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Container settlements built in Ukraine and Western Europe in 2022. Analysis and design recommendations

Introduction

According to the data from the Kyiv School of Economics as of April 2023, it was reported that 158,000 residential buildings in Ukraine had been completely or partially destroyed as a result of military operations [1]. This left many citizens homeless. As a consequence, the affected society was divided into three groups: one group chose to relocate abroad, another group opted to stay within the country but moved to regions unaffected by immediate military clashes, and the third segment of society refrained from leaving the conflict-affected areas due to fears of losing their properties and uncertainties surrounding the conditions they would encounter upon leaving their homeland. In April 2023, the United Nations Population Fund statistics officially registered 5.4 million internally displaced persons (IDPs), while the number of refugees who fled to Europe surpassed 8.1 million [2]. The state and local authorities of Ukraine, as well as other European countries, faced the challenge of providing accommodation for hundreds of thousands of people.

The concept of housing for refugees is associated with the search for small housing units that can fulfill the basic needs of the residents [3], [4]. The container settlements being the subject of the article are one of the faster ways to provide refugees and IDPs with a place to live during the war, as well as until the housing stock is rebuilt. In 2021, the United Nations Economic Commission for Europe (UNECE) published a study on refugee settlements and affordable housing, which described 28 positive examples [3]. The housing settlements listed there provide refugees with the opportunity to integrate into the communities of cities and villages, contribute to regional development, demonstrate economic effectiveness, adhere to sustainable architectural standards, and ensure long-term operation [3].

In order to conduct our research, 12 container settlements constructed in the Lviv and Kyiv regions in 2022 were visited, while the remaining settlements were analyzed based on information available in online resources. The research focused on various aspects such as the area of the buildings, spatial layouts, identification of building types and structures (number of storeys, location of entrances to the facilities, location and number of residential and auxiliary rooms, functional layout, and room equipment).

Container settlements for refugees from Ukraine established in Europe in 2022

In 2022, many cities in Europe faced the problem of a large number of refugees from Ukraine. Regulatory provisions introduced after the European Union directives on temporary protection helped to regulate mass arrivals of people. In some European countries, due to extreme conditions and limited time, constructing container settlements was one of the popular options for housing refugees.

Germany has extensive experience in building housing for refugees. Depending on the region, the authorities approached the selection of plots, design, and construction of settlements differently. In 2022, it was planned to build nine container settlements for refugees in medium-sized or large cities and municipalities in Germany [5]. The main objective of the authorities was to accommodate and integrate refugees into society while avoiding overburdening the local communities. In July 2022, the first container settlement in the district for 118 refugees from Ukraine appeared in Unterschleissheim. The district of Munich built two-story buildings with open metal staircases on land donated to the municipality by the city [5]. In January 2023, Ukrainian refugees began settling in a container settlement

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located in a nature park near Neubiberg on a former airstrip. The settlement was built thanks to volunteers and intensive support from the municipality of Neubiberg. In the settlement for 432 refugees, twelve two-story container buildings and an administration building are located linearly close to each other [6]. Each building consists of six independent dwelling units with a spacious kitchen-living room and three bedrooms, a bathroom with a toilet, a shower and a washing machine [6], [7]. Bedrooms for two people are equipped with a metal bunk bed, two wardrobes and a fridge. To ensure the safety of the residents, the settlement is fenced and guarded. Attention is given to addressing various needs, such as medical care, education for children in nurseries and schools, as well as traffic and parking issues [6]. The initial expected service life of the container settlements built in 2022 is two years, but there are plans to extend it [5], [6]. Apart from Unterschleissheim and Neubiberg, container settlements are being built for up to 116 people in Grünwald, and 210 people in Ottobrunn, while settlements have already been built for 260 people in Unterhaching, 200 refugees in Kirchheim, 330 people in Unterföhring [7].

In the spring of 2022, two settlements in Antwerp and Mechelen were built in Belgium within a few weeks. They were to accommodate about 600 refugees from Ukraine each. There were also plans to build a settlement in Oostakker. In Antwerp, families and single mothers were housed in two-story buildings. One hundred and thirteen buildings are arranged in a rectangular grid of streets. Additionally, a public center with public buildings, a sports field with artificial turf, and a playground for children have been constructed. The buildings consist of 55 m^2 four-person residential units with a private kitchen, living room and bathroom, a children's bedroom with bunk beds and wardrobes, and an adult bedroom with a bed [8]. The container settlement in Mechelen is located on a gravel parking lot above the De Nekker water reservoir in close proximity to the city center and has easy access to public transport, and there are recreational areas nearby. In the settlement, eight detached single-family houses have a bedroom, kitchen, bathroom and hall. Three modular container buildings of the corridor type are intended for living by families of 2 to 8 people. Hygienic blocks with toilets and showers were also installed. There is a large tent with an area of 3200 m^2, which is a place to spend time together and prepare meals; there is also a doctor's office available on-site [9]. There is a place for animals and a playground on the settlement. It is possible to increase the capacity of the settlement to a thousand places [9]. In Oostakker, 200 housing units for 600 refugees will be built on a former cornfield. There are several bus stops near the settlement, a parking lot for 40 cars is planned, and a bicycle parking lot will be built on its premises. In May 2023, 50 one-story residential modules were commissioned, and the remaining 150 buildings will be completed by the end of the year. The settlement will include multi-functional rooms for conducting educational activities, publicly accessible multi-functional zones that can be used for workshops, training or other events, a playroom for children, laundries and drying rooms. Playgrounds and recreational areas will be built on the site. The planned period of use of the settlement by refugees is four years. In the future, the container buildings will be used as student and social housing [10].

Over time, the Belgian approach to constructing container settlements has changed. Small plots of land have started to be chosen for the construction of a smaller number of buildings for settlements, because they are better integrated into the urban environment and have less impact on the environment and biodiversity [11]. Containers with a long operational warranty period are purchased so that they can be used as social housing [11]. On this basis, the Brusselse Gewestelijke Huisvestingsmaatschappij (BGHM) prepared 15 two- and three-level container buildings for Ukrainian refugees in Watermaal-Bosvoorde within six weeks. These are residential units with 1–3 bedrooms. A public building was also built. The buildings were adapted as much as possible to the topography of the site, and the design assumed the preservation of all existing trees. The commune plans to help ensure communication between the inhabitants of the settlement and their neighbors, and the non-profit organization will direct them to existing medical structures and social and psychological assistance institutions [11].

In Switzerland, container settlements have been built for Ukrainian refugees in the cities of Zug, Bern and Basel, while Zurich and the Lucerne canton considered the possibility of building them. Two-story container buildings were used to build a settlement in Basel that can accommodate up to 450 people. A three-storey container building with large terraces at both ends was constructed in Zug. The project of a container settlement in Bern for 1,000 refugees sparked the most discussion. It was designed by a graphic company. The settlement consists of five buildings that form two rows of two-level roofed containers, with access to the gallery on the second level by a metal staircase. The buildings include four-person living rooms, common kitchens and hygiene rooms. There are no common rooms in residential buildings. Architect and emergency housing expert Ueli Salzmann, who has designed settlements for the United Nations (UN) and the International Red Cross, noted that the settlement in Bern fails to meet minimum humanitarian standards. He highlighted the inadequacy of having only four kitchens for 200 people, the improper room layout, insufficient living space (less than 4 m^2 per person), and narrow corridors. In his opinion, such a place can only be lived in for a maximum of a month (after: [12]). According to UN standards for emergency housing design, a minimum living space of 4.5 to 5.5 m^2 per person is recommended in cold climates [13]. On a positive note, the administrative building of the settlement has organized educational facilities for children of preschool and school age.

The specificity of the housing market in the Netherlands requires the authorities to build modular housing for refugees. In collaboration with De Meeuw, the municipality of Amsterdam built a container settlement for 240 Ukrainian refugees in the Sportpark Melkweg car park. Two three-story buildings were constructed on the plot. The dwelling unit of the house consists of a living room with a kitchen, a private bathroom and two bedrooms. Additionally, the building includes communal meeting

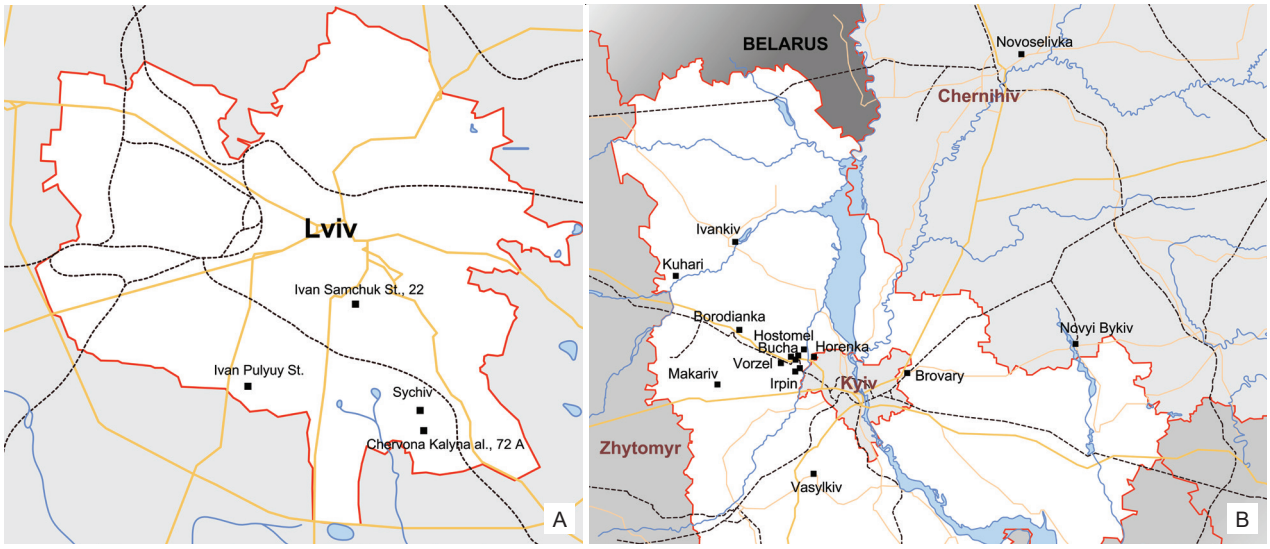

Fig. 1. Container settlements for IDPs in Ukraine: A – in Lviv, B – in the Kyiv and Chernihiv regions (elaborated by O. Pekarchuk)

Il. 1. Osiedla kontenerowe dla osób wewnętrznie przesiedlonych w Ukrainie: A – we Lwowie, B – w obwodzie kijowskim i czernihowskim (oprac. O. Pekarchuk)

areas for inhabitants and a shared laundry room. The operation of the buildings in this place is planned for three years [14]. Zaanstad is involved in the construction of 192 two-storey container houses at the junction of Parkrijklaan and Noorderveenweg in Assendelft. The area has easy access to shops and care facilities. Noise and other environmental impact studies were carried out in this area, and an environmental building permit was issued. It is planned that Ukrainian refugees will use this settlement for three years, after which it will transition into social housing for the following seven years [15].

An important stage in the construction of a settlement in the Netherlands is to agree on the selected location with the community and obtain environmental permits. The Arnhem community near Elst had objections to the opening of a temporary settlement for 150 refugees because it borders directly on the Lingezegen Park, although three three-storey buildings have already been constructed on the site, each consisting of living modules with a kitchen and a bathroom [16].

Selected examples of container settlements in Ukraine – architectural and urban solutions

There are many parallels between the current situation of refugees from Ukraine and the European immigration crisis that affected southern Europe in 2015–2016. One of the issues of refugees in Europe was overcrowding in shelters [4]. Another problem is the long period of staying in such a settlement, longer than planned. The situation in Ukraine is similar, for example, in container settlements built in 2015 (after the annexation of Crimea and the Donetsk and Luhansk regions), IDPs continue to reside there to this day, surpassing the originally anticipated three-year period of residence.

In 2022, the Republic of Poland provided Ukraine with containers that were used to build settlements for IDPs in the Lviv, Kyiv, Chernihiv and Poltava regions. There are four container settlements in Lviv (Fig. 1A). There are 14 settlements in the Kyiv region: two in Irpin, three in Bucha, one each in Borodianka, Makariv, Vorzel, Hostomel, Brovary, Vasylkiv, Ivankiv, as well as in the villages of Kuchari and Horenka (Fig. 1B). In the Chernihiv region, two container settlements have been located in Novoselivka and Novyi Bykiv (Fig. 1B), and the construction of a settlement in Poltva was completed in June 2023.

Container settlements in Lviv located at 22 Ivan Samchuk Street (Stryiski Park), Ivan Puluj Street and 72A Chervona Kalyna Avenue were closed in winter (they were not intended for winter living), but are scheduled to reopen in summer 2023. Instead, a new container settlement designed for 1,280 beds was built in Sychiv. For this purpose, eight two-story container buildings were constructed on site [17].

Location and land development

The vast majority of settlements have good infrastructural facilities, they are within walking distance of shops, kindergartens and schools. The total area of container settlements in Ukraine is approximately 0.5 to 1.6 ha in the cases where a separate plot of land has been allocated to the construction of a settlement. There are examples where container buildings have been placed within the area that is used by e.g. schools (Bucha, Vorzel), parking lot (Bucha), sanatorium (Irpin), hospital (Makariv, Poltava). The maximum area of such plots is 7.67 ha.

The city authorities paid particular attention to the beautification and division of the territory into functional zones of these container settlements, as the functional distribution of the area ensures security and increases the sense of privacy for the inhabitants [18]. Typically, a playground for children, a recreation area, waste bins, sometimes a drying laundry area, a bicycle parking lot, and a sports area are arranged in the settlements. Some container settlements have

a parking lot on-site or nearby. Parking spaces are usually located on the outskirts of the plot. However, there are settlements where the spatial development is of low quality (due to limited resources). For example, in Makariv, the area is covered with gravel, and the elements of small architecture consist of a children's swing (with cars parked nearby) and a few benches.

Container settlements from 2022 were not specially fenced. Fences are located only if they have been constructed earlier in the area where there were objects for other purposes (with the exception of container settlements in Vasylkiv and Poltava).

Containers for the construction of modular settlements were produced by Modular System, Poland. External dimensions of standard containers: 6058 × 2438 × 2800 mm (L × W × H). Containers with external dimensions of 4891 × 2438 × 2800 mm (L × W × H) are used to form the corridors [19].

Typology of buildings, functional solutions, aesthetics

The appearance of the buildings is dictated by the containers design. In many buildings in various settlements there are images of Polish and Ukrainian flags (Fig. 2A). In order to individualize the settlement in Vasylkiv, the space under the windows was additionally decorated with pictures of folk costumes emphasizing the regional diversity of Ukraine.

Until December 2022, all buildings in container settlements for IDPs were one-story buildings, with the exception of the two-story medical center located on Ivan Puluj Street in Lviv (Fig. 2B). Construction works were currently completed on two two-story container settlements: in Sychiv in Lviv and in the Lastivka sanatorium in Irpin.

The following planning schemes are used in container residential buildings: row and detached double-loaded corridor. Three container settlements in Lviv are of a row type. All other container settlements built in Ukraine in 2022 consist of detached double-loaded corridor buildings, in which only laundry and storage rooms located in separate containers may have a row arrangement.

Row planning schema usually consists of 4 to 20 containers with direct access to the settlement area. Row placing of containers around central courtyards in Lviv's container settlements helped achieve a higher level of privacy.

In the settlements of this type, canteens are built in a hall layout that provides one large main room of the building. A children's play area is often organized in a part of the general canteen area. A module of sanitary and/or laundry facilities can be attached to the main hall of the dining room.

The utility and sanitary containers can form separate rows or can be attached to the accommodation containers. The settlement may include an administrative container. In three Lviv settlements, one of the containers performs an administrative function. The location of the administration container does not have a typical placing on site. In each Lviv container settlement there is a designated space in the project for a medical point. Additionally, near the container settlement in Ivan Puluj Street in Lviv, there is a two-storey medical center built by the Red Cross Association of Ukraine, consisting of 20 containers.

An example of a row housing development is a container settlement in Lviv, Sychiv, located at 72A Chervona Kalyna Avenue, accommodating 300 beds (Fig. 3A). It consists of rows of containers: 94 accommodation containers, 3 mobile kitchen containers, 12 toilet containers, 5 shower containers, one administration and laundry container, one medical container, one chapel container, and a dining hall building consisting of 14 containers. The placement of auxiliary facilities poses a challenge in this type of residential development, as they should be accessible to the entire community equally (people living in the farthest containers have to walk about 60 m to meet their physiological needs) and usable in winter conditions. The settlement also features sports fields, playgrounds for children, and recreational areas for adults (Fig. 4A). There are several types of surfaces in the area: asphalt (1150 m^2), gravel (820 m^2),

Fig. 2. The appearance of container buildings: A – container settlement in Borodianka, B – medical center on Ivan Puluj Street in Lviv (photo by O. Pekarchuk)

Il. 2. Wygląd budynków kontenerowych: A – osiedle kontenerowe w Borodziance, B – centrum medyczne przy ul. I. Puluja we Lwowie (fot. O. Pekarchuk)

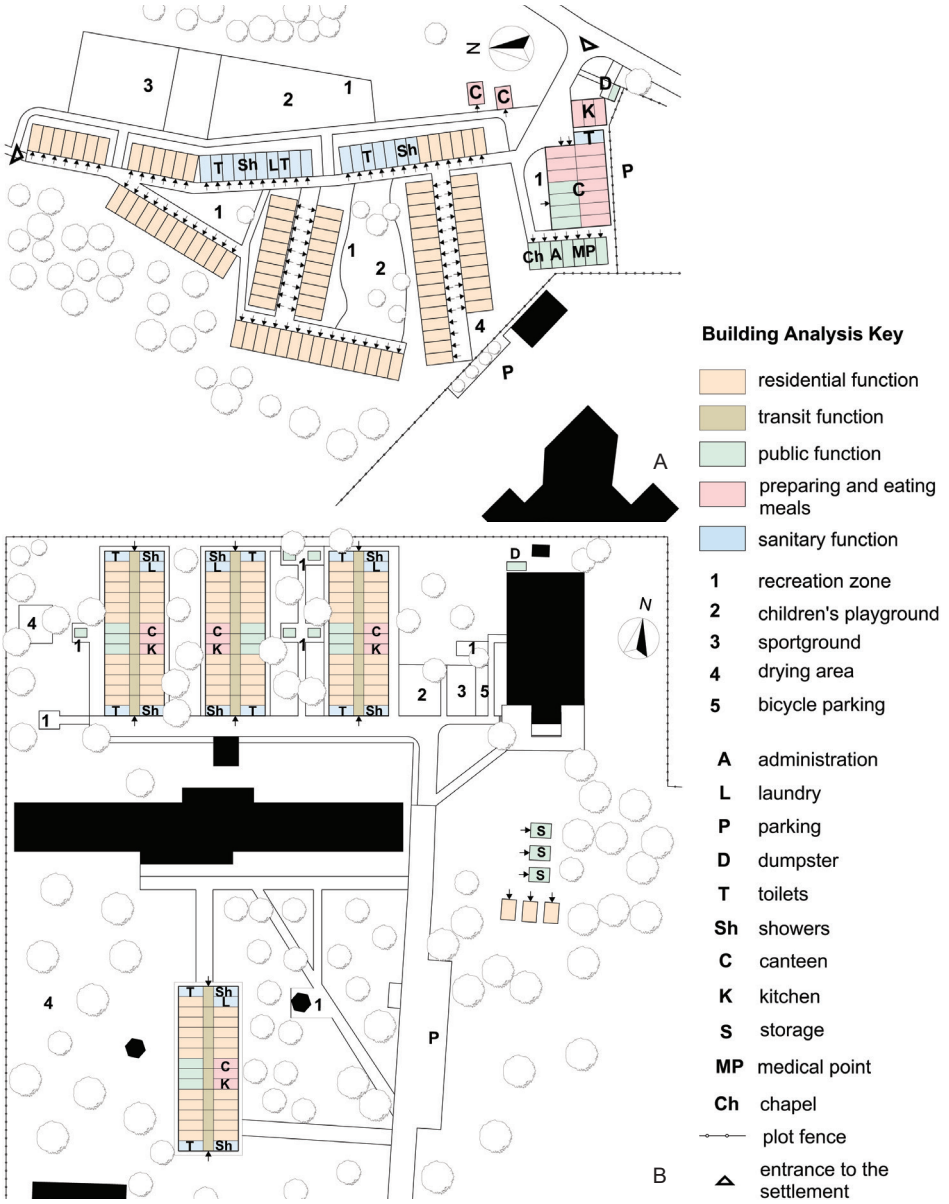

Fig. 3. Schemes of container settlements:
A – row type buildings at Lviv, 72A Chervona Kalyna Avenue, B – corridor-type buildings at Irpin, 2 Mineralna Street (elaborated by O. Pekarchuk)

Il. 3. Schematy osad kontenerowych:
A – szeregowa zabudowa we Lwowie, al. Czerwona Kałyna 72A, B – korytarzowa zabudowa w Irpieniu, ul. Mineralna 2 (oprac. O. Pekarchuk)

mulch (576 m^2). Trees, bushes, flowers and herbs have been planted.

Most residential container buildings in Ukraine in 2022 were built in a corridor layout. Container settlements contain from 1 to 8 double-loaded corridor buildings. The most common scheme is four buildings arranged in two rows of two buildings each. A typical corridor occupies approximately 570 m^2 of the plot area. This type of layout is planned for 88 to 1,280 beds (mostly around 350 beds).

During the construction of the container settlements, double-loaded corridors buildings are built using 30 to 50 containers. However, in most container settlements, a double-loaded corridors building consists of 40 containers, including 22 living units, 8 containers forming the corridor, 3 containers with a kitchenette and a dining area, 3 containers with variable functionality that can be equipped with a dining room, children's room, sports hall, library, etc., 2 containers with toilets (one for men, the other one for women), and 2 containers with separate showers for women and men (Fig. 5).

There are entrances to the building at both ends. Depending on the terrain, the buildings can be located at different heights, so there can be from one to five steps at the entrances. However, only in Poltava the buildings had ramps to provide convenient access for people with disabilities and mothers with prams. In some settlements, entrance canopies were installed, which can be useful in bad weather.

The internal area of the living container is approximately 13 m^2. The internal height of the container is 2.5 m [19], which is suitable for living quarters. Such a container is one living module that can accommodate four people. It is evident that the size of the container is insufficient for the long-term residence of four people (Fig. 6A). All living containers have two tilt and turn PVC windows in white, equipped with roller shutters on the exterior of the building [19]. The living containers are equipped with typical furniture: two bunk beds, two wardrobes, a table, and two chairs. Additionally, the rooms are equipped with mattresses and bedding.

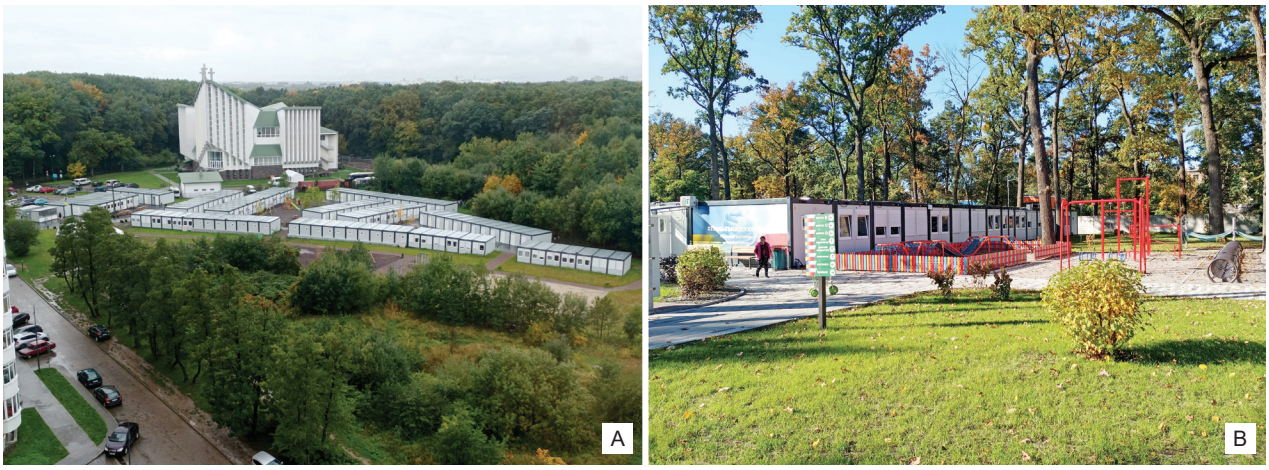

Fig. 4. Container settlements: A – row-type buildings in Lviv, 72A Chervona Kalyna Avenue, B – detached double-loaded corridors buildings in Irpin, at 2 Mineralna Street (photo by O. Pekarchuk)

Il. 4. Osady kontenerowe: A – szeregowa zabudowa we Lwowie, al. Czerwona Kałyna 72A, B – wolnostojące budynki o układzie korytarzowym w Irpieniu, ul. Mineralna 2 (fot. O. Pekarchuk)

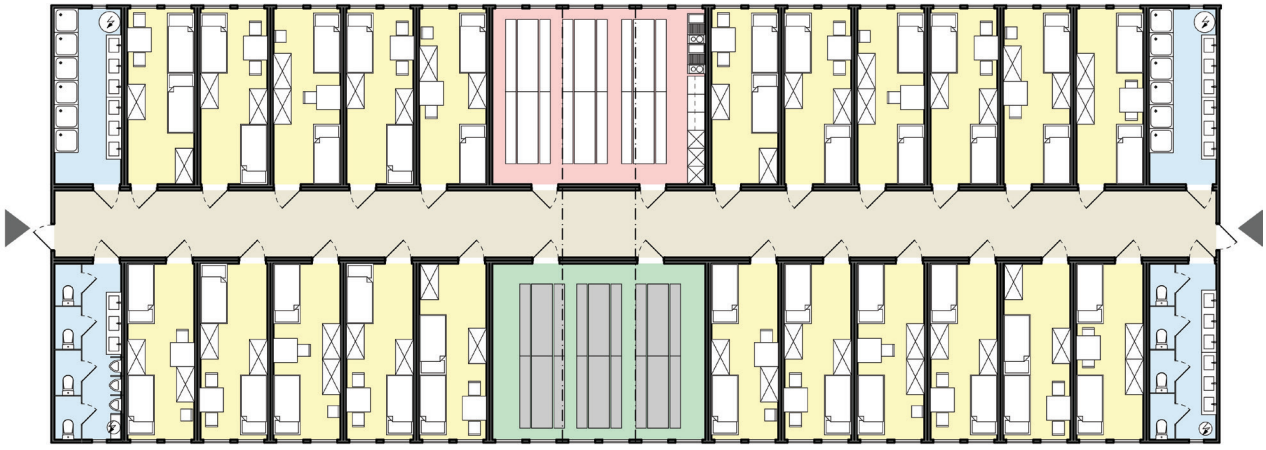

Fig. 5. Schematic plan of a double-loaded corridor container building (elaborated by O. Pekarchuk)

Il. 5. Schemat planu budynku kontenerowego typu korytarzowego (oprac. O. Pekarchuk)

The ratio of the number of living containers to the number of containers performing a utility function (transit, preparing and eating meals, leisure for adults and children) in buildings determines the degree of their economy and comfort.

Of great importance for the planning structure of the building is the arrangement of the kitchen with a dining room and the sanitary and hygienic rooms. In buildings, sanitary and hygiene containers are placed at the end of the building: at one end of the corridor, there is a container with women's toilets, opposite which there is a container with showers for women, and on the other side, there are containers with showers and toilets for men. Such a solution requires laying a larger water and sewage network than in the case of locating sanitary containers in one place. The women's toilet has four cabins and six washing places. In the male toilet container, there are four cabins, three washbasins, and three urinals. The men's and women's shower cabins are the same and contain six showers and six washing places (Fig. 6B). Since the showers are located at the ends of the buildings, users may be exposed to low temperatures and drafts near the entrance. It would be appropriate to supplement the solution with an anteroom. Each sanitary and hygienic container has a boiler.

The kitchen-dining room in the double-loaded corridor building is an isolated premise, and the entrance to it is organized from the corridor. It is placed in the central part of the building. The area of the kitchen-dining room is about 42 m^2.This premise can be used not only for preparing and eating meals, but also for meetings and communication among the inhabitants. It has six tables as standard, with the capacity to accommodate 48 people at the same time. Sometimes, tables stacked on top of each other are used as racks for storing kitchen utensils (Fig. 6C). The use of large-sized tables reduces the efficiency of using the dining room space. Inhabitants usually install additional refrigerators in this room. The standard kitchen solution includes two electric cookers with two burners each and

Fig. 6. Rooms of the double-loaded corridor building:
A – living room, B – bathroom, C – kitchen-dining room, D – corridor, E – playroom, F – gym (photo by O. Pekarchuk)

Il. 6. Pomieszczenia korytarzowego budynku kontenerowego:
A – pokój, B – łazienka, C – kuchnia-jadalnia, D – korytarz, E – strefa dla dzieci, F – strefa sportowa (fot. O. Pekarchuk)

two sinks with a drain. The standard set of kitchen furniture consists of two standing cupboards, three hanging cupboards, and three tall kitchen cupboards. This set of furniture and kitchen equipment was designed to meet the needs of households of 88 inhabitants. A separate room opposite the kitchen-dining room with an area of approximately 42 m^2 can have various public functions, which increases the comfort of inhabitants.

The area of the corridor is approximately 86 m^2. The entrances to the rooms are along the corridor. The corridors are equipped with air conditioners. In some buildings, residents have arranged additional places to store shoes in the corridor (Fig. 6D).

An example of a double-loaded corridor residential development is the settlement for 320 beds in Irpin, which was built on the territory of the Dubky sanatorium (Fig. 3B), consisting of four buildings. Citizens of Irpin, who had lost their homes as a result of the war, found accommodation there. Three 40-container buildings are located in one line. Spatial development has been prepared for this part of the sanatorium area. Paths made of cobblestones have been laid, and a recreational and sports zone with sports equipment and hammocks and a playground for children have been organized nearby (Fig. 4B). One building was located in the park zone in front of the sanatorium building. There is a drying area nearby. In the settlement, in the standard scheme of the double-loaded corridor the building plan was altered so that one of the living containers was replaced with a laundry container, which was arranged with water supply and drainage. In Irpin, each building utilizes the separate room opposite the kitchen-dining room differently: in one building, it serves as a playroom (Fig. 6E), in the second building, it functions as a gym (Fig. 6F), and in the third building, it is utilized as a library.

Utilities

Sanitary and kitchen containers in settlements are connected to the central water supply and sewage system or to local water treatment networks, water intake can be organized from wells, which requires the availability of electricity. In Deputatska Street in Bucha, the functioning sewage network is equipped with electric pumps. However, during a power outage, the sewage system does not work.

The containers are equipped with lighting, sockets, and individual electric convectors for heating. In container settlements, there is no individual way to account for the consumed resources (water, electricity) for a separate dwelling unit, since residents do not pay for communal services. These costs are covered from local budgets. However, later on, there may be a problem with paying for utilities, as the

entire cost will be distributed equally among all residents, which could cause dissatisfaction and conflicts, as well as problems with paying for the resources used, as was the case in the container settlements built in 2015. In the settlements that are not equipped with electricity generators, there is no water or heating during a power outage.

Recommendations for the design of container settlements for IDPs in Ukraine

In Ukrainian and European practice, municipal authorities choose their own plots of land (municipal property) for the construction of container settlements in order to avoid paying rent, engaging in contract procedures, and to ensure the possibility of extending the settlement's operational period. When selecting a location, it is important to consider the accessibility and availability of infrastructure facilities such as kindergartens, schools, hospitals, etc., as well as the potential impact of increased demand on the local infrastructure [13]. It is necessary to consider the possibility of organizing a kindergarten within the settlement if there are no kindergartens within a 500-meter radius. If there are no schools within a 1-kilometer radius, arrangements must be made for children to have transportation to schools. Therefore, it is important to conduct a logistical analysis, assessing accessibility, public and alternative transportation development, as well as the condition of the road infrastructure (roads, bike paths, sidewalks) [3].

Ecological analysis (assessment of the natural system, relationships between elements of local nature and terrain topography) is important when selecting a plot of land, because the environmental condition has a direct impact on the well-being of both refugees and local residents [11], [13]. When selecting a site for the construction of settlements, the suitability of the soil cover for small-scale cultivation should be evaluated, seasonal vegetation and the presence of existing trees should be examined, and noise levels should be determined. It is advisable to avoid areas where gusty winds can stir up dust clouds [13]. To avoid potential delays in the future approval process for project documentation, it is recommended to refrain from selecting plots of land that are adjacent to protected areas. During the design process, it is important to preserve existing trees (they will provide shade and protection from the wind), install grass cover (preventing dusting), and maintain biodiversity. Among the key topographical features to consider when choosing a site are: terrain slope (1–5% to avoid extensive earthworks for construction and the need for stair installation at building entrances), groundwater level (below 3 meters from the surface of the settlement), and soil cover type (to avoid non-permeable soils), proximity to water bodies (to determine the risk of flooding) [13]. Due to the extreme conditions and limited time, it is advisable to simplify the environmental expertise. It is recommended to pre-select plots for the construction of temporary housing in case of crisis situations.

It is crucial to engage IDPs in the improvement and organization of their lives in container settlements [3]. The inhabitants can plant shrubs and flowers in the area, take care of small gardens, as well as clean the area and common areas of buildings (kitchens, corridors, laundries, hygiene rooms, etc.). Additionally, they can paint container buildings, as well as engage in painting and decorating premises.

The functioning of settlements requires financing; therefore, the economic potential of the region and the availability of jobs or the possibility of opening new enterprises should be taken into account [3]. Employment of IDPs will benefit the local economy. The social integration policy should include obligatory actions for the education of the inhabitants of the settlement, social and cultural awareness, as well as interaction with local communities [3].

Container settlements built in 2022 in Europe and Ukraine are not adapted to the long-term stay of refugees and IDPs. However, the construction of container buildings with a warranty period of at least 10 years will not only extend the life cycle of the building (important for Ukraine, since the duration of the war and housing rebuilt is unknown), but will also allow containers to be reused.

The creation of the settlement for 300 people is an optimal solution, as it allows the best integration of inhabitants with the urban environment. It is advisable to design the settlement with two-story buildings because this height of container buildings is the most common in European practice and allows for optimal use of the terrain, engineering networks, and infrastructure.

The analysis of European and Ukrainian examples of spatial planning reveals that the design of courtyards takes into consideration the inhabitants' need for peace and privacy, creating a multi-level system of public, semi-private, and private zones. The grid urban layout of the settlement requires the shaping of a square on which various public spaces will be organized (playground, outdoor gym or sports field, recreational areas, etc.), as well as public utility buildings with places to spend time together, for training sessions, laundries, etc. It is necessary to create inclusive and accessible public spaces to promote social and psychological health based on the pursuit of common interests [3]. It is advisable to provide a place for parking bicycles and the possibility of a parking lot nearby or within the settlement. Additionally, it is necessary to allocate space for municipal waste segregation containers on or near the settlement [13].

The architectural form of the buildings affects the overall image of the settlement, therefore predicting the scenario of seasonal transformations of the buildings can be beneficial. For example, with the onset of cold weather in Bern, temporary structures were installed around the perimeter of the buildings, as the galleries and passages on the first floor were not sheltered from wind and precipitation. This allowed for modifications in the aeration characteristics to enhance the micro-climate of the interior space, but it also led to changes in the level of illumination in the general transit traffic area. From an aesthetic standpoint, the building took on two artistic interpretations. Furthermore, temporary structures can be utilized to create additional features such as reserve spaces for storing auxiliary equipment, shade tents for summer dining areas, etc. Another measure aimed at altering the appearance of buildings and enhancing their energy efficiency is the construction of additional elements in the building

structure. For instance, in Antwerp, gable roofs were placed over container buildings. In order to improve the existing Ukrainian settlements, it is essential to explore the possibility of building verandas and open terraces.

Ukrainian container settlements are built on the principle of shared use of kitchens, dining and hygiene rooms. In European settlements, additional options are implemented where the kitchen and bathroom are shared by 2 to 5 rooms. Containers (dwelling units) for one family with individual bathrooms, kitchen niches, equipped with transformer furniture for eating and sleeping, are most suitable for creating settlements intended for long-term residence and creating comfortable basic living conditions. It is necessary to use flexible planning solutions of dwelling units to provide housing for families of different composition. Based on studies of foreign practice of architectural design, it is advisable to equip a room or dwelling unit for people with disabilities on the ground floor of container buildings [3].

Design solutions should aim at maximizing the potential of passive solar heating in winter and avoiding it in summer by taking advantage of the terrain and features of the designed landscape. Additionally, it is important to remember about the correct location of surfaces that transmit light and heat (windows and doors). This was accomplished through careful building orientation and placing windows on the sunny side of the building. Installing external roller shutters on the windows will help reduce room heating during the summer. It is also advisable to ensure the integrated use of renewable energy technologies such as solar collectors and batteries, air recuperators, rainwater and melt water collection systems, as well as biological wastewater treatment and filtration systems [4]. Effective thermal insulation materials should be utilized to optimize acoustic properties. The indoor air quality standards include the following criteria: ensuring minimum indoor air quality parameters, monitoring the supply of outdoor air, and increasing ventilation to prevent wall wetting and the growth of mold, which has been observed in some Ukrainian settlements. Additionally, it is essential to ensure the functioning of reliable water supply system and install water meters for each dwelling unit.

Color and imagery can be used to change and unify the surroundings of the container settlement, giving it an identity and facilitating the orientation of inhabitants in the space. European settlements show that attention should be paid to shaping the high-quality internal environment of container rooms due to visual comfort. Color also allows to emotionally and visually model the internal environment, and it positively affects the psychological perception of the container premises. Furthermore, the placement of furniture, its design, and the ability for transformation and multifunctionality will visually enlarge the space. Personalizing the space with interior accessories will help refugees feel at home.

Summary

The construction of container settlements is one of the quick options for solving housing problems that arise as a result of emergencies. As it can be seen from the above analysis, they are only a temporary solution. None of the constructed container settlements is intended for use by Ukrainian refugees or IDPs for more than four years. However, the technical characteristics and warranty period of the containers allow for their further exploitation for various social purposes. Unfortunately, sometimes the poor living conditions in container settlements are justified by their temporary nature. However, among the analyzed European settlements built in 2022, there were examples where the architectural and planning approach focused on creating fully functional housing (e.g., in Antwerp) rather than temporary shelters.

Based on the information about Ukrainian and European settlements and the analysis conducted, recommendations have been developed for the design of container settlements. Spatial, architectural, technological and interior design solutions are proposed that can ensure a better level of housing quality, and not only the satisfaction of the basic needs of inhabitants. It was found that a properly selected urban and pro-ecological approach not only allows for faster integration of residents with the socio-economic life of the host communities, but also provides better living conditions.

The article should be regarded as a contribution to further analysis of settlements for IDPs in Ukraine. The next step will involve studying the impact of architectural characteristics on the quality of life in container settlements and assessing potential changes in the spatial structure using parametric tools.

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References

[1] Kyiv School of Economics, *$147.5 billion – the total amount of damages caused to Ukraine's infrastructure due to the war, as of April 2023*, https://kse.ua/about-the-school/news/147-5-billion-the-total-amount-of-damages-caused-to-ukraine-s-infrastructure-due-to-the-war-as-of-april-2023// [accessed: 20.06.2023].

[2] UNFPA EECA, *Ukraine Emergency Situation Report #18–17 May 2023*, https://reliefweb.int/report/ukraine/ukraine-emergency-situation-report-18-17-may-2023 [accessed: 20.06.2023].

[3] United Nations Economic Commission For Europe, *Housing for Migrants and Refugees in the UNECE Region: Challenges and practices*, UNECE, Geneva 2021, 60, https://unece.org/sites/default/files/2021-02/Housing%20for%20Migrants_compressed_0.pdf [accessed: 18.04.2023].

[4] Woźniak-Szpakiewicz E., *EU migrant crisis and increasing demand for modular construction: modular social housing complex for refugees in Munich*, [in:] *Back to the Sense of the City, 11th VCT International monograph book*, Centre de Política de Sòl i Valoracions, Barcelona 2016, 921–931, doi: 10.5821/ctv.8094.

[5] Borst Ch., *Leben im Containerdorf – In Unterschleißheim stehen erste Unterkünfte des Landkreises für Ukraine-Flüchtlinge*, "Merkur.de", 17.08.2022, https://www.merkur.de/lokales/muenchen-lk/unterschleissheim-ort29622/leben-im-containerdorf-in-unterschleissheim-stehen-erste-

unterkuenfte-des-landkreises-fuer-ukraine-fluechtlinge-91728455.html [accessed: 5.04.2023].
[6] Hettich H., *Zu Besuch im Neubiberger Containerdorf*, "Merkur.de", 23.12.2022, https://www.merkur.de/lokales/muenchen-lk/neubiberg-ort29121/ukraine-zu-besuch-im-neubiberger-containerdorf-91991272.html [accessed: 5.04.2023].
[7] Boschert A., *Unterkünfte für Flüchtlinge: Vorerst gelandet*, "Süddeutsche Zeitung" 2022, 22.12.2022, https://www.sueddeutsche.de/muenchen/landkreismuenchen/neubiberg-landebahn-landschaftspark-fluechtlinge-ukraine-container-1.5720825 [accessed: 5.04.2023].
[8] Van Rooy D., *Antwerps nooddorp klaar voor eerste Oekraïense vluchtelingen*, https://www.vrt.be/vrtnws/nl/2022/04/27/antwerps-nooddorp-voor-oekraiense-vluchtelingen-klaar-voor-gebru/ [accessed: 5.04.2023].
[9] Van de Sande S., *Bouw van nooddorp voor ruim 600 Oekraïense vluchtelingen op grindparking aan De Nekker gaat van start*, https://www.nieuwsblad.be/cnt/dmf20220327_93725778 [accessed: 5.04.2023].
[10] gent, *Nooddorp voor Oekraïners in Oostakker*, https://stad.gent/nl/oekraine/nooddorp-voor-oekrainers-oostakker [accessed: 5.04.2023].
[11] Van den Eynde S., *Start van de plaatsing van 15 tijdelijke modulaire woningen voor Oekraïense vluchtelingen op de Kwartelsite*, https://slrb-bghm.brussels/nl/persberichten/start-van-de-plaatsing-van-15-tijdelijke-modulaire-woningen-voor-oekraiense [accessed: 5.04.2023].
[12] Grindat J., *Criticism of the container village for refugees*, https://www.world-today-news.com/criticism-of-the-container-village-for-refugees/ [accessed: 5.04.2023].
[13] UNHCR The UN Refugee Agency, *Camp site planning minimum standards*, https://emergency.unhcr.org/emergency-assistance/shelter-camp-and-settlement/camps/camp-site-planning-minimum-standards [accessed: 5.04.2023].
[14] DEMEEUW, *Een veilige plek voor Oekraiense vluchtelingen,* https://www.demeeuw.com/nieuws/een-veilige-plek-voor-oekraiense-vluchtelingen/ [accessed: 5.04.2023].
[15] ZNSTD, *192 tijdelijke woningen op braakliggende terrein langs Noorderveenweg in Assendelft*, https://wonen.zaanstad.nl/nieuws/192-tijdelijke-woningen-op-braakliggende-terrein-langs-noorderveenweg-in-assendelft [accessed: 5.04.2023].
[16] Friedrichs S., *Opvang Oekraïense vluchtelingen op omstreden grond nadert voltooiing, zowel uit Arnhem als Elst bezwaren*, https://www.gelderlander.nl/arnhem/opvang-oekraiense-vluchtelingen-op-omstreden-grond-nadert-voltooiing-zowel-uit-arnhem-als-elst-bezwaren~aca12878/ [accessed: 5.04.2023].
[17] Hryhorash A., *U Lvovi vstanovliat "zymove" modulne mistechko dlia pereselentsiv: yakym vono bude*, https://bzh.life/ua/gorod/vo-lvove-ustanovyat-zimnij-modulnyj-gorodok-dlya-pereselenczev-kakim-on-budet/ [accessed: 18.01.2023].
[18] Stocker M., Schneider G., Zeilinger J., Rose G., Damyanovic D., Huber-Humer M., *Urban temporary housing environments – from a systematic comparison towards an integrated typology*, "Journal of Housing and the Built Environment" 2021, Vol. 36, 1457–1482, doi: 10.1007/s10901-020-09812-x.
[19] Modular System, *Katalog produktowy*, https://modularsystem.pl/do-pobrania/ [accessed: 6.04.2023].

Abstract

Container settlements built in Ukraine and Western Europe in 2022. Analysis and design recommendations

Container settlements are used all over the world as temporary housing in crisis situations, which is associated with the possibility to satisfy the basic needs of people in a short period of time. The aim of the article is to research the main features of the built container settlements for internally displaced persons (IDPs) in Ukraine and to determine the advantages and disadvantages of their operation. 12 container settlements built in 2022 with the support of the Polish government in the Lviv and Kyiv regions were visited for the study. The article contains information on container settlements that relate to land use, built-up area, number of container units, typology and function of the purpose of buildings and their equipment and control of these objects. The analysis of container settlements for Ukrainian refugees in Europe and IDPs in Ukraine has allowed for a focus on indicating successful architectural and urban solutions. The results of the study may be an impulse to improve the quality of the conditions in temporary housing for IDPs. The determination of effective architectural and urban models used in Europe in the construction of container settlements will help during the planning, construction and organization of the living environment of new settlements in Ukraine.

Key words: internally displaced persons, refugees, container settlements, container architecture

Streszczenie

Osiedla kontenerowe powstałe w Ukrainie i w Europie Zachodniej w 2022 r. Analiza i rekomendacje projektowe

Osiedla kontenerowe wykorzystywane są na całym świecie jako tymczasowe mieszkania w sytuacjach kryzysowych, stwarzają możliwość zaspokojenia podstawowych potrzeb ludzi w krótkim okresie. Celem autorki artykułu było zbadanie głównych cech osad kontenerowych dla osób wewnętrznie przesiedlonych w Ukrainie oraz ustalenie zalet i wad wynikających z ich działania. W ramach badania odwiedziła ona 12 osiedli kontenerowych wybudowanych w 2022 r. przy wsparciu polskiego rządu w obwodzie lwowskim i kijowskim. Artykuł zawiera informacje na temat użytkowania gruntów, wielkości terenu zabudowania, liczby jednostek kontenerowych, typologii i funkcji przeznaczenia budynków i ich wyposażenia oraz kontroli tych obiektów. Analiza osiedli kontenerowych dla ukraińskich uchodźców w Europie i osób wewnętrznie przesiedlonych w Ukrainie pozwoliła skupić się na wskazaniu udanych rozwiązań architektonicznych i urbanistycznych. Wyniki badania mogą być impulsem do poprawy jakości warunków w tymczasowych mieszkaniach osób wewnętrznie przesiedlonych. Określenie skutecznych modeli architektonicznych i urbanistycznych stosowanych w Europie przy budowie osiedli kontenerowych pomoże w planowaniu, budowie i organizacji środowiska życia nowych osiedli w Ukrainie.

Słowa kluczowe: osoby wewnętrznie przesiedlone, uchodźcy, osiedla kontenerowe, architektura kontenerowa