and adjacent walkways to increase the width of a bycicle lane from 1 to 1.5m. This the minimum for a one-way bicycle path.

On both sides of the pavement (between the pavement and the walkways) relatively narrow green belts (1.5m wide) are constructed. These green belts are poorly maintained, so the growth even impacts the visibility. What is more important, the debrice acumulated in the green belt blocks the water coming from the walkways to the inlets located along the outer edges of the pavement. Poor maintenance in these zone also causes cloging of inlets and the drainage system in general.

Figure 9. Poorly maintained green belt and drainage system

Perhaps, as a long-term measure, complete reconstruction of combined walkways and bycicle lanes that will redirect the waterflow outwards, is proposed. The quantity and the quality of water coming from these surfaces would not hidraulicaly and environmentaly affect enbankments and agricultural lands within the corridor. This measure calls for thorough reconstruction of walkways and bycicle lanes, but reduces the load on inlets. What is more, all the material that could clog the inlet, would be redirected to the sides.

4. CONCLUSIONS

The paper presents the methods of cross section rearrengement helping the road meet its'role within the network. This particular case-study is concentrated on the particular sub-urban arterial, which is supposed to exist within the urban environment, but the corridor is still uninhabited and the actual speeds are excessive. In the foreseeable future, the environment will not change and the speeds are expected to remain high, causing frequent and severe traffic accidents.

Bearing in mind that the road alignment could sustain higher speeds, the measures proposed are directed towards the rearrangment of the elements of a typical cross section.

The elements in concern are traffic lanes, stop lanes, edge lanes, walkways and bycicle lanes, as well as repositioning of light poles, safety barriers and curbs.

Literature:

Note: All the material is based on the field tour done by the authors. All the pictures were taken by authors as well.