

Research on Traffic Impact Assessment of Project Under Construction Based on TransCAD



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Abstract Traffic impact assessment is to evaluate the potential effects of a particular development on the traffic network in the affected area. It aims to test the interaction degree of various traffic and discuss whether the new contradictions and the negative effect of traffic are brought. This article first determined the basic parameters of the traffic impact assessment. After determining the study area, the traffic flow of each intersection within the scope of the study was counted, and the specific conditions of the roads involved were investigated. On the basis of the data obtained from the survey, TransCAD software was used in the estimation of The OD matrix to predict the background traffic, and then superimposed the traffic volume to obtain the traffic assignment result. Finally, a traffic impact assessment was carried out according to the relevant regulations, and proposed relevant improvement measures for each specific problem.

Keywords Traffic impact assessment · Estimation of OD matrix · Improvement measures

1 Introduction

A traffic impact assessment is an evaluation of the potential impact that a particular development's traffic will have on the road network in its scope of impact [1]. The study of the effect of new development on the current urban traffic is now a significant topic in terms of sustainable development of urban traffic [2]. It was studied in [3, 4] the management and methods of urban road construction on road traffic impacted area.

In terms of traffic impact assessment, after experiencing the climax of urban construction and development from the 1920s to 1970s, the USA has carried out relevant thinking on the construction of transportation facilities. By analyzing the impact of construction projects on the road network and other traffic systems in

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the influenced regions of projects, the USA decided whether to modify its scale, and from the middle of 1980s, it made a more in-depth and extensive study of the traffic impact assessment system [5, 6]. To study the relationship between traffic impact assessment and city construction, Chen et al. [7] summarized the traffic impact assessment project development trend and characteristics by project count and scale, geography position, and project type. In addition, TIA was applied in many fields, such as incident management [8], moving work zone operations [9], etc. Kaparias et al. identified and proposed related models and metrics linking traffic characteristics with traffic safety effect [10].

With this background of the research, this paper carries out research on TIA of project under construction with TransCAD software, then the capacity and level of service of each road are analyzed in detail. Finally, some useful measures are proposed.

2 The Determination of Parameter

In this paper, the Yujingwan District in Shenyang, China, is regarded as the object, which is located in the west of Hunnan District, the Olympic Sports Center to the east, museums to the south, Changbai Island to the west, and Hun River to the north. There are more than ten bus lines. Youth Avenue, Shenying Street, Hunnan West Road, Danfu Expressway, Metro Line 2, and bus lines run through the city, and Metro Line 9 is under construction. There are 21 intersections around the project, 22 open parking lots, 2 main roads, 2 secondary roads, and 10 branches, totals 14 roads.¹ The traffic is complex. Therefore, it is very reasonable to select this communities as the research object.

According to *Technical Standards for Traffic Impact Assessment of Construction Projects*, the influenced scope of assessment was set to 100,000 m², which is the area enclosed by Nandi West Road, Sanyi Street, Shenying Street, Hunnan West Road and Jinyang Street, while the third year after the completion of the project, and morning rush hour of the working day were set as the evaluation period of the project.

3 Traffic Survey and Data Processing

The survey involved 21 intersections and 14 roads. Intersections include Sanyi Street-Nandi West Road, Caixia Street-Linbo Road, Qixia Street-Linbo Road, Jiahe Street-Linbo Road, Qixia Street-Hunnan West Road, Linbo Road Lane 2-Linbo Road, and Linbo Road Lane 2-Mingbo Road, etc., while roads include Nandi West Road,

¹The transport data for this research work was obtained from the actual intersection of Qixia Road, Yujingwan District, Shenyang, China.

Table 1 Capacity of a single lane

Type of the road	The capacity of a single lane
Main road	1350
Secondary road	1300
Branch	1250

Xiandao South Road, Changbai South Road, Hunnan West Road, Jinyang Street, and Qixia Street, etc.

The bidirectional capacities of the roads are shown in Table 1.

The bidirectional capacity is equal to the capacity of a single lane multiplied by the number of the lanes. The capacity of the roads is shown in Table 2.

Table 2 Capacity of road

No.	Road name	Number of lanes	Road nature	Bidirectional capacity (pcu/h)
1	Nandi West Road	Bidirectional four lanes	Secondary road	5200
2	Xiandao South Road	Bidirectional four lanes	Branch	5000
3	Changbai South Road	Bidirectional four lanes	Branch	5000
4	Hunnan West Road	Bidirectional ten lanes	Main road	13,500
5	Jinyang Street	Bidirectional eight lanes	Secondary road	10,400
6	Linbo Road	Bidirectional four lanes	Branch	5000
7	Qixia Street	Bidirectional six lanes	Branch	7500
8	Jiahe Street	Bidirectional four lanes	Branch	5000
9	Caixia Street	Bidirectional six lanes	Branch	7500
10	Mingbo Road	Bidirectional two lanes	Branch	2500
11	Linbo Road 2	One-way street	Branch	1250
12	Sanyi Street	Bidirectional four lanes	Branch	5000
13	Shenyang Street	Bidirectional six lanes	Main road	8100
14	Youth Avenue Branch	Bidirectional six lanes	Branch	7500

4 Traffic Demand Forecast Based on TransCAD

4.1 Background Traffic Forecast

The Estimation of OD Matrix

With the help of TransCAD software, the data obtained is divided into each specific road section. And then, a new basic matrix is built with a value of 1, and the interior of the communities is 0. Therefore, the estimation result of the OD matrix is obtained through the traffic assignment method and user equilibrium (see Fig. 1).

According to the estimation result of the OD matrix obtained in Fig. 1, the traffic flow, traffic saturation, and the level of service of each road are obtained by traffic assignment for the traffic area and the estimation result of the OD matrix (see Table 3).

Taking Hunnan West Road as an example, one-way traffic capacity is equal to half of the bidirectional capacity, while maximum in one-way section is equal to the maximum flow of one-way section divided by one-way traffic capacity, and the level of service is calculated by *Technical Standards for Traffic Impact Assessment of Construction Projects*.

From the above table, we can see that the saturation of each road section in the scope of the assessment is uneven, and the level of service is different, which are four degrees of A, B, C, and F. The two roads with a lower level of service are Shenyang Street and Sanyi Street, which are connected to Youth Avenue and close to the Olympic Center with large traffic volume. Therefore, there are many traffic problems with a low level of service. While the main reason for the other roads with a high level is that wide road, and less traffic demand of the surrounding traffic districts. Thus, the function of districts has not been fully developed and utilized, this causes the traffic produced and attracted small, and the level of service is high.

Background Traffic and Traffic Attraction Forecast

In the scope of the study, the utilization of each construction projects should be investigated, which are occupancy of residential projects, utilization of commercial and official projects, and then the situation of the target year can be predicted based on

	1	2	3	4	5	6	7	8	9	11	12	13	14	15	16	17	18	19	20	21	22	23
1	0.00	139.16	65.62	136.00	17.46	3.12	0.00	40.04	43.26	146.34	89.88	134.24	21.73	29.07	19.66	23.33	19.87	21.47	38.62	21.42	27.20	45.46
2	139.16	0.00	25.58	95.82	6.70	0.94	0.00	21.98	32.71	132.82	70.41	122.58	16.21	23.18	12.68	16.72	13.90	16.03	29.20	12.45	21.56	37.82
3	65.62	25.58	0.00	46.18	10.15	0.16	0.00	21.88	37.65	363.77	21.26	39.81	14.96	22.86	10.50	15.33	12.22	14.79	30.23	9.54	21.82	40.52
4	136.60	95.82	46.18	0.00	1.07	2.54	0.00	89.90	95.04	121.00	61.28	133.43	45.57	61.16	55.53	56.98	45.85	43.97	93.78	91.99	95.88	87.90
5	17.46	6.70	10.15	1.07	0.00	1.90	0.00	14.59	22.41	34.49	11.77	26.49	22.91	31.19	20.37	24.38	20.72	22.41	26.50	22.02	29.09	37.47
6	3.12	0.94	0.16	2.54	1.90	0.00	0.00	1.14	2.30	6.18	3.62	6.00	4.31	6.57	2.34	3.76	3.21	4.34	5.08	1.52	6.21	9.09
7	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
8	40.04	21.98	21.88	89.90	14.59	1.14	0.00	0.00	107.76	35.96	21.69	53.54	14.20	24.42	7.56	14.09	10.44	13.90	99.35	4.53	21.99	87.06
9	43.26	32.71	37.65	95.04	22.41	2.30	0.00	107.76	0.00	22.14	59.58	104.14	42.68	73.18	83.30	72.38	42.00	39.90	91.87	33.57	62.17	81.40
11	146.34	132.82	363.77	121.00	34.49	6.18	0.00	36.96	22.14	0.00	39.61	60.05	18.05	30.62	33.68	39.31	13.93	17.51	4.96	27.18	27.41	16.90
12	89.88	70.41	21.26	61.28	11.77	3.62	0.00	21.69	59.58	39.61	0.00	1217.34	39.45	61.19	58.86	54.77	38.39	37.80	57.27	221.78	53.94	58.80
13	134.24	122.58	39.81	133.43	26.49	6.00	0.00	53.54	104.14	60.05	1217.34	0.00	65.22	88.77	113.19	96.59	72.12	62.03	89.74	447.56	79.18	86.02
14	21.73	16.21	14.96	45.57	22.91	4.31	0.00	14.20	42.68	18.05	39.65	65.22	0.00	747.63	31.18	39.29	44.45	39.69	97.28	24.20	258.56	943.31
15	29.07	23.18	22.86	61.16	31.19	6.57	0.00	24.42	73.18	30.62	61.19	88.77	747.63	0.00	70.31	67.98	143.44	83.66	168.80	45.67	422.87	800.53
16	19.66	12.68	10.50	55.53	20.37	2.34	0.00	7.56	63.30	33.68	58.86	113.19	31.18	70.31	0.00	63.68	22.59	28.56	64.01	15.97	56.55	56.35
17	23.33	16.72	15.33	56.98	24.38	3.76	0.00	14.09	72.38	39.31	54.77	96.59	39.29	67.98	63.68	0.00	37.32	36.97	64.26	30.05	57.93	64.77
18	19.87	13.90	12.22	45.85	20.72	3.21	0.00	10.44	42.00	13.93	38.38	72.12	44.45	143.44	22.59	37.32	0.00	36.33	236.68	18.39	98.06	135.56
19	21.47	16.03	14.79	43.97	22.41	4.34	0.00	13.90	39.90	17.51	37.80	62.03	39.69	83.66	29.56	36.97	36.33	0.00	84.13	22.96	67.01	78.80
20	38.62	29.20	30.23	93.78	28.50	5.08	0.00	99.35	91.87	4.96	57.27	89.74	97.28	168.80	64.01	64.26	236.68	84.13	0.00	38.39	130.13	78.23
21	21.42	21.42	9.54	91.99	22.02	1.62	0.00	4.53	33.57	27.18	221.78	447.56	24.20	45.67	15.07	30.05	18.39	22.96	38.39	0.00	39.28	43.48
22	27.20	21.56	21.02	55.88	29.09	6.21	0.00	21.99	62.17	27.41	53.94	79.18	298.56	422.87	56.55	57.93	98.06	67.01	130.13	39.28	0.00	427.80
23	45.46	37.82	40.52	87.90	37.47	9.09	0.00	87.06	81.40	16.90	58.80	86.02	943.31	800.53	66.35	64.77	135.56	78.80	78.23	43.48	427.80	0.00

Fig. 1 Estimation result of OD matrix

Table 3 Traffic flow and the level of service

No	Road name	One-way traffic capacity (pcu/h)	Maximum flow of one-way section (pcu/h) ^a	Maximum in one-way section V/C	The level of service
1	Hunnan West Road	6750	3105	0.46	B
2	Shenyang Street	4050	2714	0.67	C
3	Nandi West Road	2600	1300	0.5	B
4	Jinyang Street	5200	1768	0.34	A
5	Qixia Street	3750	712	0.19	A
6	Caixia Street	3750	1125	0.3	A
7	Jiahe Street	2500	875	0.35	A
8	Changbai South Road	2500	958	0.38	A
9	Linbo Road	2500	700	0.28	A
10	Mingbo Road	1250	423	0.34	A
11	Sanyi Street	2500	2932	1.17	F
12	Xiandao South Road	2500	400	0.16	A
13	Linbo Road 2	625	149	0.24	A
14	Youth Avenue Branch	7500	2181	0.29	A

Letter “a” represents each or one

above results to obtain the traffic production and attraction; while in the surrounding scope of the study area, virtual traffic districts should be investigated according to its economic growth, and then traffic production and attraction of each district in the target year can be determined according to the growth.² The results are shown in Table 4.

4.2 Traffic Volume of Superimposed Projects

Based on the original the OD matrix, the OD matrix obtained by the gravity model method is used to superimpose it, and then the superimposed OD matrix obtained by traffic distribution is used to traffic assignment for the road network. Thus, a diagram of the desire line is drawn (see Figs. 2 and 3; Table 5).

It can be seen in Table 4 that after superimposing the traffic volume within the scope of the assessment, the saturation of each road section is uneven, and the level

²The data in Table 4 was calculated by the simulation software-TransCAD.

Table 4 Forecast results of background traffic demand

Communities number	Status quo		Target year		Prediction criteria	Assignment ID
	Production pcu/h	Attraction pcu/h	Production pcu/h	Attraction pcu/h		
1	1150	1151	1533	1535	Occupancy rate 75%	3
2	908	910	1816	1820	Occupancy rate 50%	20
3	824	825	1177	1179	occupancy rate 70%	8
4	1421	1423	1776	1779	Occupancy rate 80%	2
5	406	407	1015	1018	Utilization rate 40%	11
6	75	76	750	760	Occupancy rate 10%	1
7	21	35	210	350	Utilization rate 10%	21
8	706	707	1176	1178	Occupancy rate 60%	4
9	1155	1156	1283	1284	Occupancy rate 90%	23
10	1192	1193	1703	1704	Occupancy rate 70%	5
11	2271	2272	2672	2673	Occupancy rate 85%	6
12	3099	3100	4714	4715	Average annual growth 15%	13
13	2531	2532	3849	3851	Average annual growth 15%	18
14	3003	3004	4567	4569	Average annual growth 15%	14
15	829	830	1842	1844	Occupancy rate 45%	19
16	880	881	2200	2203	Occupancy rate 40%	17
17	1065	1067	1521	1524	Occupancy rate 70%	15
18	772	773	1930	1932	Occupancy rate 40%	16

(continued)

Table 4 (continued)

Communities number	Status quo		Target year		Prediction criteria	Assignment ID
	Production pcu/h	Attraction pcu/h	Production pcu/h	Attraction pcu/h		
19	1531	1532	2041	2043	Occupancy rate 75%	24
20	1171	1172	1464	1465	Occupancy rate 80%	22
21	1964	1965	2311	2312	Occupancy rate 85%	25
22	3227	3228	4908	4909	Average annual growth 15%	12

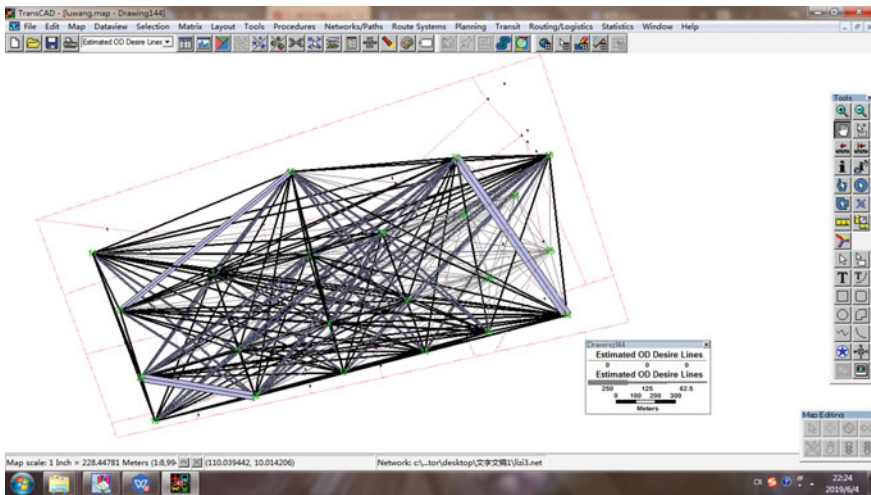


Fig. 2 Diagram of travel desire line after superposition

of service is different, which are five degrees of A, B, C, D, and F, but the overall level of service is high, and there are more A-levels. Except for Nandi West Road and Sanyi Street, the levels of service of other roads are relatively high. Hunnan West Road, Sanyi Street, and Nandi West Road are adjacent to Youth Avenue with large traffic volume. Hence, the road saturation is high, and the burden is heavy, especially Sanyi Street. Qixia Street is located in the center of the scope of the study, and the project newly built is besides, most of the newly produced traffic will be loaded on this road, thus the level of service is low. Of course, its assignment results may not be consistent with the truth. Firstly, the traffic flow of the roads is obtained by artificial observation and statistical analysis; hence, there are some errors. The second is that in the process of analysis with TransCAD, the centroid of traffic districts may not

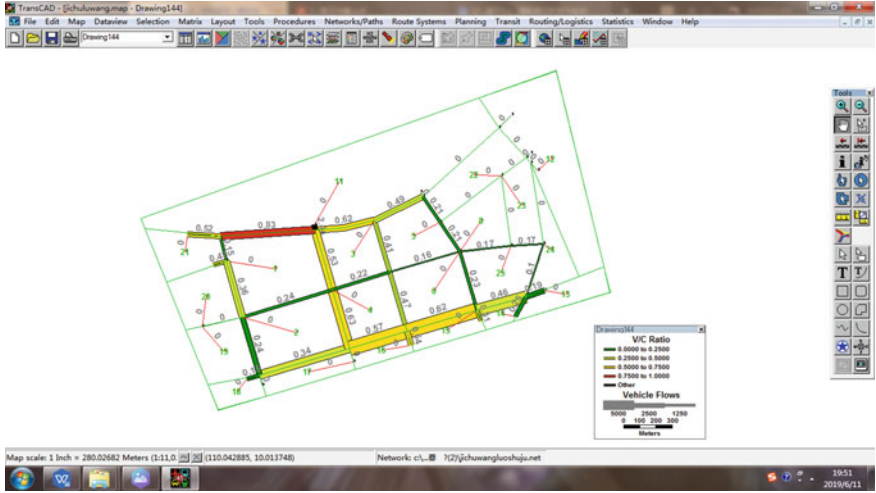


Fig. 3 Diagram of traffic assignment results

Table 5 Results of superimposed traffic assignment in target year

Serial number	Road name	One-way traffic capacity (pcu/h)	Maximum flow of one-way road section(pcu/h)	Maximum in one-way section V/C	The level of service
1	Hunnan West Road	6750	4185	0.62	C
2	Shenyng Street	4050	1013	0.25	A
3	Nandi West Road	2600	2158	0.83	D
4	Jinyang Street	5200	1872	0.36	A
5	Qixia Street	3750	2363	0.63	C
6	Caixia Street	3750	863	0.23	A
7	Jiahe Street	2500	1175	0.47	B
8	Changbai South Road	2500	950	0.38	A
9	Linbo Road	2500	600	0.24	A
10	Mingbo Road	1250	425	0.34	A
11	Sanyi Street	2500	2925	1.17	F
12	Xiandao South Road	2500	1000	0.4	A
13	Linbo Road 2	625	150	0.24	A
14	Youth Avenue Branch	7500	2175	0.29	A

be the origin and destination of transportation, and the traffic demand produced by traffic districts directly reaches the intersection, which is inconsistent with the truth, therefore, there are errors.

5 Traffic Impact Assessment and Improvement Measures

5.1 Assessment Results

Based on the above traffic impact assessment, the following results are obtained:

- (1) The construction of the project has increased the load on the surrounding traffic network, and the level of service of all roads has changed to a certain extent. Except for Qixia Street, the impact of each road is less than the maximum allowable impact, but all are at the lowest acceptable degree, and some roads have even improved. The project under construction has no significant impact on the traffic of the surrounding roads; therefore, it is acceptable.
- (2) The construction of the project has declined the level of service of the surrounding intersections to a certain extent, but it is still higher than the minimum acceptable level of service. The project under construction has no significant impact on the surrounding intersections; therefore, it is acceptable.
- (3) The scheme of project construction has planned an entrance and exit in the east, west, south, and north four directions. Therefore, traffic and pedestrians can pass in a safe and orderly manner, and the entrances and exits are not set on the main roads of the city; therefore, it has a little direct impact on it.
- (4) According to the mass traffic impact assessment, after the project is finished and put into use, the new public traffic demand is less than its remaining capacity, and public traffic system can satisfy its demand. Thus, there is no significant impact and it can be accepted.
- (5) According to the static traffic impact assessment, parking facilities for the project cannot satisfy the parking demand of the project itself. Therefore, the project under construction has a significant impact on the surrounding static traffic system, and it is unacceptable.

From the above assessment results, it can be known that there is no significant impact on the traffic system within the scope of assessment due to the finished project, and relevant improvement measures should be proposed.

5.2 Improvements

According to the relevant requirements, if the new project has a significant impact on the surrounding traffic system, it is necessary to propose corresponding improvement

measures. Improvement measures should be improved from two aspects of the project itself and the surrounding traffic system.

- (1) For roads, channelization should be implemented to regulate the traffic to improve the traffic capacity. Overpasses can also be built on roads where the traffic volume is close to saturation to reduce traffic delays caused by pedestrians crossing the road and improve traffic capacity of the road.
- (2) For intersections, it is possible to optimize the traffic light timing, to increase the green time of the road with heavy traffic, and improve the level of service of intersections.
- (3) For the entrance and exit of the project, it is recommended that the properties should implement traffic control of right-in and right-out at the entrance and exit of the project in peak hours to reduce the impact of its traffic volume on adjacent roads, thus the traffic of the communities can be integrated into the traffic of the road more quickly and reduce delays.
- (4) For public transport, the departure frequency should be adjusted in peak hours to satisfy travel demand.
- (5) For parking facilities, parking areas should be divided, and ground parking facilities should be added.

6 Conclusion

This paper carries out research on traffic impact assessment of the project under construction with TransCAD and analyzes the traffic impact of the project under construction. Firstly, parameters of traffic impact assessment, which are start threshold, the scope of influence, and the evaluation period were determined. Then, the estimation of the OD matrix was carried out with TransCAD software, and the forecast results of traffic demand in target year without project were obtained. Based on this, the new traffic demand of the new project was predicted and loaded it into the district, and the gravity model was used for traffic distribution of production and attraction, and the user equilibrium model was used to traffic distribution. Finally, traffic assessment results were obtained by a traffic impact assessment. The results show that the completion of the project has no significant impact on the transportation system within the evaluation fields.

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