

Impact Of Unregulated Pedestrian Crossings On Road Network Capacity

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Abstract – There are reviewed the main factors which impact road network capacity in zone of unregulated pedestrian crossings. Carried out experimental research on definition of “aggressive” vehicle drivers proportion, which break the rules of passage through unregulated pedestrian crossings. Determined pedestrian flow density on unregulated crossings, at which practical capacity of multi-lane roadway is maximum.

Keywords – capacity, road network, unregulated pedestrian crossings, pedestrian flow intensity.

I. Introduction

The main problem with which faces today automobile transport in city – is transport delays, which appear because of range of reasons. One of the main reasons is growth of vehicles amount and transportation volumes, which causes increasing of traffic intensity on the city road network, resulting in decrease of streets and roads capacity. This is due to the fact, that city infrastructure goes behind in development with the same intensity as vehicles amount grows. [1].

Construction of roads of high quality with multi-level junctions – is the task of top priority. For solving the problem of increasing the road network capacity it is necessary to build relief roads, bridges, tunnels, underground crossings, overhead roads, detours around the city. But building of new roads is costly and labor-intensive process which demands large capital investments and time [1; 2]. So, to the foreground walk out organizational arrangements, in particular – implementation of modern technologies, resources and traffic control systems with the purpose of increasing road and streets capacity and decreasing transport delays in pedestrian crossings zone. Correct prognoses of capacity and its comparison with existing (or expected) traffic intensity are important conditions of placement ground pedestrian crossings, and therefore rational use of capital investments.

II. Detection of influence regularities of traffic and pedestrian intensity on road network capacity volume

The most important factor, which characterizes transport-operating qualities of city road and street network, is its capacity. Under street capacity mean the maximum amount of vehicles which can pass through the street per unit of time providing necessary speed and road

safety. On its volume have impact roadway parameters, technical-operating characteristics of vehicles, type and amount of traffic regulation technical means, separate elements of environment totality etc [2 – 4]. Very important in this proportion is choose of rational ground pedestrian crossings scheme placement under different roadway geometric parameters, with the purpose of satisfying the requirements in safe pedestrian movement and traffic flow delays minimization.

Pedestrian movement inevitably connected with crossing of streetway. Such crossings can be in one level with the roadway (unregulated and regulated crossings) and in different levels – with the arrangement of above-ground and underground pedestrian crossings. Suppress amount of pedestrian crossings are above-ground: they are arranged on all intersections, on street sections, near buildings and constructions which generate pedestrian flows.

For determination of impact pedestrian crossings on road network capacity it is necessary to know pedestrian speeds of movement at crossing the roadway, method of traffic regulation on the street, and intervals between vehicles in traffic flow, which are accepted by pedestrians for crossing.

Vehicular movement in the flow on the road network in unregulated pedestrian crossing zone can be examined on the base of mass service theory, which allows determining capacity of the road section with the formula [3]:

$$P = \frac{1}{\Delta t_i} e^{-N_{II} \Delta t_i}, \quad (1)$$

where P – road capacity, auto/sec; N_{II} – intensity of pedestrian movement, ped/sec; Δt_i – minimal interval between vehicles, sec; t_{II} – minimal time, which pedestrian spend at crossing of one lane (critical interval), sec.

On the road network capacity volume in general significantly affects fraction of drivers which break the rules of passage through unregulated pedestrian crossings. In this time, amount of road accidents with the participation of pedestrians with every year increases. Due to statistical data, road accidents with pedestrians are happening in next places: in zones of public passenger transport stops – 35%; on unregulated pedestrian crossings – 30%; on unregulated intersections – 20%; on regulated pedestrian crossings – 10%; on regulated intersections – 5%.

From given data can be done conclusion, that in residential places the largest amount of road accidents (to 75%) happens on road sections between intersections. Therefore, we can assume that such typical accident is explained by certain peculiarities of human behavior, which cross the road, breaking the road traffic rules by drivers, and also “aggressive” driving manner.

Fraction of “aggressive” drivers is calculated by formula [4]:

$$Q_{acp} = \frac{q_{acp}}{N_{mp}}, \quad (2)$$

where q_{acp} – intensity of “aggressive” vehicle drivers, auto/hour; N_{mp} traffic flow intensity, auto/hour.

Then, taking into account fragment of “aggressive” vehicle drivers road capacity will look like [4]:

$$P = \frac{1}{(1 - Q_{acp})} \left(\frac{1}{\Delta t_i} e^{-N_{mp} \Delta t_i} \right), \quad (3)$$

For determination of roadway capacity in zone of unregulated pedestrian crossings, for different pedestrian flow density, at modeling traffic flows of network it is necessary primarily to receive information about existing traffic intensity on road network sections.

III. Results of field research

For assessment of necessary and enough information about traffic flow characteristics it is advantageous to use sampling traffic record, methods and probability of which depend on earlier received regularities of distribution characteristics in time and space.

During research were defining such indexes: length of pedestrian crossings (width of the street); density of pedestrian flow; amount of vehicles which broke the rules of passage through unregulated pedestrian crossings; time of crossing the roadway by pedestrians; traffic flow intensity through the crossing.

On the next stage, during modeling the impact of pedestrian crossings on road network capacity, such limitations were made:

- traffic flow intensity – 1200 auto/hour;
- intensity of “aggressive” vehicle drivers – 120 auto/hour;
- minimal interval between vehicles – 2,5 sec;
- pedestrian speed – 1,35 meter/sec;
- one lane of roadway width – 3,75 meters.

Results of modeling road capacity volume in zone of unregulated pedestrian crossings, depending on pedestrian flow density, is given on picture 1.

It is known that with the enlargement of pedestrian flow density on unregulated crossings essentially decreases road network capacity. General tendency and volume of such decrease: under enlarging of pedestrian flow density from 100 to 1000 ped/hour decreases road capacity approximately on 6-8% under the same traffic flow intensity. Moreover, decrease of capacity is the same for multilane roads.

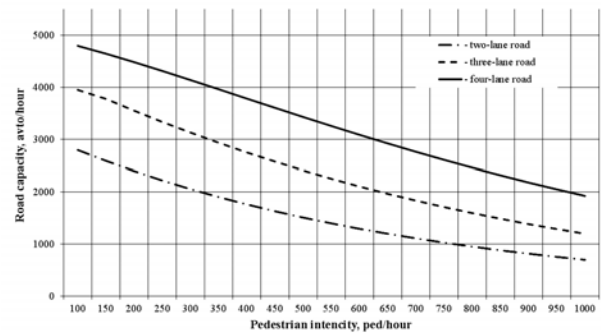


Рис. 1. Dependence of road capacity from pedestrian movement intensity on unregulated pedestrian crossings

Conclusion

For results of modeling there is stated pedestrian movement density on unregulated crossings, for which practical multilane roadway capacity is maximal, so regime of traffic flow movement, despite of obstacle presence, will be optimal. The purpose of further research in this direction is development of software, which allows defining optimal distances between pedestrian crossings and city streets intersections, and also consideration of parking impact, for which will be reached optimal conditions of traffic flow movement and high efficiency of transport service.

References

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