TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

**ACTA TECHNICA NAPOCENSIS**

**Series: Applied Mathematics, Mechanics, and Engineering**
**Vol. 65, Issue Special II, September, 2022**

# ROAD TRAFFIC ANALISYS IN THE CONTEXT OF HEAVY TRAFFIC TRANSPORT REMOVAL POLICY

**Nicoleta GENCĂRĂU, Theodor OPRICA, Oana OȚĂT, Laurențiu RACILĂ, Lucian MATEI, Mihaela RACILĂ, Ilie DUMITRU, Alexandru OPRICA**

***Abstract:*** *According to road traffic study, identifying different vehicle movement factors inside a network necessitates a thorough examination. These metrics are affected multiple factors, including the direction of travel, the fluctuation in transportation demand throughout the day, the position of the artery in the territory, the type of road, and the size of the area being studied. The purpose of this article is to examine different transport politics and plans based on traffic factors. The comparison of normal traffic through the studied zone and the solution without heavy traffic gives us a starting base for the implementation in the field of different politics with regards to different vehicles classes.*

***Keywords:*** *road traffic, road junction, traffic policies, microscopic simulation.*

## 1. INTRODUCTION

Traffic or movement is a corporate demand resulting from the need to carry out the numerous operations scattered around the area and provides the opportunity to participate in and profit from them [1].

Although the population of most Romanian cities has declined since previous censuses, involvement in more and more everyday activities has increased the requirement for daily travel and mobility.

Furthermore, the growing contact between individuals and groups has resulted in the demand for travel across ever-larger areas [2,3]. Physical mobility has come to be supplied predominantly through the use of motor vehicles as a result of economic growth and automatically enhanced access to resources.

Urban mobility is based on the movements of people and goods in certain territories, and can be seen by the opportunities for socio-economic development the community provides [4]. The increase in traffic leads to an overall economic growth of a community.

Traffic flows are not consistent in general; they vary in time and place. As a result, the sampling of random variables is used to quantify variables of interest in traffic flow theory [5]. In reality, traffic characteristics are averages from statistical distributions, not absolute amounts.

The behavior of an average group of cars is evaluated in macroscopic analysis, and the characteristics investigated are the intensity and density of traffic.

Thus, road traffic may be described as movement created by cars and people centered on certain land surfaces specifically constructed for this purpose [6].

This article tracks the activity of a project whose major goal was to enhance the fluidity of vehicle and pedestrian traffic, mobility, and, most importantly, the safety of traffic participants at the investigated junction, by analyzing different transport policies and solutions that can't be tested in the field.

For road users, the main roads often come with a variety of difficulties. These can be categorized into different types:

- The increase in the requirement for parking spaces
- Travel alternatives to go green
- Without considering traffic flows, the existing infrastructure for roads and road transport will soon be insufficient.

## 2. TRAFFIC DATA GATHERING

The traffic measurements were made taking into account the recommendations of the norm AND 557/2015 – "Instructions for making the records of the road traffic on public roads", approved by the Order of the Minister of Transport no. 481/233.03.2015.

The collection of data on the current characteristics of the traffic and mobility of people and goods was carried out by several methods of harvesting:

- Inquiries in intersections;
- Origin destination surveys;
- Placement of traffic metering video equipment at intersections.

Also, the video footage existing in the Slatina Traffic Police database in the points of interest for the traffic study were requested and analyzed.

The traffic censuses were carried out by distributing the human observers in 3 critical points of the network, namely: the intersections of A.I. Cuza – Artileriei, A.I. Cuza – Ecaterina Teodoroiu and Artileriei – Ecaterina Teodoroiu.

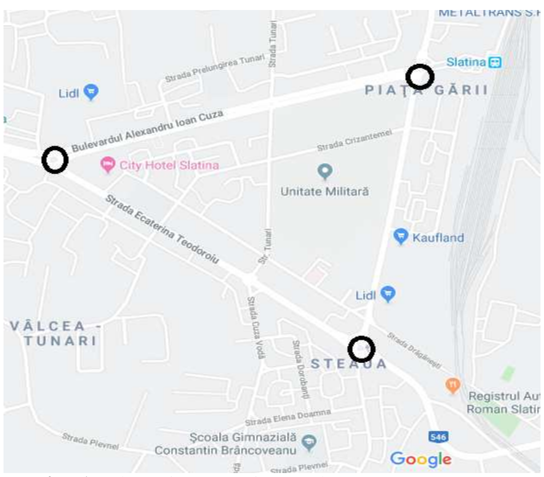


**Fig. 1.** The 3 intersections where census posts were located

In addition to the traditional techniques of manually measuring traffic volumes at junctions, video cameras and other equipment specialized to capturing and analyzing road traffic were utilized in this traffic research [7].

Their usage enables for continuous traffic monitoring in the region and aids in obtaining more accurate traffic statistics by removing the risk of human mistake.

**Fig 2.** Images from monitoring cameras

The coefficients and average yearly traffic evolution rates established for the period 2010-2025 were utilized in the hypothesis of average developments for all public roads by CNADNR-CESTRIN in order to estimate the future evolution of traffic. The year of the measurements, 2019, was chosen as a reference year, and the extrapolation approach was employed for the long-term prediction period, taking into consideration socio-economic factors. This was done in order to calibrate the data we collected and also to analyze the error coefficients for the traffic measurements.

## 3. VIRTUAL NETWORK DESIGN

The virtual network design started form the evaluation of all necessary measures to improve road traffic conditions, taking into account that the main measures, those related to traffic fluidization, increased passenger transport capacity, and increased road user safety and comfort, to take into account:

- Average travel speed;
- Number of stops;
- Journey time;
- Fuel consumption;
- Medium efficiency index.

The study area is in the eastern portion of Slatina. This is a densely populated neighborhood that has absorbed most of the mobility associated with getting to and from work in industrial zones.

During peak hours, the traffic in the studied area is particularly congested since this is the region utilized for travels to and from work for residents working in the industrial park, as well as the only street that may have heavy traffic, being regarded an outside ring in terms of heavy traffic [8].

Neighborhood retail centers like Lidl, Kaufland, etc. are located on the main streets and also near intersections and serve as sites of attraction for neighboring inhabitants. The city's main train station is located at the northern end of the studied area, to the east, and is not a large traffic producer, according to traffic data.

The traffic data was obtained using virtual inductive loops, with Quercus SmartLoop video analyzers, and a modeling of the whole study area was completed. Several calibration factors have been added to the modeling as a result of the preliminary simulations and the necessity to calibrate the virtual network:

- Traffic light in the north-west area in order to create the corresponding vehicle platoons entering the studied network as well as the queue blocking the first roundabout
- Illegal parking, the blockage of the first lane, of the south boulevard, between two major roundabouts.

The virtual network system consists in sections of around 15 km, composed by lanes measuring almost 24 km. the whole system is made by more than 200 sections and more than 60 intersections and accesses.

In the same time the network demand data is powered by 26 centroids that are part of demand data. The values from the centroids are gathered into an origin/destination matrix. One of the issues we need to deal with in such a vast system is that obtaining a true destination origin matrix for the entire city is quite tough [9, 10].

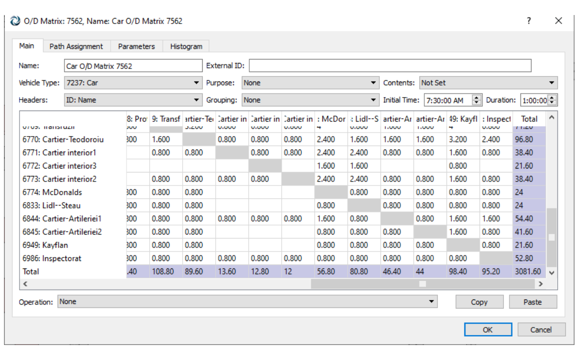

**Fig 3.** O/D matrix for passenger vehicles

In most situations, measurements are taken from traffic, like the measurements taken and described above and after processing the data with specialized software a destination origin matrix is created using mathematical implemented in the software [11].

The necessity to build complicated origin – destination matrices consist in complex iterations of preliminary data and models. The result ca be seen in the figure bellow.

Such models need a large amount of time, effort, and data to construct, nevertheless, a traffic simulation model will give a more complete analysis and, in the case of a microsimulation model, will also provide an important visual representation of traffic operation.

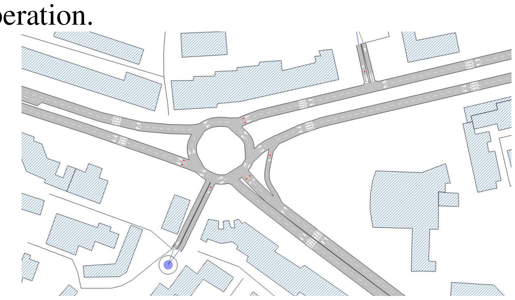

**Fig 4.** Virtual roundabout – multiple sections crossing

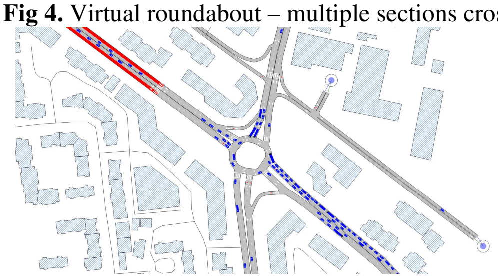

**Fig 5.** Microsimulation of the study area

The necessity to construct a credible and verifiable way to determining the paths taken by traffic to proceed from the trip origin to the trip destination adds to the complexity of these models.

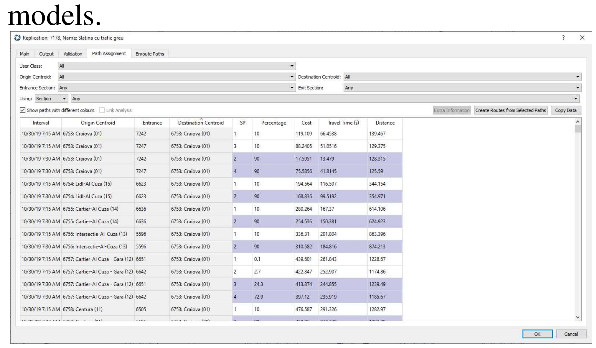

**Fig 6.** Path assignment for base simulation

## 4. SIMULATION AND RESULTS

Whatever the simulated strategy, consideration should be given to the problems that freight policies have in traffic. Thus, it is necessary to carry out an assessment on the following key points and outputs from Aimsun platform:

- Evaluation in terms of the waiting time in traffic;
- Pollution assessment;
- Speed of travel assessment;
- Evaluation from the point of view of traffic stops.

In order to facilitate the evaluation process and to be able to compare several road connections or sections, from the point of view of the city key points, it is necessary to carry out the same graphic representation, as follows:

- Blue colour – category of vehicles – touring;
- Green colour – vehicle category – vans;
- Red colour – vehicle category – heavy-duty vehicles;

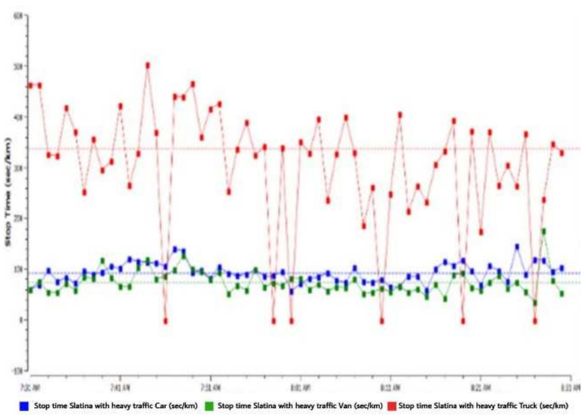


**Fig 7.** Delay time – real simulation

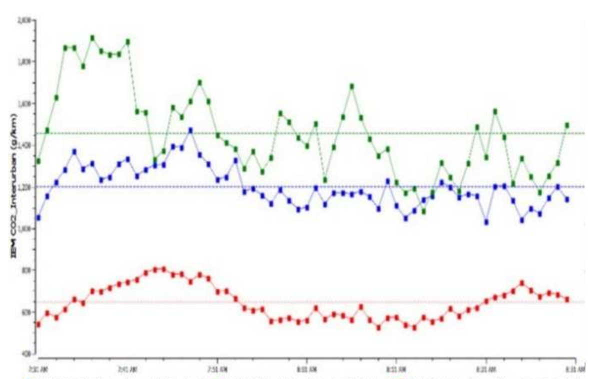


**Fig 8.** Chemical pollution $CO_2$ – real simulation

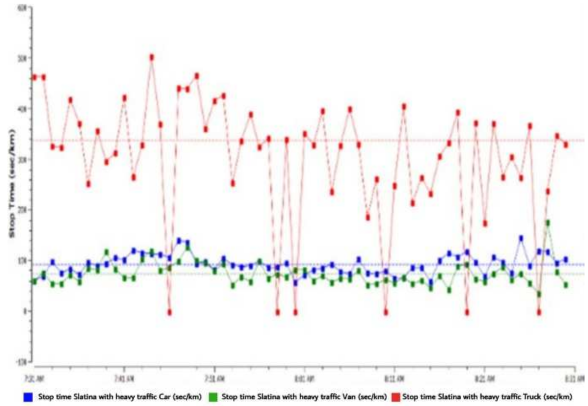


**Fig 9**. Stop time – real simulation

Evaluation of traffic in connection to the abolition of heavy transport by traveling through the municipality of Slatina's belt. The evaluation must be done in light of the existing circumstances, as determined in the preceding chapter. When compared to the existing scenario, the time spent in traffic delays has decreased by more than 20%. This may also be seen in the reduction of traffic congestion at important intersections.

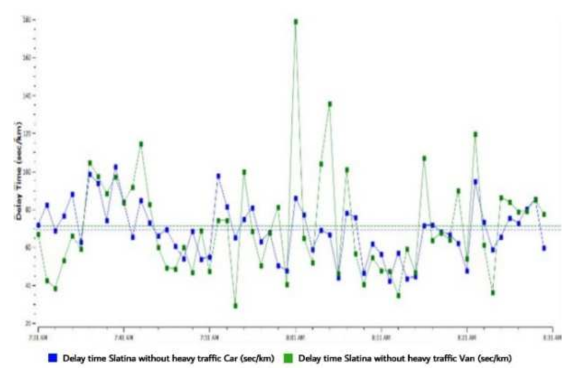


**Fig 10**. Delay time – simulation without HT

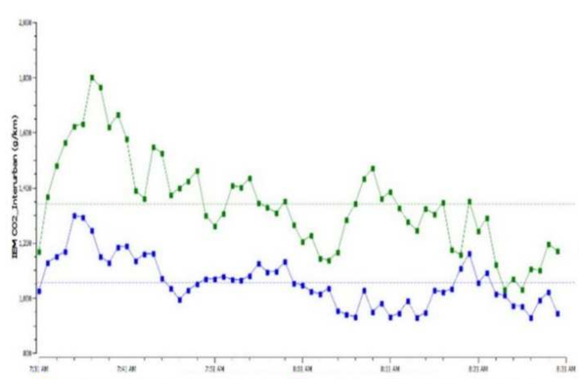


**Fig 11**. Chemical pollution $CO_2$ – simulation without HT

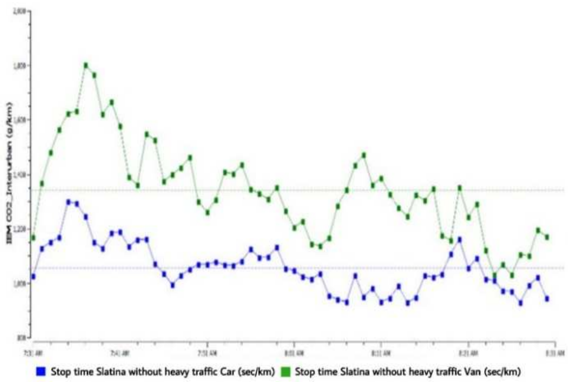


**Fig 12**. Stop time – simulation without HT

## 5. CONCLUSIONS

Driving styles and their relationship to traffic may be modeled using different transport platforms and mathematical algorithms. This aids researchers in determining how different driving styles affect traffic flow in a given conditions or location. Lane modifications, for example, can have a significant influence on traffic since they disrupt the flow of traffic in the area. Researchers can design and implement different strategies or procedures to enhance traffic flow and minimize congestion by researching how these moves affect traffic.

For instance, they may be valuable in a traffic-appeasing project that has a lot of vehicles in a very limited region. This traffic issues maybe noticed in the core network used to evaluate the artery carry as merchandise connection to forceful style.

The simulation findings clearly demonstrate that in terms of chemical pollution and fuel consumption, the driver conditions and driving styles with regards to lane shifting behavior that is increased to the maximum permissible in city driving conditions is the best of this scenario.

Following the simulation of normal traffic conditions, we can distinguish certain basic characteristics from which it will be started in the evaluations of certain policies and solutions for traffic optimization.

In terms of travel speed, it can be noted that tours and vans have about comparable values, with an average of 15 km/h. This is also owing to the fact that heavy-duty trucks travel at such low speeds that platoons form.

In terms of travel speed, it can be noted that tours and vans have about comparable values, with an average of 15 km/h. This is also owing to the fact that heavy-duty trucks travel at such low speeds that platoons form.

Reducing the delay times, a decrease of about 20% can also be observed, automatically leading to the reduction of chemical pollution in the studied area

From the simulation of the evaluation of the street tram without heavy traffic, it can be observed an increase in the speed of travel by about 18% compared to the current situation. At the same time, it is observed the reduction of downtime by about 20 sec/km.

## 6. REFERENCES

[1] Moridpour, S., Majid, S., Geoff, R.: Lane changing models: A critical review. Transportation Letters: The International Journal of Transportation Research. 2., 10.3328/TL.2010.02.03.157-173, pp. 157-173, 2010.

[2] Virginia Tech Transportation Institute Cambridge Systematics, Inc.: Microscopic Analysis of Traffic Flow in Inclement Weather. Publication No. FHWA- JPO-09-066, 2009.

[3] Dumitru, I., Zorilă, M,V., Ţolescu, R.S., Racilă, L., Pascu, C.I, Oprica, A.C., Burghilă, D.V., Matei, L., Vîlcea, E.J., Popescu, C., Badea-Voiculescu, O., Mogoantă, L., Experimental model for the study of traumatic brain injury, Romanian journal of morphology and embryology, vol. 61, 2020

[4] Khan, Z. H., Aaron, T.: A macroscopic traffic model for traffic flow harmonization. European Transport Research Review. 10. 10.1186/s12544-018-0291-y, 2018.

[5] Radu-Frent, C., Todirite, I., Capatina, D., Iliescu, M., Mechatronic system for increasing mobility of people with locomotor disability, The Romanian Journal of Technical Sciences. Applied Mechanics, vol. 66, 2021

[6] Gipps, P. G.: A model for the structure of lane-changing decisions. Transportation Research B 20(5), pp 403-414, 1986.

[7] Beleș,. H., Țolea, B.A., Crișan G.F., Dogar,

C.A., Ciotachiev, V.V. The assessment of pedestrian's head injury risk at the contact with the vehicle's hood. Annual Session of Scientific Papers "IMT ORADEA 2019" 30–31 May 2019, Oradea, Romania. IOP Conf. Series: Materials Science and Engineering 568 (2019).

[8] Cotfas, A., Dugaesescu, I., Nitu, C., Benec-Mincu, G.M., Iliescu, M., Mechatronic system for increasing mobility of people with locomotor disability, The Romanian Journal of Technical Sciences. Applied Mechanics, vol. 66, 2021

[9] Dumitru I., Racilă L., Tutunea D., Matei, L., Dima A. and Oprica A., Experimental investigation of a vehicle behaviour using different complex data acquisition systems, CONAT 2016, 2016.

[10] Stewart, J. A., Aerde, M.V.: An Assessment of Adaptive Co-ordination of Traffic Signal offsets within integration, Traffic Engineering and Control, Volume 39, 1998.

[11] Dumitru I., Matei, L., Vinatoru M., Racila L., Oprica Th.: Aspects Regarding Priority Settings in Unsignalized Intersections and the Influence on the Level of Service, Proceedings of the European Automotive, Congress EAEC-ESFA, 2015.

## Analiza Traficului Rutier în Contextul Unor Politici de Eliminare a Traficului Greu

**Rezumat:** Studiile de trafic rutier arata că identificarea diferiților factori de mișcare a vehiculelor în interiorul unei rețele necesită o examinare amănunțită. Printre acesti factori sunt direcția de deplasare, fluctuația cererii de transport pe parcursul zilei, poziția arterei în teritoriu, tipul de drum și dimensiunea zonei studiate. Scopul acestui articol este examinarea diferitelor politici și planuri de transport bazate pe factorii de trafic. Compararea traficului normal prin zona studiată și soluția fără trafic greu oferă un punct de plecare pentru implementarea unor politici privind traficul rutier al diferitelor clase de vehicule.

**Nicoleta GENCĂRĂU**, PhD Student, University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, gencarau.nicoleta.h6y@student.ucv.ro, Office Phone: +40 251 543 739

**Theodor OPRICA**, Lecturer, University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, theodor.oprica@edu.ucv.ro, Office Phone: +40 251 543 739

**Oana OȚĂT**, Lecturer, University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, oana.otat@edu.ucv.ro, Office Phone: +40 251 543 739

**Laurențiu RACILĂ**, Assoc. Professor, University of Craiova, Faculty of Mechanics, MApCC, 107 Calea Bucuresti street, Craiova, Romania, laurentiu.racila@edu.ucv.ro, Office Phone: +40 251 543 739

**Lucian MATEI**, Lecturer, University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, mateiclucian@gmail.com, Office Phone: +40 251 543 739

**Mihaela RACILĂ**, Assoc. Professor, University of Craiova, Faculty of Science, Applied Mathematics, 13 A.I.Cuza street, Craiova, Romania, mihaela.racila@edu.ucv.ro, Office Phone: +40 0251 41 37 28

**Ilie DUMITRU**, PhD Professor, University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, dumitru_ilie@yahoo.com, Office Phone: +40 251 543 739

**Alexandru OPRICA**, PhD Student, **corresponding author,** University of Craiova, Faculty of Mechanics, ATII, 107 Calea Bucuresti street, Craiova, Romania, alex.oprica91@gmail.com, Office Phone: +40 251 543 739