PREFABRICATED CONSTRUCTION MARKET IN UKRAINE

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I. INTRODUCTION

The full-scale military invasion of Ukraine by the Russian Federation has caused extensive damage to residential, social and critical infrastructure. Ukraine is now faced with the need for rapid, large-scale and, at the same time, long-term recovery in difficult security, economic and demographic conditions.

The scale of the challenges requires not only financial and material resources, but also the implementation of technological solutions capable of ensuring the efficient use of time, energy resources and human potential.

In this context, rapid construction technologies appear to be one of the most appropriate solutions, capable of meeting both the urgent needs of the affected population and the strategic tasks of restoration and development of the territories.

Thanks to reduced implementation times, energy efficiency, structural mobility and less dependence on logistical and seasonal factors, rapid construction allows for the fast deployment of residential, social and administrative facilities even in difficult conditions.

The rational use of resources, time, energy, materials and personnel is key to the restoration of the state. In such conditions, the market's ability to adapt to new challenges, introduce innovations and develop flexible construction models is not only an indicator of its viability, but also a prerequisite for the transformation of the entire housing policy.

Given the new challenges, there is a growing need to update state building standards, simplify property registration procedures, and clearly define the legal status of prefabricated buildings.

At the same time, we hope that state regulatory policy will adapt to current market needs, given the critical need for rapid housing and infrastructure reconstruction. The focus on deregulation, updating the regulatory framework and supporting innovation creates the potential for the full integration of fast-track construction technologies into the country's overall spatial development system.

The aim of this study is to systematically examine the prefabricated construction market in Ukraine in the context of full-scale war and its role in post-war reconstruction. The study will consider:

- the definition, classification and current trends in the development of the segment;
- the strategic advantages of prefabricated solutions in the context of limited resources;
- barriers that hinder the scaling of the technology;
- the potential for regulatory adaptation.

The study also draws on international experience in the application of relevant technologies, which allows us to understand the prospects for the implementation of prefabricated construction as part of an innovative and sustainable model of spatial development in Ukraine.

II. CONTEXT

The full-scale invasion, which has been ongoing since 24 February 2022, has led to massive destruction of housing stock, social infrastructure and critical facilities. According to RDNA4 estimates, more than 13% of Ukraine's housing stock has been destroyed or seriously damaged, and more than 2.5 million households have been destroyed or damaged. At the same time, the scale of reconstruction needs is steadily growing, especially as internal displacement continues.

The construction market in Ukraine finds itself in an extremely challenging environment. Demand for new housing and social infrastructure facilities is high, but its implementation is hampered by a number of objective circumstances:

- a shortage of construction materials due to disrupted logistics and import dependence;
- an acute shortage of skilled labour;
- high costs of energy and production processes;
- difficult access to financing;
- an unadapted regulatory and legal framework that hinders the introduction of innovative technologies.

In conditions of limited resources, an unstable security environment and a critical need for housing, one of the most promising areas is the use of rapid construction technologies. This approach involves the manufacture of structural elements in controlled factory conditions, followed by transportation and assembly on prepared sites. This format significantly reduces construction time, lowers dependence on weather and logistical factors, and optimises costs.

Despite its numerous advantages, rapid construction is still a relatively new phenomenon for the Ukrainian market, as this technology has been used mainly for low-rise private houses, temporary structures, and commercial facilities (small architectural forms, hotel modules, campsites, etc.).

The key barrier to scaling up is the regulatory framework, which is not adapted to the needs of prefabricated construction, including state building standards that do not take into account the specifics of prefabricated structures. This creates certain obstacles to the legalisation of such facilities as full-fledged real estate objects, which, in turn, affects investment attractiveness and access to financial instruments.

However, the construction market is currently showing signs of recovery. The emergence of new projects, foreign investors, and the implementation of pilot initiatives with the support of international organisations (donors and charities) indicate the gradual formation of a separate segment of the prefabricated construction market in Ukraine. This creates the conditions for deeper integration of relevant technologies into the practice of restoring the housing sector and the construction industry as a whole.

III. METHODOLOGY

This study is based on a comprehensive methodological approach that combines quantitative and qualitative analysis tools and draws on a wide range of data sources, allowing for a comprehensive assessment of the current state, challenges and prospects for the development of the prefabricated construction market in Ukraine.

The information basis of the study consists of:

- current Ukrainian legislation in the field of construction, urban planning, energy efficiency and housing;
- analytical and reporting materials from the Ministry of Economy of Ukraine, the State Statistics Service, the State Agency for Reconstruction and international organisations (in particular, the World Bank, UNDP, UNHCR, etc.);
- materials from specialised associations and unions of manufacturers of prefabricated structures;
- industry publications, reports from consulting companies, and marketing research results;
- public databases on the construction products market, export and import operations, the volume of construction work, etc.

The following methods were used in the research process:

- comparative legal analysis (to study differences in approaches to regulating prefabricated construction in Ukraine and abroad);
- system analysis (to study the market as a complex system with many participants and interdependencies);
- structural-functional approach (to analyse the role of individual technologies in the overall system of housing and social infrastructure restoration);
- statistical analysis (for processing and visualising data on the dynamics of construction work, production and export of modular structures);

- content analysis (to identify key issues, narratives and rhetoric related to rapid construction in Ukrainian and international documents);
- expert interviews (consultations with representatives of companies, government agencies, and think tanks).

The use of an integrated approach made it possible to identify the main trends and barriers to development in the field of prefabricated construction in Ukraine, in particular regulatory gaps, technological capabilities and institutional prospects. This formed the basis for recommendations on improving regulatory policy, stimulating innovation and ensuring sustainable development of the industry in the context of the country's post-war recovery.

IV. GENERAL CHARACTERISTICS OF THE CONSTRUCTION MARKET IN UKRAINE

The construction industry is of strategic importance for the development of Ukraine's economy. While in European Union countries the share of the construction sector in the gross domestic product (GDP) structure averages 5–7%, in Ukraine, prior to the full-scale invasion, this figure was gradually increasing: from 2.3% in 2015 to 3.2–3.3% in 2020–2021.

However, after 24 February 2022, there was a sharp decline in activity in the industry. **At the end of 2022, the share of construction in GDP was only 1.2%.**

In 2024, according to the State Statistics Service of Ukraine, real GDP grew by 2.9%, but **the share of the construction industry remained below 2%.** At the same time, the Ministry of Economy of Ukraine notes that, based on the results of the year, thanks to the implementation of recovery programmes and increased demand for construction work, the industry is showing steady upward momentum.

The state budget for 2025 forecasts real GDP growth of 2.7%. The forecast is based on expectations of a gradual stabilisation of the security situation, increased investment, development of the processing industry, growth in domestic demand, and stimulation of the construction sector as one of the drivers of recovery.

Along with macroeconomic indicators, the issue of the shadow economy remains relevant, particularly in the construction sector. According to estimates by the Ministry of Economy, **in 2023, approximately 40% of Ukraine's economy operated in the shadow**. This level of shadowing significantly exceeds similar indicators in developed countries but is comparable to countries with similar institutional characteristics.

In the pre-war time, the share of the shadow economy gradually decreased to 27% in 2019, which was associated with a reduction in redistribution through public finances, increased productivity in the formal sector, and the growing attractiveness of formal employment. However, with the outbreak of war, the situation changed and the shadow economy grew, which is natural in

conditions of increased economic uncertainty and limited opportunities for the state to effectively supervise and administer in a state of martial law.

According to Danylo Getmantsev, head of the parliamentary committee on finance, tax and customs policy, at least UAH 1.5 trillion circulates in Ukraine's shadow economy, of which UAH 500-600 billion could potentially go to the budget. The Ministry of Economy acknowledges that bringing these funds out of the shadows is a gradual and lengthy process, but the state is already taking measures to "de-shadow" certain industries, in particular through digitalisation, reforming the control system, transparent procedures and fiscal modernisation.

Recent years have seen the development of several key trends that are gradually transforming the construction sector in Ukraine and shaping new standards for its operation:

- Circular economy. As a result of the full-scale invasion, Ukraine has faced unprecedented volumes of construction waste, which is a direct result of the destruction of residential and critical infrastructure. According to a Yale E360 study, more than 1.5 billion tonnes of construction waste have been generated since the start of the invasion in Ukraine, much of which is unsuitable for traditional disposal. In the Kyiv region alone, according to BDO estimates, more than 185,000 tonnes of debris have already accumulated after the hostilities. The implementation of circular economy principles, including material recycling, waste reduction and the integration of recycled components into new construction projects, is becoming not only an environmental but also an economic necessity. An example of this is the activities of Neo-Eco Ukraine, the Ukrainian subsidiary of the French multinational company Neo-Eco, which applies 16 years of experience in recycling construction waste into new building materials through circular economy projects.
- Decarbonisation of construction. According to the updated EU Energy Performance of Buildings Directive (EPBD), all new buildings in the European Union must be zero CO_2 emissions starting from 2030, and public buildings from 2028. These innovations are aimed at decarbonising Europe's building stock. Accordingly, on the path to European Union membership, in order to harmonise with European

standards, Ukraine needs to implement the relevant requirements for energy efficiency, embodied carbon and climate neutrality of buildings into national building legislation.

- Energy-efficient construction. Given the energy shortage resulting from massive attacks on Ukraine's energy and gas infrastructure, the instability of the energy system and the need to improve the country's energy security, the implementation of energy-efficient solutions has become a priority. Such solutions include modern thermal insulation, integration of renewable energy sources (in particular solar panels), and optimisation of internal engineering systems. The potential of solar generation in Ukraine is estimated at over 230 GW, which creates a basis for a large-scale transition to autonomous and energy-efficient facilities.
- Development of green architecture. Practices for integrating natural elements into the urban environment are being implemented in Ukraine, including green roofs, facades with vegetation, and the use of environmentally friendly materials. Such solutions not only reduce the environmental impact but also improve the microclimate, noise levels, and comfort of residents.
- Green building certification. The practice of applying international certification systems, such as LEED, BREEAM, and EDGE is developing. They provide validation of the efficiency of facilities in the areas of energy and water conservation, air quality, materials, environmental impact, and social impact. This creates competitive advantages for developers and opens up access to green financing.

- Use of the latest technologies. Innovative technologies, in particular 3D printing and building information modelling (BIM), are becoming increasingly widespread. For example, in 2021, the company called Melivora, which was later reorganised into the engineering and technology company 3D QUANTER, implemented Ukraine's first 3D-printed building project with an area of 48 square metres in the town of Nedryhailiv, Sumy region. As part of this pilot project, Ukrainian engineers developed and applied Ukraine's first 3D construction printer of the lifting-radial type, created specifically for working with concrete mixtures in construction. In 2023, as part of a charitable project, 3D UTU company built a single-storey residential building with an area of 130 square metres using 3D printing in the village of Mykhailivka-Rubezhivka in the Kyiv region. Also, in 2025, as part of the Team4UA humanitarian programme, a project was implemented in Lviv to build a school printed on a 3D printer using 90% local materials.

In addition to the negative impact of the full-scale invasion on the economy, Ukraine's construction sector faces a number of structural and systemic challenges that hinder its full development and reduce its investment attractiveness:

- Shortage of skilled labour. Due to mass migration, mobilisation and the general ageing of the labour force, there is a significant shortage of

personnel in the construction industry. There is a particularly acute shortage of engineering and technical personnel, specialists in modern construction technologies and energy efficiency, as well as workers in the main construction trades.

- Problems with the supply of construction materials and an urgent need to develop new logistics routes. A significant part of the logistics chains has been disrupted or destroyed. Some of the materials were imported from temporarily occupied territories or from regions where hostilities are now taking place. This necessitates the establishment of alternative economic ties, the formation of new logistics corridors, and the development of domestic production of construction materials.
- Regulatory barriers and corruption risks. Despite partial digitalisation and individual steps to reform the licensing system in the construction sector, problems with bureaucratic procedures, lengthy approval times, as well as abuse and lack of transparency in the issuance of permits, approval of project documentation and commissioning of facilities remain a serious deterrent. Duplication of functions between regulatory authorities and the complexity of navigating regulatory requirements complicate the implementation of construction and infrastructure projects. To reduce the administrative burden and corruption risks, it is necessary to further simplify procedures, strengthen the institutional capacity of state bodies, expand digital services, and introduce effective control methods. The key is to create a transparent and predictable investment environment that is understandable and attractive to investors.
- Market monopolisation and limited access for new players. A significant portion of resources and land plots are concentrated in the hands of large development companies. It is difficult for new companies to enter the market due to a lack of start-up capital and insufficiently developed financial and tax instruments to support small and medium-sized businesses in the construction sector.

According to the State Statistics Service, the volume of construction work performed in Ukraine in 2022 amounted to UAH 113.8 billion, in 2023 — UAH 165.8 billion (an increase of 48%), and in 2024 — UAH 210.2 billion (an

increase of 27%). The construction of buildings in 2024 increased to UAH 87.6 billion, compared to UAH 65.5 billion in 2023 and UAH 49.4 billion in 2022.

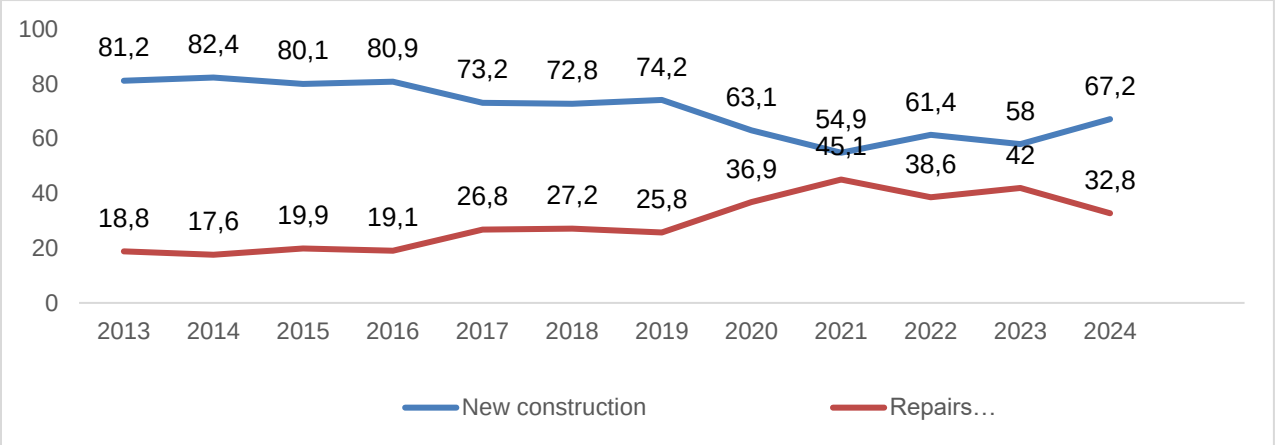
Also, in 2024, there was an increase in the area of housing commissioned — 9.76 million square metres compared to 7.38 million square metres in 2023.

Volume of construction work performed (construction output) in Ukraine, 2018-2024, million UAH

Period	2018	2019	2	2021	2022	2023	2024
Volume of construction work performed, million UAH	141213	181697.9	2020	258,073.6	113,828.2	165,818.2	210,197.4
Growth, %		***29***	***11***	***28***	***-56***	***48***	***27***

The dynamics of construction work volumes in Ukraine in 2018–2024 clearly demonstrates the dependency on the economic and security situation in the country. After a long period of growth in 2018–2021, there was a sharp decline of 56% in 2022 due to the full-scale invasion. However, in 2023, the sector showed an impressive recovery with a 48% increase, which continued in 2024 (+27%). This indicates the gradual adaptation of the industry to wartime conditions, as well as the growing role of construction in the process of the country's economic recovery.

Distribution of completed construction works (volumes of construction output) by type of construction, 2013-2024, %



During 2013-2016, Ukraine maintained a consistently high share of new construction (including reconstruction), exceeding 80%. Starting in 2017, a gradual change in structure was observed: the share of new construction began to decline, while the volume of repair work increased. The most noticeable reduction in the share of new construction occurred in 2020–2021, to 63.1% and 54.9%, respectively. In 2021, it reached a minimum of 45.1%, accompanied by a peak in repair work of 36.9%.

Since 2022, the situation has been gradually changing: the share of new construction has grown from 61.4% in 2022 to 67.2% in 2024, while the share of repairs has decreased from 38.6% to 32.8%. This trend is evidence of a recovery in construction activity, particularly within the framework of programmes to reconstruct and rebuild the country after a full-scale war, as well as a return of investment to capital projects.

Volume of construction work performed (production of residential and non-residential buildings), 2018-2024, million UAH

Period	2018	2019	20	20	2022	2023	2024
Buildings*	**66,791.6**	**83,589.3**	**80,625.6**	**102,894.3**	**49,439.1**	**65,511.5**	**87,605.9**
- residential	29,344.8	33,208.8	29,083.6	39,147.9	19,832.6	22,906.6	27,445.8
- non-residential	37,446.8	50,380.5	51,542.0	63,746.4	29,606.5	42,604.9	60,160.1
of which:							
transport and communications buildings	550.5	737.8	769.6	668.8	536.9	605.0	343.8

Industrial buildings and warehouses	10,363.2	13,414.6	15,971.8	19,848.4	9,960.0	12,570.6	17,784.8
***Growth, %**		***25***	***-4***	***28***	**-52**	**31**	**34.1**

Between 2018 and 2021, the construction market showed steady growth, peaking in 2021 at UAH 102.9 billion, which indicated active investment in residential and commercial real estate. However, in 2022, volumes halved to UAH 49.4 billion (-52%), which was the deepest decline in the period under review.

In 2023 and 2024, there is a clear trend towards recovery in the industry. The volume of construction increased to UAH 65.5 billion in 2023 (+31%) and to UAH 87.6 billion in 2024 (+34.1%). This indicates a gradual return of capital and the implementation of restoration and new construction projects.

Residential construction grew from UAH 19.8 billion in 2022 to UAH 27.4 billion in 2024, but still did not reach the pre-war level of 2021 (UAH 39.1 billion). At the same time, the importance of single-family housing is growing — in 2024, 4.97 million m² of such buildings were commissioned, exceeding the 2021 figure. This indicates a shift in focus from multi-storey to individual housing in the context of internal migration, security challenges and decentralisation of development.

Non-residential construction, including industrial and transport facilities, is recovering more actively. In 2024, the volume amounted to UAH 60.2 billion, which already exceeds the 2021 figure (UAH 63.7 billion). Investments in industrial buildings and warehouses are growing particularly dynamically — from UAH 9.96 billion in 2022 to UAH 17.8 billion in 2024 (+78%), which indicates a focus on the development of production infrastructure, the relocation of enterprises, and the formation of new logistics chains.

Area of residential buildings commissioned, Ukraine, 2018-2022, sq. m.

	Single-family houses	Buildings with two or more apartments	Dormitories
2018	4,247,660	4,434,586	7,110

2019	5,847,163	5,176,389	5,775
2020	4,271,823	4,172,313	7,085
2021	4,351,564	7,051,835	30,391
2022	2,783,504	4,320,519	6,201
2023	3,482,538	3,886,163	12,051
2024	4,974,545	4,782,577	1,759

Regulatory and legal regulation of the construction industry in Ukraine is based on a complex system of legislative and technical documents. This system is based on the Constitution of Ukraine, the Civil and Land Codes, as well as specialised laws: "On the Fundamentals of Urban Planning", "On the Regulation of Urban Planning Activities", "On Investment Activities", "On Architectural Activities", "On Building Standards", "On Energy Efficiency" and others. State building standards (DBN), state standards (DSTU) and technical conditions (TU) also play an important role in ensuring the technical regulation of the design, construction and operation of facilities.

Institutional support for the implementation of construction policy in Ukraine is provided by legislative bodies (in particular, the Verkhovna Rada of Ukraine through the relevant parliamentary committee), central executive bodies — the Ministry of Development of Communities and Territories of Ukraine, the State Inspectorate of Architecture and Urban Planning, the State Agency for Energy Efficiency, the State Agency for Infrastructure Restoration and Development, and others.

Regional and district state administrations, as well as local self-government bodies, play an important role in the implementation of policy at the local level. They formulate and implement local urban development policy, monitor compliance with building standards and ensure the effective implementation of development programmes.

Overall, Ukraine's construction market is gradually adapting to new challenges, demonstrating potential for sustainable growth, modernisation and integration with European standards, which is key in the context of the country's recovery and development.

V. THE PREFABRICATED CONSTRUCTION MARKET IN UKRAINE

5.1. General market overview and description of the technology of prefabricated construction

Historically, the use of prefabricated structures in residential construction was often a response to crisis situations — economic turmoil, wars, housing shortages. Over time, this anti-crisis solution has transformed into a sustainable and effective practice that combines speed, cost-effectiveness and technological adaptability.

The history of prefabricated construction dates back to 12th-century England. At that time, wooden structures were popular, which people bought and assembled themselves.

In particular, a striking example of the effective use of prefabricated structures in infrastructure construction is the British Crystal Palace, an exhibition pavilion made of glass and steel, erected in 1851 in Hyde Park for the World's Fair. The structure was designed as temporary, with the possibility of further dismantling and relocation. After the event, it was successfully moved to another location, where it functioned for more than eight decades, confirming the flexibility and durability of such solutions.

At the beginning of the 20th century, during the development of the metalworking industry, wooden structures were replaced by metal ones.

The American experience with prefabricated structures began with housing during the Gold Rush, when many house kits were supplied from Germany, France, and China. In the first decades of the 20th century, the commercial idea of the American retailer Sears, Roebuck and Co. became widespread. The company created catalogues with models of various cottages that had a fixed price. Customers ordered housing and received materials by mail.

Mass production of metal frame houses began after World War II, when there was a high demand for housing. Manufactured in factories, prefabricated structures were quickly assembled on site in a matter of days or weeks. This type of construction allowed for the rapid restoration of the housing stock in European countries after the war.

In particular, in the United States, the use of prefabricated buildings made the affordable American dream a reality in the Levittown neighbourhoods built for veterans' families. This was the world's first experience of mass low-rise construction.

In European countries, such as Britain, to overcome the post-war housing crisis, the main focus was also on houses with wooden and metal frames (sometimes using waste from the aviation industry), asbestos panels, and later — prefabricated reinforced concrete. The Emergency Factory Made programme provided the British with 1.5 million new homes.

“BISF house” is a steel-framed house that was produced in the UK after 1946 as part of the Emergency Factory Made housing programme.

At the same time, the Soviet Union issued a decree "On the development of the production of prefabricated reinforced concrete structures and components for construction." The decree was aimed at modernising the construction industry through the active introduction of prefabricated reinforced concrete structures. The document set out tasks for expanding production capacity, improving the technical level of construction, standardising typical elements and wider use of industrial methods in residential and civil construction. This was to ensure the mass, rapid and cost-effective construction of facilities in the face of growing demand for housing and infrastructure.

Prefabricated buildings on metal frames were practically not built, since metal in the USSR was a strategic resource and was used primarily in industry and for the construction of infrastructure facilities. Instead, priority was given to reinforced concrete panel construction, which became the basis for mass housing development in cities.

With independence, Ukraine gradually began to adapt new approaches and global technologies. The centralised system was replaced by a market-based approach, which stimulated competition and innovation in the construction sector. Since the 2000s, domestic manufacturers have been actively improving methods of rapid construction, primarily frame-modular systems, lightweight metal structures, sandwich panels, etc.

Given the absense of the classification of quick-assembly technologies in Ukraine, quick-assembly houses can be divided into prefabricated and modular.

Quick-assembly technologies			
Prefabricated structures	On wooden frame	On metal frame	Panels
Modular structures	On wooden frame	Containers-based	On metal frame

Prefabricated structures are assembled on the construction site either completely or partially. Partial assembly means that certain materials, primarily panels, are pre-manufactured at the factory, thereby minimising installation time on site.

Modular structures are assembled in a factory environment and then transported and installed on the construction site.

There are two main types of modular construction: permanent **modular** construction and **relocatable** buildings.

Permanent modular structures are manufactured in factories and transported to the site ready-made, installed and usually not intended for relocation.

Relocatable modular buildings are manufactured entirely in factories and transported to the site ready-made, from where they can be easily relocated.

In international practice, houses that are prefabricated in a factory and delivered to the site in maximum configuration are called **"prefabricated buildings" or "prefabs".** However, there is no proprt English equivalent for the term "**quick-assembly**"[1]. **In essence, the term "quick-assembly houses" includes "prefabs" (i.e., those manufactured in a factory) and other prefabricated houses (for example, those assembled entirely on site from lightweight frames without prior factory work).**

Features of prefabs constructions technology:

- the ability to construct buildings at any time of the year

[1] That is to say that within this study authors use prefabricated buildings" or "prefabs" as equivalent to quick-assembly structures term.

- the availability of industrial production of houses
- the possibility of relocating buildings
- minimal load on the foundation (in this regard, columnar or screw piles are most often used for such buildings)
- short-term installation work
- construction technology usually does not involve the use of "wet processes"
- minimal involvement of special ("heavy") equipment
- simplified legal component of real estate registration (possibility of registering the object as temporary without commissioning).

Prefaricated buildings are constructed from wood, metal structures, reinforced concrete structures, and plastic. Each of these materials has its own advantages and disadvantages, which determine the properties of the entire building.

The economic benefits of using this technology are particularly noticeable in the construction of commercial buildings. Industrial facilities are the second largest users of this technology. A significant part is occupied by facilities in the agro-industrial sector: livestock complexes, greenhouses, premises for agricultural machinery, etc. The technology is also becoming increasingly popular in the residential sector.

Features of the prefabricated construction market assessment:

- The prefabricated construction market is represented by various construction technologies that do not have a clear classification and separate code in the Classification of Economic Activities ([2]). Various types of construction products are also used for construction.
- construction using prefabricated technology can be the main or additional activity of a company

[2] KVED is the Classification of Economic Activities, which is a system of codes for classifying different types of businesses in Ukraine. Entrepreneurs (both individuals and legal entities) must choose the appropriate KVED that corresponds to their activities in order to register their business and conduct entrepreneurial activities legally.

- the possibility of constructing prefabricated buildings as temporary structures and absence of commissioning requirement - due to the legislative gap and legal inconsistency
- The export and import of prefabricated and modular buildings is carried out under code 9406001100 (mobile homes), under which all prefabricated houses are recorded. Another difficulty in assessing foreign trade arises from the assignment of different codes to the same type of product. For example, a CLT panel may cross the border under code 441882 or 441881. At the same time, the panel may not be classified as CLT.
- A large share of the unformalised market.

5.2. Features of quick-assembly construction technologies in Ukraine

Quick-assembly construction technology in Ukraine can be classified as an innovative solution in the low-rise construction industry. As previously mentioned, structures are divided into prefabricated and modular types based on the type of assembly.

Prefabricated houses on a metal frame

In its classic form, the frame of a quick-assembly building consists of a set of cross frames connected by horizontal and vertical ties and roof purlins.

Enclosing elements, namely roofing and facade materials, are used around the perimeter. In Ukraine, sandwich panels are most often used — a combination of two sheets of profiled sheet metal[3] and insulation. Lightness and durability have made this material the most popular for the construction of prefabricated buildings.

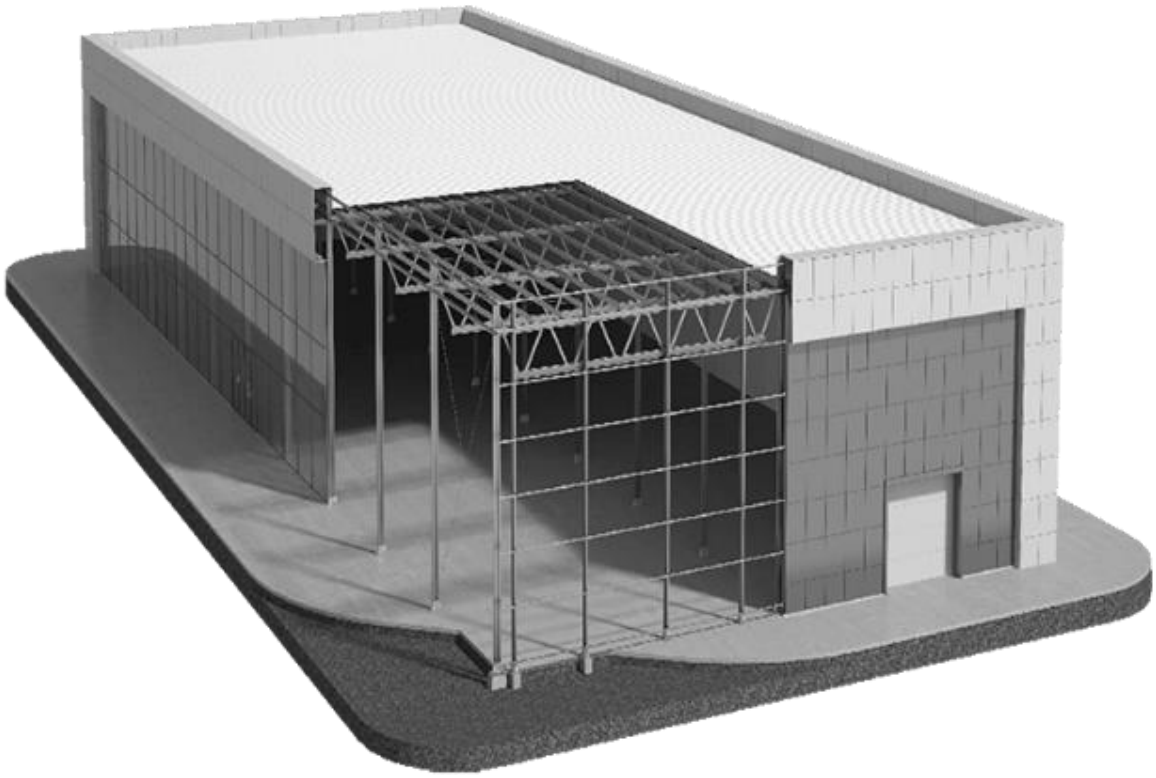
Buildings are delivered to the site either as a complete set or piece by piece according to the installation schedule.

This construction technology is actively used for the construction of commercial, agricultural and industrial facilities.

Features of this technology:

[3] Profiled sheet – cold-rolled steel profiled sheet

- work can be carried out regardless of the season and weather conditions
- thanks to the lightness of the steel frame, buildings do not require massive foundations
- reusable steel structures after dismantling the facility
- High degree of maintainability and availability of replacement parts for building components
- ease of building construction, installation of engineering systems and communications
- long service life.



Among the companies working with this technology are:

LENTAB Ukraine LLC

RAUTA GROUP LLC

SSM Zavod LLC

ThermaSteel LLC

Instil Ukraine LLC and others.

Prefabricated buildings on a wooden frame

While industrial and commercial facilities are most often built on the basis of lightweight metal structures, wooden structures are used more for residential buildings. It is the simplest construction technology in the world.

The frame is based on thick, strong boards (most often made of pine). The moisture content of the selected wood material should not exceed 10-12%.

A frame is erected on the foundation, repeating the exact contours of the future house. The frame has intermediate and corner posts, lower and upper straps, transoms and struts, between which openings for windows are created. On the outside, the frame is most often sheathed with OSB boards. The space between the frame elements is filled with insulation, the type and thickness of which is calculated specifically for each object (depending on the climate and heat transfer of the surrounding structures). Inside the house, the air is vapour-proofed, which prevents moisture from entering the house.

Glued materials. Exterior wall panels are often sheathed with 15 mm moisture-resistant OSB boards (Oriental Strand Board). Such boards are also used for flooring and roofing.

Insulation. The thickness of insulation for exterior walls is usually at least 150 mm, for interior partitions – 100 mm, for floor slabs – 200 mm, and for roofs – 400 mm.

Insulation of the insulation. In order to preserve the properties of the insulation, it must be reliably protected from wind and moisture penetration. Before installing the panels in place, a waterproofing membrane is attached to them from the outside. After assembly, the joints of the panels are glued with special tape. On the inside, the insulation is protected by a vapour barrier, and as a result, it is sealed inside the wall. This creates the so-called "thermos effect", which ensures high heat-saving characteristics of the house. Ventilation is also mandatory in frame houses to prevent water vapour from penetrating the insulation. If such ventilation is not installed, moisture may accumulate in the insulation after 5-7 years, causing it to lose its properties and the frame to start rotting.

Frame construction technology can be divided into two groups:

- frame-frame
- frame-panel

The first group of technologies is also called open panel technology: it consists of a set of assembled frames delivered from the factory. Roof and floor elements are also delivered assembled, and all these elements are assembled into a finished house frame at the construction site. The frame is then insulated and protected with vapour barrier and cladding. Frame-frame technology is most widespread in the USA and Canada and is considered classic.

The second group is the frame-panel option, also known as closed panel technology. It differs from the first in that completely finished wall and floor panels are delivered from the factory. At the construction site, they only need to be fastened together. Closed panel technology is particularly popular in Europe.

Features of this technology:

- availability of materials
- lightweight construction, allowing any type of foundation to be chosen
- high strength of the structure with low weight
- ease of work and finishing, which determines the speed of construction
- rapid biological decomposition, characteristic of all types of wood. It can be combated with special treatments and antiseptics.
- airtightness of the building, requiring the mandatory installation of a ventilation system
- High fire hazard of buildings (need for additional fire protection measures and coatings).

Among the companies working with this technology are:

KARPATY BUD KARAKAS LLC

KYU-BLOK LLC

Modern Wooden Houses LLC

BK "PROSTO HOUSE LLC

Frame-panel houses using hemp and straw insulation

Frame construction technology can use different types of insulation. In Ukraine, straw, industrial hemp and reeds are widely used.

To build frame houses from industrial hemp, a hemp solution based on industrial hemp ash, lime, a binding agent, and water is used. The mass for hemp insulation is mixed for a few minutes, after which it is poured as a solid monolithic wall, and when it hardens, a concrete ash is created from the component solution. Hemp contains a high percentage of silicon dioxide, which has a strong effect when combined with lime. This combination creates a strong material (like cement) that is lighter than concrete and brick.

The solution can also be reinforced and moulded into "formwork", allowing it to be used in the construction of absolutely any building.

The production of straw panels uses rye straw with a moisture content of no more than 12%, dry calibrated pine beams treated with fire retardant and

antiseptic compounds, moisture-resistant 1st grade plywood and high-strength self-tapping screws. Special equipment for the manufacture of panels evenly distributes and compresses the straw.

The finished panels are transported and installed on a previously prepared construction site. Then finishing works are carried out, for example, coating straw panels with lime plaster or clay.

Features of this technology:

- high level of environmental friendliness, hypoallergenic properties and affordability
- long service life
- specialists do not recommend building a house in winter
- in houses made of straw panels, it is not possible to hang heavy equipment on the walls (boilers, gas columns, boilers, etc.)
- the need for structural measures to protect against rodents.

Among the companies working with this technology are:

LIFE HOUSE BUILDING LLC

HEMPAER LLC

KONOPLYANI TECHNOLOGII LLC

ARTHOUSE BUILD LLC

SIP panel construction

This technology is based on SIP (Structural Insulated Panel) structural insulation panels. A SIP panel is a multi-layer structure consisting of thermal insulation material – self-extinguishing polystyrene foam of the PSB-S brand with a density of 25 kg/m^3 , which is glued under high pressure between two OSB (Oriented Strand Board) plates.

OSB is made from wood chips obtained by splitting high-quality wood. The multi-layer sheet is impregnated with resins with the addition of boric acid and synthetic wax. The direction of the wood fibres can be different – longitudinal or transverse. But the type of panel depends on the internal filling:

- a structurally insulated panel is created on the basis of expanded polystyrene, which is glued to OSB sheets under pressure, or on the basis of liquid polymer foam, which is injected into the space between the OSB. This is the most common and cheapest type of SIP panel, which is effectively used for the construction of residential and farm buildings;
- Neopor insulated panels are premium materials. The filler is based on expanded polystyrene with graphite particles (graphite foam). Graphite can reflect infrared heat waves like a mirror, which reduces the thermal conductivity of the material.
- SIP fibre cement board. Fibre cement is a fire-resistant, improved wood, but it belongs to the class of artificial, rather fragile materials.

SIPs can be manufactured in the form of panels for walls, floors and roofs. SIP technology is not frame construction, but panel construction. Only the upper and lower binding beams, as well as the vertical connecting beam, act as the frame. Panels can be delivered to the construction site with pre-installed windows and doors, plasterboard cladding and electrical wiring. A finished house built from SIP panels can be clad with brick, wood or other materials.

Features of this technology:

- usually low noise insulation

- open installation of engineering systems

Among the companies working with this technology are:

Bauen House LLC

SIP FABRIKA LLC

SERVUS Trading House LLC

SIP ATLAS LLC

SIPEKO LLC

CLT panel construction

CLT panels first appeared in the 1990s. The first samples of this material were developed in Austria in 1996, although the idea of building houses from such panels originated in Switzerland. The Austrians became interested in the new material and improved it, giving it a modern look. The first factory for the production of CLT panels was opened by KLH in Austria. Since the early 2000s, the use of CLT panels in global construction has been steadily increasing.

Cross-laminated timber (CLT) panels are wooden boards glued together under high pressure in several layers. Hardwoods and softwoods are used to produce CLT panels. The layers of wooden lamellas are stacked perpendicular to each other, crosswise. Each lamella consists of 3 to 12 layers.

The dimensions of the panels may vary depending on the manufacturer and are usually as follows: length – up to 24 m, width – up to 3 m, thickness – up to 0.5 m. The most popular size is 6x9 m, which is equivalent to one full wall of a house. The minimum size of CLT panels is usually 3x3 m. Polyurethane glue that does not contain formaldehyde and solvents harmful to human health is used for gluing. The process of assembling and pressing the panels can take from 15 minutes to 1 hour, depending on the equipment and type of glue. The panels are delivered to the construction site ready for installation. Door and window openings and channels for engineering communications are cut out in the panels at the factory. The panels arrive at the construction site already numbered and are delivered according to the building's installation plan, so assembly takes place in a very short time.

Features of this technology:

- long service life
- Buildings made of cross-laminated timber are 30% lighter than steel and concrete structures, so there are fewer requirements for the building foundation.
- CLT panels do not deform. Glued in a factory from dried wood, a monolithic wooden panel does not require plastering, which reduces the period of finishing work and the time required to commission the building
- High thermal insulation properties. Thanks to cross-bonding technology, there are no cold bridges or heat leaks, so the panels have at least 35% better thermal insulation properties than logs or timber, including glued timber of similar dimensions.
- CLT panels are a solid material, which, when ignited, makes it difficult for oxygen to reach the burning surface. The thermal resistance of the panels is characterised by a burning rate of 0.6-0.7 mm per minute at a temperature of 1200 degrees
- High sound insulation
- Despite the guaranteed service life (some European manufacturers give up to 200 years), it is not yet known how long houses built with CLT

panels will last. There is no data on the behaviour of the structure over time due to the short history of the technology

- high production cost of CLT panels due to the use of expensive equipment and the need for highly qualified personnel
- The need for additional costs due to wall insulation when building in cold climates.
- open installation of engineering systems

Among the companies working with this technology are:

- REZALT UKRAINE LLC
- FinnDom LLC (importer)

Modular houses

Quick-assembly construction technologies have become very popular around the world. This has led to a variety of solutions, among which modular houses occupy a special place.

Modular buildings are buildings constructed from ready-made, pre-prepared prefabricated structures (modules). The design of such buildings allows two or more modules to be quickly connected to each other. The connections can be either horizontal or vertical, thus forming multi-storey building structures.

The main materials used to create the blocks are metal or wood, which form the frame of the house. Modular houses can also be based on shipping containers. Basalt wool, polystyrene foam, or technical hemp can be used as insulation. Vinyl or metal siding, textured plaster, and wooden beams are used for exterior finishing.

Modular houses are easy to transport and, if necessary, increase the interior space by adding new modules or changing the functional purpose of rooms. Work on the construction site is limited to clearing the territory, connecting to utilities, and occasionally pouring the foundation.

Modular structures are especially popular in Scandinavian countries, the USA, and Western Europe.

Features of this technology:

- the possibility of transportation and reassembly
- the combination of plasticity and strength gives the modular structure increased resistance to seismic vibrations and seasonal soil shifts . Thanks to these properties, a modular house can be built even on sites with problematic soil structure or complex terrain relief;
- limited architectural solutions
- difficulty of transportation (special trawls are required)

Among the companies working with this technology are:

ARTMETAL LLC

UNITFAB LLC

Quick-assembly buildings made of sandwich panels: glass fibre reinforced concrete and reinforced concrete

A glass fibre reinforced concrete (GRC) sandwich panel is a modern three-layer wall structure with an outer layer of durable glass fibre reinforced concrete, insulation (expanded polystyrene, mineral wool) and an inner layer of GRC, which ensures quick installation, high thermal insulation, resistance to moisture, fire, aggressive environments and durability, creating a finished facade without additional processing.

The panels are mass-produced, shipped in finished form, painted, and do not require further processing. Low-rise buildings can be dismantled and reassembled as needed.

Features of this technology:

- the panels are mass-produced, shipped from the factory in finished form
- due to the significant weight of the structure, a foundation is required
- the slabs are delivered and shipped by special transport, which entails additional costs

Among the companies working with this technology are:

AFB ASPECT LLC, BUDOVA Construction Company, Well-being ConTech (group of companies)

BMZ BETON LLC

ICF technology

ICF (insulated concrete form) technology involves the construction of formwork for concrete from insulated moulds made of rigid insulating material. After constructing formwork one storey high with door and window openings, the formwork is filled with concrete using a concrete pump. The concrete becomes the load-bearing structure of the building, and the ICF elements provide its thermal insulation.

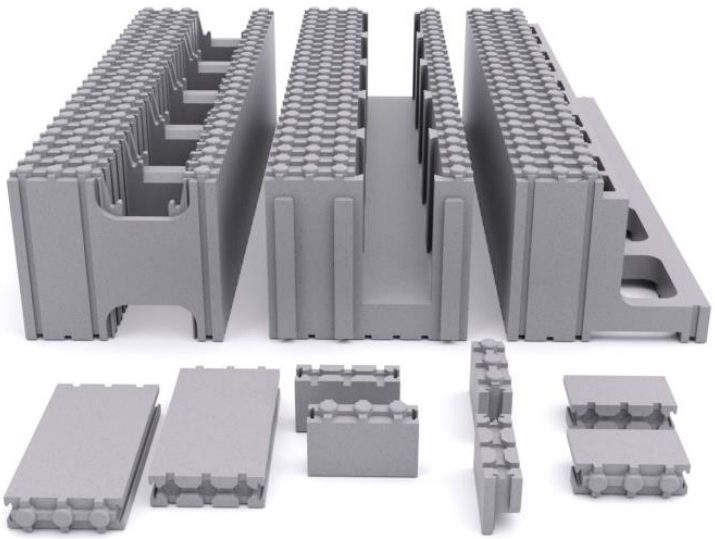
Features of this technology:

- a layer of polystyrene foam insulation 10, 20 or 30 cm thick allows you to build energy-efficient or even passive houses
- the construction team can completely build a floor in a short period of time. The exceptional quality of the forms allows them to be filled with concrete from a pump up to a height of 3 metres
- a wide range of products allows the manufacture of external and internal walls, foundations, partitions, retaining walls and floor slabs
- Cheap transportation. Removable MCFU elements (thermal insulation side walls and plastic lintels are transported separately and assembled on site) allow you to transport up to 750 square metres of walls in a single 40-foot HC container.

Among the companies working with this technology are:

IZODOM Ukraine LLC

BVK AVKOM LLC




Mercedes-B
VOLVO

5.3. Features of legislative regulation of prefubs in Ukraine

Prefabricated constructions in the context of Ukraine's full-scale recovery after the extensive destruction caused by military aggression is emerging as a technological solution that allows for the urgent implementation of residential, social and infrastructure development projects. At the same time, its legal status, implementation procedure and regulatory requirements are still being developed and do not fully meet the current market challenges.

The legal distinction between capital and prefabricated construction is crucial for determining the legal status of structures, their operational capabilities, financing, connection to utility networks, and registration of ownership rights. Against the backdrop of an urgent need for rapid and large-scale restoration of destroyed housing stock and infrastructure, especially for internally displaced persons, it is important to establish a clear regulatory framework for the legalisation and widespread implementation of such solutions.

This section examines the existing legal and regulatory framework and identifies the key differences between capital and prefabricated structures in accordance with the Civil Code, urban planning legislation, state building standards (DBN) and subordinate regulatory acts. Based on this, directions for regulatory improvement are proposed that will allow prefabricated buildings to be integrated into Ukraine's sustainable spatial development system as full-fledged elements of residential and social infrastructure.

According to Article 181 of the Civil Code, immovable property (real estate, real estate) includes land plots, as well as objects located on a land plot, **the movement of which is impossible** without their depreciation and change of purpose.

As for the characteristics of capital structures and buildings, the legislation does not contain a definition of the term "capital structure", but according to Section 3 "Terms and Definitions" of the National Classifier of Buildings and Structures, NK 018-2023, approved by Order of the Ministry of Economy of Ukraine No. 3573 dated 16 May 2023, it is stated that:

- a structure is a structure **connected to the ground**, created from building materials and components and/or for which construction work is being carried out;
- buildings are covered structures that can be used separately, **built for permanent purposes**, forming above-ground or underground premises intended for human habitation or stay, placement of equipment, animals, plants, and objects;
- residential buildings (houses) are structures at least half of whose total area is used for residential purposes. If less than half of the total usable area is used for residential purposes, the building is classified as non-residential in accordance with its intended purpose.

Therefore, we can conclude that **a capital structure is a building with a foundation, intended for permanent use, which cannot be moved without its depreciation, and which is subject to registration as immovable property.**

A temporary structure is a structure without a foundation that can be dismantled or moved and, accordingly, is not considered immovable property.

The Law of Ukraine "On Regulation of Urban Development" contains the concept of temporary structures. In particular, Article 28 defines a temporary structure *for* commercial, domestic, social, cultural or other purposes *for the conduct of business activities* as a single-storey structure made of lightweight materials, taking into account the basic requirements for structures specified in the technical regulations for construction products, buildings and structures, and is installed temporarily, without the construction of a foundation.

A temporary structure *for business activities* may have a covered space for temporary accommodation of people (pavilion with an area of no more than 30 square metres along the outer contour) or may not have such a room.

The basis for the placement of a temporary structure is a location passport, which is provided by the urban planning and architecture authority (Procedure for the placement of temporary structures for business activities, approved by Order of the Ministry of Regional Development, Construction and Housing and

Communal Services of Ukraine No. 244 of 21 October 2011). For the preparation of a temporary structure location passport, urban planning conditions and restrictions on the development of the land plot are not provided.

Also, for the period of the legal regime of martial law, a state of emergency in Ukraine or in certain areas thereof, and for one year after its termination or cancellation (temporary norm), the concept of **a "temporary structure for the life support of the population"** has been introduced - a low-rise (up to two stories high) quick-assembly structure made of lightweight materials (mobile (inventory), prefabricated, container or combined type, etc.) that meets the minimum requirements established by the Cabinet of Ministers of Ukraine for the life support of internally displaced persons and can be dismantled and moved for subsequent reuse or without such reuse.

The placement of temporary structures for the life support of the population is carried out on the basis of the approved placement scheme for such structures. The placement scheme is developed by an architect who has the appropriate qualification certificate, or under his supervision in the form of an electronic document, and is entered into the Register of Construction Activities (Resolution of the Cabinet of Ministers of Ukraine No. 904 of 4 August 2023 "On Approval of the Procedure for the Development, Approval, and Publication of the Placement Plan for Temporary Structures for Life Support of the Population, its Composition and Content, Requirements for Temporary Structures for Life Support of the Population, their Construction, Relocation, and Dismantling").

It is determined that **temporary structures for life support of the population and their complexes are not construction objects within the meaning of the Law "On regulation of urban development" and real estate objects within the meaning of the Civil Code of Ukraine**.

Resolution of the Cabinet of Ministers of Ukraine No. 904 of 4 August 2023 defines a special procedure for the placement of temporary structures for life support of the population. It emphasises the temporary, mobile nature of such objects, the mechanism of placement, construction, relocation and dismantling. These temporary structures are not subject to the classic permitting and acceptance regime as "construction." Depending on the design solution,

temporary structures can be mobile (inventory), prefabricated (from flat, linear elements, block containers, etc.), container or combined type, etc.

In accordance with this Resolution, there are requirements for temporary structures for life support of the population and their compliance with DBN.

Scope of requirements	Resolution standards	DBN	What must be complied with
Mechanical resistance, stability, durability of structures	Must meet the minimum requirements for mechanical resistance and stability (clause 9, clause 20)	Characteristic and calculated (limit and operational) values of loads and impacts are determined in accordance with DBN V.1.2-2:2006 "System for ensuring the reliability and safety of building structures. Loads and impacts. Design standards". DBN V.1.2-14:2018 "System for ensuring the reliability and safety of building structures. General principles for ensuring the reliability and structural safety of buildings and structures"	Calculation of loads, suitability of materials, maintainability, connection of components
Fire safety	Fire safety distances, firefighting equipment, water supply (clauses 12, 19)	The operation of temporary structures (complexes of temporary structures) is carried out in compliance	Fire safety distances between temporary residential buildings and buildings for other purposes must be at least 15

		with the Fire Safety Rules in Ukraine, approved by Order of the Ministry of Internal Affairs No. 1417 of 30 December 2014 DBN B.2.2-12:2019 "Planning and development of territories"; DBN B V.1.1-7:2016 "Fire safety of construction objects. General requirements"	metres, reservoirs, fire alarms
Inclusiveness	Ramps, door widths, toilets, etc. (clauses 6, 13–16)	Clauses 5.3.1 and 5.3.2 of DBN V.2.2-40:2018 "Buildings and structures. Inclusiveness of buildings and structures. Basic provisions"	Door width, accessibility, information signage
Sanitary and hygienic conditions	Number of bathrooms, showers, living conditions (clauses 13–16)	DBN V.2.5-64:2012 "Internal water supply and sewerage. Part I. Design. Part II. Construction"	Bathrooms, showers, ventilation, hygiene, temperature
Engineering support	Connection to networks or autonomy (clauses 8, 9, 18–19)	DBN V.2.5-23:2010 "Engineering equipment of buildings and structures. Design of electrical equipment	Electrical networks, water supply, sewerage

		for civil facilities" in terms of requirements for residential buildings and dormitories and the Rules for the installation of electrical installations. Requirements of sections 6.2 and 13.3 of DBN V.2.5-74:2013 "Water supply. External networks and structures. Basic design provisions" and paragraphs 8.2, 8.9 of DBN V.2.5-64:2012 "Internal water supply and sewerage. Part I. Design. Part II. Construction".	
Service life and possibility of dismantling	Service life, possibility of relocation (clauses 12, 20, 21)	DBN V.1.2-2:2006 "System for ensuring the reliability and safety of building structures. Loads and impacts. Design standards" DBN V.1.2-14:2018 "System for ensuring the reliability and safety of construction objects. General principles for ensuring the	Suitability for dismantling, repairability

		reliability and structural safety of buildings and structures"	

The issue of **small architectural forms** is regulated by the Law of Ukraine "On the Improvement of Settlements". A small architectural form is an element of decorative or other-purpose element for improvement of the facility. Small architectural forms include, in particular: gazebos, pavilions, canopies; park arches (arcades) and columns (colonnades); street vases, flower pots and amphorae; decorative and playful sculptures; street furniture (benches, tables); stairs, balustrades; park bridges; fences, gates, grates; information stands, boards, signs; other elements of improvement specified by law.

The placement of small architectural forms is carried out by decision of the owner of the improvement object in compliance with the requirements of legislation, norms and rules.

Construction works on the erection of temporary buildings and structures without foundations on a land plot does not require permits. In accordance with the Government Resolution "On Approval of the List of Construction Works that Do Not Require Documents Granting the Right to Perform Them and After the Completion of Which the Object is Not Subject to Acceptance into Operation" dated 7 June 2017 No. 406, the following construction works, in particular, do not require a permit:

- the construction of temporary buildings and structures on a land plot without foundations, in particular sheds, gazebos, tents, covers, stairs, flyovers, summer showers, greenhouses, garages, as well as wells, wells, outhouses, toilets, cesspools, pavements, fences, open and covered swimming pools, cellars, cellar entrances, gates, wickets, porches, terraces, and verandas - for individual (farmstead) residential buildings, garden houses, and summer cottages;
- placement of temporary structures for conducting business activities in accordance with Article 28 of the Law of Ukraine "On Regulation of Urban Development";

- placement of temporary structures and complexes intended for life support (temporary accommodation and services) of the population, in particular the population affected by emergencies, military actions or terrorist acts, evacuated population, internally displaced persons, as well as persons involved in the inspection and restoration of damaged objects, restoration work to eliminate the consequences of emergencies, military actions or terrorist acts.

Therefore, prefabricated construction that does not involve placing the relevant structures on a foundation, i.e. there is no attachment to the land plot (foundation), is recognised as temporary construction of structures, and accordingly such structures are not "construction objects", they do nor require comissioning like immovable property, and therefore no ownership rights to the building as immovable property arise.

Thus, among the risks are the inability to register ownership of the immovable property and, accordingly, the vulnerability of the owner, as well as the peculiarities of connecting utilities (electricity, water supply/sewerage, gas supply and heating) as to a permanent residential premises.

If the quick-assembly construction involves a foundation, then the building is a capital construction project (there is a foundation, design, impact class, etc.), and the usual rules of construction and commissioning apply:

- ownership or use rights to land with the appropriate intended purpose are required;
- notification/permit for construction work depending on the class of consequences (CC1 — notification, CC2–CC3 — permit (classes of consequences: CC1 (minor consequences) — individual residential buildings up to 500 square metres, up to 2 storeys high, farm buildings. Permanent occupancy — up to 50 people, temporary occupancy — up to 100; CC2 (medium consequences) — medium-rise apartment buildings, public buildings. Permanent occupancy — from 50 to 400 people, temporary occupancy — up to 1,000 people. Significant economic damage is possible; CC3 (significant consequences) - high-

rise and complex facilities, facilities with mass gatherings of people. Permanent occupancy - over 400 people, temporary occupancy - over 1000 people. Significant social and environmental consequences in the event of an accident);

- construction in accordance with project documentation in compliance with DBN (main: DBN V.2.2-15:2019 – "Residential buildings. Basic provisions" (number of floors, planning requirements, minimum apartment sizes, distances between buildings); DBN V.1.1-7:2016 – "Fire safety of construction facilities. General requirements" (degrees of fire resistance, fire resistance limits of structures, fire breaks); DBN V.2.6-161:2017 – "Wooden structures. Basic provisions" (calculation and use of wood, glued wood, panels), DBN V.1.2-2:2006 – "Loads and impacts. Design standards" (calculation for snow, wind, seismic activity, operational loads), DBN V.1.2-14:2018 – "General principles for ensuring the reliability and structural safety of buildings and structures" (general requirements for the strength and safety of structures).);
- commissioning in accordance with the Procedure approved by Resolution of the Cabinet of Ministers of Ukraine No. 461 dated 13 April 2011 – submission of a declaration (SS1)/certificate of readiness (SS2-SS3), assignment of an address;
- registration of ownership rights.

With regard to prefabricated construction using wooden structures, it should be noted that buildings in which load-bearing and enclosing structures are made of combustible materials, in particular wood; no fire resistance limit is set for structural elements; fire protection treatment of wood is not required; panels, beams, and shield elements made of wood are allowed and **will most likely be classified as fire resistance class V**.

As a result, in accordance with DBN V.1.1-7:2016, **such buildings may have restrictions on the maximum number of storeys** and intended use, in particular: **Fire resistance class V is permitted mainly for low-rise buildings (1–2 floors)** for **individual or commercial use,** which do not have

increased fire protection requirements, as well as limited floor area within a single fire compartment (section 5, DBN V.1.1-7:2016).

In the modern conditions, especially given the need for rapid restoration of housing, infrastructure, provision of housing for internally displaced persons and development, there is a growing demand for prefabricated buildings in Ukraine. At the same time, the current legislation and regulatory framework do not take into account the specifics of such structures, which creates regulatory barriers to their large-scale implementation.

In order to remove these barriers, it is proposed to make comprehensive changes to the legislation, covering the definition of terms, simplification of licensing procedures, adaptation of building codes, standardisation of production and certification:

- It is necessary to legally define and establish terms that will distinguish construction using prefabricated technologies from other capital construction, in particular, the definition of the terms: "prefabricated construction", "modular building (structure)", "standard modular system", "standard design for the construction of a prefabricated modular building (structure)" and others. These terms should be included in the Law of Ukraine "On the Regulation of Urban Development" to provide a legal basis for the separate regulation of quick-assembly and modular construction, which differs in its technical and operational characteristics from capital construction.
- it is advisable to develop separate state building standards: "DBN: Residential and public buildings made of prefabricated and modular structures". This DBN should establish: simplified design requirements; adapted standards for fire resistance, heat and sound insulation; the possibility of installation without a foundation; standards for demountable or mobile structures; integration of autonomous engineering systems (water, heat, electricity).
- It is advisable to introduce national technical conditions or DSTU for typical modular structures and create a state register (list) of certified typical technical solutions.

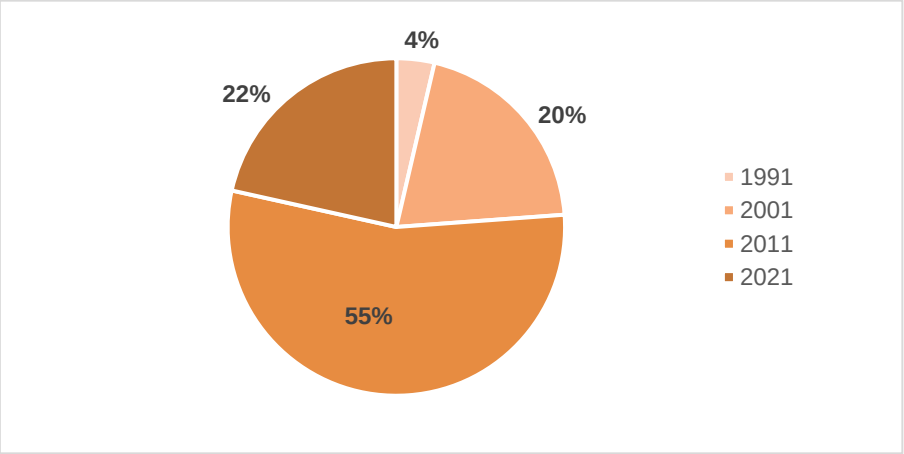
- for modular structures of consequence class CC1 (residential buildings up to 2 storeys, with an area of up to 300 sq. m.), it is proposed to allow the submission of a simplified package of documents: modular system passport, technical documentation, layout plan, acceptance certificate;
- for buildings and structures of consequence class CC2, erected from certified modular structures in accordance with approved standard technical solutions, to introduce the possibility of applying a simplified examination of project documentation to the extent necessary to confirm the facility's compliance with the safety requirements established by state building standards.

5.4. Operators in the prefabricated construction market in Ukraine

There are **over 300 operators in the prefabricated construction market** in Ukraine, including both manufacturers of structures and contractors (builders) specialising in the relevant technologies. These data are provided by the Association of Prefabricated Structure Manufacturers, as there are currently no official state statistics on the number of such companies. This fact reconfimes the need to formalise the market and introduce a separate classification for accurate accounting of its participants and volumes.

The largest number of operators in the prefabricated construction market was registered after 2011, with 71% more companies registering in 2021-2022 than in 2019-2020. This trend is accompanied by increased demand for prefabricated construction projects.

Years of registration of operators in the prefabricated construction market

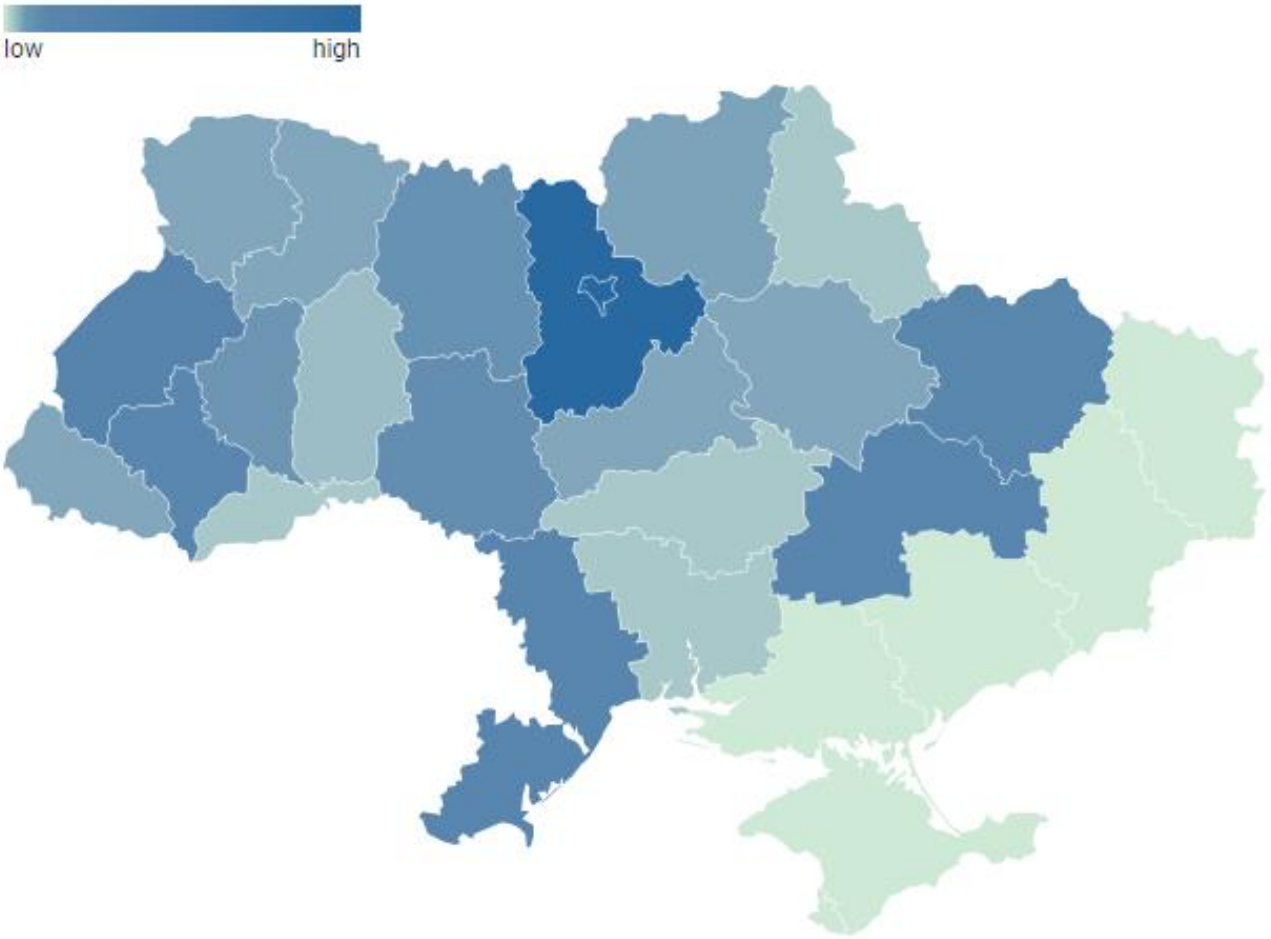


Most of the market operators are located in:

- Kyiv region (142 legal entities),
- Lviv region (27 legal entities),
- Odesa region (17 legal entities),
- Dnipropetrovsk region (17 legal entities),
- Kharkiv region (15 legal entities).

In terms of the number of branches, the Kyiv region also prevails with 12 branches (mainly representative offices of companies from western Ukraine), followed by Lviv region with 8 branches and Odesa region with 11 branches.

Map showing the regional distribution of market operators



It should be noted that operators in the western regions of Ukraine are more focused on the production of wooden houses in the private residential sector, as well as the production/construction of hotel infrastructure facilities. This is due to the specific characteristics of the region and its development. Companies in the central and eastern parts of the country work with different technologies and implement projects of various purposes and sizes.

Only about 3% of companies (manufacturers of prefabricated structures) on the Ukrainian market have foreign investments.

Among Ukrainian companies with foreign investment are:

ADIndeo-Ukraine (Germany)

ARCHIKONT (Austria)

LLENTAB Ukraine (Sweden)

FinnDom (Finland)

REINBOU ECOSYSTEM Ukraine (France)

Smart Logis Ukraine (Germany, Austria)

Among foreign companies on the Ukrainian market:

Divario (Switzerland)

Continest (Hungary)

Dorce (Turkey)

Karmod (Turkey)

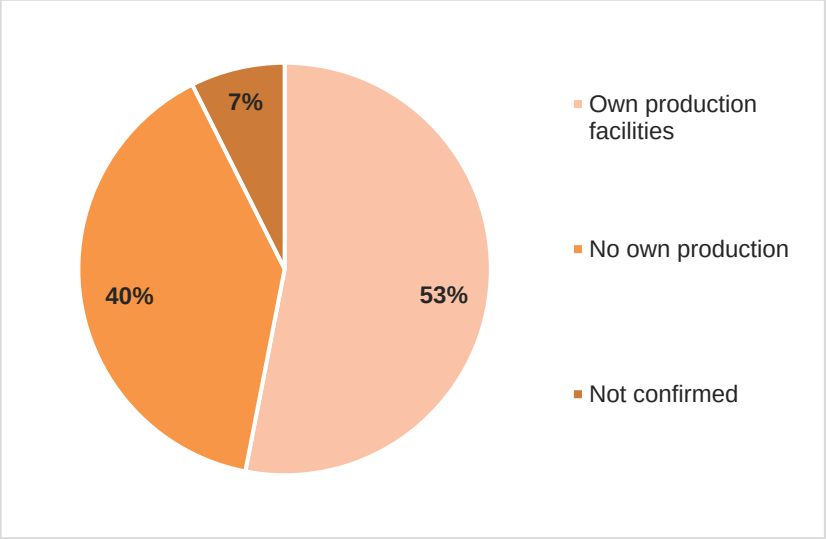
Pol Plan (Poland)

Honka (Finland)

Construction using quick-assembly technology is the main activity for 77% of manufacturers, while 23% are companies that manufacture construction products and focus their efforts on sales rather than building construction. This also includes companies that additionally work with traditional construction technologies.

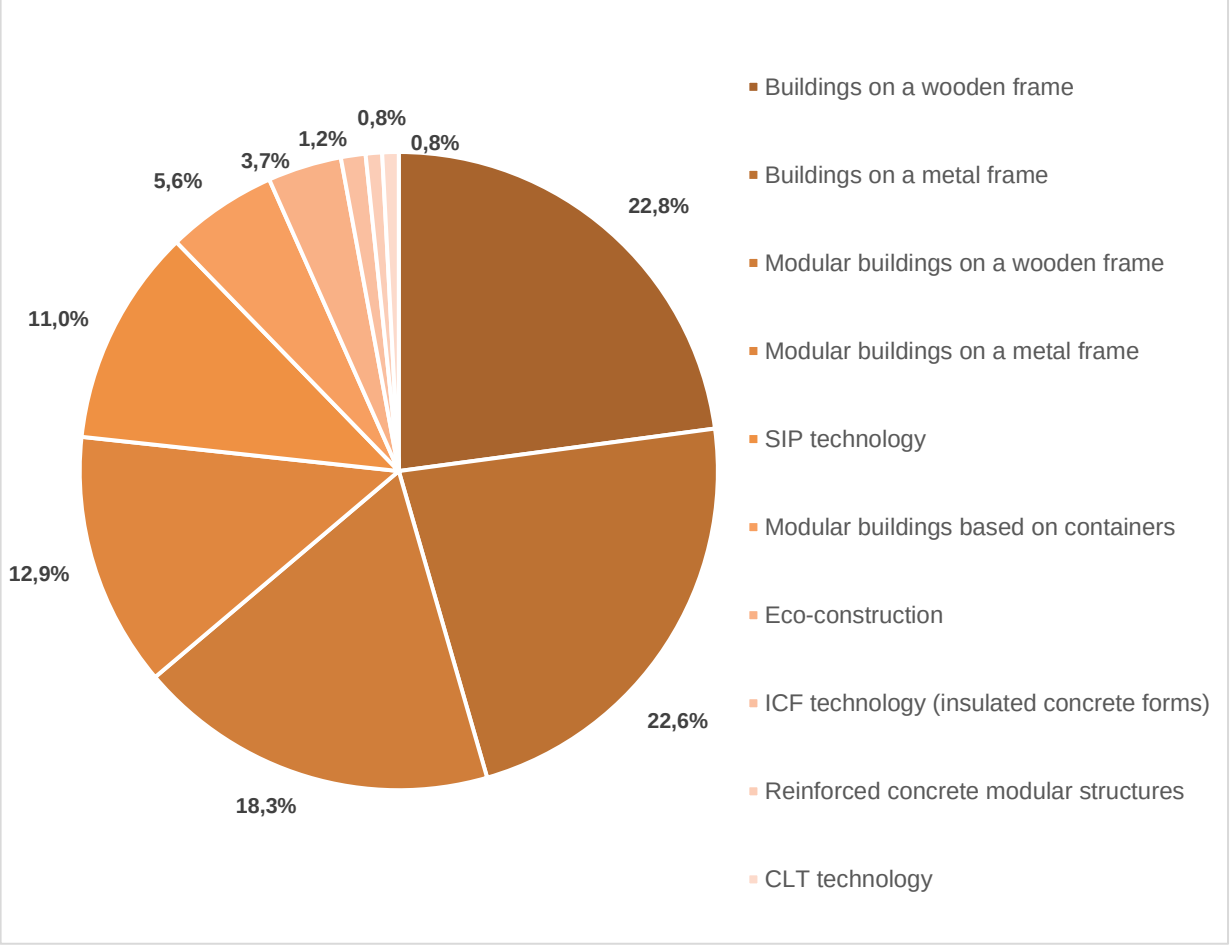
The diagram below shows the share of operators that have their own production facilities where construction products are manufactured or structural elements and modular houses are created for further assembly on site. Up to 40% of market operators are construction companies that import products or purchase them on the Ukrainian market for further use.

Number of manufacturers with their own production facilities



When analysing market offerings, prefabricated buildings on wooden and metal frames are considered more popular. ICF and CLT technologies are only beginning to develop in the Ukrainian market.

Share of companies by type of prefabricated construction



5.5. Production and sales volumes of prefabricated buildings in Ukraine

Companies involved in the manufacture of prefabricated and modular buildings based on wooden frames note the following:

- a 70% decrease in orders in 2022. The companies' income was secured by projects that were financed in 2021. In 2023, companies began to reach 50% of their 2021 levels. In 2024, the market landscape began to change due to orders from international organisations, such as a tender for 3,000 modular houses organised by the UNHCR
- an increase in the production of modular buildings to provide housing for victims or IDPs
- market operators estimate the shadow economy in the modular production segment at 30%, while the shadow economy in the frame construction sector is estimated at up to 80% (influenced by the specifics of the technology used to build private facilities and cash payments)
- The popular size of a residential building using frame technology is considered to be 80-100 square metres, and 30-40 square metres for modular construction.

The eco-construction segment is experiencing steady growth. The longer a company has been on the market, the more orders it receives. Market operators also note increased demand for modular construction among young people, especially in the IT sector.

In Ukraine, 53 companies offer the construction of houses using SIP technology. In 2022, about 15% of market operators suspended their activities for the duration of the war. Other companies saw a drop in orders of up to 80%. Demand began to recover in 2023.

CLT technology is relatively new to the Ukrainian market and is currently represented by only one manufacturing company.

In recent years, there has been an increase in the use of metal building structures, as well as the production of building structures made of aluminium alloys, which are used due to their special properties (corrosion resistance, strength, low weight, attractive appearance).

The analysis of foreign trade in prefabricated and modular houses based on wooden and metal frames was carried out under the UKTZED code[4] - 940600.

Exports of modular houses significantly exceed imports. In 2021, Ukrainian manufacturers exported 68% more products than in 2020. However, attention should be paid to imports, which at first glance seem insignificant, but their growth rate is 131%, which may lead to an increase in imported products on the Ukrainian market.

Dynamics of exports/imports of modular houses to Ukraine, kg

	2020	2021	Growth
Exports, kg	809	1,201,868.2	48
Imports, kg	151,583.9	334,225.0	120
Balance, kg	657,935.1	867,643.2	

Dynamics of exports/imports of modular houses to Ukraine, thousand US dollars

	2020	2021	Growth
Exports, thousand USD	2,437	4,082.5	68
Imports, thousand dollars	355.4	819.9	131
Balance, thousand dollars	2,081.5	3,262.6	

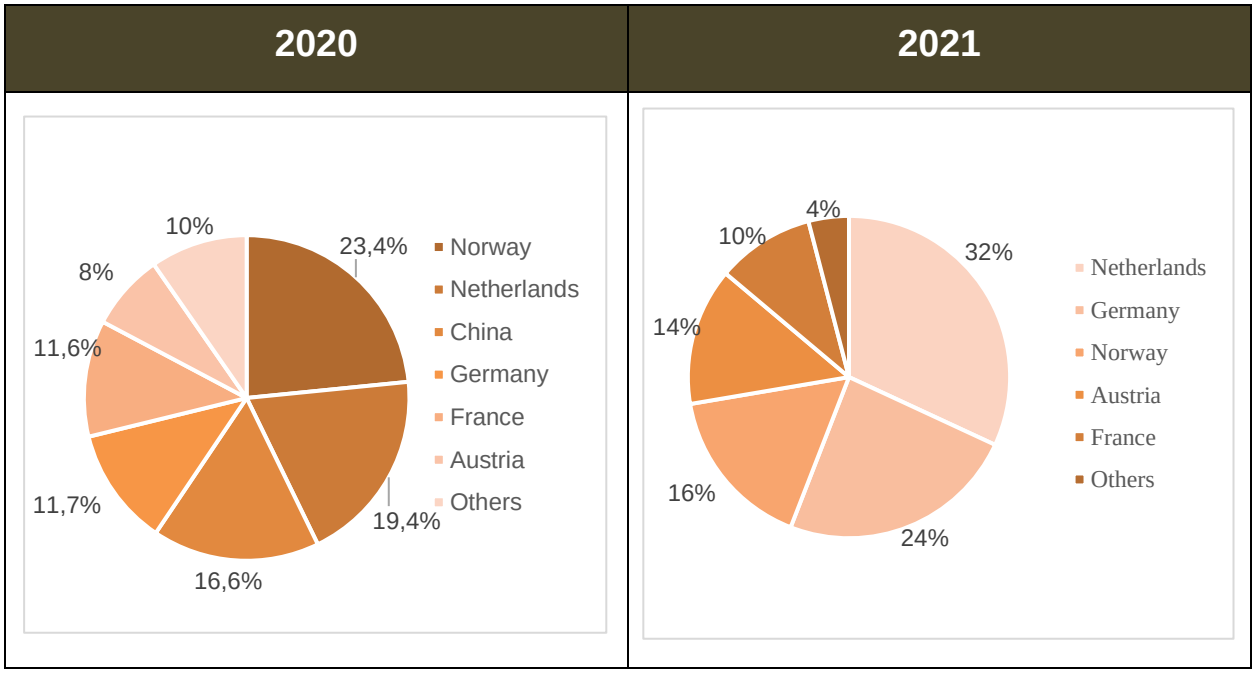
Ukrainian manufacturers export most to EU countries: Norway, the Netherlands, and Germany. According to a study by Mordor Intelligence, the

[4] UKTZED code – a classification of goods used by Ukrainian customs.

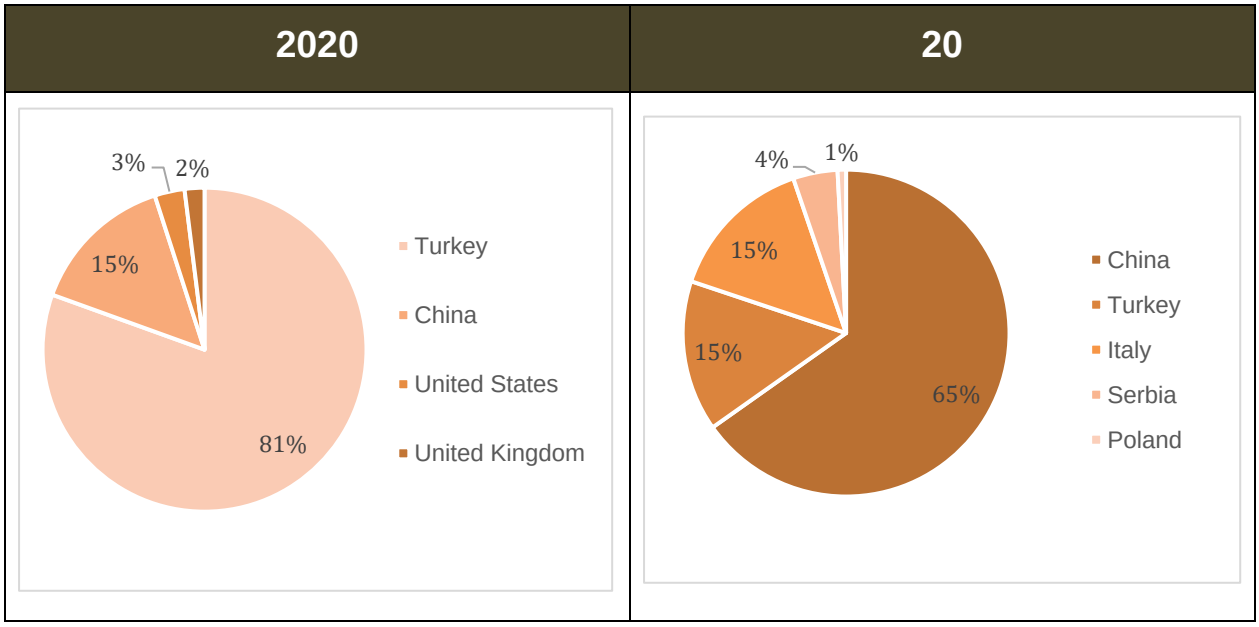
European modular construction market will grow steadily until 2027, with an average annual growth rate of 5.4%.

The main share of imports is divided between Turkey and China. In order to increase trade, manufacturers in countries such as Turkey and Poland are adapting their online platforms for Ukrainian consumers.

Country shares for exports of modular houses from Ukraine, %



Share of countries importing modular houses to Ukraine, 2020-2021, %



International companies are actively operating in the Ukrainian market. Today, Ukraine is open to foreign aid, which allows companies to enter the market and promote their products. These factors contribute to a further increase in imports and pose both a threat to domestic producers and a stimulus for development.

VI. INTERNATIONAL EXPERIENCE IN THE USE OF PREFABRICATED CONSTRUCTION TECHNOLOGIES

Global practice shows that fast-track (modular and prefabricated) construction technologies are actively developing and becoming increasingly widespread amid growing demand for fast, efficient and sustainable building construction. According to Global Market Insights, in 2023, the global market for modular and prefabricated construction reached $155.3 billion, and the compound annual growth rate is expected to be 5.7% until 2032. The main drivers are economic efficiency, reduced construction time and reduced environmental impact.

The United States is a leader in the implementation of modular construction, with a share of $38.6 billion in 2023. Main areas of use: residential construction, schools, hospitals, housing for veterans. The government and private companies are investing in BIM technologies, 3D printing, and analytics. Modular homes are actively used to deal with the aftermath of natural disasters and in urban projects, for example in New York and San Francisco.

In Canada, demand for modular construction is growing in response to the need for housing for industrial workers in remote regions. It is actively used in office, educational and multi-family construction. Companies provide temporary solutions for the energy sector.

Germany is the leader in the European market with a 24% share in 2023. The main areas of focus are housing for migrants, energy efficiency and sustainable development. Modular systems with CLT technology are popular, and BIM and off-site production automation are being implemented.

France. Market growth of 6% is driven by the modernisation of residential infrastructure and support for energy-efficient technologies. Lightweight modular blocks combining wood and steel are common in urban areas.

The United Kingdom is actively introducing modular construction as a solution to the housing shortage. The state plans to build about 300,000 houses each year. Plug-and-play solutions, 3D printing, and modular schools are widespread.

Japan is a leader in the standardisation and automation of modular production. It uses modular construction in densely populated areas and for rapid response to emergencies.

The rapid development of modular construction in China is supported by government affordable housing programmes. Steel and concrete modules dominate, with smart components being integrated. China is a leader in the production and implementation of robotics in construction. The photo below shows Mini Sky City (J57), a 207.8-metre-high, 57-storey skyscraper built in China in just 19 days using modular construction technology from Broad Sustainable Building. The building consists of 90% factory-made modules that are quickly assembled on site. A total of 10,345 tonnes of high-strength steel was used. The tower has 800 apartments and offices for 4,000 people. The construction method avoided the use of 15,000 concrete mixers and reduced CO_2 emissions by 12,000 tonnes. Most of the steel was made from recycled scrap. Construction was completed in 2015.

VII. PEST ANALYSIS OF THE PREFABRICATED CONSTRUCTION MARKET IN UKRAINE

PEST analysis allows us to consider the factors that influence the construction industry, primarily prefabricated construction: political, economic, socio-cultural and technological.

Political	Economic
The continuation of military operations in Ukraine, which makes it impossible to predict the development of the construction market and the reconstruction of territories. The presence of corruption risks. From 1 January 2025, tax authorities may conduct documentary and factual checks, provided that safe conditions for their implementation are in place. Current regulations do not allow domestic manufacturers to label their products with the CE mark and freely sell them on the EU market without additional certification.	International financial assistance continues, which affects both budget support and the implementation of social programmes and infrastructure projects. Between 2019 and 2024, the cost of construction in Ukraine doubled. Prices for building materials rose by an average of 60% in 2022, and labour costs by 30%. At the same time, the cost of building materials and services increased by approximately 24% in 2024. As of 3 April 2023, the unemployment rate in Ukraine stands at 137,300 people, of whom 31,500 are under the age of 35. Since June 2022, the unemployment rate has been falling by 8-11% every month. In June 2025, the unemployment rate is estimated at around 12%, which is the lowest since the start of the full-scale war . The official number of registered

	unemployed persons at the end of 2024 was approximately 94,200. In 2025, household consumption will increase, as will the average wage (by approximately 15-17%). The number of studies of the construction market and building materials in Ukraine by foreign companies increases. The emergence of ESG reporting (support for sustainable development) in companies.
Social	**Technological**
The population of Ukraine is declining rapidly. Almost every third citizen dies at the age of 65. There is a significant shortage of specialists in the construction industry. There is an increase in the mobility of the population and business in general.	Development of digitalisation and process automation. Integration of new technologies in Ukraine: CLT, ICF, construction of houses using 3D printers. Trend towards the reuse of construction waste. Increasing popularity of reuse projects.

VIII. CONCLUSIONS AND RECOMMENDATIONS

The study of the prefabricated construction market in Ukraine shows that in the context of large-scale destruction of infrastructure and housing stock as a result of military aggression, this technology can become one of the key tools for the country's recovery. Analysis of the industry has revealed both significant prospects and substantial barriers to its development.

The construction sector in Ukraine is showing signs of recovery after a critical decline in 2022, when construction volumes fell by 56%. In 2023-2024, steady growth is expected (+48% and +27% respectively), indicating that the industry is adapting to wartime conditions.

Prefabricated construction technologies are becoming particularly relevant due to reduced implementation times, energy efficiency, structural mobility and reduced dependence on logistical and seasonal factors.

There are over 300 companies operating in the field of rapid construction in Ukraine, about 3% of which have foreign investments.

The market is dominated by prefabricated buildings on metal and wooden frames, as well as modular solutions.

Exports of modular houses from Ukraine significantly exceed imports, which indicates the competitiveness of domestic manufacturers in the international market. The main export destinations are EU countries: Norway, the Netherlands, and Germany.

There is a trend in the market towards the introduction of environmentally friendly technologies, in particular the use of hemp and straw insulation, CLT panels, and the integration of circular economy principles.

Demand for prefabricated (mostly modular) buildings has changed since 2022: it is now mainly driven by international and charitable organisations implementing projects to provide housing for internally displaced persons and other affected persons.

At the same time, the development of quick-assembly construction technologies is hampered by a number of systemic problems:

- low level of production and consumer culture regarding this type of technology, due to the short period of its use in Ukraine and the limited economic capacity of the population
- the regulatory framework is not adapted to the specifics of rapid construction
- the lack of a clear classification of technologies in product codes
- Legal uncertainty regarding the status of prefabricated structures, which are often not recognised as immovavbe property (prefabricated structures are most often recognised as temporary structures or construction products under current legislation and are not put into operation as real estate)
- high share of the shadow market
- an investment climate that is not conducive to attracting foreign capital.

To remove these barriers and develop the industry's potential, the following is proposed:

1. Legislative regulation

- develop and enshrine in legislation terminology related to prefabricated construction
- develop and implement an updated classification of prefabricated construction technologies with corresponding product codes
- legislatively regulate the status of prefabricated structures, defining their place in the system of real estate objects and the legal field of Ukraine, i.e. create legal mechanisms for recognising prefabricated buildings as real estate objects with the possibility of registering ownership rights (for more details, see section 5.3.)
- introduce simplified procedures for obtaining permits and commissioning for prefabricated construction projects
- Review the current legislation of Ukraine related to the field of prefabricated construction (e.g., regarding the timber market, etc.) and update it with a view to developing and supporting the industry.

2. Technical regulation:

- develop separate state building codes for prefabricated, including modular, structures
- Adapt requirements for fire resistance, thermal insulation and other technical parameters to the specifics of the technologies
- create a register of certified standard technical solutions

3. Economic incentives:

- create a system of state support for manufacturers of prefabricated structures through tax breaks and access to preferential loans
- develop financial support mechanisms for consumers, including mortgage programmes for the purchase of modular housing
- Encourage foreign investment in the industry by creating transparent conditions and providing guarantees

4. Innovative development:

- support the introduction of BIM technologies, 3D printing and other innovative methods in prefabricated construction
- create industry competence centres for the exchange of experience and technology transfer
- Develop vocational education and a system of professional training for the new type of construction

5. Integration with European standards:

- harmonise national legislation with European directives on energy efficiency and decarbonisation of buildings
- introduce international certification systems for green construction
- ensure the possibility of marking domestic products with the CE (Conformité Européenne) mark for free access to EU markets.

Implementing these recommendations will transform prefabricated construction from a niche segment into a powerful tool for Ukraine's recovery and modernisation. Thus, prefabricated construction should become not only

a temporary solution to overcome the crisis, but also a strategic direction for the transformation of Ukraine's construction industry. Its full integration into state policy will create the conditions for the sustainable restoration of the housing stock, modernisation of infrastructure and the formation of a new architectural environment that meets modern requirements for safety, energy efficiency and quality of life.