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Special generators in tasks of transportation demand assessment

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Abstract

The article addresses an issue of public attraction facilities in tasks of transportation planning and, in particular, in tasks of transportation demand assessment. Special attention is paid to facilities which shall be classified as special generators. Special generators are facilities with trip generation characteristics differing from those of the facilities related to residential, commercial and industrial territories. It is suggested to use the trip generation value as a key indicator for the significance of a facility as a special generator. Such value can be used to divide all facilities into classes determining the significance of its accounting and distinguishing in tasks of traffic simulation and transportation demand assessment. Examples of results in assessing dependencies of the specific generation values regarding trips to special generators and the share of trips to such facilities grouped according to modal split are given.

Keywords: public attraction facilities; special trip generators; transportation demand assessment.

1. Prerequisites of the study

Recently, in Russia, draft revisions to the Federal law "Concerning motor roads and road management in the Russian Federation", which include a concept of the "public attraction facility", i.e. "...buildings, structures, constructions, and other facilities or their combination involving significant volumes of freight and/or passenger flow, designed for work, everyday activities and recreation of citizens, as well as for industrial-production, administrative-business, trade, terminal-warehouse, educational, municipal, health-related, sporting, transport and

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other types of activities..." have been introduced. Quantitative criteria to qualify a facility as a public attraction facility have not been formulated. It is necessary to establish such criteria. It is obvious that public attraction facilities represent a source of additional transportation demand generation and, consequently, result in an increase of the level of service (LOS) of adjacent roads, which, in its turn, in combination with poor traffic management, leads to an increase in the number of road accidents and transport delays.

The prepared draft stipulates the responsibility of developers for the construction of access areas leading to such facilities, construction of parking lots and other transport infrastructure elements in the area of such facilities. Therefore, both the construction of public attraction facilities and individual solutions (e.g. solutions on the arrangement of access to such facilities) will require a series of procedures including calculation procedures to assess transportation demand in the facility area and in the adjacent road network.

It should be noted that the considered situation relates not only to public roads but to many cities of Russia where, for example, a new shopping and recreation center constructed within the city results in the overloading of the adjacent street and road network (Box, 1994; Levashev, 2017). Thus, similar regulations considering public attraction facilities shall be developed in relation to the development of urban territories.

It is obvious that detailed reference materials considering facilities of various types shall be available for urban areas. For those purposes, the Research and Development Transport Laboratory of the Irkutsk National Research and Technical University set up a task to develop methods of transportation demand assessment considering facilities of various types affecting the LOS of urban street and road networks.

2. Special trip generators and their influence on transportation demand

In foreign publications (Bureau of Traffic Operations, 2017; City of Durham, 2017) describing modern practice of transportation planning, special attention is paid to traffic impact analysis (TIA). This analysis is applied to territories where it is planned to construct new facilities or hold public events. In guidelines of various US states, special recommendations on the necessity of perform such analysis can be found. For example, in the traffic impact analysis guidelines adopted in Wisconsin (USA), two analysis options are suggested (Bureau of Traffic Operations, 2017):

- an abbreviated TIA (carried out if a development will generate between 100 and 500 trips in the peak hour);
- a full TIA (carried out if a development will generate more than 500 trips in the peak hour).

It is stated in North Carolina (USA) (City of Durham, 2017) that such type of urban-planning analysis as TIA is required if the proposed development is expected to generate 150 or more peak hour vehicle trips. Trip generation estimates must be obtained from the latest version of the ITE Trip Generation Manual (Institute of Transportation Engineers, Washington, DC, USA).

The State of California Department Transportation (Caltrans) establishes thresholds for trips generated by urban projects, requiring traffic impact assessment regarding the adjacent street and road network (City of Stockton, 2002).

- a project (territory) generates over 100 peak hour trips on a State Highway Facility;
- a project (territory) generates 50 to 100 peak hour trips on a State Highway Facility operating at LOS (Level of Service) “C” or LOS “D”;
- a project (territory) generates 1 to 49 peak hour trips on a State Highway Facility operating at LOS “E” or LOS “F”.

Typical hours to analyze the LOS of the adjacent street and road network in case of new facilities (TIA) are the average Tuesday through Thursday A.M. peak hour and P.M. peak hour. Exceptions to this may include special trip generators in the territory considered (City of Durham, 2017).

Special trip generators are facilities with trip generation characteristics differing from those of the facilities related to residential, commercial and industrial territories (State Department of Highways and Public Transportation, 1975).

Accounting of special generators in transportation planning is especially important. The list of facilities classified as special generators includes the following (Clifton et al., 2015; Desai and Vala, 2017; Handy, 2015; Quintero et al., 2014; Report No FHWA/TX-15/0-6760-1, 2015; Souche, 2010; Steiner, 1998):

- military bases;
- educational institutions;
- hospitals;
- shopping centers;
- large activity centers and mixed-use development territories;
- other facilities having specific character for distribution of daily trips;
- territories where any events take place (public events);
- new territories or existing territories subject to further development.

Special generators are also important in the formation of a city transportation models when it is necessary to improve transportation demand models to consider facilities, whose trip generation characteristics are not fully captured by basic dependencies for trips related to work, recreation and everyday activities (Florida Department of Transportation Research Office, 2010). Special generators can be classified into three groups in travel demand forecasting: "regular", "periodic" and "special". "Regular" special generators produce trips on every weekday and/or weekend. A public event in annual celebration of a city day can serve as an example of a "periodic" special generator. Professional publications mainly focus on "regular" special generators (Florida Department of Transportation Research Office, 2010).

3. An approach to the accounting of special generators in tasks of transportation demand assessment

According to the results of studies (Levashev, 2017; Levashev et al., 2013) on specifics of functioning of business, housing, shopping and other facilities, performed by the Research and Development Transport Laboratory of the Irkutsk National Research and Technical University, we can conclude that, for example, such public attraction facilities as shopping and recreation centers shall also be classified as special generators since their daily load differs from general trip distribution characterized by two peak periods (A.M. and P.M. peak hours).

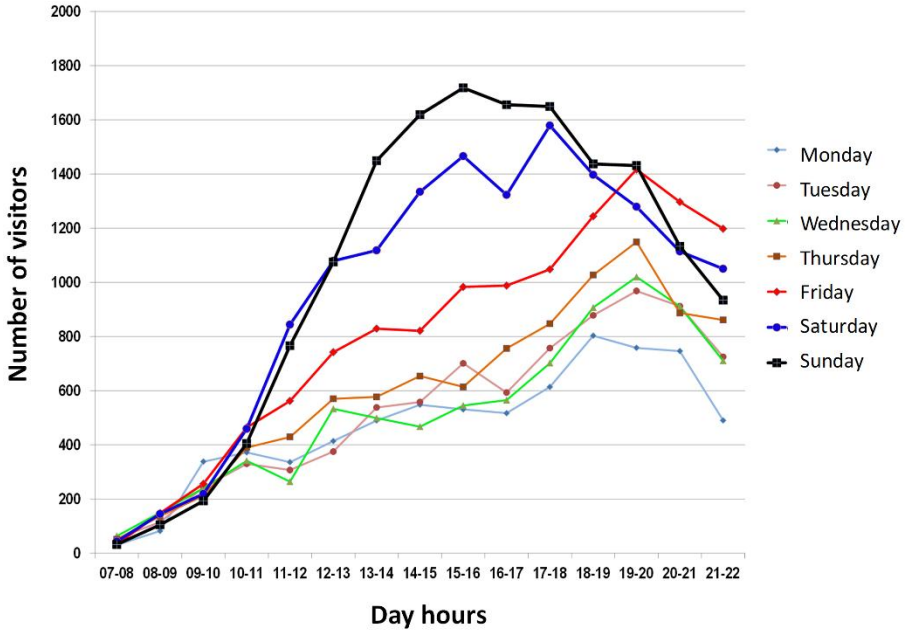

Fig. 1. Daily distribution of the number of visitors of Jam Moll shopping and recreation center (Irkutsk) within a week.

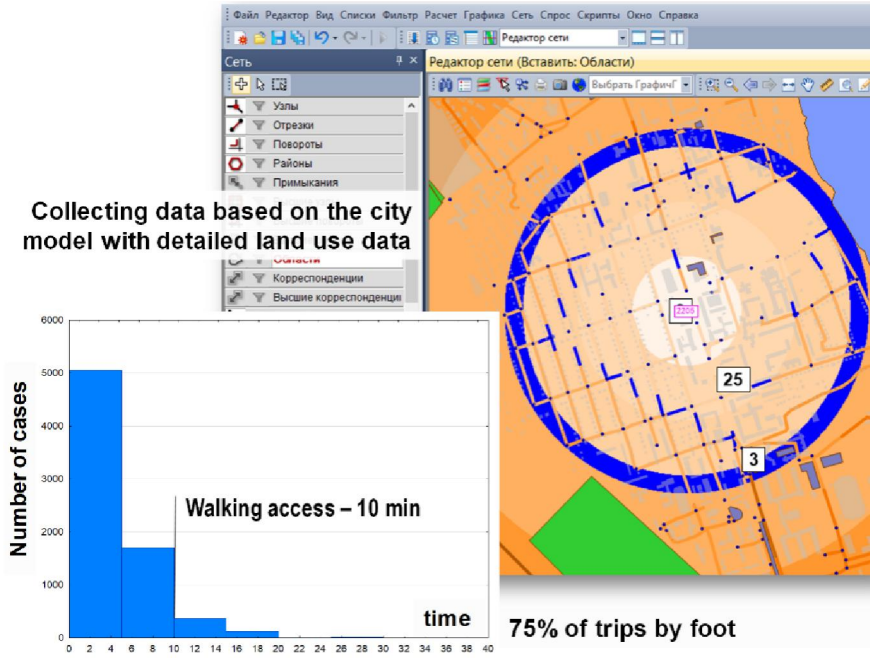

Fig. 2. Collecting the data on characteristics affecting the distribution of special generator trips based on a city transportation model including a detailed description of urban territory use parameters (facilities and transport infrastructure elements).

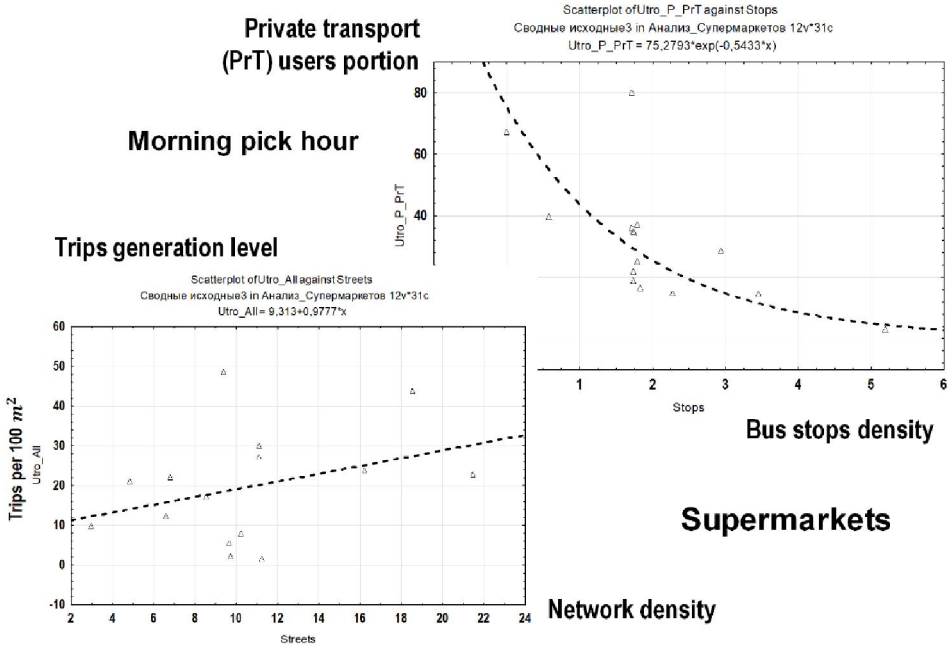

Fig. 3. Examples of results in assessing dependencies of the specific generation values regarding trips to special generators on street-and-road-network density and density of stops.

Figure 1 shows an example of daily distribution of the number of visitors of Jam Moll shopping and recreation center within a week.

Results of studying facilities of various types and their analysis allowed formulating basic principles to develop approaches and methods for special generators' accounting in tasks of transportation demand assessment:

- the trip generation value is a key indicator for the significance of a facility as a special generator. Such value can be used to divide all facilities into classes determining the significance of the special generator itself and the significance of its accounting and distinguishing in tasks of traffic simulation and transportation demand assessment;
- large supermarkets, large sports centers, etc., as well as large activity centers and mixed-use development territories including shared parking lots, can be classified as "regular" special generators (as shopping and recreation centers) based on the trip generation indicator;
- studying special generators requires an analysis of visitor flows with a subsequent modal split depending on the city area (center, districts, outskirts) in order to define the influence of transport infrastructure development and urban territory use intensity on trip generation volumes and the modal split.

Figures 2 and 3 show an example of collecting the data on characteristics affecting the distribution of special generator trips based on a city transportation model including a detailed description of urban territory use parameters (facilities and transport infrastructure elements), and obtained results of assessing dependencies of the street-and-road-network development level (street-and-road-network density correlating with the development of the adjacent territory) on the values of specific trip generation regarding special generators and the level of public transport infrastructure development (density of stops) per a share of trips to such facilities using individual transport.

4. Conclusion

It is suggested to use the above approach as the basis to study transportation demand generated by city facilities corresponding to the concept of the special generator. As a result of accumulation and systematization of information on operation modes of special generators, it will be possible to form a database of trip generations. The planned activities shall result in a reference database including classification of special generators and their important characteristics such as specific trip generation values and daily distribution of trips to generators. Quantitative criteria will be determined, based on which it can be established what special generators shall be considered as public attraction facilities.

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