

Design of Automated Warehouse Based on Computer Simulation

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Abstract. As/RS (Automated Storage and Retrieval System) is an important part of modern logistics System, which is widely used in various industries. At present, it has become one of the signs of enterprise production and management informatization. In this paper, the method of software simulation aided design is used to carry out the planning and design of finished tile warehouse in brick and tile factory. And through the simulation animation to see the warehouse each transportation, storage equipment and trailer, stacker and so on state, the simulation system will reflect the blocking and bottleneck position and situation in the system, the computer simulation results provide a direct reference and basis for the scheme optimization and improve the quality of the design.

Introduction

Automated Storage and retrieval is a kind of storage and retrieval system with the aid of mechanical facilities and computer management and control systems (including control systems and upper management systems) such as high-rise shelves, lane stackers, automatic sorting systems, automatic loading and unloading systems, peripheral facilities and equipment, etc. ^[1-3]. The automated storage and retrieval system consists of three-dimensional high-rise shelves, lane stacker Crane, storage and retrieval system, storage management control system and civil engineering and auxiliary facilities part composition.

The design content includes the process of loading and unloading, the management of loading and unloading, the interface of loading and unloading, the application of conveying equipment (stacker, trailer) , the route of conveying system, and the design of storage space. ^[4-6] the planning and design of three-dimensional warehouse of finished tiles in brick and tile factory was carried out by using the method of software simulation aided design. Finally, a warehouse model with similar warehouse management strategy is established and its reliability and stability are verified by simulating the operation of the system

Problem Description

Business Background

A brick and tile enterprise mainly produces hollow brick, standard brick, perforated brick, tile and other products, the factory purchased a new land plan for the construction of a warehouse inventory of more than 5500 items. The newly purchased land of the brick and tile factory covers an area of 3000 square meters and is of "L" type.

Primitive Conditions

- ①Year working time: 251 Days;
- ②Working Hours: 3 Shifts, 24 hours a day
- ③The storage area of the warehouse has a net height of 20 meters, a net width of 55 meters and a net length of 22 meters
- ④finished brick size and quality: Each finished brick length of 24 cm, 5.3 cm wide, 11.5 cm high, the quality of each 2.5 kg.
- ⑤finished bricks and tiles cargo stacking specifications for 144 finished bricks and tiles per pallet, pallet and the total quality of goods is about 370kg.

⑥The finished goods warehouse of the brick and tile factory contains five categories of products, represented by A, B, C, D, E.

Theoretical Research and Application of Design Method

Design of Automatic Stereoscopic Warehouse

①Determine Shelf Form

The stacking rule of the goods is 144 bricks per pallet, so the unit weight of the finished bricks is between 350kg and 400kg, and the quality is high. This topic uses the beam type double shelf, this kind of shelf load-bearing, high Factor of safety, single-storey load-bearing up to 1 to 2 tons, so can withstand brick and tile quality, improve Factor of safety.

②Shelf Selection and Dimension Calculation

According to the above known conditions, the final number of shelves is 20 rows, 20 rows and 15 layers.

③Calculate the number of moving machines

Maximum amount of work per month completed by trailer

$E_i = 23 \text{ (Pallet / hour)} \times 24 \text{ (hour / day)} \times (251 / 12) \text{ (day / month)} \times 0.35 \text{ (ton / Pallet)} = 4392.5 \text{ (ton / month)}$

The utilization ratio of machinery d is 0.8, and the number of trailers is N

$$N = \sum_{i=1}^k \frac{E_i}{720Kd}$$

$$N = 4392.5 / 720 \times 1 \times 0.8 = 7.01 \text{ (Dais)}$$

Determine the Work Style of the Warehouse

① How the three-dimensional Shelf area connects to the delivery system:

Loading: conveyor--loading mode

Out of storage: out of storage platform--trailer mode

② Goods unit access to high-rise shelves form--Conterminal access

Build a Simulation Model

Based on the Characteristics of Logistics Simulation Model

Based on the characteristics of logistics simulation model, the complex system can be modeled separately. In this paper, the finished product warehouse of brick and tile factory is modeled separately the whole model consists of three sub-modules: Quality Inspection and Transportation System, shelf and control panel, and sorting system. As shown in figure 1.

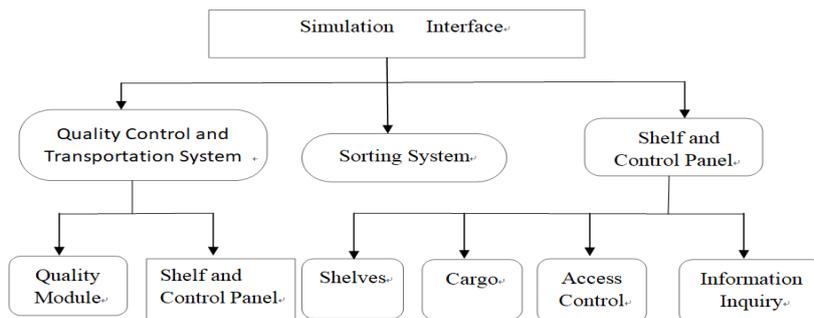


Figure 1.Hierarchy Diagram of the Simulation Model

Quality Inspection of Simulation Modules

During the process of simulation, the Pallet  representing bricks is generated by the Source  of brick kiln, and the unqualified products are diverted to drain 1, which represents the processing area. Flow Control 

This module uses two methods: Examine and Bypass. Examine is used for quality control. The brick factory has 90% qualified rate, so 90% of the goods are good and 10% are bad.

As shown in figure 2



Figure 2. Working state of conveyor system

Analysis of Simulation Results

The storage system in each time after the storage of real-time data statistics, the types of products in the warehouse as well as the number of inventory statistics table Stocks, and pop-up inventory product sketch, the schematic is a bar chart containing the number of items in stock as well as the product details. The data analysis section is controlled by a Method called Stock stat.

Conclusion

Based on the eM-Plant software, the main research results of modeling the finished tile warehouse are as follows:

- ①The size and quantity of the equipment are calculated by various parameters.
- ②On the basis of parameter calculation, a simulation model of automated storage and retrieval system is established by using eM-Plant, which is close to the actual situation and practical.
- ③The design of the warehouse control panel is completed by using the dialog design function in the eM -Plant software.
- ④Using the powerful programming and data statistics and data analysis and processing functions of eM-Plant software, the inventory statistics table is established to make real-time statistics of the quantity and type of goods in the warehouse.

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