

The Principles and Objectives of Logistics Enterprise Warehouse Layout and Its Layout Mode and Design -- Taking Ordinary Warehouse Layout Plan as an Example

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Abstract. This paper takes the logistics enterprise warehouse layout as the research object, the ordinary warehouse layout plan as an example, summarizes and analyzes the eight principles and three objectives of the logistics enterprise warehouse layout and its four layout patterns and five design contents, It has certain reference significance for helping logistics enterprises in reality to carry out warehouse layout plan, as well as improve warehouse utilization efficiency and economic benefits.

Keywords: logistics enterprise; warehouse layout; principles and objectives; model and design; general warehouse.

1. Introduction

Warehouse layout is the scientific plan and overall design of the quantity, scale, geographical location, warehouse facilities, roads and sites of a certain area or warehouse area in a certain period of time and so on. The warehouse layout is very far-reaching for the logistics enterprise, because the main operation content of the logistics enterprise is closely related to the warehouse in all aspects. If the warehouse layout is unscientific and unreasonable, then the warehouse itself not only can be fully utilized, but also it will affect other purchase, transportation, packaging, loading and unloading, distribution processing, delivery and other links, resulting in adverse effects of low overall operating level and high cost of logistics enterprises, etc. Therefore, logistics enterprises must scientifically and rationally carry out warehouse layout, in order to make full use of the warehouse and other links related to the warehouse, the general warehouse layout plan is taken as an example to analyze how the logistics enterprises should conduct warehouse layout under normal circumstances, it is conducive to help logistics enterprises in the real world to carry out scientific and rational warehouse layout plan, and improve warehouse utilization efficiency and economic benefits.

2. Principles of Warehouse Layout of Logistics Enterprise

For logistics enterprise, warehouse layout is a very important aspect; modern warehouses undertake more and more functions, building a powerful and well-equipped warehouse is the basis of warehouse operations. The layout of the warehouse is directly related to the smooth progress of the warehouse work, and indirectly related to purchase, transportation, distribution processing, delivery and other links closely related to warehouse; logistics enterprise must follow some basic principles of the warehouse layout.

(1) Principle of convenient storage

Storage and safeguard are the most basic function of the warehouse, regardless of the type of warehouse, the storage of goods is the most basic requirement. The logistics enterprise should consider the nature and characteristics of the stored goods in the process of warehouse layout. The layout design makes the goods in the warehouse to maintain their original quality and traits in the warehouse.

(2) Principle of efficient operation

Warehouse is the main venue for logistics operations of logistics enterprises. In the warehouse, it is often necessary to carry out many operations such as warehousing, delivery, transfer, loading and unloading, circulation processing, packaging, weighing, etc. When carrying out warehouse layout, it

must be beneficial to improve the continuity and efficiency of the work, and do well in the correct and efficient completion of various operations.

(3) Principle of cost efficiency

In the process of warehouse layout, logistics enterprises also need to pay close attention to their economic cost- efficiency. It is necessary to pay attention to saving construction investment. In the design process, power supply, water supply, heating, communication and other facilities should be arranged in centralized to save costs. In the process of operation after construction, it is beneficial to reduce operating costs and inventory costs.

(4) Principles of space utilization

The space of the warehouse is limited for the logistics enterprise, every space of the warehouse must be scientifically and reasonably utilized, and the warehouse plane and space should be utilized to the utmost extent. Try to make good use of the height of the warehouse. Under the premise of meeting the requirements of the operation, we can set up several layers on the shelf, minimize the number of channels and the width of the channel, and do not waste space in space.

(5) Scientific principles of cargo space

In order to scientifically and rationally plan the cargo space, the same kind of goods or similar goods should be placed together or adjacent to each other. The goods with very high frequency of entering and leaving the warehouse are placed near the exit, and the heavy goods are placed on the bottom of the light goods, the commodity with signs face the channel, reasonable collocation is conducted according to the size of the goods and reasonable conditions of the warehouse, the goods code should be scientific and standardized.

(6) Principle of convenient connection

Storage is a very important part of the logistics process; it not only bears the function of custody, but also undertakes the function of connecting other links of logistics. Warehousing is closely related to logistics processes such as purchase, transportation, packaging, distribution processing, handling, and delivery. In the process of layout design, the warehouse also needs to be able to link other parts of logistics well.

(7) Principles of safety regulations

In the warehouse, it is often necessary to carry out many operations such as warehousing, unloading, transferring, adjusting, packing, weighing, loading and unloading, circulation processing, etc., and in the actual operation process, so many operations are likely to be carried out simultaneously, it is required to control the relevance and security of the warehouse layout, and also pay attention to the fire and anti-theft design.

(8) Principle of beauty and harmony

The goods should be neat and tidy in the warehouse, the whole warehouse should be clean and bright, the receiving area, delivery area, inspection area, storage area, sorting area, processing area, temporary storage area, packing area, tally area, equipment storage office areas must be scientific and rational layout plan etc., the entire warehouse cannot be chaotic and must be designed in a well-organized, beautiful and harmonious.

3. Goals of Warehouse Layout of Logistics Enterprise

Logistics enterprise must have clear objectives in the layout of the warehouse, so that the warehouse after construction can not only complete the task of warehousing, but also complete the task with high efficiency, and also can be well connected to the other aspects of logistics operations, logistics enterprise warehouse layout, its main goal is to protect goods, improve benefit and efficiency, and maintain its advanced applicability.

(1) Goal of protecting commodity

As a warehouse, protecting goods is the most basic goal. There are thousands of goods in the warehouse, and the warehouses of large logistics enterprise are very busy. There are many vehicles and goods entering and leaving every day. It is necessary to protect the quality of the goods, so that

the basic properties of the goods in the warehouse even after a long period of storage remain unchanged and are not damaged.

(2) Goal of economic efficiency

Logistics enterprise must consider the efficiency and benefit issues in the process of warehouse layout, so that the planned warehouse can not only complete the tasks efficiently, but also complete the tasks with low cost and high efficiency. This requires logistics enterprise to have a reasonable layout when the warehouse is laid out, and can combine logistics efficiency with economic benefits.

(3) Goal of advance and applicability

The layout design of modern warehouses should fully consider the issue of advanced nature; it is not only a simple and basic way to complete various logistics operations, it is necessary to introduce some advanced logistics mechanization, automation, intelligent facilities and equipment to fully operate science, the technical means is used to operate in the warehouse logistics, moreover, consider the enterprise's own situation to be advanced and applicable.

4. Modes of Warehouse Layout of Logistics Enterprise

There are many types of logistics enterprise warehouse layouts, the most representative ones are: radiation mode, absorption mode, focus mode, fan mode and so on. The specific choice of which mode depends on the logistics enterprise's own situation, the storage of goods, the storage environment requirements, the plane and three-dimensional layout, the degree of mechanization and so on.

(1) Radiation mode

The radiation mode means that there are multiple users and the warehouse is in the middle position, and the goods are transported from the center to the users in all directions, and the shape is radial, as shown in Fig.1, it is suitable for economic areas where the user is concentrated, or when the warehouse is a transit point in the trunk transportation line.

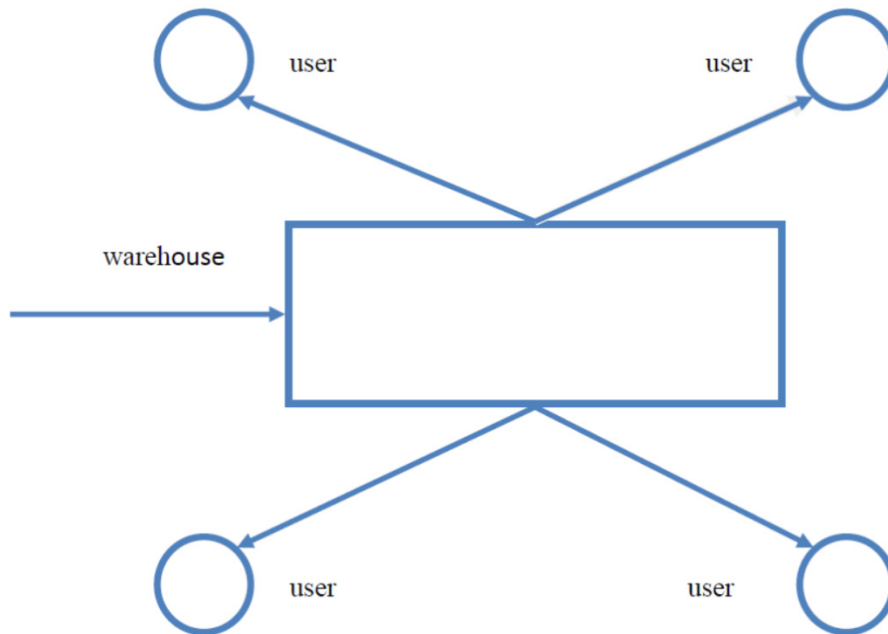


Fig.1 Radiation mode

(2) Absorption mode

Absorption mode means that goods are transported from various places to the warehouse, there are multiple places of production and the warehouse is located at an intermediate position, and its shape is absorbent, as shown in Fig.2. This type of warehouse is more suitable for manufacturing raw material warehouses, and various raw materials, parts and components are transported from various manufacturers, or commercial enterprise warehouses, and various commodities are purchased from suppliers to warehouses.

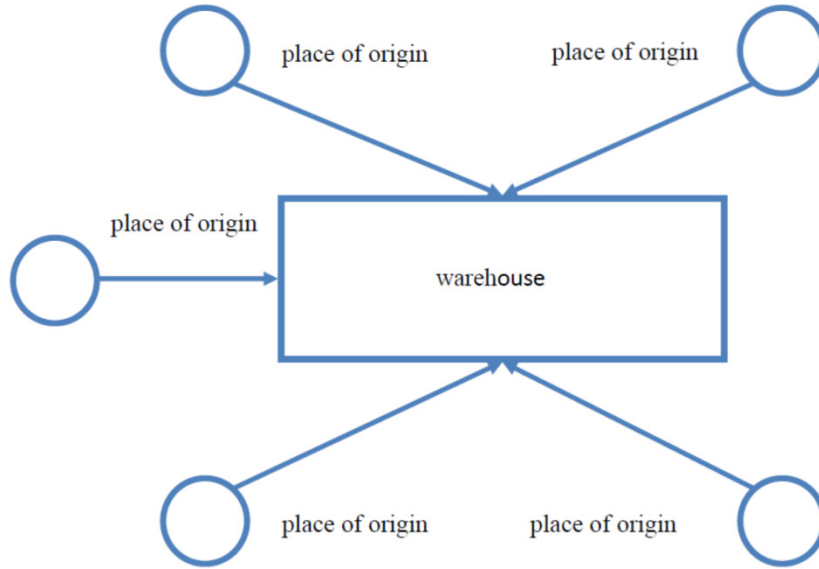


Fig.2 Absorption mode

(3) Focus mode

This kind of warehouse is similar to the absorption warehouse, but it is no longer a warehouse in the middle position, but an economic area where the production enterprises gather. The warehouses are scattered around, not the users and the cargo owners. The shape is in focus, as shown in the Fig.3. This type of warehouse is suitable for situations where production enterprises are more concentrated in economic regions.

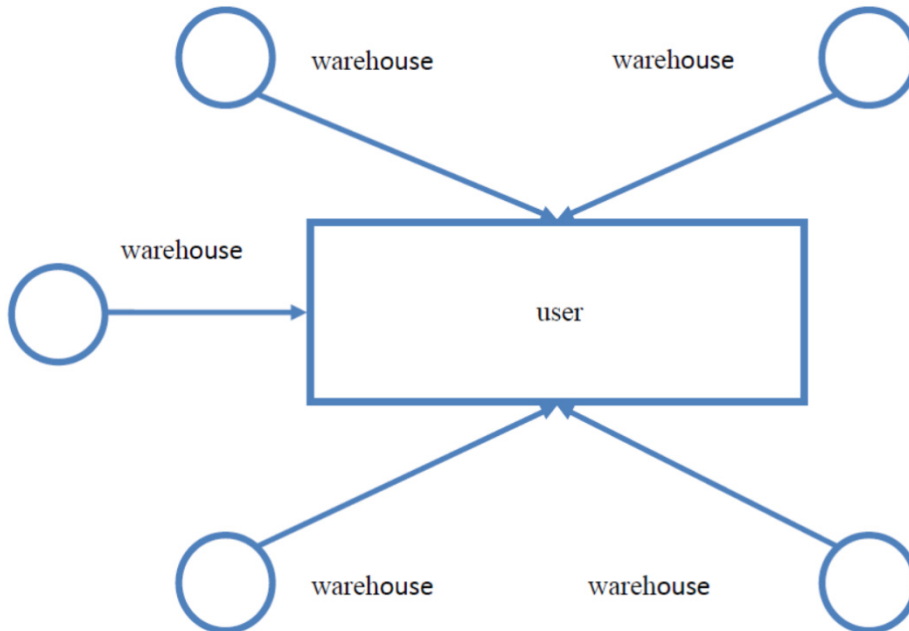


Fig.3 Focus mode

(4) Fan mode

Fan mode warehouse means that the goods are transported from the warehouse in one direction, and the radiation direction is consistent with the transport direction of the trunk line, and its shape is fan-shaped, as shown in Fig.4. This type of warehouse is suitable for transporting warehouses on the main line, and the upper area of the next warehouse is just the reasonable transportation area of last warehouse.

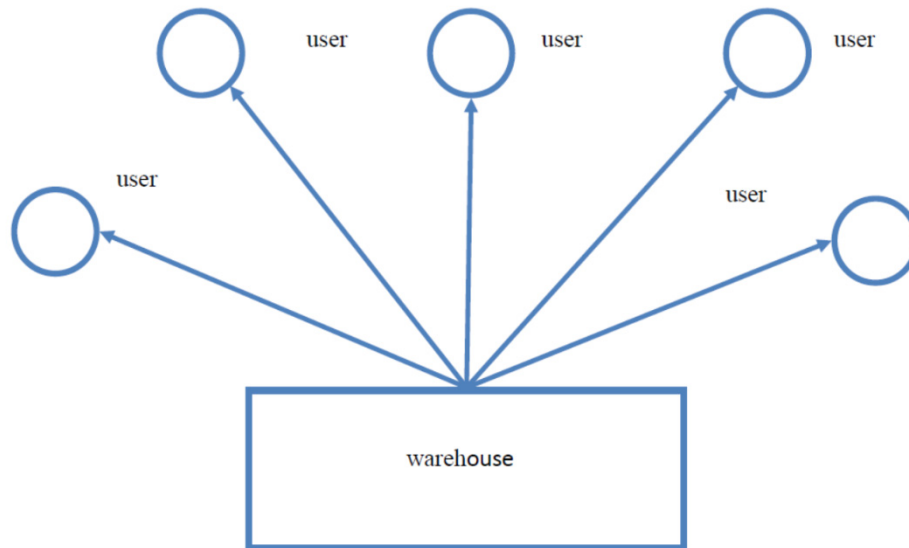


Fig.4 Fan mode

5. Designs of Warehouse Layout of Logistics Enterprise

When designing warehouse layout, logistics enterprises need to consider the internal and external environment and the specific conditions of the enterprise, select the warehouse structure, design the warehouse plane shape, arrange the space of each area of the warehouse and configure the facilities and equipment needed for the warehouse.

(1) Choice of warehouse structure type

There are many types of warehouse structures, mainly based on the functions and tasks of the warehouse. The main consideration of the warehouse function is simple storage or accompanying sorting, distribution processing, delivery and other functions, and its tasks are mainly storage or turnover. It is also necessary to consider the physical and chemical properties of the storage object, the internal and external environmental requirements of the warehouse, and the amount of investment in the enterprise.

(2) Design of warehouse plane shape

In the general absence of construction land restrictions, ordinary warehouses are basically rectangular design, therefore, the shape design of the warehouse is determined according to the length (L) and width (W) of the warehouse plane shape. Assuming that the warehousing platform is in the corner of the warehouse, the round-trip inspection method is used. According to the research of logistics expert Francis, the warehouse plane can be designed as follows:

$$W^* = \sqrt{\frac{D+8r}{2D+8r}} \cdot \sqrt{S} \quad (1)$$

$$L^* = S/W^* \quad (2)$$

$$T^* = 2\sqrt{\left[\frac{1}{2}D + 2r\right] \left[\frac{1}{4}D + 2r\right] \sqrt{S}} \quad (3)$$

Among them, the meanings of W^* , L^* , D , R , S , T^* characters are:

W^* : optimal width (m);

L^* : optimal length (m);

D : the unit length cost of the goods entering and leaving the warehouse and the number of goods entering and leaving the warehouse per year (yuan/meter);

R : annual perimeter cost per unit length (yuan/meter);

S : warehouse area (m²);

T^* : total associated cost (yuan) under the optimal solution.

The relationship among the areas in each warehouse is divided into six main relationships: M, V, I, O, U, and X, the relationship among different areas may be different. The meanings of the six characters are:

- M: Most important,
- V: Very important,
- I: Important,
- O: Common,
- U: Unimportant,
- X: Forbidden,

(3) Warehouse CIO layout model method

There are many warehouse layout methods. The COI layout model method is used to design the warehouse layout. The model assumes that each cargo enters and exits the I/O point in the same proportion, and the unit distance cost of the moving goods is independent of the I/O point. The model is as follows:

$$\min \sum_{i=1}^m \sum_{j=1}^n \left[\frac{1}{S_i} \sum_{k=1}^p C_i f_i p_k d_{kj} \right] x_{ij} \quad (4)$$

Meet:

$$\sum_{j=1}^n x_{ik} = S_i \quad i = 1, 2, \dots, m \quad (5)$$

$$\sum_{i=1}^m x_{ik} = 1 \quad j = 1, 2, \dots, n \quad (6)$$

$$x_{ij} = 0 \text{ or } 1 \quad i = 1, 2, \dots, m \quad j = 1, 2, \dots, n \quad (7)$$

Then:

$$W_j = \sum_{k=1}^p p_k d_{kj} \quad (8)$$

Objective function:

$$\min \sum_{i=1}^m \sum_{j=1}^n \frac{f_i C_i}{S_i} w_j x_{ij} \quad (9)$$

The meanings of f_i , c_j , p_k and d_{kj} are as follows:

F_i : the frequency of entry and exit of item i ;

C_j : the cost of moving the unit distance of the unit item;

p_k : the ratio of entering and leaving the warehouse through low k I/O points;

D_{kj} : the distance of the storage space j to k number I/O.

(4) Configuration of warehouse facilities and equipment

The main operations in the warehouse include operations such as safeguard, storage, delivery, transfer, group support, sorting, and packaging. When configuring warehouse facilities and equipment, it is necessary to consider the configuration of facilities such as mechanization, automation, and intelligence required for each operation. At the same time, it is coordinated with the reasonable plan of facilities and equipment, working methods and required area.

Table.1 Configuration of warehouse facilities equipment

Functional requirements	Facility equipment configuration
stock, pick up	shelves, forklifts, stacking machinery, lifting machinery, transportation machinery, etc.
sorting, distribution	sorters, pallets, trucks, conveyors, etc.
inspection, conservation	inspection instruments, tools, maintenance equipment, etc.
fire prevention, anti-theft	temperature monitor, fire alarm, anti-theft monitor, anti-theft alarm device, etc.
distribution processing	processing operations, machine tools, etc.
control, management	computer, auxiliary equipment, etc.
supporting facilities	cargo, platform, track, road, site, etc.

(5) Determination of warehouse storage order

The warehouse storage location includes fixed cargo space and random cargo space. The warehouse storage order can be determined by the four-position method, segment positioning method, category group positioning method, address positioning method, coordinate positioning method, computer positioning method, etc. Moreover, the design of warehouse storage should be in line with the principle of convenient handling, not only to facilitate the entry and exit of goods, but also to reduce the time of receiving and dispatching operations as much as possible. For goods that adopt the delivery system, the storage location should be close to the area where the goods are loaded; the goods that are taken from the delivery system should be close to the warehouse outlet to facilitate the entry and exit, and convenient for incoming and outgoing cargo vehicles.

6. Conclusions and Prospects

This paper takes the general warehouse layout plan as an example; comprehensively analyzes the eight basic principles, three main objectives, four layout modes and five design contents of the logistics enterprise warehouse layout, from the main aspects, it analyzes in detail how logistics companies should carry out warehouse layout design under normal circumstances, especially help small and medium-sized enterprises in the real estate to carry out warehouse layout design, with the continuous expansion of logistics enterprises, various factors that need to be considered in warehouse layout are more and more complicated, in reality, logistics enterprises should deeply analyze their own characteristics and main business as well as the internal and external environment of the enterprise, only by analyzing specific problems can logistics enterprises make the warehouse layout design more scientific and reasonable..

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