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METHODS AND MODELS TO OPTIMIZE THE CHOICE OF VEHICLE PRODUCT STRUCTURE

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Abstract- In this paper, the main approaches choice of rolling stock for the transport of building products is presented based on review of scientific literature reviewed. This is a problem solving for choosing the rational rolling stock. The model of the product structure optimization calculate to select vehicles with a maximum capacity of rolling stock for the transport of articles construction.

Keywords: Optimization Methods, Choosing of Rolling Stock, Car Load Capacity, Performance Optimization Services.

I. INTRODUCTION

Currently, using the rolling stock does not fully meet the needs of construction, and transportation costs which are 25% of the cost of construction and installation works. Lower transportation costs in the construction can be achieved by using more efficient types of rolling stock, the introduction of advanced methods of the organization of transportation, as well as the creation of the automated transport management systems. On the correct choice of load capacity and the extent of its using depends largely on the performance and, consequently, the transport costs of construction [1].

In establishing the carrying capacity of rolling stock should be based on lot of size panels which determined as a function of technological processes, taking into account technological possibilities and design features of road transport. This can be achieved using proposed method, which based on the idea of choosing the optimal size of the rolling stock with a complete set of products to meet the requirements of receipt of their construction projects.

II. ANALYSIS OF EXISTING METHODS AND MODELS OF EQUIPMENT PRODUCTS

In [2], it does not take into account the technological requirements for the installation of products and unreasonably assumed average weight of the product, equal to 2 tons. According to them, load capacity vehicle should vary depending on the distance of transportation. Taking into account the carrying capacity of their submission vehicle operating in urban environments, must reach a value of 90 tones. Of course, in view of these shortcomings, this and similar techniques cannot be used in our studies.

In [3, 4] the problem of a complete set of different products is considered with the following parameters: length of l_i, width of b_i, weight of q_i, and the number of n_i, i = 1, m which is required to carry them out at the highest possible value of the coefficient of capacity utilization vehicle. The solution of this problem is reduced to the problem of minimizing underutilized-duty of vehicle. Firstly, create all kinds of sets, then these sets are selected certain amount in accordance with the terms of the problem.

$$\sum_k (q - \sum_i n_i^q q_i) \to \min \quad (1)$$

where n_i^k is the number of items of the ith type k Ohm is completed with constraints:

a. the mass of products included in the kit k_y

$$\sum_k n_i^k \le q \quad , \quad i = 1, 2, ...m \quad (2)$$

b. the width of the platform vehicle

$$\sum b_i P_k \le B \quad , \quad P_k = 1, 2, ..., P \quad (3)$$

where P_k is the row number in whom complete in width

c. the length of the platform vehicle

$$\sum_i I_i U_k \le L \quad , \quad U_k = 1, 2, ..., U \quad (4)$$

where U_k is row number in whom complete in length;

d. the condition of transportation of all goods

$$\sum_k n_i^k X_k = m_i \quad (5)$$

e. integrality condition

$$X_k \ge 0 \quad (6)$$

In these works the choice sets are carried out initially created options in accordance with the terms of the problem. This and other existing methods cannot be used for solving the transport logistics reasons. In the first place because they do not provide the speed and very time-consuming. They solved the problem for a certain type of vehicle, also does not provide consistent delivery of products [5, 6].

Therefore, the development requires improved universal method devoid of the above disadvantages. This method should provide a complete optimization of products, both for the same type, and using different vehicle capacity [7, 8].

Problems of increasing the efficiency of road transportation in modern conditions are of great importance [9, 10]. Therefore, the rational organization of transport according to right selecting the type and size of the vehicle and its efficiency going use depends largely on their terms and costs of transportation process. To achieve this, in addition to be used as a better vehicles according to the operating conditions, it is advisable to solve the following problems:

a. Selecting a rational size vehicle including on the formation of traffic partitioning;

b. Development of a science-based approach to cargo configuration;

c. Development of algorithms and programs of formation, the optimal flight - kits for vehicle are operated, and selected the optimal size.

Sequence of analysis of the product's installation requirements allow consumers reducing to the following classification: grade products are strictly in compliance with a predetermined sequence; subject to certain restrictions on the sequence. The task of the authors of the first type to the form is formally equivalent to the problem on the performance in the theory of optimal systems. A second type of problem is solved by exhaustive search.

It is obvious that the requirements today to ensure the quality and efficiency of work, may be provided on the basis of advanced technology and driving the process. Therefore, the choice of the exchange has to be based on evaluation of design excellence and parameters, taking into account the specific characteristics of equipment and transport-focusing of goods. For this purpose were analyzed work on issues of packaging and packaging of goods [5, 6].

These developments were discussed in terms of compliance with the requirements of transport logistics to improve the efficiency of the use of motor vehicles. Thus were determined their possible using as a model in our studies.

III. PROBLEM STATEMENT AND MODEL OF PRODUCT STRUCTURE USING GRAPH THEORY

Graph theory is gaining to increase interest among specialists in various fields of science and technology. Its attractiveness is due not only to the widest variety of possibilities of use, but also the beauty of the results achieved by simple means.

Graph theory has been used by us for complete products. Interplay and consistency of delivery of products according to customer requirements can be conveniently represented by graphs.

IV. BACKGROUND INFORMATION

Consider the example of a complete set of overlapping panels of a typical floor home series 113-64-100. Layout panels overlap typical floor plan is shown in Figure 1 and Table 1, where (I) - (IV) are the stairwells.

It is known that the graph consists of two finite sets of elements called vertices and edges. Each edge is defined by the pair of vertices. If the edges of the graph are defined ordered pairs of Vertices. Then the graph is called oriented, otherwise, the graph is undirected. A graph G is connected, if there exists a path between every pair of vertices. In solvable problems to refer to the graph vertices used symbols V_1, V_2, ..., V_n. Each vertex is characterized by weight products of q_1, q_2, ..., Q_p; length of l_1, l_2, ..., ln; width b_1, b_2, ..., b_n. Note that when picking a vertex can appear once.

Consider a graph I, consisting of n vertices and m edges with Adjacency matrix $M_c = [l_{ij}]$ of graph G have one vertex for each row and one for each of the arc column. Adjacency matrix M of graph G is called the matrix elements of the order. The parameters characterizing each product are shown in Table 1.

Table 1. Layout panels overlap of Figure 1

(I)	$\frac{3}{2}$	1	4	5	6	$\frac{8}{7}$	**(II)**	$\frac{10}{9}$	11	12	$\frac{14}{13}$	**(III)**	$\frac{16}{15}$	17	18	19	**(IV)**	$\frac{21}{20}$	22
23	24	$\frac{25}{26}$	$\frac{27}{28}$	29	30	31	32	33	34	35	36	37	38	39	40	$\frac{41}{42}$	$\frac{43}{44}$	45	46

Table 2. Parameters of products

Parameters products					
Type of product	Weight of one product, m	Length product, m	Width product, m	Number of products, items	The numbers of products of this type
1	1.625	1.98	0.1	2	3,21
2	2.103	2.58	0.1	4	8,10,14,16
3	2.3	3.16	0.14	4	25,27,41,43
4	2.05	2.58	0.14	4	26,28,42,44
5	2.368	3.16	0.1	4	7,9,13,15
6	2.875	3.76	0.1	2	2,20
7	4.525	5.76	0.1	24	1,5,6,11,17,18,22,23,24,29,30,36, 37,38,39,40,45,46
8	4.7	5.76	0.1	2	4,19

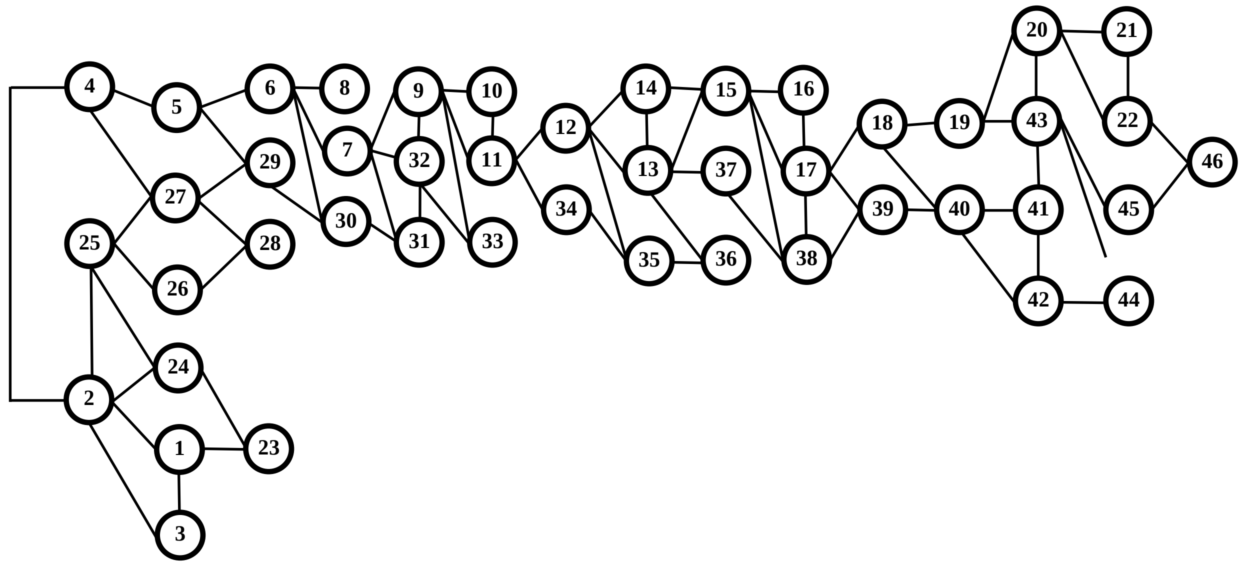

Figure 1. Scheme of the admissible sequence of assembly products

V. SOLUTION METHOD

Builders requirements when installing panels overlap is as follows:

1) Installation begins with one of the panels taken to the stairwells;

2) Then, to make installation of any unmounted or panel from the number of steps adjacent to the opening.

Suppose that we start with the installation adjacent to the first aperture of products, which are the elements of Count 2, 25, 4. Suppose, as an initial element we chose the number 2. Then in the second step mounted element can be one of the elements of the first order (25 or 4) or elements of the second order (1, 3, 24) having a connection (adjacent to the panel 2), i.e., fins connected to the selected cell 2 as the root of the graph (Figure 2). If we left Shan second choice on the element 24 at the third step, another panel may be mounted one of the following: a first order of 25 and 4: the second order of 2 or 3 with the panel and interconnecting elements 24 and 26 from the second 23 of the third order (Figure 2).

Thus, at each step of the candidate for the installation on the order of elements that can be higher and lower order which have connection with the previous mounted elements (Figure 2).

A given set of products in Table 1, it can be represented as a graph, with the requirements for sequence delivery to the consumer. Products can be independent or connected with each other. Note the following for each product or products that preceded it completely characterize the partial ordering graph. In this graph can be targeted or undirected, and represent a combination. These variants can be set and meet all possible requirements for the delivery of products.

To optimize the set of products, we used a modified branch and bound method, in which each vertex of the graph represents the number of concrete panels, characterized by the weight and dimensions of the product. Here it was given the task of drawing up a complete set to the total number of required components was minimal and necessary for the delivery of the entire list of products which it will contribute to the large value of the coefficient, capacity utilization reporting rolling stock.

For the preparation of the initial information set it is require to use the products and determine the version of the assembly. Then dismember list items is adjusted based on existing restrictions. A complete set of products, which boils down for planning the maximum load of the rolling stock of the same size, leads to the minimization of their quantity.

Managers and department equipment are interested in minimizing the number of sets which are possible under existing resources. The articles submitted to the packaging and the requirements are on the sequence of their delivery and, therefore, included in the kit (Figure 1). To achieve this goal, in accordance with the requirements and restrictions should solve the problem of groups of products included, taking into account the parameters are used by the vehicle. While minimizing the total required amount of sets using the graph, it can be founded for satisfying some given own weight sets. As a result, the vehicle configuration is selected with a maximum load capacity of utilization.

The Graph theory is gaining to increase interest among specialists in various fields of science and technology. Its attractiveness is due not only to the widest variety of possibilities of use, but also the beauty of the results achieved by simple means. Graph theory has been used in the paper for complete products. Interplay and consistency of delivery of products according to customer requirements can be conveniently represented by graphs.

It is known that the graph consists of two finite sets of elements called vertices and edges. Each edge is defined by a pair of vertices. If the edges of the graph are defined ordered pairs of vertices, then the graph is said to be oriented, otherwise the graph is undirected.

A given set of products can be represented as a graph, with the requirements on the order of their delivery to the consumer. Products can be independent or connected with each other.

Note the following issues for each product that preceded it completely for characterizing the partial ordering graph. In this graph it can be targeted or undirected, which represent of combination thereof. These variants can be set and meet all possible requirements.

To optimize the product structure, we used the modified branch and bound method, in which each vertex of the graph represents the number of products and is characterized by the weight and dimensions products while meeting the relevant restrictions

VI. MODEL OF SELECTION OF VEHICLE

Selection of vehicle with a maximum load capacity determines the product structure. The task of drawing up a complete set to the total number of required components was minimal necessary for delivery of the entire list of products. The considered rolling stock will contribute to the large value of the coefficient capacity utilization. As a result, a complete set of selected vehicle with the maximum load capacity obtained by

$$J_{\max} = \frac{\sum_i \sum_{ie} R_j q_i}{k q_n} \quad (7)$$

where k is the number of sets; R_j is the set of numbers of products included *vy* set; q_i is the ith weight of the product and q_n is payload considered vehicle. Subject to the constraints:

- On-duty vehicle;

$$\sum_{i \in R_j} q_i \delta_i \quad (8)$$

- The length of the platform vehicle;

$$\delta_i = \{ \begin{matrix} 1 \\ 0 \end{matrix}$$

$$\max \sum_{i \in R_j} l_i \delta_i \le L_k \quad (9)$$

- The width of the platform vehicle;

$$\sum_{ri \in R_j} \max b_i \delta_i \le B_k \quad (10)$$

integrality condition;

$$R \ge 0 \quad (11)$$

on the sequence of delivery of products;

$$\omega, \forall g, \;\; R, R+1, ..., m; \; \omega \le g \le R \quad (12)$$

which are the condition of carriage of goods for the delivery of products.

$$\sum_{i=1}^{k} R_j = m \quad (13)$$

The Graph structure and its topology are a set of vertices (products) and lines connecting them which show the sequence of delivery. Graph can be written adjacency matrix (cohesion) of the orders.

Along the main diagonal the bear is 1, and entry is set to 1, if there is an edge connecting a vertex to a vertex, and it is 0 if no edges. Vertices connected by an edge are called adjacent. The number of edges incident to the vertex (incoming or outgoing), is called the rank of the top. The top of the rank 1 is a dead end, and through it cannot pass any way.

The way from the top to top of an ordered sequence of edges starting at the ends is not passing twice through the exact same vertex, and therefore the end of each previous edges coincides with the beginning of the intermediate top rib later. These columns are the possible ways of taking into account the coupling. Valid path is the sum of the weights of vertices which does not exceed the permissible limit. We assume that the optimal path is the sum of the weights.

The developed algorithm configuration and programming, SET- PRN1 EXE, allow to optimize the capacity utilization rate of rolling stock. Main menu reflects tasks: 1- create a new database; 2- open an existing database; 3- open the database ves_svar; 4- exit.

If it is successful, the database name appears, and enter a value or -1. In this case, the default input parameters previously are used in rolling stock. After entering the vehicle, enter the product number from which to start the equipment. Packaging can be paused at any time after the formation of the next set. To continue with the development kits, press any button.

Note that after the formation, each set of raw data is excluded in the packaged products, i.e. the related parameters are automatically set to zero without changing the rest numbers. Therefore, while we get a modified adjacency matrix of the remaining products. With the resumption of equipment we can start it with any product for the desired alternative vehicles.

The proposed method provides the complete set of products and the objective to increase the using of various vehicles which are carrying the capacity for evidence-based on approach.

Figure 1 shows that the use of the rolling stock such as NAMI-790 load capacity of 19 t and 14 t, cassette-type would increase the utilization of rolling stock in the transport panels overlap to 0.95 and 0.966 with the number of sets of k=18-12. The current utilization of rolling stock varies from 0.7, it is obvious the opportunities to improve their performance over 35.74-36%. The components identified optimal parameters and trailer tape length L=6 m, width 0.6 m, as for all the sets have the maximum number of the calculated length L=5.62 m and a width of 0.4 m.

VII. CONCLUSION

1. Determining the optimum load capacity of rolling stock construction of large sizes should be based on the party panels, taking into account the technological possibilities of road transport.
2. Drawing up the technological transport schemes installation should take into account the conditions of effective using the rolling stock of optimal sets using by the computers.
3. The use the performance method in the theory of optimal control systems has allowed the product structure to obtain the solution of the problem of choosing the optimal size of the rolling stock.
4. Application of the method of choosing the optimal size of rolling stock provides a complete set of overlapping panels revealed option with improved performance of the rolling stock more than 38%.

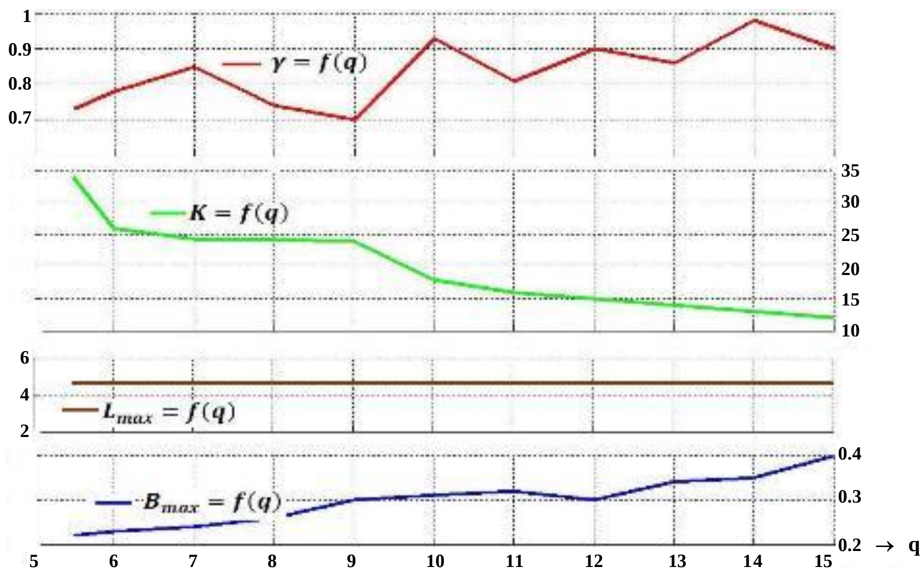

Figure 2. Results of calculation of the product structure

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BIOGRAPHY

Afik Allahverdi Allahverdiyev was born in Azerbaijan, in 1937. He received the M.Sc. degree in the field of Road Transport Operation as a Mechanical Engineer from the Polytechnic Institute of Azerbaijan, Baku, Azerbaijan in 1960. He completed his doctoral thesis on "Development of methods and models for optimizing trucking logistics" and graduated in Ph.D. degree in Automation of the Experimental Study from Faculty Retraining Discounts for New, Promising Areas of Science and Technology from Moscow Car and Road Institute, Russian Academy of Sciences, Moscow, Russia in 1985. Currently, he is an Academic of the Republican International Academician Modern Sciences behalf of Lutfi Zadeh. He is a Doctor of Sciences, Professor and Academic of the International Academy of Ecoenergy, Baku, Azerbaijan. He became a correspondent for the public finished the Republican Council of People's University. He is also a member of the Union of Journalists of Azerbaijan. He is the author of 165 scientific papers. His research interests cover the areas of fuzzy control, development of methods and models for the optimization of road transport and logistics automation and process control industries.