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CONFIGURING THE STREET TRAM THROUGH THE AIMSUN SOFTWARE GRAPHICAL ELEMENTS

Abstract: *The transportation system is a complex, alive and dynamic mechanism. Taking into account all of the problems of a public transport the difficulty is to make a virtual network that can be improved and organized from the point of view of a systemic approach. Now, public transport is a critical point in urban development and should be treated as one of most important areas in a city. Public transport in the city is considered to be of great importance, in terms of social development and quality of life. In terms of city development, an important aspect is to create a public passenger transportation system that is safe, affordable, economical, reliable and environmentally friendly. The role of the public transport in economy and all aspects of the city development, from the point of view of the citizens, dictates the need to introduce measures in the system that are harmonious, balanced and effective and that can make the difference from development to stagnation.*

Key words: *simulation; public transportation; management systems; modelling; traffic*

1. INTRODUCTION

The mobility of cities in general is referred as the mobility of the urban population that is traveling in public transport. This type of mobility can be defined and considered as the number of trips by public transport in relation to city residents during the year. Based on the road traffic literature, the relationship written bellow is generally used to calculate the mobility within an area [8].

$$M_{tr} = \frac{Q}{N_{pop}} \qquad (1)$$

- Q - is the number of passengers transported during one year, in thousand passengers;
- N_{pop} - urban population, thousand persons;

By using the formula in the above form, and analyzing the result, gives the engineer the possibility (given the number of trips, passenger and year as input information) to determine how to upgrade the public transport with minimum investments and to develop the infrastructure based on opportunities available in every case scenario [1], [2].

Taking into account an entire city: public transportation, transport vehicle, personal vehicles, traffic behaviour, traffic lights, road quality, geometry of streets and junctions, pedestrians, etc. can be very difficult and can create extreme problems if the graphical elements can’t be used in seeing the models and networks. Taking into account the theory of complex systems, any nonlinear dynamic system will present an instability phenomenon called the sensitivity to initial conditions, so that relatively long-term solutions can’t be predicted [3].

Important help in achieve optimization of public transport for a whole city and in junction as well (which will take into account multiple factors which belong at the city level) are graphical elements used to model and simulate networks of road transport platform software, like Aimsun and Vissum.

2. BACKGROUND

2.1 Public transport network in Craiova city

The tendency in major cities of Europe and also worldwide is to discourage individual / personal transport in favour of public transportation. With this in mind, measures that increase attractiveness of the public transport need to be much more tangible, particularly in regard to comfort, traffic safety, insurance, capacity, etc., while ensuring an appropriate degree of consistency on witch all major cities need to grow [4], [5].

Taking into account all of these problems the objectives of this paper are the following:

- Create a virtual model of the important arterial roads of Craiova city, with important graphical elements, that need to be addressed in large models like this;
- Creating and establishing the current situation of the public transport in the Craiova city's main arterial roads;
- Creating a simulation of the green light for the public transport in different areas where the street tram network allows it.

2.2 Virtual network

In order to make a virtual transport system in Craiova, we used a simulation and modelling software platform for road traffic called Aimsun.

Based on research on the current public transport in Craiova, it was concluded that modelling of the whole city is not necessary because most of the city's common communications only operate on the main thoroughfares.

Due to this fact, only the main transport networks of the city were modelled in the Aimsun program. The virtual system is composed of:

- 85 km long network
- 139 km of traffic lane
- 762 road sections
- 269 intersections
- 55 centroids
- 103 public transport stations

After creating the main system of virtual arterial roads, the virtual model had to be populated with different categories of road vehicles, based on traffic measurements [6]. 55 centroids were used for this stage (generating and attracting vehicles that enter and exit the network). Based on these centroids a target matrix was created for the whole model. In addition, 86 detectors (virtual inductive loops) distributed at key points of the city were also used to make the virtual home destination matrix.

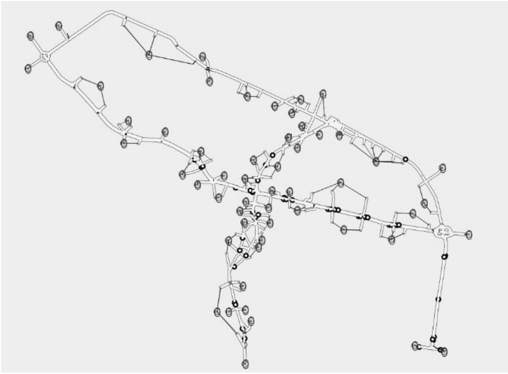

Fig. 1 Centroid configuration

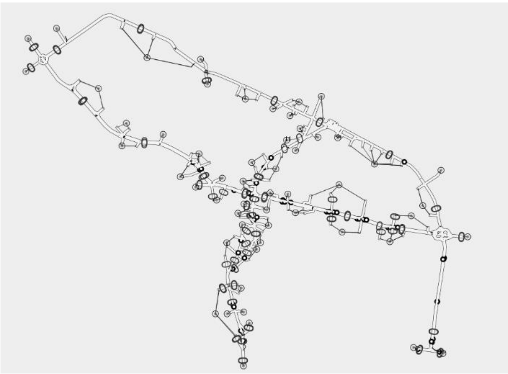

Fig. 2 Detector configuration

One of the problems that arises in such a large system is that a matrix of real destination of the whole city is very difficult to achieve. In most cases, traffic measurements are made at key points whereby, based on these measurements, a matrix of destination originates using mathematical models.

Aimsun can generate this matrix on its own, based on Wardrop's mathematical model. Very important at this stage is the configuration of the detectors based on which Aimsun will generate the destination home matrix.

Because the model is in its infancy, it is necessary to achieve the allocation of routes that network vehicles follow based on various parameters:

- Cost
- Waiting times
- Traffic volume
- Vehicle classes

Once Aimsun performs the allocation of routes for each vehicle in the virtual network, the destination origin matrix based on the information contained in the detectors and the information generated during the route allocation is made.

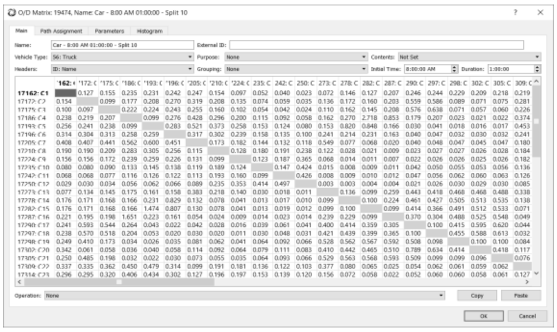

Fig. 3 Car origin / destination matrix

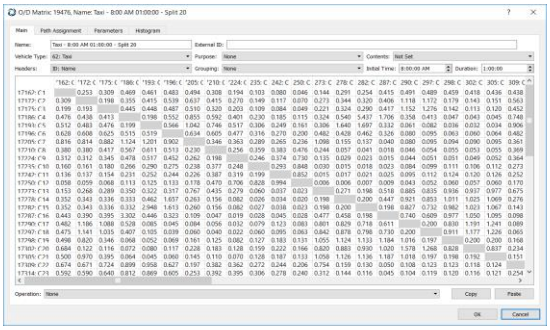

Fig. 4 Taxi origin / destination matrix

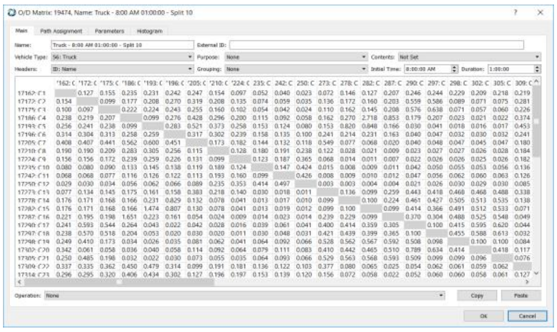

Fig. 5 Truck (van) origin / destination matrix

2.3 Graphical modelling of the public transport system

The public transport system modelled for Craiova has all the bus and tram routes in Craiova because there is currently no route with few stops on the main thoroughfares [7]. For the joint transport configuration, a destination origin matrix is not required because we know exactly what the current configuration, is waiting times in the station, route, stations stopping public transport, etc. The public transport plan contains 17 bus and tram lines running through the city after a fixed schedule.

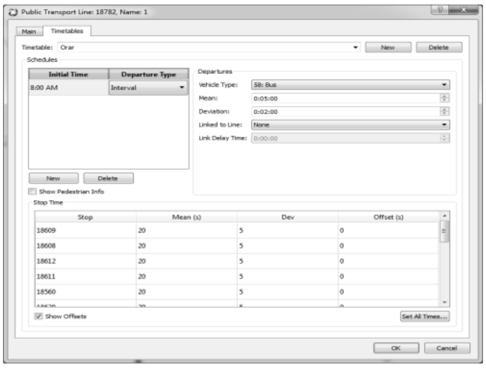

Fig. 6 Public transport line configuration

It can be seen in the figure above that the average time between buses is 5 minutes and there may be a deviation from this for 2 minutes. The average bus stop time in the station is 20 seconds and there may be a deviation from this 5-second time.

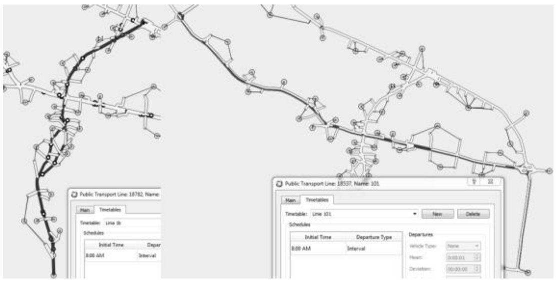

Fig. 7 Aimsun view of bus route 1b and tram 101

The configuration of the public transport system for Craiova is very easy to achieve, since, with the calibration of the simulated model in Aimsun for the main arteries and with the modelling of the public transport system for Craiova, the system configuration was made automatically.

Configuring the public transport system involves real-time simulation of the vehicles that make up the fleet of autonomous transport. These real conditions are not influenced by the fleet itself, but by how the model created in Aimsun works.

Because the modelling of the public transport system for Craiova implied the introduction into Aimsun of the parameters that make up the public transport network, parameters that are fictitious, their configuration is superfluous. At the time when the transport network was calibrated for the city's main thoroughfares, it was also automatically configured the public transport system that is dependent on the street structure and overall traffic parameters.

3. GRAPHICAL SIMULATION OF THE PUBLIC TRANSPORT

A very good way to achieve optimization of public transport is to create priority lanes for the circulation of vehicles belonging to public transport [6].

To achieve this optimization stage, priority traffic lanes were made for public transport vehicles on the following streets:

- The Bucharest Way
- Nicolae Titulescu Boulevard
- Calea Severinului street
- Carol I boulevard (partly)
- Aries Street street
- Simion Barnutiu street
- The Way of the Union
- Nicolae Romanescu Boulevard

In order to simulate these priority bands for public transport vehicles, the following were required:

- 55 centroids
- 86 detectors
- 18 cost functions for different arteries and sections
- 6 types of experiments
- 30 public transport lines
- 763 sections
- 5 vehicle classes
- 103 public transport stations

For simulation of these priority bands, the model of the main arteries on which the joint transport was made at the previous stage was used. The same model was used to make comparisons between traffic parameters before and after optimization.

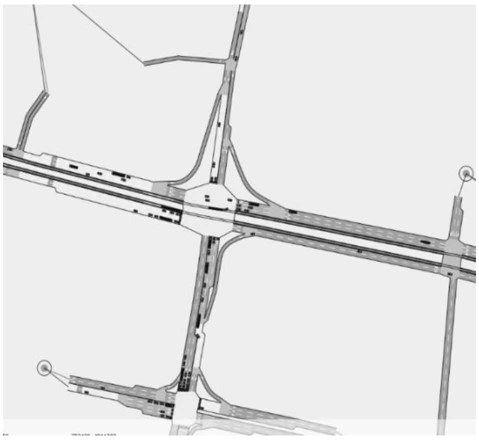

Fig. 8 Graphical simulation of the virtual network

The simulation results can be seen in the following figures:

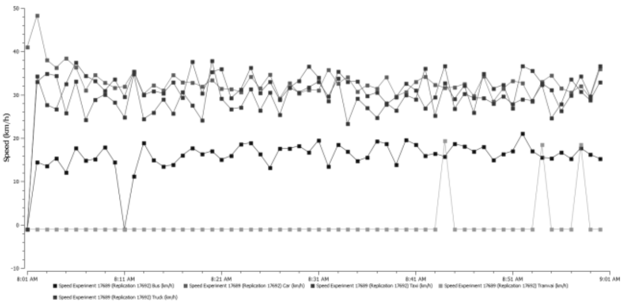

Fig. 9 Vehicle category speed

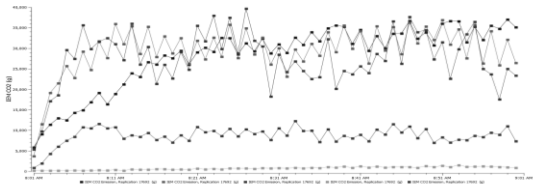

Fig. 10 Vehicle category CO2 emissions

4. CONCLUSIONS

Craiova has a well-developed public transport network covering the whole area of the city and providing environmentally friendly transportation of residents from home to areas of general interest.

Due to material objective conditions and in the absence of a concrete plan for the development and modernization of this network, which should have been pursued on a permanent basis, the quality of public transport has gradually deteriorated over the past 15 years, with nothing to be done for maintenance and rehabilitation tramway lines, or to renew the fleet of vehicles.

The study case was made in order to see what methods of public transport optimization can be implemented in the Craiova city. Further more the optimization solutions were tested on different parts of the city to see were they can fit better.

The priority band solution was simulated in the central area of the city, were the traffic is crowded at peek hours. The optimization results were compared with the current traffic conditions in terms of vehicle delay and speed.

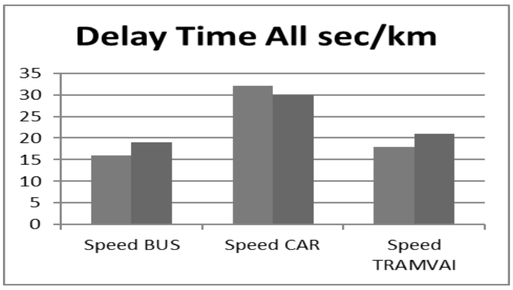

Fig. 11 Delay time graphical representation

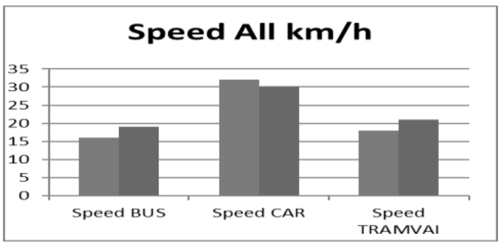

Fig. 12 Delay time graphical representation

As you can see in the figure above traffic delay time decreases to buses and trams for 30 sec / km when the priority lane is introduced into the network transport on main roads in the city of Craiova. A disadvantage of these measures can be the increased delay time in light vehicle traffic by 23 sec / km.

Another improvement is the cruise speed of public transport in the city's main arteries.

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