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Nikolina Stošić, BSc¹
E-mail: nikolina_stosic@yahoo.com

Valentina Mirović, PhD¹
E-mail: plast@uns.ac.rs

Jelena Mitrović Simić, PhD ¹
E-mail: mjelena@uns.ac.rs

Vuk Bogdanović, PhD ¹
E-mail: vuk@uns.ac.rs

Nemanja Garunović, PhD ¹
E-mail: garunovic@uns.ac.rs

¹ University of Novi Sad, Faculty of Technical Sciences, Trg Dositeja Obradovića 6, Novi Sad, Republic of Serbia

NETWORK MODEL OF THE MUNICIPALITY ODŽACI

Key Words

Traffic planning
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Model of traffic
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Abstract

In this article first we set the theoretic basis related to brief description of the transport model and macro-planning. Most of the article is related to defining the network model of the municipality Odžaci, alongside the previously described procedures of transport model design. The existing state of the system has been defined and the specific process of zone system creation has been described, based on postal address codes.

1. INTRODUCTION

The importance of an efficient transport system is reflected in enabling unhindered mobility of people and goods. Cities face numerous problems, out of which many result from the very transport system and represent the obstacles for providing an efficient transport and simultaneously providing quality life.

By means of traffic planning a balance is established between traffic offer (transport ability) and traffic demand (transport demands). The development of computer technology and its application in the field of traffic planning provided conditions for

conducting better quality analyses and finding solutions to the previously mentioned problems.

In the process of transport system planning, a very significant phase is model forming and using. The transport model, as it was previously mentioned, consists of the systems of offer and the systems of demand. The system of offer describes the availability of transport systems and infrastructure, while the system of demand includes the models which determine the demand for the transport, which is based on socio-economic characteristics of the given area.

In this article the focus is on a detailed definition of the network model as one of the fundamental phases in the creation of the transport model, on the example of the municipality Odžaci. The network model of the municipality was defined and the basic data on the zones within the observed area were entered by applying the software package *Visum*.

Specificity of the article and the model is reflected in the use of the data from unusual sources for the creation of the zone system. The reason for the application of the postal address codes results from the lack of the existing socio-economic data in the whole Serbia and the region as a basis for defining the traffic models and further traffic system management.

2. POSITION OF THE MUNICIPALITY, THE RELATIONSHIP OF URBAN AND RURAL SETTLEMENTS

The municipality Odžaci is in the western part of Bačka, on the left bank of the Danube. It is surrounded by municipalities Apatin, Sombor, Kula, Vrbas, Bačka Palanka, Bač and it is bordered with The Republic of Croatia on the river Danube. Figure 1 shows previously described position of the municipality Odžaci.

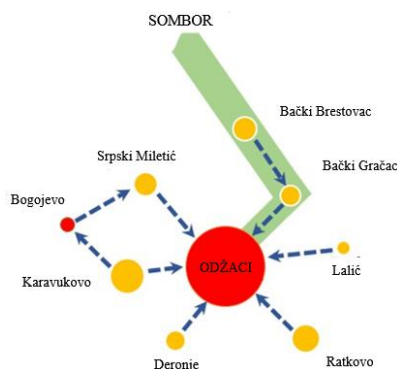


Figure 1. The relationship of the settlement, municipality centre and the town of Sombor

By its territory size it belongs to smaller municipalities on the territory of Vojvodina, and it belongs to the regional centre Sombor. The centre of the municipality, the

settlement Odžaci, is located in the centre of the territory, while other settlements are radially positioned around the municipality centre.

The municipality Odžaci consists of nine cadastral municipalities: Odžaci, Bački Gračac, Bački Brestovac, Srpski Miletić, Bogojevo, Karavukovo, Deronje, Ratkovo and Lalić. According to the census from 2011, 30,154 residents live in the listed nine settlements, therewith that in the municipality centre – settlement Odžaci there are 29.22% of the municipality population. The average population density is 74 inhabitants per 1 km². The total number of households on the territory of the whole municipality is 11,073, while the average number of household members is 2.7 [1].

The settlements of the municipality Odžaci have the characteristics of typical settlements in Vojvodina with the elements of classical colonization and planned construction, adapted to the relief and terrain hydrography. Planning basis of the settlement has been preserved, which was also contributed by the creation of the adequate urbanism documentation [1].

3. MODEL CREATION BY MEANS OF THE SOFTWARE PACKAGE *VISUM*

The essence of this chapter is description of the arterials network on the level of municipality and definition of the basic elements of the model of transport offer (nodes, links, centroids, traffic zones and connectors), as well as description of the methods for the determination of inhabitants on the level of traffic zones. Today there is a series of software packages which enable a very reliable outcome of the planning process. Further in the text the basic characteristics will be defined, as well as the procedure of transport model forming within the software package *Visum*.

Visum is a software package which enables modelling of all types of private and public transport within one integrated model. The application of *Visum* software enables consistent management of the basic data which are given in transport and information systems, by means of the network editor. Unlike Geography Information System (GIS), this software allows keeping complex relationships within one or more transport models. A transport model consists of the demand model, network model based on the software package *Visum* and different influence models [2].

3.1 Description of the network and zone system of the municipality Odžaci

Definition of the network model starts with the procedure of network description. In the practical sense it was necessary to put *Openstreet* map into the software package *Visum*, since this map contains a network of links and nodes, and its map coding has been previously conducted.

In the following step the check of links and nodes was conducted, concretely, checking the speed on arterials which go through populated places, as well as categorized nodes checking. It also means deleting certain links and nodes which were not necessary for this paper creation.

The links on the Openstreet map have already been categorized into 99 categories, while in the very paper links of 4 categories can be found: type 30, 40, 50 and 70. On the town arterials most commonly used links were the type 70 (speed 50km/h, capacity 400 veh/h). Arterials of a higher order go through populated places, where the speed had to be corrected in accordance with the speed limit in populated places (50km/h). The number of links was reduced to 1,178 at the end of this procedure. State roads of the class I and II intersect the territory of the municipality, that is, they connect Odžaci with Ratkovo, Srpski Miletić, Deronje, Lalić, then Srpski Miletić with Bogojevo, thus they were categorized as such. The roads Odžaci – Karavukovo – Bogojevo and Odžaci – Bački Gračac – Bački Brestovac are local roads, therefore they have been categorized as such.

The same procedure was also conducted for nodes. The four nodes were categorized as signalized intersections, while the other nodes were regulated by traffic signs. The number of nodes in the network is 430.

After the network checking, the following step was zone system defining. The basic idea when creating the network model of the municipality Odžaci was to divide the municipality area into traffic zones, so that each settlement (Ratkovo, Srpski Miletić, Karavukovo, Bogojevo, Lalić, Bački Gračac, Deronje and Bački Brestovac) represent a special traffic zone, while the settlement Odžaci, as the municipality centre, was divided into 20 traffic zones. The spatial plan of the municipality Odžaci did not define the division into traffic zones, which posed a great challenge when this article was done. Also, there were no adequate research studies of this area which would enable an appropriate information basis for further research. Therefore, in order to fulfill certain criteria necessary for creating the zone system, zone creating of the settlement Odžaci was conducted on the basis of Postal address codes. A postal address code can be defined as a numeric label of the address consisting of 6 digits. The aim of this method of zone creation is that each whole comprises a certain number of inhabitants. A free access to the internet portal *Pošta Srbije (The Post Office of Serbia)* enabled an insight into the map, borders and numeral label of each postal address code of a settlement. Zone borders were primarily created so that each zone has approximately a similar number and contains the whole number of postal address codes. On the basis of the data available on the internet portal *GEOSrbija*, according to the number of construction plots, it was established how many inhabitants there are in each postal address code.

The following form was used for calculating the number of inhabitants which comprises one postal address code:

$$BS_n = 2,7 \times BRp \text{ (stanovnika)} \quad (1)$$

BS_n – number of inhabitants n of a postal address code area

n – ordinal number of the postal address code area

2.7 – average number of household members

BRp – number of construction plots of a postal address code area

During this procedure the attention was directed to the recognition of the types of housing in certain postal address code areas.

Since individual housing prevails in settlements, postal address code areas with multifamily housing were recognized. The original zone borders were then adapted to the housing type. The first created zones were those with multifamily housing. After that the borders of other zones were defined, taking into consideration the number of inhabitants, as well as the area covered by a postal address code.

Table 1. List of zones, postal address codes, number of inhabitants of each zone of the settlement Odžaci

ZONE	Number of postal address codes	Number of inhabitants	ZONE	Number of postal address codes	Number of inhabitants
1	12	535	11	14	443
2	4	135	12	15	589
3	3	1092	13	14	443
4	6	216	14	7	213
5	16	518	15	2	0
6	17	767	16	18	671
7	12	346	17	5	157
8	22	464	18	8	282
9	9	143	19	24	1376
10	7	246	20	4	175
TOTAL				214	8811
AVERAGE				441 inhabitants by a zone	

Table 2. List of zones – settlements, number of inhabitants of each zone

ZONE	The name of the settlement	The number of inhabitants
21	Srpski Miletić	3038
22	Bački Gračac	2286
23	Ratkovo	3411
24	Lalić	1343
25	Bogojevo	1744
26	Karavukovo	4215
27	Deronje	2487
28	Bački Brestovac	2819

With zone borders defined in this manner, the calculation of inhabitants of a certain zone was conducted. The number of inhabitants of each zone was calculated as the sum of inhabitants of each postal address code area which forms that zone. Table 1 shows the list of zones with the number of postal address codes which form the

zones, as well as the number of inhabitants of each zone, while in Table 2 other zones (settlements) are shown, with their number of inhabitants.

Further in the text the results of the process of zone system creating will be shortly discussed. The original idea when defining zones borders was that all zones have approximately the same number of inhabitants. However, it was not possible due to different circumstances (e.g. type of housing in the zones, the area covered by a postal address code, etc.).

Considering all these, the form of the zone system was successfully defined in a different way. The largest number of zones has approximately the same number of inhabitants (labelled in green on the graph), ranging between 200 and 500 inhabitants. Then “extreme” (labelled in red on the graph), like the zones with significantly larger number of inhabitants (3 and 19) and the zones with no inhabitants (15). The other zones have a smaller or larger number of inhabitants in relation to the average value (labelled in blue on the graph). The previously described can be seen in the Figure 2.

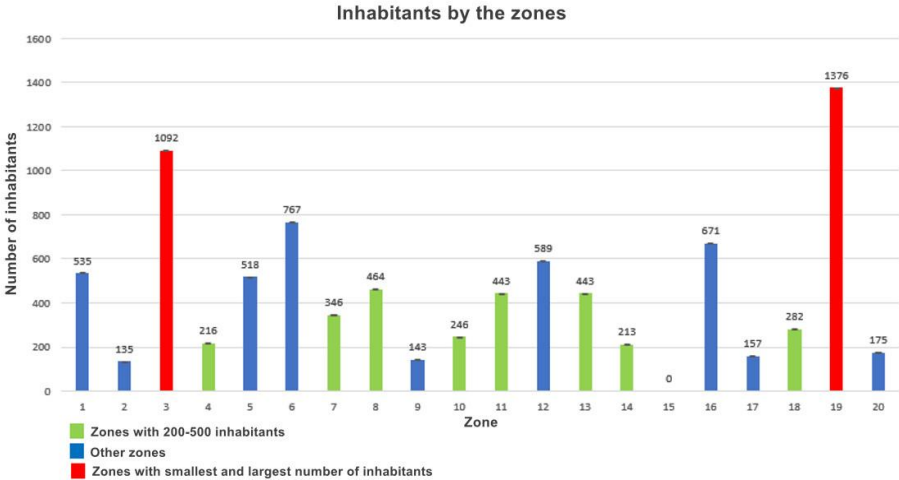


Figure 2. Display of inhabitants by the zones

Zone 3, which covers 3 postal address codes, differs from the other zones by population density. It is related to the area where there are exclusively the facilities for multifamily housing. Therefore, in relation to other zones a larger number of inhabitants resides in the given area.

Also, within the zone 19 it can be observed that there is a larger number of inhabitants due to the mixed type of housing in the zone. Zone 19 is also typical by the fact that postal address codes were defined in such a way that the whole could not be divided into two or more zones.

On the other hand, in the zones 4, 7, 8, 10, 11, 13, 14 and 18 it can be noticed that the number of inhabitants is between 200 and 500 inhabitants by a zone, which

represents a slight deviation in relation to the mean. In a larger number of zones individual housing is present.

Zone 15 represents an area where there are work areas, warehouses and industrial plants, therefore the number of inhabitants there is equal to zero.

After defining traffic zones it is necessary to connect each centroid with nodes by means of a link which was categorized as a connector. *Visum* enables to check the created network by means of searching the shortest route, by which it was determined that nodes, links and connectors were properly defined.

Figure 3 shows the display of the zone system in the software package *Visum*, while the Figure 4 shows the zone distribution of the settlement Odžaci.

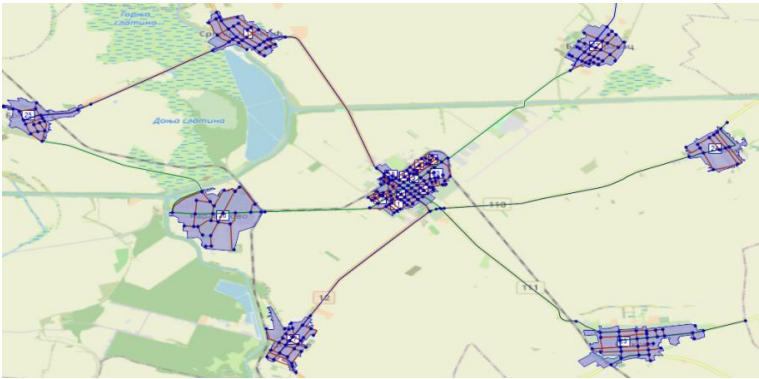


Figure 3. Zone system of the municipality Odžaci



Figure 4. Traffic zones in the settlement Odžaci

After creating the traffic zones and determining the number of inhabitants in each of them, the data on the number of inhabitants were put into the software package *Visum*. This step finalised the work on creating the network model.

4. CONCLUSION

This article describes the procedure for creating the network model of the municipality Odžaci, which means the description of the network and zone system formation. *Openstreet* map was used as the basis with the data on links and nodes networks. Zones were formed on the basis of the postal address codes and it was necessary that each zone covers the whole number of postal address codes. The software package *Visum* was used for the creation of the network model of the municipality Odžaci, with certain limited functions of the software package.

Observing the example of the municipality Odžaci, many advantages and benefits were noticed for the creation of the transport model. One of them is orthogonal street network, which is present in all settlements of the municipality Odžaci and it facilitated the creation of traffic zones.

As it has been previously stated at the beginning of this article, the specificity of this model is reflected in the use of the data of the postal operator in the creation of the zone system. In the existing system of the data we have found that it is one of the ways of creating a sufficiently reliable model. Definitely further research in all towns and municipalities should be directed to obtaining reliable socio-economic data which, apart from the number of inhabitants include a whole series of attributes which are used for describing and interrelating traffic demand and offer.

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