

THE ANALYSIS OF ROAD TRAFFIC ON CALEA UNIRII STREET IN SUCEAVA CITY

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Abstract: *There was conducted a short-term census to determine the service level and circulation capacity of the intersections located on the Calea Unirii street at km 4 + 980.00 (Iulius Mall intersection), km 5 + 651.00 (Dedeman intersection), km 6 + 720.00 (Burdujeni). It was determined the instantaneous speeds at peak hour in the busiest quarter of an hour on the part of the street between pedestrian traffic light controlled crossings. Below we are presenting the results obtained.*

Key words: *service levels, traffic census, circulation capacity, instantaneous speeds, speed diagram.*

1. Introduction

The city of Suceava, the seat of Suceava County, has a population of approx. 106.000 inhabitants and is a powerful center of polarization of socio-economic activities at regional level. The street network has a radial configuration with 5 main directions (DN 2 - to Bucharest, respectively to Siret, DN 29 - to Botosani, DN 29A - to Dorohoi, DN 17 - to Vatra Dornei), and circulation tends to focus on several major arteries that cross the central area of the city.

The street Calea Unirii overlaps with DN 29A, it is a street of the second category, with four lanes, with a length of 3.40 km and a width of 14.00 m. The street has three roundabouts: at km 4 + 980.00 (Iulius Mall intersection), ovoid type; at km 5 + 651.00 (Dedeman intersection), circular type; at km 6 + 720.00 (Burdujeni), circular type.

There are four stations for public transport, two for each direction. At the same time, the street has a delimitation island for movement directions, namely between km 4 + 870 ÷ 4 + 950; km 5 + 010 ÷ 5 + 340; km 5 + 360 ÷ 5 + 630.

Figure 1, 2 and 3 show the traffic during the short-term census that was conducted on Calea Unirii Street.

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Fig. 1. Image of traffic on Calea Unirii Street



Fig. 2. Image of traffic on Calea Unirii Street



Fig. 3. Image of traffic on Calea Unirii Street

2. Case Studies

2.1. The Analysis of Current Road Traffic Situation on Calea Unirii Street

There was conducted a short-term census for 3 days, during 8 hours a day, and the MZA (the daily annually average) calculation is made with relation (1) [1]:

$$MZA = \frac{1}{n} \times \sum_{i=1}^n q_{ki} \times c_{kz} \times c_{ki} \times c_{ka} \quad (1)$$

where:

- n – the number of traffic census days;
- q_{ki} – the traffic intensity for the "k" vehicle group during the traffic census on day "i";
- c_{kz} – adjustment factor for the 24-hour level;
- c_{ki} – adjustment factor for the MZL level (the daily monthly average);
- c_{ka} – adjustment factor for the annual level.

The short-term census lasted for 3 days. In each day, the traffic was reviewed in four posts for 14 hours a day from 07:00 to 21:00. Review posts were:

- post P1-km 5+700 - direction Burdujeni - Suceava (at the base of the overpass);
- post P2-km 5+700 - direction Suceava - Burdujeni (at the base of the overpass);
- post P3-km 4+870 - direction Suceava - Burdujeni (at the end of the bridge over the Suceava River - at the bazaar);
- post P4-km 4+870 - direction Burdujeni - Suceava (at the end of the bridge over the Suceava River - at the bazaar).

All the vehicles have been reviewed in each post of census, on each lane, separately.

There were also four posts for pedestrians review at crosswalks. The post were placed at:

- Bazaar station – OMV (uncontrolled crosswalk);
- LIDL station – polyclinic (traffic light controlled crosswalk);
- Carrefour access station – Ambro (traffic light controlled crosswalk);
- Bus station – Carrefour access, before the Dedeman roundabout (traffic light controlled crosswalk).

Based on the conducted traffic censuses, it was calculated the daily annually average (MZA) in 24 hours, for physical and standard vehicles, for both 2016 (current year) and a prospective period of 15 years, 2031 (see Table 1).



Fig. 4. Image of the four review posts were located

Intensity of the daily annually average (MZA) in physical and standard vehicles on Calea Unirii Street.

Table 1

Vehicle type	MZA2016 (physical vehicles)	MZA2031 (physical vehicles)	Equivalence factor in standard vehicles (cars)	MZA2016 (standard vehicles)	MZA2031 (standard vehicles)
Bicycles, motorcycles	63	56	0.5	32	28
Cars	15316	28382	1.0	15316	28382
Minibuses	269	652	1.0	269	652
Trucks <3.5 tons	1698	3549	1.0	1698	3549
Two axle truck	377	701	2.5	943	1753
Three and four axle trucks	126	209	2.5	315	523
Articulated vehicles	193	332	3.5	676	1162
Buses and coaches	1281	2818	2.5	3203	7045
Tractors, special vehicles	21	33	3.5	74	116
Road trains	62	99	4.0	248	396
Animal traction vehicles	0	0	3.0	0	0
Total	19406	36831		22774	43606

The figures 5, 6, 7, 8, 9, 10 show the distribution of traffic reported by hours in the P1, P2, P3, P4 posts in physical and standard vehicles.

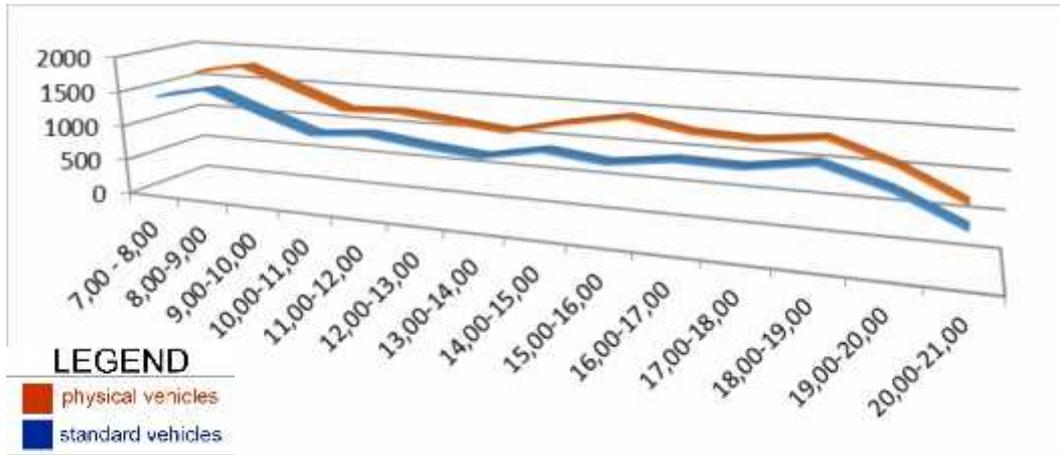


Fig. 5. Image of the traffic distribution in post P1 - Lane 1 + Lane 2

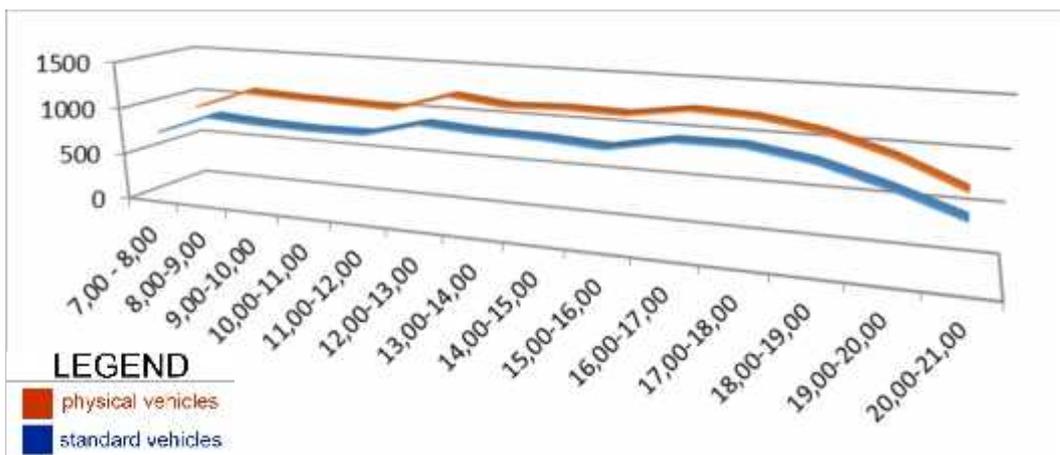


Fig. 6. Image of the traffic distribution in post P2 - Lane 1 + Lane 2

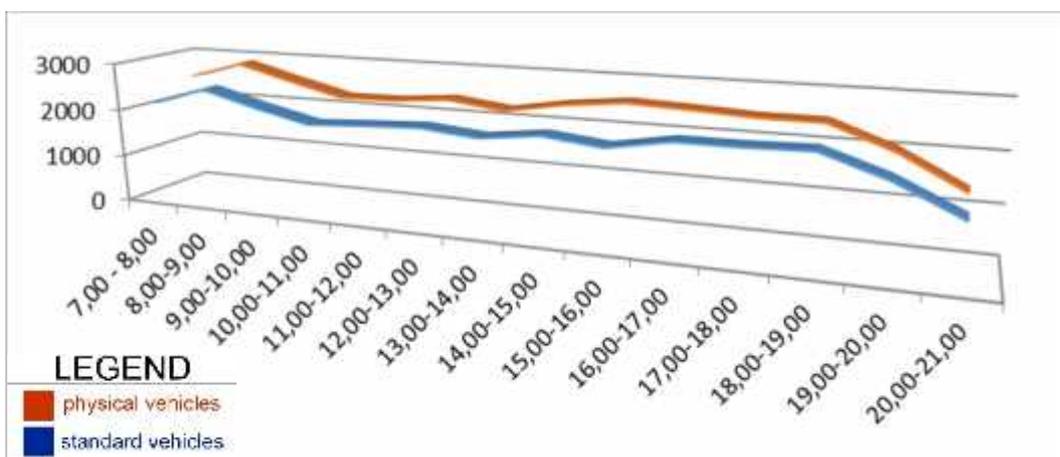


Fig. 7. Image of the traffic distribution in post P1 + P2

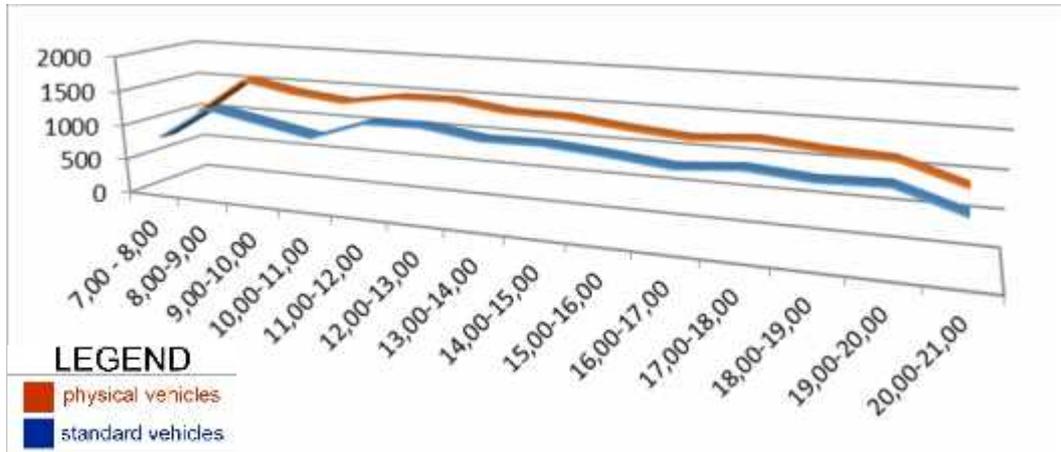


Fig. 8. Image of the traffic distribution in post P3 Lane 1 + Lane 2

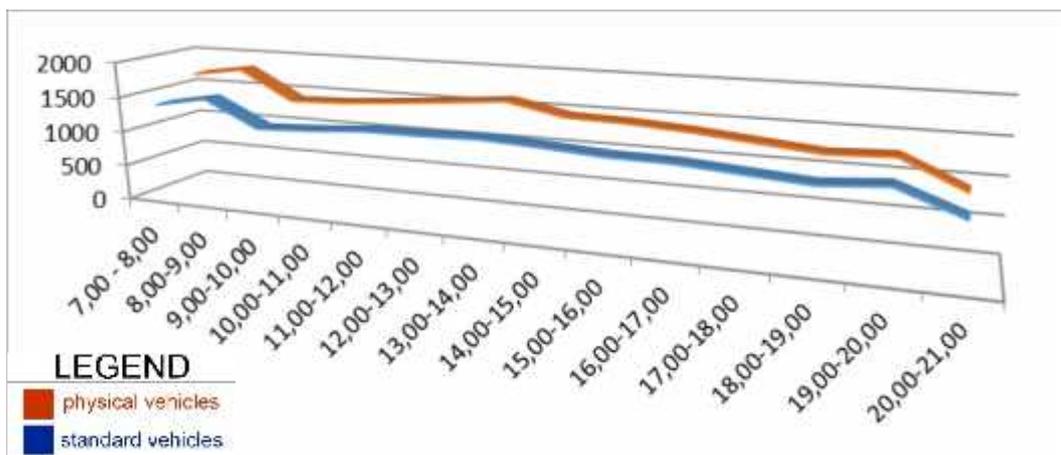


Fig. 9. Image of the traffic distribution in post P4 - Lane 1 + Lane 2

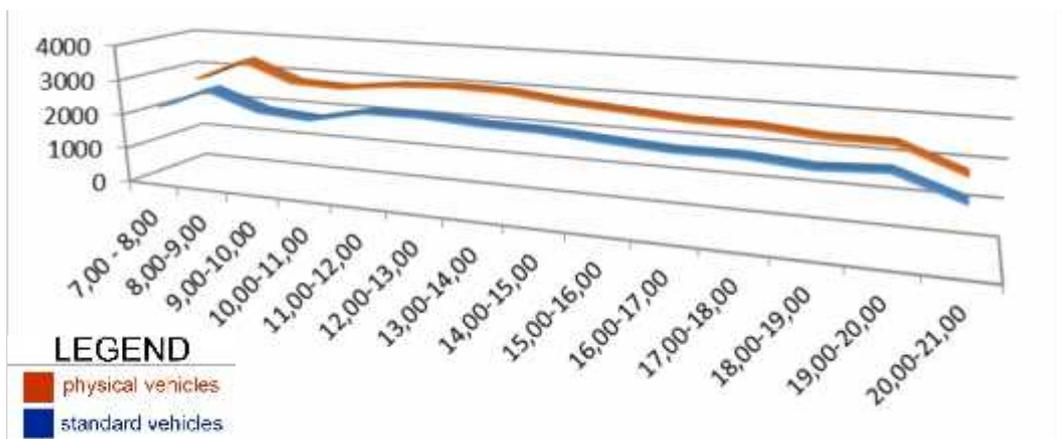


Fig. 10. Image of the traffic distribution in post P3 + P4

There was conducted a census for the number of pedestrians at the four pedestrian crossings on the Calea Unirii Street, the traffic evolution is shown in Figure 11.

Due to the large number of vehicles, namely: a MZA2016 (physical vehicles) = 19.406 units, respectively MZA2016 (standard vehicles) = 22.774 units. and the existence of four crossings of pedestrians located at the level and the two roundabouts at Iulius Mall and at Dedeman, as well as the intersection in "T" Ambro - Access Carrefour, there are frequent traffic jams, especially in the morning on the Burdujeni - Suceava direction, and in the Suceava - Burdujeni direction the traffic is very uniform around 1000 vehicles/hour.

It is worth mentioning that the roundabout that is blocking is the one from Iulius Mall.

In the P1 post, in the direction of Burdujeni - Suceava (Lane 1 + Lane 2) the peak time is 8:00 - 9:00 with a traffic in physical vehicles of 1562 pcs. and 1766 pcs. in standard vehicles.

In the P2 post, in the direction of Suceava - Burdujeni (Lane 1 + Lane 2), the peak time is 17:00 - 18:00 with a traffic in physical vehicles of 1075 pcs. and 1237 pcs. in standard vehicles.

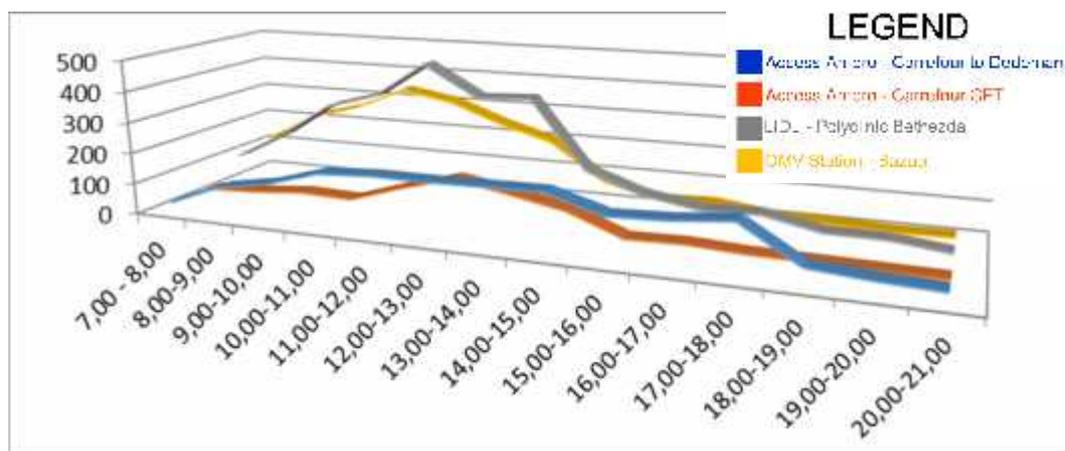


Fig. 11. *Image of the number of pedestrians*

In the P3 post, in the direction of Suceava - Burdujeni (Lane 1 + Lane 2) the peak time is 8:00 - 9:00 with a traffic in physical vehicles of 1278 pcs. and 1547 pcs. in standard vehicles.

In the P4 post, in the direction of Burdujeni - Suceava (Lane 1 + Lane 2) the peak time is 8:00 - 9:00 with a traffic in physical vehicles of 1513 pcs. and 1802 pcs. in standard vehicles.

The circulation capacity of the Calea Unirii Street is exceeded.

2.2. The Evaluation of Traffic Capacity from the Iulius Mall Roundabout [3]

Based on the census conducted on the P1, P2, P3, P4 posts, Burdujeni - Suceava and Suceava - Burdujeni peak hours were determined and after a week, on the same day of the week when the first census was made, the traffic was measured for an hour on all lanes.

The schematic representation of the Iulius Mall roundabout is shown in Figure 12.

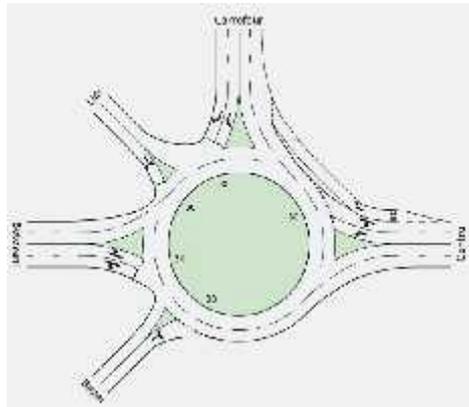


Fig. 12. *Image of the Julius Mall roundabout.*

The traffic values on the circular ring of the intersection are shown in Figure 13.

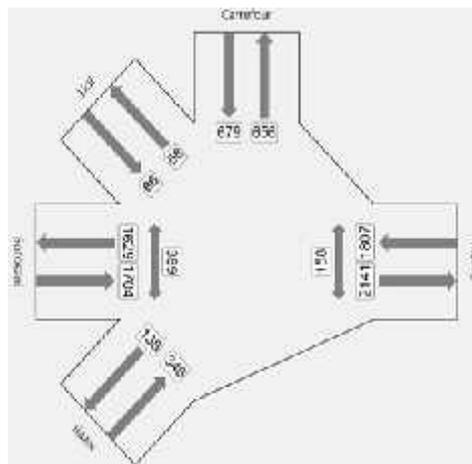


Fig. 13. *Image of the traffic values on the circular ring of the intersection.*

Service levels for each direction are shown in Figure 14.

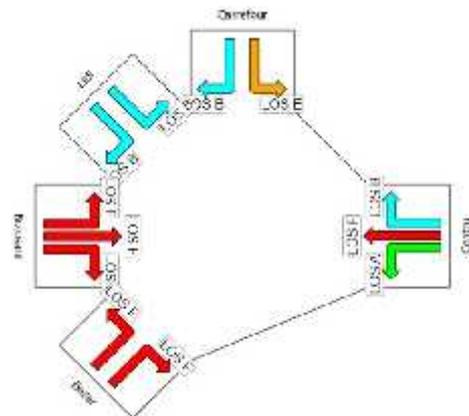


Fig. 14. *Image of the service levels for each direction*

In the current configuration, the studied intersection had reached and exceeded the maximum level of service (service level F, which represents that the traffic delays for more than 50 seconds, the road traffic in the intersection area is difficult especially on the Burdujeni – Suceava / Suceava - Burdujeni, respectively to Combucoovina), which is why frequent traffic jams will occur. Therefore, it is necessary to study the alternatives that support local traffic.

2.3. The Intersection between the Calea Unirii Street, Ambro and the Carrefour Access

The intersection between the Calea Unirii Street, Ambro and the Carrefour access is traffic light controlled and in Figure 15 it is shown, schematically, the traffic and his distribution in rush hour.



Fig. 15 - Image of the traffic and his distribution in rush hour

Table 2 shows the number of vehicles crossing the intersection from each access in every direction and the number of lanes from each access.

The number of vehicles crossing the intersection

Table 2

Access	Ni (standard vehicles/h/access)	Direction	Ni (standard vehicles/h/access)	Number of lanes
North	940 + 34 = 974	forward	940	3
		left	0	
		right	34	
South	1320 + 280 = 1600	forward	132	3
		left	280	
		right	0	
East	0	-	-	-
West	220 + 240 = 460	forward	0	2
		left	240	
		right	220	

The total number of standard vehicles entering the intersection at peak time is 3034 standard vehicles / hour.

2.4. The Determination of Instantaneous Speeds

It was determined at peak hour in the busiest quarter of an hour on the part of the street between pedestrian traffic light controlled crossings.

In the direction of Burdujeni – Suceava, between Ambro - Carrefour and the Iulius Mall roundabout is presented the speed diagram in figure 16.

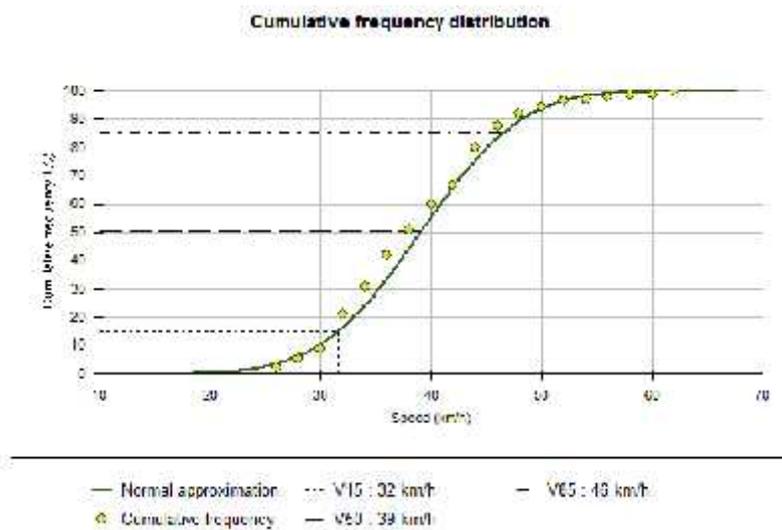


Fig. 16. Image of the speed diagram in the direction of Burdujeni – Suceava, between Ambro - Carrefour and the Iulius Mall roundabout.

In the direction of Suceava – Burdujeni, between the Dedeman roundabout and Ambro – Carrefour access is presented the speed diagram in Figure 17, resulting in speeds.

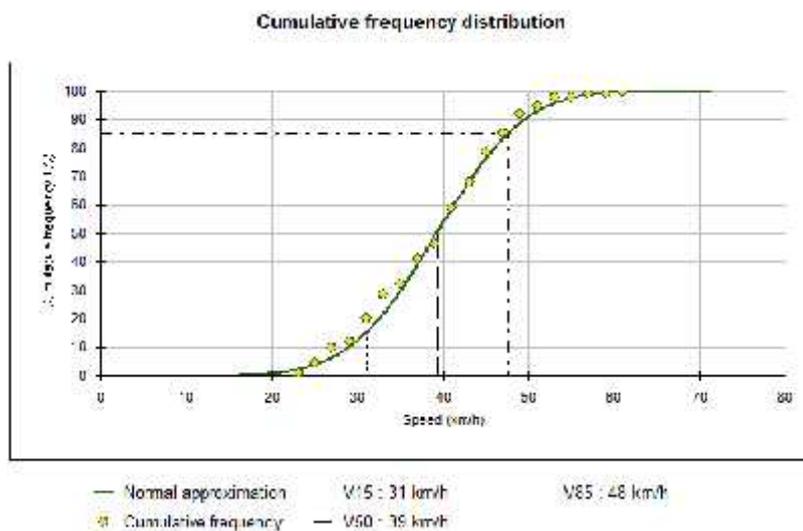


Fig. 17. Image of the speed diagram the direction of Suceava – Burdujeni, between the Dedeman roundabout and Ambro – Carrefour access.

It can be noticed that on the three speed-determining sectors where no traffic jam has occurred and the velocity values are significantly equal.

3. Conclusions

For the fluidization of the traffic it is proposed the realization / rehabilitation of the underground passage or the creation of an aboveground passage, possibly moving the pedestrian crossing from the bazaar under the bridge over the Suceava River, if the water management service allows this.

The circulation capacity of the Calea Unirii Street is exceeded [2], resulting for the current traffic a number of four strips per sense.

The roundabout at Iulius Mall has the service level "F" that is not functional and measures must be taken to divert traffic and eventually to prohibit heavy traffic.

The deviation of the traffic will be done on other traffic arteries, but it necessarily results the necessity of building a new road bridge over the Suceava River.

Linking traffic lights on both directions by increasing "green" times and eventually adopting "green light" traffic.

It is necessary to remove the pedestrian crossing from Bazaar and moving it under the bridge over the Suceava River.

Prohibition of the access to the road that leads to Bazaar, respectively to the Combucovina company by the roundabout from Iulius Mall from Suceava.

Is necessary the Prohibition of the left turn towards Carrefour from Suceava.

Removing the two pedestrian crosswalks from the Carrefour - Ambro access and the Carrefour access - to Dedeman and a single pass in the middle of the distance between the two, with a waiting time at the traffic light of at least 90 seconds.

Prohibition of bypassing the roundabout from Dedeman from Suceava, respectively prohibiting access to the Carrefour area by the roundabout, from Suceava.

References

1. AND 600 - 2014
2. STAS 10144/5-89
3. Highway Capacity Manual – HCM 2010, Volume 3: Interrupted Flow, Chapter Roundabouts.