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USING TOPOGRAPHIC ELEVATIONS IN CREATING TRAFFIC SCENARIOS IN JUNCTIONS

Abstract: *Due to the changes in the road traffic caused by the continuous growth of the motor fleet, the increase of the existing fleet mobility index and the increase in the number of vehicles passing through the city, it is usually necessary to intervene in the road traffic with traffic lights. It is necessary to transform the old system of the traffic network into a new efficient system, corresponding to a new road infrastructure with increased vitality. The paper aims to demonstrate the use the elevation from topographic equipment's to design the junctions vertical and horizontal signalization, in every detail.*

Key words: *Road signs, Traffic, Fluidization, Vehicles, Light signals.*

1. INTRODUCTION

The circulating factor has always been the main element through which human activity, manifested on a stretched or narrower territory, has found the possibility of deployment and exploitation.

The need to establish contacts and connections between people or groups of people has led to the demand for frequencies that have increased, highlighting the phenomenon now called circulation.

Thus, road traffic can be defined as the movement generated by vehicles and persons, focusing on certain land surfaces specifically designed for this purpose, linked to the pursuit of life and human activities [1].

This paper follows the activity of a project that has as its main objective the better fluidization of the car and pedestrian traffic, the improvement of the mobility and mainly the increase of the safety level of the participants in the traffic at the studied intersection, by realizing the traffic controller signalling diagram at a minimum service level of C, according to the normative for the design of intersections at level on public roads.

2. BACKGROUND

The intersection studied for the implementation of a road traffic control system by traffic lights is at the meeting point between County Road 73A and County Road 792C, as seen in the fig 1. The four accesses have a right horizontal profile, intersecting them at an angle of 90˚. This along with the good quality of the road allows and tempts the participants to increase the speed of travel before entering the intersection, which is the decisive factor in the production of traffic accidents. In fact, this intersection has been given a negative reputation in this respect, and in recent years there have been many such undesirable road events, many of which have resulted in serious consequences.

Also, the lack of horizontal signalling is a factor that increases the risk of intersection displacement.

As a result of the traffic measurements made, there was a very large share of heavy traffic. Access to the locality is forbidden to cars with a mass greater than 7.5 tons, the DJ792C takes heavy traffic from the DJ73A, forcing truck drivers to change direction, which can lead to congestion at intersection.

In this area, the 6 m roadway width is on both the DJ792C and the DJ73A. The carriage of trucks on the intersection is cumbersome due to the reduced width of the belts, occupying both directions of movement and leading to numerous blockages. The two county roads can be considered collector / distributing arteries, being part of the second class.

Fig. 1 Aerial view of the intersection.

2.1 The operating mode of the light signals

This system involves a table with phase interruption times and flexibility for the length of the time cycles that depend on the possible combinations of vehicles that are given input on different traffic streams as follows:

- Time table (exact input / output time)
- Change the time table
- Displays conflicts (red-light automatically controlled)
- Safety time table

Based on HCM (Highway Capacity Manual) the calculation for the time table is based on the following formula [4], [8]:

$$\Delta t_{i-j} = \frac{l_i}{v_i} - \frac{l_j}{v_j} + 1 \qquad (1)$$

Δt_{i-j} - safety time

l_i - the passing distance of the vehicles from the stop line "i" to the point of conflict

l_j - vehicle crossing distance from stop line "j" to point of conflict

V_i - The lost speed of vehicles during the intersection

V_j - The speed of the vehicles passing through the intersection

The safety time between the expiration time of the vehicle and the occurrence of the pedestrian is calculated using the following formula, which is according to the road traffic literature [5], [8]:

$$t_{v-p} = \frac{L_V}{V_V} + 1 \qquad (2)$$

L_V - the distance the vehicle travels from the stop line at the end of the pedestrian crossing, which is in the expiration phase

V_V - vehicle speed in the expiration phase = 30 km / h

The safety time between the pedestrian overflow phase and the vehicle phase is calculated using the road traffic technical literature, by using the formula [8]:

$$t_{p-v} = \frac{L_P}{V_P} + 1 \qquad (3)$$

L_P - distance of pedestrian crossings

V_P - Walking speed of the pedestrian in the expiration phase

2.2 Traffic scenarios editing

According to the normative, the type of analysis for the design of the traffic lightning system (traffic engineering), to achieve the goal of the traffic light diagram, traffic volumes, geometry, service level are required. To be able to create different traffic light diagrams we collected data from all 4 arteries for each direction and vehicle category by manual counting.

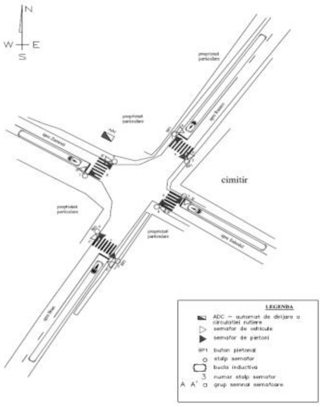

Fig. 2 Traffic light positioning on a topographic elevation of the junction.

Based on the fig. 2 traffic light placement we can define the lane groups [2], [3].

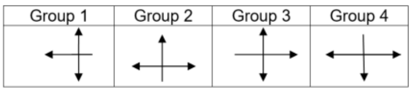

Fig. 3 Lane groups.

Referring to fig. 2, the location of the signal groups coincides with the band groups, as follows:

- Vehicle signal group A coincides with group 1 of lanes with forward, left and right traffic lanes;
- Vehicle signal group B coincides with Group 2 bands with forward, left, right and forward traffic lanes;
- Vehicle signal group C coincides with group 3 of lanes with right, left and forward traffic;
- Vehicle signal group D coincides with Group 4 with forward, left and right traffic streams;

Table 1

Volume and type of entries.

Volume and type of entries												
	A			B			C			D		
	Left	Forward	Right	Left	Forward	Right	Left	Forward	Right	Left	Forward	Right
Volume V(veh/h)	10	63	9	9	12	2	11	84	16	5	21	10
%vehicle grele,%HV	2,4			26			5,4			16,6		
Rush hour factor, FV	0,74			0,74			0,74			0,74		
Pedestrian volume (p/h)	32			0			10			10		
Bycicle volume,(b/h)	6			3			4			8		
Parkings	No			No			No			No		

After the measurements were calibrated, table 1, the next step is to calculate the saturation flux [6], [7] on the band groups, namely: Group 1 (signal group A) - saturation flow 1348 veh.; Group 2 (signal group B) - saturation flow 991 veh.; Group 3 (signal group C) - saturation flow 1262 veh.; Group 4 (signal group D) - saturation flow 1063 veh. This can be seen in the table below, table 2.

Table 2

Saturation flow.

Date	Group 1	Group 2	Group 3	Group 4
S_0	1800	1800	1800	1800
Fw	0,94	0,94	0,94	0,94
f_{HV}	0,97	0,79	0,94	0,85
fg	1	1	1	1
fp	1	1	1	1
N	1	1	1	1
fbb	1	1	1	1
fa	1	1	1	1
f_{LU}	1	1	1	1
f_{LT}	0,85	0,85	0,85	0,85
P_{RT}	0,10	0,08	0,14	0,27
f_{RT}	0,98	0,96	0,94	0,96
f_{LTp}	1	0,97	0,97	0,92
f_{RTp}	0,97	0,92	1	0,97
S	1348	991	1262	1063

S – saturation flow; S_0 - the basic saturation flow; N - the number of bands in the group of movements; f - the adjustment factor for the following conditions (W - bandwidth; HV - heavy vehicles; g - declivity; p - parking; bb - buses blocking - the type of the studied area LU - the use of bands RT - LT – veh. to the left; Rpb - Interference of cyclists or pedestrians at the right turn, and Lpb - Interference of cyclists or pedestrians at the left turn).

After the saturation flow, we need to establish the conflict matrix that takes into account the calculation of the traffic light signal plan, as in fig. 4.

		1	2	3	4	5	6	7
	→	A	B	C	D	a	c	d
1	A			X				X
2	B				X	X	X	
3	C	X						X
4	D		X			X	X	
5	a		X		X			
6	c		X		X			
7	d	X		X				

Fig. 4 Conflict matrix.

2.2 Topographic elevations in junctions

After the basic calculation the next step is to use the topographic elevation of the junction and establish and design the following critical scenarios:

- Vertical and horizontal signalization, fig. 5 & 11.
- Traffic light positioning.
- Traffic light pole positioning, fig 6.
- Traffic light pole construction details, fig 7.
- Electrical sewerage.
- Electrical power surge discharge.
- Electrical cable design, fig. 8 & 9.
- Inductive loop design, fig. 10.
- Cable connection.

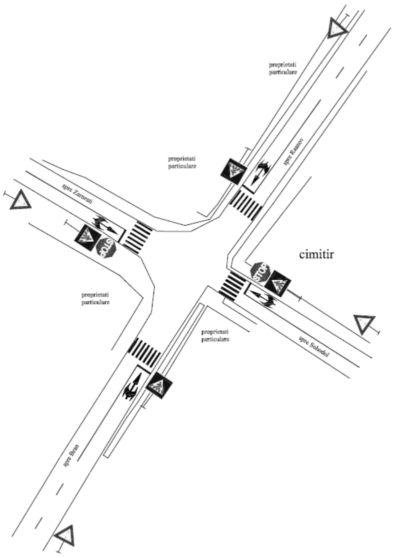

Fig. 5 Vertical and horizontal signalization.

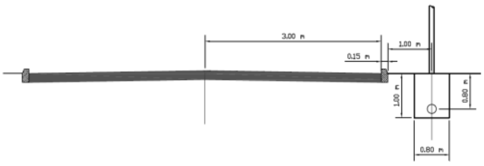

Fig. 6 Traffic light pole positioning.

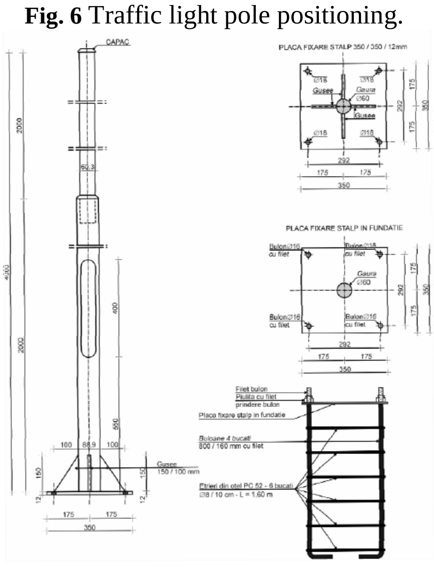

Fig. 7 Traffic light pole design.

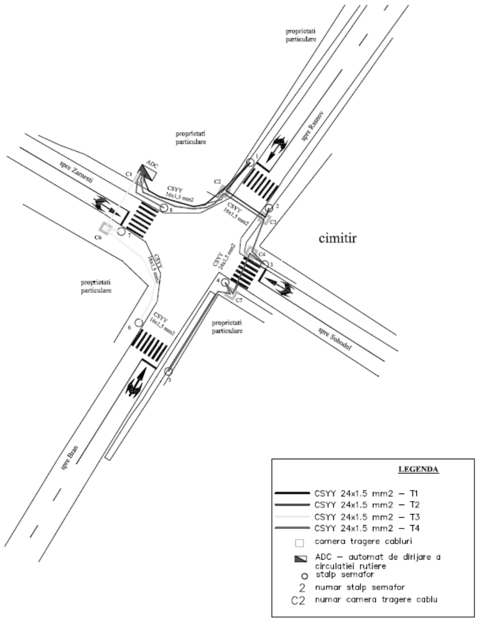

Fig. 8 Electrical cable design.

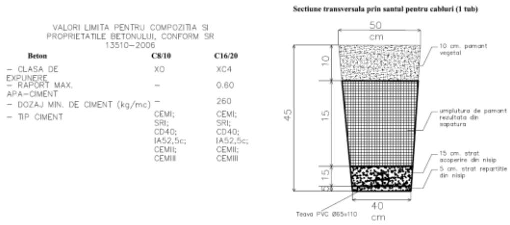

Fig. 9 Cable duct design.

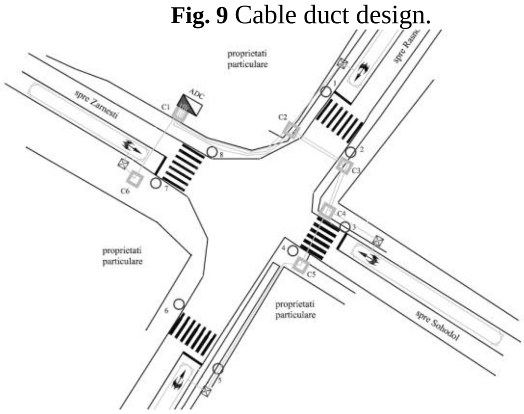

Fig. 10 Inductive loop design.

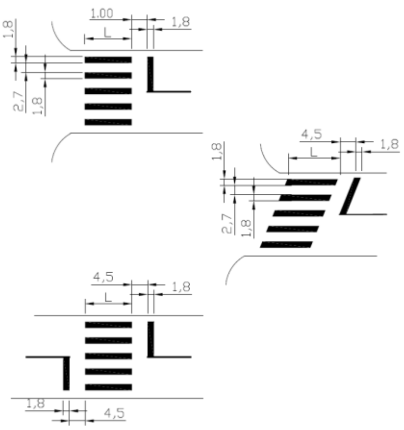

Fig. 11 Design of the road marking for pedestrians.

3. CONCLUSIONS

For the traffic engineer, congestion occurs much later, that is, only when the traffic intensity reaches a threshold in the vicinity of the capacity (maximum flow) of a road artery, and when further increases in the low traffic intensity are recorded, relatively significant decreases in the speed of the flow.

At the same time, the traveler is able to convey congestion only to the extent that his expectations regarding the duration of the journey or the movement of the goods as he has assumed have not been respected solely due to the extension of the duration of the itinerary on infrastructure.

Based on this theory it is important to take into consideration the effect of congestion from both the traffic engineer and the traffic participant. This effect is the accidents and incidents in the studied zone.

Using topographic elevations in creating traffic scenarios in junctions is much complicated that it looks at first glance. The design of an intersection is based also on the national normative. Taking in account the national normative and the topographic elevations, the traffic scenarios are also modified in accordance to the local geometries and the positioning of the existing road elements.

One of the main aspects in creating a traffic light junction is the road accidents and incidents that are affecting the studied area. After the design of the junction based on the principle of topographic elevations, one of the important aspects is to evaluate the dynamic of accidents in the studied area. The first 3 years show how the road accidents and incidents are increasing over the years. The junction was design with traffic lights at the end of the 3th year. The importance of well collated traffic scenarios in intersections can be seen in the decreased of incidents and accidents at the studied junction.

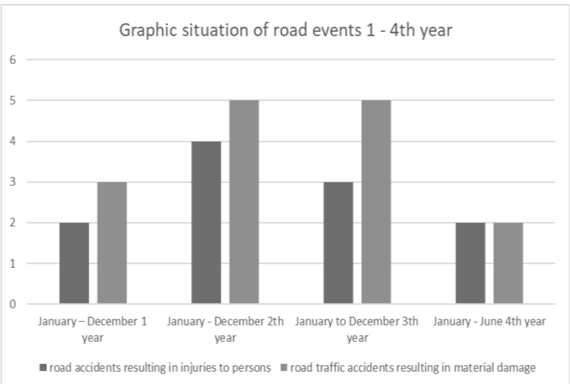

Fig. 12 Accidents and incidents dynamics.

The elements of the above graphic, fig. 12, detaile the dynamic on incidents in the studied area.

- January – December 1 year
  - 2 road accidents resulting in injuries to persons
  - 3 road traffic accidents resulting in material damage
- January - December 2th year
  - 4 road accidents with personal injury
  - 5 road accidents resulting in material damage
- January to December 3th year
  - 3 road accidents resulting in injuries to persons
  - 5 road accidents resulting in material damage
- January - June 4th year
  - 2 road accidents resulting in injuries to persons

2 road accidents involving material damage

4. REFERRING

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