A research of the community’s opening to the outside world

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Abstract. Closed residential areas, called community, the traffic network and result in various degrees of traffic congestion such as amputating, dead ends and T-shaped roads. In order to reveal the mechanism of the congestion, establish an effective evaluation index system and finally provide theoretical basis for the study of traffic congestion, we have done researches on factors for traffic congestion and have established a scientific evaluation index system combining experiences home and abroad, based on domestic congestion status. Firstly, we analyse the traffic network as the entry point, and then establish the evaluation model of road capacity with the method of AHP index system. Secondly, we divide the condition of urban congestion into 5 levels from congestion to smoothness. Besides, with VISSIM software, simulations about traffic capacity before and after community opening are carried out. Finally, we provide forward reasonable suggestions upon the combination of models and reality.

1. Introduction
The traffic congestion has been a common problem of numerous mega-cities around the world. It affects the healthy development of cities in many ways [1-3]. At present, the main characteristics of closed communities in China are: closure, large area, big population, single function, out of touch with each other, etc. These characteristics have reduced the density and reachability of traffic network. Urban roads are also affected by traffic flow within the community. Meanwhile, this increases the traffic pressure around traffic network [4-6].

In China, with the policy which allows no construction of closed community, open communities have become mainstream. However, in terms of construction and management about open communities, there are no researches on community security, protection of property rights, environmental quality as well as design rationality. Hence, it is urgent to improve the management, legal principle, technology, and ideas of design [7-8]. With the existing road resources, how to better alleviate the traffic congestion has become one of the most important subjects on solving urban transportation problems [7]. As a result, it is urgent to study and establish a scientific evaluation index system of traffic congestion [1]. Only after further investigation on the mechanism of formation and propagation features, can we set up a scientific scheme to meet travellers’ needs. From these, we can see that it’s significant to study the problems of traffic congestion for the development of cities [8-10].

2. Evaluation methods
Cities, which has its essence of diversity is its, is a complex of multiple functions. Open community is developed on the basis of this diversity. From the perspective of planning and construction, open
The community has open space and private living rooms. Open space is taken for daily activities and communications. While the latter are living places, which are secure and quiet. Seen from the road system, the organic combination of open residential roads and surroundings can help ease traffic problems in cities [13]. By using AHP model, we have merged the information of each indicator. Finally, we figure out the extent of impact of district opening on the road capacity (Fig. 1).

According to the difference of road traffic, the operational condition can be divided into 5 grades: high degree of delay, moderate delay, general delay, low delay and no delay [2]. The evaluation factor sets which conclude to \( U = \{ u_1, u_2, u_3 \} \) are corresponding to the number of nodes, the road area and the degree of street. At the same time, we’ve determined the sets of judgments \( V = \{ v_1, v_2, v_3, v_4, v_5 \} \) which correspond to non-congestion, low-level congestion, general congestion, moderate congestion, high degree of congestion for five evaluation levels. Then, we integrate the three indexes with AHP and figure out that \( W = (0.55, 0.18, 0.27) \) And the fuzzy evaluation matrix is established: \( R = (r_{ij})_{3x5} \).

Based on the evaluation matrix, we can combine the resulting matrix and Weight vector to the final computation.

\[
B = W \cdot R = (0.55, 0.18, 0.27) \cdot R = (b_1, b_2, b_3, b_4, b_5)
\]

The degree of congestion can be judged from vector \( b \). From the number of nodes, we can see that the road area rates weigh of the large. Therefore, this paper mainly analyzes the current traffic situation of the important intersections (road nodes) around the district, so that we can obtain the relationship between the average traffic velocity and delay time. In fact, the number of road nodes and the road area rate have a significant effect on the average speed of traffic. That is to say, the more nodes and road area there are, the larger \( V \) average will be. Therefore, we will study the impact of \( V \) average on road capacity instead of the number of nodes and road area rates.

3. Comparison of the road capacity based on VISSIM simulation

The opening of the closed cell id a good way resolve traffic congestion. In terms of impacts of two types of residential areas on the traffic before and after opening of community, as well as the operational condition, we need to compare current condition with previous condition. Here, the evaluation function of VISSIM is used to simulate the traffic network. Based on the results, we can judge whether or not the traffic network should be opened.
Figure 2 Comparison of traffic volume before and after community opening

Then we get the following data:

| Vehicle class | Number of vehicle | Time(h) | Distance (km) | Delay (h) | Average speed (km h⁻¹) | Average delay(s) |
|---------------|-------------------|---------|---------------|-----------|------------------------|-----------------|
| Small car     | 156               | 21.94   | 175           | 58.67     | 7.98                   | 46.2            |
| Large Bus     | 11                | 2.38    | 104.8         | 3.57      | 48.07                  | 20.16           |

Then we get the following data:

| Vehicle class | Number of vehicle | Time(h) | Distance (km) | Delay (h) | Average speed (km h⁻¹) | Average delay(s) |
|---------------|-------------------|---------|---------------|-----------|------------------------|-----------------|
| Small car     | 156               | 20.02   | 175           | 58.36     | 8.66                   | 45.89           |
| Large Bus     | 11                | 2.18    | 104.8         | 3.56      | 48.07                  | 20.16           |

From the above model, we calculate the basic road capacity before and after opening. Assuming that, the same type vehicle speed before and after opening the communities is equal to each other. Compared to road capacity before opening, the road capacity after opening has increased by

\[
\frac{C_{After}}{C_{Before}} = \frac{1}{1000v_{After}(I_o)^{-1}} = \left(\frac{v_{After} - v_{Before}}{v_{Before}}\right) \times 100\% \tag{3}
\]

Based on the data in the table with this formula, we can find that the road capacity for small cars has increased by 8.5%, while for large passengers that has increased by 9.2%.

4. Conclusion

To conclude, we provide five suggestions, there are as follows: Firstly, make substantial increases of the road density, set multiple entrances and exits so as not to be directly connected with the trunk roads. Besides, the circles around the roads can resolve the impact of left turn traffic on local road networks. At the same time, improving the capacity of the joint between entrances and channels, mainly depends on the spatial position, area of joint, the capacity of adjoining road and the ways of dealing with traffic flow at the junction [14-15]. Secondly, the location of passageway should ensure the safety, effectiveness of vehicles and avoid non-project traffic. The size of passageways must be able to match the size of vehicles; The road area should be appropriately enlarged when it comes to the compression of streets and roads; Review and demonstrate the width motor vehicle lane standards and then reduce the lower limit of vehicle width; Closely restrain the conditions and range of intersection channelizing broaden.; Properly use the distance of boundary line area; Provide access for prevailing conditions and requirements about enhancing city vitality.

Thirdly, auxiliary roads and adjust ways of traffic flow. Such as the implementation of one-way traffic and restricted access [10]. It is necessary to shrink the width of motorway and emphasize rights of walking and cycling.
Fourthly, we could separate car streams and pedestrian flow in both time and space through signal lights, signs, overpass and tunnels. And then, get through amputating roads and T-shaped roads. Improve the connectivity of traffic networks. Besides, roads in public space such as parks and greenbelts should be available to pedestrian and bicycles. Generally, we can reduce new traffic volumes through restraint of construction of closed communities as well as transferring the land utilization. That means to transfer the residential lands into traffic lands. In this way, public space in our streets can be enlarged. Finally, For the communities, which have no developed internal traffic networks, its opening will not help to ease traffic congestion but bring about negative impacts. So, this kind of community should not be opened.

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