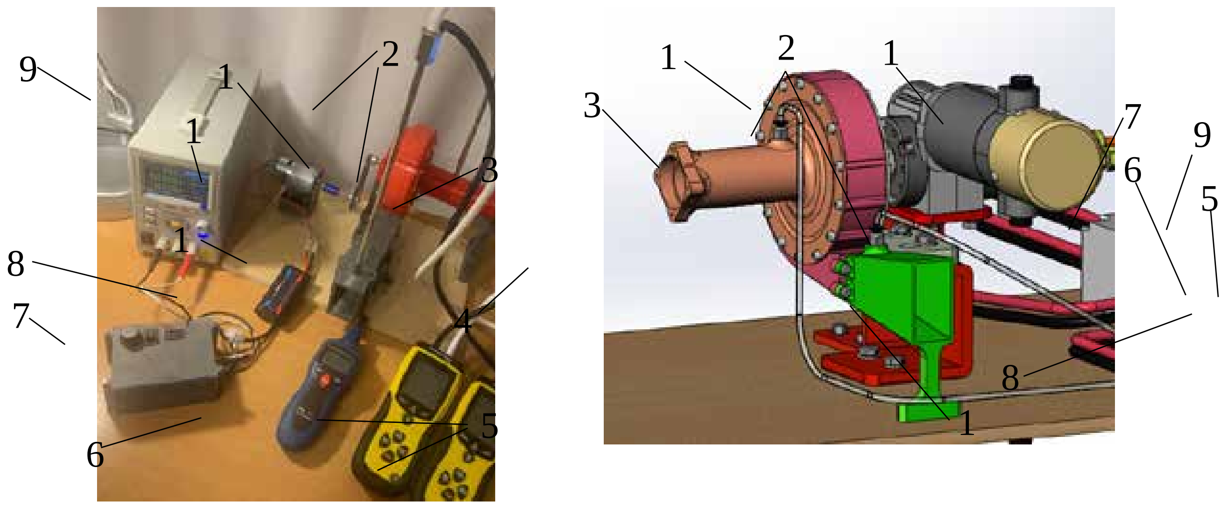

1 – ІВРВ (робоче колесо та равлик); 2 – трубка Піто; 3 – вхідний трубопровід; 4 – вхідний апарат (Вентурі); 5 – дифманометр; 6 – прилад для вимірювання кількості обертів (тахометр); 7 – регулятор обертів привідного двигуна; 8 – ватметр; 9 – лабораторне джерело живлення; 10 – привідний двигун; 11 – вихідний трубопровід.

Рис. 1.02. Лабораторний стенд–установка для випробувань ІВРВ

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ASSESSMENT OF LAYOUT SOLUTIONS FOR A SERVICE ENTERPRISE

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Problem statement. The most important condition for developing the material and technical base of society is the creation of modern enterprises based on advanced principles of production organization, with the broad introduction of comprehensive mechanization and automation of technological processes. During the design stage of technical service enterprises, tasks must be solved to optimize the sizes, capacities, layout solutions, and territorial placement of enterprises, improving labor productivity, and more. To align the service enterprise's subdivisions, select the optimal direction for the production process, internal transportation, and cargo and personnel flows, layout planning is carried out. Layout planning involves a schematic plan of the enterprise's building, showing production subdivisions, auxiliary, and utility-service rooms [1].

Layout planning is a complex and labor-intensive task due to the variety of requirements for the placement of production subdivisions: technological, construction, fire safety, sanitary and hygienic. This creates multiple solution options, meaning no single layout plan can be definitively correct. In practice, it is very difficult to fully meet all requirements, necessitating compromise solutions. Moreover, no quantitative indicators exist to evaluate the quality of layout solutions.

Main research materials. The initial data for creating a layout plan include technological processes, the composition of areas and other rooms located within the production building, and principles of layout to ensure their interconnection. Layout planning involves solving tasks to establish functional interconnections between areas and determine the placement of production zones. Layout solutions can vary, but by creating several options, the best one can be selected for further equipment planning. Rational plans feature short and relatively small cargo flows. Layout plan development resembles solving a transportation problem in mathematics with several planning constraints. Interconnections between areas are determined based on technological process schemes related to the movement of repair objects. The primary layout rule is aligning cargo movement direction with the production process direction. To achieve this, it is necessary to determine which parts move through production subdivisions and in what sequence, as well as their weights.

To select a rational layout plan for the production building and simplify its implementation, a cargo flow diagram is created. The cargo flow diagram shows the direction and weight of transported goods. Multiple cargo flow diagrams are made and analyzed to select the best option. The optimal layout is one that achieves a direct production process flow with the shortest cargo movement paths and the fewest reversing and crossing flows. Stages of the production process involving transportation, the weight of parts at each stage (or percentage of the entire machine’s weight), and the names of rooms or sections where production stages occur are conveniently entered into a table [2]. Instead of a table, cargo flow quantities can be calculated based on a "chess record." To create such a record and build a cargo flow graph, the chosen object is typically the machine model with the maximum workload during the busiest repair period. A disadvantage of the table or record is the difficulty of visualizing interconnections between areas; thus, a network graph may be created for clarity. To establish functional interconnections between production subdivisions, cargo departure and destination points and their weights or percentages of the overall repair object weight are determined, and a route scheme is developed. On the scheme, all departure and destination points (production sections) are shown in diamonds, and cargo movement sequences and directions are shown with arrows. To indicate the significance of connections between sections, the weight or percentage of total object weight is marked above the arrows (example in Figure 1) [3].

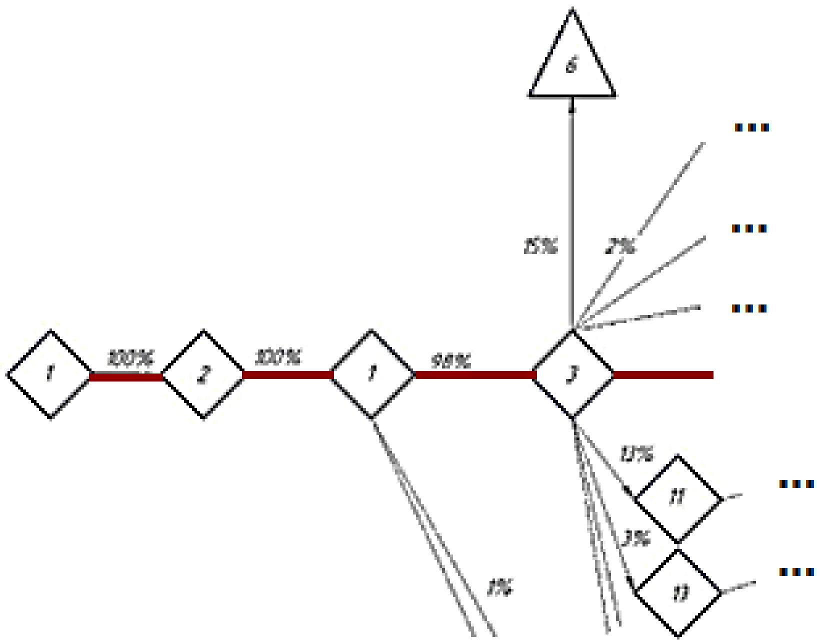

Fig. 1. Example of a network graph of cargo movement between sections

When constructing a cargo flow graph, the weight of transported goods is reflected by the width of the arrow showing cargo movement direction. The width can be scaled according to the weight or percentage of the object's repair weight. Arrows are marked with cargo weights or percentages of the total object's weight. For clarity, arrow colors can indicate the type of flow: green for repairable aggregates, nodes, and parts; blue for repaired products; red for rejected items. The arrows are connected according to the chosen technological process repair scheme.

The arrangement of sections should ensure the technological sequence of machine repair with minimal transportation distances. High-significance sections are prioritized in layout planning and placed adjacently where possible. These include sections for external machine washing → disassembly and washing → repair and assembly → filling and testing machines. Sections with minor cargo flows are placed in remaining areas, considering construction, fire safety, sanitary, and other requirements.

Tables and cargo flow graphs reveal sections requiring lifting and transport equipment, such as disassembly-washing, repair-assembly, and engine maintenance sections. When determining section placements, cargo flows must be considered alongside non-calculable factors like optimal working conditions (lighting, natural ventilation, etc.) and the potential for future expansion of main production sections.

Key rules for arranging sections in a service enterprise:

− mutual placement of disassembly-assembly and part recovery sections is determined by the technological process and primary cargo flow direction;

− part and node movement should follow the shortest path in line with technological sequence requirements, considering their weight and dimensions;

− fire-safe sections (welding, forging, metalwork, testing) should be isolated with fire-resistant walls and preferably located near external walls;

− rooms partitioned with walls should be placed near external building walls to simplify construction and ventilation;

− it is not recommended to separate areas from one another with partitions if this complies with the conditions for performing the technology, as well as safety or fire safety requirements, i.e., the technological processes carried out in these areas do not involve the release of harmful gases, moisture vapors, etc. (e.g., locksmith-mechanical, assembly, and other areas).

Conclusions. A properly designed cargo flow diagram helps rationally arrange production building subdivisions, identify sections requiring various lifting and transport equipment, and calculate equipment types and quantities.

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