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Formation of the network of spare elements warehouses

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Abstract: Discusses the redundant machinery construction enterprises. The method of calculation of a network of warehouses taking into account the possibility of different conditions of the reserve from the part to the backup machine. The technique allows you to determine the required number of warehouses of different levels, taking into account the time of delivery of the spare element from the warehouse on the other hand, it is necessary to take into account that the increase in inventory helps to slow down the turnover of reserve elements, increases the cost of the Insurance Fund.

1. Introduction

Reservation of the fleet of machines allows optimizing the cost of the formation of its size and storage capacity of spare parts. Russia's conditions are characterized by territorial disunity of facilities and weak road infrastructure. This is typical for such a mountainous country like Tajikistan.

However, rationalizing the warehousing network can dramatically reduce the cost of spare parts. As a rule, the researchers of this topic [1-7] simplify the solution of reviewing tasks by bringing to one level of warehouses and turning the hierarchical structure into a linear chain. In the works [8-12] the ways of solving the problem are outlined, but the final version is not given.

For the current state of modern construction is practicality characterized by of the objects being constructed separately. Insufficiently developed infrastructure, causing significant transport costs, long waiting period for the delivery of spare elements from manufacturing plants, development of technical centres and dealerships, raises the question of creating a spare parts supply network - peripheral regional network of warehouses.

Let us consider the functional hierarchy of spare elements in the system of servicing by the mechanisms and machines of building objects. Spare elements can be contingently classified into several groups:

- A spare technological set of machines and equipment for the production inherent in the organization of construction work in question.
- Backup construction machine.
- Reserve node, complete unit.
- Spare block.
- Detail, fixed connection.

It is obvious that a reserve technological set (if it is available or can be made up of reserve machines) should be located on the central base of a large or specialized organization such as mechanization management or in the place where the main construction objects are located. In case if one object has the priority in a building that is much higher than that of other elements; this group can be placed in the location of this separate object and used as a "hot" backup.

Approximately the same policy should be applied in respect of large building machines, placing reserve units on the central base of the unit or at the main support station.

A more difficult task is to form warehouses of deficient elements, the need for which is significant. Here we have two possible conditions:

a) The storage of reserve elements should be as close as possible to the consumer;
b) The increase in the number of warehouses reduces the efficiency of the reserve use.

The construction in the North, especially in the conditions of Siberia, is characterized by the territorial dissociation of building objects and poorly developed infrastructure. In this regard, the task of storing spare parts is of considerable relevance, since there are certain economic losses for any solution.

In general, the size of a separate warehouse must satisfy the following condition:

$$P_{nej} \leq P_{ye} \tag{1}$$

where:

P_{nej} - losses and costs associated with storing the e- element in the j- warehouse;

P_{ye} - losses and costs associated with the delivery of the e- element from the central warehouse.

However, entire losses across the warehouses will differ from the simple sum of loss amounts from each warehouse. This is due to the fact that the system of warehouses has the property of emergency.

The task of completing warehouses of the reserve equipment can be formulated as follows: a fleet of machines of the well-known nomenclature the revitalized structure is given in the directive order of each machine. Patterns of machine failure and the transition of the elements of the machine from the serviceable to the faulty are known. A set of warehouses with their organizational and economic characteristics is given. It is necessary to determine the required number of reserve elements and their placement in the system of warehouses subdivisions.

2. The solution to the problem

We carry out the classification of reserve elements based on their production needs. Let us determine the cost of the e- element at the facility supplied from the j- warehouse.

If all j- warehouses are denoted by N, then two options can occur: the e- element is requested at j- warehouse and the e- element is not requested at j- warehouse. Thus, we can make two sets of elements:

M^* is the set of e- elements that are requested through all warehouses, M^{**} is the set of e- elements requested only through separate warehouses.

Here it is necessary to determine the volume of reserve elements in each warehouse. Their number on a separate item in stock may vary in the range $0 \leq M_e^{**} \leq M^*$

In general, j warehouse contains I types of elements

$$I^n = \sum_{e=1}^{I} M_j \tag{2}$$

The volume of the warehouse J is determined by the expression

$$N_j = \sum_{r=1}^{R} \sum_{e=1}^{I} M_{ej} \tag{3}$$

Where: r {0,1,2,...,R} is a number of e- item in stock.

The total amount of spare parts in the contracting organization

$$N = \sum_{j=1}^{I} \sum_{r=1}^{R} \sum_{e=1}^{J}, M_{ej} = \sum_{j=1}^{I} N_j \tag{4}$$

The total cost in the spare elements equals:

$$\sum_{j=1}^{I} \sum_{r=1}^{R} \sum_{e=1}^{J}, M_{ej} = \sum_{j=1}^{I} \sum_{r=1}^{R} \sum_{e=1}^{J} S_{ejr} + Q_{ej} \tag{5}$$

Where: S_{ejr} Need of e- element requested by the j- warehouse;

Q_{ej} Reserve of the e- element in the j- warehouse in case of an abnormal supply and demand of this element.

Thus, the division of the number of warehouses on one side reduces the delivery time of the reserve element to the non-efficient machine, when on the other side, the amount of insurance reserve increases, which leads to a slowdown in the warehouse turnover.

The second important point in the formation of volumes and the nomenclature of warehouses is to determine the possibility of replacing the concrete element on the object.

Indeed, there is a need for one or another spare element (even the simplest detail) to be available at any object, but due to the difficulties of replacing it in the field, the machine must be sent to a central repair shop. Therefore, we form the new set M, which includes only those reserve elements, which, according to the technical principle, can be requested only from one or several warehouses.

So, in the network of warehouses, their significance and size should be classified. The first group of warehouses includes warehouses with a full or maximum set of reserve elements for a large construction organization.

This may be a central warehouse, a specialized repair warehouse or warehouses of mechanization organizations, a warehouse of a Stroymashservis type dealership company.

The second group includes warehouses of mechanization divisions bases (when the repair service is centralized), warehouses of priority facilities when servicing a significant amount of equipment at a small distance from each other and under the condition of good transport connection between facilities.

The third group includes warehouses of reference points, object-specific warehouses of large objects. The fourth group includes small warehouses, warehouses for distribution of tools with a minimum number and a narrow range of backup elements (hardware, filters, etc.)

This gradation allows us to systematize the distribution of spare elements and determine their rational volume. This technique can also be used by construction equipment manufacturers to supply their technical centres.

3. Conclusion

The given method provides justification of the hierarchical structure of warehouses and reserve sites of construction equipment and, first of all, is suitable for use by large holders of construction equipment,

as well as for the construction of large objects (for example, Rogun HPP in Tajikistan). The technique provides the possibility of using spare sets of machines (individual machines) as a "hot" reserve.

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