

2.6 Combination of architectural and constructive solutions when creating a multifunctional complex as an example of a real competition project in Ukraine

In the modern city, where space is the most valuable resource, multifunctional buildings become the center of innovation and functionality. These structures embody modern approaches to design, integrating various functions and spaces for communication and interaction. They embody not only the technical complexity of construction but also a high level of architectural skill, creating unique objects that influence the life and image of the city.

Several examples of world experience were considered for the analysis of multifunctional buildings in the world

Multi-generational community center Excelsior Springs Community Center / SFS Architecture. This facility is located in Excelsior Springs, Missouri. It is an example of how modern buildings can become a center of active life for a community, as well as a reflection of advanced technology and design. Construction was completed in 2016, and the area of the complex is 4,650 m². Each building system and activity zone is highlighted with a characteristic color as shown in Figure 2. In addition to providing a bright and dynamic environment, colors also serve as important landmarks within the facility.



Figure 1. Exterior of Community Center

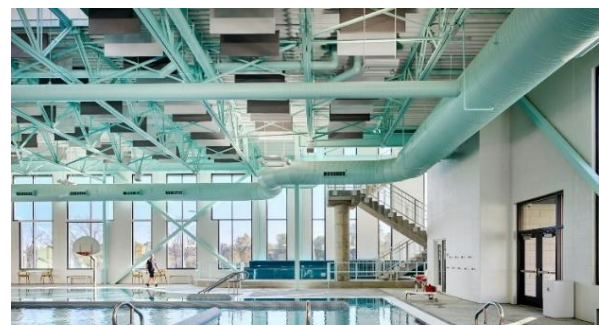


Figure 2. Interior of the pool area



Figure 3. Exterior of Shopping center

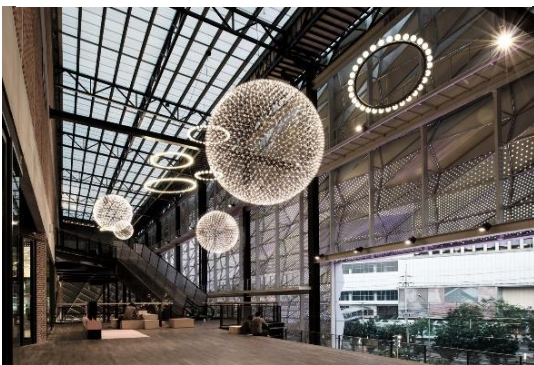


Figure 4. Interior of Shopping center

Shopping center The Street Ratchada /

Architectkidd. This property is located in Bangkok, Thailand. Construction was completed in 2016, and the area of the entire complex is 42,000 m². Consisting of cafes, restaurants, and other retail and commercial functions, The Street Ratchada, comprising cafes, restaurants, and other retail and commercial functions, creates new outdoor and semi-indoor urban spaces for interaction with the surrounding people and community. The interior design offers a variety of spaces to cater to young people, while the design approach strips away most surface finishes and decorations, revealing the steel, concrete, and brick structural elements.

The building facade is intended to connect the open plaza with the interior retail spaces. At first glance, the uninterrupted metallic surface appears to exude a sense of monumentality, but it is a porous layer made up of triangulated panels that are uniquely sized and cut, giving it a dynamic and intricate appearance. The gradient transparencies of the perforated panels unveil the underlying framework and the atrium behind which serves as an intermediate public space, which can be seen in Figure 4. At night, the lighting transforms the facade, making it appear less solid and creating a welcoming glow that emanates from the atrium and extends to the outdoor and public areas.

Rehabilitation Centre Groot Klimmendaal / Koen van Velsen The project is located in the forest outside Arnhem, the Netherlands. Construction was completed in 2011 and the area of the entire complex is 14,000 m². The rehabilitation center “Groot Klimmendaal” is a coming together of both complexity and simplicity with attention to



Figure 5. Exterior of rehabilitation center

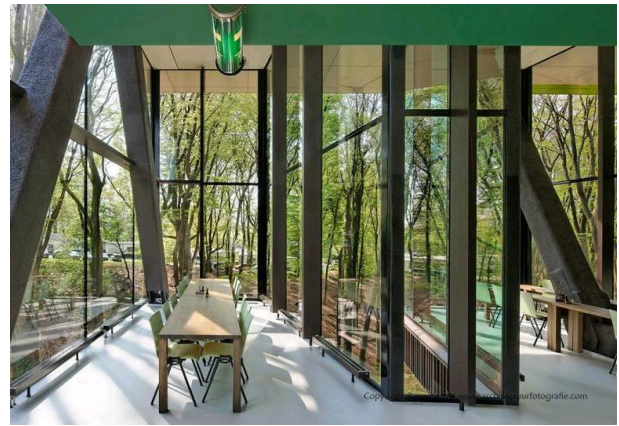


Figure 6. Interior of rehabilitation center

physical, practical, and social details. Transparency, continuity, layering, diversity, the play of light and shadow, and the experience of nature are all ingredients of this stimulating environment.

The arrangement of the program is clear. Below are offices, above is the clinical area, and on the roof is a Ronald McDonald House with its distinct identity. The double-height ground floor at the entrance level accommodates special program elements such as a sports facility, fitness center, swimming pool, restaurant, and theater. These facilities are not only used by patients but also by their family members and members of the local community, including schools and theater groups, on a regular basis. This arrangement places both the patient and the building at the heart of the community.

The idea of the developed competition project is to create a multifunctional complex, the shape of which will preserve the existing natural environment of the area in which the design is being carried out. It is expected to use rolled metal as the main structural element, as well as modern materials for facades and roofs from local manufacturers.

The construction of metal structures is one of the important branches of the construction industry in Ukraine. This construction method allows you to create reliable and functional structures for various industries, from industrial complexes to residential buildings.



Figure 7. General view of the building

The construction of metal structures has numerous advantages. First, it is the speed of construction, as metal structures can be manufactured in advance and quickly assembled on-site. They also have high reliability and resistance to various weather conditions. Metal structures are light, which facilitates transportation and installation. In addition, they open up many design possibilities and allow the creation of modern and aesthetically attractive buildings. Metal constructions allow you to create large and open spaces for holding various events and activities, so they are used to construct sports arenas, stadiums, concert halls, and other entertainment facilities.

Guided by the idea of preserving local trees, we placed the main buildings of the complex at a distance from each other but provided a connection through a gallery between them. Such a decision made it possible to provide the buildings with high-quality insulation, and also from their windows there are wonderful views of the surrounding area. The main view of the building can be seen in Figure 7.

The complex consists of three buildings: 1) "residential and treatment" – a building with single and double wards for patients, which also includes doctors' offices; 2) Dining room; 3) physical and water training. The buildings are connected by a ring hallway with an arcade. At any time from the transition, going out into the inner yard is possible. An additional hallway arcade feature was also built in, offering different

tactile surfaces so that people learning to walk with prostheses could practice walking at any time.

The spatial rigidity of steel frames is provided by frame structures, as well as discs with overlapping and coating. In the frames, the connection of the crossbar with the column is rigid, and vertical ties are installed from the plane of the frame.

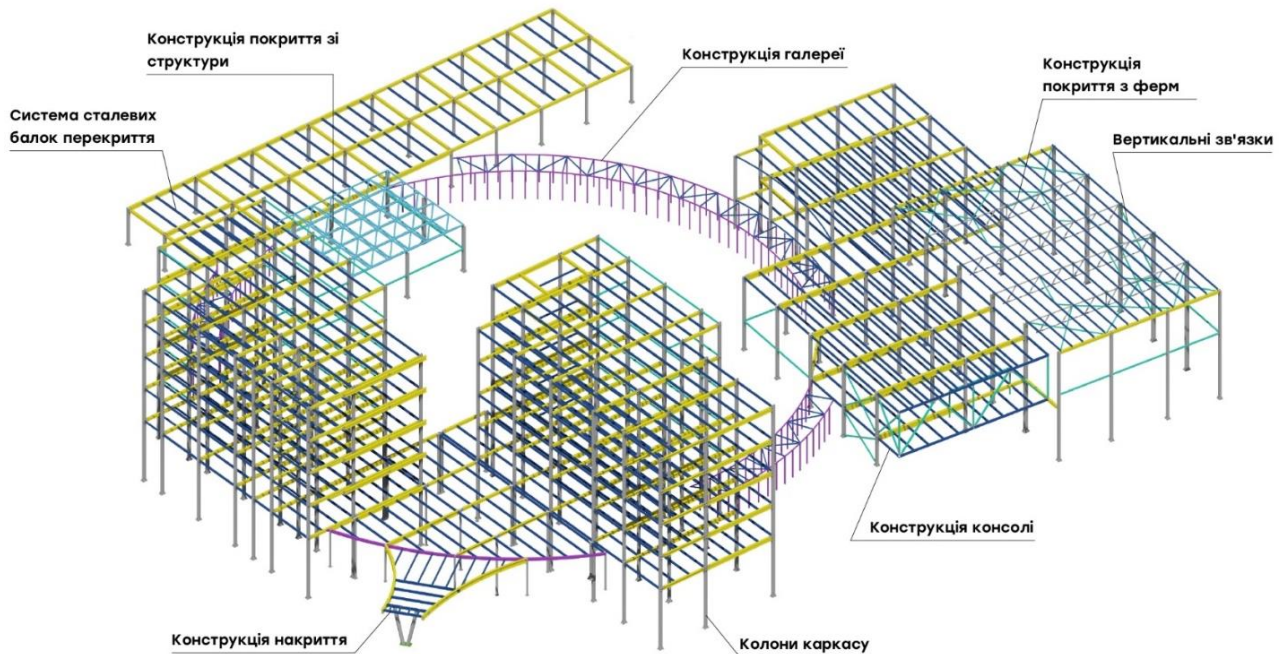


Figure 8. Diagram of the building frame

The connection of the columns with the foundations is rigid. The floors are monolithic on the profiled flooring, which is fixed to the steel beams of the floor. The cantilever section is solved using connections and trusses.

The long-span covering over the pool is solved by a system of flat trusses, purlins, struts, and ties. The covering over the dining room was decided using a steel spatial structural design, which allowed to reduce of the height of the covering structure and added architectural expressiveness. You can consider the application of various constructive solutions in more detail in Figure 8.

Several products from the Ruukki Construction, Ruukki Primo Skyline 150 (RR20) and Ruukki Primo Plana 10 with perforation (Light gray 7035) were used for the design of facades. Their double curved edges ensure greater strength of the facade. The advantages of SP2D W230 sandwich panels for the walls and SPC W190/150 sandwich panels for the roof were also used.

SP2D W ENERGY is a sandwich panel of increased energy efficiency with mineral wool filling and a lock with hidden fastening. Sandwich panels with increased energy efficiency help to reduce the energy consumption of the building by up to -20% compared to traditional sandwich panels. Energy-saving sandwich panels of the ENERGY series minimize energy losses of the building through the joints and the surface of the product due to the presence of a tubular seal in the locks and special sealing of the panel joints.

We used the Design Venice S10 (RR40) design profile for the facades of the production premises of the food building

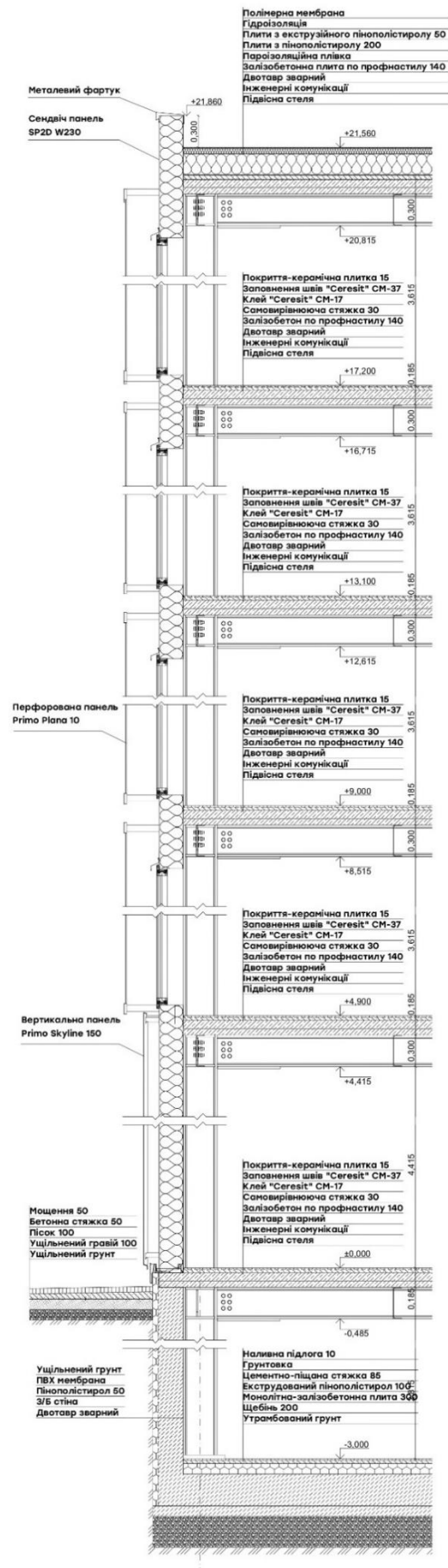


Figure 9. Detailed section along the wall



Figure 10. Interior of the pool area

A separate block of the building is allocated for the treatment pool, due to the different temperature and humidity levels of this room. Hydromassage baths are also located in this space, with the expectation of constant supervision of the patient by a medical worker during their use.

The main pool is a rectangular recess with cutouts for stairs and a ramp. To comply with the terms of the design task, a ramp for the disabled is located next to the main stairs of the pool (descent into the water is carried out using an automated platform and a wheelchair of various types and parameters), and mechanical manipulators with a seat for direct descent of the patient into the water. By configuration, the pool consists of three swimming lanes and a pre-considered turning area at the ramp, which is calculated concerning the standard dimensions.

To cover the span of 20 m above the pool room, a roof structure was designed on flat single-span trusses supported by columns. The node supporting the truss on the column is shown in Figure 11. Purlins, vertical ties, and struts were added to ensure system rigidity. Due to the technical requirements, this flat truss consists of two parts of 10 m each, so a truss connection node was designed, which is shown in Figure 12.

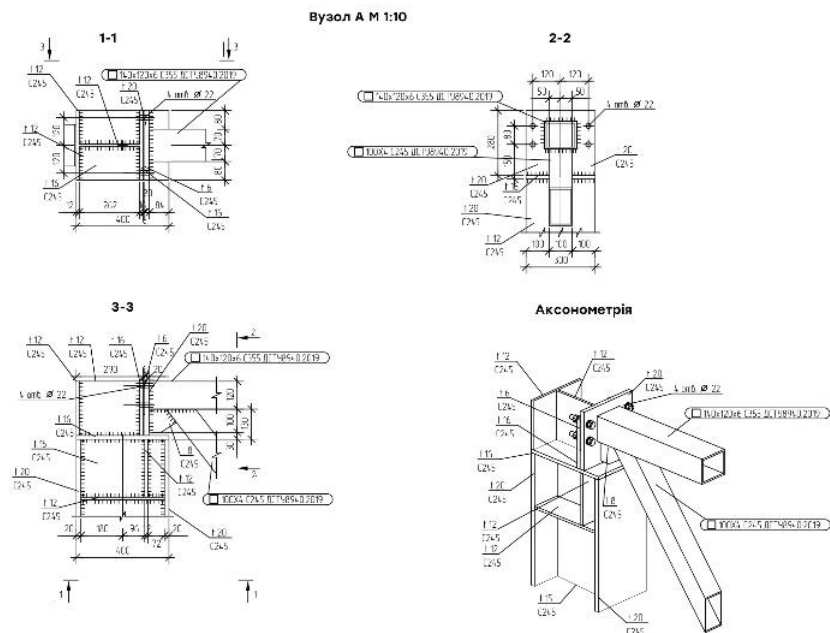


Figure 11. The support node of the truss on the column

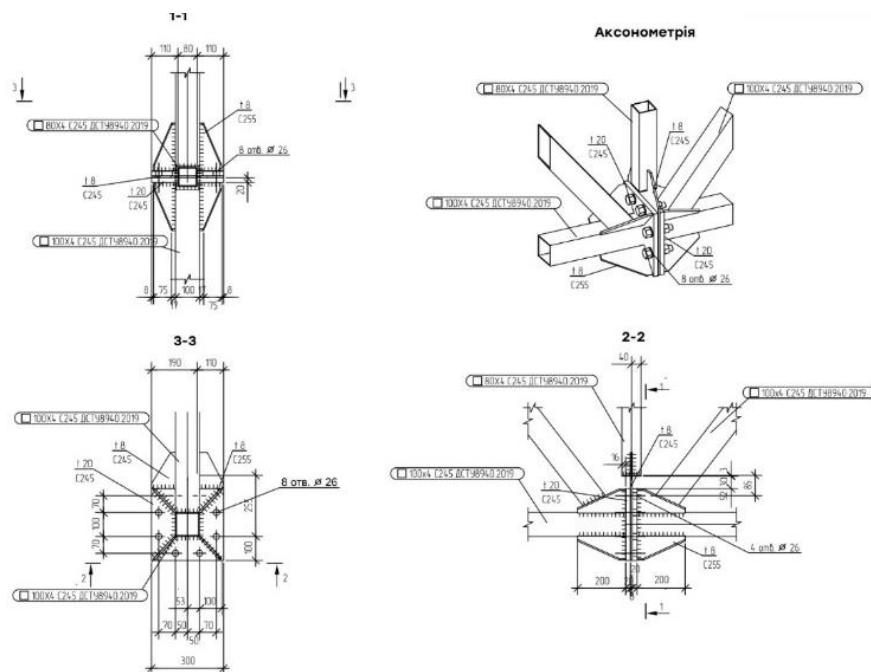


Figure 12. Truss connection node

Conclusion: the use of a frame system made of metal structures and sandwich panels for facades and roofs is a trend in modern architecture for the construction of multifunctional buildings, which opens up many possibilities in the creation of innovative and functional spaces. These technologies allow efficient use of space,

ensuring the stability and safety of the structure, and also pave the way for creative architectural solutions.

Steel structures allow for the creation of buildings with long spans, making them ideal for many types of structures, from large commercial centers to sports arenas and cultural facilities. Sandwich panels for facades and roofs add to these elements of speed and efficiency in construction, reducing construction time and costs. In addition, the use of these technologies helps to reduce the impact on the environment, as they allow efficient use of materials and energy, and reduce the amount of waste during construction.

The creation of such a structure takes place in a very short time, which leads to the increasing relevance and popularity of this method of building construction, therefore the use of such technologies is not only technically justified, but it also has great potential for the creative development of architecture and the improvement of the quality of construction projects in Ukraine and the world.