ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

THE INFLUENCE OF THE CONFLICT POINTS UPON THE TRAFFIC FLOWS FROM AN INTERSECTION

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Keywords: road traffic, traffic flow, intersection, conflict point.

Abstract The subject of this paper concerns the analysis of the conflict points and their influence upon the traffic flows from an intersection. The intersection that was analyzed represents a part of an important road, which is in fact the main entrance into Braşov from Bucureşti. This intersection was studied using the real data collected in the field and it also has been analyzed using the intermediary, evacuation and access times that a vehicle needs in order to pass safely through the intersection. In the end of the paper, the results of the experimental data are discussed and the proper conclusions are stated.

1. INTRODUCTION

The road traffic worldwide becomes more crowded and less safe every day, and this rule also applies in the case of our country.

Here, in the past, the transport was not a very big problem due to the small number of vehicles that were on the roads. During the last years, since the number of vehicles (automobiles and transport vehicles) increased, in the large cities of our country a lot of traffic problems occurred. Braşov is one of these cities that will be the subject of the present study.

The traffic problems that are the most disturbing in our town are the rush hour traffic jams. They are caused by the large number of vehicles that move throughout the town at certain time intervals.

If we take into account the fact that in the whole country the total number of vehicles has an increasing tendency, one can only ask if these problems are only the beginning of traffic problems that we will have within Braşov, too. Another question that occurs is if the street network, already suffocating, is able face the new traffic demand and how.

The aim of this study is to analyze the problems that occur within an urban signalized intersection from the conflict points point of view and also, to try to explain what happens and why.

The intersection that is the subject of this study represents a part of an important entrance in the town. As the name says, the Calea Bucureşti Street is the entrance from the Bucureşti direction, but also it makes the connection between two very important tourist areas. This street is also the entrance for the Săcele town and it makes the connection of Noua neighborhood with the center of the town.

Another road traffic component in the area which also generates problems is the fact that the goods demand grew and it determined the presence of malls. They imply various car dealerships in the area, many vehicles, pedestrians and also gas stations, for which people do not have proper access and exit areas, and no alternative routes.

All these facts determine a very difficult traffic during rush hours; the traffic jams being its result.

The main direction of the traffic has the direction from the entrance into the town and towards the central areas and from the town to the big shops, which represent the biggest commercial area.

2. EXPERIMENTAL

The Calea Bucureşti – Carpaţilor intersection, which is depicted in Fig.1, is a very delicate point for the traffic. Here a lot of problems occur when people do their daily journeys (to and from the places they work).

Fig. 1: The Calea Bucureşti – Carpaţilor Street intersection in Braşov

This intersection is the point where all people in Răcădău neighborhood, which work in downtown direction and further areas, will merge within the traffic that comes from Bucureşti. When considering their return direction, namely, from work towards Răcădău neighborhood, the access is made before this intersection through a brace.

This brace is unlike most of the others on this route, the difference being the length and the width. It starts before the traffic light, leaving enough space on that lane such as the quenches formed on the city towards Bucureşti direction will not interfere with the right turn movement. The brace has two lanes and it can easily support both the public transportation lines towards Răcădău neighborhood and the people’s vehicles.

Fig. 2: The brace for the access to Răcădău neighborhood

In Fig.2 the brace for the access to Răcădău neighborhood is depicted.
As it can be easily seen, it has two lanes. On these two lanes, besides the public transport lines, there are a lot of people passing by, since they are residents in the area. The area is quite large, so a lot of traffic is generated from and for this direction.

When considering the direction from Bucureşti towards the center of the town, there are four lanes.The first one is for the right turn and forward motion, for which (forward movement) there are the next two lanes also.
The fourth lane, which is taken from the opposite sense, is for the left turn, as can be observed in Fig. 3.

Fig. 3: The Calea Bucureşti – Carpaților Street intersection in Braşov seen from the city center direction

If we take into account the Răcădău neighborhood approach, then we may observe that it has one lane for the right turn and forward motion and two lanes for the left turn. One of these is accomplished through the enlargement of the road section in the vicinity of the intersection.

The road coming from the center of the city, when not considering the vehicles for the Răcădău neighborhood, has two forward lanes and one left turn lane.

The other secondary road, namely the O. Augustus Street, has also an increased section near the intersection since from a two lane street; it becomes a four lane one. The first lane is for the right turn and forward motion, the second one for the movement forward and the third and last one for the left turn lane, as can be observed in Fig. 4.

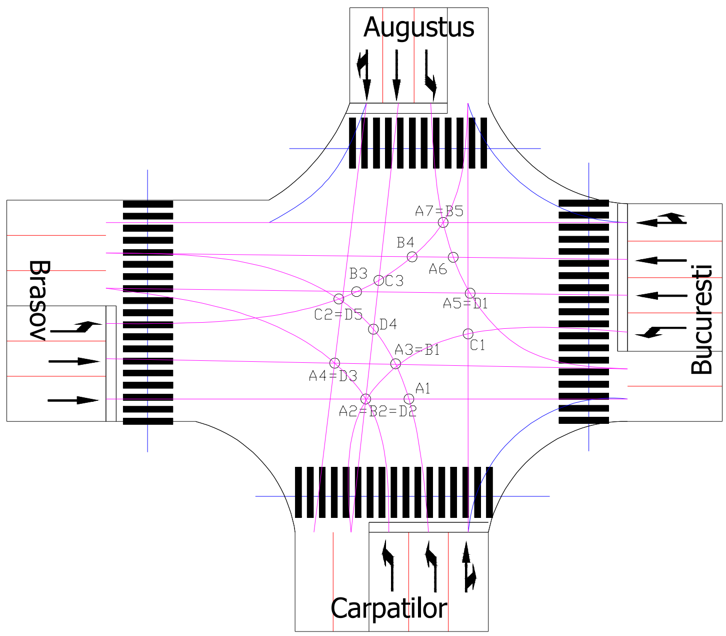

Fig. 4: The Calea Bucureşti – Carpaţilor Street intersection in Braşov and its conflict points

From the geometry of the intersection, as presented above, we can clearly see that the secondary accesses are not symmetrical and when considering their forward motions, the drivers will move on an oblique trajectory. This is why the time needed by a vehicle in order to cross the intersection, will increase.

If we take the phase succession for this intersection into consideration, it is a classical one. First, the right turn and forward motion for the main directions, than the left turn. While the third and fourth phases are represented by the right turn and forward motion and the left turn for the secondary streets.

The intermediary time table with respect to this important intersection is the one presented in Table 1.

Table 1: The phase planning and the intersection coefficients

CALEA BUCUREŞTI - CARPAŢILOR					
			4 Evacuates - 1 Enters		
	Da	De	Ta	Te	Ti
A1	30,43	13,68342	2,189209	5,189915	3,000707
A2	26,2	13,95451	1,884892	5,239204	3,354312
A3	29,12	17,10428	2,094964	5,811889	3,716925
A4	22,97	18,70498	1,652518	6,102926	4,450408
A5	15,82	19,4994	1,138129	6,247366	5,109236
A6	17,52	15,59952	1,260432	5,538297	4,277865
A7	18,53	11,69964	1,333094	4,829227	3,496134
				Ti max	5,109236
			1 Evacuates - 2 Enters		
	Da	De	Ta	Te	Ti
B1	24,94939	29,46	1,79492	8,058384	6,263463
B2	29,10763	26,2	2,094074	7,465657	5,371583
B3	26,07386	27,23	1,875817	7,652929	5,777112
B4	32,74392	21,65	2,355678	6,638384	4,282706
B5	36,9885	18,53	2,661043	6,071111	3,410068
				Ti max	6,263463
			2 Evacuates - 3 Enters		
	Da	De	Ta	Te	Ti
C1	18,18	16,42953	1,307914	5,689207	4,381293
C2	17,72	27,96728	1,27482	7,786981	6,51216
C3	19,46	24,28738	1,4	7,117907	5,717907
				Ti max	6,51216
			3 Evacuates - 4 Enters		
	Da	De	Ta	Te	Ti
D1	18,84419	24,12	1,355697	7,087475	5,731778
D2	29,02093	13,33	2,087836	5,125657	3,03782

D3	24,46862	16,53	1,760333	5,707475	3,947142
D4	28,49114	20,31	2,049722	6,394747	4,345025
D5	24,85397	22,72	1,788056	6,832929	5,044874
				Ti max	5,731778
				Ti	23,61664

In order to understand the table we have to know that:

$$V = D / T \quad (1)$$

In words this means that the speed (V) is equal with the ratio between the distance (D) and time (T).

In traffic, the maximum speed of the vehicle is limited by legislation. The distances (the geometry of the intersection) were measured, so we have all the data that we need in order to find out the intermediary time.

Although it looks simple, the intermediary time method of calculation includes more factors than just the speed and distance.

In order to have the most realistic values for the time lost we have to take into account that the drivers are human. This means that they will have delays in execution of maneuvers and maybe even disturb traffic by selection of wrong lane for their moving direction. The driver will have a reaction time which is taken into consideration. Other aspects that are important are: the length of the vehicle, the acceleration of the vehicle.

The formula for the intermediary time is:

$$T_i = T_e - T_a \quad (2)$$

Where Te is the time needed by the car that is in the space of the intersection to evacuate and Ta is the time that the car that is entering the intersection on the green time of the next phase will need to accede.

The evacuation and acceding time are calculated from the stop line to the conflict point.

The evacuation time has the following composition:

$$T_e = t + 0.5V_e / V_a + (D_e + 1) / V_e \quad (3)$$

In formula 3, t is the reaction time for the driver and it has a value of one second, Ve is the evacuating speed (the lowest value for the evacuation speed) and is 5.5 m/s, the acceleration a is 4.5 m/s2, De is the evacuating distance measured from the stop line to the conflict point, and l is the vehicle length, namely 6 m.

The access time, also measured from the stop line to the conflict point has a simpler formula:

$$T_a = D_a / V_a \quad (4)$$

In formula 4, Da represents the access distance and Va the acceding speed which has the maximum legal value admitted in our case 13.9 m/s.

3. RESULTS AND DISCUSSIONS

Although it looks that the formulas for the intermediary time are switched, there is a good reason for this. The most dangerous conflict situation occurs when the driver passing on the last second of green needs time to shift gears or losses time for other reasons. The acceding car into the intersection on the first seconds of green moves with the maximum legal speed and those not encounter any car at the stop line, so is not slowing down when entering the space of the intersection. So, with these formulas we will have the intermediate time for safe driving through intersection.

When the field measurements where made, the observer also noticed the trajectory of cars in the crossing of the intersection so the data in the table is based on the fact in the field.

But the reality is that the intermediary time can be greatly shortened if the drivers will move on the optimal trajectory. As presented before, the time needed to evacuate or accede depends on the distance. So, if the distance varies, the time will also vary. Taking this fact into account, we will discuss about the trajectory of vehicles, importance, and safety.

The trajectory of vehicles is determined by the driver. Many drivers do not know that one car that moves in an intersection and does not take into account that there are other traffic participants, may delay a lot of vehicles.

The intermediary time for point A1 was 2.40 seconds. But the intermediary time may vary from negative values to a value that is two times greater than the one calculated with the field data. The negative value for the intermediary time means that the cars will never meet. That implies the disappearance of the conflict point.

The implication of negative values for the intermediary time is benefic to traffic. This means that in that point no accidents will happen if the drivers move on the green light. Between that phases there will be no need for yellow time and so the green light can be longer. If we have a longer green light, there will be more cars per minute passing through that intersection, and we will realize a good traffic optimization. But in the same time, if drivers will move however they see fit, the time needed to evacuate safely for one of these situation will rise up to 4.5 seconds, time that translates into money losses, pollution increase, and noise level increase (disturbances of pedestrians and residents in the area) and this might result in traffic jams.

The traffic jam has a bigger opportunity to occur because the vehicles from different phases will enter in the same time in the space of the intersection. They will meet in the center and will have nowhere to go. This way the traffic will stop fully or partially but the delays will surely be huge.

4. CONCLUSIONS

The intermediary time is a little bit smaller than the lost time, when compared to another intersection that was also analyzed, although the general dimensions are the same.

The geometry of this intersection, and the fact that the lanes are not one after the other, makes the crossing time bigger, but the trajectory closer to the best one. This is one of the reasons why the lost time in this intersection is slightly smaller.

The area that was analyzed is a very important one, because here there are three accesses for the County Hospital: one on the secondary street, namely O. Augustus St., one directly in the main street and the last one a few meters after the intersection but exactly before the public transport station. The only access that is positioned correctly is the one on O. Augustus Street; the other ones that go directly in the main flow only disturb the traffic.

The management of this type of intersection must ensure enough time such as there will be no queues on the main flow direction. In the same time, it must make sure that the integration of the secondary traffic flow in the main one is made without too many problems that can create a lot of discomfort for the majority of the drivers in the intersection.

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