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МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ
ФАКУЛЬТЕТ АРХІТЕКТУРИ, БУДІВНИЦТВА ТА ДИЗАЙНУ
КАФЕДРА КОМП'ЮТЕРНИХ ТЕХНОЛОГІЙ БУДІВНИЦТВА ТА РЕКОНСТРУКЦІЇ АЕРОПОРТІВ

ДОПУСТИТИ ДО ЗАХИСТУ

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(ПОЯСНЮВАЛЬНА ЗАПИСКА)

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ЗА СПЕЦІАЛЬНІСТЮ 192 «БУДІВНИЦТВО ТА ЦИВІЛЬНА ІНЖЕНЕРІЯ»
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«ПРОМИСЛОВЕ І ЦИВІЛЬНЕ БУДІВНИЦТВО»

Тема: **«Виробнича будівля в м. Буча Київської області »**

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INTRODUCTION

Production buildings are large-sized facilities where production lines are located and conditions are provided for the working process and the full operation of the equipment. Industrial buildings can be typical or unique, consist of one or more objects.

There are industrial buildings for the following purposes: production shops; technical buildings; warehouses; logistics complexes; hangars and sheds; energy complexes; administrative buildings; other.

The construction of industrial buildings is carried out in strict accordance with the regulated norms. Industrial buildings must meet fire safety requirements, be able to withstand the loads that occur during the production process, and have an attractive appearance.

With the help of the technology provided for by this thesis, the construction of a production facility is carried out quickly: metal structures prefabricated at the factory are delivered to the construction site. Next, a frame is assembled, on which, depending on the purpose of the object, sandwich panels, corrugated sheets or other materials are fixed.

The construction of industrial buildings and structures using this technology provides a number of advantages:

– Fast construction. Buildings made of metal structures are prefabricated. It takes much less time to create them than to build similar objects made of brick or concrete.

– Payback. Construction costs are significantly reduced.

– Stylish appearance. This is an important factor: the image of the company depends on the first impression.

The predominant type of industrial buildings are one-storey (approximately 64% of all industrial buildings). This is due to the requirements of technology, the possibility of transferring loads from heavy equipment directly to the ground, the relative simplicity and cost-effectiveness of their construction. The structural elements of one-story industrial buildings, both in their forms and in their functional features, differ significantly from those used in residential and public buildings. Such buildings are erected, as a rule, framed with curtain wall panels made of lightweight concrete or other materials. The structural schemes of one-story industrial buildings are diverse: the most common are single-span and multi-span frame schemes of frames with a coating system (flat and spatial) in the form of domes and cable-stayed structures. Coatings are made flat or pitched, with lanternless or lantern superstructures. Single-story multi-span frame buildings come with spans of the same or different widths and heights or single-span. A span is an internal volume bounded by two rows of columns and end walls.

CHAPTER 1. ANALYTICAL REVIEW

Based on the fact that information technologies are now widely used in the design of buildings and structures, this section will also pay attention to this issue. The section presents the experience of developing a steel frame for a one-story industrial building using building information modeling software, as well as other advanced technologies.

In modern industrial construction, a significant amount of work is the reconstruction of buildings and structures or the strengthening of their individual elements. In this regard, the issues of assessing the technical condition of structures, the further operation of which seems problematic, are becoming increasingly relevant. The issues of assessing the technical condition of the structures of buildings in operation are resolved on the basis of a full-scale survey with the identification of existing defects and damage. To analyze the actual operation of structures, verification calculations are performed. The calculation of the structures of operated buildings in order to assess their technical condition has a number of features that are reflected in the current standards [24, 17]. For buildings erected on subsiding soils, the cause of defects and damage may be uneven deformations of the subsiding base. Deviations from the design position of the building foundations lead to a distortion of the frame elements, a change in their stress-strain state. The verification calculation of such buildings, along with the calculation for the specified loads and impacts, should contain a calculation that takes into account uneven deformations of the subsidence base. The first works on the calculation of buildings and structures on subsidence soils used the simplest calculation schemes: frameless buildings were modeled with beam systems [24, 18, 16]; the calculation of frame buildings was reduced to the calculation of flat frames [19, 18, 17]. The modern approach to studying the interaction of the "building foundation" system is based on spatial computational models, in which the soil foundation is considered as a multilayer body that models the geological structure of the subsidence of the site [24, 16, 15]. At the same time, it seems possible to take into account the uneven ground deformations due to local soaking, the heterogeneity of the composition of individual layers, the presence of foreign inclusions in the form of technogenic deposits, etc. Such a calculation makes it possible to predict uneven ground settlements and, accordingly, a change in the stress-strain state of structures. However, when assessing the technical condition of operated facilities erected on subsiding soils, it often becomes necessary to solve a slightly different problem, in which the initial data for determining the stress-strain state of structures are their deformations, deviations from the design position, recorded as a result of instrumental examination.

Steel structures are widely used for the installation of long-range coatings in the shops of industrial buildings and public sports and entertainment facilities [24, 15]. Their advantages over reinforced concrete are that they are lighter, during their construction the construction time and investment cycle in general are reduced, energy savings are achieved during production, transportation and construction. To date, the average service life of industrial buildings and structures in Ukraine is 30 ... 50 years, and some buildings up to 80 years [24, 17], which requires scheduled inspections of the technical condition of buildings and, if necessary, repair work.

In [24–15], based on the results of the survey of existing buildings, it is substantiated that the main structural defects are the result of errors in their design, manufacture and installation [24–15]. Damage to structures that occur and develop during their operation is a consequence of gross violations of the rules of technical operation, inaccuracy of taking into account the existing stress-strain state of structures in reinforcement and reconstruction projects. In [17–15], a model of element degradation is proposed, which aims to establish the law of reliability as a function of time, and thus allow to predict its technical condition. The change in internal forces in the structural elements of the spatial framework of the building is influenced primarily by the external load, as well as the type of calculation scheme (the degree of its static uncertainty). One of the main loads on the territory of Ukraine on steel structures of light coatings of buildings is the snow load [24, 18] (about 50-70% of the total load, including the own weight of the coating structures). Unfavorable combinations of loads should also include wind load [24, 15], especially since it has pulsating, variable height characteristics of the building characteristics [24–16]. In addition to the variable atmospheric load, the load-bearing steel frame of the production building is also significantly affected by the load from bridge or overhead cranes. This load is temporary, variable, requires mandatory consideration of the coefficients of dynamism.

Despite the significant amount of recommendations for regular technical inspections of buildings and structures, published summary reports of such inspections, as well as identifying the causes of accidents and construction ways to prevent them, the feasibility of changing the design scheme of the diameter of the building efforts in its elements.

CHAPTER 2. ARCHITECTURAL DESIGN

2.1. Master plan of the site

An industrial building has been developed in the project.

From the administrative point of view, the object is located in the Kyiv region, on arable land.

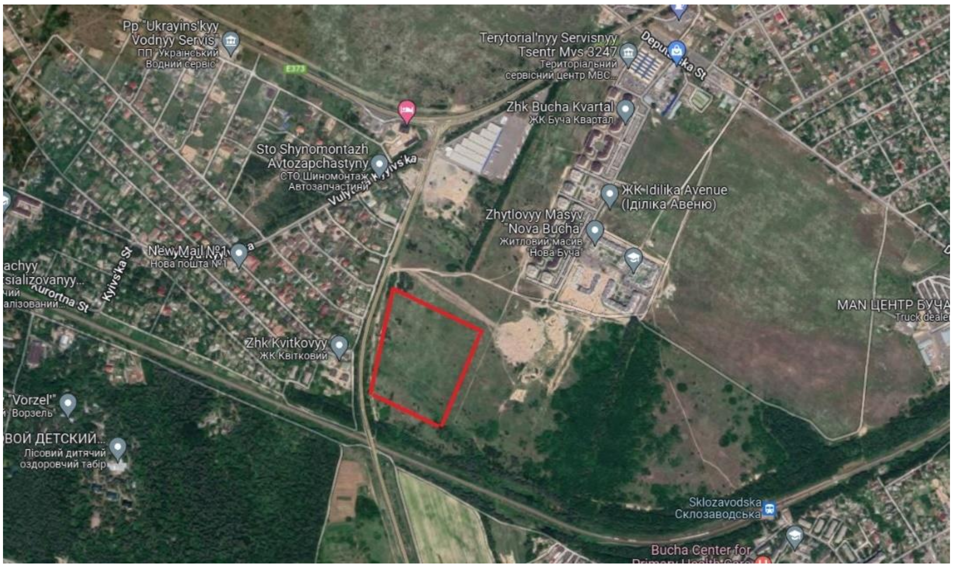

Fig. 2.1. Situational layout

The relief of the area is hilly with a decline to the northeast.

The construction site is partially occupied by existing buildings and underground communications.

The master plan is developed in accordance with the technological scheme and in compliance with current norms and rules.

The layout of the building was based on the following main features:

– providing a given technological scheme;
– zoning of the territory when placing production and auxiliary facilities;
– economical use of land;
– reduction of the length of roads inside the site and utilities.

Vertical planning is solved taking into account the technology of work, topographic conditions of the area, taking into account the projected highway, which provides for departures. Vertical planning is taken into account the terrain and solved by local backfill of driveways and sites to the marks dictated by the minimum rise in the building above the axis of the driveway.

The surface water drainage on the site is designed to be open with a bypass through artificial structures in low-lying areas.

In addition, drainage on the site is solved in conjunction with the drainage of water from the ground of the road. Before the start of production, the removal of fertile soil at the base of the embankment is planned, followed by its removal for use on unproductive lands. Embankment planning is provided from imported soil. Filling of the embankment should be carried out in layers with layer-by-layer compaction to a density of at least 0.95 of the maximum density that can be achieved for the soil used.

Passages on the site are accepted single-slope. In the side stone with the width of the carriageway 4.5 m. Passages are solved in the area of technological pumping and diesel power plant. In another area, a cross-section with a width of 3.5 m and a width of 1 m. The pavement and driveways are made of 0.18 m thick concrete slabs, 0.03 m thick on a leveling layer of sand and 0.15 m thick on a rubble base with 0.08 m of roadside reinforcement. Pedestrian paths are mostly combined with driveways. Separate sidewalks are made of medium-grained asphalt concrete 0.04 m thick with a gravel base 0.08 m thick. Along the perimeter of the site there is a fence made of metal mesh on reinforced concrete pillars. Lawns are sown with perennial grasses.

2.2. Space planning

The project envisages the construction of sites for technical equipment and ancillary buildings, as well as the use of existing buildings for the location of equipment. Architectural decisions on buildings are made taking into account construction and climatic conditions of the construction area. Geometric parameters of buildings – modular dimensions of spans and floor heights meet the requirements of [40].

Degree of fire resistance of buildings *II*.

According to the degree of responsibility of the building on the site of UKPG belong to the following classes: technological pump – *I*; diesel power plant – *I*.

The design of buildings and structures is based on technological layouts for the application of standard solutions, supply of equipment of maximum factory readiness, typification and unification of structures and components.

Planning decisions are based on the principles of maximum blocking of sites with interconnected technology with observance of fire breaks.

When developing building projects, the capabilities of the construction organization are taken into account. Depending on the requirements of technological processes, concrete or rubble coatings will be installed on open technological sites. Along the perimeter of the sites are outlined with side stone.

Racks with traverses from rolled profiles are provided under technological pipelines. Foundations for equipment are made of monolithic concrete or reinforced concrete with the installation of anchor bolts and embedded parts. Prefabricated metal platforms, ladders and fences according to the current series are arranged for maintenance of technological equipment. Laying of communications and engineering networks is supposed to be performed on reinforced concrete racks.

Description of the technological process of the pump:

- pumping and injection of solutions of corrosion inhibitor and hydration;
- pumping hydrocarbon condensate into the condensate line.

Pumps are located in the main working area of the pump. This area has the largest volume and area needed to ensure safety and prevent high concentrations of gas with air.

In the additional area there are rooms for staff, vent chamber, compressed air compressor, switchboards.

Compressed air compressor provides clean compressed air control and measuring devices using mechanisms in pneumatic control systems automation. Here is the following technological equipment:

– two $PKS-3{,}5A$ compressors with electric motors.

– installation of air purification and dehumidification $A200U-02$. An air trap is provided for air accumulation.

The technological pump includes such pumps as:

– methanol injection into the heat exchanger $T-1$ pumps $H-2-1, H-2-2. (Sun\ 40/16\ K14)$;

– methanol injection into the gas pipeline and condensate pipeline by pump $H-2-3$ $(ND\ 40/16\ K14)$;

– injection into gas wells and inlet threads of corrosion inhibitors by pumps $H-2-4\ -\ H-2-9. (Sun\ 16/40\ K14)$;

– pumping hydrocarbon condensate into the condensate pipeline pumps $H-3-1, H-3-2. (PT-6.3\ /\ 6.3)$;

Volume-planning solution of technological pumping. The object of design is a technological pump. Frame-type building, which consists of two parts:

– main work area;

– additional area.

The main area measures $18 \times 30\ m$ and has a lantern design. The level of the roof is $+7.950$, and the design of the lantern is $+9.750$. The additional zone has dimensions of $12 \times 18\,m$. The roof mark is $+6.300$. That is, there is a difference in height between parts of the building.

Load-bearing structures – steel columns, trusses and beams.

Enclosing structures – wall panels of steel profile with insulation type "$Sandwich$".

There are the technical and economic indicators of the building in table 2.1.

Table 2.1

Technical and economic indicators of the building

Designation	Name	Unit	Qty
$S1$	Building area	м^2	756
$S2$	Usable area	м^2	540
$S3$	Total area	м^2	756
$S4$	Area of the main purpose premises	м^2	612
$S5$	Auxiliary area	м^2	89
V	Construction volume	м^2	5616
$S6$	Area of external fences	м^2	750
$K1$	Planning factor S1 / S2	–	1.4
$K2$	Efficiency of use volume V / S2	м	10.4
$K3$	Compactness index S6 / S3	–	7.43

2.3. Industrial sanitation

In the process of labor a person is short-term or long-term adverse factors – industrial hazards. They are all divided by the nature of the action on the human body. The following harmful factors act on the person in the technological pump: physical hazards: increased gassiness due to improper installation of superchargers and pipelines and dust in the air due to the fact that the floor is made of concrete screed, high noise and vibration produced by pumps; psychophysical hazards: arising from noise and vibration produced by pumps and resulting in physical and mental fatigue during work.

The main normative document on the regulation of sanitary and hygienic working conditions is "State sanitary rules of planning and construction of settlements" [38].

Increased gassiness is dangerous for the action of natural gas on the blood and lungs. The technological pump must systematically control the gas content in the air of the working area. This control is carried out periodically by the station laboratory. The method of poisoning prevention is to minimize the contact of workers with the air zone of the shop, which is primarily satisfied by the introduction of mechanization and automation of the shop. Also a big role is given to the ventilation of the shop, which should be designed to dilute to a safe level. All workers must be familiar with safety rules and know the initial signs of gas, must be able to use first aid.

Dust hazards are mostly of inorganic origin and are caused by concrete floors and dust blown everywhere. In general, its level of harmfulness is low, but in order to prevent equipment failure and the well-being of workers, it is necessary to periodically monitor the concentration of dust in the air. To prevent air pollution, the number of workers in the shop and the thorough and systematic dusting of the premises with the help of mobile or stationary vacuum units must be minimized.

Pumps are a source of vibration, but its level in the process pump is not too high, as the pumps are installed on separate foundations. To reduce vibration, the excitation effect of vibration forces in the pumps themselves and the reduction of vibration on the way of its propagation, ie the use of vibration isolation and dynamic vibration dampers, are used.

The source of noise are pumps, which occurs due to the action of mechanisms and friction of gas on the inner surface of the pipes. The sound pressure level should not exceed the values specified in [36]. To reduce the noise pressure, first of all reduce the noise level in the noise sources: reducing the gaps in the gears and bearings, timely lubrication of machine parts, timely repair of equipment. Noise protection covers and screens are used to reduce gas noise.

2.4. Calculation of heat transfer resistance for buildings and structures from panels as "Sandwich"

Indoor air parameters: temperature 16℃, relative humidity 50 %. Humidity of the room is normal. Operating conditions of wall panels – "A"

The wall consists of expanded polystyrene – 40 kg/m^3, 0.041 $W/(m \times °C)$ which is laid between 2 steel sheets 1 mm thick, and therefore in calculations we will not consider them.

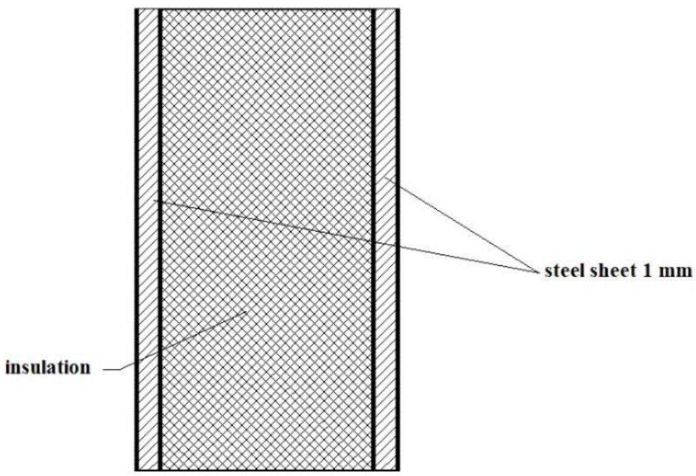

Fig. 2.2. Cross-section of the wall panel

Визначимо розрахунковий опір теплопередачі нашої стіни:

$$R_0 = \frac{n(t_e - t_i)}{\Delta t^e \alpha} = \frac{1(16+23)}{5 \times 8.7} = 0{,}89 м^2 \times {}^0C/W \quad (2.1)$$

where $n = 1$ is the coefficient that takes mi depending on the position of the outer surface of the wall to the outside air;

$t_e = 16$ ℃ – design temperature of indoor air, ℃.

$t_i = -23$ ℃ – estimated winter outdoor air temperature, ℃, equal to the average temperature of the coldest (five-day security 0.92).

$\Delta t^e = 5$ ℃ – normative temperature difference between the temperature of the indoor air and the temperature of the inner surface of the enclosing structure.

$\alpha = 8.7\ W/(m \times ℃)$ - the heat transfer coefficient of the inner surface of the enclosing structure.

Economically feasible wall resistance:

$$R_0^{ek} = kR_0 = 2 \times 0.89 = 1.78\ m^2 \times ℃/W, \tag{2.2}$$

where $k = 2$ is the minimum increasing ratio.

Required insulation thickness is $\delta = 0.066\ m$

Based on the structural thickness of the panel type "$Sandwich$" we take the thickness of the insulation 10 cm.

The thermal resistance of the obtained panel:

$$R = \frac{\delta}{\lambda} = \frac{0.1}{0.041} = 2.43\ m^2 \times ℃/W. \tag{2.3}$$

Thermal inertia of the enclosing structure:

$$D = Rs = 2.43 \times 0.41 = 0.99, \tag{2.4}$$

where $S = 0.41\ W/(m^2 \times °C)$ – heat transfer coefficient.

Based on culculation thickness of the panel type "$Sandwich$" we take the thickness of the insulation 10 cm.

CHAPTER 3. STRUCTURAL DESIGN

3.1. Load collection

Concentrated design load in the node of the upper belt of the truss from the constant load

$$FP = \sum_i \gamma f_i g_i^H \frac{d_1 + d_2}{2} \cdot B = 1{,}669 \cdot 3 \cdot 6 = 30\ kN \qquad (3.1)$$

де:$g_i^H -$ regulatory load from roofs and structures;

$\gamma f_i -$ reliability factor;

$d_1, d_2 -$ length of panels;

B – step truss.

Table 3.1

Load collection

№	Конструкція покриття	g_H	γf	g
1	Layer of gravel on bituminous mastic	0.4	1.3	0.52
2	3 layers of $RKP - 350B$ roofing material on mastic	0.15	1.3	0.195
3	Plates mineral wool ($80\ mm$)	0.24	1.2	0.29
4	Ball of roofing material $RKP - 350B$	0.05	1.2	0.06
5	Metal profiled flooring	0.155	1.05	0.163
6	Runs span l = 6 m	0.08	1.05	0.084
7	Construction farm coating	0.26	1.05	0.273
8	Lantern	0.08	1.05	0.084

Snow load. Concentrated design load in the node of the upper belt of the truss from the snow load, kN:

$$FC = \gamma f S_o \mu \frac{d_1 + d_2}{2} B \tag{3.2}$$

γf – coefficient of reliability of snow load;

$S_o -$ normative value of snow mass per 1 m2 of horizontal surface of the earth;

μ – коефіцієнт.

$$QA = \gamma f \omega_o K C_e^a B \tag{3.3}$$

$\omega_o -$ normative value of wind load;

К – coefficient that takes into account the change in wind load due to height;

$C_e^a -$ aerodynamic coefficient.

$QA = 1{,}4 \cdot 0{,}3 \cdot 0{,}785 \cdot 0{,}8 \cdot 6 = 1{,}58\ {}^{kN}/_{m}$

Estimated concentrated wind load on the frame riser, kN:

$$W = \gamma f \omega_o \phi_{ek} (C_e^a - C_e^н) \cdot B \tag{3.4}$$

$\phi_{ek} -$ the height of the cargo area is multiplied by the average value of the coefficient of change of wind pressure due to height.

$W = 1.4 \cdot 0.3 \cdot 1.45(0.8 + 0.6) \cdot 6 = 5.1 \quad kN$

Crane load. Estimated maximum pressure on the truss from two taps, kN:

$$D_{MAX} = \psi \gamma f F^H \sum y + \gamma f_u \sigma_{nr} \tag{3.5}$$

$P^H -$ normative maximum pressure of the crane on one cart;

$\sum y -$ the sum of the ordinates of the line of influence of pressure on the truss;

σ_{nr} – the weight of the suspension beam

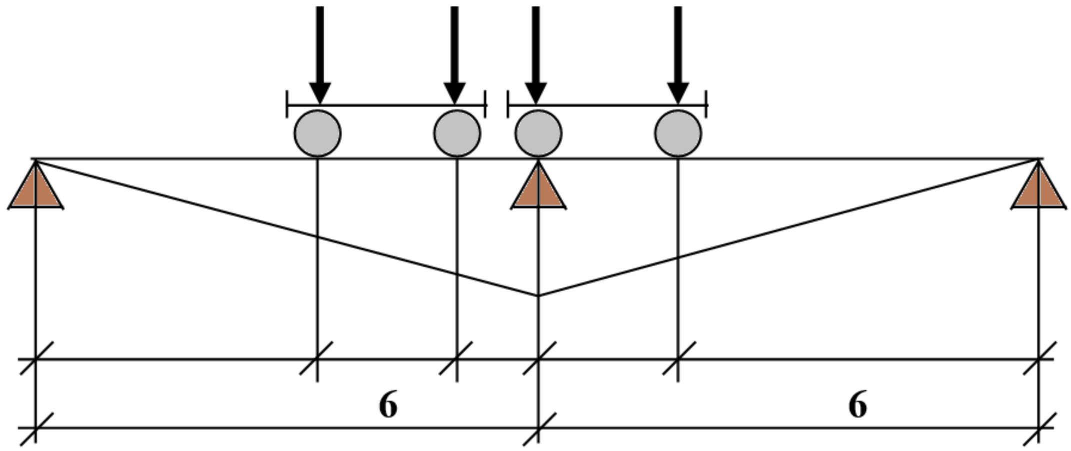

Fig. 3.1. Scheme of crane load on the beam

$\psi = 0.85$

$\gamma f = 1.1 \ F^H = 26.3$ кН

$\frac{y_1}{6} = \frac{y_2}{6-0.21}; \quad y_2 = 0.965;$

$\frac{y_1}{6} = \frac{y_3}{3.535}; \quad y_3 = 0.589;$

$\frac{y_1}{6} = \frac{y_4}{3{,}9}; \quad y_4 = 0.65;$

$\sum y = 1 + 0.965 + 0.589 + 0.65 = 3.2$

Suspension track weight: $G_{\text{п.к.}} = 50 \cdot 6 = 3\ kN$,

Then $D_{MAX} = 0.85 \cdot 1.1 \cdot 26.3 \cdot 3.2 + 1.05 \cdot 3 = 82\ kN$

Pestimated minimum track pressure on the truss from two overhead cranes kN:

$$D_{MIN} = \psi \gamma f F_{min}^{H \sum y_{n_{\text{п.к.}}}} \tag{3.6}$$

F_{min}^H – the minimum pressure of the overhead crane on one cart.

$D_{MIN} = 0.85 \cdot 1.1 \cdot 4.7 \cdot 3.2 + 1.05 \cdot 3 = 17.2$ кН

Pressure on a crossbar of a frame from braking of electric melts, kN:

$$\mathrm{T} = \psi\gamma f\,\frac{Q + g_T}{20n}\sum y = 0.85\cdot 1.1\,\frac{3.2 + 4.7}{20\cdot 2}\cdot 3.2 = 1.8\ kN \qquad (3.7)$$

3.2. Calculation of cross-sections of truss elements

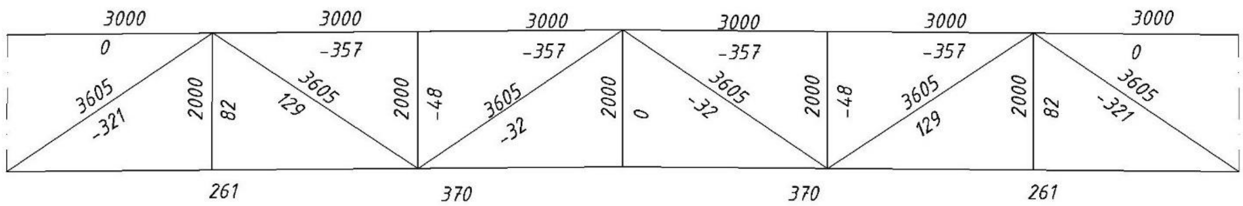

Fig. 3.2. Geometric scheme of F-1 trusses

Trusses material – $Steel\ 3ps6$, class $C245$

Estimated resistance beyond the yield strength $R_y = 240\ MPa$ [34], The elements of the truss are made of steel grade ВСт3пс6 (class $C245$) the design resistance $R_y = 24\ kN/cm$, is accepted in advance for the sheet thickness $4 - 20\ mm$. The calculated lengths are determined for the belts and the support bevel in the plane of the truss $l_x = l_0$, where l_0 is the distance of the truss, $l_y = l_1$, where l_1 is the distance between the points of attachment from the plane of the truss. Estimated length of the lattice element $l_x = 0{,}8\cdot l_0$, $l_y = l_0$. Selection of sections and testing of strength and stability of the elements of the truss is performed according to the formulas:

for stretched elements:

$$A = \frac{N}{\phi\cdot R_y\cdot\frac{\gamma_c}{\gamma_n}} \text{ and } \sigma = \frac{N}{\phi\cdot A\cdot\frac{\gamma_c}{\gamma_n}} \qquad (3.8)$$

for compressed elements:

$$A = \frac{N}{R_y\cdot\frac{\gamma_c}{\gamma_n}} \text{ and } \sigma = \frac{N}{A\cdot\frac{\gamma_c}{\gamma_n}} \qquad (3.9)$$

CHAPTER 4. TECHNOLOGY OF CONSTRUCTION

4.1. Scope and design characteristics

The technological map is designed for the installation of steel columns of a solid section of folded I-beams of a one-story production building.

The weight of the columns for the installation of which is developed a valid technological map is givenin Table 4.1.

Table 4.1.

Specification of elements

№	Name of the brand	Quantity	Unit weight, t	The mass of all, t
1	$K1$	14	0,434	6.076
Together				6.076

4.2. Structure of the complex process and scope of work

Table 4.2.

The structure of the complex process and the scope of work

№	Name of process	Unit of measurement	Count record	Amount of work
1	2	3	4	5
1	Unloading columns with a crane	100 t	$14 * 0.434/100$	0,06
4	Installation of steel resistance plates	1 cooker	14	14
5	Grasping steel support plates	1 cooker	14	14
6	Gravy concrete mixture under the slabs	1 cubic meter	$14 * 0.8 * 0.8 * 0.05$	0,448
7	Installation of columns	Piece	$according\ to\ the\ drawing$	14
8	Installation of columns	1 t	$0{,}06 * 100$	6

9	Installation and fastening of bolts	100 pcs	$14 * 4/100$	0,56

4.3. Selection of mounting cranes and load-lifting devices

The choice of mounting cranes is carried out according to the variant design. At the first stage, according to the technical parameters, we and the reference literature choose two options for identical cranes (equal in carrying capacity).

The required carrying capacity of the crane is determined by the formula:$Q_г$

$$Q_г = m_е + m_{ст} + m_г, \quad (4.1)$$

$Q_г = 0{,}434 + 0{,}12 = 0{,}554$ т

where– the mass of the element, t (task);$m_е$

$m_{ст}$– strop mass (traverse);

$m_г$ – mass of arrangement and reinforcement of the element.

The highest height of the hook lifting is determined by the formula:$H_г$

$$H_г = h_0 + h_з + h_е + h_{ст}, \quad (4.2)$$

$H_г = 0 + 1 + 6{,}0 + 1 = 8{,}0$ м

where – the distance from the level of parking of the crane to the height of the support of the mounting element, m; h_0

$h_з$ – height reserve for safety of installation;$h_з = 1\ m$

$h_е$ – height or thickness of the element, m;

$h_{ст}$ – height of slinging, m.

Departure of the crane hook is determined $L_г$on the basis of the organizational and technological scheme of installation of structures.

$$L_г = \sqrt{6^2 + 3{,}5^2} = 6{,}95 \text{ м}$$

We accept with an arrow length of 12.5 m

4.4. Selection of mounting cranes

In accordance with the calculated installation parameters from the reference literature, we select two cranes for the installation of columns, and write the results of the selection to Table 4. 3.

Table 4.3.

Selection of cranes by mounting parameters

Name and brand of elements	Calculation parameters				Crane Options				
	Mounting mass	Required hook lifting height	Required hook departure	Required arrow length	Type and brand of crane	Payload	Crane hook lifting height	Fly out the hook	Arrow length
Installation of columns	0.554	8.0	6.95	12.5	Tracked crane $MCG - 25$	2	10	7	17.5
					Kwound $KS - 59712$	2,5	11	7	18

To determine the economical version of the mounting crane, it is necessary to determine the technical and economic indicators for each option. The determining parameter of efficiency and optimality are the costs given.

4.5. Choice of vehicles

For the transportation of columns and steel crane beams, depending on their weight and dimensions, we choose the appropriate type and brand of vehicles, guided by the relevant reference literature.

Based on the distance at which it is necessary to transport the structures, we accept the pendulum method of delivery.

We accept: Semi-trailer PL 2212 D1+Tractor MAZ-6422.

4.6. Organization and technology of work

To perform connections on bolts with controlled tension can be allowed workers who have undergone special training, confirmed by the appropriate certificate.

The surface difference (deplanation) of parts over 0.5 and up to 3 mm should be eliminated by machining by forming a smooth bevel with a slope not steeper than 1:10.

With a difference of more than 3 mm, it is necessary to install gaskets of the required thickness, treated in the same way as the connection details.

The holes in the parts during assembly should be connected and fixed from the shift by traffic jams. The number of traffic jams is determined by calculations for the action of mounting loads, but they should be at least 10% with the number of holes 20 and more and at least two - with a smaller number of holes.

In the assembled package, fixed by plugs, blackness (divergence of holes) is allowed, which does not prevent free without distortion of the bolt setting. A caliber with a diameter of 0.5 mm larger than the nominal diameter of the bolt should pass in 100% of the holes of each connection.

It is allowed to clean the holes of tightly pulled bags with a drill, the diameter of which is equal to the nominal diameter of the hole, provided that the blackness does not exceed the difference in the nominal diameters of the hole and bolt.

The use of water, emulsions and oil when cleaning holes is prohibited.

To tighten bolt connections, use Dynamometric Dremometer keys type E 750-2000 N×m and Torcofic type UP to 10-750 N×m.

Dynamometric keys for tension and tension control of high-strength bolts must be tarnished at least once per shift in the absence of mechanical damage, as well as after each replacement of the control device or key repair.

Under the head of a high-strength bolt and a high-strength nut should be installed one washer on . It is allowed with a difference in the diameter of the hole and bolt not more than 4 mm installation of one washer only under the element (nut or bolt head), the rotation of which provides tension of the bolt.

After pulling all the bolts in the compound, the senior worker-gatherer (brigadier) is obliged to put the stigma (the number or sign assigned to him) in the provided place.

Tension of bolts should be controlled: with the number of bolts in the connection up to 4 - all bolts, from 5 to 9 - at least three bolts, 10 and more - 10% of the bolts, but not less than three in each connection.

If at least one bolt that does not meet these requirements is detected, a doubling of the number of bolts is subject to control. In case of detection during re-inspection of one bolt with a lower torque value, all bolts should be controlled with bringing the twisting to the required value.

All tension and tension control work should be recorded in the connection log on the bolts with controlled tension.

Bolts in flange joints should be stretched on the forces specified in the working drawings, rotating the nut to the estimated time of tightening.

The actual moment of twisting should be no less than the calculated, certain according to the formula and not exceed it by more than 10%.

In the production of welding operations, it is necessary to comply with the requirements.

The management of welding work should be carried out by a person who has a document on professional education or training in the field of welding.

Welding work should be done on the approved project for the production of welding works (PPSR).

Welding and tacking must be performed by electric welders who have a certificate for the right to produce welding works, issued in accordance with the approved Rules of certification of welders.

Welded surfaces, constructions and workplace of the welder should be protected from rain, snow, wind. At ambient air temperatures below minus 10 ° C, it is necessary to have an inventory room for heating near the welder's workplace, at temperatures below minus 40 ° C - to equip a greenhouse.

The addition of concave profile to the corner seams and a smooth transition to the base metal, as well as the execution of butt joints without strengthening (if this is provided by the drawings of the KSCA), should be provided with a selection of welding modes corresponding to the spatial arrangements of welded elements, structures (during consolidation), or mechanized cleaning with an abrasive tool.

The welded surface of the structure and the seams of welded joints after welding must be cleaned of toxins, breezes and influxes (influxes) of molten metal.

Welded assembly and mounting devices should be removed without damage to the base metal and the use of shock influences. The places of their welding must be cleaned in a level with the base metal, unacceptable defects to correct.

The need to remove assembly bolts in mounting welded joints after welding is determined by the installation organization.

The quality of tacks, welded connections of fasteners of assembly and mounting devices, due to external inspection, should not be lower than the quality of the main welded joints.

4.7. Requirements for quality and acceptance of works

The density of the screed of the assembled package should be checked with a probe with a thickness of 0.3 mm, which within the zone bounded by the washer should not pass between the collected parts to a depth of more than 20 mm.

The quality of tightening of permanent bolts should be checked by retocking them with a hammer weighing 0.4 kg, while the bolts should not shift.

The limit deviations of the actual position of the mounted structures should not exceed when accepting the values given in the table.

Table 4.5.

Marginal deviations of the actual position of the mounted structures

Setting	Limit deviations, mm	Control (method, volume, type of registration)
1. Deviation of the marks of the supporting surfaces of the column and supports from the design	5	Measuring, each column and support, geodetic executive scheme
2. The difference in the marks of the supporting surfaces of neighboring columns and	3	Same

supports in the row and in the span		
3. Displacement of the axes of columns and supports relative to the razbyvochnyandx axes in the supporting section	5	Same
4. Deviation of columns axes from the vertical at the upper section at the length of the columns, mm:		
from 4000 to 8000	10	Same
from 8000 to 16000	12	Same
from 16000 to 25000	15	Same
5. Arrow deflection (curvature) of the column, support and ligaments on the columns	0.0013 distances between anchor points, but not more than 15	Measuring, each element, journal of works
6. One-sided gap between milled surfaces in the joints of columns	0.0007 transverse column crossing size; at the same time, the contact area should not be65% of the cross-sectional area	Same

4.8. Calculation of labor costs, machine time and wages

Table 4. 6.

Calculation of labor costs, machine time and wages

№	Name of process	Unit of measurement	Amount of work	Norm of time		Labor costs	
				man-hour	machine-hour	man-hour	machine-hour
1	2	3	5	6	7	10	11

1	Unloading columns with a crane	100 t	0.06	12.00	4.40	0.72	0.26
2	Installation of steel resistance plates	1 cooker	14	1.60	0.53	22.40	7.42
3	Grasping steel support plates	1 cooker	14	0.24		3.36	
4	Gravy concrete mixture under the slabs	1 cubic meter	0.45	0.59		0.26	
5	Installation of columns	Piece	14	3.00	0.60	42.00	8.40
		1 t	6.00	0.62	0.13	3.74	0.76
6	Installation and fastening of bolts	100 pcs	0.56	11.50	4.50	6.44	2.52
Just							78.92
Total K		20					

4.9. Schedule of installation and welding works

The schedule of work is carried out on the basis of calculation of labor costs and machine time and is taken out in the graphic part of the section.

Table 4. 8.

Source data for constructing a linear graph

№	Name of process	Unit of measurement	Amount of work	Labor costs. man-shift	Duration. days	Number of changes in days	Number of links. people
1	Unloading columns with a crane	100 t	0.07	0.09	0.5	1	2

2	Installation of steel resistance plates	1 cooker	16	2.8	1	2	3
3	Grasping steel support plates	1 cooker	16	0.42			
4	Gravy concrete mixture under the slabs	1 cubic meter	0.51	0.03			
5	Installation of columns	Piece	16	5.25	1	2	4
		1 t	7.00	0.47			
6	Installation and fastening of bolts	100 pcs	0.64	0.81	0.5	1	2

4.10. Material and technical resources

Table 4. 9.

Statement of the need for devices, devices and tools

No p/p	Tools and equipment	Normative document, working drawing	Quantity	Appointment
Resistance plates				
1	Hook	Individual manufacturing	2	Raising resistance plates
2	Installation bolts	Individual manufacturing	3	Temporary fastening and verification of elements, structures
3	Spacer tubes	Individual manufacturing	2	Temporary fastening of resistance plates
4	Four-gigal sling $Q=3$ t; $m=88$ kg; $h_{st}= 4,24$ m. $Q=5$ t; $m=215$ kg; $h_{st}=9,3$ m.	Individual manufacturing	1	Slinging of goods, structures
5	Multi-coal sling	DSTU B B.2.8-10-98	1	Slinging of goods, structures

6	Mounting scrap LM-24	DSTU B B.2.8-16: 2009	4	Loosening, shifting, and installing structural elements
7	Wrench drawer	Individual manufacturing	4	Screwing and twisting bolts
8	Scraper	Individual manufacturing	2	Cleaning the surfaces of parts from dirt
9	Rectangular steel brush	Individual manufacturing	2	Cleaning surfaces from dirt and rust
10	Construction level US1-300	DSTU B B.2.8-19: 2009	1	Check horizontality and verticality
11	Folding metal meter	Individual manufacturing	1	Linear measurements
12	Leveler NV-1	Individual manufacturing	1	Definition of excesses
13	Leveling rail	Individual manufacturing	2	Definition of excesses
14	Welding machine	Individual manufacturing	1	Welding of steel elements and structures
15	Universal sling	DSTU B B.2.8-10-98	1	Slinging of goods, structures
16	Stretching from the stump rope	GOST 30055-93	1	Stretching of elements during installation
17	Steel rope thrugging	Individual manufacturing	1	Temporary fastening
18	Ladder set	Individual manufacturing	1	Installation of a working platform in the production of installation and welded works at height
19	Metal roulette RS-20	DSTU 4179-2003	2	Linear measurements
20	Rectangular steel brush	Individual manufacturing	2	Cleaning surfaces from dirt and rust
21	Scarpel	Individual manufacturing	2	Cleaning surfaces from the solution and dirt influxes
22	High steel construction OT-400	DSTU B B.2.8-18: 2009	2	Checking the verticality of structural elements

23	Folding metal meter	Individual manufacturing	3	Linear measurements
24	Mounting scrap LM-24	DSTU B B.2.8-16: 2009	2	Loosening, shifting, and installing structural elements
25	Wrench double-sided	DSTU B B.2.8-18: 2009	2	Screwing and twisting bolts

4.11. Safety

In the production of construction and installation works it is necessary to be guided by the requirements of [36].

On the construction site by order to appoint in each shift from among foremen or heads of plots:

- the person responsible for thesafe operation of the crane;
- persons responsible for the safe operation of removabledevices and containers;
- slingers.

All work should be done under the guidance of the person responsible for the safe conduct of work.

Lifting machines, removable load-lifting devices and containers that have not undergone technical inspection are not allowed to work.

It is not allowed to sling cargo in a precarious position, correct the position of the elementsof slinging equipment on the raised cargo, pull the cargo at the oblique location of cargo ropes.

Workers of all specialties must be provided with protective helmets and overalls. Workers working at height are provided with proven and tested safety belts with insuranceandwe carbines, fixed for a reliable design indicated by the master or foreman.

Workers must have a certificate for the right to produce a specific type of work, and must undergo safety briefings in accordance with the requirements.

When unloading with a crane of long-sized structures, use flexible grinding in order to eliminate the reversal of structures raised by the crane.

Do not allow unmarked, defective or non-cargo-related removable load-lifting devices to use. Defective devices from the place of work are removed;

When slinging structures with sharp ribs by strapping, it is necessary to install gaskets guarding the rope from grinding between the edges of the elements and the rope.

The dangerous area of the crane is fenced with a protective fence with clearly visible signs illuminating them in the dark. On the boundary of the danger zone to install signs warning about the operation of the crane. Safety signs installed on the carriageway of the temporary road, hang on a stretched rope. Between the suspended signs and the carriageway of the road shouldbe safely baked road dimension – 4.5 m.

It is forbidden to perform installation work at a height in open places at wind speeds of 15 m / s or more, with ice, thunderstorm or fog of the limits excluding visibility in, the front of the work. Work on the movement and installation of vertical panels and their similar structures with high sailing should be stopped at wind speeds of 10 m / s or more.

Materials (structures) should be placed in accordance with the requirements on aligned sites, adopting measures against involuntary displacement, subsidence, fall and rolling of warehousing.

To acquaint crane operators, slingers and persons responsible for the safe operation of cranes under the painting.

In the process of installation of structures of houses or structures, installers must be on previously installed and securely fixed structures or meansof priming.

It is forbidden to stay on the elements of structures and equipment during their lifting and movement.

For the transition of installers from one structure to another, stairs, transitional bridges and fencing canopies should be used.

It is forbidden to switch installers on installed structures and their elements (farms, crossbars, etc.), on which it is impossible to provide the required width of the passage during installed fencing, without the use of special safety devices (stretched along the farm or rope crossbar to fix the safety belt carbine).

Grinding should be located outside the dimensions of traffic and construction machinery. The thrusting should not apply to the sharp corners of other structures. Inflection of incest in places of their collision with elements of other structures is allowed only after checking the strength and stability of these elements under the influence of efforts from incest.

Before starting installation work, it is necessary to establish the procedure for exchanging signals between the person of the machinist who controls the installation and.

To raise the structure follows in two acceptances: first to a height of 20-30 cm, then after checking the reliability of the slinging to do further lifting.

When moving structures or equipment, the distance between them and the protruding parts of the mounted equipment or other structures should be horizontally at least 1 m, vertically - at least 0.5 m.

During breaks in work, it is not allowed to leave the raised elements of structures and equipment in a suspended position.

The elements of structures or equipment installed in the design position should be fixed so that their stability and geometric immaculateness are ensured. Work on the movement and installation of vertical panels and their similar structures with high sailing should be stopped at wind speeds of 10 m / s and moree.

4.12. Technical and economic indicators

Normative labor costs of workers, people-to-h : 78,92

Normative costs of machinists, people-to-h : 19,36

Duration of work, change: 2

Production per worker per shift: 1.5

4.13. Selection of methods of production of works, machines and mechanisms

The choice of methods of production of works is carried out so that it is possible to use means of complex mechanization and high-performance machines, on the basis of typical technological maps, maps of labor processes and reference literature. The results are summarized in Table 4.10.

Table 4.10

Selection of mechanisms and methods of work

№	Name of works	Method of work	Maximum parameters during installation work			The mechanism and its brand
			departure hook. m	hook lifting height. m	mounting weight of the element. t	
1	Cutting the plant layer of soil with a bulldozer	Cutting the plant layer of soil				Bulldozer D3-8

2	Planning a construction site	Leveling the soil surface with a bulldozer	-	-	-	Bulldozer D3-8
3	Development of soil excavator in the dump	Soil development excavator	-	-	-	Excavator E-5015
4	Warning reverse filling of sinuses under the foundation beams with a bulldozer	Filling the sinuses with a bulldozer	-	-	-	Bulldozer D3-8
6	Installation of foundation beams	Installation by crane	5	3.5	3.22	Tracked crane MCG-25 with an arrow length of 12.5 m
	Installation of metal columns	Installation by crane	6.95	8.0	0.554	Caterpillar craneMKG-25 with an arrow length of 12.5 m
7	Installation of coating farms	Installation by crane	6	15.5	4	Cranetracked and MCG-25 with an arrow length of 18 m
9	Filling the slots with window metal frames	Installation by crane	6	12.5	1	Cranetracked and MCG-25 with an arrow length of 18 m
10	Installation of wall sandwich panels	Installation by crane	6	12.5	1.05	Cranetracked and MCG-25 with an arrow length of 18 m
11	Installation of the gate frame	Installation by crane	4.5	9.5	0.95	Crane automobile KS-4561A with an

						arrow length of 18 m
12	Compaction of the soil with gravel under the rewind	Sealing with pneu motor thrambs	-	-	-	Pneumothrambovka D-220

CONCLUSIONS

In this work was designed Industrial building in Bucha of Kyiv region.

The first part of this thesis describes the analytical review.

The second part of this thesis describes the Architectural solution of the Industrial building. The Industrial building was designed in Bucha of Kyiv region

The relief of the area is hilly with a decline to the northeast.

The construction site is partially occupied by existing buildings and underground communications.

The master plan is developed in accordance with the technological scheme and in compliance with current norms and rules.

Vertical planning is solved taking into account the technology of work, topographic conditions of the area, taking into account the projected highway, which provides for departures. Vertical planning is taken into account the terrain and solved by local backfill of driveways and sites to the marks dictated by the minimum rise in the building above the axis of the driveway.

The surface water drainage on the site is designed to be open with a bypass through artificial structures in low-lying areas.

In addition, drainage on the site is solved in conjunction with the drainage of water from the ground of the road. Before the start of production, the removal of fertile soil at the base of the embankment is planned, followed by its removal for use on unproductive lands. Embankment planning is provided from imported soil. Filling of the embankment should be carried out in layers with layer-by-layer compaction to a density of at least 0.95 of the maximum density that can be achieved for the soil used.

Passages on the site are accepted single-slope. In the side stone with the width of the carriageway 4.5 m. Passages are solved in the area of technological pumping and diesel power plant. In another area, a cross-section with a width of 3.5 m and a width of 1 m. The pavement and driveways are made of 0.18 m thick concrete slabs, 0.03 m thick on a leveling layer of sand and 0.15 m thick on a rubble base with 0.08 m of roadside reinforcement. Pedestrian paths are mostly combined with driveways. Separate sidewalks are made of medium-grained asphalt concrete 0.04 m thick with a gravel base 0.08 m thick. Along the perimeter of the site there is a fence made of metal mesh on reinforced concrete pillars. Lawns are sown with perennial grasses.

The project envisages the construction of sites for technical equipment and ancillary buildings, as well as the use of existing buildings for the location of equipment. Architectural decisions on buildings are made taking into account construction and climatic conditions of the construction area.

The design of buildings and structures is based on technological layouts for the application of standard solutions, supply of equipment of maximum factory readiness, typification and unification of structures and components.

Planning decisions are based on the principles of maximum blocking of sites with interconnected technology with observance of fire breaks.

When developing building projects, the capabilities of the construction organization are taken into account. Depending on the requirements of technological processes, concrete or rubble coatings will be installed on open technological sites. Along the perimeter of the sites are outlined with side stone.

Racks with traverses from rolled profiles are provided under technological pipelines. Foundations for equipment are made of monolithic concrete or reinforced concrete with the installation of anchor bolts and embedded parts. Prefabricated metal platforms, ladders and fences according to the current series are arranged for maintenance of technological equipment. Laying of communications and engineering networks is supposed to be performed on reinforced concrete racks.

Pumps are located in the main working area of the pump. This area has the largest volume and area needed to ensure safety and prevent high concentrations of gas with air.

In the additional area there are rooms for staff, vent chamber, compressed air compressor, switchboards.

The technological map is designed for the installation of steel columns of a solid section of folded I-beams of a one-story production building.

The choice of mounting cranes is carried out according to the variant design. At the first stage, according to the technical parameters, we and the reference literature choose two options for identical cranes (equal in carrying capacity).

For the transportation of columns and steel crane beams, depending on their weight and dimensions, we choose the appropriate type and brand of vehicles, guided by the relevant reference literature.

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We accept: Semi-trailer PL 2212 D1+Tractor MAZ-6422.

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In the assembled package, fixed by plugs, blackness (divergence of holes) is allowed, which does not prevent free without distortion of the bolt setting. A caliber with a diameter of 0.5 mm larger than the nominal diameter of the bolt should pass in 100% of the holes of each connection.

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REFERENCES

1. Gasii G. Constructive concept of composite structures for construction including geological specifics / G. Gasii, O. Zabolotskyi // Budownictwo o zoptymalizowanym potencjale energetycznym. – Częstochowa: Wydawnictwo Politechniki Częstochowskiej, 2017. – vol. 20. – № 2. – P. 37–42.
2. Gasii G. Estimate of technical and economic benefits of a new space composite structure / G. Gasii, O. Hasii, O. Zabolotskyi // MATEC Web of Conferences. – 2017. – № 116.
3. Gasii G. M. A solution of construction problem of long-span civil structure by introduction steel and concrete composite cable space frames / G. M. Gasii // Zbiór artykułów naukowych. Konferencji Miedzynarodowej Naukowo-Praktycznej "Badania podstawowe i stosowane: wyzwania i wyniki" (May 30-31, 2017, Gdańsk, Polska). – Gdańsk: Diamond trading tour. – p. 6–7.
4. Gasii G. M. Comparative characteristics of the spatial grid-cable steel-concrete composite slab / G. M. Gasii / Вісник Національного університету "Львівська політехніка". Теорія і практика будівництва. – 2016. – № 844. – С. 260–265.
5. Gasii G. M. Connections systems of the composite cable space frame / G. M. Gasii // Сучасні технології, матеріали і конструкції в будівництві. – Вінниця: ВНТУ, 2017. – Т. 22. – № 1. – С. 5– 10.
6. Gasii G. M. Form-building units of the steel and concrete composite cable space frames / G. M. Gasii // Ресурсоекономні матеріали, конструкції, будівлі та споруди. – Рівне, 2017. – № 34. – С. 184–190.
7. Gasii G. M. Production of full-scale experimental modular specimens of the steel and concrete composite cable space frame / G. M. Gasii // Inżynieria Bezpieczeństwa Obiektów Antropogenicznych. – Warszawa, 2017. – № 3–4. – P. 13–17.
8. Gasii G. M. Study of behavior of flexible rods as a part of the steel and concrete composite cable space frame / G. M. Gasii // Construction, materials science,

mechanical engineering. Series: Innovative lifecycle technology of housing and civil, industrial and transportation purposes. – Dnipro, 2017. – № 100. – P. 64–69.

9. Gasii G. M. The flat double-layer grid-cable steel-concrete composite / G. M. Gasii // Proceedings of the METNET Seminar 2016 in Castellon. – Hämeenlinna, Finland: HAMK University of Applied Sciences, 2016. – P. 56 – 62.
10. Gasii G. M. Types of steel and concrete composite cable space frames / G. M. Gasii // Science and Transport Progress. Bulletin of Dnipropetrovsk National University of Railway Transport. – 2016. – №6 (66). – P. 158 – 165.
11. Gasii G. The structural and design specifics of space grid systems / G. Gasii, O. Zabolotskyi // Proceedings XVII International scientific conference VSU'2017, Sofia, Bulgaria, 8–9 June, 2017. – Sofia: VSU, 2017. – vol. 1. – p. 202–206.
12. Gasii G. M. Structural and design specifics of space grid systems / G. M. Gasii // Science and Technique. – 2017. – № 16 (6). – P. 475–484.
13. Gasii G.M. Installation technology of composite steel and concrete grid-cable coverings / G.M. Gasii // Вісник Сумського національного аграрного університету. Серія: Будівництво. – Суми; СНАУ, 2014. – № 10(18). – С. 204–207
14. Gasii G.M. Technological and design features of flat-rod elements with usage of composite reinforced concrete [Electronic resource] / G.M. Gasii // Metallurgical and Mining Industry. – 2014. – №4. – P. 23 – 25.
15. Hradil P. Reusability of components from single-storey steel-framed buildings / P. Hradil, L. Fülöp, V. Ungureanu // Steel Construction. – 2019. – Vol. 12(2). – pp. 91-97.
16. Junior V. S. Numerical Modelling Of A Single Storey Industrial Building At Elevated Temperature-Comparison Between The 2d And 3d Analyses / V. S. Junior, G. J. Creus, J. M. Franssen // Mecanica Computacional. – 2020. – Vol. 1. – pp. 1986-1997.

17. Roy K. (2019). Collapse behaviour of a fire engineering designed single-storey steel building in severe fires / K. Roy, J. B. Lim, H. H. Lau, P. M. Yong, G. C. Clifton, R. P. Johnston, C. C. Mei // Thin-Walled Structures. – 2019. – Vol. 142. – pp. 340-357.

18. Scozzese F. Analysis of non-structural damage in single-storey industrial steel buildings / F. Scozzese, G. Terracciano, A. Zona, G. Della Corte, A. Dall'Asta, R. Landolfo // Soil Dynamics and Earthquake Engineering. – 2018. – Vol. 114. Pp. 505-519.

19. Song Y. (2019). The behaviour of single-storey industrial steel frames / Y. Song, Z. Huang, I. W. Burgess, R. J. Plank // International Journal of Advanced Steel Construction. – 2009. – Vol. 5(3). – pp. 289-302.

20. Stororezhenko L.I. Steel-reinforced concrete structural guy-rope cladding / L.I. Storozhenko, G.M. Gasii, S.A. Gapchenko // Proceedings of the METNET Seminar 2014 in Moscow. – Hämeenlinna, Finland: HAMK University of Applied Sciences, 2014. – P. 79 – 85.

21. Storozhenko L. I. Combined cable space frames for agricultural buildings / L. I. Storozhenko, G. M. Gasii // Actual problems of modern technologies : book of abstracts of the IV International scientific and technical conference of young researchers and students, (Ternopil, 16th-17th of November 2017.). – Ternopil : TNTU, 2017. – 226.

22. Storozhenko L.I. Analysis of stress-strain state of the steel-concrete composite ribbed slab as a part of the spatial grid-cable suspended structure / L. I. Storozhenko, G. M. Gasii // Academic journal. Industrial Machine Building, Civil Engineering. – Poltava: PoltNTU, 2016. – iss. 2 (47). – P. 81–86

23. Storozhenko L.I. Experimental research of strain-stress state of ferrocement slabs of composite reinforced concrete structure elements [Electronic resource] / L.I. Storozhenko, G.M. Gasii // Metallurgical and Mining Industry. – 2014. – №6. – P. 40 – 42.

24. Van Thuat D. (2019). Effects of vertical actions on the responses of single-storey industrial steel building frames / D. Van Thuat, N. D. Hoa, H. V. Chuong, T. V. Hung // Journal of Science and Technology in Civil Engineering. – 2019. Vol. 13(3). – pp. 73-84.
25. Гасій Г. М. Аналіз напружено-деформованого стану трапецієподібної сталевої пластини вузла з’єднання елементів нижнього пояса експериментальної структурно-вантової сталезалізобетонної циліндричної оболонки / Г. М. Гасій // Збірник наукових праць УкрДУЗТ. – Харків: УкрДУЗТ, 2016. – №162. – С.41–47.
26. Гасій Г. М. Напружено-деформований стан сталевої пластини прямокутної форми вузла з’єднання стрижневих елементів структурно-вантової сталезалізобетонної циліндричної оболонки / Г. М. Гасій // Вісник Одеської державної академії будівництва та архітектури. – Одеса: Зовнішрекламсервіс, 2016. – №62. – С. 215–219
27. Гасій Г. М. Проектування опорного вузла структурно-вантової сталезалізобетонної вигнутої плити / Г. М. Гасій // Ресурсоекономні матеріали, конструкції, будівлі та споруди. – Рівне:НУВГП 2016. – №32. – С. 129–136.
28. Гасій Г.М. The researches of composite and spatial grid cable-stayed constructions for civil engineering / Г.М. Гасій // «Актуальні питання сучасної науки» (м. Київ, 24-25 жовтня 2014 р.). — Херсон : Видавничий дім "Гельветика", 2014. – С. 56 – 59.
29. Гасій Г.М. Техніко-економічне обґрунтування ефективності потокового методу зведення сталезалізобетонного структурно-вантового покриття / Г.М. Гасій // Збірник наукових праць Харківського університету Повітряних сил. – 2014. – №2(39). – С. 176–177.
30. Гасій Г. М. Вузлове з’єднання елементів просторового сталезалізобетонного покриття / Г. М. Гасій // Молодий вчений. – 2014. – № 9. – С. 10–12.

31. Гасій Г. М. Напружено-деформований стан структурно-вантових сталезалізобетонних конструкцій покриття / Г. М. Гасій // Проблеми сучасного будівництва: матер. Всеукр. інтернет-конф. мол. уч. і студ., 21–22 листопада 2012 р., Полтава / ПолтНТУ, Полт. держ. центр науки, інновацій та інформатизації. – Полтава, 2012. – С. 121–122.
32. Гасій Г. М. Результати експериментальних досліджень макету структурно-вантової циліндричної оболонки / Г. М. Гасій, С. А. Гапченко, Л. І. Стороженко // Перспективи розвитку будівельної галузі: матер. Всеукр. конф. мол. уч. і студ. – Полтава: ПолтНТУ, 2013. – С. 80–85.
33. Гасій Г.М. Експериментальні дослідження структурно-вантових покриттів / Г.М. Гасій // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – 2014. – №3(42). – С. 47–51.
34. ДБН В.2.6-198:2014 Сталеві конструкції. Норми проектування – [Чинний від 2015-10-01]. – К.: Мінрегіонбуд України, 2015.
35. ДБН А.3.1-5:2016 Організація будівельного виробництва – [Чинний від 2017-01-01]. – К.: Мінрегіон України, 2016. – 52 с.
36. ДБН А.3.2-2-2009 Система стандартів безпеки праці. Охорона праці і промислова безпека у будівництві. Основні положення (НПАОП 45.2-7.02-12) – [Чинний від 2012-04-01]. – К.: Мінрегіонбуд України, 2012. – 116 с.
37. ДБН Б.2.2-12:2019 Планування та забудова територій – [Чинний від 2019-10-01]. – К.: Мінрегіонбуд України, 2019. – 177 с.
38. ДСП 173-96 Державні санітарні правила планування та забудови населених пунктів. Зі змінами – [Чинний від 2019-03-07]. – К.: Міністерство охорони здоров’я (МОЗ), 2019. – (Національні стандарти України).
39. ДСТУ Б А.3.1-22:2013 Визначення тривалості будівництва об’єктів – [Чинний від 2014-01-01]. – К.: Мінрегіон України, 2014. – 30 с. – (Національні стандарти України).

40. ДСТУ Б В.2.2-29:2011 Будинки і споруди. Будівлі підприємств. Параметри – [Чинний від 2012-12-01]. – К.: Мінрегіонбуд України, 2012. – (Національні стандарти України).
41. Стороженко Л. І. Дослідження напруженого стану елементів вузлових з’єднань структурно-вантових сталезалізобетонних покриттів на основі результатів моделювання умов їх роботи / Л. І. Стороженко, Г. М. Гасій // Містобудування та територіальне планування. – К.: КНУБА, 2016. – №№61. – С. 343–347
42. Стороженко Л. І. Проектування сталезалізобетонних структурно-вантових покриттів / Л. І. Стороженко, Г. М. Гасій, С. А. Гапченко // Молодий вчений. – 2014. – № 8. – С. 30–32.
43. Стороженко Л.І. Організація й технологія зведення каркасів будівель із струкурно-вантовим сталезалізобетонним покриттям / Л.І. Стороженко, Г.М. Гасій, М.О. Коршунов, Є.В. Дяченко // Збірник наукових праць Харківського університету Повітряних сил. – 2014. – №1(38). – С. 210–212.
44. Стороженко Л.І. Технологія та організація монтажних робіт зі зведення покриттів із сталезалізобетонних структурно-вантових конструкцій / Л.І. Стороженко, Г.М. Гасій, Є.В. Дяченко, С.А. Гапченко // Молодий вчений. – 2014. – №7. – С. 17–20.
45. Стороженко Л. І. Експериментальне дослідження моделей структурно-вантової сталезалізобетонної конструкції / Л. І. Стороженко, Д. А. Єрмоленко, Г. М. Гасій, Ю.Л. Гладченко // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – Полтава: ПолтНТУ, 2012. – №3(33). – С. 243–249.
46. Стороженко Л. І. Експериментальні дослідження огороджувальних плит структурно-вантового покриття / Л. І. Стороженко, Г. М. Гасій, С. А. Гапченко, Н. Л. Голенко, В. О. Логвіненко // Тези 66-ої наукової конференції професорів, викладачів, наукових працівників, аспірантів та студентів університету. – Полтава: ПолтНТУ, 2014. – Т. 2. – С. 202–204.

47. Стороженко Л. І. Нові сталезалізобетонні структурно-вантові конструкції / Л. І. Стороженко, Г. М. Гасій, С. А. Гапченко // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – Полтава: ПолтНТУ, 2014. – №1(40). – С. 91–96.
48. Стороженко Л. І. Особливості конструктивного рішення та проектування повнорозмірного експериментального зразка структурно-вантового сталезалізобетонного покриття / Л. І. Стороженко, Г. М. Гасій // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – Полтава: ПолтНТУ, 2016. – №1. – С. 51–59.
49. Стороженко Л. І. Просторові сталезалізобетонні структурно-вантові покриття: Монографія /Л. І. Стороженко, Г. М. Гасій, С. А. Гапченко – Полтава: ТОВ «АСМІ», 2015. – 218 с.
50. Стороженко Л. І. Структурно-вантова положиста оболонка / Л. І. Стороженко, Г. М. Гасій, С. А. Гапченко, В. В. Волошин // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – Полтава: ПолтНТУ, 2014. – №3(42). – С. 178–182.
51. Стороженко Л. І. Структурно-вантові сталезалізобетонні конструкції покриттів / Л. І. Стороженко, Г. М. Гасій // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – Полтава: ПолтНТУ, 2012. – №3(33). – С. 230–234.
52. Стороженко Л.І. Виготовлення та зведення просторового сталезалізобетонного структурно-вантового покриття одноповерхової промислової будівлі / Л.І. Стороженко, Г.М. Гасій, М.О. КоршуновС.А. Гапченко, // Збірник наукових праць. Серія: галузеве машинобудування, будівництво. – 2014. – №3. – С. 192–197.
53. Стороженко Л.І. Ресурсозберігаючі технології монтажу просторового сталезалізобетонного структурно-вантового покриття / Л.І. Стороженко, Г.М. Гасій, С.А. Гапченко, М.О. Коршунов // Тези 66-ої наукової конференції професорів, викладачів, наукових працівників, аспірантів та студентів університету. – Полтава: ПолтНТУ, 2014. – Т.3. – С. 31–32.