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Study of the Impact Slice Open Block Type Village on Surrounding Traffic Capacity

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Abstract

About promoting blocks, residential area and the provisions of the unit compound are discussing gradually.In this paper, the technology and theory of applied mathematics and operational research, simulation of the traffic of the city, to live it residential area planning, to improve traffic congestion.The open problems of surrounding roads in this paper, based on the analytic hierarchy process Analytic Hierarchy Process to establish evaluation index system, and choosed no signal intersection, through quantitative comparison, C language programming method has solved these problems. Such as the proper evaluating index system is established the mathematical model of traffic, As an example, analysis the influence on surrounding roads after open block type village. Shows that the surrounding traffic capacity is greatly increased after opening block type village. The traffic department of city plan and the traffic optimization advice are given.

Key words

Capacity, wardrop equation, poisson distribution, quantitative comparison.

1. Introduction

In this paper, according to the real traffic situation, choose the sections index, area index intersection index as an evaluation index system, and use the analytic hierarchy process (AHP) to the evaluate model. Through the spot statistics, and quantitative analysis of traffic flow on intersection, such as delay time, of different types of community and the different regions of the synthetical analysis, finally in objectivity and scientific principle, and the evaluation index system has been obtained for surrounding roads open area.

The no signal intersection modeling has been established. Using the formula method, and combining with the traffic conflict to calculate the total traffic saturation and delays for the critical crossing gap and the accessory from the data, and using comparative the analyse the impact on the surrounding roads of plot open before and after, the index system have been extra-wished. As an example the traffic conflicts and traffic flow data, and total traffic saturation and delay time, have been greatly improved. for the statistical area near the main road and the Angle of the traffic department of city planning and traffic optimization, advice have been given.

2. Determine the Evaluation Index System

2.1 Following Basic Conditions Are Supposed Be Held

(1) The day is not a holiday,and the measured data of flow fluctuation is not big.

(2) The driver familiar with the road.

(3) Model formula of ekuo is requirements.

(4) Tyaffic of flat road, traffic is normal, and no trouble because of the traffic accident.

(5) For different types of vehicles, which were converted to ordinary cars, mid-size, large car, and giant car arewritteen with 1,1.2,2.0 and 4.0 respectivaly.

2.2 Mark of Each Index

The indicators are listed in the following table.

Tab.1. The Indicators

v_0	Maximum speed limit
L	The length of the body
v_p	Different ways of driving traffic conflict
K	The critical crossing gap
ι	When the conductor is apart from the
C_n	Traffic capacity
V/C	Saturation
d	The delay time
C	Design capacity

2.3 Determine the Capacity Evaluation Index System

At present, various countries have different

Standards of the problem of traffic congestion, and quantitative results generally are two congestions or congestion. In order to reflect accurately quantify of the degree of congestion, the road congestion, on the basis of completeness, which are objectivity, operability, and scientific nature[1,2]. In this paper comparability principle, the evaluation index system of road traffic capacity has been set up by using the analytic hierarchy process .

Combining with the real traffic situation, select the evaluation index system including intersection, stretch, regional indicators. etc, The flux, saturation and intersection indicators include intersection delays at ordinary times, queue length and the signal intersection line rate, link indicators include the road length and traffic flow. In order to facilitate the use of data and sorting of flux, this paper chooses the intersection saturation peace delays to the model to evaluate road traffic capacity and the evalution Index system list as flollows.

Tab.2. The Evaluation Index System

	Level indicators	The secondary indicators
The evaluation index system	The intersection indicators	The space between
		Extension of the time
		Road speed limit
		Running speed
		Traffic flow
		Traffic capacity
		Bodywork length
	Road indicators	Long road
		Wide roads
	Regional indicators	The suburbs
		The city

Traffic capacity refers to the road facilities to the ability of the traffic flow. In a certain period of time (usually take 15 min or 1 hour) and normal road, traffic, control and operation of the quality requirements, the road through the traffic facilities liquid ability [3,4]. Capacity general with veh/h (m/h), pcu/h (passenger car equivalent standard per hour), to say the basic unit is: pcu/h/ln (passenger car equivalent standard/hours/lanes) [5,6]. Intersection traffic flux said the number of cars. Degree of saturation is to describe the road or intersection traffic load indicators, or on the road intersection traffic flow divided by the road or intersection traffic capacity and, commonly known as VC ratio, namely the V/C. Can also be used by the urban road network current congestion index and to traffic congestion on urban traffic capacity index division. The total traffic saturation

$$x\frac{\sum v}{c}=\mathrm{E} \tag{1}$$

where E is the first to the third traffic saturation priority level [7,8].

Delays at ordinary times is a car on the road due to traffic flow, which leads to less speed, delaes time.

Through compares it to calculate the specific analysis, numerical flux increase, if the intersection traffic capacity increased, that area open to the surrounding road traffic, ease traffic congestion problem; Intersection saturation is smaller, road traffic capacity is unobstructed; Delays at ordinary times is reduced, road traffic capacity increase.

3. No Signal Intersection Model and the Solution of Analysis

3.1 No Signal Intersection Traffic Model

The situation of urban traffic is becoming increasingly severe, traffic congestion is often occurs, especially the intersection is easy to be a congested traffic capacity is low, travel time is growth.

The two lanes kai dike road of Li Jing-yuan outside is about 600 meters long，which connects qingyun road and green way, adjacent to national highway GS55, road traffic, road pressure heavy. Though kai road embankment is an important path of the shunt, but it is the only way of three large residential areas. Because the road area is limited, temporarily unable to expand.

Fig. 1. The Two-lane No Signal Intersection of Qingyun Road and Village Outside

It is understood that the clogging the daily in the evening after work time, a section of the left leads to two large residential green areas, and, right there is a park covers an area of a larger culture, public square dance and take a walk after supper is recreational place, a traffic large square. Analysis on the the running state of no signal intersection and the traffic.

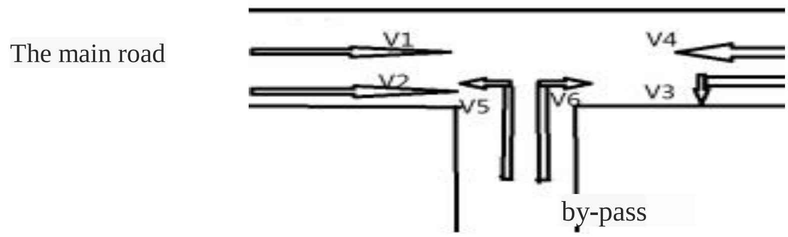

Fig. 2. No Signal Intersection

No signal intersection, all kinds of traffic priority hierarchy is as follows [9,10]:

Priority level 1: the main road go straight and turn right, the direction of 1, 2, 4

Priority level 2: turn left and turn right branch of the main road, the direction of 3, 6

Priority level 3: branch of the left, that is, direction of 5.

Mathematical model is set up [11]:

$$C_n = \frac{v_p e^{-v_p \cdot \kappa}}{1 - e^{-v_p \cdot \iota}} \tag{2}$$

where v_p is Different ways of driving traffic conflict

κ is The critical crossing gap

ι is The time of the conductor having been aparted

3.2 No Signal Intersection Model Data Preprocessing

(1) The conversion coefficient of statistical data, which needs to statistical equivalent traffic flow, so you need to different models for reduction conversion:

Tab.3. Convert Coefficient Method

Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike
1.0	1.2	2.0	4.0	0.4	0.2

(2) The equivalent traffic summary is as follows:

Tab.4. The Two-lane Traffic Flow (m/h) of the Village Outside

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
East import	83	23	4	0	8	8	124
West import	44	12	3	0	6	15	70

Tab.5. Qingyun Road Traffic (m/h)

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
Turn left	21	12	3	0	13	3	48
Turn right	25	5	0	0	6	5	35

(3) The determination of critical distance when they cross the gap with the accessory

Tab.6. κ Recommended Value Fellowship (2/4) (unit: s)

Vehicle type	Small cars	Midsize cars	Large cars	Articulated vehicle
Turn left of the main road	6.0	7.0	8.0	8.0
Branch left	6.5	7.5	8.5	9.0
Turn right branch	4.0	4.5	5.0	5.5

Tab.7. ι Recommended Value Fellowship (2/4) (unit: s)

Vehicle type	Small cars	Midsize cars	Large cars	Articulated vehicle
Turn left of the main road	2.0	2.5	3.0	4.0
Branch left	2.5	3.0	3.5	4.0
Turn right branch	1.6	2.5	2.5	3.0

(4) The conflict communication amount

Tab.8. The Conflict of Traffic Flow in Different Driving Way

Driving way	Label	Conflict in circulation	In total
Turn left of the main road	3	V1+V2	70
Branch left	6	V1+0.5V2	53
Turn right branch	5	V1+0.5V2	53

3.3 No Signal Intersection Model

(1) Capacity calculation is used following formula [11]

$$C_n = \frac{v_p e^{-v_p \cdot \kappa}}{1-e^{-v_p \cdot \iota}} \tag{3}$$

where v_p traffic volume of different driving modes for conflict, κ is critical through clearance, ι is from C to the accessory.

The first priority traffic maximum capacity

$$C_0 = 2500(\mathrm{pcu/h}) \tag{4}$$

and the second biggest priority traffic capacity:

$$C_{c,3} = C_{n,3} = \frac{70\times e^{-70\times 6/3600}}{1-e^{-70\times 2/3600}} = 1438(\mathrm{pcu/h}) \tag{5}$$

$$C_{n,6} = \frac{53\times e^{-53\times 4/3600}}{1-e^{-53\times 1.6/3600}} = 1680(\mathrm{pcu/h}) \tag{6}$$

The third biggest priority traffic capacity:

$$P_{0,3} = \left(1-\frac{48}{1638}\right)\times\left(1-\frac{35}{2080}\right) = 0.954 \tag{7}$$

$$C_{n,5} = \frac{53 \times e^{-53 \times 6.5/3600}}{1 - e^{-53 \times 2.5/3600}} = 1205(\text{pcu/h}) \quad (8)$$

$$C_{c,5} = P_{0,3} \cdot C_{n,5} = 0.954 \times 1205 = 1149(\text{pcu/h}) \quad (9)$$

Before the open area total capacity:

$$C_n = 1438 + 1680 + 1205 = 4323. \quad (10)$$

(2) Saturation calculation status and service level evaluation

The first priority traffic saturation:

$$\frac{V_1}{C_0} = \frac{124 + 70}{2500} = 0.077 \quad (11)$$

The second priority traffic saturation:

$$\frac{V_2}{C_{c,3}} = \frac{48}{1638} = 0.029 \quad (12)$$

$$\frac{V_2}{C_{c,6}} = \frac{35}{2080} = 0.017 \quad (13)$$

The third priority traffic saturation:

$$\frac{V_3}{C_{c,5}} = \frac{48}{1149} = 0.042 \quad (14)$$

The total traffic saturation:

$$x\frac{\sum V}{C} = 0.077 + 0.029 + 0.017 + 0.042 = 0.165 \quad (15)$$

Saturation of x is less than 0.25, the calculation formula for the delay:

$$d = 0.13e^{4.28x} = 0.13 \times e^{4.28 \times 0.165} = 2.6(s) \tag{16}$$

Plot after opening, the capacity calculation formula [11]:

$$C_n{}' = x\frac{v_p e^{-v_p \kappa}}{1-e^{-v_p t}} \tag{17}$$

Vehicle shunt, road traffic volume change as follows:

Tab.9. After the Open Outer Two-lane Traffic Flow (m/h)

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
East import	42	11	4	0	3	2	62
West import	15	10	3	0	2	5	35

Tab.10. After Neighborhood Opening Qingyun Road Traffic (m/h)

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
Turn left	14	7	3	0	5	1	30
Turn right	16	5	0	0	1	0	22

Tab.11. Traffic Conflict After Opening the Community

Driving way	Label	Conflict in circulation	In total
Turn left of the main road	3	V1+V2	35
Branch left	6	V1+0.5V2	29
Turn right branch	5	V1+0.5V2	29

With the above calculation work out:

$$C_{c,3} = C_{n,3} = \frac{35 \times e^{-35 \times 6/3600}}{1 - e^{-35 \times 2/3600}} = 980(\mathrm{pcu/h}) \tag{18}$$

$$C_{n,6} = \frac{29 \times e^{-29\times4/3600}}{1-e^{-29\times1.6/3600}} = 2160(\mathrm{pcu/h}). \tag{19}$$

$$P_{0,3} = \left(1-\frac{30}{980}\right)\times\left(1-\frac{22}{2160}\right) = 0.959. \tag{20}$$

$$C_{n,5} = \frac{29 \times e^{-29\times6.5/3600}}{1-e^{-29\times2.5/3600}} = 1376(\mathrm{pcu/h}). \tag{21}$$

$$C_{c,5} = P_{0,3}\cdot C_{n,5} = 0.959 \times 1376 = 1319(\mathrm{pcu/h}). \tag{22}$$

The passage after village opened after passage village:

$$C_n{}' = 980 + 2160 + 1376 = 4516(\mathrm{pcu/h}) \tag{23}$$

$$\frac{V_1}{C_0} = \frac{62+35}{2500} = 0.039 \tag{24}$$

$$\frac{V_2}{C_{c,3}} = \frac{30}{980} = 0.031 \tag{25}$$

$$\frac{V_2}{C_{c,6}} = \frac{22}{2160} = 0.010 \tag{26}$$

$$\frac{V_3}{C_{c,5}} = \frac{30}{1319} = 0.023 \tag{27}$$

The total traffic saturation after opened

$$x\frac{\Sigma V}{C} = 0.039 + 0.031 + 0.010 + 0.023 = 0.103 \tag{28}$$

The delay after village opened

$$d = 0.13e^{4.28x} = 0.13 \times e^{4.28\times 0.103} = 2.1(s) \tag{29}$$

The ratio of the area before and after the capacity opened

$$x\frac{v_p e^{-v_p \cdot \kappa}}{1-e^{-v_p \cdot \iota}} \div \frac{v_p e^{-v_p \cdot \kappa}}{1-e^{-v_p \cdot \iota}} = \frac{4516}{4313} = 1.045 > 1 \tag{30}$$

The traffic capacity of community opened:

$$C_n{}' = \frac{1.045 v_p e^{-v_p \kappa}}{1-e^{-v_p \iota}}. \tag{31}$$

So, that can be seen village capacity opened is the original 1.045 times, which is means that road access, effectively improved road traffic conditions.

3.4 No Signal Intersection Model Results

Due to delays 2.1 < 15, according to the standard of highway service level no signal intersection: and neighborhood two-lane road fork level, the level of service level for traffic flow, a slight resistance.

4. Analysis of Traffic Impact Before and After Opening Piece of Block Type Village

A residential area plan of residents in accordance with the motion and the characteristics of residential structure were divided into the following categories: block layout, layout of centripetal type, axis type layout, wai jewels layout, intensive layout metaphor type layout. [6] Now, no signal intersection model after opening to traffic force on the block type plots were analyzed:

For the plot after opening, the capacity calculation formula is:

$$C_n = x\frac{v_p e^{-v_p \kappa}}{1-e^{-v_p \iota}}. \tag{32}$$

Fig.3. Block Type Village

Because after opening the village the motion of the vehicle will get certain shunt, road traffic also can have a different degrees of change.

Tab. 12. The Community After Opening Large Road Traffic (m/h)

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
East import	122	38	61	7	5	0	320
West import	130	36	57	5	7	2	309

Tab.13. The Community After Opening Swan Lake Road Traffic (m/h)

	Small cars	Midsize cars	Large cars	Container	Motorcycle	Bike	Equivalent cars
Turn left	47	21	3	0	0	3	79
Turn right	39	14	1	0	7	1	61

Tab.14. After Open the Conflict of Traffic Flow

Drive way	Conflict combined circulation
South Lane road left	128
Turn Left lane road	114
Turn right Lane road	114

Above calculations are:

$$C_{c,3} = C_{n,3} = \frac{128 \times e^{-128 \times 6/3600}}{1 - e^{-128 \times 2/3600}} = 1493(\text{pcu/h}) \tag{33}$$

$$C_{n,6} = \frac{114 \times e^{-114 \times 4/3600}}{1 - e^{-114 \times 1.6/3600}} = 2009(\text{pcu/h}) \tag{34}$$

$$P_{0,3} = \left(1 - \frac{79}{1493}\right) \times \left(1 - \frac{61}{2009}\right) = 0.919 \tag{35}$$

$$C_{n,5} = \frac{114 \times e^{-114 \times 6.5/3600}}{1 - e^{-114 \times 2.5/3600}} = 1289(\text{pcu/h}) \tag{36}$$

$$C_{c,5} = P_{0,3} \cdot C_{n,5} = 0.919 \times 1289 = 1184(\text{pcu/h}) \tag{37}$$

$$\frac{V_1}{C_0} = \frac{320 + 309}{2500} = 0.252 \tag{38}$$

$$\frac{V_2}{C_{c,3}} = \frac{79}{1493} = 0.053 \tag{39}$$

$$\frac{V_2}{C_{c,6}} = \frac{61}{2009} = 0.030 \tag{40}$$

$$\frac{V_3}{C_{c,5}} = \frac{79}{1319} = 0.060 \tag{41}$$

After opening the total traffic saturation:

$$\mathrm{x}\frac{\Sigma \mathrm{v}}{\mathrm{c}} = 0.252 + 0.053 + 0.030 + 0.060 = 0.395 \tag{42}$$

Village open after the calculation formula for the delay:

$$d = 0.13e^{4.28x} = 0.13 \times e^{4.28 \times 0.395} = 7.05(s) \quad (43)$$

Therefore, capacity of block type village has a lot to improve than the village before opening, piece of block type of open to the neighborhood has a lot of improvement to the traffic conditions.

5. Optimization Suggestions

From the perspective of the traffic, recommendations of the department of city planning and traffic optimization are as follows:

(1) To the construction of village inside. First internal structure for the future of new village should be reasonable regulation, should reduce the occurrence of dead end highway internal construction, and should reduce the tree type structure of the plot. The best optimal model is obtained in this article, that is simulation arithmetic block layout and axis type layout are designated as the official layout. Can also make the village internal to be interrelated and constitute the internal traffic of the residential area's official website. For established residential area adopt the screening to select the right to open, the layout of the village for example: the model by this paper were proved that the piece of type layout is the preferred requirement.

(2) The village and construction village outside of the city can be specified by using the modern advanced science and technology: GIS software, the paper analyzed the data for each road, traffic, storage, and gives the optimal path of travel, which is convenient traffic. Dealing with major transport gateway between village and village docking, forms a small area of the mesh structure added to the city transportation network. To this end, we must construct a public transportation network of capillary traffic routes.

(3) Plot after opening, the traffic management advice in their neighborhood. According to traffic regulations, internal open road to the village for appropriate residents of traffic control (such as: road opening time in the rush hour, only a ban on vehicle into the village, residents breaks on the main campus of disorderly parking place strict management, and through community internal path to strengthen the noise controlled).

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