World Scientific Research Journal Volume 7 Issue 6, 2021
ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0061

Research on Traffic Flow Distribution of Two Urban Road Network Models Based on Aimsun

Hao Li[1, a]

[1]College of Transport & Communications, Shanghai Maritime University, Shanghai, China

[a]201930610041@stu.shmtu.edu.cn

Abstract

This paper first proposes two grid network models with different road network structures in the urban center. In the 1km×1km urban center area, the first road network model has a structure ratio of 1:2 between the trunk road and the branchway. The trunk road is set to two-way road of 6 lanes, the branchway is set to two-way road of four lanes, and the distance between the roads in first road network model is 300 meters. The second road network model has a structure ratio of 1:4 between the trunk road and the branchway, and the trunk road is set to two-way road of six lanes. The branchway is set as one-way road of 2 lanes, and the distance between the roads in second road network model is 300 meters. The two road network models have the same proportion of road landuse, the only difference lies in the road density and traffic organization of the branch roads. Secondly, using Aimsun simulation, the traffic flow distribution of the two road networks under the same total traffic demand of cars is compared and analyzed, and the results are displayed through the Aimsun result analysis view.

Keywords

Manuscripts; Corresponding authors; Copyright; Publishing ethics.

1. INTRODUCTION

The road traffic system is an indispensable and important part of the functioning of the city. Road network planning plays a very important role in urban overall planning, urban detailed planning, especially urban transportation planning. Due to the different structure of the urban road network, the capacity of the road network system is also different. The structure of the road network system to complete various tasks is the functional structure of the road network, which mainly includes two types of functions: the provision of transportation space and the provision of public activity space. The urban road network system can be classified according to the importance of the transportation space and public activity space provided by the road network. This is the hierarchical structure of the road network. The location relationship of roads with different functions and levels in urban space is the layout structure of the road network. These roads of different levels, locations, and functions will have different functions at different times, and have the characteristics of interconnection, convergence, and transformation. The arrangement of these connections, connections, and conversion processes is the organizational structure of the road network, mainly the time and space utilization of nodes or road sections. The two road networks studied in this paper are quite comparable in the hierarchical structure and organizational structure.

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0061

2. THE TWO ROAD NETWORK MODELS

2.1. Road Hierarchy Structure

The first road network model is shown on the left in Figure 1, where the orange roads represent trunk roads, serving medium and long-distance connections between urban clusters and the main traffic connections within the clusters. The design speed of trunk roads is set to 50km/h, with 6 lanes in both directions; The gray roads represent branchway and serve for short-distance local activities. The design speed of branchway is set to 30km/h, with 4 lanes in both directions. The first road network model has structure ratio of 1:2 between trunk road and branchway . Each road divides the 1km^2 area into a block of 300×300m. The second road network model is shown on the right in Figure 1, where the trunk road is the same as the left picture, and the branchway is set to one-way road of two lanes, which can be regarded as the branchway divided in the left picture. And after the uniform layout, the structural ratio of the trunk road and the branchway is 1:4, and each road divides the 1km^2 area into a block of 180×180m.

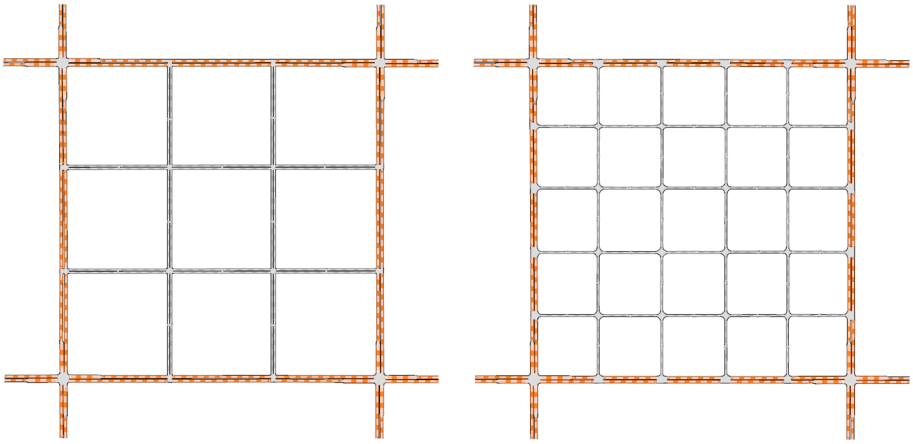

Figure 1. Road network road hierarchical structure

2.2. Traffic Zone and OD

The traffic zone includes an external traffic zone (red square area) and an internal traffic zone (green square area). The internal traffic zone can be regarded as a block surrounded by roads, and the external traffic zone refers to the external group connected to the internal land or other groups through trunk roads. The specific settings of the traffic districts of the two road network models are shown in Figure 2.

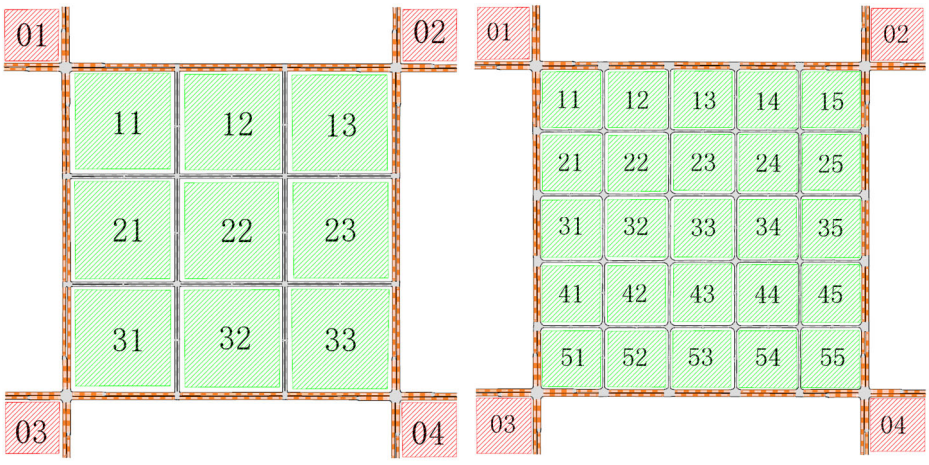

Figure 2. Traffic zone

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0061

The OD between the various external traffic zones is called transit traffic, which is set at 100 veh/h in this article, and the value in the two road network models are common. Due to the large number of internal traffic zones in the second road network model, this paper sets the OD between them first, and then distributes the sum evenly to the OD pairs of the first road network model. The traffic volume of each OD pair excluding transit traffic in the second road network model is set to 10 veh/h, and the traffic volume of each OD pair excluding transit traffic in the first road network model is set to 55 veh/h. According to this, the total travel OD of the second road network is 9200 veh/h, and the total travel OD of the first road network is 9120 veh/h, which is similar in value.

3. AIMSUN SIMULATION

3.1. Simulation Settings

1. The research purpose of this paper is mainly the distribution of traffic flow in different road network models. In order to simplify the simulation, the intersection of the simulated road network adopts no signal control scheme.

2. Set the simulation duration to 1h and set the pre-simulation for 10 minutes.

3. The random route selection model is adopted for traffic distribution, and route selection is performed based on the travel time between OD calculated under free flow traffic conditions, and the route is updated every 15 minutes.

3.2. Simulation Result Analysis

The traffic distribution of the two road network models is shown in Figure 3, and the total traffic of the road network over time is shown in Figure 4. It can be seen intuitively from Figure 3 that the traffic distribution of the second road network is more uneven than that of the first road network, and the branch roads in the central area have to undertake heavier transportation tasks. It can be seen intuitively from Figure 4 that, except for the traffic value counted at 1:00pm at the end of the simulation, the total simulated traffic of the first road network model and the second road network model fluctuates between 8800 and 9800 veh over time. The difference is not much, the result is the same as the total OD of the two road networks set in the previous section, there is a causal relationship.

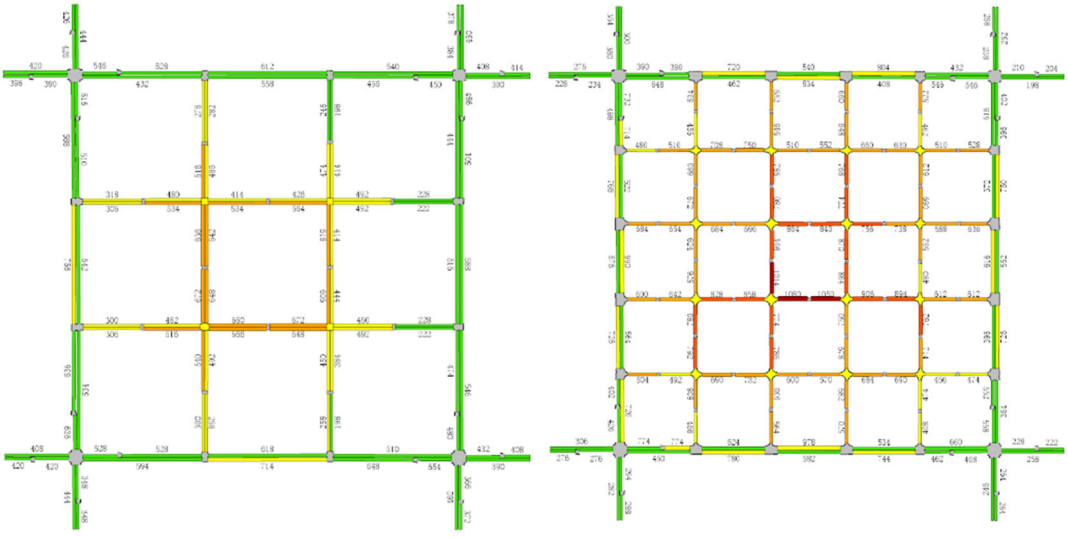

Figure 3. Simulation flow results

ISSN: 2472-3703 DOI: 10.6911/WSRJ.202106_7(6).0061

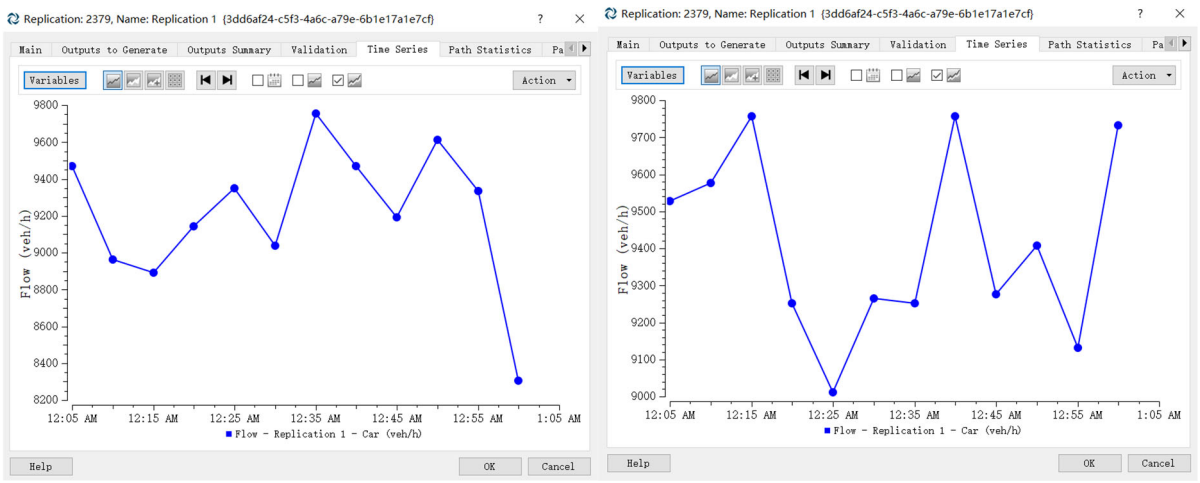

Figure 4. Total traffic change of road network

4. CONCLUSION

In this paper, two grid network models with different road network structures in the central area of the city are proposed. The difference is mainly manifested in the road network density and traffic organization of the branch roads. Through the Aimsun simulation, the Aimsun result analysis view was used to show the traffic flow distribution of the two road networks under the same total demand for cars. The result was that the traffic distribution of the second road network was more uneven than that of the first road network. Regional branch roads have to undertake heavier transportation tasks, so from the perspective of uniform flow distribution, the first road network model is better than the second road network model.

ACKNOWLEDGMENTS

Thanks are due to Dr. Wang for valuable discussion and to C. Zhao for assistance with the experiments.

REFERENCES

[1] Y.F.Chen: Analysis on the rationality of road network hierarchical structure (Traffic and transportation, China 2020), p.49-52.

[2] Ahuja, P. K. , Magnanti, T.L. , Orlin, J. B. , Network Flows: Theory, Algorithms and Applieations [J]. Prentice Hall, Englewood Cliffs, NJ, 1993China National Standardization Management Committee. Specifications of Crane Design (China Standardization Press, China 2008), p. 16-19.

[3] Michael C P. The Supply of Residential Access Streets and Secondary Arterial Roads[J]. Transportation Research Part B: Methodological, 1980, 14(1): 121-132Q. D. Zeng, Q. E. Li: Progress in Civil Engineering, Vol. 32 (2012) No. 9, p. 3077-3080.

[4] W.B. Liu: Research progress and Prospect of urban traffic microcirculation and branch network at home and abroad [J]. Planners Forum, 2009, 6.