

O.M. Beketov National University of Urban Economy in Kharkiv

(full name of university)

School of Architecture, Urban Planning and Design

(full name of institute or faculty)

Department of Architecture of Buildings and Constructions

(full name of the department)

Explanatory note

for the diploma project (work)

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(educational scientific level)

on the topic of:

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O.M. BEKETOV NATIONAL UNIVERSITY OF URBAN ECONOMY IN KHARKIV

Educational and scientific institute School of Architecture, Urban Planning and Design

Department Architecture of Buildings and Constructions

Educational and scientific level Bachelor

Educational program Architecture and urban planning

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Specialty 191 Architecture and town planning

(code and name)

APPROVED

Head of ABaC department

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March 17, 2026

T A S K

FOR THE STUDENT'S DIPLOMA PROJECT (WORK)

Kara Demir

(full name of the student)

1. Theme of the project (work) SPORT CENTER IN KHARKIV

supervisor(s) of the project (work): Veligotska Y.S., cand. arch., assoc. prof.

approved by order of higher educational institution № 255-03, issued on March 17, 2026

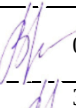
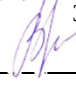
2. The deadline for student's submission of the project (work) June 18, 2026

3. Initial data for the project (work): diploma design task, results of the pre-diploma practice, topographic maps of territory, analytical studies (analysis of analogues of the design object), grapho-analytical materials

4. Contents of the explanatory note (list of questions to be developed): CHAPTER 1. «ANALYSIS OF ANALOGUES OF THE SPORT CENTER», CHAPTER 2. «ARCHITECTURAL PLANNING AND SPATIAL SOLUTION OF THE SPORT CENTER», CHAPTER 3. «TECHNICAL AND ECONOMIC INDICATORS OF THE SPORT CENTER», CHAPTER 4. «LABOR SAFETY»

5. A list of graphic materials (with exact indications of mandatory drawings): Schemes of urban planning analysis of the design site, reference plan (S 1:500), master plan (S 1:500), floor plans of the architectural object (S 1:200), elevations S (1:200), section (S 1:200), 3D spatial model of the architectural object, 3D projections of the building.

6. Consultants of sections of the project (work)

Section	Last name, initials and position of the consultant	Signature, date	
		task assigned	task accepted
1	Veligotska Y.S., cand. arch., assoc. prof. of ABaC department	 17.03.2026	 04.04.2026
2	Veligotska Y.S., cand. arch., assoc. prof. of ABaC department	 15.04.2026	 30.05.2026
3	Malysheva V.V., Assoc.Prof. of OHaLS department	 01.05.2026	 08.06.2026
4	Seriogina D.O, PhD, Assoc.Prof. of EaM department	 01.05.2026	 08.06.2026

7. Date of issuance of the task **March 17, 2026**

CALENDAR PLAN

№	Name of stages of the diploma project (work)	Term of completion of stages of the project (work)	Note
1	Determining theme of the diploma project, justifying the choice of the chosen object. Introduction	March 2026	Done
2	Analysis of analogues of the selected design object. Information collection and analysis	March 2026	Done
3	Urban planning analysis of the design site (analytical schemes, reference plan, master plan)	April 2026	Done
4	Architectural and planning solution of the selected design object (graphic design of plans, facades, section)	April 2026	Done
5	Spatial solution of the selected design object (graphic design of perspective projections, 3-D models, perspective angles)	April 2026 May 2026	Done Done
6	Development of an explanatory note (section 1)	May 2026	Done
7	Development of an explanatory note (section 2)	May 2026	Done
8	Completing the tasks of adjacent sections of diploma projects (sections 3-4)	May 2026 June 2026	Done Done
9	Completion of the explanatory note (all sections of the work) - check for plagiarism	June 2026	Done
9	General exposition of graphic material	June 2026	Done
10	Defense of the qualification work	June 2026	Done

Student  (sign here) Kara Demir (last name and initials)

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INTRODUCTION

The architecture of sports facilities is an important component of the development of the modern urban environment, as it provides conditions for the physical development of the population, the organization of sporting events, health improvement, and active recreation. Sports centers serve not only as venues for training sessions and competitions but also as significant public spaces that promote social interaction, encourage healthy lifestyles, and improve the overall quality of life.

In the context of contemporary urban development, the creation of multifunctional sports complexes capable of combining various types of sports activities, recreational functions, and spaces for cultural and public events is of particular importance. Such facilities must meet modern requirements for safety, accessibility, energy efficiency, and comfort for different categories of users. Another important aspect of design is the integration of sports facilities into the urban structure, ensuring transport accessibility and creating a favorable architectural environment.

The city of Kharkiv is one of the largest scientific, educational, and cultural centers of Ukraine. Before the full-scale invasion, the city possessed a well-developed sports infrastructure represented by stadiums, sports schools, fitness and recreation complexes, and specialized training centers for athletes. Kharkiv has traditionally been a hub for the development of numerous sports disciplines, a venue for national and international sporting events, and a center for the training of professional athletes. However, as a result of military aggression, a significant part of the city's infrastructure has been damaged or destroyed, which has substantially affected the functioning of the sports sector.

At present, Kharkiv continues to face a constant threat of missile and drone attacks, creating additional challenges for the development of public and sports facilities. According to official data, between 2022 and 2025 dozens of sports facilities in the Kharkiv region were damaged or destroyed, including sports complexes, youth sports schools, training bases, and other elements of sports

infrastructure. At the same time, the city remains an important center of social life in the region and requires modern architectural solutions aimed at the restoration and development of the sports environment.

A contemporary sports center in Kharkiv must take into account not only traditional functional requirements but also new operational conditions associated with martial law. Particular importance is attached to the creation of safe spaces with the possibility of rapid evacuation, the provision of protective shelters, the use of energy-efficient structural solutions, and autonomous engineering systems. In this regard, next-generation sports facilities should combine a high level of functionality, architectural expressiveness, and resilience to crisis conditions.

The design of a sports center involves a comprehensive solution to urban planning, functional, spatial, structural, and aesthetic tasks. The architectural image of the facility should correspond to modern trends in the development of public buildings, contribute to the creation of a comfortable environment for sports and recreation, and enhance the positive image of the city. It is also important to ensure accessibility for people with limited mobility, provide a rational organization of interior spaces, and achieve the efficient use of the site.

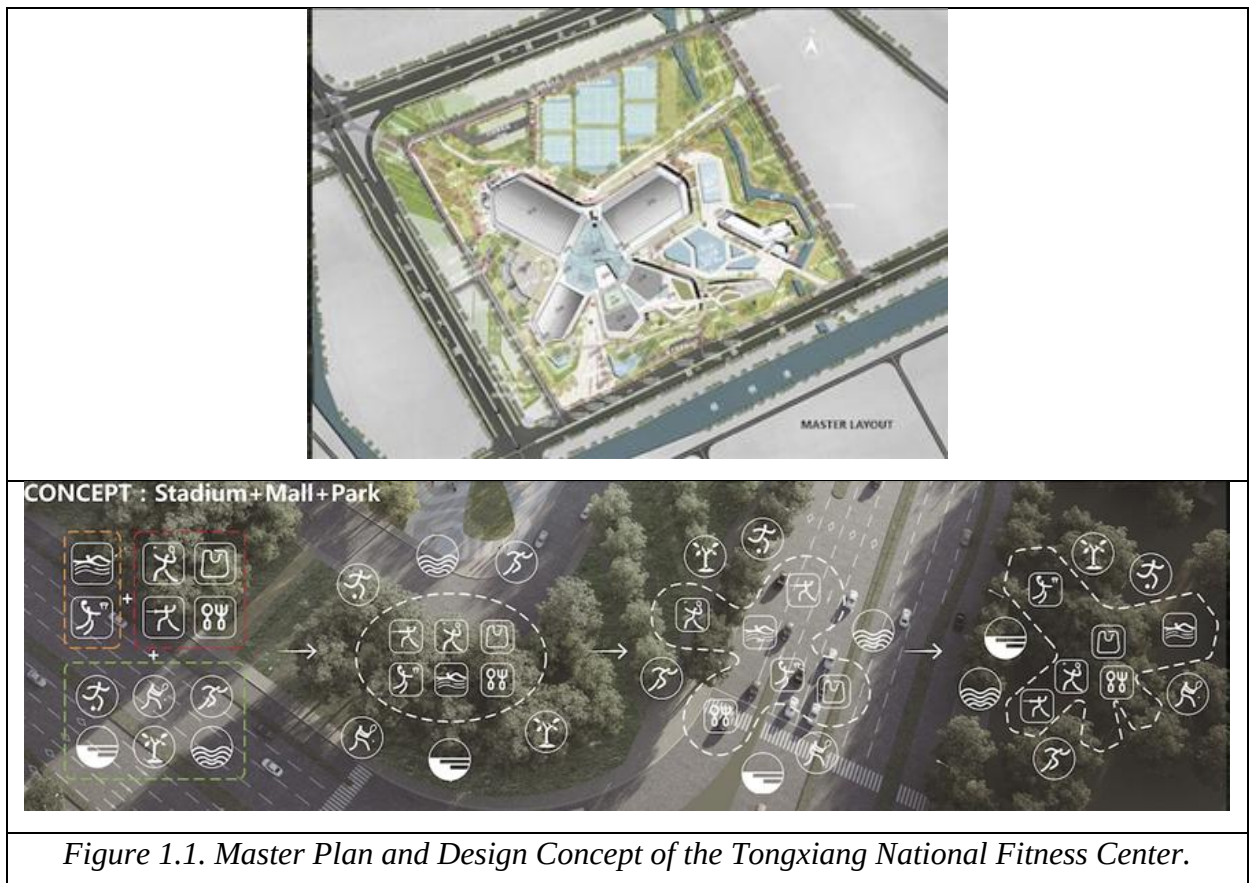
Thus, the sports center project in the city of Kharkiv is considered a component of the process of restoring urban infrastructure and creating a modern public space oriented toward the needs of the population. The proposed architectural and planning solutions are intended to promote the development of sports activities, increase the level of physical activity among residents, and create a high-quality environment for sports and leisure activities within the context of the contemporary city.

1. ANALYSIS OF ANALOGUES OF THE SCHOOL

1.1. Tongxiang National Fitness Center and Li Ning Sports Park (Tongxiang, Zhejiang Province, China)

Tongxiang National Fitness Center and Li Ning Sports Park is a modern multifunctional sports and recreational complex located in Tongxiang City, Zhejiang Province, China, on Wuzhen Avenue. The complex has become a new public and sports hub of the city, integrating sports infrastructure, recreational areas, and a landscaped park into a unified spatial system [1].

The project was designed by PT Architecture Design under the leadership of chief architect Xudong Shi. Construction of the complex was completed in 2021. The total area of the facility is approximately 96,400 m² (Fig. 1.1).



The composition of the building is organized around a large central atrium, which serves as the main architectural and functional core of the complex. The

atrium functions as an internal public plaza around which sports halls, swimming pools, fitness areas, and auxiliary facilities are arranged. This creates an open spatial structure with continuous visual connections between different functional zones. Visitors can observe sporting activities from public areas, making the interior space more dynamic and attractive.

The volumetric and spatial design of the building is characterized by smooth lines and soft geometric forms. The architects sought to avoid the monumentality typical of many sports facilities; therefore, the complex is organically integrated into the surrounding park landscape. The building features a relatively low horizontal profile that emphasizes its connection with the landscape and prevents it from dominating the surrounding environment (Fig. 1.2).



Figure 1.2. General View of the Tongxiang National Fitness Center.

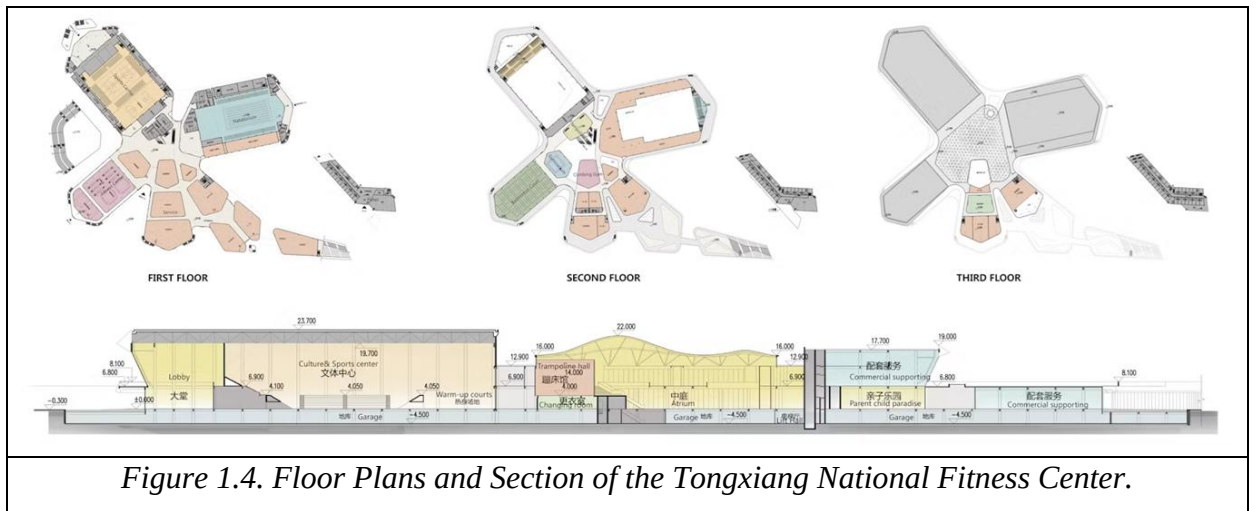
The façades play a particularly important role in shaping the architectural identity of the complex. They combine extensive glazed surfaces with metal panels and curvilinear openings of various sizes. This design solution ensures maximum penetration of natural daylight into the interior spaces and creates a sense of transparency throughout the building. Owing to the large areas of glazing, the boundary between the interior and the exterior becomes almost imperceptible, while the sporting activities within the complex are visually integrated into the urban environment (Fig. 1.3).



An important architectural feature of the complex is its integration with the surrounding landscape park. The roof is partially utilized as a public space and forms part of a network of running and walking routes. Elevated pathways transition seamlessly from the park area onto the roof of the building, creating a continuous system for movement and recreation. This approach blurs the boundaries between architecture and the natural environment, resulting in a multi-level public space.

The functional structure of the facility is designed to accommodate both professional sports and mass physical recreation. The complex includes a multifunctional sports arena, a swimming pool, a fitness center, a climbing wall, a trampoline center, rehabilitation spaces, children's sports sections, e-sports zones, and outdoor sports facilities. The central sports hall, covering approximately 5,000 m², is equipped with retractable seating, allowing the space to be adapted for sporting events, concerts, exhibitions, and public gatherings. In concert mode, the hall can accommodate up to 3,000 spectators (Fig. 1.4).

The interior design of the complex is based on the principles of openness and flexibility. Large multi-story spaces, transparent partitions, and open galleries provide visual continuity throughout all functional areas. The central amphitheater staircase serves not only as a circulation element but also as a venue for relaxation, social interaction, and various public events.



Overall, the architecture of the Tongxiang National Fitness Center and Li Ning Sports Park represents a contemporary approach to the design of sports facilities, where openness, integration with the urban environment, multifunctionality, and a strong connection with the natural landscape serve as the key principles. The building functions not only as a sports facility but also as an important public space that contributes to the active social life of the city.

The structural concept of the building is based on a combination of reinforced concrete and steel framing systems, enabling the creation of large column-free spaces required for sports halls and public areas. The primary construction materials include steel, reinforced concrete, and glass. The central atrium performs not only a circulation function but also a social one, serving as an internal public plaza, a meeting place, and a venue for various events. Within the atrium, wide amphitheater-style staircases provide spaces for relaxation, communication, and informal gatherings.

The façades of the complex are composed of extensive glazed surfaces, curvilinear openings, and perforated metal panels. Due to the transparency of the building envelope, sporting activities are visually connected with the surrounding urban environment, enhancing the openness and accessibility of the complex for city residents.

A particularly significant role in the project is played by Li Ning Sports Park, which is integrated with the building into a unified landscape system. The park

includes outdoor sports facilities, water features, recreational areas, and a network of running trails. The total length of the running routes is approximately 3.5 km, of which 2.3 km are located at ground level and an additional 1.2 km are situated on elevated walkways and the roof of the building. This creates a continuous connection between architecture and the natural environment.

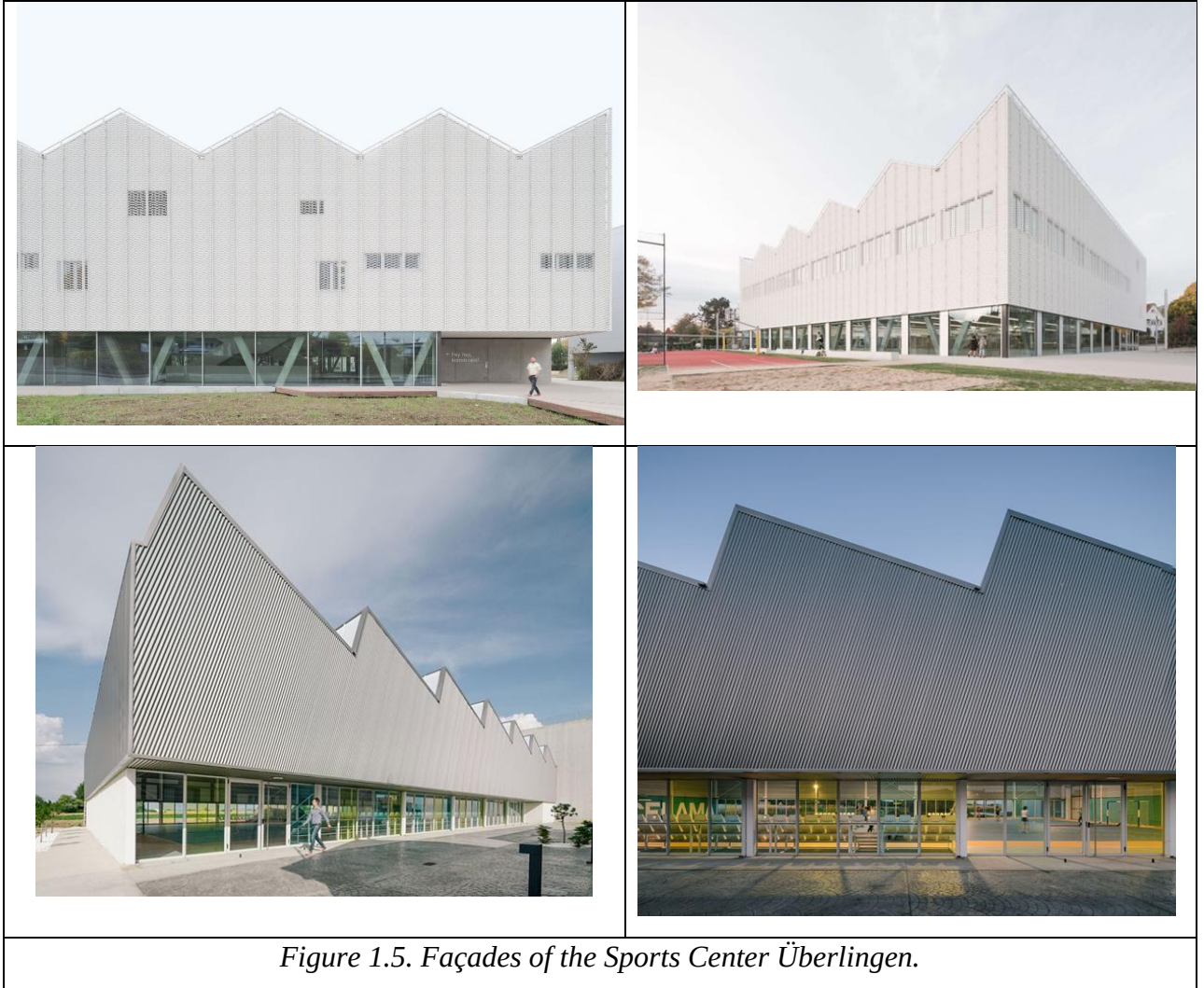
The Tongxiang National Fitness Center and Li Ning Sports Park is a vivid example of contemporary sports architecture in which a sports facility is transformed into a multifunctional public center. The complex demonstrates modern approaches to the integration of architecture, engineering, landscape design, and urban planning, creating a new type of open sports and cultural space for the community.

1.2. Sports Center Überlingen (Germany)

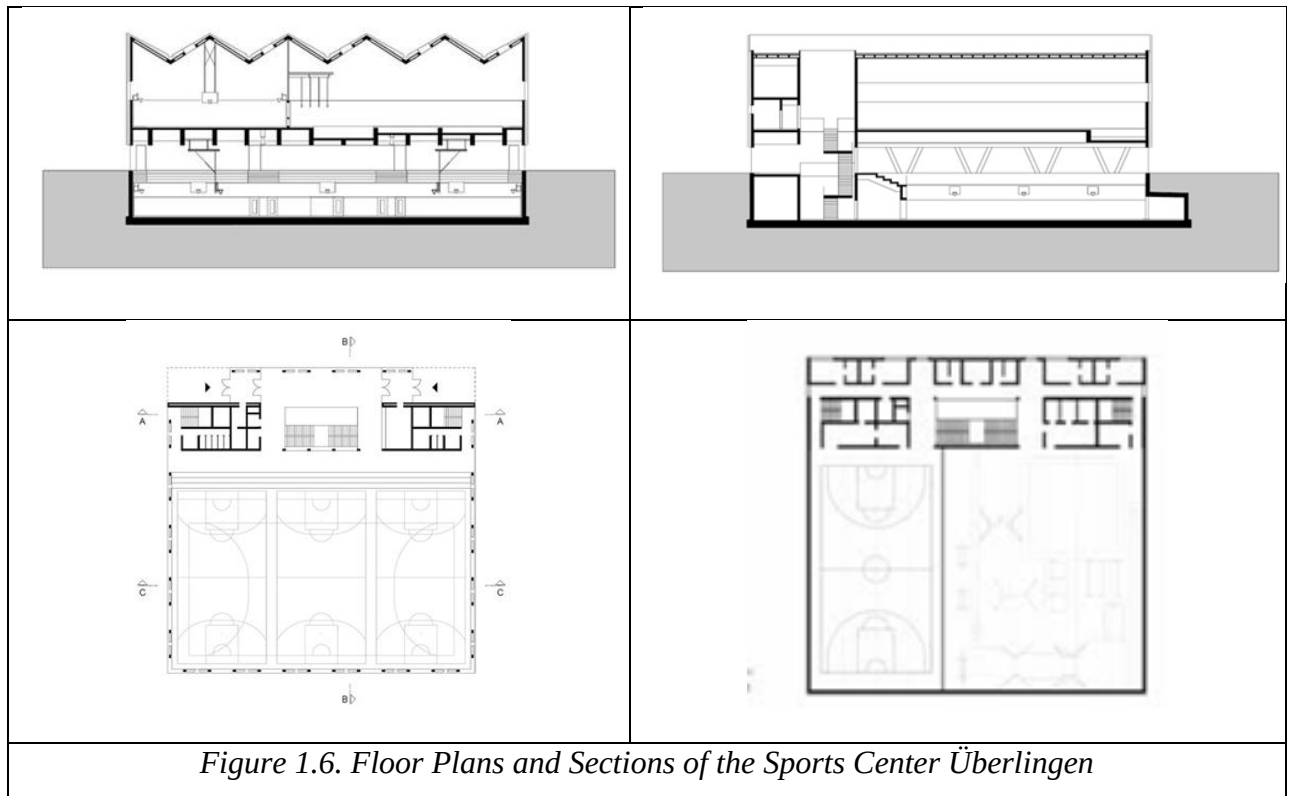
The Sports Center in the city of Überlingen, located in the federal state of Baden-Württemberg, Germany, is a contemporary example of a multifunctional sports facility integrated into the structure of a school campus. Situated near Lake Constance, the building forms part of the city's educational and sports infrastructure, developed within the framework of creating public spaces for students and local residents [2].

The project was designed by the German architectural firm Wulf Architekten (Stuttgart). Design work commenced in 2017, and construction was completed in 2020, when the facility was officially put into operation.

The architectural concept of the sports center is based on the creation of a compact and clearly defined volume that harmoniously integrates with the scale of the surrounding educational and residential development. The building is perceived as a unified architectural object with a distinctive silhouette formed by the folded geometry of its roof. A significant design feature is the contrast between the solidity of the main volume and the lightness of the façade treatment, which is executed using white expanded metal mesh panels. Transparent sections of the façade in the public areas provide visual openness and establish a strong connection between the interior and the urban environment (Fig. 1.5).



Functionally, the sports center is a multi-hall complex designed to serve both the school campus and sporting events of various levels. The building includes three sports halls for team sports, a gymnastics hall, multifunctional training spaces, spectator stands, a foyer and entrance area, as well as auxiliary facilities such as changing rooms, sanitary facilities, and administrative offices. The spatial organization is based on the principle of functional separation by levels: the lower level accommodates the main sports halls and spectator seating areas, while the upper level contains additional training and auxiliary sports facilities (Fig. 1.6).



The structural system of the building combines a reinforced concrete frame with long-span roof structures, allowing for large column-free sports spaces. The roof is designed as a folded timber structure, which not only provides the required load-bearing capacity but also creates a distinctive architectural character within the interior. The façade system consists of perforated metal panels that give the building a sense of lightness and semi-transparency. Large glazed areas in the public zones provide abundant natural daylight and establish a strong visual connection between the interior and exterior spaces.

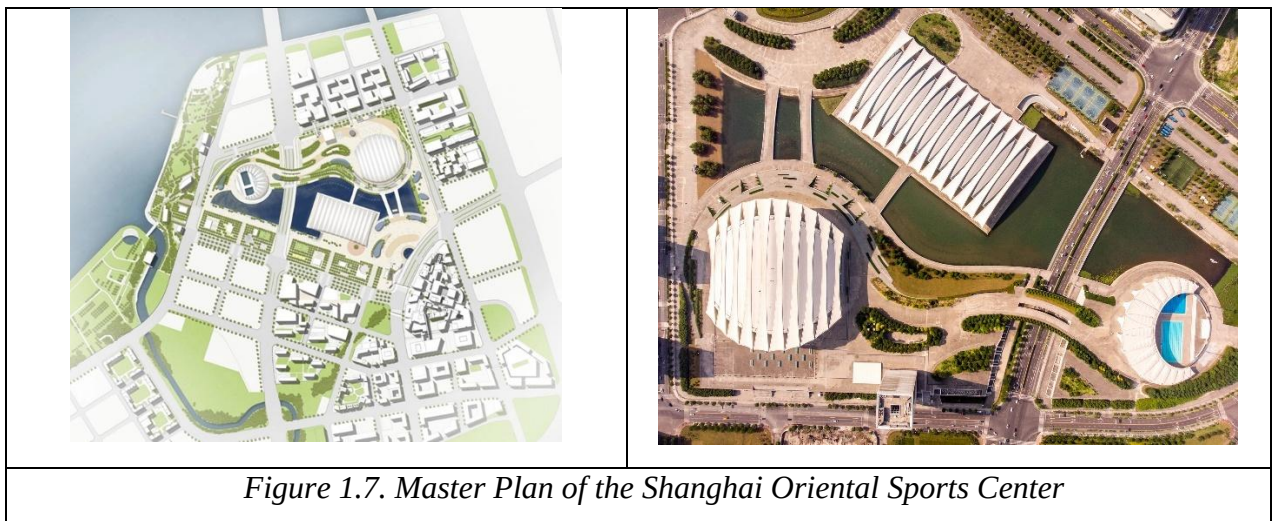
1.3. Oriental Sports Center (Shanghai, China)

Shanghai Oriental Sports Center is a modern multifunctional sports complex located in the Pudong District of Shanghai, China, on the banks of the Huangpu River. The complex was designed by gmp Architects in collaboration with Schlaich Bergermann Partner and completed in 2011 for the Special Olympics World Summer Games. The architectural concept is based on the idea of organically integrating the buildings with the surrounding water environment, which is reflected in the smooth biomorphic forms of the structures resembling pebbles or water

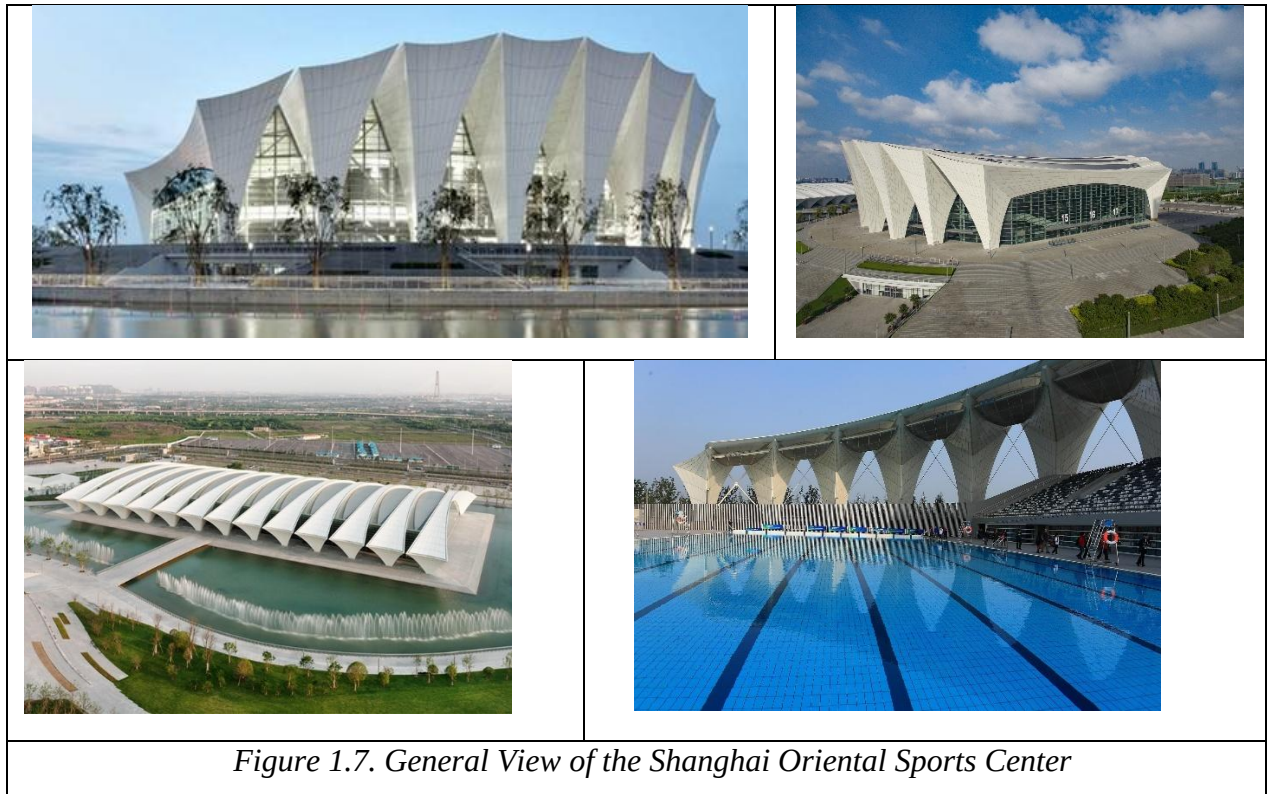
droplets [3].

The volumetric and spatial composition of the complex creates a distinctive and dynamic silhouette while ensuring harmonious integration into the surrounding natural and urban landscape. The complex consists of several interconnected functional facilities, including an indoor sports arena, an aquatic center, and an open-air stadium. Despite their different functions, all structures are united by a common architectural language characterized by flowing lines, streamlined forms, and shared compositional principles.

An important component of the project is its system of public spaces, which includes pedestrian promenades, open plazas, waterfronts, terraces, and water channels. This planning solution ensures a continuous relationship between the architectural structures and the surrounding water environment, creating a comfortable setting for recreation, sporting events, and everyday public use of the area (Fig. 1.7).



A distinctive feature of the architecture is the combination of massive structural elements with a visually lightweight building envelope. As a result, the buildings appear to “float” within the landscape, reinforcing the overall concept inspired by water. Extensive glazed surfaces enhance the visual connection between the interior and exterior environments while also improving the natural lighting conditions of the interior spaces (Fig. 1.8).



The functional and spatial organization of the interior is designed to ensure the rational and efficient separation of circulation flows for athletes, spectators, coaching staff, and technical personnel. This approach enhances safety, comfort, and operational efficiency during training sessions, competitions, and large-scale events. The interior environment includes spacious entrance halls and foyer areas for receiving and distributing visitors, multi-level spectator stands with excellent visibility, specialized training facilities, and a wide range of auxiliary and service spaces required for the full operation of the complex (Fig. 1.8).

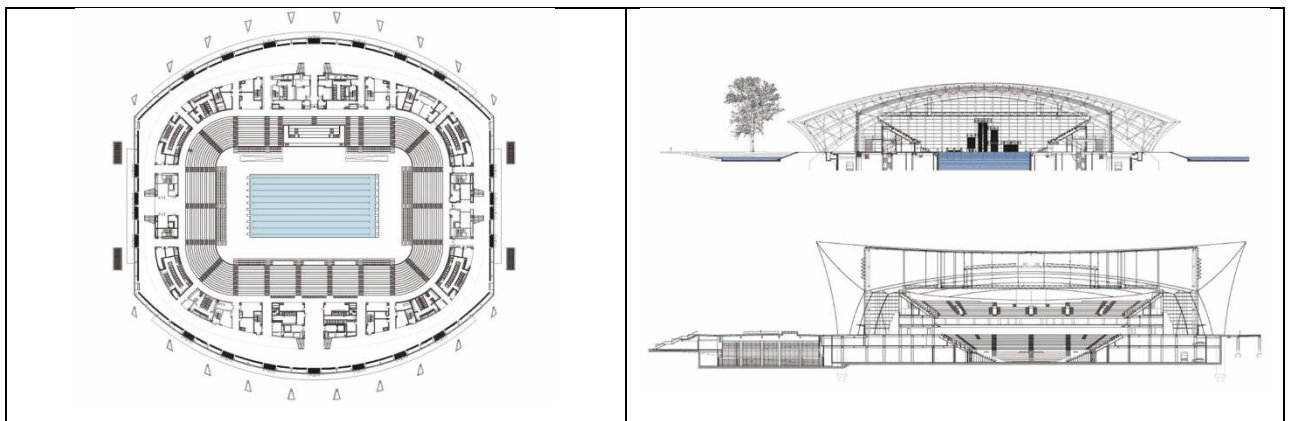


Figure 1.8. Floor Plan and Sections of the Shanghai Oriental Sports Center

Particular attention was paid to the engineering systems of the complex. The facility is equipped with advanced ventilation and air-conditioning systems that maintain a comfortable indoor climate. The swimming pools are provided with highly efficient water treatment and purification systems that meet modern sanitary and hygienic requirements. In addition, acoustic enhancement solutions have been implemented to ensure high-quality sound conditions during sporting and cultural events. Another important aspect is the integration of energy-efficient technologies aimed at reducing operational costs and improving the environmental performance of the building.

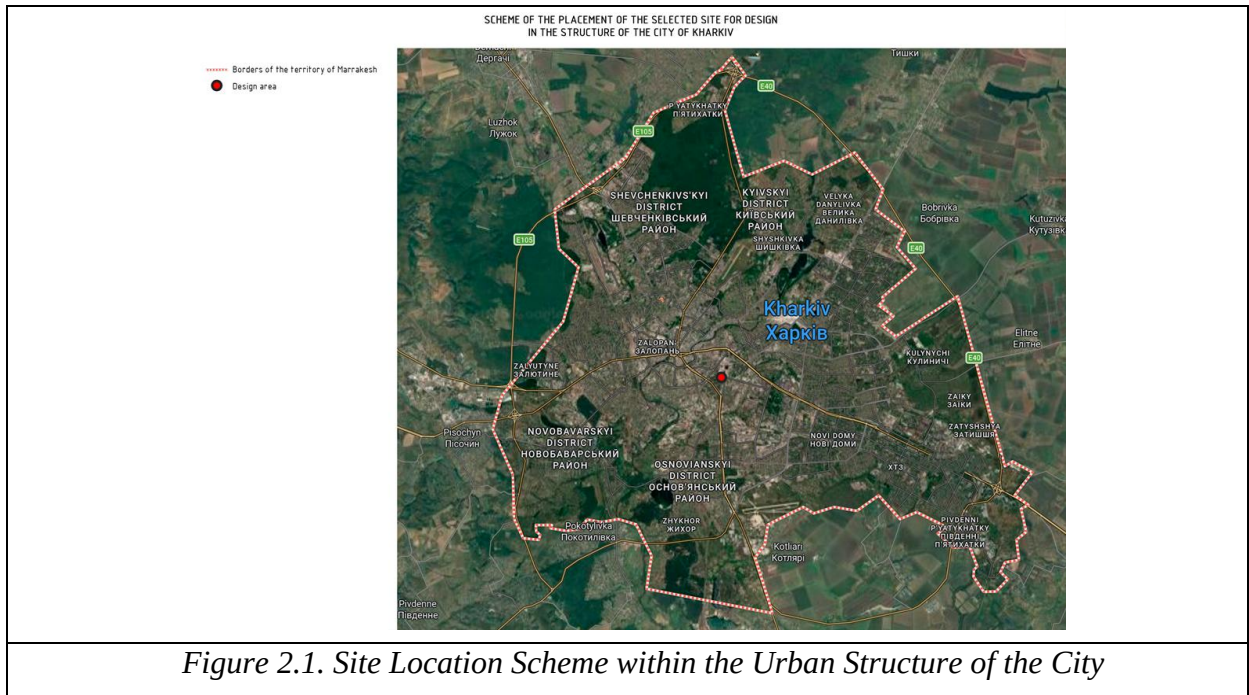
The structural concept of the complex is based on the application of modern engineering and construction technologies that allow large-span spaces to be covered without the use of internal supports. The sports arenas and main halls are equipped with long-span roof structures formed by steel space trusses and frame systems. These structural solutions create unobstructed interior spaces, improve visibility, and enable the facilities to be adapted for various formats of sporting and cultural events. The external appearance of the buildings is defined by curvilinear steel frameworks clad with lightweight façade panels and extensive glazed surfaces. The use of glass elements maximizes the penetration of natural daylight into the interior spaces and establishes a visual connection between the buildings and their surroundings.

Thus, the Shanghai Oriental Sports Center represents an outstanding example of the harmonious integration of contemporary biomorphic architecture and advanced structural solutions. The architectural concept of the complex not only emphasizes its unique artistic identity but also ensures a high level of functionality and operational efficiency. Through the integration of innovative technologies, expressive forms, and carefully planned spatial organization, the complex demonstrates the potential of modern sports architecture, where large-scale structures interact organically with the natural landscape and urban environment, creating a distinctive architectural landmark within the city.

2. ARCHITECTURAL PLANNING AND SPATIAL SOLUTION OF THE SPORT CENTER

2.1. Urban analysis of the territory of the designed object

The site selected for the design project is located within the city of Kharkiv, in the Slobidskyi administrative district, along Heorhiia Tarasenska Street (Fig. 2.1).



Heorhiia Tarasenska Street is one of the key transportation corridors of the Slobidskyi District of Kharkiv and plays an important role in the city's transportation network. In 2023, the street was renamed in honor of the Hero of Ukraine, Heorhii Oleksandrovykh Tarasenko, as a tribute to his contribution to the defense of the sovereignty and independence of the country.

The street has significant transportation importance, as it begins at Aero-Cosmic Avenue and extends in a south-easterly direction, connecting with Morozova Street. It forms part of the city street network and provides links between different functional zones of the district. The site is bounded by Petynskyi Lane on the western side and surrounded by existing development and open areas on the remaining sides.

According to the provisions of the Master Plan of the City of Kharkiv, the territory is classified as a public-use zone within the functional zoning structure.

This designation permits the placement of various public infrastructure facilities, including educational, cultural, service, and sports-related buildings.

Considering these urban planning conditions, the use of the site for the construction of a sports complex is justified and consistent with its functional designation. Furthermore, the implementation of such a facility will contribute to the development of the district's social infrastructure, improve the provision of sports facilities for residents, and promote the formation of a comfortable urban environment.

The location of the site within the central part of Kharkiv creates favorable conditions for establishing a comfortable and psychologically supportive environment for users. Well-developed infrastructure, convenient transportation and pedestrian connections, and the presence of active urban life encourage social interaction and reduce the likelihood of social isolation among residents.

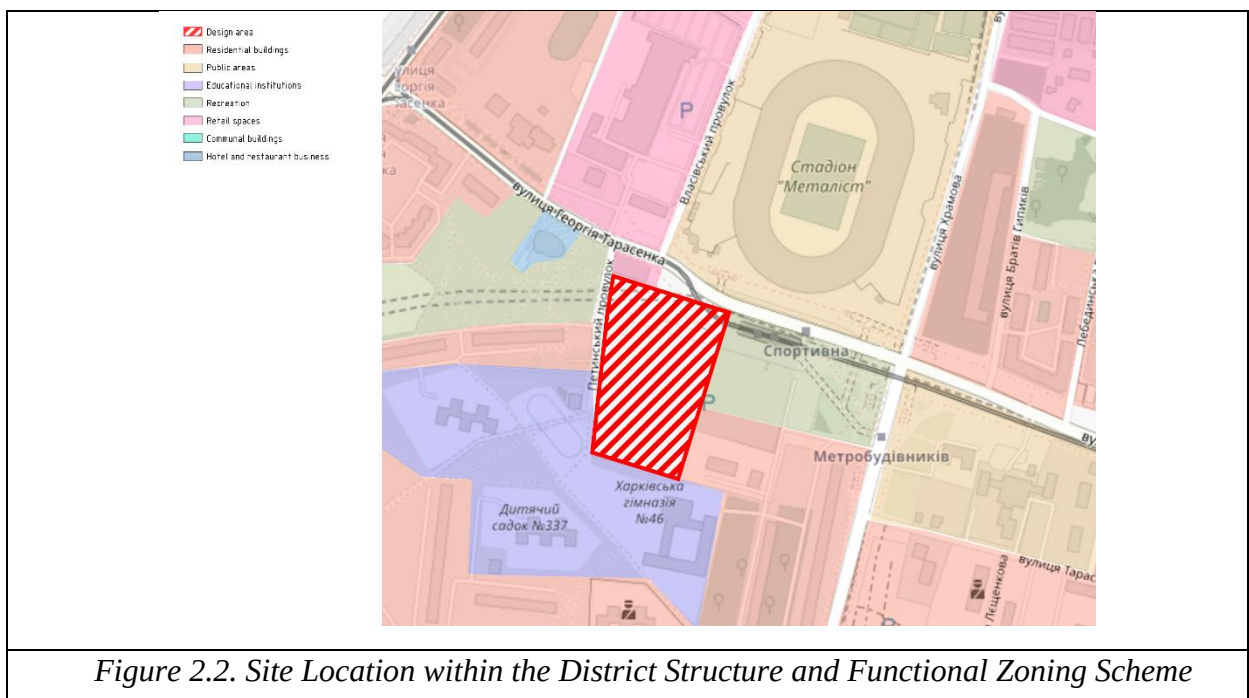
Despite its proximity to major urban transportation routes, the area is characterized by a relatively moderate noise level. This is explained by the surrounding development, which consists primarily of residential buildings combined with public facilities, including educational, cultural, administrative, and sports institutions, thereby creating a balanced functional environment.

The absence of excessive acoustic and visual stress has a positive effect on people's emotional well-being, enhances the sense of safety, and contributes to overall comfort. Such conditions are beneficial for various age groups, particularly children and young people, encouraging social activity and personal development.

In Ukraine, the functional zoning of territories is carried out in accordance with the provisions of the Law of Ukraine "On the Fundamentals of Urban Planning" [8] and the requirements of DBN B.1.1-22:2017 "Composition and Content of Territory Zoning Plans" [9]. According to these regulatory documents, urban planning involves the allocation of territories according to their functional purpose, including residential, public, industrial, recreational, and other types of development. It is also aimed at shaping the architectural and spatial structure of settlements, creating a harmonious landscape environment, and providing conditions

for recreation, public health improvement, environmental protection, and the preservation of cultural heritage sites.

The functional zoning surrounding the proposed site is characterized by a diversity of urban functions and a favorable position within the district structure. The project site is located within a public and sports-oriented area and borders several functional zones. To the north lies a public zone represented by the Metalist Stadium and related sports infrastructure. Along Heorhiia Tarasenko Street there is a commercial zone that serves residents and visitors to the district. To the north-west is a hotel and restaurant zone that includes accommodation and catering facilities. Recreational areas with green spaces adjoin the site from the west and east, creating a favorable environment for recreation and pedestrian activity. The southern and south-western surroundings are occupied by residential development, which also includes social infrastructure facilities such as Kharkiv Gymnasium No. 46 and Kindergarten No. 337. This functional context ensures high accessibility of the site, integration with the district's public spaces, and favorable conditions for active use by residents of different age and social groups (Fig. 2.2).

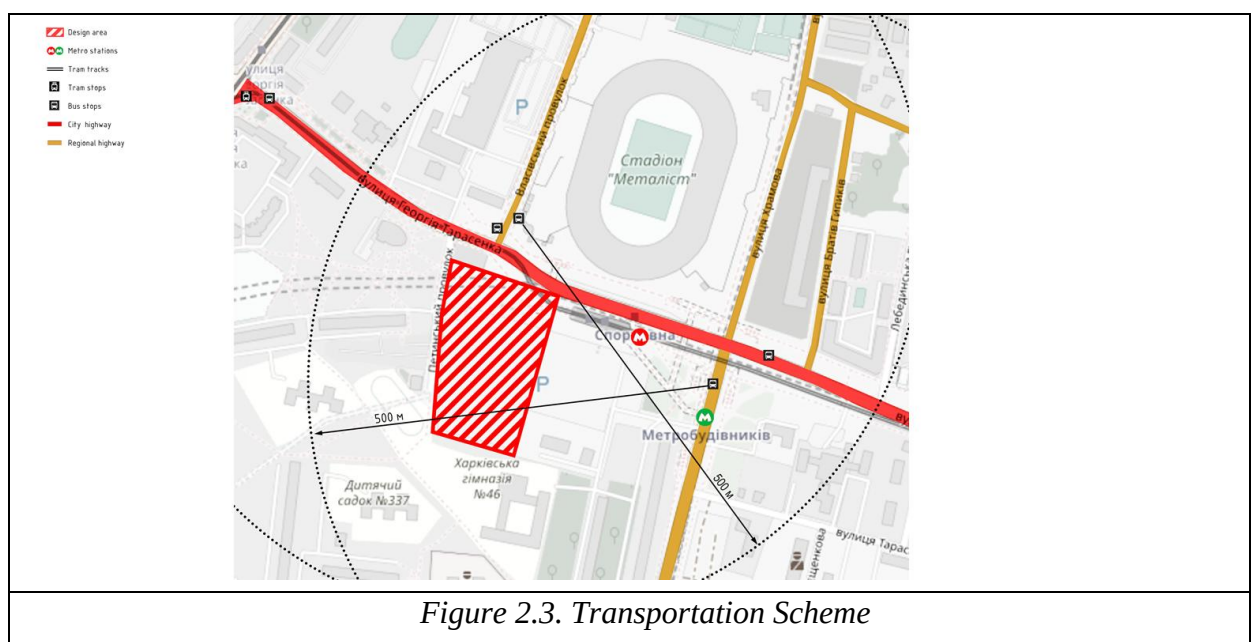


The site designated for the construction of the sports center benefits from a favorable transportation location. Within comfortable walking distance are the

Kharkiv Metro stations Sportyvna and Zavodska, located on the Kholodnohirsko-Zavodska Line, as well as Metrobudivnykiv Station on the Oleksiivska Line. The proximity of several stations serving different routes provides convenient access to the sports facility from various districts of the city, thereby enhancing its accessibility for visitors and staff.

An additional advantage is the presence of a well-developed public transportation network. Tram routes No. 5 and No. 8 operate along adjacent streets, providing regular connections with the central part of Kharkiv and other urban districts. Bus routes and shuttle services also play an important role, covering a significant part of the city and offering convenient transfers between different modes of transportation.

The integration of underground and surface public transportation ensures a high level of mobility for users of the sports center. Convenient access roads, proximity to major transportation hubs, and a wide range of travel options create favorable conditions for the daily use of the facility. Furthermore, these characteristics positively influence the development potential of the area, increase its functional value, and contribute to the efficient operation of the sports center as an important element of the public infrastructure of the Slobidskyi District of Kharkiv (Fig. 2.3).



2.2. Solution of the master plan of the new object and the landscaping of territory

The development of the master plan was carried out in accordance with the requirements of current building regulations, in particular DBN B.2.2-12:2019 “Planning and Development of Territories” and DBN A.1.1-15:2012 “Composition and Content of the Master Plan of a Settlement,” which regulate the principles of spatial organization of urban areas and approaches to the formation of their planning structure.

The site allocated for development has a complex polygonal shape, which determines the specific features of its planning and spatial utilization. At the same time, the central part of the territory is currently free from dense permanent development, creating favorable conditions for new construction and the functional development of the area.

The topography of the site is predominantly flat, with no significant differences in elevation, which has a positive impact on the organization of the construction process. Such natural conditions simplify engineering and construction works, facilitate efficient site planning, and reduce the need for additional grading measures or complex engineering interventions.

In addition, the site contains no historical or cultural heritage objects and no existing permanent buildings, eliminating the need for demolition or restoration works. This contributes to reducing the duration of the preparatory stage of the project, optimizing costs, and accelerating the development of the land plot (Fig. 2.4).

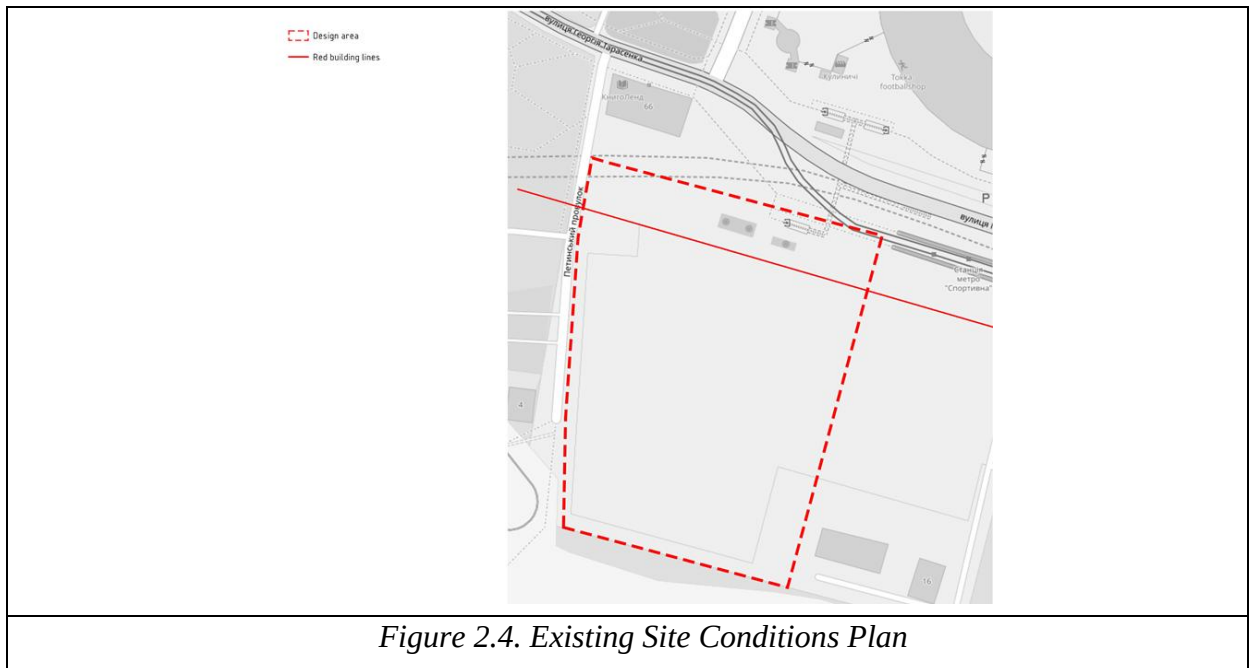


Figure 2.4. Existing Site Conditions Plan

The planning structure of the site is based on functional zoning, which ensures the efficient organization of the sports center's territory and the comfortable placement of all its components.

The central position within the site is occupied by the main building of the sports complex. It is integrated into a system of convenient pedestrian approaches and vehicular access routes arranged around the perimeter of the facility, ensuring accessibility from various directions. The building incorporates separate entrance groups, including a main entrance for visitors, a dedicated entrance for athletes, and a service entrance for staff. This arrangement allows for the effective separation of functional circulation flows and prevents their intersection.

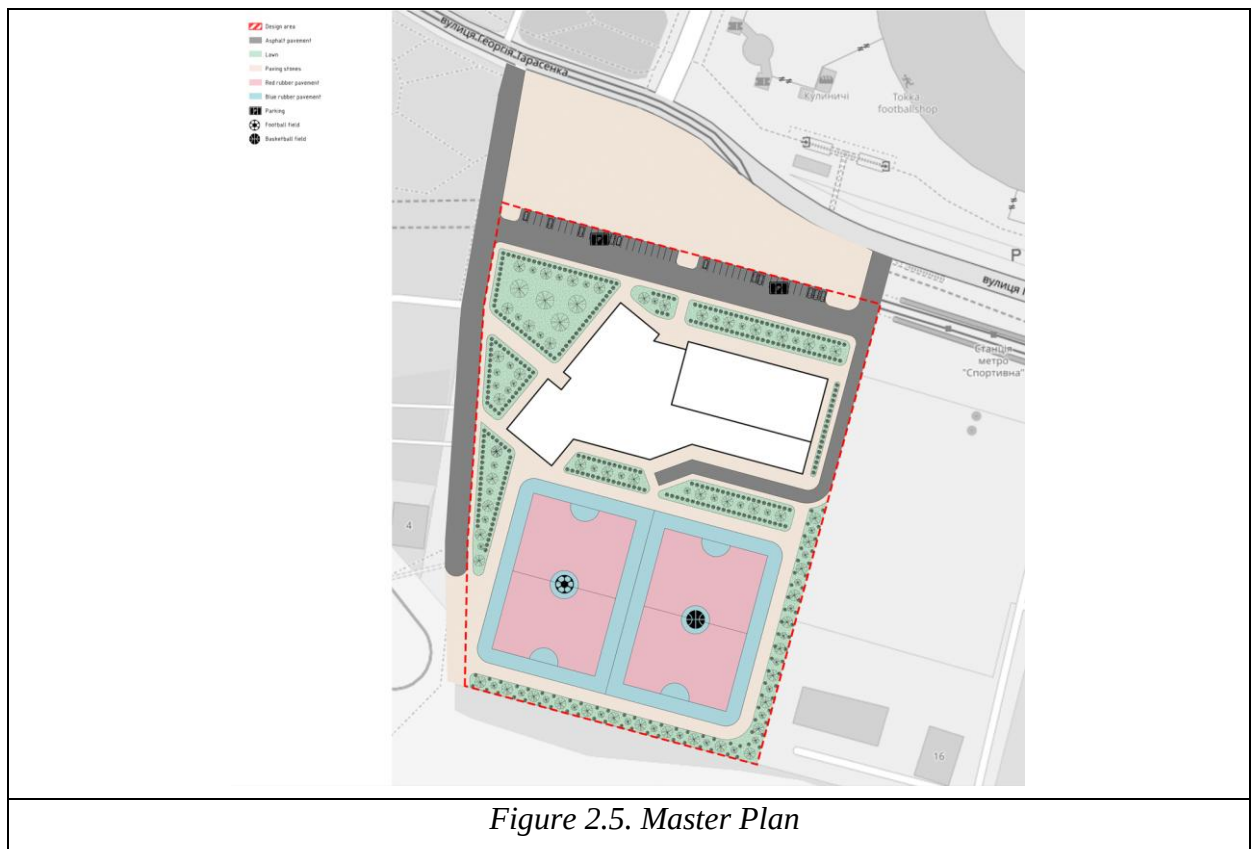
Along Heorhiia Tarasenko Street, adjacent to the main access road, a linear parking area is provided. It is intended for short-term parking by visitors to the sports center and has convenient connections to the main entrances. Such a location reduces traffic load within the internal territory of the complex and enhances pedestrian safety.

To the right of the main building, a series of rectangular outdoor sports courts is proposed. Green buffer zones are arranged along their boundaries, performing both decorative and protective functions while creating more comfortable conditions for sports activities and user recreation.

A separate functional component of the site is the recreational zone, which includes landscaped green areas, a network of pedestrian pathways, seating areas, and designed landscape spaces. This zone is intended for relaxation and leisure, providing a balance between active sports activities and passive recreation.

An important element of the master plan is the internal pedestrian network, which connects all functional zones into a unified spatial system. It provides convenient routes between the main building, sports grounds, recreational areas, and site entrances. Landscaping is evenly integrated throughout the site, contributing to the creation of a comfortable microclimate and enhancing the aesthetic quality of the environment.

The transportation layout takes into account the existing street network and the primary access roads located along the site boundaries. This ensures the efficient distribution of traffic flows, convenient access to the facility, and the minimization of conflicts between vehicular and pedestrian movement (Fig. 2.5).



Thus, the master planning of the sports center site is based on clear functional zoning that integrates sports, recreational, and service-related components into a

unified and harmonious system. This solution ensures operational convenience, safe circulation, and the creation of a comfortable urban environment for visitors of different age groups.

Within the proposed design concept, particular attention is given to the comprehensive landscaping and improvement of the site. Existing green spaces are intended to be preserved to the greatest extent possible and integrated into the updated planning concept of the territory. In addition, new landscaped areas and recreational spaces are proposed in accordance with contemporary principles of landscape design, contributing to the improvement of the environmental quality of the site and enhancing its visual appeal.

The project also предусматривает the improvement of pedestrian circulation through the creation of logically organized movement routes. Comfortable pedestrian pathways and modern outdoor lighting systems are planned to enhance both safety and convenience during evening hours.

The engineering component of the project includes the connection of the sports complex to the main urban utility networks, including water supply, sewerage, electricity supply, and district heating systems. The disposal of domestic wastewater is planned to be carried out through local wastewater treatment facilities in accordance with current regulatory requirements.

To ensure the organized collection and drainage of stormwater, the project provides for the installation of a stormwater drainage system. This solution allows effective control of surface runoff, reduces the risk of flooding, and prevents soil erosion processes within the site.

2.3. Functional planning solution of the of the sport center

The functional and planning organization of the sports complex is based on the principles of functional efficiency, rational spatial distribution, and the clear separation of user flows. The architectural solutions were developed in accordance with the requirements of DBN V.2.2-13:2003 “Sports and Physical Culture and Health Facilities” [12], which regulates the principal design parameters for such buildings.

The structure of the complex consists of several interconnected functional components, including sports, administrative and service, auxiliary, and recreational zones. The key element is the sports and wellness block, which serves as the core of the entire facility and accommodates the main spaces for sports activities. This area contains the principal sports halls and premises intended for training, public events,

and recreational and fitness activities.

The planning organization of the building is based on internal functional zoning, which provides a clear distribution of spaces according to their purpose. Separate zones are designated for athletes, visitors, and service personnel. This approach allows for the efficient organization of circulation within the complex, minimizes the intersection of user flows, and ensures a higher level of comfort and safety during operation.

A partially underground level is located beneath the building. This level accommodates technical rooms, engineering facilities, and storage areas necessary for the uninterrupted operation of the building. It also contains the swimming pool basin together with a complex of technical and auxiliary premises that support water treatment, filtration, purification, and maintenance systems.

In the event of emergencies or air raid alerts, the underground level may be used as a dual-purpose facility with the function of a temporary shelter. To ensure the safe accommodation of occupants, the design provides the necessary sanitary and hygienic facilities, emergency lighting, ventilation systems, drinking water supplies, and evacuation routes in accordance with civil protection requirements. The planning solutions were developed in compliance with DBN V.2.2-5:2023 “Civil Protection Shelters” [14].

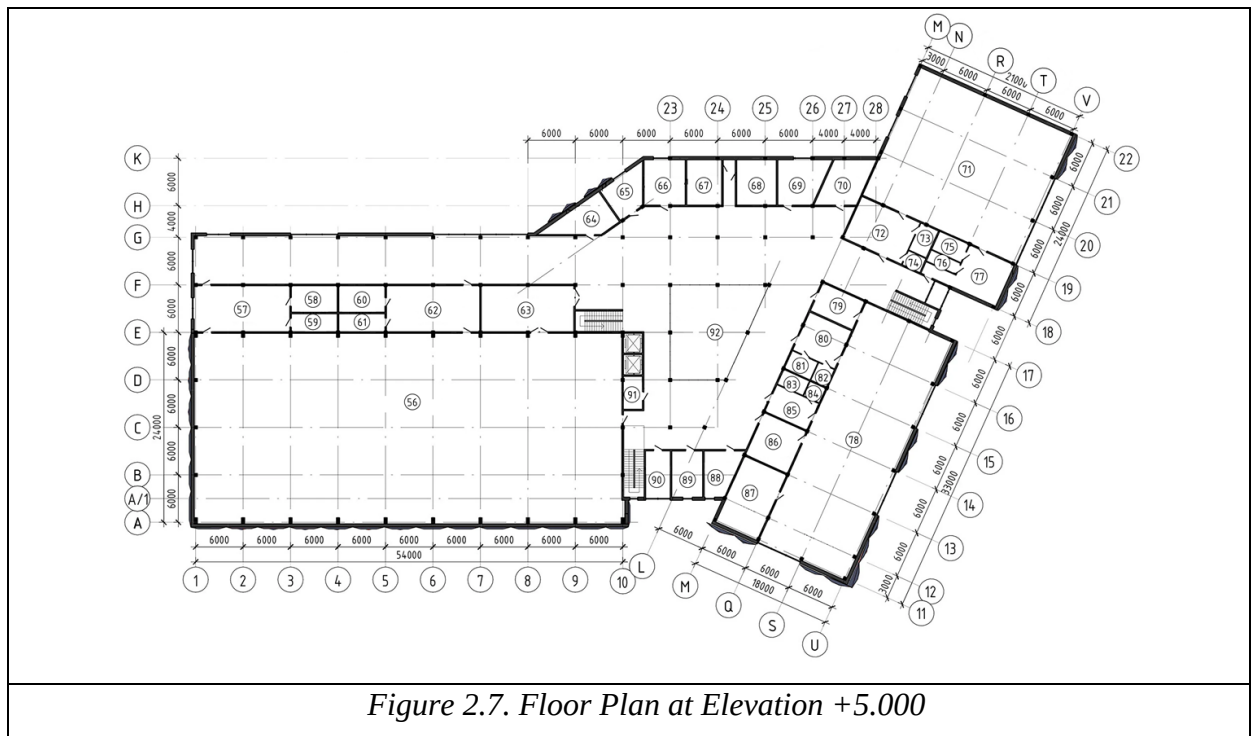
The functional program of the sports center is organized over two above-ground floors and provides facilities for sports training, wellness procedures, rehabilitation, and administrative services.

The building is equipped with two main entrances located in its central section. This planning solution ensures convenient access from different parts of the site and contributes to the efficient organization of visitor circulation while minimizing the intersection of major movement flows.

The central element of the interior space is a spacious entrance hall that serves as the primary circulation and distribution hub. It provides access to the main functional areas of the building and organizes vertical communication between floors. The lobby offers comfortable conditions for visitors, including waiting and

athletes. The floor also accommodates a martial arts hall and a fitness gym, both supported by a full range of auxiliary facilities, including changing rooms, showers, sanitary facilities, coaches' rooms, and equipment storage areas.

To support the operation of the complex, administrative offices, staff rooms, and technical premises are also provided on this level. Spatial openness and visual connectivity between floors are ensured through a double-height atrium area, which contributes to the creation of a comfortable and contemporary interior environment within the sports complex (Fig. 2.7).



Vertical circulation between the building levels is provided by three stairwells and a passenger elevator, ensuring convenient movement for visitors and staff. The stairwells are equipped with a combined lighting system that incorporates both natural daylight through window openings and artificial lighting. The doors of the stairwells and vestibules are designed to open in the direction of evacuation in accordance with fire safety requirements, particularly those established by DBN V.1.1-7:2016 “Fire Safety of Construction Projects” [16].

The project provides for the creation of a barrier-free environment that ensures comfortable and safe use of the sports complex by all categories of users, including

persons with disabilities and other groups with reduced mobility. Entrance areas are equipped with ramps designed according to regulatory requirements, handrails, and non-slip surface materials. The interior spaces of the building are adapted to the needs of mobility-impaired users through adequate corridor widths, maneuvering spaces, accessible sanitary facilities, and elevator access between floors. The design complies with the requirements of DBN V.2.2-40:2018 “Inclusiveness of Buildings and Structures” [15].

The engineering infrastructure of the complex includes water supply and drainage systems, electrical power supply, heating, ventilation, air conditioning, and fire protection systems. This integrated network of engineering services ensures reliable, safe, and energy-efficient operation of the building in accordance with contemporary performance requirements.

The functional relationship between the building and the surrounding site is organized through a developed network of pedestrian pathways and direct access to outdoor sports facilities. This solution ensures effective interaction between the indoor and outdoor zones of the complex and creates favorable conditions for sports activities both within the building and in open-air environments.

The site is designed as a unified functional and planning system that includes sports grounds, recreational areas, and parking facilities. The placement of sports courts has been determined in accordance with regulatory requirements regarding solar exposure, safety, and convenient access from the main building. Recreational zones provide comfortable conditions for visitor relaxation and serve as transitional spaces between active sports areas and transportation infrastructure.

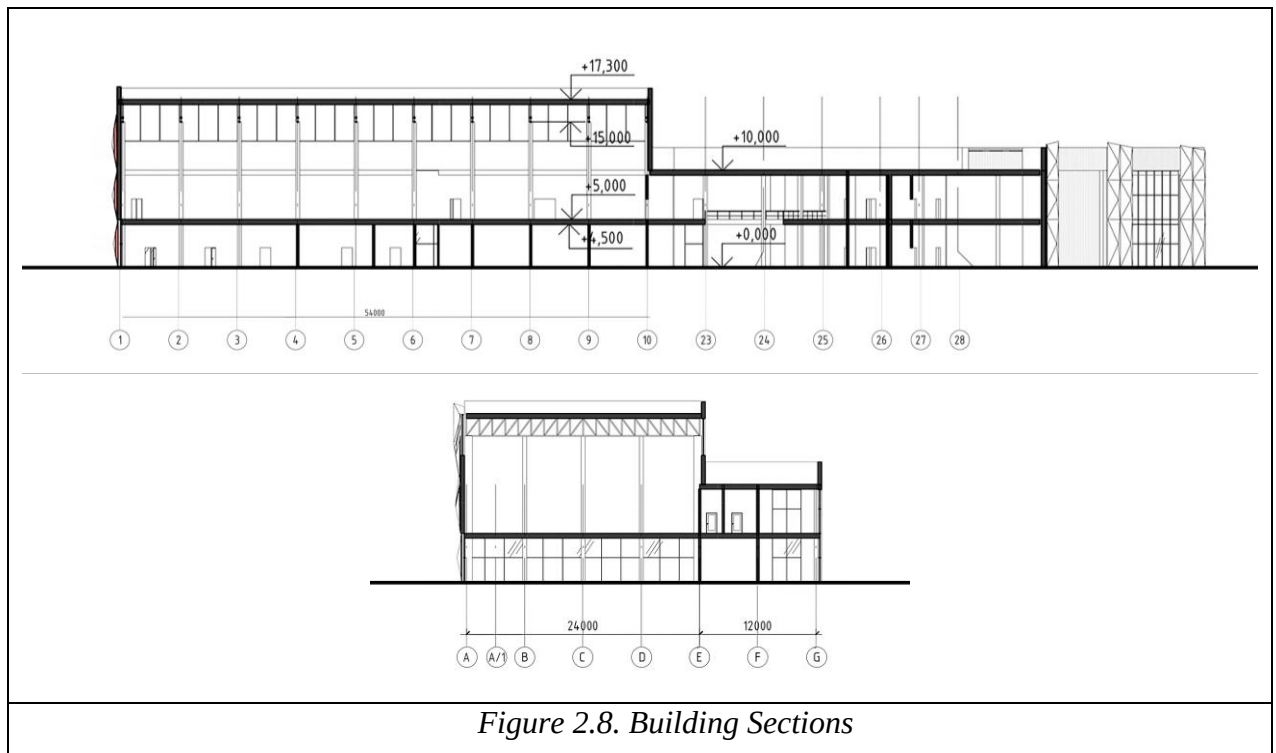
Parking areas are located within separate functional zones and maintain convenient connections with the main pedestrian routes, contributing to the orderly organization of movement and enhancing visitor safety throughout the complex.

Thus, the functional and planning structure of the sports complex is based on the principles of rational zoning, efficient distribution of user flows, accessibility, and the harmonious integration of indoor and outdoor spaces. The adopted design solutions ensure a high level of comfort, safety, and operational efficiency of the

facility.

The building has a complex polygonal configuration in plan, formed by the combination of two interconnected two-story volumes of different heights. The height of the first floor throughout the building is 5.0 m. The second floor is designed with varying heights: in one volume its height is 5.0 m, while in the other it reaches 10.0 m, creating a distinctive architectural silhouette.

A basement level with a height of 2.8 m is provided beneath part of the building, accommodating technical, auxiliary, and parking facilities. The volumetric and spatial composition of the building ensures effective functional zoning of the interior spaces while creating a dynamic architectural image. The maximum height of the building from ground level to its highest point is 17.3 m (Fig. 2.8).



The architectural design of the façades is based on the combination of large-scale structural glazing and an expressive geometric envelope formed by a triangular diagonal grid. The glass panels create a pattern of rhombic and triangular shapes, giving the building a dynamic, contemporary, and crystalline appearance. A significant portion of the façades consists of continuous floor-to-ceiling glazing, which ensures a high level of natural daylight within the interior spaces and

establishes a strong visual connection between the indoor environment and the surrounding landscape (Fig. 2.9).



Figure 2.9. Elevations

The façade composition is complemented by vertical and horizontal elements made of natural stone or warm-toned architectural concrete, which emphasize the plasticity of the building's primary volumes and create a contrast with the lightness of the glazed envelope. In certain parts of the façade, particularly at the building corners, the glazed surfaces extend beyond the main building outline, forming multifaceted bay-window elements and architectural accents that enhance the expressiveness of the overall composition (Fig. 2.10).



Figure 2.10. General View of the Sports Complex

The building roof is designed as a flat structure with a standard slope of 0.03, ensuring effective drainage of atmospheric precipitation. The drainage system is designed as an internal system, with rainwater and snowmelt being collected and discharged through a network of internal roof drains. This solution contributes to the reliable operation of the roof while improving the overall architectural appearance of the building.

Overall, the volumetric and spatial design of the sports complex combines rational functional organization, contemporary architectural approaches, and harmonious integration with the surrounding environment. The combination of the adopted design solutions creates a comfortable, aesthetically expressive, and user-friendly sports and wellness environment.

2.4. Volume-spatial and architectural-constructive solution of the of the sport center

The proposed sports center is designed using a frame structural system that provides the required spatial rigidity, stability, and reliability of the building. The load-bearing framework consists of reinforced concrete columns, beams, and roof structures that work together to receive and transfer loads to the foundation system.

The spatial rigidity of the structure is ensured by the action of rigid floor diaphragms in the horizontal plane and reinforced concrete shear walls in the vertical plane. This structural solution effectively resists horizontal loads, including wind forces, and guarantees the stability of the structural system during operation. The frame system also enables the creation of spacious interiors with large spans and flexible spatial organization in accordance with the functional requirements of the sports complex.

The foundation system has been designed in accordance with the structural scheme and the engineering-geological conditions of the site. Precast reinforced concrete cup-type foundations are provided beneath the columns to ensure reliable load transfer from the structural frame to the ground. The basement level is formed by monolithic reinforced concrete walls, which simultaneously serve as enclosure structures and foundation elements. To prevent the effects of frost heave, preparatory

layers of sand and crushed stone are provided to ensure drainage and foundation stability.

The swimming pool basins are designed in monolithic reinforced concrete, ensuring high watertightness, durability, and reliability under continuous exposure to water.

The external enclosure structures are designed as self-supporting three-layer walls with a polystyrene insulation layer, providing the required standards of energy efficiency, sound insulation, and thermal protection. The external walls are constructed of 510 mm thick silicate brick, while the stairwell walls are constructed of 380 mm thick silicate brick, meeting fire-resistance and safe evacuation requirements. The plinth structures and internal load-bearing walls are built of solid clay brick.

The elevator shaft and pit are designed in monolithic reinforced concrete, ensuring the required strength, rigidity, durability, fire resistance, and sound insulation performance.

Internal partitions are constructed of silicate brick and provide the functional zoning of interior spaces. Lintels above door and window openings are designed as precast reinforced concrete beam-type elements.

Intermediate floor structures consist of monolithic reinforced concrete slabs that provide the required load-bearing capacity and structural rigidity. The roof structure above the basketball hall is designed as reinforced concrete shell structures, allowing large spans to be covered without the need for additional internal supports.

The staircases are constructed from precast reinforced concrete elements and are designed as two-flight stairs with intermediate landings. The surfaces of stair flights and landings are finished with ceramic tiles featuring enhanced slip resistance and wear resistance. The stair slope is designed at a ratio of 1:2 in accordance with ergonomic and safety requirements. Stair railings are made of metal structures equipped with handrails fitted with polymer coverings. Spectator stands and balconies are provided with tubular metal guardrails 1.2 m high. Fire-resistant doors are provided at roof access points from the stairwells.

The roof is designed as a flat membrane roof with an organized internal drainage system. Rainwater is collected through roof drains and internal downpipes connected to the stormwater drainage network. The roofing system consists of a vapor barrier layer, mineral wool insulation, a cement-sand screed with the required slope, and a two-layer waterproofing membrane made of torch-applied roll materials.

The external glazed envelope is designed as a steel spatial diagrid system, consisting of a diagonal structural framework that forms triangular glazing modules.

Window and door units are designed using metal-plastic profile systems with multi-chamber energy-efficient insulated glazing units. External doors are metal-plastic glazed systems, while internal doors are selected according to the functional requirements of individual spaces.

Floor finishes are selected according to the functional purpose of the premises. Public and auxiliary spaces are finished with ceramic tiles, administrative areas with linoleum, sports halls with specialized maple sports parquet flooring, and fitness areas with impact-resistant polyurethane surfaces. In swimming pool areas, ceramic tiles with non-slip surfaces and enhanced moisture resistance are used. Technical rooms and the underground parking area are provided with concrete flooring, while sanitary facilities are finished with moisture-resistant ceramic tile coverings.

To enhance the durability of the structures, the project incorporates a comprehensive system of anti-corrosion measures, including foundation waterproofing, the use of concrete with improved water-resistance characteristics, protection of embedded metal components through galvanizing and painting, and the application of fire-protective coatings to steel structures. Horizontal waterproofing is provided to protect walls against capillary moisture rise. An asphalt-concrete perimeter pavement, 1.0 m wide and laid on a crushed stone base, is arranged around the building.

The interior finishes are selected according to the functional purpose and operating conditions of the spaces. Brick wall surfaces are plastered. Administrative,

public, and sports areas are finished with water-based paint systems. In sanitary facilities, shower rooms, and swimming pool areas, walls are clad with ceramic tiles resistant to moisture and disinfectants. In the pool zone, ceramic tiling is applied up to a height of 2 m, while the upper wall surfaces are finished with moisture-resistant paints.

3. TECHNICAL AND ECONOMIC OF THE SPORT CENTER

3.1. Analysis of Existing Conditions

3.1.1. Functional Zoning of the Territory (Existing Conditions)

No.	Name of zone	Area, ha	Share, %	Specific indicator, m ² /person
1	2	3	4	5
1	Land plot area	1.0250	13.8	51.3
2	External transport zone	0.6124	8.2	30.6
3	Landscaping	0.8540	11.5	42.7
4	Lawns	1.4870	20.0	74.4
5	Utility zone	0.0725	1.0	3.6
6	Unorganized territories	3.3891	45.5	not applicable
	Total within site boundary	7.44	100.0	202.6

3.1.2. Land Balance of the Development Site (Existing Conditions)

No.	Name of elements	Area, m ²	Share, %	Specific indicator, m ² /person	Note
1	2	3	4	5	6
1	Territory, total	13,520.4	18.1	67.6	
1.1	Building footprint	—	—	—	absent
1.2	Roads and paved surfaces	2,485.7	3.3	12.4	

1.3	Parking areas	3,290.5	4.4	16.5	
1.4	Sports facilities	—	—	—	absent
1.5	Recreation areas	—	—	—	absent
1.6	Green areas	7,810.2	10.5	39.1	
2	Service facilities	590.8	0.8	3.0	
1	2	3	4	5	6
2.1	Utility areas	590.8	0.8	3.0	
3	Stadium area	9,750.3	13.1	48.7	
4	Lawns	12,890.6	17.3	64.5	
5	Unorganized territories	40,210.8	53.9	201.1	
	Total within site boundary	74,358.3	100.0	372.9	

3.1.3. Technical and Economic Indicators (Existing Conditions)

No.	Indicator	Unit	Value
1	Land plot area	ha	13.52
2	Capacity	persons	200
3	Site load	persons/ha	37
4	Building footprint area	m ²	—
5	Building density	%	—
6	Green coverage	%	15.0
7	Green area per person	m ² /person	46.8
8	Share of paved areas	%	4.2
9	Paved area per person	m ² /person	11.7
10	Open parking area	m ²	2,900.0
11	Parking capacity	parking spaces	120

3.2. Design Proposal

3.2.1. Functional Zoning of the Territory (Design Proposal)

No.	Name of zone	Area, ha	Share, %	Specific indicator, m ² /person
1	2	3	4	5
1	Urban significance zone	3.2485	43.7	16.2
2	Educational zone	0.4287	5.8	2.1
3	Football fields	2.3842	32.1	11.9
4	Training areas	0.5124	6.9	2.6
5	Utility zone	0.1048	1.4	0.5
6	Recreational zone	0.7614	10.1	3.8
	Total within site boundary	7.44	100.0	37.1

3.2.2. Land Balance of the Development Site (Design Proposal)

No.	Name of elements	Area, m ²	Share, %	Specific indicator, m ² /person	Note
1	2	3	4	5	6
1	Territory, total	66,240.5	88.7	33.1	
1.1	Building footprint (total)	12,980.6	17.4	6.5	
	Sports complex building	7,584.0	10.2	3.8	
	Educational building	2,346.5	3.1	1.2	
	Open stands	3,050.1	4.1	1.5	
1.2	Roads and paved surfaces	5,960.4	8.0	3.0	
1.3	Parking areas	23,840.0	31.9	11.9	

1	2	3	4	5	6
1.4	Sports facilities (total)	19,280.0	25.8	9.6	
	Football fields (3 fields)	520.0	0.7	0.3	
	Basketball court	1,120.0	1.5	0.6	
	Jumping area	2,920.0	3.9	1.4	
	Running tracks	720.0	1.0	0.4	
1.5	Recreation areas	11,894.7	15.9	5.9	
1.6	Landscaping and improvement	1,025.0	1.4	0.5	
2	Service facilities (total)	240.0	0.3	0.1	
2.1	Utility areas	725.0	1.0	0.4	
2.2	Inventory storage	60.0	0.1	0.03	
2.3	Energy facilities	7,410.5	9.9	3.7	
3	Recreational territory	66,240.5	88.7	33.1	
	Total within site boundary	74,676.0	100.0	37.3	

3.2.3. Technical and Economic Indicators (Design Proposal)

No.	Indicator	Unit	Value
1	2	3	4
1	Land plot area	ha	7.44
2	Capacity	persons	2,200
3	Site load	persons/ha	296
4	Building footprint area	m ²	12,980.6
5	Building density	%	17.4
6	Green coverage	%	15.9

1	2	3	4
7	Green area per person	m ² /person	5.9
8	Share of paved areas	%	14.5
9	Paved area per person	m ² /person	5.4
10	Open parking area	m ²	5,960.4
11	Parking capacity	parking spaces	238

3.2.4. Volume and Planning Indicators (Sports Complex Building)

No.	Indicator	Unit	Value
1	Floors above ground	floors	2
2	Building footprint area	m ²	7,117.0
3	Building capacity	persons	1,000
4	Total building area	m ²	25,728.4
5	Area per person	m ² /person	29.7
6	Building volume (total)	m ³	97,154.3
	– above ground	m ³	71,170.8
	– underground	m ³	24,863.5
7	Volume per person	m ³ /person	99.2
8	Usable area	m ²	26,355.6
9	Usable area per person	m ² /person	26.3
10	Standard area	m ²	16,500.0
11	Standard area per person	m ² /person	16.5
12	K1	–	0.5
13	K2	–	3.5
14	K3	–	0.22
15	K4	–	0.12

4. OCCUPATIONAL HEALTH AND SAFETY

4.1. Regulation of occupational health and safety issues at the legislative level

During the design and operation of the sports center in the city of Kharkiv, one of the key objectives is to ensure safe conditions for visitors, athletes, coaching staff, and maintenance personnel. The occupational health and safety system in modern sports facilities encompasses a comprehensive set of legal, organizational, technical, and sanitary-hygienic measures aimed at preventing injuries and emergency situations [8].

The sports center belongs to a category of facilities characterized by the continuous presence of a large number of people; therefore, safety considerations must be incorporated at the earliest stages of project development. A distinctive feature of such facilities is the combination of intensive physical activities with the operation of complex engineering systems, including electrical supply, ventilation, air conditioning, water supply, and specialized sports equipment. Consequently, the regulatory framework governing occupational health and safety is continuously being improved and adapted to modern European approaches to risk management.

The basis for the architectural and planning solutions of the sports center is provided by the requirements of DBN V.2.2-13:2003 “Sports and Physical Culture and Health Facilities” [12]. This regulatory document establishes design requirements for sports buildings of various functional types, defines parameters for the safe operation of premises, and regulates the necessary conditions for training activities.

One of the most important factors in ensuring safety is compliance with the prescribed standards for sports halls. The dimensions of the premises must meet current regulations and provide sufficient space for sports activities without the risk of collisions between users. Rational planning of the interior environment makes it possible to organize training processes in a way that prevents hazardous interactions between athletes and visitors.

For a modern sports center, the principle of functional zoning is of particular

significance. The facility includes separate groups of spaces for athletes, administration, technical personnel, medical services, and visitors. Such an approach ensures an orderly movement of people throughout the building and contributes to a higher level of safety during sports events.

An essential component of the occupational health and safety system is fire protection. According to current regulatory requirements, sports facilities are classified as buildings with an increased level of responsibility due to the large number of occupants who may be present simultaneously. Therefore, particular attention is given to the fire resistance of structural elements, the use of certified finishing materials, the provision of evacuation routes and exits, and the installation of primary firefighting equipment. Planning solutions must ensure the rapid and safe evacuation of occupants in the event of an emergency.

Electrical safety also requires special attention, particularly in areas with elevated humidity levels, such as shower rooms, sanitary facilities, and athlete recovery zones. Electrical equipment must comply with the requirements of applicable regulations, and its operation must incorporate appropriate measures to protect users from electric shock.

Another important aspect of the safe operation of the sports center is the technical condition of sports equipment and facilities. All exercise machines, sports structures, and auxiliary devices must undergo regular inspections, maintenance, and safety compliance checks. This allows defects to be identified in a timely manner and minimizes the risk of injuries to users.

Thus, the occupational health and safety system of the sports center in Kharkiv is based on a comprehensive approach that combines the requirements of current legislation, building regulations, and rules governing the safe operation of sports facilities. Compliance with these requirements creates appropriate conditions for training activities, sporting events, and the daily operation of the facility, ensuring a high level of safety for all categories of users.

4.2. Identification of potential hazards in relation to the thesis object

During the design of the sports center in the city of Kharkiv, an important objective is to ensure safe conditions for visitors, athletes, and staff. To achieve this goal, a comprehensive analysis of potential hazardous and harmful factors that may arise during the operation of the facility was conducted at the design stage.

A distinctive feature of sports facilities is the combination of a large number of users, intensive physical activity, and the operation of complex engineering systems. Therefore, the safety of the facility must be ensured through a combination of architectural and planning measures, engineering solutions, and organizational procedures.

The primary hazards include risks associated with the operation of engineering equipment, electrical networks, and lighting systems. For technical maintenance personnel, potential dangers arise during the servicing of electrical equipment, ventilation units, water supply systems, and heating installations. Repair and maintenance activities may involve the risk of electric shock, mechanical injuries, and falls from height during the maintenance of lighting fixtures and ventilation systems.

The sports center may also present risks associated with areas characterized by increased humidity. These include shower rooms, sanitary facilities, and swimming pools (where provided). Under such conditions, the likelihood of slipping, falling, and electric shock increases; therefore, the design incorporates appropriate protective measures, including the use of non-slip flooring materials and specialized electrical safety solutions.

Considerable attention has been devoted to ensuring the safety of visitors during sports competitions, training sessions, and public events. Large gatherings of people may create hazardous situations related to the organization of circulation routes, congestion near entrances and emergency exits, or panic during emergency situations. To prevent such risks, the project incorporates functional zoning of both the site and the building, separation of visitor, athlete, and staff circulation flows, and the provision of an adequate number of emergency exits in accordance with

current regulatory requirements.

An important aspect of the project is the provision of fire safety. The architectural and planning solutions of the sports center ensure unobstructed access to evacuation routes, compliance with the required widths of corridors and passageways, the use of materials with appropriate fire-resistance characteristics, and the possibility of rapid evacuation of occupants in the event of an emergency.

Administrative personnel are primarily exposed to psychophysiological workloads associated with managing the operation of the sports center and organizing large-scale events. Prolonged work with computer equipment, a high level of responsibility, and the need to coordinate large numbers of people may result in fatigue and reduced work performance.

The identification of hazards for sports complex employees is summarized in Table 4.1.

Table 4.1 – Hazard Identification for Employees of the Sports Complex

Personnel category	Type of danger	Source of origin	Possible consequences
Technical staff	Electro-trauma	Working with electrical equipment, switchboards	Electric shock, burns
Technical staff	Fall from a height	Lighting maintenance, work at height	Injuries, fractures, fatalities
Technical staff	Exposure to chemicals	Use of reagents in swimming pools	Poisoning, skin and respiratory tract irritation
Technical staff	Mechanical injuries	Working with tools and equipment	Cuts, bruises, limb injuries
Technical staff	Slips and falls	Wet surfaces (swimming pools, showers)	Bruises, fractures
Technical staff	Noise and vibration	Operation of pumps, ventilation systems	Hearing loss, fatigue
Administrative	Psycho-	Organization of	Stress, fatigue

staff	emotional stress	mass events	
Administrative staff	Aggression from visitors	High-risk matches	Physical injuries, psychological disorders
Administrative staff	Trauma during an emergency	Panic, crush, evacuation violation	Injuries of varying severity
Administrative staff	Visual and physical stress	Working at the computer	Vision impairment, ORA disease
Administrative staff	Irregular working hours	Holding events, overtime work	Chronic fatigue, decreased performance

The conducted analysis demonstrates that the safe operation of the sports center largely depends on the effectiveness of architectural and planning solutions, the rational organization of interior spaces, and compliance with the requirements of regulatory documents in the fields of occupational health and safety, fire protection, and accessibility. Consideration of these factors at the design stage makes it possible to create a comfortable, safe, and inclusive environment for all categories of users of the sports center.

4.3. Study of the risk of realization of potential dangers at the thesis object and development of measures for their prevention

Based on the results of the identification of hazardous and harmful factors presented in the previous subsection, a risk assessment was carried out for hazards that may arise during the operation of the sports center. The purpose of the study is to determine the degree of their impact on employees and visitors and to justify the implementation of appropriate organizational and engineering safety measures.

The assessment was conducted using a qualitative risk analysis method, which takes into account two main parameters: the probability of occurrence of a hazardous event and the severity of its possible consequences. The combination of these characteristics makes it possible to determine the level of risk and establish priorities for risk reduction measures.

During the analysis, the probability of hazardous situations was considered as low, medium, or high. A low probability corresponds to events that occur very rarely or only under an unfavorable combination of circumstances. Medium probability characterizes situations that may arise during the operation of the facility under certain conditions. High probability is associated with events that have a significant likelihood of occurrence or may recur systematically.

The assessment of consequences was performed according to the potential impact on human health and safety. Minor consequences include incidents that do not cause significant impairment of working capacity and do not require prolonged medical treatment. Moderate consequences are associated with temporary loss of working capacity or the need for medical intervention. Severe consequences include situations that may result in serious injuries, permanent disability, or a threat to human life.

The results of the analysis indicate that the most critical risks for the technical personnel of the sports center are associated with the operation of electrical equipment and work at height. These hazards are characterized by potentially severe consequences and, in the absence of compliance with safety requirements, may occur with a relatively high probability. Therefore, these risks require priority control and the implementation of specialized protective measures.

Medium-level risks include factors associated with the use of chemical reagents for the maintenance of swimming pools and water treatment systems. Provided that proper storage conditions and technological procedures are observed, the probability of hazardous situations remains low; however, the possible consequences of exposure to chemical substances may be significant for employee health.

Risks of mechanical injuries and slips or falls on wet or slippery surfaces are assessed as moderate. Such incidents may occur during routine maintenance of the building and engineering systems; however, in most cases they do not result in critical consequences.

A separate category includes environmental factors related to noise and vibration generated by ventilation systems, pumps, and other engineering

equipment. Their impact is predominantly cumulative and manifests itself over an extended period of time; therefore, the level of risk is assessed as low to moderate, depending on the operating conditions of the equipment.

For administrative personnel, the most significant risks are associated with the organization of sporting competitions, cultural events, and the presence of large numbers of visitors within the complex. During large-scale events, conflicts, aggressive behavior by individuals, or disturbances of public order may occur. The level of these risks depends on the nature of the event and the effectiveness of organizational safety measures.

Particular attention should be paid to emergency situations that may require the mass evacuation of occupants. Although the probability of such events is relatively low, their potential consequences may be extremely serious. For this reason, risks associated with panic, crowd congestion, and disruption of evacuation procedures are classified as high.

Psychophysiological factors, including increased emotional stress, prolonged work with computer equipment, and irregular working schedules during events, are generally characterized by medium or low risk levels. However, their long-term effects may negatively affect employee performance and contribute to occupational burnout.

Thus, the results of the assessment indicate the presence of risks of varying significance within the facility. The greatest attention should be devoted to hazards associated with electrical safety, work at height, and safety management during mass events. The obtained results provide the basis for the development of a comprehensive set of architectural, engineering, and organizational solutions aimed at improving the safety of the sports center and creating a comfortable environment for all categories of users.

4.4. Conclusions

This chapter presents a comprehensive analysis of occupational health and safety issues related to the design object – a sports complex in the city of Kharkiv. The legislative framework governing occupational health and safety was reviewed,

including regulations concerning employee protection, workplace organization, and the safe operation of buildings and structures.

The analysis of working conditions revealed that the activities of sports complex personnel are associated with exposure to various hazardous and harmful factors. For technical personnel, the most significant risks include electric shock, falls from height, exposure to hazardous chemicals, and injuries during equipment maintenance. For administrative personnel, the primary concerns are psycho-emotional stress, risks associated with conflict situations during mass events, and potential injuries in emergency conditions.

The conducted risk assessment demonstrated that the facility is exposed to risks of varying severity, ranging from low to high. The most critical risks were identified as those related to electrical safety, work at height, and ensuring safety during large-scale public events. These areas require priority implementation of risk control and management measures.

The chapter also substantiates a set of organizational, technical, architectural, and planning measures aimed at improving working conditions, reducing occupational injuries, and preventing emergency situations. The proposed solutions take into account the specific operational characteristics of the sports complex as well as contemporary occupational safety requirements.

Thus, the implementation of the proposed measures will ensure an adequate level of occupational health and safety at the facility, minimize the impact of hazardous factors on personnel, and create safe conditions for the efficient operation of the sports complex.

LIST OF REFERENCES

1. Tongxiang National Fitness Center and Li Ning Sports Park (Tongxiang, Zhejiang Province, China). Available at: <https://www.archdaily.com/998481/tongxiang-national-fitness-center-and-li-ning-sports-park-pt-architecture-design>
2. Sports Center Überlingen (Germany). Available at: <https://www.archdaily.com/969477/sports-center-for-uberlingen-school-campus-wulf-architekten>
3. Oriental Sports Center (Shanghai, China). Available at: <https://divisare.com/projects/437856-gmp-architekten-von-gerkan-marg-und-partner-marcus-bredt-shanghai-oriental-sports-center>
4. Ching, F. D. K. Architecture: Form, Space, and Order. Available at: https://rsd2-alert-durden-readingroom.weebly.com/uploads/6/7/1/6/6716949/ching-architecture_form_space_order.pdf
5. Ching, F. D. K. Building Construction Illustrated. Available at: https://dn760103.eu.archive.org/0/items/FrancisD.K.ChingBuildingConstructionIllustratedWiley2014_201606/Francis%20D.%20K.%20Ching-Building%20Construction%20Illustrated-Wiley%20%282014%29.pdf
6. Sheard, R. Sports Architecture. Available at: https://api.pageplace.de/preview/DT0400.9781136743818_A23879546/preview-9781136743818_A23879546.pdf
7. John, G., Sheard, R., & Vickery, B. Stadia: The Populous Design and Development Guide. Available at: https://api.pageplace.de/preview/DT0400.9781317614487_A28397788/preview-9781317614487_A28397788.pdf
8. Law of Ukraine “On the Fundamentals of Urban Planning”. Available at: <https://zakon.rada.gov.ua/laws/show/2780-12#Text>
9. DBN B.1.1-22:2017. Composition and Content of Territory Zoning Plans. Available at: https://architect-zt.gov.ua/files/pdfs/DBN_B.1.1-22-2017.pdf
10. DBN B.2.2-12:2019. Planning and Development of Territories. Available at: <https://dreamdim.ua/wp-content/uploads/2019/07/DBN-B22-12-2019.pdf>

11. DBN A.1.1-15:2012. State Building Codes of Ukraine. Composition and Content of the City Master Plan. Available at: <https://dreamdim.ua/wp-content/uploads/2019/08/DBN-B.1.1-15-2012.-Sklad-ta-zmist-generalnogo-pla.pdf>
12. DBN V.2.2-13:2003. Buildings and Structures. Sports and Physical Culture and Health Facilities. Available at: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=6107
13. DBN V.2.2-9:2018. State Building Codes of Ukraine. Public Buildings and Structures. Available at: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=82012
14. DBN V.2.2-5:2023. Civil Protection Shelters. Available at: <https://clcgroupp.com.ua/blog/novi-budivelni-normy-dbn-v-2-2-52023-zahysni-sporudy-czyvilnogo-zahystu/>
15. DBN V.2.2-40:2018. Inclusiveness of Buildings and Structures. Basic Provisions. Available at: https://dreamdim.ua/wp-content/uploads/2022/08/Zmina1-DBN-V_2_2-40-2018.pdf
16. DBN V.1.1-7:2016. Fire Safety of Construction Projects. General Requirements. Available at: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=68456
17. DBN V.2.1-10:2018. Foundations and Footings of Buildings and Structures. Available at: <https://dreamdim.ua/wp-content/uploads/2018/12/DBN-V2110-2018.pdf>
18. NAPB A.01.001-2014. Fire Safety Rules in Ukraine. Available at: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=60541
19. Rules for Electrical Installations, approved by Order No. 476 of the Ministry of Energy and Coal Industry of Ukraine dated 21 July 2017.
20. Rules for the Technical Operation of Consumer Electrical Installations, approved by Order No. 258 of the Ministry of Fuel and Energy of Ukraine dated 25 July 2006.
21. DSTU EN ISO 7010:2019. Graphical Symbols — Safety Colours and Safety Signs — Registered Safety Signs. Available at: https://online.budstandart.com/ua/catalog/doc-page.html?id_doc=83263