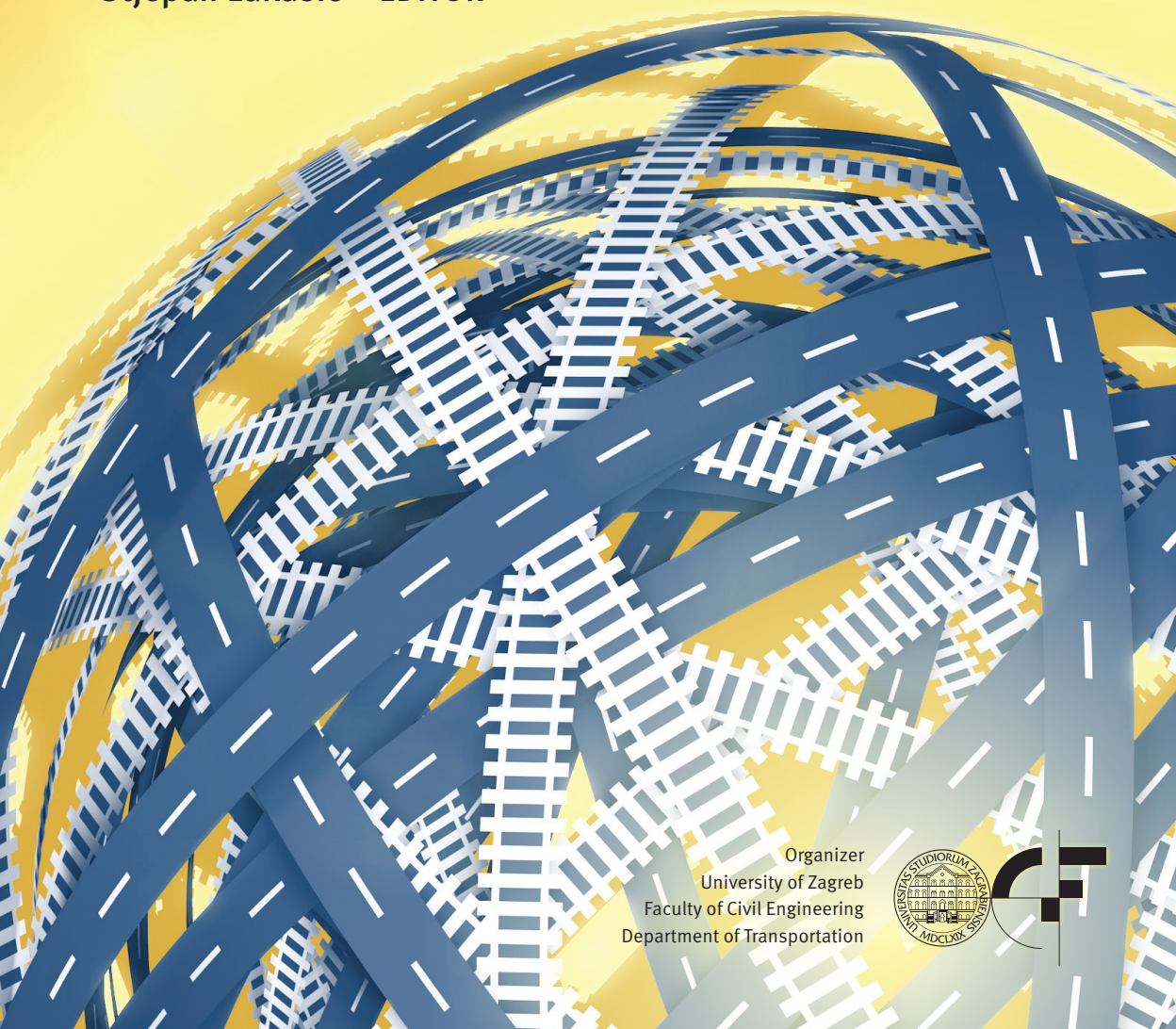
CETRA 2016

4th International Conference on Road and Rail Infrastructure
23-25 May 2016, Šibenik, Croatia

Road and Rail Infrastructure IV

Stjepan Lakušić – EDITOR



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INCREASING ROAD SAFETY BY IMPROVING ILLUMINATION OF ROAD INFRASTRUCTURE

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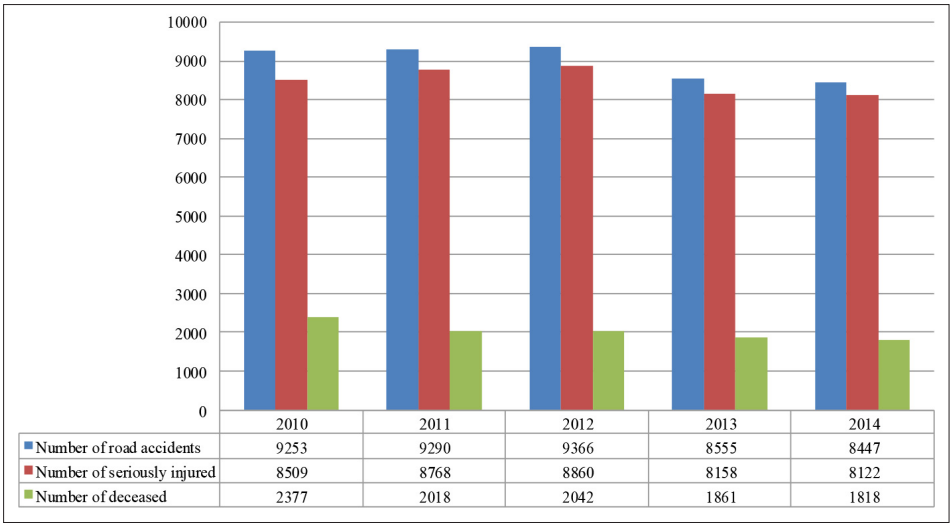
Romanian National Company of Motorways and National Roads (R.N.C.M.N.R.), Romania

Abstract

As all Member States of the EU also Romania is a country that has made objective of reducing by 50% the number of deceased victims from road accidents, by 2020. To achieve the stated objective, it is necessary to implement rapid on the entire road network, technical solution to improve road infrastructure and increasing the visibility of drivers. In order to increase road safety by reducing the number of traffic accidents is required luminance increasing existing roads due to the key role of ensuring greater visibility. In the case of road infrastructure is used luminance, which is the amount of light fell on a surface and reflection. In this article we will present different solutions of increasing luminance on different road sections by changing minor technical solutions such as: a) choosing of different types of materials to build roundabouts and b) changing the size of geometric elements of road infrastructure.
In this article will be presented the best technical solutions to choosing lighting road infrastructure, after carrying out a survey results and a modeling software program in a specific lighting. One of the measures to increase road safety awareness implemented lately is making roundabouts in order to decrease the number of conflict points at intersection. Roundabouts are good technical solutions for increased road safety provided but only for drivers wich respect the speed limits imposed. Given the inappropriate behavior shown by traffic participants regarding compliance requirements and roundabouts are a modification of road infrastructures alignment, their illumination is required.

1 Introduction

The European Union has imposed on all Member States an extremely important objective in terms of increasing traffic safety by reducing by 50% the number of deceased victims of road accidents by 2020. Compared to the EU, our country is unfortunately a leading position in the number of people killed in road accidents, but lately have been implemented road safety measures which led to the existence of a descendent trend but insuficient compared with the European average. On the network of national roads and motorways in the period 2010-2014, the number of people seriously injured or died as a result of road accidents decreased significantly, especially in the year 2014.
In Romania as in other European countries, to achieve its stated objective, it has started implementation of several modern technical solutions in order to increase traffic safety and one of the most used solution that has proved effective in decreasing the number of accidents is the roundabout. Another measure of increasing road safety on the roads, which it is envisaged to be implemented both in Romania and abroad, is the realization of lighting, especially sectors that present a high risk for drivers.



	2010	2011	2012	2013	2014
Number of road accidents	9253	9290	9366	8555	8447
Number of seriously injured	8509	8768	8860	8158	8122
Number of deceased	2377	2018	2042	1861	1818

Figure 1 Number of road accidents produced in the period 2010-2014 on national roads and highways in Romania

2 The Roundabout

Roundabouts are intersections with a single carriageway traveled in one way around a central island. Vehicles undergoing ring driven over the roundabout have priority over those entering the roundabout. The solution adoption of roundabouts, traffic intersections for treatment, is viewed with much interest in many countries nowadays, especially for reasons of traffic safety and ensure proper quality fluent. The main advantages of roundabouts are:

- **Traffic safety:** the risk of accidents is (very) low. The first reason is the low travel speeds, both convergent traffic intersection and the one who runs the roundabout itself. A second reason is the number of potential conflicts between road users, which is lower than other types of intersections.
- **Quality traffic flows:** Roundabouts provide higher levels of service for all participants, compared to intersections regulated by traffic signs or the traffic lights.

Figure 2 Example of roundabout with two lanes per direction

The technical solution roundabout is a potentially beneficial for road safety and ensure a higher quality of traffic flows but providing lighting Their heady necessary because, otherwise, this solution is presented as an obstacle to drivers due to changes drastically alignment of road infrastructure.

3 Visibility of road networks

Given the fact that roundabouts drivers sense prevail and therefore those wishing to enter it must slow down or stop, drivers should benefit from increased visibility that currently measures ensure lighting. Depending on the technical solution required, roundabouts can have central island of a small height that will ensure observation vehicles are also those who enter into them on the opposite side, or have central island with a significant size that will ensure only observing the vehicle which is in turn. In cases where there is a history of non-compliance with speed limits of drivers, roundabouts practiced with center island with great height so as to lead to an order reducing speed.

4 Case Study – Lighting roundabouts

This article will present the influence of chromatic material used to build a roundabout on simultaneously with its illumination of road safety. In the field of lighting for the road sector, the most important aspect is the luminance because it is the coefficient of light that is reflected more accurately characterize the brightness of objects.

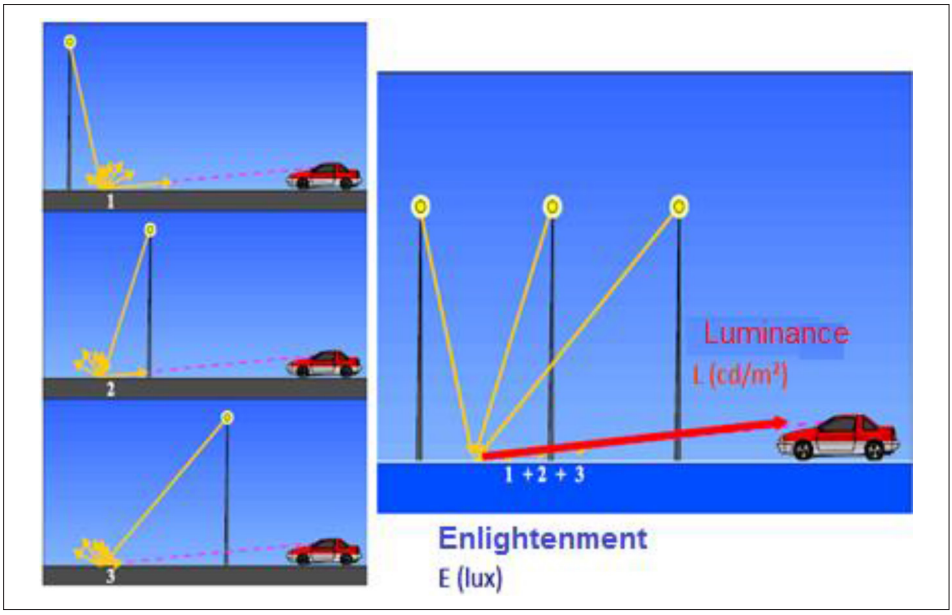


Figure 3 The principle of enlightenment and luminance

Luminance is the measure used in the design and verification of lighting and road infrastructure networks is measured in cd/m^2. By achieving an optimal luminance it is envisaged the drop of blinding drivers, both disability glare (reduced visibility is physiological and represent) and the blindness of discomfort (psychological and unpleasant conditions that create visibility). For the tests in this article, was chosen the technical solution roundabout with center island with significant height or 2 meters and a solution of road illumination lighting apparatus.

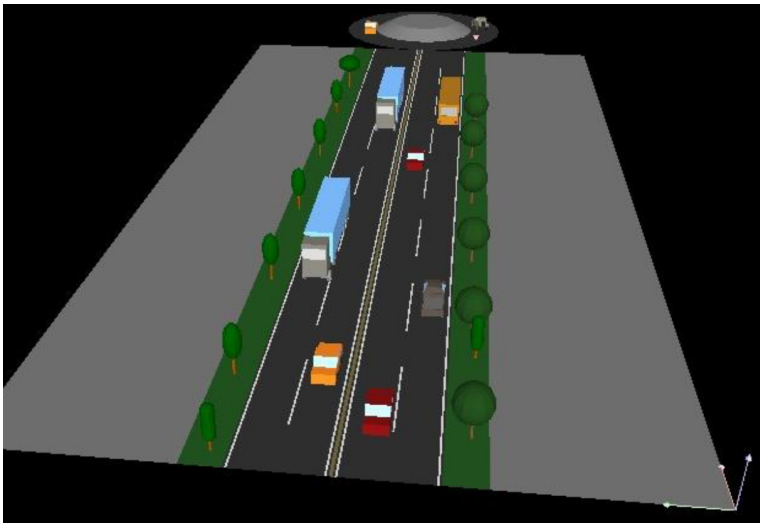


Figure 4 The technical solution – roundabout

Figure 5 The technical solution – roundabout

Simulation illumination was performed using the software DIALux, where he was selected the next unit of LED lighting and the layout was optimized by the program in compliance with condition (imposed) to ensure a degree of uniform illumination of at least 1.5 cd/m^2. (Since this simulation we assumed that talk of a roundabout with traffic we considered important and significant need to ensure lighting has been chosen ME2 lighting class according to SR EN 13201- lighting road traffic routes). Lighting appliance has the following important features: Luminous flux (luminaire): 18,500 lm; Beam (lamps): 14,800 lm; Luminaire power: 138 W.

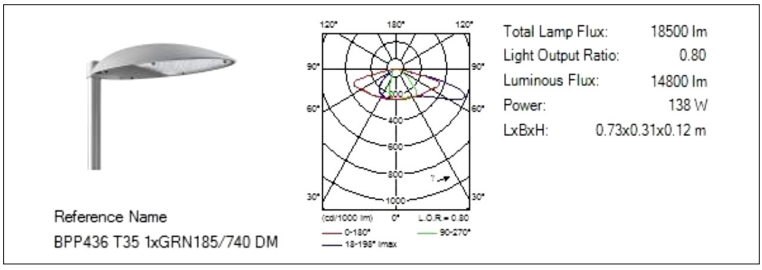


Figure 6 The Lighting appliance

After the calculations and optimizitions performed by the program, the chosen solution was an arrangement of luminaires at a distance of 34 m and a height of 10 m with a degree of ori-

entation of the device 0°. Simulations were conducted in March, the only element changed was the material used to cover the roundabout, namely:

• **Case I** – was supposed to cover the central island was used paving brick-colored tiles:

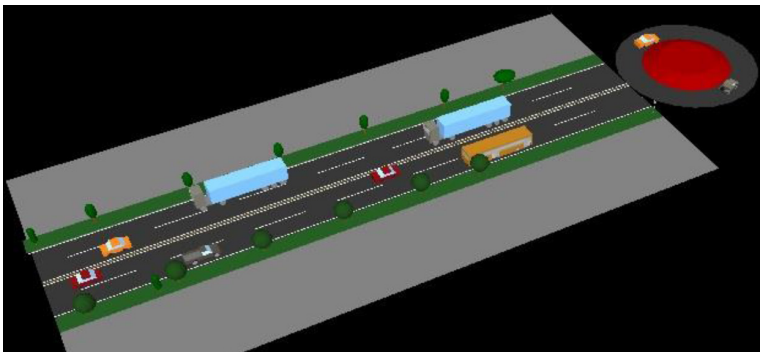


Figure 7 The central island of roundbout covered with brick-colored tiles

• **Case II** – was supposed to cover the central island was used pavement tiles in gray:

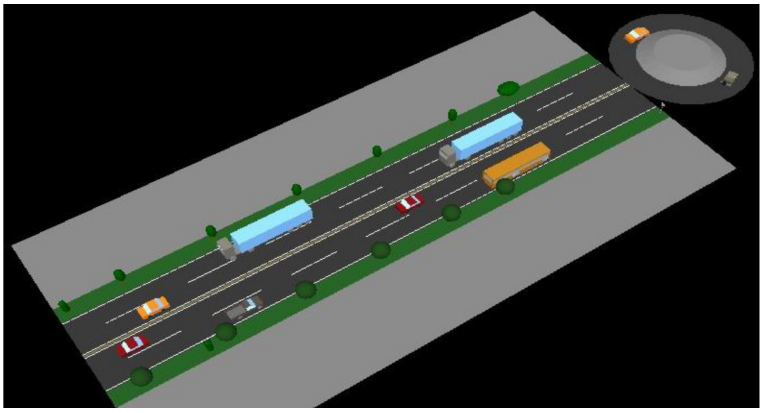


Figure 8 The central island of roundbout covered with gray pavement tiles

• **Case III** – it is also contemplated that cover the central island of grass was used:

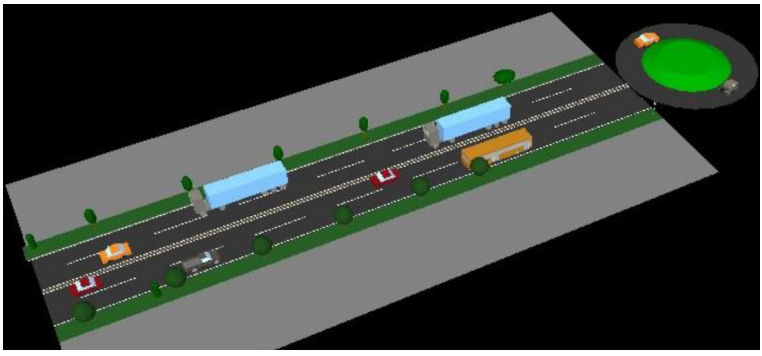


Figure 9 The central island of roundbout covered with grass.

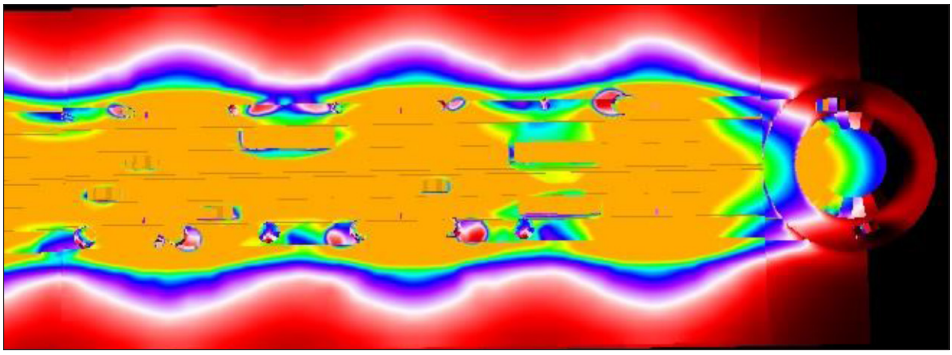


Figure 10 Luminance curve

Table 1 Measuring results.

Material used to cover center island	Luminance		
	the centreline, at the upper limit of island	the centreline, at the middle of island	left side at the border of visibility
brick-colored tiles	1.33	1.39	1.31
gray pavement tiles	1.51	1.55	1.48
grass	1.39	1.45	1.39

5 Conclusions

The best visibility for drivers due to a higher degree of illumination is provided by the solution roundabout with center island with paving slabs of concrete gray detrimental use of grass or pavement slabs of concrete brick red. Following the simulation carried out in the case study presented revealed that it can get a higher degree of light just by changing chromatic materials used without changing luminaire types and their positioning.

Refereces

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