# Potentials of Using Container Buildings for Producing Facilities for the Agro-Ecological Tourism Complexes in Kazakhstan

**Inna Ostapenko[1], Nina Kozbagarova[1] & Alexandr Bryantsev[2]**
[1]Faculty of Architecture
[2]Faculty of General Construction,
Kazakh Leading Academy of Architecture and Civil Engineering, Almaty, Republic of Kazakhstan.
Email: ostapenkoinna23@gmail.com

## Abstract

Agro-ecological tourism in Kazakhstan faces a critical problem in providing adequate infrastructure to showcase natural and agricultural processes to visitors. This issue arises due to the lack of well-developed construction infrastructure and utility mains in the areas where such facilities need to be located. This challenge also means that building structures that meet the specifics of agro-ecological tourism activities in these locations becomes significantly challenging and expensive.

A potential solution to this problem is the use of shipping containers. These units are strong, have water-proof external surfaces, are easy to assemble in most landscape environments, and do not require major foundations, thereby ensuring minimum impact on the surroundings. Shipping containers can be used as single units or in multiples, combining them to create meaningful and interesting structures for promoting agro-ecological tourism in Kazakhstan.

This paper offers layout options for such facilities, demonstrating the potential of using shipping containers to provide suitable infrastructure for agro-ecological tourism activities in Kazakhstan. This innovative approach can pave the way for developing sustainable tourism in Kazakhstan and contribute to economic growth.

**Keywords:** shipping containers, modularity, container architecture, sustainable architecture, agro-ecological tourism facilities, Kazakhstan.

## Introduction

Agro-ecological tourism in Kazakhstan is a new phenomenon, which is gaining popularity and contributes to the economic progress of the country. However, it faces serious problems in providing adequate infrastructure. Without proper facilities, it will be difficult to attract tourists interested in the natural and agricultural processes available aplenty. This arises because of the lack of well-developed construction infrastructure and utility mains in the areas where such facilities need to be located. Needless to say, building new structures that meet the specifics of agro-ecological tourism has become a significant challenge because they would be expensive. That is where the use of containers will come as an alternative yet useful strategy.

Although agro-tourism activities can be organized either on the basis of the existing newly-built agro-industrial complexes, or as self-sustainable enterprises, container-based spaces can be added to. Indeed, they can enhance the existing production facilities, accommodation, and staff community service units for the leisure activities, either permanently or temporarily. They can also demonstrate various types of agricultural activities. Promisingly, the present range of shipping containers allows creating the necessary spaces whether of the basic configuration or with an appropriate modernization.

There are many possibilities of using the containers. For example, the most common conventional containers such as the 40-DC and the 20-DC of the basic configurations can be used for the warehouses for different purposes. The refrigerated containers 40-RF of their basic configuration can be used as refrigerated compartments and refrigerators for meat, fish, dairy products and partially prepared foodstuff; confectionery products; vegetables, fruit, berries, mushrooms, tinned foods, drinks, and food scraps. Similarly, the open-top containers 20-OTC in their basic configuration with a removable canopy top can be used to store bulk consumables, coal, and compound animal feedstuffs. The flat rack containers 20-FRC with end walls in their basic configuration can be used for temporary storage of wood fuel, tares and packages, equipment that is to be installed or has been dismantled, and packaged products. Moreover, the tank containers 20-TC of the basic configuration can be used as tanks for liquid fuel, gas, potable water, atmospheric runoffs, and fire emergency water.

Design of such containers (other than the flat rack containers 40-FRC and 20-FRC) allows to group them as singles or in several layers, subject to having an adequate access through the inclined or fixed ladders and entrance ramps. In addition, the containers can be installed both on the ground, semi-underground or underground positions, depending on the technological processes they are to be used in. This especially relates to the tank containers, which can be located at the next level above the premise that is supposed to use their contents, to ensure an extra header pressure within the domestic water supply system and an easy discharge. If they are used as tanks of the water surge tower or fire tanks, they can have separate supports or be located with an elevation versus the surrounding landscape. However, the storage of gaseous fuel requires a strictly above-ground location of the tanks, whereas it would be expedient to arrange the underground storage of a liquid fuel. Besides, the underground location is typical for tanks to be used to store the atmospheric runoffs and components of the circulation water system.

However, the maximum scope of the services and the events would require different degrees of modernization of the shipping containers. This may include the creation of the windows and door openings, interior finishing compliant with the technological processes, layout of piping arrangement and utility wiring, as well as grouping of the container units in various spatial combinations. Furthermore, unlike detached containers, their combinatorial set requires the arrangement of the common pitched roof that can be rapidly installed having a minimum slope to ensure moisture proofing of the joints between the containers and create a drainage of atmospheric precipitations that will be subsequently used for watering. Inter-block thermal and air insulation shall be provided directly at the joints.

The use of the containers as separate water closets has become a commercial practice. However, their layouts based on the aim to minimize the main premises' parameters and amenities, is, to a certain extent, acceptable for rotational villages located within the prospect of being experimentally developed where the low level of comfort is compensated with social and economic incentives available to the personnel.

However, the phytosanitary control, fish, poultry veterinary care, cattle and poultry slaughter premises should not be demonstrated to tourists at all. Their modular container-based design will complement the range of facilities included in the agro-ecological tourism complex. This range is complemented with modular container filling stations, which as a part of the agro-tourism complex are designed to service cars and buses, in which tourists have arrived. Examples of container farms often used in cities to cultivate plants, mushrooms, edible insects and fish are also hardly suitable as the demonstrative and informative materials due to their spatial limitedness.

The research aims to demonstrate the potential of using shipping containers as a cost-effective and sustainable solution for providing suitable infrastructure for agro-ecological tourism activities in Kazakhstan. The research also offers layout options for such facilities to promote the use of shipping containers for producing facilities in the agro-ecological tourism complexes in Kazakhstan. The research intends to contribute to the development of sustainable tourism in Kazakhstan and promote economic growth.

## Review of Literature

Agro-ecological tourism is one of the most popular areas of the present-day recreation around the world. Different countries organize recreation activities in different ways, depending on the specifics of their nature and the climatic conditions and peculiarities of their economy management. The level of this sector's development differs from country to country. In most cases, the organization takes place on the basis of existing agricultural enterprises and natural parks. Agro-ecological tourism is a multi-faceted activity, the various types of which are considered at varying levels of details in numerous works.

In this regard, Aranda (2009) discusses rural tourism as an effective territorial development strategy. The social factor, including the family aspect is emphasized in many studies (Jablonskaet al., 2016; Darmayanti and Bahauddin, 2020). A separate aspect is agro-ecological tourism as a component of sustainable development. Here, the works by Honey (2008) and Wearing et al. (2019) appear to be prominent. It is interesting that the modularity of services in the tourism activities discussed in the work of Avlonitis and Hsuan (2017) can be applied to the modularity of the structures for tourist complexes. In fact, the modularity of shipping containers is also mentioned for example, by Mohamed, who says that "using modular containers could be suitable for limited projects which need limited spaces dimensions according to its structural features which eliminate the height and removing side walls" (2017: 781). This shows that they can be used effectively.

The theoretical and practical aspects of the reuse of shipping containers have been often considered. Thus, general design and construction matters are covered in many studies (Bernardo et al., 2013; Ismail et al., 2015; Martin et al., 2019; Laksitoadi and Syarif, 2020; Satola et al., 2020; Shen et al., 2020; Slawik et al., 2020; Kristiansen et al., 2021; Risnandar and Primasetra, 2021). The energy efficiency problems for different roofing and wall materials have been considered by Taleb, Elsebaei, and El-Attar (2019: 461) who point out that “the most effective strategy was the use of green roofs and green walls as these reduced energy consumptions by 13.5%”. Satola et al. have produced interesting results: “the life-cycle assessment results indicate that the net-zero energy design strategy has the lowest life-cycle impacts in all categories, with 26% reduction in water consumption and up to 86% reduction in terms of global warming potential with respect to the convectional, baseline design” (2020: 1). The specifics of thermal insulation are emphasized by Shen et al. who say that “as for repurposing container buildings, it means higher demands in improving both thermal resistance and hydro-thermal capacity of the envelope. For instance, the weakness in air tightness performance can be improved by applying a closed insulation enhancement throughout the whole enclosure. Such processing meanwhile can assist in lowering thermal bridge” (2020: 2).

The aspect of sustainable architecture related to containers have also been studied (Islam et al., 2016; Chen et al., 2017; Ceylan, 2020). In this regard, Islam et al. emphasize on the significance of the long-term life cycle, when they say “for all the impact categories, the overall contributions of the whole life cycle impacts have increased significantly if the design life of a building is increased to 100 years” (2016: 679).

Despite the considerable number of studies devoted to agro-ecological tourism, majority of them relate to the organizational and economic aspects. Furthermore, matters related to exhibiting space planning decisions and related service structures as such are considered quite rarely. When they are done, they refer mostly to the utilization of the existing buildings and facilities, which are adapted to the needs of tourists, some way or the other.

### The Research Issue and the Aims of the Research

However, the existing range of structures is insufficient for the active development of the potential of the agro-ecological tourism sector. Additionally, incorporating the exhibition of agricultural production into the standard operation of an agricultural enterprise is not efficient for creating an appealing exhibition scenario. In fact, it would be inappropriate to demonstrate a number of technological processes to tourists. These processes may be too complex or unappealing to visitors, and therefore, it is necessary to create a relatively self-inclusive complex of buildings and erections oriented particularly at exhibiting the agricultural activities in conjunction with the related services provided to the visitors. That means that the problems encountered at the current phase of development of the agro-eco tourism service related to the accelerated and actually simultaneous construction of numerous facilities brings forward a number of peculiar objectives. Unfortunately, they have not been researched properly from a scientific point of view.

The fast construction of a lot of typologically different facilities, which are technologically integrated in the agro-ecological tourism complexes suggests that it is possible to use end-to-end modularity. However, most of the research which have been devoted to the use of the containers do not cover the agro-ecological tourism activities. Therefore, the use of the modules based on the shipping containers as the basis for the creation of various facilities to render recreational and informative services as it is proposed in this paper, is an innovative one. The study focuses on showcasing the advantages of using shipping containers as an economical and sustainable option for building infrastructure for agro-ecological tourism in Kazakhstan. Additionally, the research will provide different layout options for constructing such facilities using shipping containers. The main objective is to support the development of sustainable tourism in the country and boost economic growth.

## Research Methods

The study employed various methods in architecture and planning to demonstrate the potential of using shipping containers as a cost-effective and sustainable solution for providing suitable infrastructure for agro-ecological tourism activities in Kazakhstan. Design thinking methodologies were employed to create layout options for such facilities, taking into account the specific requirements of agro-ecological tourism activities.

the landscape context, availability and level of development of underlying agricultural enterprises, as well as the thematic scope and seasonal character of the operations of the agro-ecological tourism complex were analyzed. Moreover, occupancy rate calculations were also conducted to determine the adequate number of structures for the different purposes, both in terms of accommodation of the visitors and housekeeping services that should be provided to the people. Further, the ease of demonstrating agricultural production in the light of the number of visitors who are to be served at the same time was considered. Finally, the possibilities of modular container systems, which would allow for the transformation or movement of the complexes to another territory if necessary were explored.

## Findings and the Discussion

### Containers

The Check Point Pavilion consists of one container 40DC installed horizontally. It includes: a duty room 13.5 sq.m.; a locker room 4.5 sq.m.; an entry way 5.0 sq.m.; and a water closet 4.0 sq.m. The Check Point Pavilion is a small structure designed to control access to an agro-tourism complex. It consists of a single 40DC shipping container that has been installed horizontally. The Pavilion has been designed to accommodate two employees who are responsible for monitoring access to the agro-tourism complex. It includes a duty room, a locker room, an entry way, and a water closet, all of which are contained within the shipping container. The Pavilion has been constructed using a single shipping container that has been installed horizontally. This installation method allows for easy and efficient assembly, as well as a compact design that takes up minimal space. Other assembly options could include stacking multiple containers vertically or horizontally to create larger structures or to accommodate more

employees. The modular nature of shipping containers makes them highly adaptable and allows for a wide range of assembly options to suit different needs and requirements (Fig. 1).


**Fig. 1**: Check Point Pavilion
Source: Author

The Security Pavilion is created with a combination of the three following containers: one container 40-DC installed horizontally, and 2 containers 40-DC* installed vertically. It includes: a duty room 13.5 sq.m.; a locker room 4.5 sq.m.; an entry way 5.0 sq.m.; a water closet 4.0 sq.m.; a lookout tower together with a staircase and observation decks with the area of 4.5 sq.m. each at the height of 2.8 m, 5.6 m, and 8.4 m. The stairways have danced stairs and removable half landings. The Pavilion is designed for the simultaneous accommodation of the three employees from the shift on duty, who are in charge of the visual and instrumental monitoring of the territory of the agro-tourism complex from the viewing decks located at different elevations of the lookout tower (Fig. 2). The assembly options may include using cranes or other heavy machinery to lift and position the containers into place, and then welding and bolting them together to create a sturdy and stable structure.

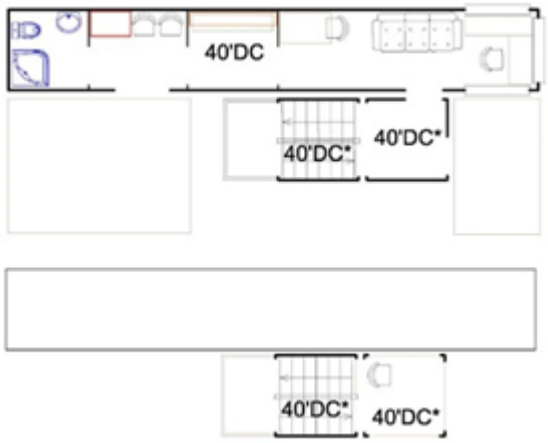


**Fig. 2**: Security Pavilion
Source: Author

The Repair Shop Pavilion (a carpenter's shop, locksmith's shop, minor repair shop) is created with a combination of the three containers of the following types: 3 x 40-DC installed horizontally. It consists of: a distribution area 4.5 sq.m.; a staff amenity room 5.0 sq.m. with a water closet 4.0 sq.m.; and three adjacent repair shop premises with the area of 18.0 sq.m. each. The Pavilion is intended for routine repair of the furniture, equipment and equipment used in the agro-ecological tourism complex. The personnel number is seven persons (Fig. 3). Here are some possible assembly options for the Repair Shop Pavilion:

1. All three 40-DC containers are arranged side by side in a straight line, with the distribution area and staff amenity room at one end, and the three repair shop premises at the other end.

2. Two 40-DC containers are arranged side by side, and the third is placed on top of them vertically, creating a two-story structure. The distribution area and staff amenity room can be located on the ground floor, while the repair shop premises are on the second floor.

3. Two 40-DC containers are arranged side by side in a T-shape, with the distribution area and staff amenity room in the stem of the T, and the repair shop premises in the arms of the T.

These are just a few possible options, depending on the available space and desired layout.

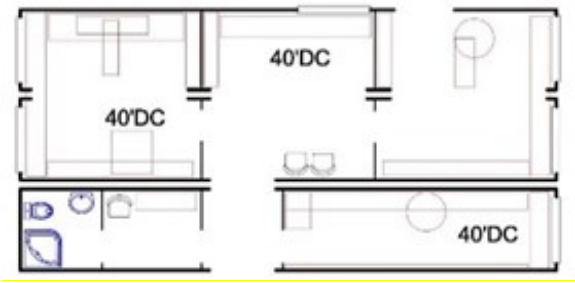


Fig. 3. Repair Shop Pavilion (locksmith's shop, carpenter's shop, and minor repair shop)
Source: Author

The Heating, Garment and Footwear Drying Pavilion is made of a combination of the four containers of the following types: 4 x 40-DC installed horizontally. It consists of: a distribution area 13.5 sq.m.; a cleaning equipment room 4.5 sq.m.; two adjacent drying rooms with the area of 18.0 sq.m. each, with four drying compartments; two adjacent heating rooms 18.0 sq.m. each, with water closets 4.5 sq.m. each, and back rooms with the area of 4.5 sq.m. each. The Pavilion is intended for heating and drying of garments and footwear of visitors walking within the complex's territory. The heating room is divided in the men's and women's parts having their own exits on the opposite sides. These areas are interconnection in terms of the layout. The capacity of each part is up to seven persons who can stay there at the same time (Fig. 4).

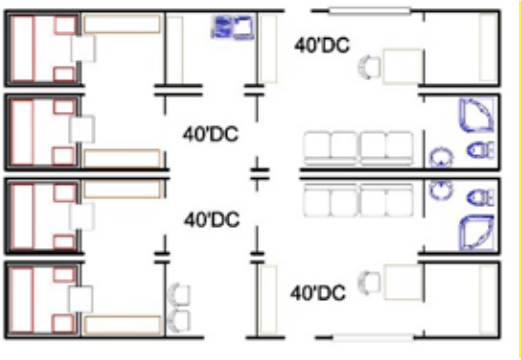


**Fig. 4**: Heating, Garment and Footwear Drying Pavilion
Source:Author

The On-Duty Staff Resting Pavilion is created with a combination of the three containers of the following types: 3 x 40-DC installed horizontally. It consists of: a lobby 9.0 sq.m.; two rest rooms with the area of 18.0 sq.m. each, with water closets 4.5 sq.m. each; and two meal rooms with the area of 13.5 sq.m. each. As to its layout, the Pavilion is configured as two symmetric blocks with the same set of premises to enable eight (4+4) employees on duty to have a rest and take a meal. A two-tier arrangement with the appropriate inclined ladders is possible (Fig. 5).

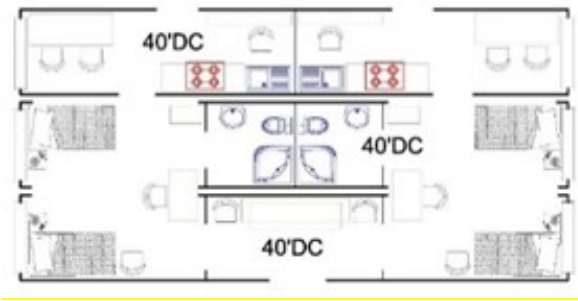


**Fig. 5**: On-Duty Staff Resting Pavilion
Source: Author

The Administration Pavilion is created with a combination of the following containers: 2 x 40-DC, installed horizontally. It consists of: a reception 22.5 sq.m.; an executive office 9.0 sq.m.; a staff office 18.0 sq.m.; and a water closet 4.5 sq.m. The Pavilion is designed for the five office employees (Fig. 6). The versatility of the 40-DC containers allows for different assembly options to be considered when designing the Administration Pavilion. For example, the two containers could be placed side by side, forming a single structure. Alternatively, the containers could be arranged in a T-shape, with one container serving as the reception area and the other forming the executive and staff offices.

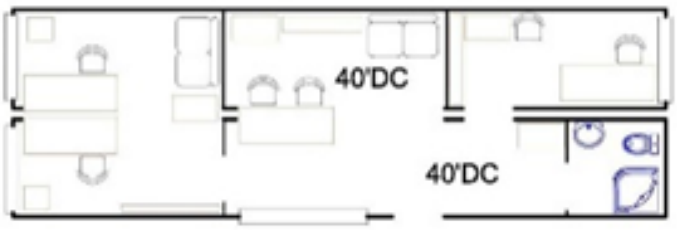


**Fig. 6**: Administration Pavilion
Source: Author

The Pavilion of Staff Amenity Rooms consists of a combination of the eight containers of the following types: 6 x 40-DC, 20-DC, and a 20-TC installed horizontally. It consists of the two adjacent blocks of the premises, including: a wind lobby 4.0 sq.m.; a dirty uniform storeroom 5.0 sq.m.; a clean uniform storeroom 4.5 sq.m.; a locker room 36.0 sq.m.; a toilet 4.5 sq.m.; and a shower room 27.0 sq.m. The blocks are grouped with the power room 4.5 sq.m.; pump room 3.5 sq.m.; back room 5.5 sq.m.; and clean-water reservoir 25.0 cub.m. As to the layout, the Pavilion is arranged symmetrically, as it has the men's and women's compartments. The Pavilion can accommodate forty (20+20) persons who can stay there at the same time. The furniture includes wardrobes with two compartments per person, tables, chairs, benches, linen cabinets, and dirty uniform storage chests. The Pavilion can have either a single-level or multilevel configuration, with the inclined staircase and elevator sections to provide for the statutory two emergency exits per level (Fig. 7).

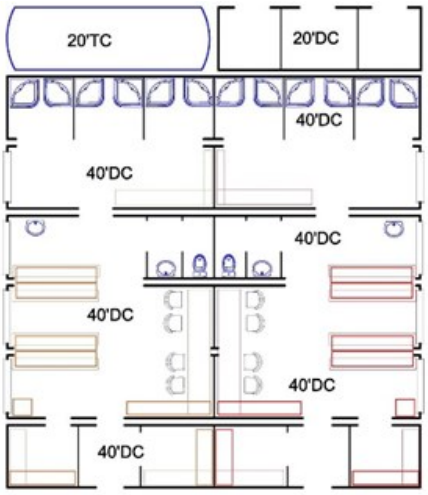


**Fig. 7**: Pavilion of Staff Amenity Rooms.
Source: Author

**Assembly Configurations**

Subsequent to the investigation of the potentials of employing the used containers for creating facilities to promote eco-tourism in Kazakhstan, the following section presents three examples of such assembly possibilities and arrangements, produced and tested in this research.

1. Security room; check point & the repair shop.
2. Premises for the personnel servicing visitors, engineering, technical, and help staff;
3. Administration premises; duty room for the personnel servicing visitors; on-duty staff resting room; staff amenity rooms;

The layouts of these assembly options of the pavilions are shown in the following Figures.

1. To combine the Check Point Pavilion, Security Pavilion, and Repair Shop Pavilion, the following assembly configuration could be used:

Place the Security Pavilion behind the Check Point Pavilion, with the lookout tower facing away from the entrance. Place the Repair Shop Pavilion adjacent to the Security Pavilion, with the repair shop premises facing away from the lookout tower. Connect all three pavilions with covered walkways for employees to pass through. Ensure there is enough space for the installation of all three pavilions and the walkways (Fig. 8).

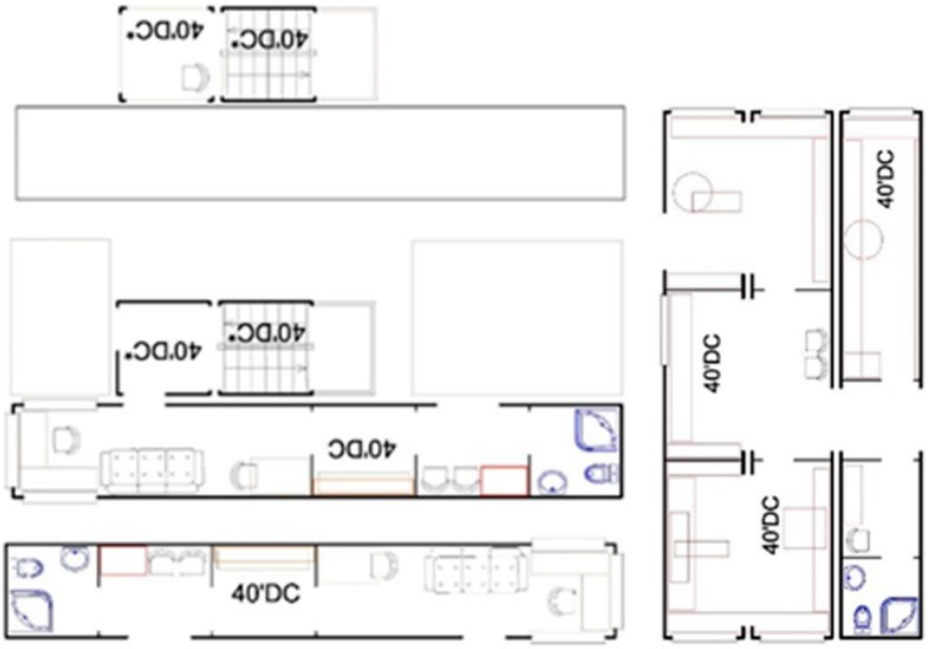


**Fig. 8**: The template of the combination of security room with check point and the repair shop
Source: Author

2. Here are some assembly configurations for the three pavilions:

**Assembly Option 1:**

Place the Repair Shop Pavilion in the center with the Heating, Garment and Footwear Drying Pavilion on one side and the On-Duty Staff Resting Pavilion on the other. Connect all three pavilions with covered walkways for employees to pass through (Fig. 9).

**Assembly Option 2:**

Place the Heating, Garment and Footwear Drying Pavilion in the center with the Repair Shop Pavilion on one side and the On-Duty Staff Resting Pavilion on the other. Connect all three pavilions with covered walkways for employees to pass through.

**Assembly Option 3:**

Place the On-Duty Staff Resting Pavilion in the center with the Repair Shop Pavilion on one side and the Heating, Garment and Footwear Drying Pavilion on the other. Connect all three pavilions with covered walkways for employees to pass through.

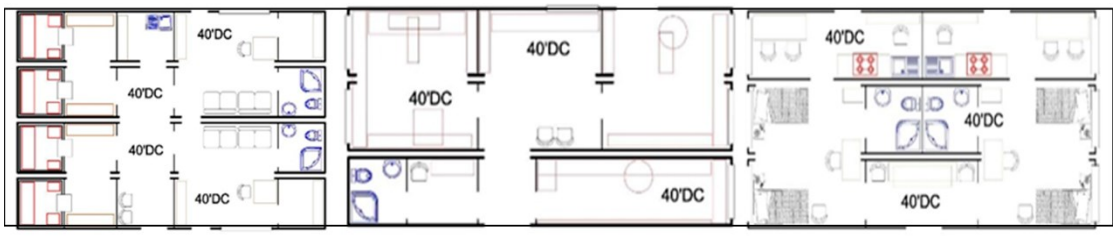


**Fig. 9**: The template of the combination of premises for the personnel servicing visitors, engineering, technical, and help staff
Source: Author

3. To assemble the Administration Pavilion, On-Duty Staff Resting Pavilion, and Pavilion of Staff Amenity Rooms between each other, the following configurations can be considered:

**1) Linear Configuration:**

The three pavilions can be arranged in a linear configuration, where the Administration Pavilion is placed at one end, followed by the On-Duty Staff Resting Pavilion in the middle, and the Pavilion of Staff Amenity Rooms at the other end. This configuration allows for easy access to each pavilion and provides a clear flow of movement for staff and visitors.

**2) L-Shaped Configuration:**

In this configuration, the Administration Pavilion and On-Duty Staff Resting Pavilion are placed side by side, forming an L-shape. The Pavilion of Staff Amenity Rooms is then placed perpendicular to the On-Duty Staff Resting Pavilion, creating a second L-shape. This configuration provides a more compact layout while still allowing for easy access to each pavilion (Fig. 10).

**3) U-Shaped Configuration:**

The U-shaped configuration involves placing the Administration Pavilion and the Pavilion of Staff Amenity Rooms opposite each other, forming the two legs of the U-shape. The On-Duty Staff Resting Pavilion is then placed at the open end of the U-shape, connecting the two legs. This configuration creates a central courtyard that can be used as an outdoor space for staff and visitors.

**4) H-Shaped Configuration:**

In this configuration, the Administration Pavilion and the Pavilion of Staff Amenity Rooms are placed side by side, forming the two legs of the H-shape. The On-Duty Staff Resting Pavilion is then placed perpendicular to the two legs, connecting them in the middle. This configuration creates a central open space that can be used as a gathering area for staff and visitors.

The choice of configuration will depend on factors such as site layout, space requirements, and user needs.

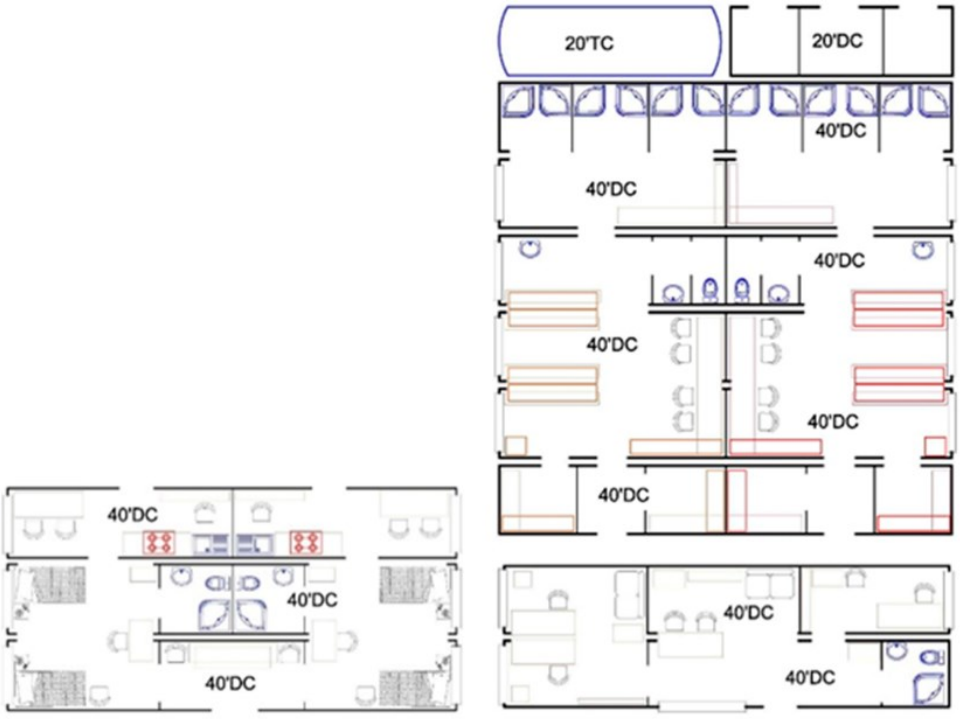


**Fig. 10**: The template of the combination of the administration pavilion, on-duty staff resting pavilion, and pavilion of staff amenity rooms
Source: Author

The creation of a complex of buildings and facilities for the agro-ecotourism activities as a component of the sustainable development system of the region involves achieving a number of parameters throughout the entire life cycle of an enterprise – creation, operation, and liquidation. The proposed modular system based on the shipping containers, which have been earlier used for their intended purposes, would solve the majority of the related problems.

The first point is related to the technologically high production level of the basic component, since the large-scale production, if compared to the single-item one, immediately gives rise to a positive economic effect, especially if it is centralized. The stream-lining of the production and permanency of the processes at each step play the key role here and ensure the high quality that is strictly controlled and verified at each step. The fact of reuse of an item that has been initially used as a tare appears to be an important element of this point, as the returning of the tare would be quite problematic both in terms of loading it with any goods that are in demand in the region of basic destination, and logistics of the empty tare.

The second point is resolvable through the transportation and installation of some components, which are well-proven technologically and logistically by the world practice and require minimum efforts to prepare a construction site, which fact predetermines an optimal low impact on the landscape. In fact, it is possible not to disturb the top soil, as it is necessary only to lay the angle corner foundations or precast reinforced-concrete monolithic ones. It is possible to use rubble concrete poles made of local materials. In case of a rock bottom, it is sufficient to merely level the places where the corner poles will be installed, whereas any sudden variations in the local topography are compensated with a stacked configuration of the containers. The dismantling of the blocks appears to be of little importance, equally.

The third point related to the power consumption economy aspect is that the main operations aimed to adjust the containers can be performed at the factory and to have them delivered to the site as operationally ready and on a "turnkey basis." If the works are carried out onsite, then most of the works shall be performed inside of a closed premise. This protects the workers from the majority of adverse natural and climatic factors. As a whole, these facilitate the achieving of the high quality of the works to be performed, reduce the period of accomplishment of such works, as this, and, in addition, involve a multiple-shift and actually round-the-clock production.

The fourth point relates to the use of highly prefabricated materials in adjustment of the containers, together with technologically proven packaging, stockpiling, transportation and application (corrugated steel deck and profiled metal for the pitched roof above a group of containers; gypsum plasterboard, fiber building boards and flake boards with guiding rails made of bent thin-walled structural iron, steel-plastic and plastic window and door frames, heat insulants for the slabs and foam insulants for welds and joints are used to the interior finishing).

The fifth point is that for the public utility purposes related to power and water supply as required to ensure operation of the complex, process the products and for waste management, which do not provide for any demonstration, it is possible to use power rooms, boiler houses, pump and tank rooms, cattle and poultry slaughter shops based on modular container units and other structures that are ready-to-operate and available on masse in the market.

The sixth point is pre-determined by the possibility to use actively wind and solar power. Furthermore, both differentiated and integrated wind and solar power generation rooms based on modular container units are also available in large numbers from the market. Solar panels can be also installed as densely as possible on the roofs of all the Pavilions in the agro-tourism complex and within a part of the neighboring territory.

The seventh point relates to the rainfall or snow-melt water collection, treatment and recycling system. It would be appropriate to use these waters in tanks, for example, to breed frogs and tortoises, as well as in the irrigation and hydroponics systems for the plant raising. Another interesting opportunity is to create the "green" roofs with the flower and lawn surface.

The eighth point relates to the arrangement of the circulation water system as a part of the water supply and sewage system, when water from wash-basins, baths, shower rooms, and toilet bowls is to be collected, treated and supplied to the toilet bowl flushing system. It is

revealing that such water can also be used to water plants, whether cultivated ones or those growing naturally.

The ninth point will allow improving performance through the differentiation of the collection of food scraps, process wastes, and household rubbish, used tare and packages. So, for example, food scraps and wastes generated in the course of the pre-sale preparation of snails, frogs, and some plant breeding products will be used to prepare feed and fertilizers.

The tenth point relates to the possibility to convert manure, plant treatment products and some residential wastewater into a biofuel. The relevant installations based on the modular container units are also common.

Another critical aspect of the operation of an agro-ecological tourism complex is publicizing an attitude of care towards nature. The object of an agro-ecological tourism is an asset that has been existing, reconstructed or newly created, and that has been turned into a highly demanded product through the organizational and financial, transport and logistical, and informative and entertainment measures. The specifics of the agro-ecological tourism are that this involves a purposeful tour to the exhibited facility and requires a relatively long stay there, suggests that there should be quite an extensive and thematically multifarious program of additional services in terms of recreation organization and a cognitive attitude to the environment, utilization of renewable energy sources, and time. The agro-ecological tourism complexes are created both on the basis of traditional land utilization resources available in a particular region and through the arrangement of new, historically indistinctive for the locality land utilization techniques. The models of organization of an agro-ecological tourism business are based on different interrelations with the agro-ecological tourism business: agroecological exhibiting, tourism and administrative-and-service ones or agricultural enterprises, which are not present in the region. The intra-model differences affect the structure of and interrelations between the composed complexes. The setup of the properly operating agro-ecological tourism complexes requires a significant number of facilities of various profiles, the function of which could hardly be compensated within the framework of an active agricultural enterprise. In these circumstances, the problem related to the determination of the requisite range of buildings and structures and adequate space planning decisions will be encountered.

Use of a modular system based on the reuse of shipping cargo containers appears to be a promising opportunity to create a complex of facilities for the agro-ecological tourism enterprise. This is based on their spatial variability, functional adaptability and low labor costs requited for the foundations, installation and dismantling operations, which have been proved by the extensive world experience. This is important to minimize the impact on the territory of exhibitional development. In practical terms, some of the agricultural production, housekeeping and housing processes are implemented, with a certain degree of comfort, within the modular container system. However, the orientation to tourism requires creating of the more comfortable spaces with the view of exhibiting of the production and a different level of amenities as required to accommodate and organize the stay of the visitors.

## Conclusions

This study concludes that the proposed three assembly combinations of containers of various dimensions and purposes, together with their relevant layouts, will solve a range of objectives pertaining to the spatial and technological organization the agro-ecological tourism enterprise's business processes. Due to the technical, technological or ethical and moral reasons, it would be inexpedient to exhibit some agricultural production processes. Therefore, to organize such processes, it would be appropriate to use the existing range of standard container modules, and employ the principles discussed above, including flexibility, scalability, and modularity.

Flexibility means that the structure can be easily reconfigured to accommodate new uses or changes in space requirements. Scalability means that the structure can be easily expanded or reduced in size as needed. Modularity means that the structure is made up of standardized, interchangeable components that can be easily assembled or disassembled, allowing for easy transportation and installation. These principles are especially important for

agricultural enterprises, which often need to adapt quickly to changing market conditions and technological advancements. The set of modular pavilions and their mutual spatial arrangement are to be adjusted depending on the specific landscape contexts, availability and level of development of the underlying agricultural enterprises, thematic scope and seasonal character of the operations of the agro-ecological tourism complex, as well as estimated attendance scale.

This exploration of the possibilities however must be expanded and enhanced. As shown, it appears to be promising to determine the aggregate of the modular facilities for various specialized complexes of a single area of interest and numerous profiles. Based on the calculations of the estimated occupancy rate, it would be expedient to determine an adequate number of structures of different purposes, both in terms of accommodation of visitors, housekeeping services that should be provided to the personnel, and in terms of the processes to be exhibited. One must also take into consideration the ease of demonstration of the agricultural production in the light of the number of visitors who are to be serviced at the same time.

The issues related to defining the time frames for the operation of the complexes, appears to be interesting. This suggests that they may be transformed or moved to another territory, which would be possible because of the modular container system.

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