KAPITEL 1 / *CHAPTER 1* [1]
OPTIMIZATION OF MATERIAL AND TECHNICAL SUPPORT DURING CONSTRUCTION OF AN INDUSTRIAL BUILDING IN ZAPORIZHZHIA

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Introduction

The relevance of the monograph's topic. Today, the construction industry requires significant reforms. Especially in terms of material and technical support. Since the construction industry cannot exist separately and independently from other industries of the general national economic system.

Therefore, the term construction complex frequently appears in many sources related to the construction industry. The construction complex is a complex multifunctional system of interconnections between industries that provide the construction industry with necessary material and technical resources.

Consideration of the construction complex as a whole and its constituent components allows us to conclude that construction can be considered a system that includes a set of interconnected and interdependent flows. The main ones are flows of information, material, technical and financial resources, etc.

It is known that in order to achieve the necessary results in reducing the construction period of buildings and structures, improving their quality at acceptable costs, it is essential to optimize and rationalize the relevant material flows that correspond to the specifics of the construction. In construction organizations and enterprises of the construction industry, material flows can be considered interconnected and interdependent processes of movement of own and attracted resources to achieve the set goals.

It is not a secret that construction as a system is primarily perceived through material and technical support of construction processes. In order to build any buildings and structures, the necessary amount of building materials, structures, products, raw materials, and technological equipment, indicated in the project for construction and assembly works, must be supplied. The process of organizing construction production

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involves the clear supply of these resources in the required volumes, specified terms, and the appropriate quality. Experience of various industries in the country and abroad shows that logistics is used to solve such tasks.

Within the framework of logistics systems, a number of tasks and their complexes are solved, including forecasting the need for building materials and controlling of stocks, collecting and processing of orders, and determining the sequence of material flows.

The subject of logistics is the comprehensive management of all material and non-material flows in the systems.

As one of the significant subjects of final consumption of material resources, the construction complex should be most interested in effective forms of their acquisition in rational use.

For materials, building structures and components, the rationalization of material flows in order to minimize the costs associated with them is of primary importance, which determines the feasibility and necessity of using logistics as an effective scientific tool for managing the formation and movement of material flows.

Having a clearly expressed productive heterogeneity in the construction cycle, the composition of materials at each stage of the cycle changes (when arranging foundations, erecting walls, roofing, interior works, construction of communications, etc.). Therefore, each stage of the construction cycle requires appropriate logistic solutions. If in industry the starting point for logistics solutions is the product, then in construction it is a stage of the construction cycle.

The above justifies the relevance of the selected topic in terms of optimization of material and technical support for the construction of an administrative and residential building in Zaporizhzhia.

The purpose of the monograph is to explore the theoretical and methodological aspects and practical possibilities to optimize the processes of material and technical support of the construction of an industrial building in Zaporizhzhia, using the logistics science and implementing its modern tools to improve the construction organization processes.

Main tasks:

- analysis of theoretical, normative and scientific sources regarding the optimization of material and technical support of construction;
- analysis of architectural and structural solutions of an industrial building in Zaporizhzhia;
- solving production issues related to the construction technology of an industrial building in Zaporizhzhia;
- optimization of material and technical support for the construction of an industrial building in Zaporizhzhia.

The object of the research is the production processes of construction and assembly works (CAW) during the construction of an industrial building in Zaporizhzhia.

The subject of the research is the mechanism and tools that will facilitate the optimization of the material and technical support for the construction of an industrial building in Zaporizhzhia.

Research methodology: analysis and evaluation of literary sources, economic-mathematical methods, modeling of CAW production processes, system analysis.

In the process of research, the results of domestic and foreign research institutes, which consider the problems of optimization of material and technical support for the construction of an industrial building in Zaporizhzhia in the context of the use of the logistics science, were studied and summarized.

Scientific novelty. It consists in the application of modern logistics science approaches to optimize the material and technical support of the construction of projects. Solving complex practical tasks in organizing construction, reducing construction period, and minimizing production costs of construction and assembly works.

Personal contribution. The main ideas and research results characterizing scientific novelty and practical significance were obtained personally by the author.

Approbation. The main provisions of the work were published at the specialized scientific and technical conference for students, graduate students, postgraduates and teachers of EESI named after Yu.M. Potebnia ZNU in the section "Industrial and Civil Engineering" (2024, Zaporizhzhia).

1. Theoretical analysis of organizational processes in context of the research object: provision of material and technical resources construction of projects

1.1.1. The essence of construction in modern market conditions

The construction industry is often criticized for excessive conservatism, standardization and bureaucracy in document processing. However, it is not easy to implement the latest technologies in construction, since the main requirements for construction projects are safety compliance, i.e. each technological process of construction and assembly works is based on a regulatory framework, standardization and must correspond to the pricing of construction products: the final cost of the project must be reasonable, and efficiency in reducing costs in the future – to be significant, plus, prolonged over time. Any technology requires appropriate design and a whole set of project teamwork, quality control, as well as staff training [5, 19, 22, 23].

A generally accepted definition of the term "capital construction" has not yet been formulated in many technical sources and specialized educational literature.

Construction – creation (erection) of buildings and structures [1]. Construction products are new or reconstructed buildings and structures, that are finished and prepared for commissioning [2].

Construction is characterized by a variety of production connections. Dozens, and in the case of large projects, hundreds of design, scientific, research, construction and assembly organizations, manufacturers of main technological equipment, suppliers of construction and assembly equipment and construction materials, structures, and products are involved in the construction of any project; banks and other country's economic entities, whose capital in one way or another is involved in construction. Despite the fact that the ultimate goal of all participants in the investment process is

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the same – obtaining the maximum possible profit, each participant has its own specific goals and tasks during the construction process. Therefore, there is a need to create an economic criterion that would unite all participants in the investment process in achieving a common goal – completion of construction within the specified time with minimal costs, rather than pursuing only their own interests [36].

In a broad sense, construction (as an industry) also includes major and current repairs of buildings and structures, as well as their reconstruction, restoration and renovation.

The construction process includes all organizational, research, design, construction, installation and commissioning works related to the creation, modification or demolition of the building, as well as interaction with the competent authorities regarding the production of such works.

Capital construction is the activity of the state, legal entities and individuals, aimed at creating new and modernizing existing fixed assets for production and non-production purposes. Capital construction is one of the most important sectors of material production of countries.

The concept of "capital construction" includes not only new construction – the construction of enterprises, roads, public buildings and structures, which is carried out on new sites; but also expansion – carrying out construction of subsequent phases of an existing enterprise based on a new project, additional production complexes; reconstruction – rebuilding of existing structures according to a new project, workshops and other buildings, technical re-equipment – implementing a complex of measures to raise the technical level of individual production sites, as well as restoration and capital repair of buildings and structures [41, 45].

One of the most acceptable definitions, in our opinion, is the following: Capital construction is the process of creating new, reconstructing, expanding and technical reequipment of existing projects of industrial and social infrastructure.

The difficulty of studying the aspects of capital construction lies in the variety of organizational and economic forms of the construction production process, a large number of participants with different functional goals and tasks, and the significant

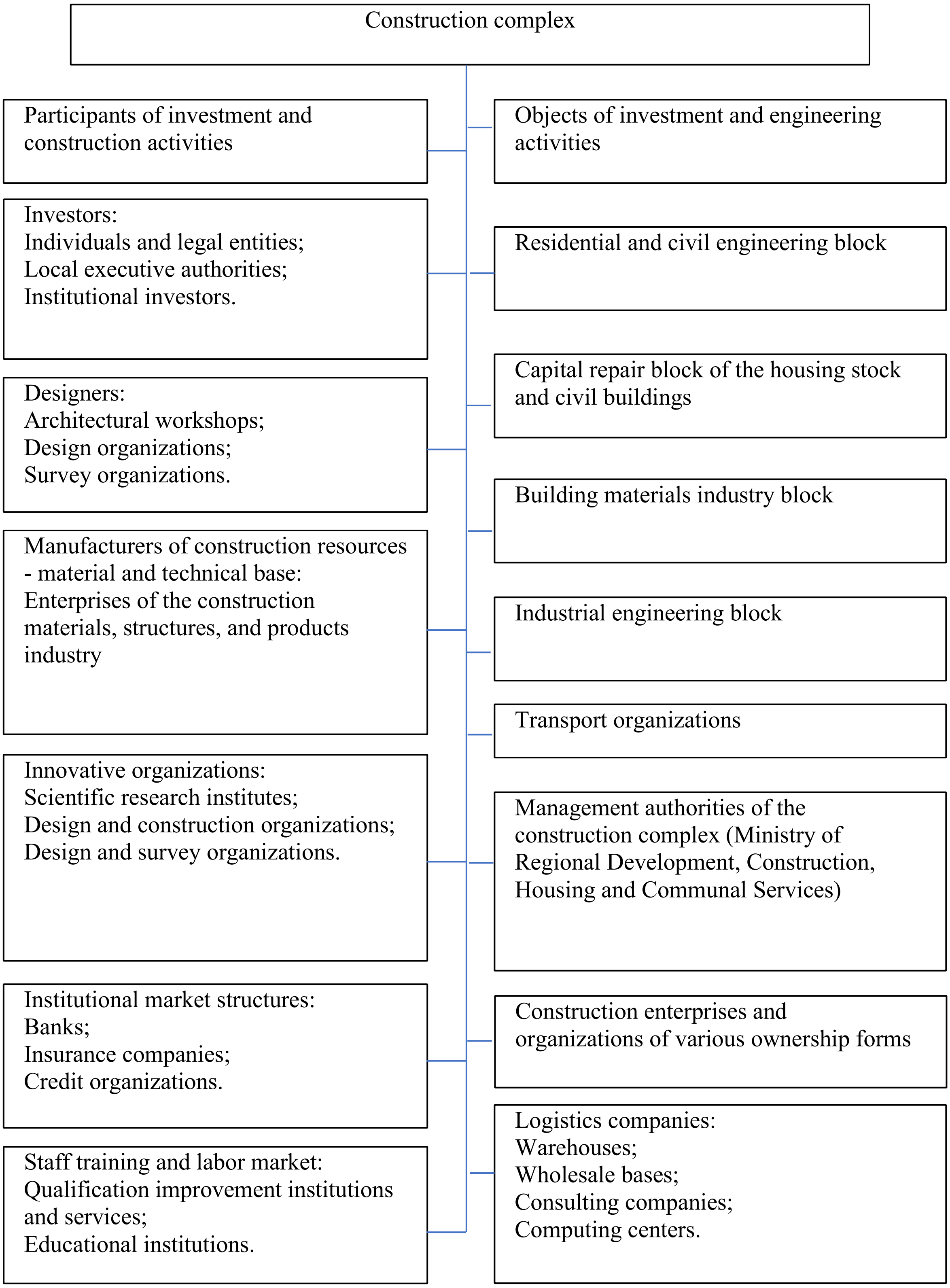

Figure 1.1 – Composition of the construction complex

dependence of the construction production process on natural conditions. Investor – customer – designer – contractor – specialized construction organizations – all these parties participate in the process of construction production (construction of any building). Besides these direct participants in the construction process, dozens of manufacturers of technological equipment, construction machines and materials are involved in creating construction products (Figure. 1.1).

But there is another distinguishing feature of this process, which is the characteristic of the long duration of the production cycle, a significant variety of construction objects, and the implementation of the production process at the site of the future functioning of fixed assets [5, 47].

1.1.2. The basic provisions on the organization and planning of construction

The sector unites the construction industry, the activities of customers, contractors, design and research institutes and organizations. It involves various sectors of the national economy, which provide construction with metal structures, cement, timber, machines, transport, fuel, and energy resources [1, 2, 4, 7].

Construction production is a complex of construction and assembly works, performed in a technological sequence, resulting in the creation of finished construction products [1, 2, 4, 7].

Construction production is a set of works that are combined in a certain way and are performed by various co-executors – customers, designers, builders, suppliers of construction materials, structures, products, technological equipment, etc. The number of such co-participants in the construction of a single project reaches several dozens, and sometimes even hundreds.

Three stages are distinguished in construction production: 1. Preparation for construction – technical and economic research of feasibility of construction; design, engineering and technical preparation for construction. 2. Direct execution of construction – combination of all technological elements of the construction process in order to create construction products. 3. Realization of marketable construction products – commissioning of completed projects and their transfer to the customer as the main production and non-production assets [11, 23].

Under these conditions, the final result – the receipt of finished construction products in the form of finished buildings and structures – depends on the arrangement and synchronization of related works by individual executors, i.e., on the level of production organization.

In general, the organization of construction production is understood as the form, order of combining the work of individual co-executors with the material elements of production and separate construction and assembly, and specialized processes among themselves in space and time to ensure the fullest use of existing and new equipment, labor, material, and financial resources and increasing the profitability and production efficiency on this basis.

The organization of construction production during the erection of individual buildings, structures or their complexes involves the organization of [26]:

- preparatory works, i.e. works related to the development of organizational and technological documentation on the production technology of construction and assembly works, planning and control over the progress of both individual projects and their complexes;

- general construction works, i.e. works on the preparation of the construction site of the project (structure) – vertical planning, construction of temporary buildings, structures, communications, as well as construction of permanent buildings and structures.

Basic provisions of organization:

- construction and assembly works related to the construction of communications that will be used during construction of individual buildings and structures in accordance with concluded subcontracts;
- production base of construction (quarries, production enterprises, fleets of construction machines and vehicles, warehouses, etc.).

The main tasks of the organization of construction production are [41, 45]:

- steady reduction of the cost of work and increasing production profitability;
- increase the volume of performed works and the output of finished construction products;
- any increase in labor productivity;
- strict economy and thrifty consumption of material resources;

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- maximum use of existing fixed assets;
- rational use of working capital and acceleration of its turnover;
- improving working conditions and raising the technical and material level of workers.

The organization of construction production includes measures for [DBN]:

a) calendar planning of preparatory and construction works, taking into account the necessary deadlines for the completion of construction and the execution of individual stages of work, agreed by the actions of construction participants, compliance with the requirements of legislation, normative acts and documents;

b) labor and material and technical support for the execution of planned works;

c) rational organization of work and mechanization of labor;

d) management of the execution of production processes according to the requirements of design decisions, taking into account the composition, volumes, terms and season of work execution, technological sequence requirements, possibilities of mechanization, composition and qualifications of work performers;

e) achieving the design operational properties of the construction project, ensuring the appropriate quality of construction products;

f) ensuring comprehensive construction safety, including protection and preservation of the environment – natural, social, technogenic and compliance with the requirements of DSTU (State Standards of Ukraine) [12] regarding hazardous factors of the production environment, severity, and intensity of the labor process;

g) implementation of author's and technical supervision [8, 9] during the construction of projects, as well as, if necessary, scientific and technical support in accordance with DBN B. 1.2-5;

h) acceptance of completed works and completed construction projects.

When addressing issues of the construction production organization, it is necessary to be guided by the following basic provisions (principles): that stem from the trends of scientific and technical progress and advanced construction experience.

Proportionality of production, which assumes compliance with each other of all production capacities of construction, assembly and specialized organizations involved in the erection of individual projects or their complexes in a specified (planned) period of time.

The basis for maintaining of this proportionality is the inclusion in the structure of each construction organization of the main and auxiliary production links that correspond to each other. For example, when creating house-building plants, the production capacities of the industrial and construction departments, which respectively carry out the production and assembly of structures, must be mutually coordinated.

One of the methods of implementing proportionality in production is calendar and operational planning, during which tasks are selected for each production link and executor, based on its production capacity.

Methods of organizing construction processes [27, 28, 30-33].

The flow-line method of construction organization [34].

With the flow-line method, the overall technological construction process is divided into parts (for example, arranging foundations, erecting walls and ceilings, coatings, etc.), which are performed by separate crews. In this case, work on the next project (division) starts immediately after finishing on the previous project. Thus, the work is performed without interruption. Separate works in the flow-line method are performed in parallel.

The flow-line method is a progressive method of organizing construction production. The essence of the flow-line method is the organization of sequential, continuous and rhythmic production of construction works, which allows the effective use of material and labor resources. The flow assumes the release of certain volumes of construction products at regular intervals, increasing the profitability of construction. Experience shows that transition to "flow" reduces construction duration by an average of 20%, labor productivity increases by 8-10%.

With the flow-line method of construction organization, the process of construction production is divided into separate components and operations, the implementation of which is entrusted to separate complex crews or specialized groups.

When organizing construction using the flow-line method, the erection of the building is usually divided into the following cycles: preparatory, zero cycle, erection of the above-ground part and finishing works.

The current method is complemented by the industrialization of construction, that is, the continuous transformation of the construction process into a mechanized process of flow assembly of buildings and structures from factory-made components.

In construction practice, for the planning and management of construction flows, construction processes are modeled using graphic representation: linear and network schedules are developed.

The flow-line methods of construction organization [27]:

Thus, in the serial production of industrial products, the main chain is *the flow line – a set of workplaces located along the course of the technological process and intended to perform the technological operations assigned to them.*

The main parameters of flow production are: *rhythm* – the time interval between the release of two consecutive products (details); *pace* – the number of products (details) that are produced per unit of time.

With the flow-line method, the following principles of production organization are implemented:

rhythmicity – regular repetition of production operations at equal time intervals;

proportionality – equality or multiplicity of the duration of technological operations at workplaces;

parallelism – simultaneous execution of technological processes at different workplaces;

continuity – continuous execution of processes within a work shift.

The essence of the flow-line organization of construction [11]:

The main features of flow-line production are also used in the flow organization of construction. However, compared to industrial production, construction has specific characteristics, such as:

- immobility of construction projects (products), which necessitates the movement of work crews (crews) together with construction machines and equipment;

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- a significant influence of climatic conditions on the execution of technological processes (a large amount of work in construction is carried out outdoors).

For these reasons, it is much more difficult to organize flow-line production in construction than in industry.

According to the specifics of construction production, the main flow link in construction is a specialized team equipped with appropriate construction machines, equipment and tools.

The essence of the flow-line method will be explained on the example of organizing the construction of several identical projects, for example, one-story buildings [11].

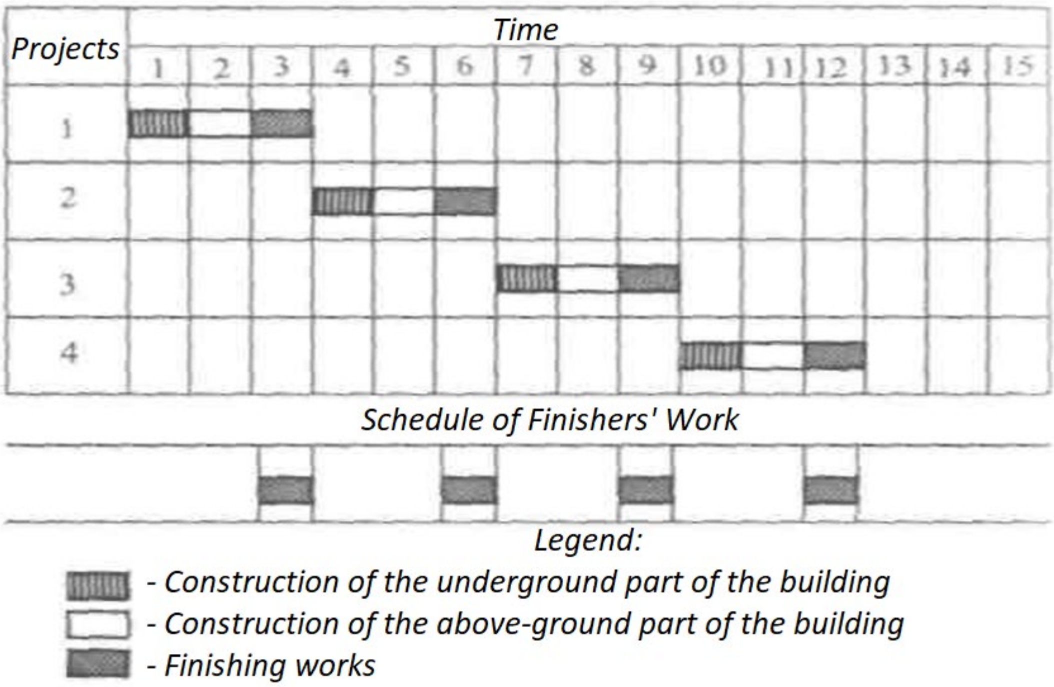

Figure 1.2 – Construction schedule of projects with the sequential work method for crews

Flow design in construction consists of the following stages [11]:

1. To identify the projects that will be constructed using the flow method; it is desirable that these projects should be identical or similar in terms of volume-planning, structural solutions, and the labor intensity of various construction and assembly works. Typical residential or industrial buildings, as well as linear structures (roads, canals, pipelines, electrical networks, etc.) best meet these

requirements.

2. The construction of each project is divided into separate technological processes, preferably equal or multiple in terms of labor intensity.
3. To determine the rational technological sequence of the execution of processes taking into account the volume-planning solutions of the project and occupational safety requirements.

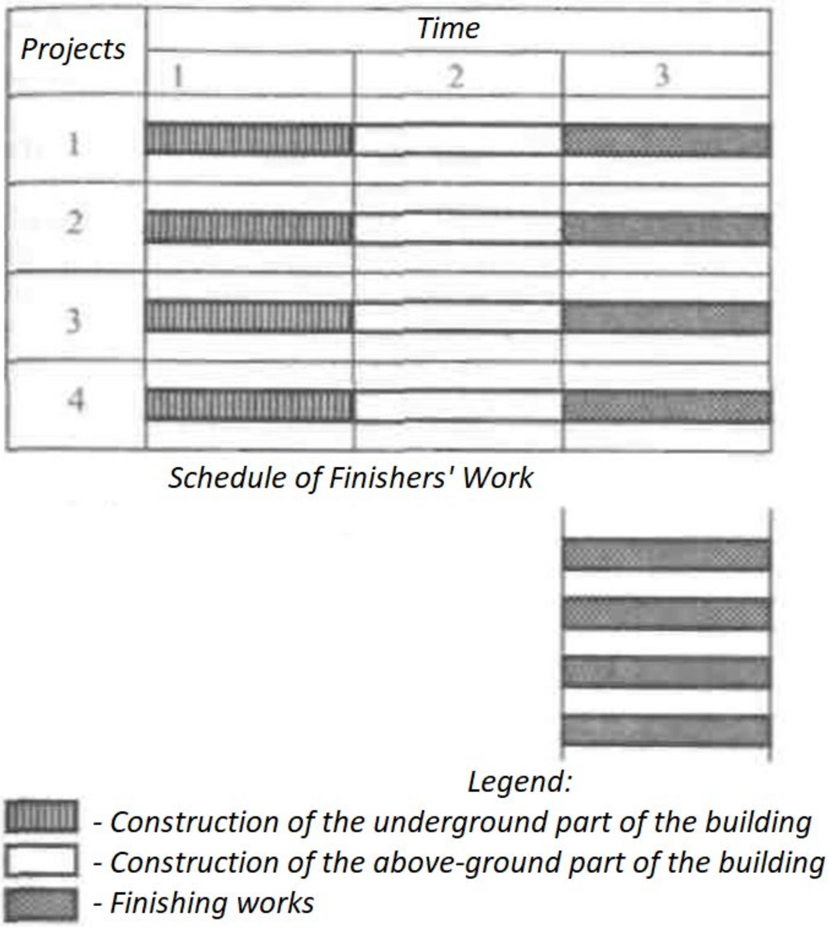

Figure 1.3 – Schedule of finishers' work

The flow-line method of construction and assembly works combines sequential and parallel methods, preserving the advantages of both while eliminating the disadvantages of each of them. Let us suppose that it is necessary to lay *m* identical external sewage networks. The main processes for laying each of the networks will include trench excavation, installation of an artificial base, laying pipelines at a given direction and slope with joint sealing, hydraulic testing and backfilling of trenches. As noted above, the specified processes are executed sequentially, but it is not necessary to wait for the end of one process on the entire route in order to start the next one. The entire route can be divided into sections called *divisions,* with the calculation that on all divisions the volume of work during the execution of the main homogeneous processes is the same. If for the performance of these volumes of work, the number of each team is assumed to be the same, the duration of its work on the division was also the same, then the number of divisions will correspond to the number of main processes in the complex production process.

The flow-line method is the one of construction organization, which ensures a planned and rhythmic release of finished construction products, based on continuous and uniform work of crews (units) of constant composition, provided with timely and complete supply of all necessary material and technical resources [11, 27, 28, 31, 35, 41-44].

Non-flow methods occur in the irregular production output, which is characterized by product release at uncertain or varying intervals and in different quantities. It is not coincidental that flow-line construction methods have found the greatest application at house-building plants (HBP), where the production is most homogeneous. The main principle of the flow method in construction is the full use of the production capacity of the construction organization with uniform and continuous loading of grassroots construction units (construction sites, crews, units and individual workers). When organizing the flow in construction, a complex construction process is divided into simpler processes or operations [2, 5, 11].

Each simple process is assigned to a separate specialized team or unit. The entire front of works is divided into several sections (divisions). Crews (or units), keeping their constant composition, move uniformly across the general work front, transitioning from one division to another.

The first team (or unit) always performs the first process in technological order, while the last brigade completes the work and leaves the finished section. Thus, the work is carried out simultaneously in several divisions, and in each division, it is at a different readiness stage.

The advantages of the flow-line method turned out to be so obvious that it spread to many construction sites in our country. The field of application of the flow-line method is very wide: this method can be used to carry out individual construction processes, the construction of individual buildings (flow on individual projects) and, finally, the construction of a whole complex of projects (flow in the construction of residential areas or industrial enterprises) [11, 27, 28, 31, 35, 41-44].

The parallel method significantly speeds up production. With this method, the same type of work is performed simultaneously on different projects, the duration of construction is equal to the construction time of one project, the intensity of consumption of material and technical resources is the greatest. With the parallel method, the construction of all buildings begins and ends at the same time. The main advantage of the parallel method of building houses is the minimum construction period [11, 27, 28, 31, 35, 41-44].

The following disadvantages can be noted [11, 27, 28, 31, 35, 41-44]:

- a significant amount of equipment and labor is required to implement the method;
- the maximum consumption of resources of each type at each specific moment of time (high simultaneous demand for sets of earthmoving and transport machines, assembly cranes, construction structures of a certain type, etc., necessary for the simultaneous construction of *m* buildings);
- the type and range of consumed resources are constantly changing.

The sequential construction method has the following advantages:

- the total number of workers engaged in the construction remains constant and has the minimum possible value;
- the level of resource consumption is also minimal.

Despite the noted advantages, this method is not free from disadvantages.

Disadvantages of the sequential method:

- significant overall construction duration;
- inevitable downtime of machines, crews, certain difficulties in manufacturing plants, transport and supply organizations, caused by frequent changes in types of materials and structures.

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The division of the construction process into separate technological processes, the specialization of executors, the different intensity of the performance of individual works and the consumption of resources determines the mathematical dependencies between the operations of the production process, determining their quantitative characteristics and the sizes of production units.

Therefore, having established the patterns and quantitative dependencies that take place in construction processes, it is possible to increase the construction production efficiency due to the use of modern economic and mathematical methods and personal computers in the development of organizational and technological documents and the design of the flow organization of production. The task of construction flow design is to determine its parameters, which, taking into account rational technology and work organization, ensure the construction of projects within the standard duration, continuous loading of resources (crews, machines, mechanisms) and uninterrupted construction and assembly work on each project [11, 27, 28, 31, 35 ,41-44].

The design of the construction flow is based on data on volume-planning and structural solutions of project to be included in the flow, by grouping of similar buildings or parts for each type of building, taking into account the specialization and number of crews, machines and mechanisms that can perform given types and scope of works. The main task of flow calculation is to reduce the construction duration, ensuring the most productive use of workers and mechanisms due to the saturation of the work front with the maximum number of resources. At the same time, all calculations should be based on the real number of resources that can be allocated by the relevant construction organizations to perform the volume of work according to the flow [11, 27, 28, 31, 35, 41-44].

1.1.3. Modern tools of material and technical support in terms of the application of the logistics science

The innovation of logistics consists, firstly, in a change of priorities in the economic practice of construction firms, where the central focus is on the optimization of the management of resource movement processes. Secondly, the novelty of logistics

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consists in the use of a comprehensive approach to the issues of the movement of material resources in the process of production support and improvement of economic ties with the enterprises within production cluster, which ensures a better coordination of the participants of this process. Thirdly, the novelty of logistics consists in the use of the theory of compromises among the participants of the production cluster, which allows to obtain a general result [1, 4, 6, 7, 23].

A number of scientists give an answer to one question "What is logistics?".

Professor Rezera S.M. understands logistics as "*the science of planning, control and management of transportation, storage and other material and non-material operations carried out in the process of delivering raw materials and materials to the production enterprise, in-plant processing of raw materials, materials and semi-finished products, delivery of finished products to the consumer according to the his interests and requirements, as well as transfer, storage and processing of relevant information"* [8, 9, 15].

Professors Myrotyn L.B. and Nekraov A.H. formulated a short definition "...logistics is a time-dependent location of resources, or strategic management of the entire supply chain" [18].

The US Council of Logistics Management in 1976 amended the definition of logistics to: "*Logistics is* the *process of planning and ensuring (including control) the effective and continuous inflow of goods, services and related information from the place where they are created to consumers, aimed at the full satisfaction of consumer requests"* [17].

This definition does not cover all the specific concepts that are included in the functional area, it reflects the need for unified management of product and material flows from the source of raw materials and materials to the point of distribution of the finished product.

Scientist Stakhanov V.M. made following definition: "...Logistics is a process of planning, implementation and control of efficient and cost-effective moving and storing of materials, semi-finished products and finished products, as well as obtaining information about the supply of goods from the place of production to the place of consumption in accordance with the requirements of the client" [3, 21, 24].

Let us summarize the main terms of "logistics" in (Table 1.1).

After researching and analyzing these terms (Table 1.1), we can derive a definition of logistics that meets the needs of the construction industry – the science of organization, planning, management and control over the movement of materials and accompanying information and financial flows based on a systematic approach in any logistics systems.

Logistics in construction is a modern tool that will simplify the organizational processes of construction [1, 4].

Construction production has a significant specificity from a logistics point of view. The main factors of logistic receptivity of construction production are [21, 24]:

- the constantly growing need for production rationalization, aimed at simultaneously reducing construction time and improving the quality of construction products;
- reorientation of construction firms narrow-function construction to solving customer problems;
- unification of construction technologies up to the implementation of information technologies;
- high material intensity of construction production and, therefore, the need to find additional ways to reduce the share of material costs in the cost of construction products;
- the increase in the degree of individualization of the production process in both residential and other types of construction, which inevitably leads to the expansion of the range of consumed material resources, diversity in payment schemes for finished products, and construction and contracting work, etc.;
- territorial separation of the firm's construction sites, which increases transport and procurement costs for material and technical support, which also necessitates their minimization;

Table 1.1 – Definitions of the term "logistics" by domestic and foreign scientists and specialists [1, 4]

Scientific school	Author	Definition
The Institute of World Economy and International Relations of the Russian Academy of Sciences	Fedorov L.S. Dr. Econ. Sciences, Prof.	Logistics – is the improvement of the management of the movement of material flows from the primary source of raw materials to the final consumer of finished products and related information and financial flows based on a systems approach and economic compromises to achieve a synergy effect. Logistics – is a form of optimizing market relations, harmonizing the interests of all participants in the chain of movement of goods.
State University — Higher School of Economics	Sergieiev V.I. Dr. Econ. Sciences, Prof.; Sterligova A.N., PhD, assoc. prof.	Logistics is the science of management and optimization of material and related flows (informational, financial, service, etc.) in micro- and macro-economic systems. Logistics – is management of material flows, service flows and related information and financial flows in the logistics system to achieve the set goals.
Ternopil Commercial Institute	Smyrychanskyi A.V. Dr. Econ. Sciences, Prof	Logistics is an integral management tool that contributes to the achievement of strategic, tactical and operational goals of the business organization due to effective (in terms of reducing total costs and meeting the quality requirements of final consumers for products, works, and services) management of material and/or service flows, as well as accompanying informational and financial flows, control and regulation of the movement of material and information flows in space and time from the primary source of their origin to the final consumer.

- barterization of commodity exchange operations and the use of non-monetary forms of payment for completed construction and assembly works (especially this applies to residential construction), which makes it necessary

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to turn to specialized intermediary organizations or create your own sales services.

The logistics system of a construction company is an organized organizational and technological structure in which the management and implementation of the movement of the logistics flow is carried out by means of the execution of a set of logistics operations in order to meet the production demand in material resources in a timely manner, and consumers (buyers, customers) – in finished construction products with minimal logistics costs [16].

Suppliers of material and technical resources for construction are [1,4,16,18]:

- manufacturing enterprises that produce appropriate products for industrial and technical purposes (mainly building materials) and sell them on the market;
- subcontractors, who, on a contractual (agreement) basis with the general contractor (construction company), perform not only special construction and assembly works, but also in most cases provide construction with special materials and equipment;
- trade and intermediary organizations specializing in the resale of material and technical resources used in construction;
- importing firms, i.e. the same trade and intermediary organizations, but specializing in the purchase of materials and equipment abroad and their delivery to the domestic market;
- specialized firms performing special types of production, logistics or commercial operations.

Structural elements of the infrastructure of construction logistics systems [1, 4, 21]:

- transport, including all transport organizations ensuring the spatial movement of material and technical resources from the places of their production to the places of consumption;
- communication, including all communication operators ensuring the movement of information flows in the material and technical support of

construction;

- equipment, which means a set of enterprises and organizations, the main purpose of which is production and technological equipment of construction.

The main operations for the management of material and technical support of a construction company are:

- determination of the company's needs in material and technical resources in accordance with consumer orders for construction products or in accordance with the approved design and estimate documentation;
- studying market conditions and establishing rational economic relations for the procurement (supply) of material and technical resources;
- in-house planning of materials supply for construction, including the development of operational schedules for the supply of projects under construction;
- organization of supply of purchased material and technical resources and management of production stocks;
- combination of construction and supply technologies, organization of production and technological equipment of buildings (projects) and management of unfinished production stocks;
- operative management of materials supply for construction, control and regulation of these processes.

Procurement logistics in capital construction is the activity of managing the supply of material and technical resources, production and technological equipment of construction, maximally synchronized with the production of construction products, ensuring the deadlines agreed with customers for its commissioning at the lowest costs.

Tasks of procurement logistics in construction [21]:

- the procurement of material and technical resources should be carried out in accordance with the needs of construction production, which involves the appropriate organization and management of material, informational and financial flows for material and technical supply of construction;
- creation of a system of production and technological equipment of

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construction, where material and technical resources arrive at construction sites in the most prepared form for production consumption according to schedules linked to construction technology;

- the supply of construction production with material and tangible elements should be subordinated to the main goal - the timely and quality execution of customer orders;
- minimization of procurement and logistics costs with a given level of reliability and efficiency of the material and technical supply of construction system.

Since finished products in construction are buildings, industrial facilities, etc., distribution logistics in the material aspect represents the sale to the relevant investor.

1.1.4. Concepts and types of logistics

The concept of logistics is a system of views on the rationalization of the production and commercial activities of enterprises by optimizing logistics flows.

Currently, three concepts of logistics have been developed [1, 4, 9, 17, 21].

The first concept is mainly supported by former supply representatives. They believe that logistics is material and technical supply, and the subject of logistics is the management of material flows.

The second concept includes management of the movement of material flows (supply and procurement, loading and unloading, transport, forwarding, customs, warehouse operations and inventory regulation), which were previously independent. However, internal production processes are omitted [1, 4, 9, 17, 21].

The third concept includes management of logistics flows throughout the entire cycle of supply, production and distribution of products. This concept is the most progressive.

A concept is a system of views on a particular phenomenon or process.

Based on this, the system of views on the rationalization of economic activity by optimizing supply processes is the concept of logistics [1, 4, 9, 17, 21].

The material flow is understood as a set of raw materials, materials, and semi-finished products that, in the form of objects of labor, arrive from suppliers to production units and, transforming into finished labor products, through distribution channels reach consumers. Circulation includes the arrival of material resources into the warehouse of the enterprise, their transfer to the workshop for the initial operation, transporting of unfinished labor products within the workshop, between workshops and, finally, after the end of all operations, the movement of finished labor products outside the enterprise to the sphere of their consumption [1, 4, 9, 17, 21].

Consideration of these formally heterogeneous, but unified in content, processes as an integral complex plays an important role. It is clear that the functions that form the material flow of industrial production are technologically interconnected, and the costs caused by them are economically dependent. This means that changes in one activity will affect all others, and efforts to reduce individual costs can lead to higher total costs.

The conceptual approach to the development of the logistics system assumes that logistics functions are considered as a crucial subsystem of the overall corporate system. This means that logistics systems should be created and managed based on the overall goal of achieving maximum efficiency of the entire construction organization (firm) [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

Insufficiently prompt actions of the supply department can negatively affect the operation of the production-dispatch department, and disruptions in the work of the latter, in turn, disorganize the sales apparatus activities. The desire to optimize the functioning of production units can lead to warehouse overload with certain types of products and untimely supply of others. Low shipping costs will become very high if the shipping service sacrifices delivery speed and reliability or if it requires excessively expensive packaging. Moreover, reducing transportation costs may increase storage costs. The larger the volume of the batch of parts that are put into production, the lower the setup costs of equipment. However, the costs of storing work-in-progress are increasing. Conversely, as batch size decreases, storage costs decrease, and setup costs increase. The location of production facilities, warehouses, and technical inspection points affects transportation costs [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The JUST-IN-TIME concept. Period of appearance: late 1950s [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of just-in-time concept:

Delivery of the necessary material resources at the required time to the required place or the supply of material resources directly before their launch into production or the synchronization of the supply with the production schedule [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

Goals and objectives [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40]:

- minimal (zero) stocks of material resources, work-in-progress, finished products;
- reduction of production cycles;
- procurement relationships with a small number of reliable suppliers and carriers;
- effective information support;
- high quality of finished products and logistic services.

Key points:

Demand plays a decisive role, regulating the movement of material resources and finished products. Logistics systems are "pull" systems.

Advantages:

Application of this concept significantly improves the quality of produced goods, reduces the production costs, almost eliminates safety stocks, and accelerates the turnover of the company's working capital.

The DRP concept – Distribution requirements planning [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of the DRP concept:

The main tool of logistics management in the DRP system is a schedule that coordinates the entire process of supplies and replenishment of finished products in the distribution network [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

Goals and objectives:

Plans and regulates stock levels at the firm's bases and warehouses in its own product-producing sales network or at wholesale distributors.

Key points:

It is based on consumer demand, which is not controlled by the firm

Advantages:

- reduction of logistics costs associated with storage and management of stocks of finished products;
- reduction of stock levels due to accurate determination of the quantity and place of supply;
- reducing the need for warehouse space due to the reduction of stocks;
- reduction of the transportation costs through effective feedback on orders;
- improving coordination between distribution and production.

The MRP concept – "Materials / manufacturing requirements / resource planning" [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of the MRP concept:

- meeting the need for material resources when planning production and delivery of products to consumers;
- maintaining a minimum level of production stocks;
- planning of production operations;
- planning of procurement operations and the schedule of delivery of material resources to the enterprise at minimal costs.
- Goals and objectives:
- satisfaction of needs in materials, components and products for production planning and delivery to consumers;
- maintaining low levels of material resources and finished products in stocks,
- planning of production operations, delivery schedules, procurement operations.

Key points:

Ensures the inflow of the planned amount of material resources and product stocks over the planning period. It starts by determining how much and when it is necessary to produce the final product.

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Advantages:

It is an effective planning technique, integrating functional areas of business, allowing the implementation of the logistics concept in material flow management.

The "LEAN PRODUCTION" concept [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of the LEAN PRODUCTION concept:

The essence of this concept is expressed in the creative combination of the following main components:

- high quality;
- small production batches;
- low stock levels;
- highly qualified personnel;
- flexible equipment.

Goals and objectives:

- high standards of product quality;
- low production costs;
- quick response to consumer demand;

Key points:

- reduction of preparatory and completion time;
- reduction of production batches;
- reduction of the main production time;
- quality control of all processes;
- reduction of production logistics costs;
- partnership with reliable suppliers.

Advantages:

It requires significantly fewer resources than mass production – fewer stock, less time to produce a unit of product, less losses from defects, because production batches and production time are minimized.

The "QUICK RESPONSE" (QR) concept [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of the QUICK RESPONSE concept [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40]:

The quick response method is the logistics coordination between retailers and wholesalers.

Goals and objectives:

Improving the promotion of finished products in their distribution networks in response to the additional changes in demand.

Key points:

Implementation of these concepts is carried out by monitoring retail sales and transmitting information about sales volumes for the specified nomenclature and assortment to wholesalers, and from them to manufacturers of finished products.

Advantages:

It allows us to reduce the stocks of finished products to the required level, but not below the value that allows us to quickly satisfy consumer demand, and at the same time significantly increase the turnover of stocks.

The "Kanban" concept (from the Japanese Kanban - "map") [1, 4, 8, 9, 16, 17, 18, 21, 24, 37-40].

The essence of the Kanban concept:

All production units, including the final assembly lines, are provided with material resources strictly according to the production schedule and only in the amount and by the time required to fulfill the order.

Goals and objectives:

- rational organization and balanced production;
- comprehensive quality management at all stages of the production process and the quality of initial material resources;
- partnership with reliable suppliers and carriers;
- increased professional responsibility of all personnel.

Key points:

The means of transmitting information about the need for material resources in this system is a special Kanban card.

Advantages:

There is a way to implement the "just in time" logistics concept in practice.

The "AUTOMATIC REPLENISHMENT" concept [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

The essence of the AUTOMATIC REPLENISHMENT concept:

An even more improved concept of QR and CR [1, 4, 8, 9, 15, 16, 17, 18, 21, 24, 37-40].

Goals and objectives:

Provides suppliers (manufacturers) of finished products with the necessary set of rules for making decisions on product attributes and categories.

Key points:

A category is a combination of size, color and associated products, usually presented together in a certain point of sale of a retail network.

Advantages:

By applying this concept, a supplier can meet the needs of retailers in a product category by eliminating the need to track unit sales and stock levels for rapid implementation items. This strategy also allows to reduce the expenses of retailers, related to the separation of stocks and ensuring the reliability of their replenishment.

1.2. Analysis of architectural and construction solutions of the industrial building in Zaporizhzhia

1.2.1. Initial data for design

Industrial building project in Zaporizhzhia

The building has a rectangular shape with dimensions of 42x15m. The floor heights are 3.6m and 3.3m.

- Building area – 1,890 m^2
- Construction volume of the building – 23,614 m^3
  including: underground part – 1,991 m^3
- Total building area – 6,668 m^2
- Useful area – 5,427 m^2

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The construction site is located in the III climatic zone. The prevailing wind directions are:

- for the winter period – northeastern;
- for the summer period – northern, northeastern.

The average annual air temperature is +9ºC; the average temperature of the hottest month (July) is +22.8ºC; of the coldest month (January) is - 4.9ºC.

The average annual rainfall is 516 mm.

The ground freezing depth is 0.80 m.

There are no underground mining operations, karst voids, or explored fossils under the territory of the construction site.

The topography of the site is flat with a slight slope from northwest to southwest, from an elevation of 72.80 to 70.70, with an overall slope of 0.018.

Engineering and geological studies: vegetation layer – 1.3 m; loess loam – 8.8 m; fine-grained sand – 8 m. Groundwater level at depth of 21 m. The waters are non-aggressive.

The building belongs to the II degree of fire resistance.

1.2.2. Master plan

The construction site is located in the left-bank part of the Leninskyi District in Zaporizhzhia, within an existing residential development.

The site is bordered by:

- Northwest – Maiakovskyi ave.;
- Northeast – Patriotychna str.;
- Southeast – Lermontova str.;
- Southwest – Peremohy str.

Transport connections of the site with the residential area are carried out by city transport. Access to the building is facilitated by existing roadways on Peremohy Street and Maiakovskyi ave.; parking for private vehicles is also planned.

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1.2.3. Spatial planning solutions

The designed building has an important urban planning significance in the building system of Peremohy, Patriotychna, and Lermontova Streets.

The expressiveness of the architectural composition and the unity of the ensemble is achieved by the plasticity of building's facades, the scale in combination with constructive logic, construction techniques, and harmony with the functional requirements of the project and the surrounding development.

Placement of the building on the site ensures standard and superior insulation of nearby residential buildings.

The building has dimensions of 42.0x15.0 m; floor heights are 3.3 and 3.6 m. The building houses the services and laboratories of the joint-stock company. Under the first floor there is a basement, containing warehouse facilities, a diesel generator station, and technical premises.

The architectural and compositional solution of the facades is determined by the spatial planning structure of the building with the use of modern finishing and protective structures.

The main facade is designed with an inclined plane of the external wall, made of individually manufactured aluminum and polymer-coated stained-glass windows. Both the plane of the inclined external wall and the triangular part of the building, protruding beyond the edge of the external wall, also made of aluminum-stained glass, give the building a unique appearance on the main facade.

External expanded clay concrete wall panels and external brick walls were faced with "Etalbond" type aluminum panels in light beige color. The basement and first floors on all facades were faced with dark gray granite slabs measuring 1200x600mm.

The porch of the main entrance was lined with granite.

Window blocks are made of aluminum, filled with single-chamber double-glazed windows.

Stained-glass windows and lobby vestibules are aluminum with a polymer coating, binding on a steel frame filled with heat-reflective glass.

- The doors are wooden, covered with clear varnish.

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- The roof is flat, rolled with a protective layer of gravel.
- The interiors are designed in a strict business style, which corresponds to the purpose of the building. Modern finishing materials are used in the interior decoration: plastic, drywall, aluminum, decorative coatings, glass, wood.

Lighting calculation

Lighting is lateral, single-sided.

The windows are metal-plastic (aluminum profile) filled with single-chamber double-glazed windows, with a height of 1.82 m.

With single-sided lateral lighting, we determine the area of light openings according to the formula (L.1 DBN V. 2.5.-28-2006):

$$100\frac{S_0}{S_n} = \frac{e_n \cdot K_r \cdot \eta_0}{\tau_0 \cdot r_1} K_b$$

where S_0 is the determined area of light openings (in light) with lateral lighting;

S_n – floor area of the room. S_n =6.15×6.03=37.08;

e_n - normative value of coefficient of natural light (KEO) (for public buildings KEO = 1.0% according to Appendix K DBN V. 2.5.-28-2006);

Kr – the reserve factor, which is accepted according to (Table 3);

ηo – light characteristic of windows, determined according to DBN V. 2.5-28-2006.

η0 = 18.6

$$\frac{l_n}{B} = \frac{6.030}{6.150} = 0.988 \approx 1$$

$$\frac{B}{h_1} = \frac{6,.50}{1,.20} = 3.2$$

we accept by interpolation η_0 = 18.6.

B – the depth of the room

h_1 – height from the level of the conventional working surface to the top of the window.

τ_0 – total light transmission coefficient:

$\tau_0 = \tau_1 \times \tau_2 \times \tau_3 \times \tau_4 \times \tau_5$, with lateral illumination τ_4, τ_5 are not taken into account (τ_1=0.8, τ_2=0.85, τ_3=1).

Then τ_0=0.8×0.85×1=0.68

r1 - the coefficient that takes into account the increase in KEO during lateral lighting due to the light reflected from the surfaces of the room and of the underlying layer adjacent to the building, which is accepted according to table L.5 DBN V. 2.5-28-2006.

r1 =2.2:

$$\frac{B}{h_1} = 3{,}38$$

$$\frac{l}{B} = \frac{5}{6.15} = 0.81$$

ℓ – distance to the calculation point;

$\rho_{average}$ =0.4.

$$\frac{l_n}{B} = \frac{6.03}{6.150} = 0.988 \approx 1$$

ℓ_n – room length;

r1=2.2.

K_b – coefficient that takes into account the shading of windows by opposite buildings, determined according to DBN V. 2.5-28-2006.

In the project, the distance "P" to the opposite building (dormitory) is 35 m, the mark of the cornice of its roof is 28.2 m, the mark of the bottom of the window of the typical floor of the administrative building is 7.8 m.

$$\frac{\mathrm{P}}{\mathrm{H}_b} = \frac{35}{20.4} = 1.71$$

at $\frac{\mathrm{P}}{\mathrm{H}_b}$ = 1.71 – K_b = 1.15.

$$\frac{100 \cdot S_0}{37.08} = \frac{1 \cdot 1.2 \cdot 18.6 \cdot 1.15}{0.68 \cdot 2.2}$$

$$100 \cdot S_0 = \frac{951.7}{1.496} = 636m^2$$

$S_0 = \frac{636}{100} = 6.36m^2$ – area of two window openings

S=3.18 m^2 – the area of one opening

When h_{approx} = 1.82 m – b_{approx} = 1.74m

The project uses windows measuring 1.82 x 1.82 m (on three sides of the building, except for the axes of G-K with stained glass windows).

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Accepted window openings comply with sanitary and technical standards.

1.2.4. Design solutions

The building is a prefabricated reinforced concrete frame, designed according to the 1.020-1/83 series (link version). The spatial stability of the building is ensured by the combined work of vertical rigidity diaphragms and horizontal slabs (rigidity discs). Horizontal forces are perceived by reinforced concrete rigidity diaphragms, which are installed in the plane and from the plane of the frames.

In order to prevent the adverse effects of planting soils when they are soaked on the deformation of the building foundation, the project envisages the cutting of the planting layer with pile foundations. As piles we use driven stacked piles with a cross-section of 350x350 mm, and a length of 25.28m. To ensure the piles are driven to the design marks, the project envisages driving them into pilot wells with a diameter of 400 mm.

The grillages are made of monolithic reinforced concrete of the columnar type.

Part of the sloping wall enclosure of the main facade is resolved by arranging metal frames that work together with the reinforced concrete frame of the building.

The intermediate floor slabs a made of prefabricated multi-hollow reinforced concrete slabs.

Wall panels are made of expanded clay concrete, with a thickness of 350 mm and a volumetric weight of 1,100 kg/m ^{3}.

Corrosion protection of the piles from aggressive groundwater is achieved by using sulfate-resistant Portland cement concrete for the piles.

Heat engineering calculation of wall enclosure (Figure 2.1)

Where:

1. Expanded clay concrete γ= 1,100 kg/m^3; δ=315 mm
2. Cement-sand mortar δ=35 mm.
3. Insulation – basalt fiber.
4. Drywall sheet δ= 12 mm.

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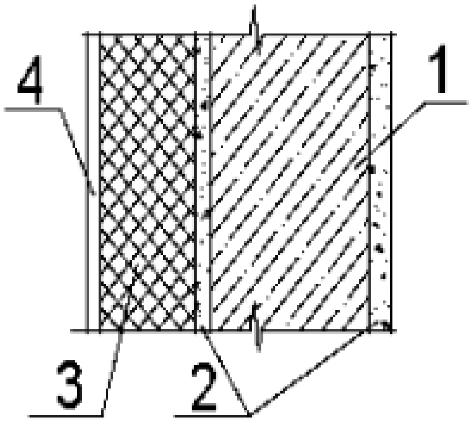

Figure 2.1 - Heat engineering calculation of wall enclosure.

We determine the operating conditions:

$t_в$=18°C.

Indoor air humidity is 60%.

Room mode – normal (DBN V. 2.5.-28-2006).

Humidity zone – dry (DBN V. 2.5.-28-2006).

Operating conditions – A (according to Appendix 2).

The heat transfer resistance of the protecting structure R_o should be no less than the required heat transfer resistance R^r_o.

Heat transfer resistance of the enclosing structure R^r_o for Zaporizhzhia is equal to 2.1 m^2×°C/W according to the table. 1a, Amendment 1.

The heat transfer resistance of the enclosing wall structure adopted in the project is determined by the formula (1):

$$R_0 = \frac{1}{\alpha_B} + R_k + \frac{1}{\alpha_H} \quad (1)$$

where α_B = 8.7 W/m^2×°C; α_H = 23 W/m^2×°C according to DBN V. 2.5.-28-2006, table. 6

R_k is the sum of the heat transfer resistances of the layers of enclosing wall structure.

$$R = \frac{\delta}{\lambda}$$

where δ is the thickness of the layer, m;

λ is the thermal conductivity coefficient of the layer material, W/(m×ºC).

$$R_1 = \frac{0.315}{0.385} = 0.818$$

$$R_2 = \frac{0.035}{0.76} = 0.046$$

$$R_3 = \frac{X}{0.038}$$

$$R_0 = \frac{1}{8.7} + R_К + \frac{1}{23} = 0.114 + R_К + 0.043$$

$$R_К = 0.818 + 0.046 + 0.046 + \frac{X}{0.038} = 0,91 + \frac{X}{0.038} = R_К$$

$$R_0 = 0.114 + 0.043 + 0.91 + \frac{X}{0.038} \geq 2.1$$

$$1.067 + \frac{X}{0.038} = 2.1$$

$$0.04 + X = 0.08$$

$$X = 0.04$$

At the thickness of the insulation, made of basalt fiber "RockwooL", 40 mm – the condition is fulfilled.

$R^r_o \geq R_o$

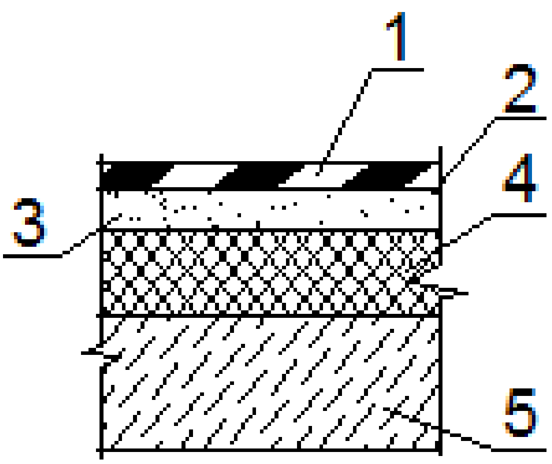

Figure 2.2 - Heat engineering calculation of the roof

Heat engineering calculation of the roof (Figure 2.2):

1. Ruberoid (4 layers) – 8 mm.

2. Bitumen mastic – 10 mm.

3. Cement-sand mortar – 15 mm.

4. Insulation – basalt fiber.

5. Prefabricated reinforced concrete slabs – 220 mm.

We determine the operating conditions:

$t_в$=18°C.

Indoor air humidity is 60%.

Room mode – normal (DBN V. 2.5.-28-2006).

Humidity zone – dry (DBN V. 2.5.-28-2006).

Operating conditions – A (according to Appendix 2).

The heat transfer resistance of the protecting structure R_o should be no less than the required heat transfer resistance R^r_o.

Heat transfer resistance of coverings and overlapping R^r_o for Zaporizhzhia is equal to 2.5 m^2×°C/W according to the table. 1a, Amendment 1.

The heat transfer resistance of the enclosing wall structure adopted in the project is determined by the formula (3):

$$R_0 = \frac{1}{\alpha_B} + R_k + \frac{1}{\alpha_H} \quad (3)$$

where α_B = 8.7 W/m^2×°C; α_H = 12 W/m^2×°C

R_k is the sum of the heat transfer resistances of the layers of enclosing wall structure.

$$R = \frac{\delta}{\lambda}$$

$$R_1 = \frac{0.007}{0.17} = 0.047$$

$$R_2 = \frac{0.001}{0.27} = 0.037$$

$$R_3 = \frac{0.015}{0.76} = 0.002$$

$$R_4 = \frac{X}{0.038}$$

$$R_5 = \frac{0.22}{1.92} = 0.115$$

$$R_0 = \frac{1}{8.7} + R_К + \frac{1}{12} = 0.114 + R_К + 0.083$$

$$R_K = 0.047 + 0.037 + 0.02 + \frac{X}{0.038} + 0.115 = 0.219 + \frac{X}{0.038}$$

$$R_0 = 0.114 + 0.219 + \frac{X}{0.038} + 0.083 \geq 2.5$$

$$0.416 + \frac{X}{0.058} = 2.5$$

$$0.024 + X = 0.12$$

$$X = 0.12 - 0.024 = 0.092$$

$$X = 0.092$$

At the thickness of the insulation, made of basalt fiber "RockwooL", 92 mm – the condition is fulfilled.

$R^r_o \geq R_o$

1.2.5. Sanitary and technical equipment

Heating, ventilation and air conditioning systems are designed in the building.

The source of heat supply for the building is the city's external heating networks. The heat carrier is water with temperatures:

- 140 – 70°C – for heat supply systems of radiators, stairwell heating, workshops;

- 105 – 70 °C – for heating systems of service premises.

The project includes facade-based automatic regulation of air parameters to the calculated values using elevator units with the installation of " Elektronika-5" regulators on them. Air parameter control and regulation sensors are located in control rooms and outside.

Heat consumption accounting and control are carried out using measuring and regulating devices installed on the control unit of the heat point.

Supply and exhaust air ducts, as well as air conditioning systems are laid in shafts and in suspended ceilings.

Mitsubishi "DR" type air conditioners are installed on each floor in the elevator lobbies.

The designed building is located on a site free of buildings and is in close proximity to city communications.

Water consumption for external fire extinguishing is 30 l/s. Fire extinguishing is carried out from existing fire hydrants.

The building's water supply is provided by two inlets with a diameter of 80 mm and a total length of 115 m. The inlets are made of galvanized steel water-gas pipes with highly reinforced anti-corrosion insulation.

The pressure at the connection points is 25 m. Shut-off valves are installed in wells. Wells are designed from prefabricated reinforced concrete elements.

Domestic wastewater is discharged into the city collector with a diameter of 200 mm. Sewage from sanitary units is discharged by two outlets with a diameter of 100 mm and a total length of 80 m.

Pipelines for sewage networks are made from cast iron sewer pipes.

The designed building includes:

- telephone communication via the Unified Automated Communication Network of the country (EACC);
- administrative and economic communication from the institution's digital PBX for 300 numbers;
- radio broadcasting from the city radio relay node.

Radiofication of the building is carried out by connecting to city radio broadcasting networks through a radio mast installed on the roof.

Automatic IP-105 and DIP-3 type heat and smoke fire detectors installed on the ceilings of protected premises and manual fire detectors of the IPR type installed on evacuation routes are used as fire detectors. The fire alarm networks are routed together with the radio broadcasting networks.

1.3. Optimization of material and technical support of the construction of an industrial building in Zaporizhzhia

1.3.1. Solving practical problems related to the organization of the construction of an industrial building in Zaporizhzhia

We carry out the development of the building construction organization as a section of the work production project in accordance with the requirements of DBN

A.3.1.-5-2009 "Organization of construction production", DBN A.3.2-2-2009 "Labor safety and industrial safety in construction", DNAOP No. 0-1.03.93 "Rules for the arrangement and safe operation of cranes", DBN V.1.1.7–2002 "Fire safety of construction sites", DSTU 2272-93 "Fire Safety Rules in Ukraine. NAPB - 01.001-05-2005", DSTU B A.3.2-15:2011. Lighting standards for construction sites (GOST 12.1.046-85).

The initial data for its development are:

- architectural and structural drawings
- climatic and hydrogeological characteristics of the construction area
- technological maps for the execution of certain types of works, which consider the methods of production of works and the technological sequence of their execution
- local and project estimates.

The construction site has a calm terrain with some existing structures. These structures, as well as existing trees, are subject to dismantling and uprooting during the preparatory period.

Local building materials, structures and parts are used for construction, which are delivered by motor vehicles along existing transport highways. The distance for transporting concrete is 16 km, and for other materials is 30 km.

The construction site is supplied with electricity from the existing nearby transformer substation, water – from the existing water supply network. The sanitary and living conditions of workers at the construction site are provided in accordance with the accepted norms, and temporary buildings and structures for these purposes are chosen based on standardized typical sections.

The planned start of construction is March 5, 2023.

Before the start of construction, the following preparatory work must be carried out on the site: dismantling the building and clearing the territory, engineering preparation of the site – grading the territory with organized stormwater drainage, arrangement of temporary roads, networks, temporary buildings and structures.

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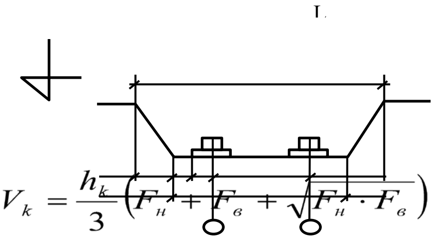
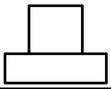
Table 3. 1 – List of the work scope

Name of works	UOM	Sketch and calculation formula	Scope of work
1	2	3	4
1. Soil development by a "backhoe" excavator - in the dump - loading into vehicles	1000 m^3	 $V_k = \frac{h_k}{3}\left(F_{н} + F_{в} + \sqrt{F_{н} \cdot F_{в}}\right)$	0.17 0.844
2. Cutting of under-excavated soil	100 m ^{3}	Thickness of 0.2 m	0.17
3. Backfilling and soil compaction	1000 m ^{3}	$V_{backfill} = V_{exc}$	0.17
4. Pile driving	pile		212
5. Arrangement of monolithic strip foundations	m ^{3}		2.61
6. Foundation waterproofing: - horizontal; - lateral coating	100 m^2		0.39 1.67
7 . Masonry of walls from lightweight concrete blocks	m^3		120.33
8 . Laying of floor slabs	pcs		741
9. Brick partitions	m^2		34
10 . Filling window openings with metal-plastic blocks	m^2	Ok1- 1.81x1, 81 -2pcs; OK2- 1.81x2, 41-2pcs; OK3- 1.81x2, 11- 7pcs; OK4- 1.81x0, 91- 1pc	437
1 1. Filling the holes with imported door blocks	m^2	D1 - 2.07x0, 91 - 4 pcs.; D2- 2.07x0, 67 - 2 pcs.; D3- 2.07x1, 01-4pcs; D4-2.07x1, 31-6 pcs.	349.5
12. Floors: type 1 – mosaic; type 2 – linoleum type 3 – ceramic tiles; type 4 – concrete;	m^2		1.02 0.22 0.54 0.17
13. Plastering work	100 m^2		3.38
14. Painting inside the premises	100 m^2		2.6
15. Glazing	100 m^2		0.437
16. Arrangement of porches	m^2		17.22
17. External cladding of walls with panels	100 m^2		0.46
18. Facing the plinth with granite	100 m^2	H= 0.6 m	0.4
19. Paving around the building	100 m^2	1.5 m around the building	0.985

Additional measures for the safety of construction and assembly work have been

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developed. The duration of the preparatory period is 1.5 months (35 days).

In order to reduce the duration of the construction of the building, the maximum combination of construction processes in time is provided, and the most time-consuming processes (arrangement of monolithic structures, floors, roofs, painting and plastering works) must be performed using small mechanization tools.

1.3.2. Development of a calendar plan for the construction of the project

We develop a building construction calendar in the form of a network diagram.

The network diagram for the construction of the facility is developed in the following sequence:

a) based on the nomenclature and labor intensity of the works (see the local estimate), and knowing the technological sequence of their execution, we compile the topology of the network diagram. At the same time, all works are grouped so that they can be performed by one comprehensive team (for example, arrangement of monolithic foundations, roofing, etc.), costs are summed up;

b) the duration of work, the number of workers in a shift and changeability, are determined in the work card (Table 3.2);

c) the time parameters of the network diagram are calculated (Table. 3.3);

d) linear work production schedule is built on an early completion basis. Summing up the daily need for workers, a resource loading chart is constructed, and the coefficient of uneven use of workers is determined:

$K_u = N_{max} / N_{av} \leq 1.5$

where N_{max} is the maximum number of employees per day N_{max} = 30 people;

N_{av} is the average number of workers per day $N_{av} = Q/T_{cr}$ = 7,749/369 = 21 people.

Q is a labor costs in the most loaded shift; man-days, Q = 8,450 man-days;

T_{cr} is a duration of the critical path of the network diagram, days, T_{cr} = 369

K_u = 30/21= 1.43

Adjusting the network diagram to achieve more even resource utilization is not required.

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Table 3.3 - Calculation of the network diagram

№	Work code		N_{ij}	T	Early deadlines		Late deadlines		Time reserves		Critical path	T_{sk}	N_{sk}
	i	J											
1	1	2	4	10	0	10	0	10	0	0	*	0	4
2	2	3	5	21	10	31	10	31	0	0	*	10	5
3	3	4	0	10	31	41	31	41	0	0	*	31	10
4	3	5	10	23	31	54	33	56	2	0		41	12
5	4	6	2	15	41	56	41	56	0	0	*	54	9
6	5	6	0	0	54	54	56	56	2	2		56	11
7	5	7	7	7	54	61	60	67	6	6		61	4
8	6	7	4	11	56	67	56	67	0	0	*	67	10
9	7	8	10	83	67	150	67	150	0	0	*	150	18
10	8	9	4	26	150	176	211	237	61	0		163	20
11	8	12	6	13	150	163	150	163	0	0	*	176	24
12	8	13	8	40	150	190	153	193	3	0		190	24
13	9	10	8	40	176	216	237	277	61	0		204	28
14	10	11	10	76	216	292	277	353	61	0		216	30
15	11	18	3	6	292	298	353	359	61	61		226	24
16	12	13	0	0	163	163	193	193	30	27		243	18
17	12	15	8	83	163	246	163	246	0	0	*	246	28
18	13	14	8	14	190	204	193	207	3	0		292	21
19	14	15	6	39	204	243	207	246	3	3		296	11
20	14	16	6	22	204	226	224	246	20	20		298	8
21	15	16	0	0	246	246	246	246	0	0	*	301	8
22	15	17	10	50	246	296	251	301	5	5		359	5
23	16	17	8	55	246	301	246	301	0	0	*	369	0
24	17	18	8	58	301	359	301	359	0	0	*		
25	18	19	5	10	359	369	359	369	0	0	*		

Table 3.4- Need for construction machines and mechanisms

Machines and mechanisms	Brand, type	Technical characteristics	Q-ty, pcs	Engine power, kW (HP)	Duration of stay at the construction site (date)	
					start	end
1	2	3	4	5	6	7
Bulldozers	D-494A	Swivel, blade length 4.15 m, height 1m	1	79 kW [108 HP]		
Caterpillar diesel excavators	E505	bucket capacity 0.65 m^3	1	48		
Pneumatic rammer	I-157	Air consumption $2m^3$/min	2	-		
Road roller			2			
Crawler cranes	MKG-16	load capacity 20 t boom length 10m lifting height 9.5m	1	79		
Tower crane	KB 602	load capacity 8 t boom length 20 m lifting height 19.5 m	1	110		
Crawler crane	MKG-6.3	load capacity 6.3 t boom length 10 m lifting height 10 m	1	55		
Welding Equipment	TD-300		1	20		

Machines and mechanisms	Brand, type	Technical characteristics	Q-ty, pcs	Engine power, kW (HP)	Duration of stay at the construction site (date)	
					start	end
1	2	3	4	5	6	7
Portable Compressor Unit	CO-7A	pressure up to 686 kPa [7 at], supply 2.2 m^3/min	1	4.0		
Vibrator	I-18		2	0.8		
Bituminous mastics application machine	CO-122A		1	4.9		
Mortar Pump	CO-49B	productivity 3 m^3/h	1	4.0		
Motor Rollers	D-130A	Weight 5 tons	1			
Construction mast lifts	TP-17	load capacity 0.5 t	2	2.8		
Electric pump units with manual adjustment for mortar supply		supply of mortar 2 m^3/h, pressure 150 m	2	4.0		
Vibrolath	Z-47		1	0.6		
Electric paint sprayer	Z-61		2	0.27		
Flatbed Trucks	MAZ	load capacity up to 5 t	2			
Flatbed Trucks		load capacity up to 8 t	1			
Dump trucks		load capacity up to 7 t	2			

1.3.3. Designing of the construction master plan

For the organization of construction of a building and the rational use of the construction site, we are developing a project construction master plan at a scale of 1:200.

The master plan primarily shows the location and coordination of the main construction machinery and mechanisms, whose operating radius determines the safe placement of all auxiliary facilities.

According to the developed technological map on the erection of the building frame, work is carried out using KB 602 tower cranes. The distance between the building and crane's movement axis is determined to ensure a safe distance between the building and the crane.

The service area of the tower crane is determined by the maximum required reach of the hook during installation, which is 20m. The crane's danger zone is taken as no less than the zone of possible load drop, which is the maximum reach of the hook plus 7m, at a potential drop height of up to 20m.

The master plan shows the installation locations of concrete pumps and

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compressor units.

Materials are supplied to the roof using two TP-17 mast lifts with a load capacity of 0.5 tons each, which are installed after dismantling the crane. The dangerous zone of the lift is 5 m.

The roads. For the delivery of materials and structures to the construction site during the preparatory period, a circular temporary gravel road 3.5m wide is arranged. Unloading areas 2.5m wide and 18m long are arranged. The road curvature radius is 12m. The dangerous part of the road, which falls within the limits of the cargo movement zone, is shown in hatching on the master plan. To prevent traffic passing through this zone, detour paths 3.5m wide and with a 12m curvature radius have been designed.

Temporary buildings and structures.

To ensure normal conditions for the implementation of CAW and sanitary and living conditions of workers, temporary buildings and structures are designed according to typical unified sections based on the maximum number of workers, engineering and technical personnel, and employees. ($N_t = N_{work} + N_{eng} + N_{emp} + +N_{SS}$)* 1.05 = 36 людини).

Table 3.5 – Ratio of categories of employees

Workers	Engineering and technical personnel	Employees	Service staff
85%	8%	5%	2%
30 people	3 people	2 people	1 person

At the same time, women make up 40% – 14 people from the maximum number of workers, men – 60% – 22 people.

The calculation of the necessary areas of temporary buildings and structures is given in (Table 3.6).

Temporary buildings and structures are located outside the crane's danger zone. The site manager's office (foreman) is located near the site entrance. Utility premises are located in one zone near the entrance. The service radius of the sanitary unit is no more than 100 m.

Warehouses. Placement of the construction in the master plan is made on the basis of ensuring the shortest material transport path with minimal reloading.

Covered warehouses are located near the border of the crane's operating zone, and open warehouses are located inside this zone. (Required area of warehouses – see Table 5.7). The border of open material storage areas is no more than 0.5-1.0 m from the edge of the road. Concrete reception is arranged in $1m^3$ buckets at the road's expanded section.

Networks. Temporary networks of water supply, sewage, electricity supply are located on the free area of the construction site, considering the requirement for minimal length.

The source of temporary water supply is the existing factory network. In order to comply with fire safety requirements, the temporary fire water supply is combined with the household water supply, made of steel pipes with a diameter of 125mm and equipped with two fire hydrants located no more than 150m apart and 2.5m from the road. Additionally, sand buckets, fire shields, and designated smoking areas are provided. The temporary water supply is buried 0.3m deep.

For temporary power supply, a mobile transformer substation KTPN-72M-160 is designed according to the required calculated capacity with a mixed power supply scheme. The overhead power grid runs along the perimeter of the site along the fence; there are lanterns every 20m; there are also additional spotlights on temporary supports at the corners of the site and additionally at near assembly work areas.

The master plan also provides for the laying of low-voltage networks (radio, telephone) and dispatching communication means.

During the entire period of construction, the site is protected by an inventory metal fence with 2 entrances/exits.

Calculation of temporary water supply.

The calculation is performed for the period of maximum water consumption. Total water consumption consists of production, household and drinking needs and water consumption for showers.

$$Q_{total} = Q_{pr} + Q_{h\text{-}d} + Q_{sh} \quad (3.1)$$

Production needs

Table 3.9 – Water consumption during the "zero" cycle works.

№	Name of processes	UOM	Daily scope of work	Specific water consumption, l	Coefficient of water consumption unevenness
1	Work of an excavator with an internal combustion engine	veh-hour	6.67	15	1.5
2	Excavator refueling	1 veh.	2	120	1.25

$$Q^{1}_{pr} = \Sigma\frac{V\cdot q_1\cdot K_1}{1000\cdot 8.2} = \frac{6.67\cdot 15\cdot 1.5}{1000\cdot 8.2} + \frac{2\cdot 120\cdot 1.25}{1000\cdot 8.2} = 0.02 + 0.04 = 0.06 m^3/h$$

Table 3.10 – Water consumption during the above-ground construction works.

№	**Name of processes**	UOM	Daily scope of work	Specific water consumption, l	Coefficient of water consumption unevenness
2	Brickwork	thousand pcs	12.29	150	1.5
3	Watering of brickwork	thousand pcs	12.29	200	1.5

$$Q^{2}_{pr} = \frac{12.29\cdot 150\cdot 1.5}{1000\cdot 8.2} + \frac{12{,}29\cdot 200\cdot 1.5}{1000\cdot 8.2} = 0.34 + 0.45 = 0.79 m^3/h$$

Table 3.11 - Water consumption during finishing works.

№	Name of processes	UOM	Daily scope of work	Specific water consumption, l	Coefficient of water consumption unevenness
1	Plaster works	m²	111.6	7-8	1.5
2	Painting works	m²	146.8	1	1.5
3	Arrangement of floors	m²	8.13	30	1.5

$$Q^{3}_{pr} = \frac{111.6\cdot 8\cdot 1.5}{1000\cdot 8.2} + \frac{146.8\cdot 1\cdot 1.5}{1000\cdot 8.2} + \frac{8.13\cdot 30\cdot 1.5}{1000\cdot 8.2} = 0.163 + 0.05 + 0.03 = 0.243 m^3/h$$

$$Q_{pr} = \max\{Q^{1}_{pr}; Q^{2}_{pr}; Q^{3}_{pr}\} = 0.79\ m^3/h$$

Consumption of water for household and drinking needs.

$$Q_{h\text{-}d} = \frac{N_t\cdot q_2\cdot K_2}{1000\cdot 8.2} = \frac{43\cdot 25\cdot 2}{1000\cdot 8.2} = 0.24 m^3/h$$

N_t – total number of employees;
q_2 – specific consumption of water per 1 person (q_2 = 25 l);

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K_2 – coefficient of hourly unevenness of water consumption (K_2 =2);

Water consumption for showers

$$Q_{sh} = \frac{N_1 \cdot q_3 \cdot K_3}{1000 \cdot t} = \frac{11 \cdot 30 \cdot 1}{1000 \cdot 0.75} = 0.4 \text{ m}^3/\text{h};$$

where N_1 = 30% of N_{max} = 0.3·37 = 10 people – the number of workers who take a shower after the shift (t = 0.75 hours);

q_3 = 30 l – specific water consumption for 1 person;

K_3 = 1 is the coefficient of water consumption unevenness.

The total water consumption will be:

Q_{total} = 0.79 + 0.24 + 0.4 = 1.43 m³/h

Water consumption for fire-fighting needs is 10 l/sec or 36 m³/h for a construction site area of up to 30 hectares.

According to the water flow data, the diameter of the pipe is determined:

$$D = \sqrt{\frac{4Q_{flow}}{\pi \cdot V \cdot 3600}} = \sqrt{\frac{4 \cdot 36.715}{3.14 \cdot 1.2 \cdot 3600}} = 0.104\text{m}$$

Q_{total} = 1.43 m³/h

Q_{calc} = max
Q_{fire} + 0.5 Q_{total} = 36 + 0.715 = 36.751 m³/h

π = 3.14
υ = 1.2 m/s - speed of water in the pipes

We assume that the diameter of the temporary water pipe is equal to 125 mm.

Table 3.12 – Calculation of the required transformer power.

№	Consumer	UOM	Q-ty	Specific electricity consumption, kW	Demand coefficient K	Power coefficient, cosφ	Required power, kVA
1	2	3	4	5	6	7	8
1. Production needs							
1	Vibrator I-18	pcs	2	0.8	0.1	0.4	0.40
2	Mortar pump Z-485	pcs	1	2,2	0.6	0.7	1.89
3	Crane KB100.3	pcs	1	110	0.3	0.5	66

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№	Consumer	UOM	Q-ty	Specific electricity consumption, kW	Demand coefficient K	Power coefficient, cosφ	Required power, kVA
1	2	3	4	5	6	7	8
4	Compressor unit SO-7A	pcs	1	1	0.6	0.7	0.86
5	Electric pump units	pcs	2	4.0	0.1	0.4	2
6	Bituminous mastics application machine CO-122A	pcs	2	4.9	0.1	0.4	2.45
7	Electrical welding transformer	piece	2	20	0.35	0.4	35

Table 3.12 – Calculation of the required transformer power. Continuation.

№	Consumer	UOM	Q-ty	Specific electricity consumption, kW	Demand coefficient K	Power coefficient, cosφ	Required power, kVA
1	2	3	4	5	6	7	8
1. Production needs							
8	Mast lift TP-17	piece	2	2.8	0.6	0.7	2.4
						TOTAL	114.57
2. Electric lighting							
2.1 Internal							
1	Domestic premises	m²	131.7	0.012	0.8	1	1,263
2	Office premises	m²	58.4	0.015	0.8	1	0.7
3	Warehouses	m²	119,4.8	0.007	0.35	1	0.292
4	Workshops	m²	24.48	0.013	0.3	0.65	0.15
5	Under construction area	m²	1350	0.00012	0.8	1	0.13
						TOTAL	2.535
2.2 external							
1	Concrete works sites	100 m²	21.16	0.08	1	1	1.7
2	Lighting of open warehouses	100 m²	3.78	0.0	1	1	3.02
3	The territory of construction areas	100 m²	104.04	0.015	1	1	1.6
4	Internal roads	1 km	0.31	2.5	1	1	0.8

№	Consumer	UOM	Q-ty	Specific electricity consumption, kW	Demand coefficient K	Power coefficient, cosφ	Required power, kVA
1	2	3	4	5	6	7	8
			8				
5	Emergency lighting of passages	100 m	2.09	0.37	1	1	0.8
						TOTAL	7.92
						In total	125.1

Required transformer power is:

$$P_r = 1.1\left(\Sigma \frac{P_n \cdot K_1}{\cos\varphi} + \sum \frac{P_T \cdot K_2}{\cos\varphi} + R_{on}K_3 + P_{ob}\,K_Ч\right) = 1.1 \cdot 125.1 = 137.61 \text{ kVA}$$

We selected the mobile transformer substation KTPN-72M-160.

1.3.4. Technical and economic indicators

1. The construction duration is 369 days
2. The cost of CAW is 7,132.54 thousand UAH
3. Labor costs of the project 115.213 thousand man-hours
4. Labor costs per 1 m³ of the building 1.14 man-days
5. Daily output per worker UAH 1,065.8
6. Worker utilization rate K=1.48 < 1.5
7. Indicators of the master plan:
   7.1 length:
   - roads 425 m
   - temporary water pipes 155 m
   - electrical network 527 m
   - sewerage 105 m
   - telephone network 38 m

   7.2 Construction site utilization coefficient

$$K = \frac{S_{constr}}{S_{constr.site}} = \frac{S_{build} + S_{temp} + S_{ljh} + S_{WH}}{S_{constr.site}} = 58\%.$$

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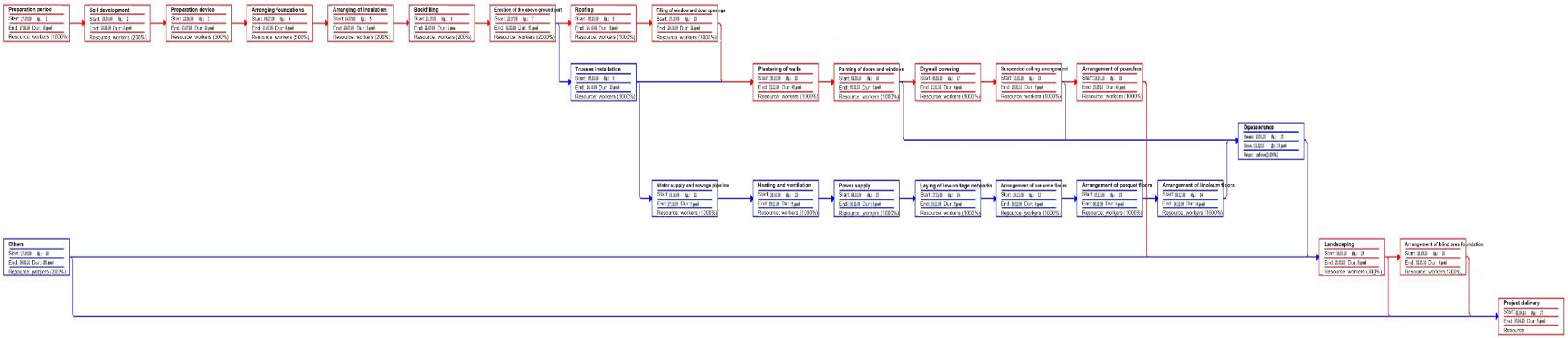

Figure 3.1 – Network diagram made in the Microsoft Project program

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1.3.5. Optimizing the organization of construction processes using logistics tools

We have analyzed and reviewed logistics concepts that provide the opportunity to improve organizational processes in the construction of an administrative and residential building in the city of Zaporizhzhia.

These are the following logistics concepts:

- The "just-in-time" concept is a modern logistics system concept in production (operational management), supply, and distribution, based on the synchronization of the processes of material resources and finished products delivery in the required quantities at the time when the logistics system links need them, in order to minimize the costs associated with the creation of stocks.

The key elements of this concept are:

- rational organization and balanced production;
- overall quality control at all stages of the production process and the quality of raw material resources from suppliers;
- partnership only with reliable suppliers and carriers;
- increased professional responsibility and high labor discipline of all personnel.

MRP systems manage materials, semi-finished products, and their components for construction and assembly works. The main goals of MRP systems are:

- satisfying the need for materials, components and products for production planning and delivery to consumers;
- maintaining a low level of stocks of material resources, unfinished production, finished products;
- planning of production operations, delivery schedules, purchasing operations.

In achieving these goals, the MRP system ensures the flow of planned quantities of material resources and stocks of building materials.

- The logistic concept of "continuous replenishment" (CR) is a modification of the "quick response" aimed at eliminating the need for orders to replenish finished product

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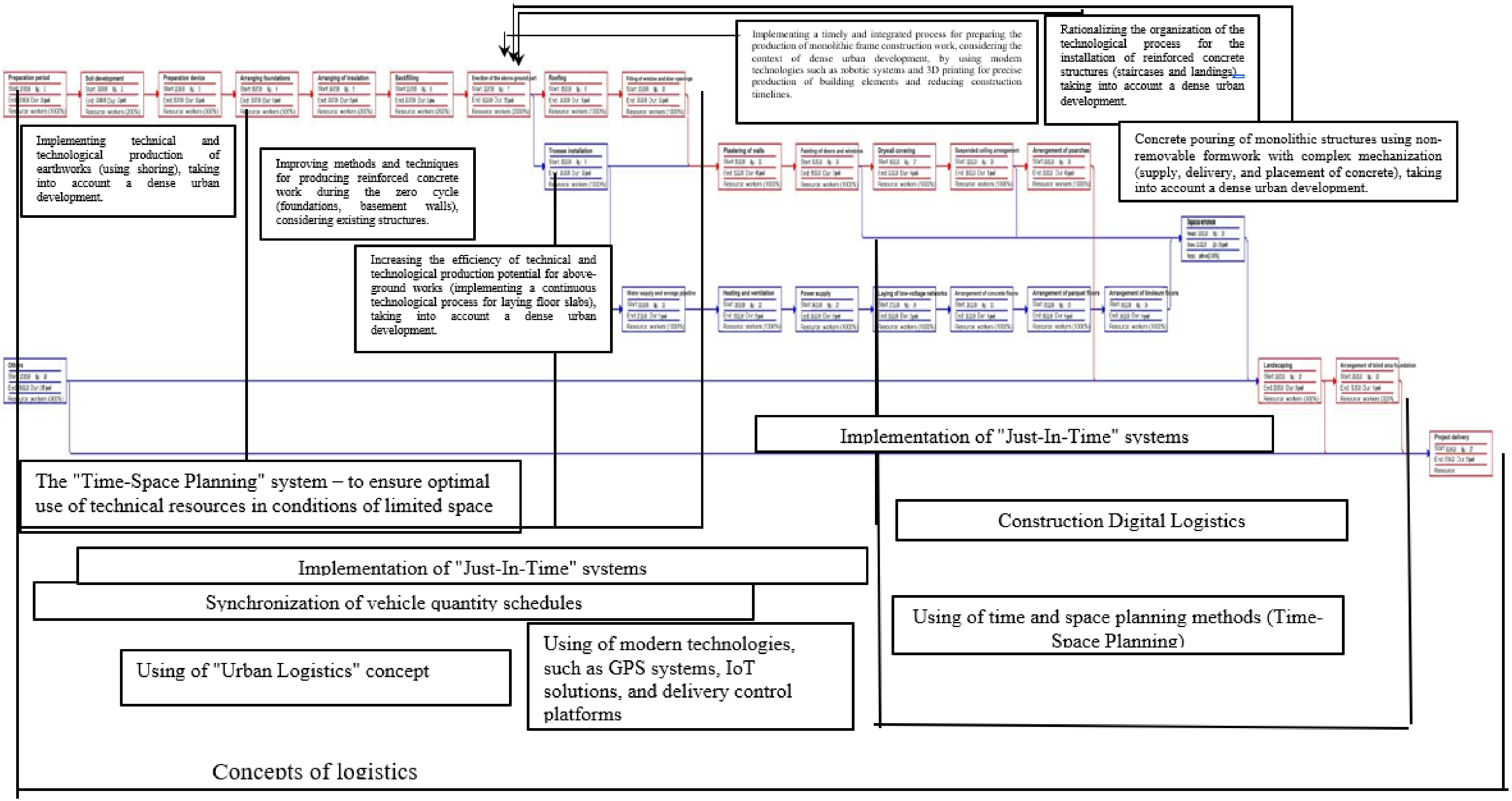

Figure 3.2 – Improvement of organizational processes using logistics concepts

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stocks. The purpose of this strategy is to establish an effective logistics plan aimed at continuous replenishment of finished products stocks at retailers. The further development of the "quick response" and "continuous replenishment" strategies has led to the appearance of "automatic replenishment" (AR) logistics concept.

Table 3.13 - Calculation of the network diagram taking into account logistical approaches

Work number	Start of work	End of work	Resource	Duration	Early start	Early ending	Late start	Late ending	Total reserve, R	Private reserve
1	1	2	40	25	0	25	0	25	0	0
2	2	3	16	2	25	27	25	27	0	0
3	2	57	6	14	25	39	25	39	0	-12
4	3	4	16	10	27	37	27	37	0	0
5	3	30	16	2	27	29	27	29	0	0
6	4	5	12	3	37	40	37	40	0	0
7	5	6	12	2	40	42	40	42	0	0
8	6	7	10	2	42	44	42	44	0	0
9	6	8	10	1	42	43	42	43	0	0
10	7	9	10	2	44	46	44	46	0	0
11	7	10	4	1	44	45	104	105	60	0
12	8	11	4	3	43	46	48	51	5	5
13	8	3	0	0	43	43	43	43	0	8
14	9	11	10	5	46	51	46	51	0	0
15	10	14	4	1	45	46	105	106	60	0
16	11	12	8	14	51	65	51	65	0	0
17	11	13	10	3	51	54	77	80	26	0
18	11	35	0	0	51	51	125	125	74	0
19	12	15	10	5	65	70	65	70	0	0
20	13	16	8	4	54	58	80	84	26	26
21	14	17	4	1	46	47	106	107	60	0
22	15	16	22	14	70	84	70	84	0	0
23	16	18	10	5	84	89	84	89	0	0
24	16	19	10	3	84	87	102	105	18	0
25	16	21	12	10	84	94	117	127	33	0
26	17	22	8	1	47	48	107	108	60	0
27	18	20	8	14	89	103	89	103	0	0
28	19	23	4	3	87	90	105	108	18	18
29	20	23	10	5	103	108	103	108	0	0
30	21	28	15	27	94	121	127	154	33	33
31	21	43	0	0	94	94	151	151	67	67

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Work number	Start of work	End of work	Resource	Duration	Early start	Early ending	Late start	Late ending	Total reserve, R	Private reserve
32	22	23	0	0	48	48	108	108	60	60
33	23	24	8	14	108	122	108	122	0	0
34	23	25	10	3	108	111	132	135	24	0
35	24	26	10	5	122	127	122	127	0	0
36	25	27	4	3	111	114	125	128	24	24
37	26	27	8	11	127	138	127	128	0	0
38	27	28	8	16	138	154	138	144	0	0
39	27	55	15	23	138	161	138	151	0	-7
40	28	29	0	0	154	154	151	154	0	0
41	28	49	0	0	154	154	154	154	0	0
42	29	57	5	5	154	159	154	159	0	-5
43	30	31	16	5	29	34	29	34	0	0
44	31	32	5	3	34	37	34	37	0	0
45	32	33	12	2	37	39	37	39	0	0
46	33	34	10	5	39	44	39	44	0	0
47	33	35	10	3	39	42	122	125	83	9
48	34	36	8	14	44	58	44	58	0	0
49	35	37	4	3	51	54	125	128	74	9
50	36	37	10	5	58	63	123	128	65	0
51	36	38	4	2	58	60	58	60	0	0
52	37	39	8	14	63	77	128	132	65	0
53	37	40	10	3	63	66	140	140	92	0
54	38	42	4	2	60	62	160	162	0	4
55	39	41	10	5	77	82	142	140	65	0
56	40	43	4	3	66	69	240	240	92	92
57	41	43	8	14	82	96	340	340	65	65
58	42	46	4	2						
59	43	45	10	3						
60	43	49	12	10						
61	43	44	10	5						
62	44	47	8	14						
63	45	48	4	8						
64	46	50	4	2						
65	47	48	10	5						
66	48	51	8	14						
67	48	52	10	3						
68	49	54	15	27						
69	50	51	0	0						
70	51	53	10	5						
71	52	53	4	3						
72	53	54	8	11						

Work number	Start of work	End of work	Resource	Duration	Early start	Early ending	Late start	Late ending	Total reserve, R	Private reserve
73	54	28	0	0						
74	54	57	8	12						
75	55	56	15	23						
76	56	57	0	0						
77	57	58	10	15						

Table 3.14 – Comparison of traditional methods and with the ones using logistics concepts

№	Indicator	Traditional methods	Using logistics concepts
1	Duration	369	340
2	Reduction in Number of People	by 15%	
3	Reduction in the cost of CAW → The cost of the project	by 25%	

Conclusions

- We have conducted a detailed analysis of theoretical, normative and scientific sources in the field of optimizing material and technical support for construction. The need to implement logistics as a field of knowledge was substantiated. It provides optimization of material and technical support and reduction of labor costs by 25%.
- An analysis of the architectural and structural solutions of an industrial building in the city of Zaporizhzhia was carried out in the form of volume-planning, structural solutions. The heat engineering calculation of the main structures, external walls and garret overlapping was carried out.
- The processes of the organization have been improved due to the optimization of material and technical support for the construction of an industrial building in Zaporizhzhia.