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Analysis of Traffic Impact of Yiyang Xiliuwan Bridge Construction on Relevant Areas

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ABSTRACT: This paper aims at the fact that the completion of the construction of Xiliuwan Bridge will have a great impact on the original bridge crossing flow in Yiyang, and the traffic flow of road network in Heshan District and Ziyang District needs to be redistributed. According to the current situation of Yiyang's economic and population development level, the traffic flow and related traffic planning are combined for prediction and analysis. Based on the prediction of the road network after the completion of the construction of Xiliuwan Bridge, the overall improvement countermeasures and measures are proposed, so that the relevant areas of Yiyang can reach the overall optimal mode, ensure traffic safety, achieve orderly and efficient operation.

KEY WORD: Traffic congestion; OD prediction; Saturation; Expected line; Road network improvement; Traffic flow analysis

I. INTRODUCTION

With the improvement of people's quality of life, family cars have entered ordinary households, and the sharp increase of private cars on the roads has brought greater traffic load to the roads, making the comfort of passengers worse. The research, analysis, and planning of traffic network flow have become increasingly important. In the face of traffic congestion, one of the solutions is to build new roads to divert vehicles from congested roads to other roads, so as to reduce traffic pressure on congested road sections. In order to improve the congestion of vehicles passing through the bridge in Zijiang District and meet the needs of economic and social progress in Yiyang, Xiliuwan Bridge is newly built on the Zijiang River. The construction of this bridge has a direct impact on the adjacent Kangfu Road and the distribution of vehicles on the original bridge. Therefore, it is particularly important to conduct simulation analysis on the Xiliuwan Bridge and allocate the traffic flow after the construction of the new bridge in Heshan District and Ziyang District, including Huilongshan Bridge and Longzhou Bridge. There are few research plans for similar projects both domestically and internationally, with a small research scope and no use of professional software such as TransCAD for simulation and prediction. Yao and Liu [1] take the traffic organization during the reconstruction of the Nihong Bridge in Harbin as an example to elaborate the traffic organization plan and traffic management measures. Chen [2] according to the urban traffic development policy and relevant transportation planning, proposed improvement countermeasures and measures to eliminate the adverse traffic impact of the construction project on urban traffic.

II. DESIGN PRINCIPLE

1. Design Ideas

Through the field traffic survey, relevant data on the current situation of traffic flow at the important intersections such as Huilongshan Bridge, Longzhou Bridge, Walmart Intersection, Huatian Intersection in Yiyang City are obtained, and the flow direction diagram is obtained through conversion processing. The model is generated by TransCAD professional software, and the OD prediction of future traffic flow is carried out by this model. The road network after OD prediction is reanalyzed, and the overall opinions are given. The project flowchart is shown in Figure 1.



FIGURE 1. Project process

II. RESEARCH METHOD

This project adopts the four-stage method (OD prediction), which is the classical method of traffic planning for the traffic engineering specialty, and uses TransCAD software to predict the road network flow in the future years and allocate it to the existing road network. The saturation and traffic distribution of the road network in the current situation and the predicted future years are compared and analyzed.

2.1 Research Areas Zoning and Main Roads

This research mainly studies the two districts of Heshan District and Ziyang District in Yiyang City, from Ziyang East Road in the north, to Yingbin East Road in the south, to Jinshan Road in the west, and to Taohualun Road in the east. The main research roads include Walmart intersection, Huatian intersection, Huilongshan Bridge, and Longzhou Bridge. This area is studied by four stage method of traffic engineering. The division of study areas and main roads are shown in Figure 2.

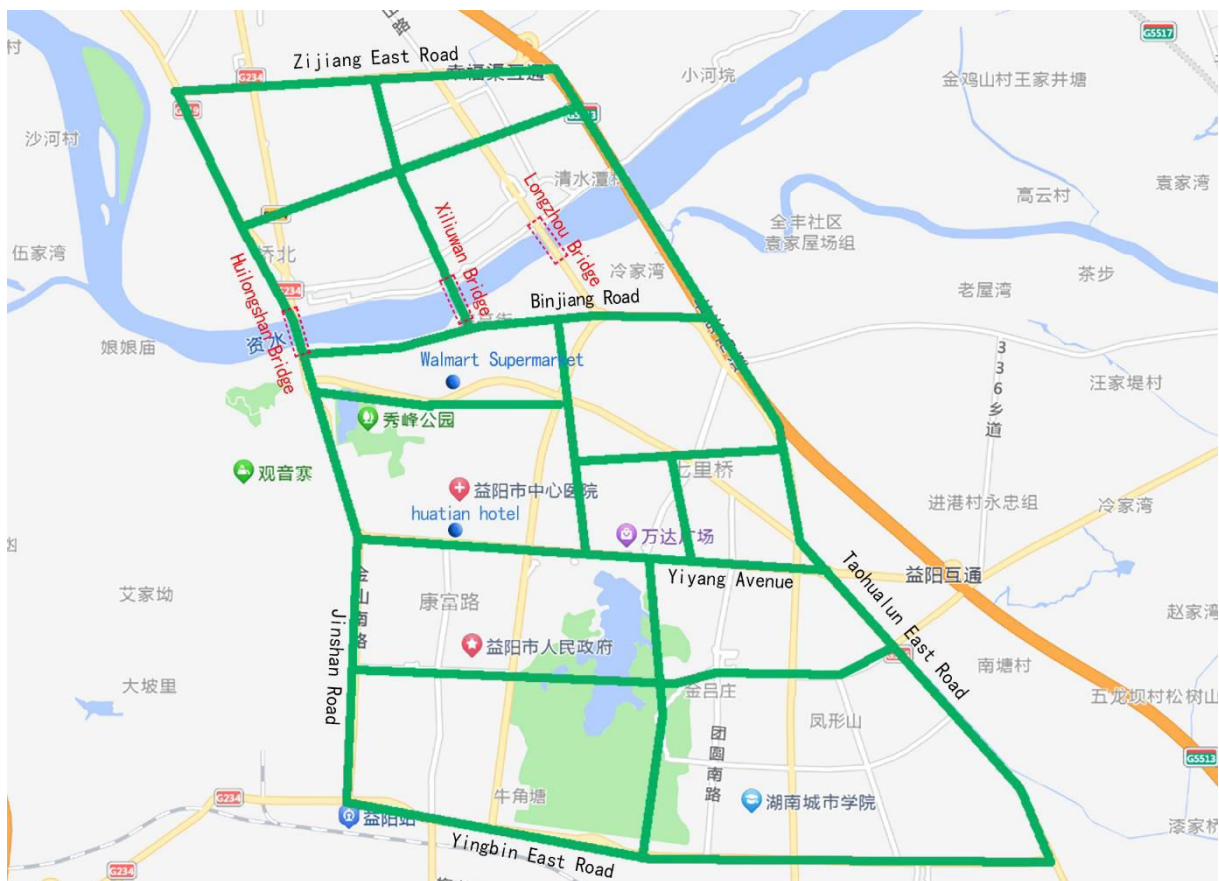


FIGURE 2. Research areas zoning and main roads

2.2 Traffic Flow Direction of Main Links

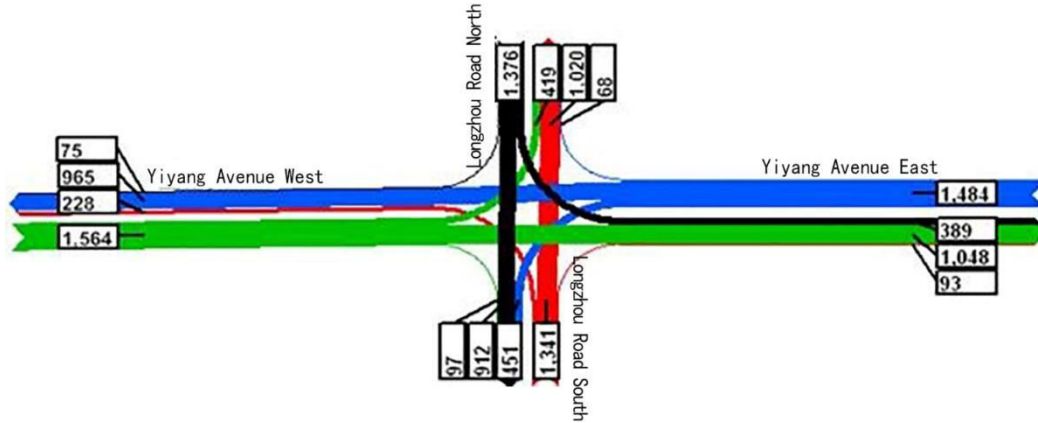


FIGURE 3. Flow direction at the intersection of Yiyang Avenue and Longzhou Road

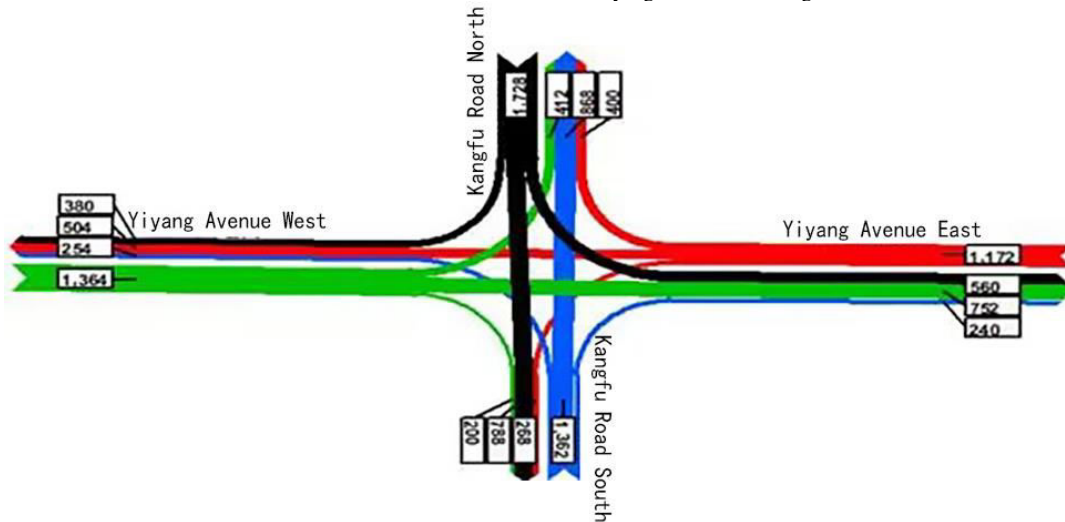


FIGURE 4. Flow direction at the intersection of Yiyang Avenue and Kangfu Road

2.3 TransCAD Model Prediction (Four Stage Method)

1) The OD Matrix of Current and Future

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	923.00	118.00	142.00	95.00	83.00	47.00	71.00	12.00	24.00	36.00	59.00	130.00	107.00
2	188.00	2465.00	169.00	131.00	207.00	94.00	113.00	56.00	19.00	38.00	75.00	150.00	226.00
3	150.00	137.00	1065.00	164.00	123.00	41.00	109.00	27.00	14.00	55.00	96.00	82.00	68.00
4	142.00	106.00	213.00	1384.00	160.00	53.00	177.00	89.00	18.00	124.00	195.00	71.00	35.00
5	84.00	168.00	151.00	134.00	1311.00	185.00	202.00	118.00	17.00	50.00	101.00	34.00	67.00
6	39.00	79.00	66.00	92.00	131.00	1023.00	144.00	157.00	118.00	52.00	105.00	13.00	26.00
7	23.00	46.00	54.00	62.00	92.00	85.00	600.00	77.00	31.00	38.00	69.00	8.00	15.00
8	74.00	98.00	123.00	147.00	221.00	295.00	246.00	1917.00	270.00	172.00	197.00	25.00	49.00
9	97.00	129.00	162.00	194.00	226.00	356.00	323.00	388.00	2522.00	291.00	259.00	32.00	65.00
10	104.00	78.00	182.00	286.00	156.00	130.00	260.00	234.00	208.00	2028.00	312.00	52.00	26.00
11	89.00	67.00	200.00	244.00	177.00	133.00	222.00	155.00	111.00	266.00	1729.00	44.00	22.00
12	173.00	144.00	130.00	115.00	101.00	58.00	87.00	29.00	14.00	43.00	72.00	1125.00	159.00
13	87.00	95.00	78.00	61.00	70.00	43.00	52.00	26.00	9.00	17.00	35.00	104.00	675.00

FIGURE 5. Current OD matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	0.00	184.87	157.99	314.31	120.34	157.92	120.34	120.34	120.34	189.38	120.34	113.76	120.34
2	1.00	0.00	1.00	1.00	1.00	1.00	126.65	115.78	126.65	86.71	121.51	93.36	81.77
3	1.00	283.67	0.00	1.00	1.00	1.00	126.65	115.78	126.65	86.71	121.51	112.23	114.21
4	1.00	150.19	95.96	0.00	95.96	862.76	93.28	120.34	93.28	102.07	120.34	113.76	120.34
5	115.78	79.85	27.48	27.48	0.00	116.62	126.65	115.78	126.65	333.19	121.51	115.69	121.51
6	1313.20	75.20	25.71	1313.20	76.01	0.00	202.23	92.20	202.23	86.71	132.81	112.23	114.21
7	124.37	91.62	55.13	55.13	124.92	97.77	0.00	124.37	124.92	161.77	180.25	123.05	136.99
8	1.00	79.85	27.48	314.31	1.00	333.19	1.00	0.00	1.00	333.19	1.00	110.81	1.00
9	124.14	79.85	27.48	27.48	1.00	75.00	1.00	124.14	0.00	214.29	281.45	122.55	151.55
10	115.78	85.82	32.10	722.26	1.00	1.00	116.79	115.78	116.79	0.00	153.17	122.04	134.98
11	76.75	79.44	34.64	143.83	92.66	83.17	1.00	76.75	1.00	1.00	0.00	110.81	1.00
12	74.60	115.28	77.12	102.45	93.89	109.53	223.10	74.60	223.10	109.53	74.53	0.00	109.53
13	62.44	119.40	58.36	100.57	93.33	1.00	542.41	62.44	542.41	1.00	53.64	110.81	0.00

FIGURE 6. Future OD matrix

2) The Expectation Line of Current and Future

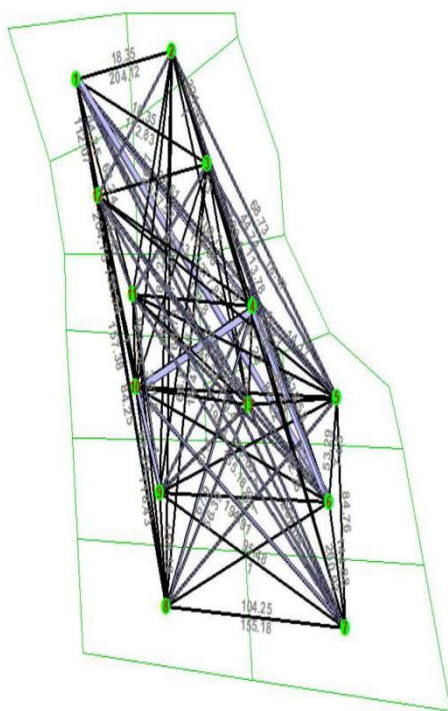


FIGURE 7. Current expectation line

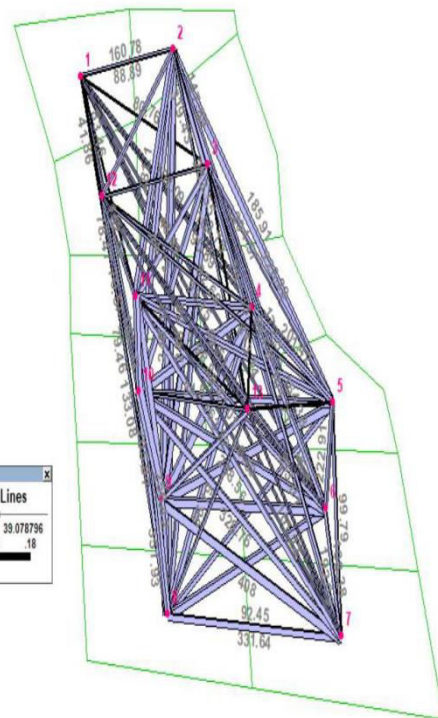


FIGURE 8. Future expectation line

3) The Saturation of Current and Future (v/c)

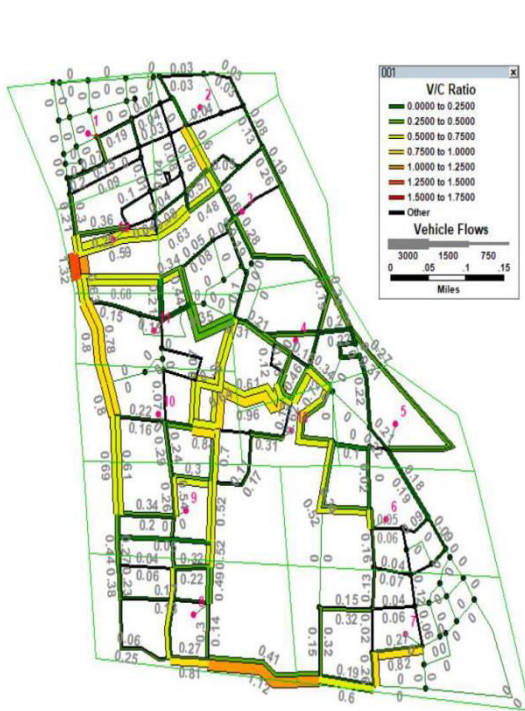


FIGURE 9. Current saturation (v/c)



FIGURE 10. Future saturation (v/c)

According to the comparative analysis of the current and future expectation lines and saturation in Figures 7 to 10, it can be concluded that after the construction of the Xiliuwan Bridge, the saturation of the intersection section adjacent to the Huilongshan Bridge and Longzhou Bridge has decreased. After the new Xiliuwan Bridge is opened to traffic, the saturation can remain below 0.55, and the traffic is relatively smooth. At the same time, the saturation of the east side of Binjiang Road adjacent to the Xiliuwan Bridge has increased. The traffic flow of the Huilongshan Bridge on Binjiang Road was changed to use the Xiliuwan Bridge to cross the river. However, considering all aspects of Heshan and Ziyang districts, overall improvements are needed to maximize the overall traffic capacity of the research area and optimize the service level.

3. Key Technologies and Main Indicators

For the study of road network OD area in Heshan District and Ziyang District, it is necessary to reasonably divide the traffic OD area, accurately analyze and process the survey data, make multiple allocation attempts, extensively consult the relevant basic data, and try to increase the accuracy of predictions. After the construction of the new bridge, the redistributed road network flow is researched, important roads are selected for saturation and delay analysis, so as to ensure smooth road network connectivity between Heshan District and Ziyang District after the bridge is completed, and achieve corresponding service levels for each link.

4. Innovative Characteristics

Using professional software TransCAD to process the data obtained from various social surveys, using OD backstepping to allocate the road network traffic flow, adopting professional software for simulation, improvement analysis, and forming a reasonable road traffic design plan to improve operational efficiency.

III. APPLICATION PROSPECTS AND IMPROVEMENT SUGGESTIONS

After the completion of the construction of Xiliuwan Bridge, the future traffic congestion in the most direct areas affected by Xiliuwan Bridge during the peak period is analyzed and predicted. It is mainly focused on the large traffic flow, the relatively small road capacity, and the location of the link in the center of Yiyang City. It is impossible to

reduce driving delays by improving the road capacity through road surface reconstruction. Therefore, it can be considered through the improvement of urban public transportation, the reasonable allocation of traffic flow across the bridge, and the choice of people's travel mode.

Once the Xiliuwan Bridge is completed and put into use, the saturation on the east side of Binjiang Road adjacent to the Zijiang Fifth Bridge will increase. The original flow of Binjiang Road passing through the Huilongshan Bridge will be changed to cross the river through the Xiliuwan Bridge. For the increase in the flow on the east side of Binjiang Road, ramps can be added to ease traffic.

According to the analysis of traffic survey data, the proportion of buses in the traffic flow is 13%, and bicycles account for 5%. The corresponding overall improvement suggestions are proposed for buses and bicycles, and ultimately establishing a multi-level and multi-type urban comprehensive transportation system with public transportation as the main body and various transportation modes combined.

1) Public Transportation

The low utilization rate of public transportation not only indicates that urban residents have a low willingness to choose public transportation, but also shows that the current urban public transportation services in China have not formed sufficient attractiveness for residents to travel. According to the distribution of traffic flow, the service level of each link can be adjusted to the bus route, enhance the punctuality of buses, increase bus schedules, improve the quality of bus drivers, adjust the location of bus stops to shorten the distance for passengers to cross and transfer, improve the internal environment of buses, and increase the public's utilization rate of the bus.

2) Bicycle

Firstly, strengthen the construction of bicycle transportation infrastructure, constantly improve the bicycle travel environment, build bicycle lanes, and improve bicycle parking facilities. Secondly, accelerate the construction of public bicycle service system to facilitate short distance travel and transfer for citizens. Furthermore, plan and build shared bicycle storage points through the people-oriented concept. Finally, strengthen the promotion of bicycle transportation, so that the concept of green travel is deeply ingrained in the hearts of people.

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