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Highway freight terminal facilities allocation based on flexsim

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Abstract

For different technical levels of highway freight terminal, you need to allocate the appropriate facilities (such as parking lots, warehouses, loading and unloading areas, roads) to complete the various operations of vehicle and goods in the stations. According to the demand of the facilities' ratio in the current revision of "classification and construction requirement of highway freight terminal", the paper uses the flexsim computer simulation technology combined with AutoCAD and 3dsMax design software to simulate the highway freight terminal. A simulation result is given of the area ratio of the different technical levels of highway freight terminal.

Flexsim software is a typical integration between virtual reality technology and discrete object-oriented simulation. In order to make the software more suitable for the simulation model of highway freight terminal, this paper comprehensively analysis the mapping relationship of the road freight station facilities and various objects in the flexsim software. By using external drawing software to create 3D models imported into flexsim simulation software, and create highway freight terminal user object libraries in flexsim, such as: truck. This will enable more realistic simulation models of highway freight terminals. In this paper, on the basis of a comprehensive analysis of the simulation characteristics of the highway freight terminal and flexsim simulation methods, a typical road freight station is used for an example to establish the simulation models and give a simulation result of the area ratio of the different technical levels of highway freight terminal. Effective technical means to scientific decision-making for the road freight station planning and construction program are provided.

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1. Introduction

Now at our country the size of the Highway Network is developed rapidly and accordingly the highway freight terminal is increasing dramatically, but the current criteria for the classification of the station level within the industry can not meet demands. Therefore, there is a need to develop"classification and construction requirement of highway freight terminal" industry standards in order to achieve rational use and optimize the allocation of resources. For instance, Eiichi T, Michihiko N and Tadashi Y[1] studied the optimal size and location planning of public logistics terminals, Teodor, GabrielCrainica and GilbertLaporte[11]analyzed the planning models for freight transportation. The industry standard was ratio of the facilities area on different technical levels of highway freight terminal. Now the study of ratio of area, most papers adopt a flexible coefficients, regression analysis or other methods to determine, such as Ji Jian-feng, Hou Guo-xiang , Zou Zhi-yun[3]. But he calculation is cumbersome, there is a certain degree of error in the forecast of total freight of the whole society in the planning target year with the quantitative methods.

With the development of computer simulation technology, object-oriented discrete virtual reality simulation technology has been at the forward position of the computer simulation technology research, and computer simulation technology has less investment, risk-free, convenient and flexible, short operation cycle, quick and other advantages. Therefore it has been widely used in industrial production, transportation, military and other fields, and achieved significant result. Although the use of computer simulation of highway freight terminal can greatly improve the efficiency of the planning, within the simulation software entity object insufficiency to the highway freight terminal facilities and other reasons, the application of simulation technology in the planning of highway freight terminal has not made much progress.

Flexsim software is a typical integration between virtual reality technology and discrete object-oriented simulation. Hu Da-wei, Xi Jian-guo[6]used flexsim simulation development platform and object-oriented discrete virtual reality simulation technology simulating the planning and construction of highway bus terminal program dynamically. At present, the flexsim simulation is mainly used in the field of logistics, warehouse optimization and design, Berth assignment and optimization of production lines, and the use of flexsim in hub is basically a blank[5, 12]. Fang Sheng[7]used flexsim simulation technology to build highway freight terminal simulation models, analyze the model and identify the system bottlenecks, ultimately optimize the the highway freight terminal simulation mode. Nowadays, the applications of virtual reality technology and object-oriented simulation technology in designing and analysis of road freight station layout and facilities operation arrangements are not widely. Therefore, there is a need to explore the use of computer simulation to study the feasibility and effectiveness of highway freight terminal facilities' area ratio. In this paper, on the base of a comprehensive analysis of the simulation characteristics of the highway freight terminal and Flexsim simulation methods, as typical highway freight terminal for example to establish the simulation models and give a simulation result of the area ratio of the different technical levels of highway freight terminal. Effective technical means to scientific decision-making for the highway freight terminal planning and construction program are provided.

The paper is structured as follows:a current revision of "classification and construction requirement of highway freight terminal" industry standards is presented in section2. In section3 we illustrate the flexsim simulation software, followed in section4 by a detailed description of the basic information of road freight station simulation and the entity mapping of highway freight terminal facilities in flexsim. Section5 presents the highway freight terminal facilities simulation. Finally, in section 6, we analysis the simulation results and conclude the paper along with some suggestions for future work.

2. Industry standards for highway freight station

Highway freight transportation is one of the main ways of modern transportation, and also constitutes one of the two basic modes of transportation in the land transport of goods. It occupies an important position in the

whole field of transportation and is playing an increasingly important role, especially since the reform and opening up, china's national economy has developed rapidly, road infrastructure construction is developing with each passing day. Along with the improvement of the technical level of the road network, the continuous progress of the automobile industry, highway freight transportation has dramatically increased in both the absolute level of traffic and the proportion of the goods transport in the whole society .

China has 2585 highway freight terminal to the end of 2007 among which there are 202 first-class terminals, 274 secondary terminals, 897 third-class terminals and 1212 fourth-class terminals, freight terminal has 38. 88 million tons of average daily cargo throughput (see table1). Except the number of secondary terminals reduced a little compared with 2006, the others has a different degree of increase. In recent years, the total number of freight terminal is increasing, and year by year so is the throughput capacity of the freight terminal.

Table 1. The situation of freight terminal from 2002 to 2007 as follows:

	list of the freight terminal in2002-2007					
	Freight terminal classes					daily cargo throughput
	Total	first-class	second-class	third-class	fourth-class	million tonnes
2002	1562	173	252	483	654	204. 66
2003	1654	98	264	524	768	209. 23
2004	1802	102	285	509	906	362. 09
2005	1840	137	332	478	893	513. 03
2006	2132	186	343	552	1051	871. 648
2007	2585	202	274	897	1212	3888

About the level industry standard of highway freight terminal, according to the current revision of "classification and construction requirement of highway freight terminal", highway freight terminal can be classified into four types as follows:

● Type1:Integrated service-oriented highway freight terminal;

First-class:6 million tons or over annual handling capacity, registered capital of more than 40 million yuan or covers an area of 600 acres or more.

Second-class:3~6 million tonnes annual handling capacity, registered capital of 10~40 million yuan or covers an area of 300~600 acres.

Third-class:1. 5~3 million tonnes annual handling capacity, registered capital of 2. 5~10 million yuan or covers an area of 150~300 acres.

● Type2:Transportation highway freight terminal;

First-class:4 million tons or over annual handling capacity, registered capital of more than 30 million yuan or covers an area of 400 acres or more.

Second-class:2~4 million tonnes annual handling capacity, registered capital of 10~30 million yuan or covers an area of 200~400 acres.

Third-class:1~2million tonnes annual handling capacity, registered capital of 2~10 million yuan or covers an area of 100~200 acres.

- Type3:Warehousing highway freight terminal;

   First-class: 200 thousand m^2 or over handling capacity, registered capital of more than 20 million yuan or covers an area of 500 acres or more.

   Second-class:100~200 thousand m^2 annual handling capacity, registered capital of 5~20 million yuan or covers an area of 300~500acres.

   Third-class:30~100 thousand m^2 annual handling capacity, registered capital of 1~5 million yuan or covers an area of 100~300 acres.

- Type4:Information service highway freight terminal.

   First-class:500 times or over average daily trading volume, registered capital of more than3 million yuan or covers an area of 200 acres or more.

   Second-class:300~500 times average daily trading volume, registered capital of 1~3million yuan or covers an area of 100~200 acres .

   Third-class:100~300 times average daily trading volume, registered capital of 0. 5~1million yuan or covers an area of 50~200 acres.

   According to the above-mentioned four types, the industry standard presented the recommended proportion of highway freight terminal facilities configuration(see table2). In addition, the highway freight terminal Normative Appendix is also presented, including the area calculation of the main parts of freight station and the number of facilities and equipment(see Appendix A and Appendix B).

Table 2. The recommended proportion of highway freight terminal facilities configuration as follows:

Highway freight terminal		Facility Names			
		Office facilities	Production facilities		Living facilities
			Warehouse facilities and Information trading center	Parki and road facilities	
Integrated service-oriented	First-class	≤7%	≥45%	≥40%	≤8%
	Second-class	≤8%	≥40%	≥45%	≤7%
	Third-class	≤9%	≥35%	≥50%	≤6%
Transportation	First-class	≤3%	≥40%	≥50%	≤7%
	Second-class	≤4%	≥35%	≥55%	≤6%
	Third-class	≤5%	≥30%	≥60%	≤5%
Warehousing	First-class	≤3%	≥50%	≥40%	≤7%
	Second-class	≤4%	≥45%	≥45%	≤6%
	Third-class	≤5%	≥40%	≥50%	≤5%
Information service	First-class	≤3%	≥50%	≥40%	≤7%
	Second-class	≤4%	≥45%	≥45%	≤6%
	Third-class	≤5%	≥40%	≥50%	≤5%

3. The flexsim simulation software

   Flexsim is a universal discrete event simulation software and is used to model and simulate different systems of several different industries. According to a rough estimate, in the magazine "Fortune" top 500 companies, half are flexsim customers which including some well-known enterprises like Daimler Chrysler, Northrop

Grununan, Diseover Card, DHL, Bechtel, Bose, etc. . Besides flexsim, specifically for the manufacturing, logistics and other fields, set computer three-dimensional image processing technology, simulation technology, artificial intelligence technology, data processing technology as a whole. what's more, the flexsim have a model warehouse with almost all existing physical object, such as the processors, the operators, conveyor belts, forklifts, traffic lights, tanks, shelves, automatic stacking machine, etc. , data information can also be easily expressed by flexsim model library. In addition, flexsim provides the original data fitting, modeling entry, graphical model construction, simulation experiments by run the model, optimizing the results, generating 3D animation video files, etc. , and also provides the interface with other software tools such as C++IDE. The structure of flexsim software and its constituted modules shows that flexsim provides the interface of the simulation model with ExperFit and Microsoft excel, so the user can distribution fit the input data by ExperFit and also can easily achieve the data exchange with the model simulation in Microsoft excel, including output and dynamically modified operating parameters by running the model.

4. Association analysis of the highway freight terminal and flexsim

In this section we present the basic information of highway freight terminal layout(see Fig1.) and the scale parameters of highway freight terminal. Besides the entity mapping of highway freight terminal facilities in flexsim are also been presented(see table3).

4. 1. The basic information of highway freight terminal simulation

The industry standard of "classification and construction requirement of highway freight terminal"applies to all highway freight terminals, therefor this paper take typical road freight stations as an example. As we know, highway freight terminal process equipment includes warehousing transport vehicles, forklifts, laneway machine and tray etc.

According to the production process, venue shape characteristics, surrounding conditions and freight terminal management mode, the general layout of the freight terminal divide the station into several areas for facilitating management and production, and then arrange the buildings, structures and other facilities to meet the flow of goods, traffic and pedestrian flow shortly and smoothly without disturbing each other in each region according to production technical process.

The main function of road freight terminal includes transportation, storage, handling, packaging, and circulation processing and information services. The building facilities of typical road freight terminal in this paper are: repositories, loading and unloading areas, park, station house and living service areas. According to table2, this paper selects warehousing third-class highway freight terminal in which annual handling capacity are37 thousand m^2 or covers an area of 120 acres. By the formula: 1 mu = 666. 6 square meters known: 120 acres = 80, 000 square meters. So we can calculate:

    a. Warehousing basement area: S1 = 26800 (m^2).
    b. Loading and unloading areas: S2 = 18400 (m^2).
    c. Park area: S3 = 8200 (m^2).
    d. Station house area: S4 = 1600 (m^2).
    e. Living service area: S5 = 1600 (m^2).

According to these above-mentioned parameters and the recommended proportion of highway freight terminal facilities configuration(see table2), the general layout of freight terminal illustrated in Fig1.
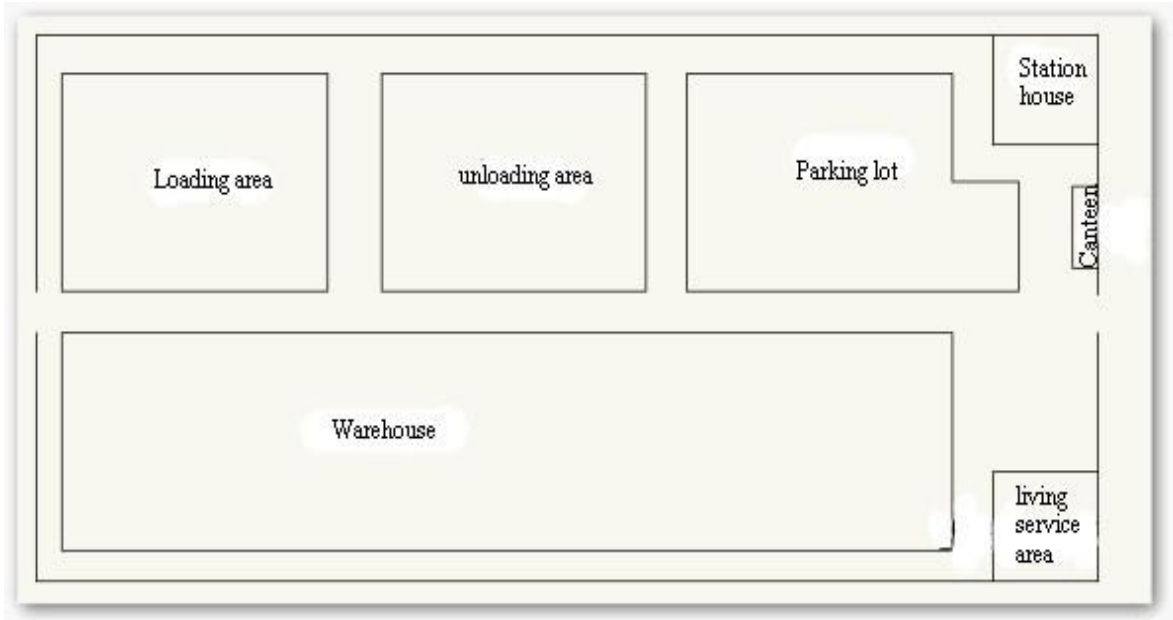

Fig. 1. highway freight terminal layout

4. 2. The entity mapping of road freight station facilities

To establish the entity mapping of highway freight terminal facilities in flexsim, you must know about the flexsim objects' function, as well as the role it play in the highway freight terminal. For example: the processor entity, which simulates some processing need or delay delays. It can represent a machine in the factory, a doctor services for patients. Based on the flexsim objects' function, the entity mapping of highway freight terminal facilities in flexsim as follow:

  a. Vehicle inbound area corresponded with temporary storage area.
  b. Cargo unloading area corresponded with decomposer.
  c. Cargo arrival area corresponded with temporary storage area.
  d. Cargo storage area corresponded with shelf.
  e. Cargo loading area corresponded with synthesizer.
  f. Parking promoter area corresponded with processor

5. The highway freight terminal facilities simulation

In this section we illustrate the highway freight terminal facilities simulation by briefly describing the simulation model of highway freight terminal and using simulation steps of flexsim software to complete the simulation of highway freight terminal.

5. 1. The establishment of the simulation model

In order to establishing the simulation model of highway freight terminal, firstly we should establish the appropriate proportional layout of highway freight terminal based on the reality of the highway freight terminal layout. Mapping highway freight terminal layout in Fig2. to flexsim forming of a proportional layout of highway freight terminal layout program, as illustrated in Fig2. Then, in accordance with the designed highway freight terminal facilities layout planning, sequentially place the flexsim object entity corresponding to each facility in the corresponding position of the proportional layout, to establish the highway freight terminal object layout, as showed in Fig3.
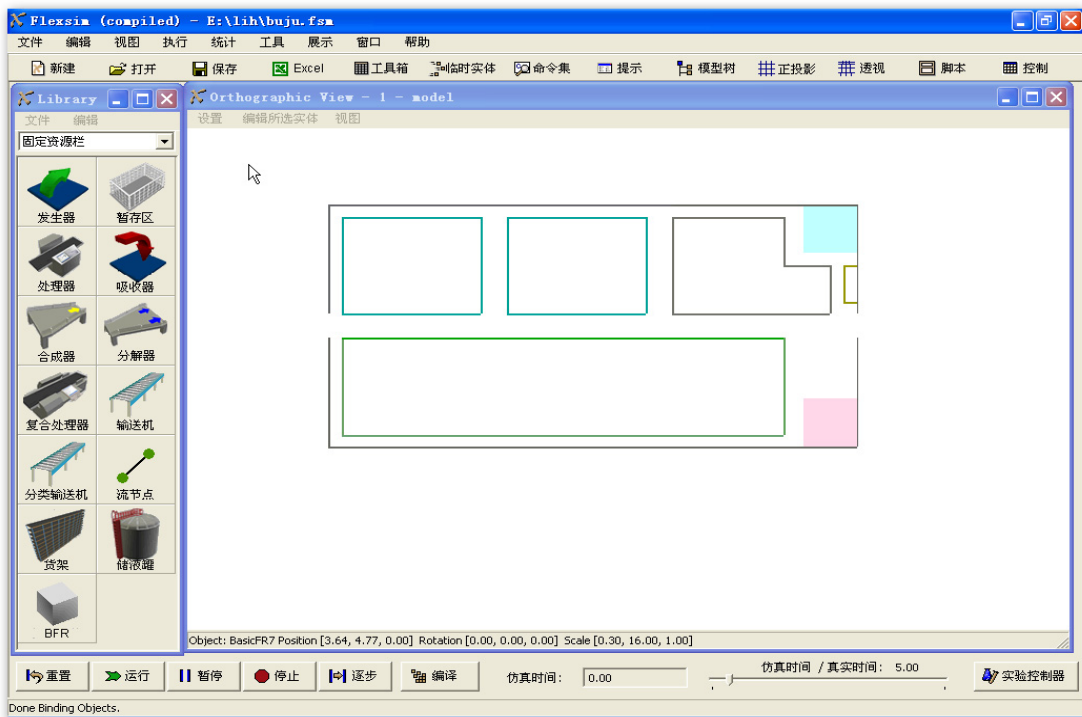

Fig. 2. proportional layout of highway freight terminal layout program
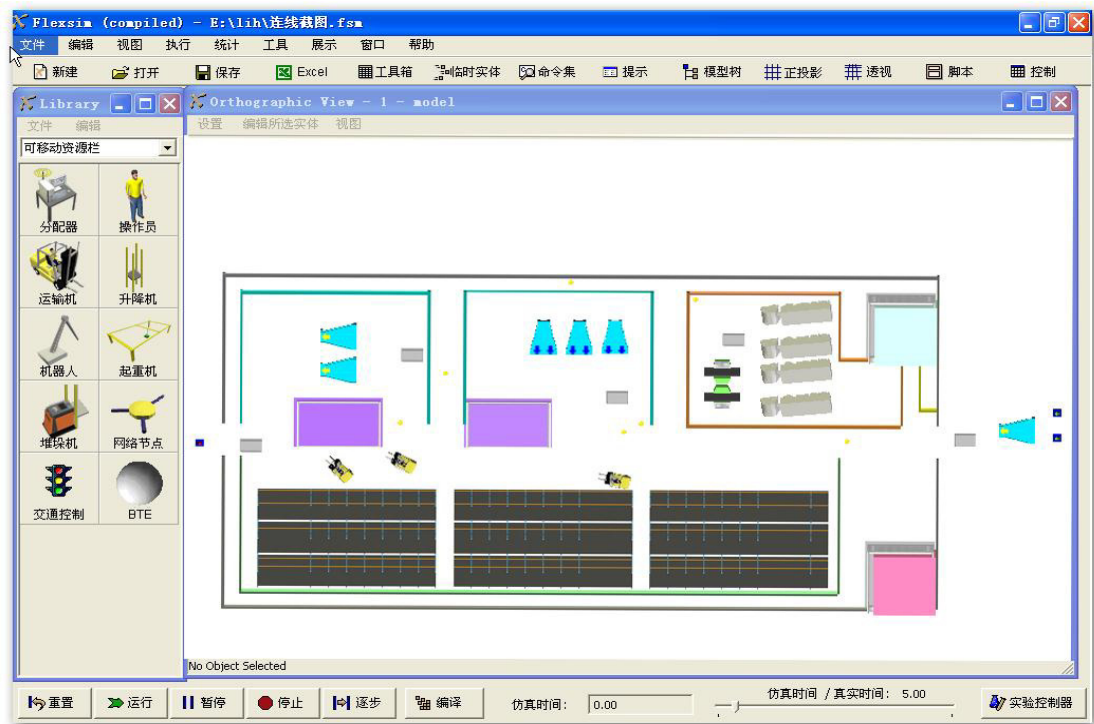
Fig. 3. highway freight terminal object layout

5. 2. Defining flow

Based on the logical relationship between the various objects of the system, connecting the corresponding input, output with intermediate port, to build a simulation model of the logic flow. The connection lines between the objects is the process of the simulation model, and the logical relationship is determined by the order of connection. In this paper, traffic and cargo flows are defined as follows:

◆   Traffic volume definition

Traffic volume definition is actually pitted truck routes, that is to say a solution to where to inbound, where to unload, where to park, where to load, and finally where to outbound. In this paper, pitted vehicles firstly bound for unloading area to unloading, entering the park to waiting for after unloading, and then to shipping cargo loading area, finally outbound the terminal.

◆   Goods flow definition

The flow of goods is composed by the inbound cargo flow and the outbound flow. Where inbound cargo flow refers to the arrival goods inbound with the vehicle, then reach the unloading areas to discharge the goods to the stockpiling area, and finally transported by forklift or stacker into the warehouse for storage. And outbound cargo transported by forklift or stacker to the stockpiling areas, and then outbound the terminal with the vehicle after been loaded.

5. 3. Entity connection

When the object entities have been dragged into the proportional layout and have defined the flows, the next step is to orderly connect the various entities in accordance with the logic operation relationship of various facilities, otherwise traffic volume and goods flow can not move in the highway freight terminal as required. It should be noted that even if the order of connection error, the model can not go wrong when compiled. However, the model does not run in accordance with the predetermined requirements, so particular attention to connection with the entities, which is most error-prone in flexsim. Connecting all entities in accordance with the flow definition to establish highway freight terminal model connection diagram, as shown in Fig4.

5. 4. Parameter settings and model running

Most of physical parameters setting can be directly called from flexsim internal function, but some settings you will need to rewrite the the flexsim original program or re-programming. Procedures written by C++ Language can be directly applied in flexsim model view. The physical parameters of highway freight terminal are set as follows:

➢   Determining the tonnage of goods;

According to the annual cargo throughput is 120 million tons and the warehouse's day shipments is 667 tons, so 135 vehicles of 5 tons are needed.

➢   Processing time setting;

Unloading time is 360s, loading time is160s. the waiting time in the parking lot is100s

➢   Speed setting.

The running speed of the forklift is 1m/s, and the acceleration is 0. 5m/s2. the vehicle speed is 1. 39m/s.

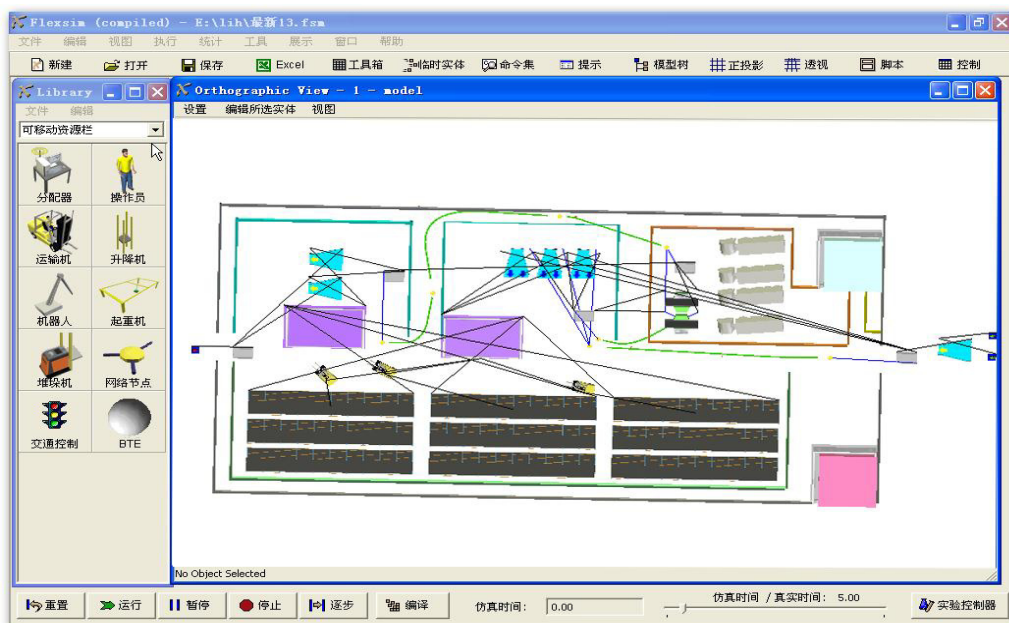The model must be compiled and reset after built the model, and then run the model.

Fig. 4. highway freight terminal model connection diagram

6. Analysis of simulation results and conclusions

Flexsim has a powerful function of data statistics, which can analysis all object entities involved in each model, and can dynamic display in real time with graphics. Each case as shown in Fig. 5. ~Fig. 7.
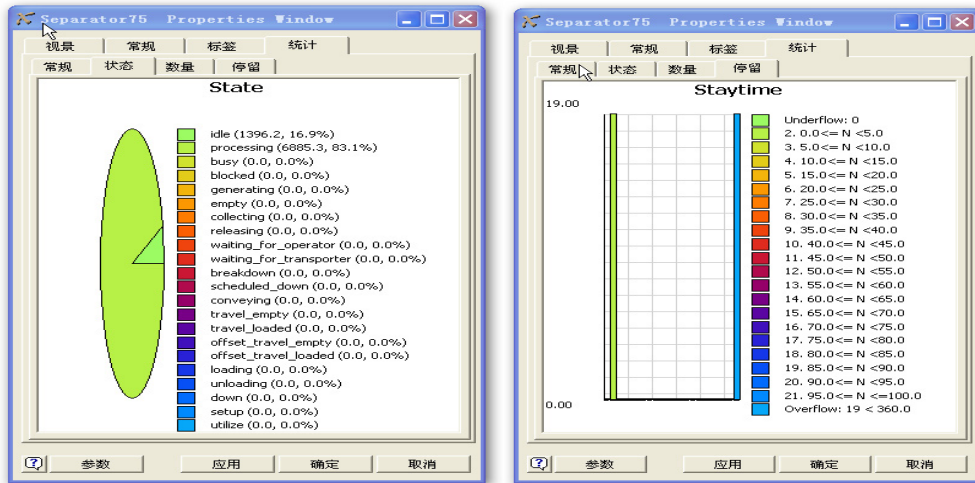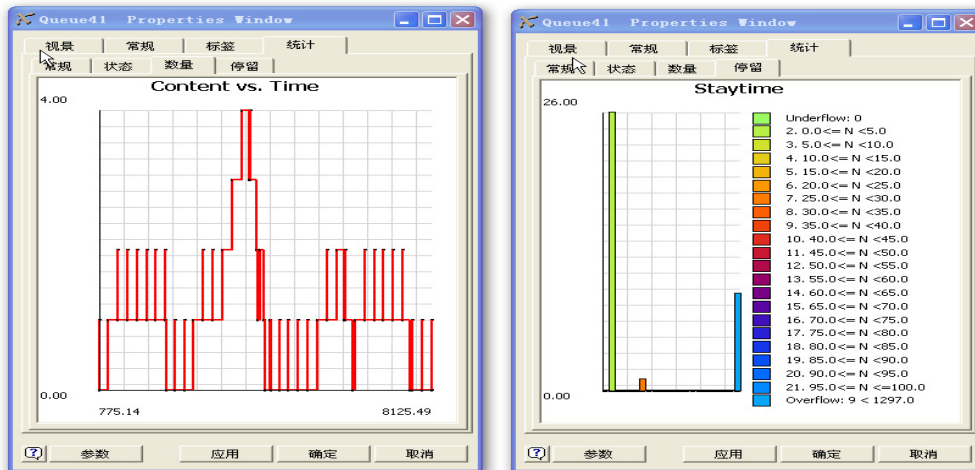
Fig. 5. The trucks unloading
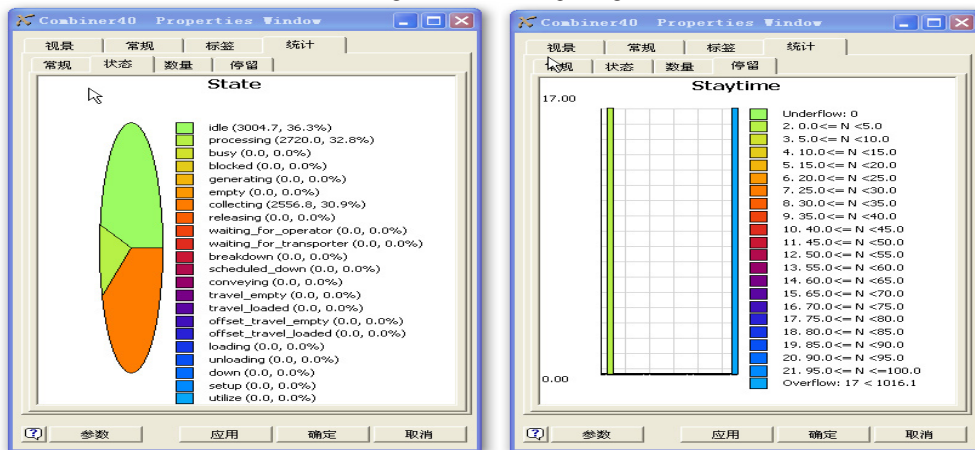

Fig. 6. Trucks in the parking

Fig. 7. The trucks loading

From Fig. 5. to Fig. 7. , we know that the highway freight terminal moves well without obstruction. Add a splitter or a synthesizer in the model and run it, you will found wasted facilities, which means an increase in the unloading area or the loading area (an increase the proportion of production facilities in the area of road freight station) will appear waste. Similarly, reduce a splitter or a synthesizer in the model and run it, equipment´s load rate is too large or blocking phenomenon are founded, this is to say reducing the area of unloading area or loading area(reducing the production facilities in the area of road freight station) will appear the above-mentioned bad phenomenon. Therefor, the area ratio requirements of each facility in "classification and construction requirement of highway freight terminal" are in line with the actual. Effective technical means to scientific decision-making for the highway freight terminal planning and construction program are provided.

Flexsim software is still in its infancy in China. And as a beginner, many aspects have to be improved in the future work. For example:the details of the flow of goods and traffic did not fully consider;the interface with other modeling tools still need to be improved.

References

Eiichi T，Michihiko N，Tadashi Y．Optimal size and location planning of public logistics terminals[J]．Transportation Research，1999，35(3)．

VIEIRA. The value of service in freight transportation[D]. Ph．D．thesis, Massachusetts Institute of Technology, Boston, Mass. L. F. M. , 1992.

Ji Jian-feng, Hou Guo-xiang , Zou Zhi-yun. The road freight station Scale determining method[J]．Highways & Automotive Applications，2006(10).

TAVASSZYG L A. Characteristics and capabilities of the Dutch freight transport system models[J]，RAND，Santa Monica, 1994.

Li Xuan, Hong Yi-Tian, Zhang Hui, et al. Flexsim system simulation software in the distribution center sorting system design[J]. Logistics Engineering and Mangement, 2009, 31(1):37-39.

Hu Da-wei, Xi Jian-guo. Simulation system for bus station based on Flexsim[J]. Journal of chang, an University:Natural Science Edition, 2010, 30(2):89-95.

Fang Sheng. Road freight terminal simulation based on Flexsim[D]. Xi'an: Chang' an University, 2010.

Ye Huai-Zhen, Yan Qi-Peng. Application of Terminal System Operating Simulation of Highway Freight Transportation[J]. Journal Of Chong Qing Jiao Tong Institute, 1998, (02).

Iwata K. A modeling and simulation architecture for virtual manufacturing systems[J]. Annals Of the CIRR. 1995，44(l):212 — 216.

QUANDT R. W , BAUMOL W J. The demand for abstract transport modes[J]. Journal of Regional Science , 22.

Teodor, GabrielCrainica, GilbertLaporte . Planning models for freight transportation [D]. European Journal of Operational Research, Volume 97, Issue 3, 16 March 1997, Pages 409-438.

Gelenbe E, Guennouni H. Flexsim:a Flexible manufacturing system simulator[J]. European Journal of Operational Research, 1991, 53(2):149-165.

Appendix A

The area calculation of the main parts of freight station

A1 The area calculation of the freight station house

$$A_1 = A_2 + A_3 + A_4 + A_5 + A_6 + A_7$$

$$（A1）$$

Where A_1 denotes the freight station house area, A_2 the cargo acceptance area, A_3 the cargo delivery area, A_4 the other business office area, A_5 the production scheduling and joint office, A_6 the conference room and A_7 the information monitoring center.

A1. 1 The cargo acceptance area

$$A_2 = a_1 \times R_1$$

$$（A2）$$

Where A_2 denotes the workshop area of cargo acceptance, R_1 the number of business people at cargo acceptance area and a_1 the required area for each one, which is $6m^2 \sim 10m^2$.

A1. 2 The cargo delivery area

$$A_3 = a_2 \times R_2 \qquad (A3)$$

Where A_3 denotes the formalities area at cargo delivery area, R_2 the number of business people at cargo delivery area and a_2 the spaces area of delivery procedures, which is $6m^2 \sim 10m^2$.

A1. 3 The other cargo delivery area

$$A_4 = a_2 \times R_3 \qquad (A4)$$

Where A_4 denotes the other business office area and R_3 the number of business people at cargo delivery area.

A1. 4 The production scheduling and joint office area

$$A_5 = a_2 \times R_4 \qquad (A5)$$

Where A_5 denotes the scheduling and intermodal office space area and R_4 the number of office staff required.

A1. 5 Conference room area

A_6 is $30m^2$ when it is small meeting rooms, $60m^2$ when it is medium meeting rooms and above $60m^2$ when meeting rooms is large.

A1. 6 The information monitoring center area

The information monitoring center area A_7 must be larger than 50 square meters and shall not be less than three thousandths of a total gross floor area of the highway freight station, which is configured generally from 3‰ to 5‰.

A2 The area of the warehouse (shed)

$$A_8 = \frac{Q_1 \times T_1 \times K_1 \times a_3}{f_1} \qquad (A6)$$

Where A_8 denotes the interim warehouse area, Q_1 the maximum throughput of the average daily transshipped cargo, K_1 the storage coefficient, which is $0.5 \sim 0.7$, T_1 the transit storage period, which is $1d \sim 2d$, a_3 the area Per ton cargo covers, which is $1.2m^2/t \sim 1.5m^2/t$ and f_1 the area utilization factor, which is $0.6 \sim 0.8$.

A2. 2 Warehouse (shed)

$$A_9 = \frac{Q_2 \times T_2 \times K_1 \times a_4}{f_2} \qquad (A7)$$

Where A_9 denotes the warehouse area, Q_2 the maximum throughput of the average daily Storage cargo, T_2 the average storage period of cargo, which is $7d \sim 9d$, a_4 the area of average cargo covers and f_2 the utilization coefficient of area, which is $0.7 \sim 0.9$.

$$A_{10} = (0.3 \sim 0.4)A_9 \qquad (A8)$$

Where A_{10} denotes the Storage Sheds area.

A2. 3 Information trading center area

$$A_{11} = a_2 \times R_5 \qquad (A9)$$

Where A_{10} denotes the information trading center area and R_5 the number of business people at the information trading center.

A3 Venue facilities

A3. 1 Goo yard area

$$A_{12} = A_{13} + A_{14} \qquad (A10)$$

$$A_{13} = \frac{Q_1 \times T_1 \times K_2 \times a_5}{f_2} \qquad (A11)$$

$$A_{14} = \frac{Q_2 \times T_2 \times K_2 \times a_5}{f_2} \qquad (A12)$$

Where A_{12} denotes the freight yard area, A_{13} the transit freight yard area, A_{14} the warehousing freight yard area, K_2 the storage coefficient and a_5 the area Per ton cargo covers, which is 0. 6m^2/t ~ 1. 0m^2/t.

A3. 2 Loading and unloading (operation) field

A3. 2. 1 The simplex operation loading and unloading (operation) field

$$A_{15} = 2 \times L \times L_t \qquad (A13)$$

Where A_{15} denotes the area of he simplex operation loading and unloading (operation) field, L the total length of the warehouse and L_t the length of transport vehicles.

A3. 2. 2 The sided operation loading and unloading (operation) field

$$A_{16} = 2 \times A_{15} \qquad (A14)$$

A3. 3 Park

Vertical parking in the parking lot, the unit parking area is shown in Table A1.

Table A1 motor vehicle parking lot design parameters

Parked way	Unit parking area F （m^2/veh）						
	I	II	III	IV	V	VI	VII
Vertical	40	55	65	75	80	95	110

Where in the table , I is Two-axle vehicles, II is Triaxial vehicles, III is Four-axle vehicles, IV is Triaxial semi-trailer, V is Four-axle semi-trailer, VI is Five-axis semi-trailer and VII is Six-axis or above semi-trailer.

Park area

$$A_{17} = N \times F \qquad (A15)$$

Where A_{17} denotes the parking area, N the number of daily parking and F the unit parking area, which illustrated in table A1.

Appendix B

The number Calculation of facilities and equipment

B1 Crane loading and unloading equipment

$$S_1 = (Wd)/(J_n t_d) \qquad (B1)$$

Where W denotes the daily processing cargo volume, d the tray average load, J_n the device working ability and t_d the device annal working days.

B2 Unpack loading and unloading machinery

$$S_2 = C_d K_d / t_m p_t t_j \qquad (B2)$$

Where C_d denotes the annal amount of packing and unpacking, K_d the unbalance factor, P_t the number of boxes Forklift loading and unloading hourly, t_j the number of working hours a day and t_m the number of working days per month.

B3 Vessel equipment

$$S_3 = G/V \qquad (B3)$$

Where G denotes the Non-container processing cargo and V the tray average load.

B4 Transport equipment

$$S_4 = WL/(J_n t_d L_d \tau) \qquad (B4)$$

Where W denotes the annual workload of transport equipment, L the average transport distance, L_d the average mileage daytime running and the utilization factor, which is0. 8~0. 9.