The Impact of Community Opening on Road Access

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Abstract. In this paper, we mainly study the influence of community opening on the surrounding road traffic. Firstly, we use the explanatory structural model to determine the evaluation system of 10 indicators in two levels. Then we use these indexes and establish them based on the road intersection model and the no-signal crossroads the district road access model to assess the impact of residential open roads on the surrounding roads.

1. Introduction

First of all, the establishment of evaluation index system, due to too many indicators can be excavated, so the first of the literature to a large number of evaluation indicators to filter. There are complex relationships between the identified indicators, and the model is used to decompose the indicators. Then, the influence of open area on the passage of the surrounding roads is studied. After the analogy analysis, the actual traffic situation of the vehicles passing through the community before and after the open cell is reduced to the traffic pattern through the roundabout and through the signalless crossroads. Therefore, the study on the capacity of the surrounding roads before and after the opening of the residential area can be transformed into the comparison problem between the circular intersection and the traffic capacity of the signalless crossroads. Finally, the model was established to simulate the impact of road traffic before and after opening. This paper will simulate the three cases, and compare and analyze the simulation results, and the simulation results are compared with each other.

2. Assumptions

1. The road around the area is flat and there is no uphill.
2. Ignore the impact of different models on traffic capacity.
3. Ignore the negative effects of traffic accidents.
4. Suppose we collect the data is true and effective.

3. Analysis and Solution of Problem

3.1 Establish an evaluation index system

This paper selects the appropriate evaluation index system to evaluate the influence of the open area on the surrounding road traffic. Considering the complexity of the evaluation index system and the hierarchical relationship between the evaluation indexes, this paper chooses the explanatory structural model ISM to solve the problem [1].

Question. Therefore, the following steps are completed:

Step1. Identify the evaluation indicators, access and filter by access to information;

Step2. Matrix solution. The correlation matrix is analyzed, and the matrix is obtained, and the skeleton matrix is obtained.

Step3. Solve ISM. According to the skeleton matrix, the hierarchical relationship graph is constructed and the evaluation index system is obtained.

According to the background knowledge, 14 indicators were selected, including the total traffic volume s_1, the main road flow ratio s_2, the free speed s_3, the queuing length s_4, the lane width s_5, the lane number s_6, the non-straight road Coefficient s_7, the weather situation s_8, the number of

residential import and export s9, road safety facilities s10, regional travel volume s11, community population s12, community area s13, community population structure s14.

Calculated, the resulting skeleton matrix is as follows:

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	1	0	0	0	0	0	1	1	1	0	0	1	0	0
2	0	1	0	0	0	0	1	1	1	0	0	1	0	0
3	0	0	1	0	0	0	1	1	1	0	0	0	0	0
4	0	0	0	1	1	0	1	1	1	0	0	1	1	1
5	1	1	1	0	1	0	0	0	0	0	0	1	1	1
6	0	0	1	0	0	1	0	0	0	0	0	0	0	0
7	0	0	1	0	0	0	1	0	0	0	0	0	0	0
8	0	0	1	0	0	0	0	1	0	0	0	0	0	0
9	0	0	1	0	0	0	0	0	1	0	0	0	0	0
10	1	1	1	0	0	0	0	0	0	1	0	1	1	1
11	0	0	1	0	0	0	1	1	1	0	1	0	0	0
12	1	1	1	0	0	0	1	1	1	0	0	1	0	0
13	0	0	1	0	0	0	1	1	1	0	0	0	1	0
14	1	1	1	0	0	0	1	1	1	0	0	1	0	1

According to the calculation results, the first two layers of the structural model are defined as the evaluation index system, that is, the final evaluation index system includes two indicators, the first layer of indicators for the surrounding traffic capacity indicators include the surrounding road traffic, Branch road and the main road flow ratio and free speed, queue length, these indicators reflect the district around the road capacity. The second layer of indicators for the community impact factors, including the district within the lane width, lane number, the number of district import and export, these indicators reflect the open area on the road capacity of the impact.

3.2 Road Traffic Capacity Model[2]

3.2.1 Residential Capacity before Opening:

1) Theoretical model of traffic capacity at roundabout

Through the access to information we can see that the study of the traffic capacity of the intersection of most of the following formula to calculate.

$$Q_{ring} = 3600 \times \frac{\alpha q_r e^{-\lambda(t_c - t_m)}}{1 - e^{-\lambda t_f}}$$

$t_m(S)$ ----- the minimum distance between the front; $q_r(pcu/h)$ -----the intersection of traffic within the intersection; t_f -----the distance from the vehicle; t_c -----critical gap time; α ----- ring intersection Traffic flow distance greater than or equal to $t_m(S)$ traffic ratio;

Solving the Capacity of Residential Area before Opening According to the above results, it can be seen that the traffic capacity of the surrounding roads is mainly affected by the first layer index of the evaluation index system. Therefore, these four indexes are used to solve the traffic capacity of the surrounding roads before the opening. Define the total traffic for the surrounding roads qr , Branch and main road flow ratio b, The free speed of the vehicle is V, Queue length is Laccess to information that the free speed and the minimum distance from the front is proportional to the relationship between, and when the speed of 60km / h, the minimum front time is 2s. Then the free speed is V, the minimum front time calculation formula is:

$$t_m = \frac{V}{60} t_m^0$$

Among them, $t_m^0 = 2s$.

Taking into account the actual situation in the crossroads are usually set up traffic lights, so the introduction of left turn coefficient η .

So the district before the opening capacity calculation formula is:

$$Q_{front} = 3600\eta \times \frac{\alpha q_r e^{-\lambda(t_c - \frac{V}{60}t_m^0)}}{1 - e^{-\lambda t_f}}$$

3.2.2 Residential Capacity after Opening

1) Signalless crossroads on the capacity of the theoretical model

According to the information, we can see that the discussion of the traffic capacity of the signalless crossroads is mostly through the gap theory, that is, the vehicles on the main road can be given priority through the intersection, the vehicles on the secondary road will have to stop and wait for the traffic on the main road Neutral can only pass.

The traffic capacity of the signalless crossroads is:

$$Q = Q_P + Q_S = Q_P + \frac{Q_P}{1 - e^{-qt}}$$

Among them, Q_P ------ the main road traffic (pcu/h); Q_S ------ The number of traffic on the slip road (pcu/h); q----- $\frac{Q_P}{3600}$ (pcu/h); t0 -----Critical clearance time, for parking waiting for the vehicle, t0 = 7 ~ 9s; for slow down waiting for the Vehicle, t0 = 6 ~ 8s.t -----the distance between the vehicle on the secondary road and the distance from the front of the vehicle, t = 3 ~ 5 s.

The Solution of the Traffic Capacity of the Surrounding Road after the Opening of the Residential Area.

After the opening of the district, the vehicle can be simplified as shown below.

The calculation formula of road traffic capacity in the district is:

$$Q_1 = q_r\beta + \frac{q_r\beta e^{-qt_0}}{1 - e^{-qt}}$$

The calculation formula of the peripheral traffic capacity of the district is:

$$Q_2 = 3600\eta \times \frac{\alpha q_r\beta e^{-\lambda(t_c - \frac{V}{60}t_m^0)}}{1 - e^{-\lambda t_f}}$$

So the district after the opening of the surrounding road capacity calculation formula is:

$$Q = q_r\beta + \frac{q_r\beta e^{-qt_0}}{1 - e^{-qt}} + 3600\eta \times \frac{\alpha q_r\beta e^{-\lambda(t_c - \frac{V}{60}t_m^0)}}{1 - e^{-\lambda t_f}}$$

References

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