The impact of residential opening on road access

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Abstract. This paper uses the travel time and the maximum traffic flow to establish the capacity model to study the impact of the residential openness on the capacity of the surrounding roads, and select three districts in Florida for verification. The results show that the road opening to alleviate traffic congestion has contributed to the situation, the larger the district, the effect is more obvious.

1. Introduction

At present, the mode of domestic residential area is mostly enclosed residential area. These residential areas generally adopt a totally enclosed management mode, which makes the use of planning elements such as roads, afforestation and public facilities of a residential area independent of the urban structure and self-contained system to meet the internal needs of the residential area. The management of the district to bring convenience to the management, but also to the city traffic to some problems.

First, the area around the city traffic jam. Due to the size of the plot or the side length is too large, resulting in longer travel distance, traffic concentration, the formation of traffic overlay. Traffic overlay refers to a road or a section of the road around, although the purpose and direction of travel is different, but no other road for its purpose to the direction of the need to detour from the road to the destination flow direction, forced to influx.

Second, district traffic generated in the peak single, that is the same purpose of internal travel, exacerbating the pressure of urban traffic. During peak hours, traffic bottlenecks are easily caused. Traffic on urban roads is also large and mutual interference is caused by mutual inaccessibility. With limited road resources, traffic can only be slowly digested by roads.

Third, due to the small area of the building can not be ignored, sometimes the closed area along the urban road is too long to reduce the density of the road but also reduce the connectivity between urban roads, resulting in the region of the road network density is low, hindering the city branch Mainly, the secondary road to share the traffic pressure, resulting in low accessibility between roads, diversion capacity is low, the organic capacity is small, thus impeding the smooth flow of traffic.

After the opening of traffic in the district, the density of the branch road network has been increased, which has strengthened the connection between the trunk road and the trunk road, the trunk road, the secondary trunk road, the secondary trunk road and the secondary trunk road, and the traffic in the city has changed. Improvement of traffic conditions around the road in the district after the opening up can not be achieved and how to achieve this is the focus of this paper.

2. Model

2.1 Capacity

In order to quantitatively describe the traffic capacity of the road network, the concept of travel time and maximum traffic volume is introduced. By setting the coefficients to relate the sum, we consider the impact of road traffic.

$$\phi = \frac{K}{T}$$

In the final model analysis, this parameter is mainly considered as the target. The larger the T is, the smaller K is, the smaller it is. This indicates that the degree of road traffic congestion is increased.

2.2 Travel time

The United States Federal Highway Administration gives the classic road resistance function[1] :

$$t(V) = t_0\left[1+\alpha\left(\frac{V}{C}\right)^{\beta}\right]$$

t_0 is free travel time for the road section,

V is traffic at that time passed the road, in pcu / h,

C is the basic passage capacity of the road, in units of pcu / h,

α, β are model parameters to be determined, the proposed value of 0.15,4

t_0 is calculated as follows:

$$t_0 = \frac{L}{u_0}$$

Refer to the following table for the recommended basic capacity of a link:

When the vehicle passes the intersection, it will cause delay, and the delay time needs to consider entering the traveling time. This article uses the average delay calculation method [2]:

$$d = \frac{0.5T\left(1-\frac{t_g}{T_m}\right)}{1-\left[\min(1,x)\cdot\frac{t_g}{T_m}\right]}$$

T_m : signal cycle length,

t_g : effective green time,

x :saturation V/C

The revised BPR function is:

$$t(V) = t_0\left[1+\alpha\left(\frac{V}{C}\right)^{\beta}\right]+d$$

The total travel time of the road network is calculated on the basis of the traffic and impedance functions of each road section. The calculation method is as follows:

$$T = \sum_{i=1}^{s} t_i f_V$$

and

$$t_i = \sum_{j=1}^{n} t_j V_j$$

Where s is the total number of paths in the idealized model, n is the number of road segments in each path, and f_V is the modified traffic volume.

2.3 Network maximum flow model

By building a neighborhood into an approximate network map, we can analyze the maximum traffic volume of the map and evaluate the traffic capacity of the district.

The classic method of seeking maximum flow is Ford-Fulkerson algorithm[3].According to the Ford-Fulkerson algorithm, the simplified cell is regarded as the digraph D = (V, A), where A is the arc set and the entrance to the road as V_s, Export as a closing point recorded as V_t, the other points for the middle point. The basic capacity of residential roads as the arc capacity. For each arc $(v_i, v_j) \in A$, there is a capacity set corresponding to $c(v_i, v_j) \geq 0$. Such a directed graph D is usually called a

network, denoted as D = (V, A, C). Starting from a feasible flow from V_s to V_t, the maximum flow from V_s to V_t can be found after the labeling process and the adjustment process. Specific solution process is as follows:

1).Mark V_s as $(-,+\infty)$,V_s has become a mark of the unmarked points, the rest are not marked points.

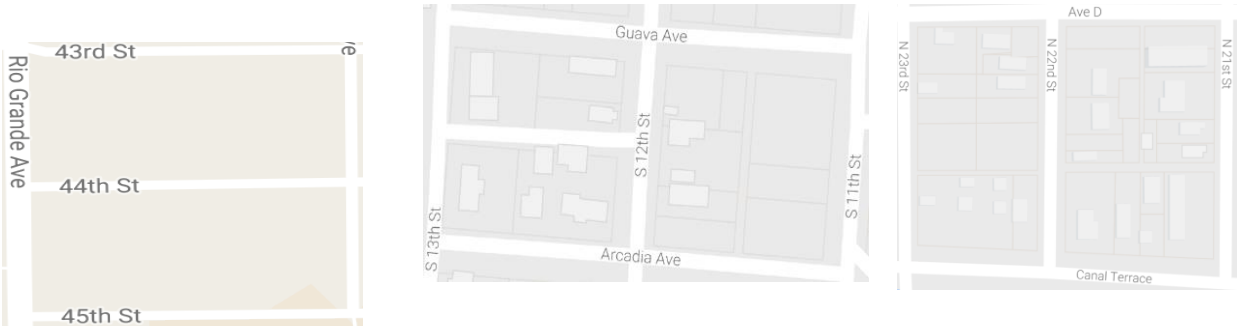
2). Take a labeled unchecked point V_i, for all unmarked points a V_j, If there is a unsaturated arc (V_i,V_j), then mark V_j as $(V_i,l(V_j))$,and $l(V_j)=\min\left[l(V_j),c_{ij}-f_{ij}\right]$,$V_j$ has become a marked unchecked point. If non-zero arc (V_i,V_j),then mark V_j as $(-V_i,l(V_j))$,and $l(V_j)=\min\left[l(V_j),f_{ji}\right]$, V_j has become a marked unchecked points, V_i has become a marked unchecked points.

3). Repeat the step 2),untill V_t become a marked point,or every points are checked.If V_t become a marked point, show that we get an augmented chain from V_s to V_t,then turn into the adjustment process. If all the punctuation have been checked, indicating that the feasible flow at this time is the maximum flow K, the end of the algorithm.

3. Model Analysis

In the process of selecting a cell, we mainly choose to build a real model by comparing a typical classic plane model with a relatively large amount of data. By analyzing the original data we obtained and analyzing the free travel time T and the largest network flow K on the road sections, and then we have ϕ to compare the coefficient of consideration.

We picked three communities out of three towns in DeFuniak Springs, Orlando, Fort Pierce, FL and got their floor map on Google Maps is shown in figure 1.



(a) (b) (c)

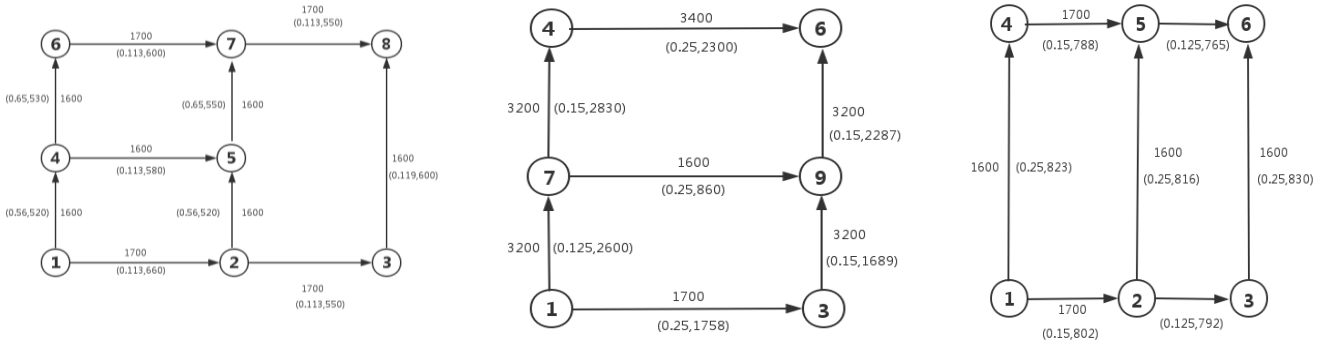
Fig.1 Maps of typical communities

Through the Florida Department of Transportation website [4] obtained the traffic flow of the district and the basic information of the road. The traffic flow of the district in one day is shown in table 1.

Table 1. Communities traffic information

	Defuniak Springs		Orlando		Fort Pierce	
Direction	East-Bound	West-Bound	East-Bound	West-Bound	North-Bound	South-Bound
Traffic	10858	9712	80883	75629	13926	16074

After modeling the above cells, the following roadmap is obtained for analysis (figure 2).



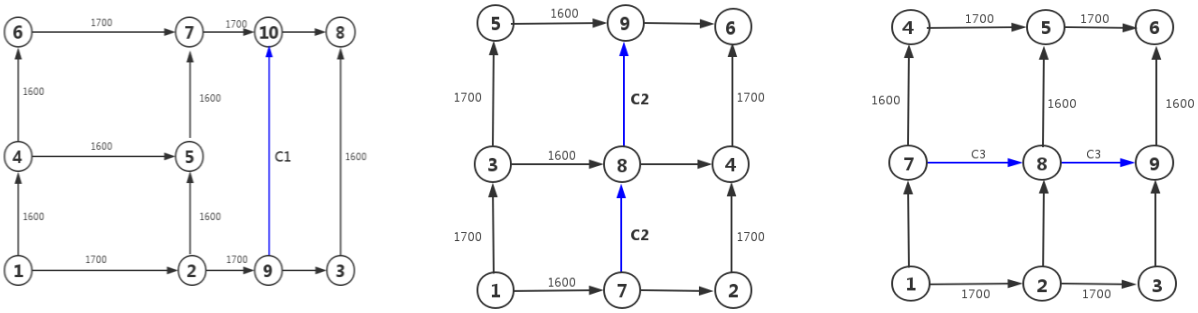
(a) (b) (c)

Fig. 2 Graphs of community models

The figures on the edges in the picture above represent the basic capacity of the road, and the figures in brackets represent the length of the road and traffic flow.

Through the application of the model, the coefficient of capacity of the three cells is calculated as {20.367, 52.258, 37.226}.

After the district is open, the model changes as shown in figure 3.



(a) (b) (c)

Fig. 3 Graphs of modified community models

Calculate the capacity coefficient of the community again, the result is {21.257,57.639,41.368}.

Analysis of the above results shows that the opening of residential area has a certain gain effect on the capacity of the road network, and the larger the size of the residential area, the higher the degree of closure, and the better the effect of dredging the road after opening up.

4. Summary

According to the results, we can see that the appropriate opening of the residential area can effectively alleviate the congestion of the surrounding roads. Therefore, planning residential area into a radial distribution, forming a circular road to reduce the number of driving nodes, thereby reducing the impedance coefficient to reduce travel time. In times of heavy traffic, large, closed communities can be opened to reduce congestion.

References

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