

Based on Hierarchy Analysis Method of Evaluation of the Village Roads Open

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Abstract: Whether to open area for residents in the end is good or bad can become important factors to implement this goal completely. Using the analytic hierarchy process to evaluate the influencing factors of road traffic, the evaluation index system of a total of 3 categories, identified 11 indicators, including small opening, road traffic factors influence the results is the largest intersection saturation (up 66.67%), residential location (up 66.67%), followed by traffic crossings and relative delay rate (50% increase) etc.. Within the area of the road within the scope of the operating capacity will be compared before and after the openings of the district, the improvement rate of each index are more than 50%. In the end, the different types of residential areas are compared and found that the more open the intersection of various types of cells, the better the extent of the smooth flow of the surrounding roads.

Keywords: Analytic hierarchy process; Road traffic impact factor; Delay rate; Evaluation index system

Received 25 June 2016, Revised 23 July 2016, Accepted 25 July 2016

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1. Introduction

With the rapid development of economy and the overall progress of the society, China's cities are undergoing a comprehensive transformation from the traditional to the modern. Rapid urbanization provides a powerful driving force for urban development, and improves the efficiency of urban resource allocation. But the rapid urbanization process also makes all kinds of social problems and social contradictions become more and more prominent. Diversified way of thinking, demand and behavior determines the development trend of the spatial pattern of residential building. The closed cell and open areas is one of the city caused by the regional differences of the development of the problem, brought great difficulties to the difference of city governance, become a major bottleneck restricting the harmonious and healthy development of the city. The closed residential area as a widely adopted standard development mode and spatial organization form in the country spread, its scale and speed are quite amazing, city environment and social problems brought by the closed area was criticized. Through the analysis of the problem, select the appropriate evaluation index system to evaluate the impact of community opening on the surrounding road traffic.

2. Model assumptions

(1) Assuming that the selected lanes are in line with ideal conditions, that is, the weather is sunny. The wind is less than 3, to ensure that the road conditions and weather conditions in terms of the road conditions are comparable.

(2) Car flow, the flow of people and the speed of the data is not affected by the weather.

(3) The detected data is accurate and reliable.

(4) In order to calculate conveniently, do not take into

account the proportion of various types of vehicles in the selected road section.

(5) District near the main road traffic capacity is equal.

(6) The area of road can withstand traffic operation.

(7) Assuming the basic capacity of the road $C=1$.

3. Problem analyses

According to the requirements of the subject selected the appropriate evaluation index system, first through the relevant literature to select the influence of traffic capacity open to the surrounding road index, a total of 13 indicators, through the system of AHP selected 2 indicators. The final effect of 11 evaluation index system of district open to the surrounding roads, and then to evaluate the index for this subjective index hierarchy and complex using rank method, using AHP, calculate evolved into matrix algorithm to get the final weights using a hierarchy on the next level of weight, will be small open and not open the weights of various index is the degree of influence.

4. The establishment and solution of the model

4.1. The impact model of cell opening on the surrounding road traffic

Application of AHP [1] analysis of the decision problem, first put the problems organized, hierarchical, construct a hierarchical structure model. These levels can be divided into three categories: decision-making layer, middle layer, solution layer, layer of the open cell type 1 is two ring opening open area, open cell type 2 as a tree open area, open cell type 3 mesh type open area, the number and complexity of layer hierarchical structure of the problem and need to analyze the degree of detail. Set up road traffic open comprehensive evaluation system, as shown in Figure 1.

Table 1 Symbolic descriptions

Symbols	instructions	Symbols	instructions
A	Comprehensive evaluation of road traffic	B1	Intersection index
B2	Road index	B3	Regional index
C1	Intersection traffic	C2	Intersection saturation
C3	average delay	C4	Link saturation
C5	Travel time	C6	Congested link length
C7	relative delay rate	C8	Cell structure
C9	Accessibility	C10	Area
C11	Cell location	C12	Safety degree

4.2. Index introduction

(1) Intersection index

According to the intersection of traffic characteristics and the role of Road intersection, intersection evaluation indicators include: cross port traffic volume C1, intersection saturation C2, the average delay of C3.

Intersection traffic C1: in a small intersection through the number of vehicles, due to the intersection traffic volume is a reverse indicator; it is calculated in the calculation of the weight of its reciprocal.

Intersection saturation C2: the ratio of the actual traffic volume at the intersection of a small area and the traffic capacity of the intersection is the congestion index of the overall traffic of the intersection. As the intersection degree of saturation is a reverse index, it is calculated that the weight is calculated.

The average delay of C3: the average intersection delay for all vehicles in the peak period of intersection delay length in actual driving time and during this period of the road length according to the time difference between the driving speed smooth passages of the average value. It is a measure of area intersection vehicle operation condition evaluation index. Intersection average delay can be more accurate and intuitive response intersection congestion severity. Because the average delay is a reverse index, it is the reciprocal of the weight.

travel time C5, the length of the congested sections of C6, the relative delay rate of C7. The length of travel time and congestion section can be obtained by direct measurement.

Road saturation C4: (V/C), the degree of congestion of the road segment. Due to the degree of saturation of the road is a reverse indicator, it is calculated the weight of the countdown.

Relative delay rate C7: the relative delay rate is a non dimensional index, can be compared to different road conditions, travel patterns, such as congestion. Because the relative delay ratio is a reverse index, the weight is calculated.

(3) Regional indicators

Regional indicators include the cell structure C8, up to C9, small area C10, cell location C11, security C12.

Cell structure C8: we have three kinds of structure of the study area, which is the ring cell, the tree cell, reticular cell.

Accessibility C9: accessibility is also known as accessibility, which is reflected in another aspect of traffic quality. It is the use of a specific transport system from a given location to reach the location of the convenience of the degree of convenience. The accessibility of land use and traffic system evaluation combined, in the case of congestion can be accepted, the accessibility of the changes with the purpose of travel, geographical location of time and travel patterns change.

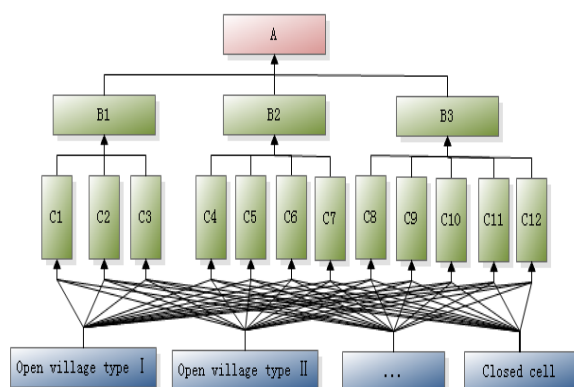


Figure 1. Road traffic open comprehensive evaluation system.

(2) Link index

Road indicators include the degree of saturation C4,

4.3. All the judgments matrices in structure

The criteria layer occupied in the target to measure the proportion are not necessarily the same, in the decision maker's mind, they occupy a certain proportion, by 1-9 scoring each index score of each index data base. The judgment matrix $A = (a_{ij})_{n \times n}$, the weight calculation of each index by AHP, the comprehensive evaluation index of open road traffic intersection A, B1 index B2 index B3 index section, regional, fork traffic C1, C2 intersection saturation, average delay of C3, saturation C4, travel time C5, congested road length is C6, the relative delay the rate of C7, C8 cell structure, up to C9, area C10, area location C11, the safety degree of C12 judgment matrix respectively:

$$A = \begin{bmatrix} 1 & 2 & 1 \\ 0.5 & 1 & 0.5 \\ 1 & 2 & 1 \end{bmatrix} \quad B1 = \begin{bmatrix} 1 & 3 & 2 \\ 0.3333 & 1 & 0.3333 \\ 0.5 & 3 & 1 \end{bmatrix}$$

$$B2 = \begin{bmatrix} 1 & 0.5 & 1 & 0.3333 \\ 2 & 1 & 1 & 0.3333 \\ 1 & 1 & 1 & 0.3333 \\ 3 & 3 & 3 & 1 \end{bmatrix}$$

$$B3 = \begin{bmatrix} 1 & 3 & 5 & 2 & 4 \\ 0.3333 & 1 & 3 & 0.5 & 2 \\ 0.2 & 0.3333 & 1 & 0.3333 & 0.5 \\ 0.5 & 2 & 3 & 1 & 3 \\ 0.25 & 0.5 & 2 & 0.3333 & 1 \end{bmatrix}$$

$$C1 = \begin{bmatrix} 1 & 0.5 & 2 & 3 \\ 2 & 1 & 3 & 4 \\ 0.5 & 0.3333 & 1 & 2 \\ 0.3333 & 0.25 & 0.5 & 1 \end{bmatrix}$$

$$C2 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.5 & 0.25 \\ 2 & 2 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C3 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.3333 & 0.25 \\ 2 & 3 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C4 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.3333 & 0.25 \\ 2 & 3 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C5 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.3333 & 0.25 \\ 2 & 3 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C6 = \begin{bmatrix} 1 & 0.5 & 2 & 3 \\ 2 & 1 & 3 & 4 \\ 0.5 & 0.3333 & 1 & 2 \\ 0.3333 & 0.25 & 0.5 & 1 \end{bmatrix}$$

$$C9 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.5 & 0.25 \\ 2 & 2 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C10 = \begin{bmatrix} 1 & 2 & 0.5 & 0.3333 \\ 0.5 & 1 & 0.3333 & 0.25 \\ 2 & 3 & 1 & 0.5 \\ 3 & 4 & 2 & 1 \end{bmatrix}$$

$$C11 = \begin{bmatrix} 1 & 2 & 1 & 1 \\ 0.5 & 1 & 0.5 & 1 \\ 1 & 2 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$$C12 = \begin{bmatrix} 1 & 0.5 & 2 & 3 \\ 2 & 1 & 3 & 4 \\ 0.5 & 0.3333 & 1 & 2 \\ 0.3333 & 0.25 & 0.5 & 1 \end{bmatrix}$$

4.4. Hierarchy single sorting and consistency checking

$$CI = \frac{\lambda_{max} - n}{n}$$

CI (index consistency) of the consistency index is calculated, which is the maximum Eigen value of the judgment matrix. All layers are tested by means of consistency.

4.5. Level total ordering and consistency checking

Finally to get the elements, especially the rank weights of each scheme the lowest layer to the goal, and scheme selection. On the level of total order also need to verify the consistency, the synthetic weight calculating layer elements of the overall goal of the system, and the alternative ranking. Solving the following model:

$$\min Z = \sum_{i=1}^n \sum_{j=1}^n (a_{ij} w_j - w_i)^2 \quad s.t. \sum_{i=1}^n w_i = 1$$

$$w_i > 0, i = 1, 2, \dots, n$$

Calculate the geometric mean of each element of the

matrix: $\bar{w}_i = \sqrt[n]{\prod_{j=1}^n b_{ij}} (i = 1, 2, \dots, n)$. Normalized processing of

$$W_i = \frac{\bar{w}_i}{\sum_{j=1}^n \bar{w}_j} (j = 1, 2, \dots, n)$$

vector: $\sum_{j=1}^n \bar{w}_j$. In the formula for

the weight of the index values, the final weight vector:

$\bar{w}_i = \sqrt[n]{\prod_{j=1}^n b_{ij}} (i = 1, 2, \dots, n)$. The biggest characteristic

root of the judgment matrix λ_{max} :

$$\lambda_{max} = \frac{1}{n} \sum_{i=1}^n \frac{(BW)_i}{W_i}$$

The matrix order in the formula is the value of the weight of the index, the consistency evaluation index is calculated, which will be used as a measure of the deviation of the consistency of the judgment matrix.

The average random consistency indexes of the judgment matrix (the average value of the maximum Eigen value):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$

Table 2 Judgment matrix A-B

A	B1	B3	B2	Wi
B1	1	2	1	0.4
B3	0.5	1	0.5	0.2
B2	1	2	1	0.4

Random consistency ratio of judgment matrix:
 $CR = \frac{CI}{RI}$. By the Table 2, $W = (0.4, 0.2, 0.4)^T$,
 $CR = 0 < 0.1$ Repeat the same steps, can get the entire judgment matrix $CR < 0.1$, that the judgment matrix with satisfactory consistency. And then come to the results as shown in Table 3. And Table 2 from this can be seen that the number of open nodes of the road traffic capacity of the greater impact, of course, cannot exceed the scope of the road within the scope of the road.

After the indicators for the primary election, but also to select the test index system can be quantitative, can

also be qualitative. Quantitative testing reflects the objectivity. Through quantitative tests found that qualitative analysis cannot be aware of the problem. Qualitative tests can give full play to people's initiative, the evaluation indexes were analyzed, the index system of the qualitative test is generally in the comprehensive evaluation of the "design patterns", the quantitative test is in the comprehensive evaluation index system of "form" in the. According to the existing research results, the difficulty degree of index data acquisition and whether it can directly reflect the degree of openness, the analysis results are shown in the Tble 4.

Table 3 Regional total evaluation

Cell types	Open cell type I	Closed cell type	Open cell type II	Open cell type III
The evaluation score normalization	0.1905	0.1811	0.249	0.3794

Table 4 Evaluation index weight and importance

Indicators of how important	The evaluation index											
	B1			B2				B3				
	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12
weight	0.133	0.198	0.0504	0.2111	0.0197	0.0325	0.0841	0.0133	0.0562	0.0599	0.0798	0.066
Main		√		√								
Secondary	√						√					
general			√		√	√		√	√	√	√	√

Table 5 Weight increase ratio

Index type	open weigh	not open weight	weight increase ratio
Intersection traffic volume	0.6667	0.3333	50.00%
Intersection saturation	0.75	0.25	66.67%
Average delay	0.75	0.25	66.67%
Travel time	0.7415	0.2585	65.13%
Section saturation	0.6667	0.3333	50.00%
Travel time	0.72	0.28	61.13%
Cell structure	0.6667	0.3333	50.00%
Cell location	0.75	0.25	66.67%
Safety degree	0.7425	0.2585	65.16%

5. Conclusion

Open area has a certain amount of relief to the road traffic. Different district open road traffic of easing degree is also different. Government departments should according to the characteristics of the area and the nearby traffic condition to decide whether to open. Open village blindly, can increase the district safe hidden trouble.

References

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