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

School of Architecture, Urban Planning and Design

Department of Architecture of Buildings and Constructions

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Alsaid Abdullah Omar

Supervisor: Veligotska Yuliia_______
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T A S K

FOR THE STUDENT'S QUALIFICATION WORK

Alsaid Abdulla Omar

Topic of the project (work): "The features of designing mixed-use high-rise complexes through adaptive urban morphologies"

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6. Consultants of project sections (works)

Section	Surname, initials and position consultant	Signature, date	
		Task issued	Task accepted
1	Yu.S. Veligotska, Ph.D., Assoc. prof.	01.12.2025	14.02.2026
2	Yu.S .Veligotska, Ph.D., Assoc. prof.	16.02.2026	14.03.2026
3	Yu.S .Veligotska, Ph.D., Assoc. prof.	16.03.2026	18.04.2026
4	A.V. Naboka Ph.D, senior lecturer	20.04.2026	30.04.2026
5	V.V. Malysheva, Ph.D., Assoc. prof.	20.04.2026	30.04.2026

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7	Development and graphic design of analytical schemes (models) based on scientific research (writing "Section 2", subsection 2.3 and "Conclusions to Section 2")	March 2026	Done
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10	Preparation of the master's thesis	April 2026	Done
11	Defense of the master's thesis before the examination commission	May 2026	Done

Student ________ Alsaid Abdullah Omar

Supervisor ____________ Yu.S. Veligotska.

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INTRODUCTION

Today, in the conditions of rapid urbanization and the transformation of contemporary cities, the architecture of high-rise complexes is becoming one of the most important directions of architectural and urban development. The active growth of urban populations, the shortage of land resources, and the increasing complexity of social and functional processes require the creation of architectural objects capable of combining multiple functions within a single spatial structure. In this context, mixed-use high-rise complexes represent a modern type of architectural environment that integrates residential, business, commercial, recreational, cultural, and public functions into one vertically organized system.

Modern mixed-use high-rise complexes are characterized not only by their multifunctionality, but also by their ability to adapt to the changing urban environment and the dynamic needs of society. The contemporary city requires architectural solutions that can respond to changing social, economic, environmental, and technological conditions. This creates the need for adaptive urban morphologies, which represent flexible spatial and planning systems capable of transformation and integration into different urban contexts. Adaptive urban morphologies allow high-rise complexes to interact more effectively with the surrounding urban fabric, transport infrastructure, public spaces, landscape systems, and environmental conditions.

Today, mixed-use high-rise complexes are becoming dynamic architectural structures in which multifunctional human activity takes place throughout the entire daily cycle. Such complexes create new models of interaction between architecture, people, and the urban environment through the integration of public spaces, green systems, pedestrian connections, vertical zoning, multifunctional platforms, and adaptive planning solutions. The role of these complexes is no longer limited to providing workplaces or residential units; instead, they form complex urban ecosystems capable of ensuring comfort, communication, recreation, work, mobility, and environmental sustainability within a unified architectural structure.

The need for adaptive and multifunctional architectural solutions is constantly increasing due to the changing rhythm of modern life, technological development, climate challenges, and the transformation of urban processes. It can be assumed that in the future the role of mixed-use high-rise complexes will continue to evolve according to new social demands, sustainable development principles, and the requirements of flexible urban organization.

Thus, the design of mixed-use high-rise complexes through adaptive urban morphologies is a complex architectural and urban-planning task, since it requires the creation of an integrated public environment that combines multifunctionality, vertical organization, adaptability, environmental sustainability, and effective interaction with the surrounding city structure.

The analysis of scientific publications showed that modern architectural theory contains numerous studies devoted to high-rise architecture, multifunctional buildings, and urban morphology. These issues are reflected in the works of Gelfond A.L., Barkhin M.G., Bokov A.B., Jencks C., Koolhaas R., Yeang K., and other researchers. Foreign studies also pay considerable attention to sustainable high-rise development, mixed-use architecture, vertical urbanism, and adaptive urban systems.

However, despite the significant amount of accumulated theoretical and practical material concerning high-rise and multifunctional architecture, there is still insufficient scientific justification regarding the design of mixed-use high-rise complexes through adaptive urban morphologies. There is a lack of methodological approaches that systematize principles, factors, planning models, and architectural techniques for the formation of such complexes in contemporary urban conditions.

In this regard, there is a need to consider mixed-use high-rise complexes as an independent object of architectural and urban research and design, as well as to develop approaches to their formation taking into account modern urban challenges, environmental requirements, technological opportunities, and human needs.

The stated relevance and the current level of research on the chosen topic indicate the necessity of conducting a theoretical study aimed at revealing the main regularities of designing mixed-use high-rise complexes through adaptive urban morphologies, determining their main architectural and urban-planning elements, identifying design methods and techniques, and developing conceptual design proposals.

In this regard, the **purpose of the work** is to reveal the features of designing mixed-use high-rise complexes through adaptive urban morphologies.

In accordance with this goal, the **research objectives** were defined:

1. To determine theoretical approaches to the study of mixed-use high-rise complexes and adaptive urban morphologies.

2. To analyze the practical experience of designing mixed-use high-rise complexes in contemporary architecture.

3. To identify current trends in the formation of mixed-use high-rise complexes.

4. To determine the factors influencing the formation of mixed-use high-rise complexes within adaptive urban morphologies.

5. To determine architectural and urban-planning methods for designing mixed-use high-rise complexes.

6. To develop an experimental project proposal for a mixed-use high-rise complex based on adaptive urban morphology principles.

The object of the study is a mixed-use high-rise complex.

The subject of the study is the features of designing mixed-use high-rise complexes through adaptive urban morphologies.

Research methods:

• comparative analysis to identify patterns in the formation of mixed-use high-rise complexes and adaptive urban morphologies;

• comparative analysis of graphic materials (master plans, urban schemes, plans, and sections of high-rise multifunctional buildings) to determine planning structures, spatial organization, and formation principles;

• deductive and inductive methods for summarizing and systematizing the obtained data at general and detailed levels;

• structural and systemic methods for building models of prospective mixed-use high-rise complexes within adaptive urban environments;

• analysis of urban contexts and territories through visual observation and photo-fixation to identify the peculiarities of architectural and urban environment formation.

The results of the study were published at the conference The architectural synthesis of modern residential systems and Moroccan vernacular principles. Abstracts of XIX International Scientific and Practical Conference. Sofia, Bulgaria. [1].

SECTION 1. THEORETICAL AND PRACTICAL PREREQUISITES MIXED-USE HIGH-RISE COMPLEXES

1.1. Theoretical experience of formation of mixed-use high-rise complexes

Modern urban activities increasingly combine management, entrepreneurship, innovation, digital communication, housing, recreation, trade, and public interaction within integrated architectural systems. In contemporary cities, these processes require the formation of multifunctional environments capable of adapting to rapid urban growth, technological development, and changing social demands. The increasing density of urban territories, reduction of vacant land plots, and the growing complexity of urban infrastructure stimulate the development of mixed-use high-rise complexes as one of the dominant forms of contemporary architecture [2].

A mixed-use high-rise complex is a multifunctional vertical architectural structure that integrates residential, office, commercial, recreational, cultural, and public functions within a unified spatial and planning system (fig.1.1). Such complexes create new forms of urban interaction and represent vertically organized fragments of the city capable of functioning as adaptive urban environments [3].

Adaptive urban morphology is a flexible architectural and urban-planning approach based on the transformation, integration, and contextual adaptation of architectural forms and urban systems according to changing environmental, social, economic, and technological conditions [4]. Through adaptive morphologies, mixed-use high-rise complexes become capable of interacting effectively with transport infrastructure, landscape systems, public spaces, climatic conditions, and surrounding urban fabric (fig.1.1).

The architectural design of mixed-use high-rise complexes has actively evolved in recent decades due to the transformation of urban lifestyles and the increasing demand for multifunctionality. Modern high-rise structures no longer function only as office towers or residential buildings; instead, they form complex vertical urban ecosystems where different functions interact within a unified adaptive environment [5].

The analysis of scientific literature revealed the following definitions of terms.

Figure 1.1 Terminology

Mixed-use high-rise complex is a vertically organized multifunctional architectural structure combining residential, office, commercial, recreational, and public functions within a single spatial system designed for intensive urban interaction [3].

Adaptive urban morphology is a system of flexible spatial and planning solutions that allows architectural and urban structures to adapt to changing environmental, technological, and socio-economic conditions [4].

Vertical urbanism is an approach to urban development based on the concentration of multifunctional urban processes within vertically organized architectural systems [6].

The analysis of scientific studies showed that issues related to mixed-use architecture, high-rise urbanism, and adaptive urban morphology are widely explored mainly in foreign architectural theory and practice. Research on contemporary high-rise architecture and multifunctional urban systems is presented in the works of Rem Koolhaas, Ken Yeang, Norman Foster, Richard Rogers, and Zaha Hadid [5].

Questions concerning the relationship between high-rise buildings and the urban environment were explored in the works of Aldo Rossi, Roger Trancik, and Léon Krier. Their studies focused on urban morphology, spatial identity, contextual integration, and the interaction between architecture and public space [7–8].

An important contribution to the study of mixed-use skyscrapers is the book *Tower and Office: From Modernist Theory to Contemporary Practice* by Inaki Abalos and Juan Herreros (fig.1.2). The publication examines the evolution of high-rise construction, office environments, curtain-wall systems, and mixed-use skyscrapers, emphasizing the transformation of urban structure through vertical integration of functions [9].

The ecological and adaptive aspects of high-rise architecture were comprehensively explored in the works of Ken Yeang. In *The Skyscraper Bioclimatically Considered*, the author investigates environmental approaches to tall-building design, climatic adaptation, vertical landscaping, and sustainable urban integration [10].

The book *Delirious New York* by Rem Koolhaas examines the concept of vertical urbanism and the development of Manhattan as a prototype of multifunctional high-rise urban morphology, where multiple urban functions coexist within vertically layered structures (fig.1.2) [11].

Another important source is *Building Type Basics for Office Buildings* by A. Eugene Kohn and Paul Katz, which analyzes principles of office and multifunctional building design, spatial organization, and planning strategies for high-rise complexes [12] (fig.1.2).

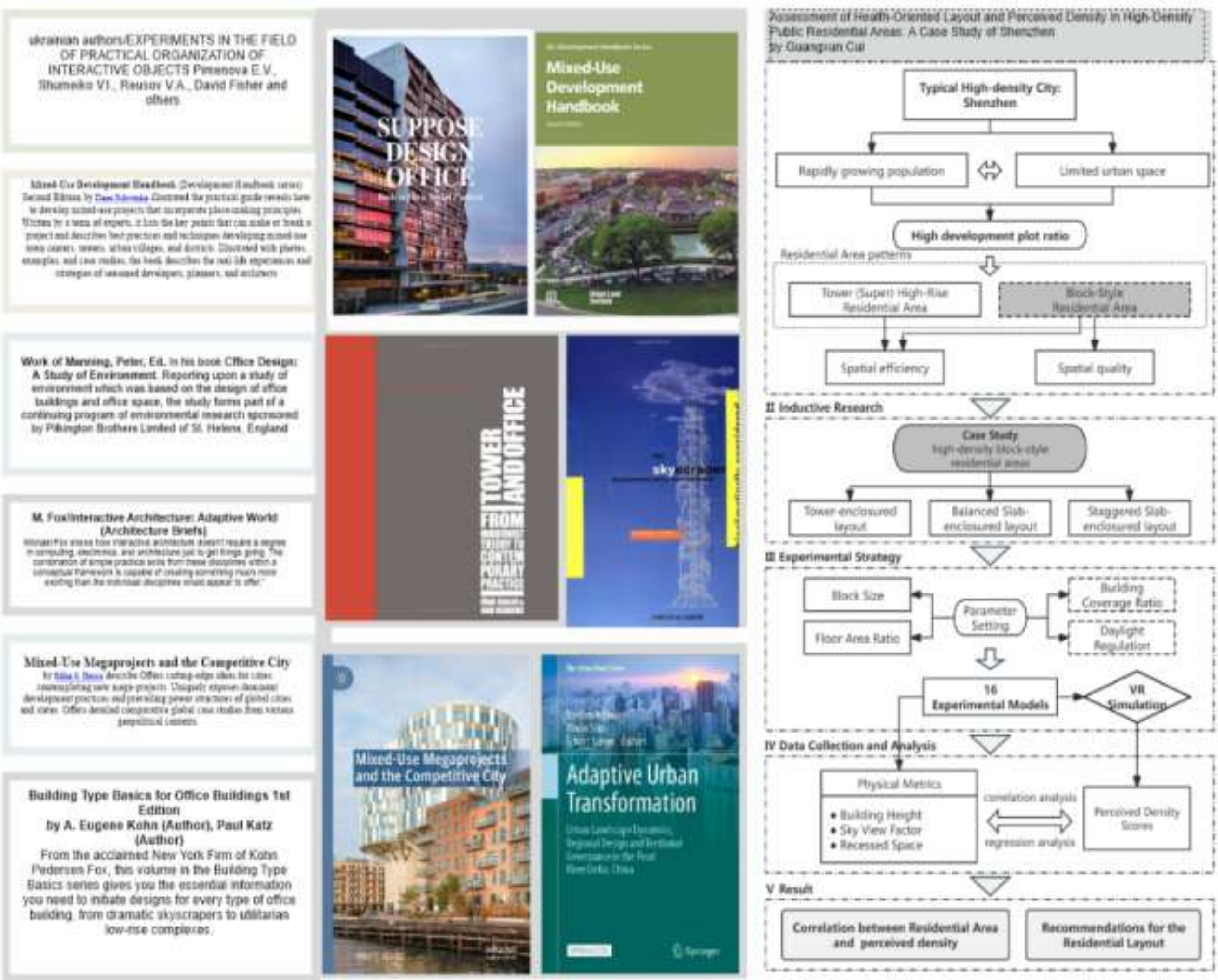


Figure 1.2 Theoretical experience

Urban morphology and spatial adaptation principles were also analyzed in Roger Trancik's work *Finding Lost Space: Theories of Urban Design*, which examines the relationship between architecture, urban voids, public spaces, and the formation of integrated urban structures [13].

The considered scientific works form the theoretical basis for a comprehensive study of the features of designing mixed-use high-rise complexes through adaptive urban morphologies. The relevance of this topic is determined by the necessity of developing adaptive, multifunctional, environmentally integrated, and spatially flexible architectural systems capable of responding to contemporary urban challenges.

1.2. Practical experience of formation of mixed-use high-rise complexes

The formation of contemporary mixed-use high-rise complexes, to which many modern cities aspire, is directly connected with the transformation of urban environments and the emergence of adaptive urban morphologies. In conditions of rapid urbanization, increasing population density, and limited land resources, many countries are developing multifunctional urban districts and vertical urban centers in which residential, office, commercial, recreational, cultural, and public functions are integrated into unified architectural systems. Today, the task of mixed-use high-rise complexes is not only the concentration of functions within one structure, but also the creation of adaptive urban environments capable of responding to changing social, environmental, technological, and economic conditions [2].

One of the most significant examples of adaptive high-rise architecture is the Al Bahar Towers project in Abu Dhabi designed by Aedas [14]. The project demonstrates how adaptive urban morphology can respond to climatic and environmental conditions while maintaining multifunctionality and high urban density.

The towers use an innovative parametric facade system inspired by the traditional Islamic mashrabiya. The adaptive facade consists of movable triangular elements covered with fiberglass that automatically respond to solar radiation and changing sun angles throughout the year. This dynamic environmental system reduces solar gain, improves thermal comfort, and increases energy efficiency (fig.1.3). The external shading structure functions as a secondary facade layer positioned independently from the main curtain wall [15].

The interior organization of the complex is based on open, flexible, light-filled spaces that create visual continuity and adaptability. The office floors have orthogonal planning systems capable of accommodating both open-space layouts and individual office structures. In addition to office functions, the complex contains atriums, public waiting zones, retail areas, sports facilities, parking structures, residential apartments, and

Figure 1.4 Al Bahar Towers project in Abu Dhabi

entertainment spaces. The flowing forms of staircases, integrated LED lighting, and sculptural interior elements emphasize the adaptive and dynamic character of the architectural environment.

Another important example of designing mixed-use high-rise complexes through adaptive urban morphologies is the VietinBank Business Center in Hanoi, Vietnam, designed by Foster + Partners [16]. The project demonstrates the transformation of Hanoi into an international financial center and represents one of the first large-scale multifunctional high-rise developments in Vietnam.

The complex consists of two landmark towers connected by a seven-story podium that integrates conference halls, luxury retail, restaurants, cafes, roof gardens, and public spaces. The taller 68-story tower accommodates the headquarters of VietinBank, while the second 48-story tower contains a five-star hotel, serviced apartments, and recreational facilities (fig.1.4). Such vertical zoning demonstrates the principles of adaptive urban morphology, where multiple urban functions are concentrated within interconnected vertical systems [16].

The architectural image of the complex is formed through ribbed facade systems that provide shading and improve environmental performance. The facade creates solar protection, regulates daylight penetration, and forms a recognizable silhouette within the urban panorama. Roof gardens and landscaped terraces strengthen the ecological integration of the complex and create intermediate recreational environments within the vertical structure.

An interesting example of adaptive multifunctional architecture is *The Milestone* project by MVRDV in Esslingen, Germany [17]. This multifunctional office and public building demonstrate the integration of digital technologies, adaptive facades, and contextual urban morphology (fig.1.5).

The facade is designed as a crystalline structure with partially mirrored and fritted glass surfaces containing photovoltaic elements. The facade reflects the surrounding landscape, topography, and urban environment while simultaneously functioning as an interactive information surface. The project integrates restaurants, cafes, meeting rooms, and flexible office environments that support social interaction and a healthy work-life balance [17].

Figure 1.4 VietinBank mix used center in Hanoi

The analysis of the project revealed the following adaptive design features: dynamic facade systems, roof greening, flexible volumetric forms, extensive glazing, combined spatial organization, atrium spaces, water elements, and interactive public environments.

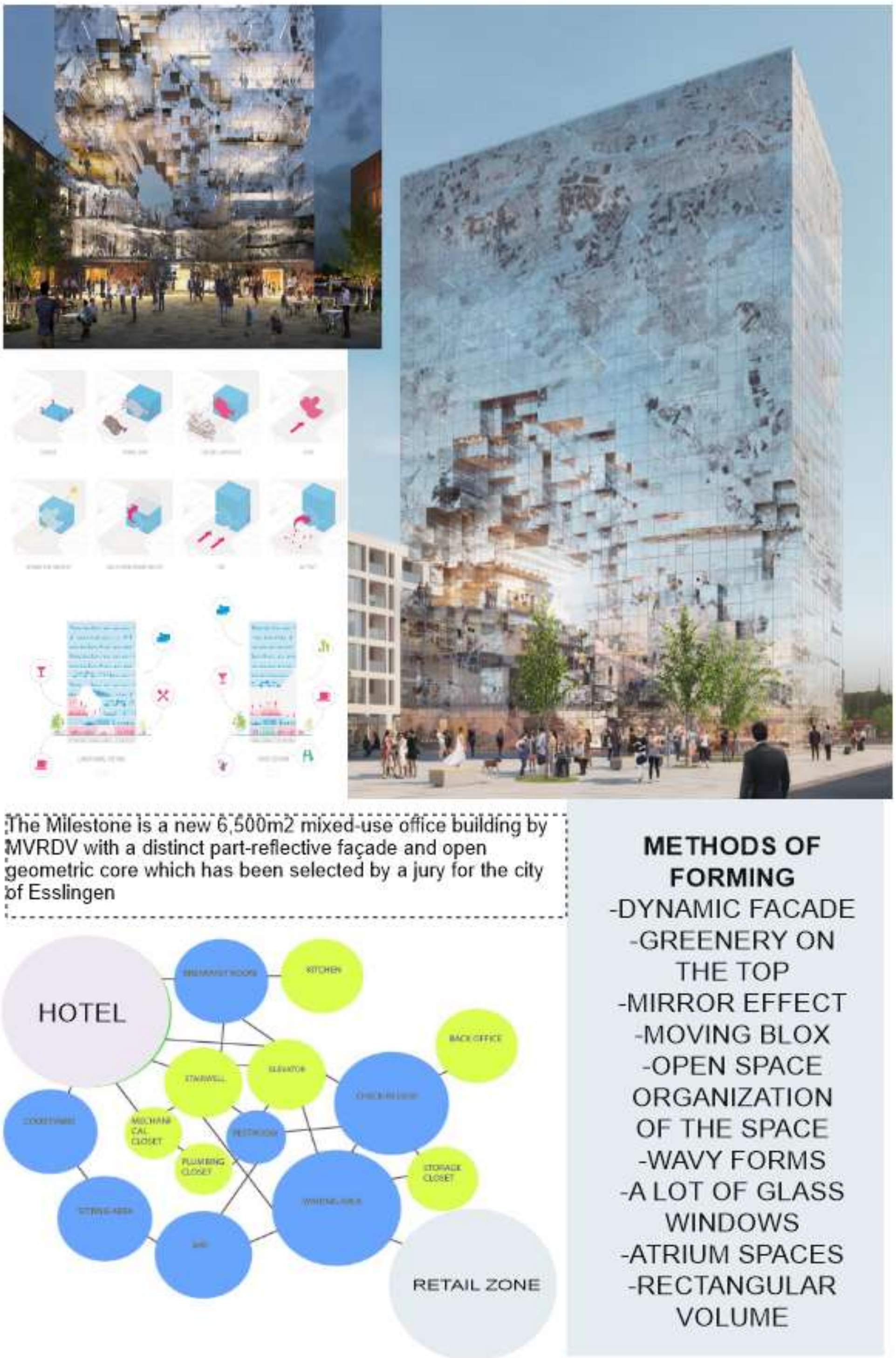


Figure 1.5 The Milestone project by MVRDV in Esslingen, Germany

Another interesting proposal is the multifunctional media center developed by DRDS Architects for Busan, South Korea [18]. The KNN Multipurpose Media Center combines media studios, office spaces, retail functions, museums, and public spaces within a vertically integrated adaptive structure (fig.1.6).

The project is conceived as a landmark urban element connected with surrounding public infrastructure and open urban spaces. The combination of a vertical tower and a multifunctional podium create a dynamic urban node that intensifies pedestrian activity and forms a new relationship between architecture and the surrounding cityscape (fig.1.6). The analysis revealed such adaptive features as media facades, interactive structures, modular systems, lighting technologies, flexible public spaces, ribbed facade geometries, and extensive use of glass surfaces [18].

Figure 1.6 DRDS Architects for Busan, South Korea

The next object is Marmormolen mixed use center Denmark considered is a mixed-use high-rise complex that combines retail, office spaces, apartments, recreational functions, and public amenities within a vertically integrated urban structure [19]. It is known as an example of sustainable modern construction. The project focuses on sustainability, using solid wood structures and aluminum-glass facades to reduce CO_2 emissions. The building is 20 stories high and is positioned as one of the tallest wooden towers in the country. Structural elements include exterior glued laminated timber and cross-laminated timber (CLT) to create a warm, natural look (fig.1.7).

Figure 1.7. Marmormolen mixed use center Denmark

This multifunctional high-rise complex is designed as an adaptive architectural organism integrating commercial, recreational, residential, and public functions into a unified spatial system. In the center of the structure there is an internal courtyard and atrium space intended for recreation, social interaction, and natural lighting.

The lower levels include shopping, entertainment, and public functions that activate the pedestrian environment and establish connections with the surrounding urban fabric. The middle floors are occupied by office spaces combined with co-working zones, recreation areas, cafes, and restaurants, while the upper levels contain apartments, hotel functions, sports facilities, swimming pools, and recreational terraces [19].

The facade of the building is formed using curved glass surfaces and flexible volumetric elements that create a dynamic architectural image and provide panoramic visual interaction with the city. Large glazing areas improve natural lighting and strengthen the relationship between interior spaces and the urban environment.

Therefore, based on the identified features of mixed-use high-rise complexes, it can be concluded that contemporary adaptive urban morphologies integrate multifunctionality, flexible planning systems, environmental technologies, interactive structures, dynamic facades, and vertically organized public spaces.

The analysis revealed various approaches to adaptive multifunctional architecture characterized by different spatial organizations, environmental strategies, technological systems, and urban integration methods.

As a result of the study, mixed-use high-rise complexes can be classified according to architectural and urban-planning characteristics, adaptive morphological structures, environmental strategies, and the nature of integrated functions and activities. Architectural and urban-planning features significantly influence the scale of development, spatial organization, environmental performance, and the interaction between high-rise complexes and the surrounding urban environment.

1.3. Modern trends of mixed-use high-rise complexes through adaptive urban morphologies

Contemporary mixed-use high-rise complexes through adaptive urban morphologies are increasingly transforming into multifunctional urban systems that combine residential, office, commercial, recreational, and public functions within integrated vertical environments. The development of such complexes is influenced by rapid urbanization, increasing density of cities, environmental challenges, technological innovation, and the growing demand for flexible and sustainable urban spaces. As a result, modern architectural practice demonstrates several major trends that shape the formation of adaptive high-rise environments.

One of the most important contemporary trends is the **ecological tendency and environmental integration of architecture**. Modern mixed-use high-rise complexes increasingly incorporate principles of sustainable development and bioclimatic design. Adaptive urban morphology promotes the integration of natural systems into the vertical structure of buildings through roof gardens, vertical landscaping, green terraces, and sky gardens. Natural ventilation, daylight optimization, rainwater collection systems, and renewable energy technologies become integral architectural elements rather than additional engineering solutions. Environmental strategies influence not only the technological systems of the building but also its volumetric-spatial composition and urban integration. Contemporary high-rise architecture therefore increasingly develops as an environmentally responsive system connected with urban ecology and climatic adaptation.

Another important trend is the strengthening of mixed-use **integration within vertical urban structures**. Contemporary high-rise complexes no longer function as monofunctional office or residential towers, but instead integrate diverse functions into unified adaptive environments. Residential apartments, offices, hotels, retail spaces, entertainment functions, cultural environments, and public amenities are vertically combined within one structure. Functional stacking and zoning create continuous urban activity throughout the day and improve the efficiency of land use in dense urban environments. Podium structures increasingly contain public and commercial functions

Figure 1.8. Modern trends of mixed-use high-rise complexes

connected to pedestrian infrastructure, while upper levels accommodate more private residential and office spaces. Such integration contributes to the formation of “vertical urban communities” capable of functioning as self-sufficient fragments of the city.

The trend toward openness and public connectivity also significantly influences adaptive urban morphology. Contemporary mixed-use high-rise complexes increasingly prioritize the creation of open, permeable, and socially active urban environments. Public plazas, elevated terraces, sky gardens, and pedestrian connections are integrated into the architectural structure in order to strengthen interaction between the building and the surrounding city. The architectural environment becomes less isolated and more connected with public urban life. Visual permeability, transitional spaces, and multifunctional public platforms improve accessibility and social interaction while simultaneously reducing the separation between private architecture and public urban infrastructure.

An important direction in the development of contemporary adaptive morphology is the integration of **interactivity and smart technologies** into architectural environments. Digital technologies increasingly influence the operation, adaptability, and environmental performance of mixed-use high-rise complexes. Smart building systems, automated environmental controls, media facades, digital monitoring technologies, and real-time data systems improve operational efficiency and environmental comfort. Interactive facades and intelligent management systems allow buildings to dynamically respond to climatic conditions, occupancy levels, and operational demands. Such technologies also contribute to energy efficiency, environmental monitoring, and optimization of internal building systems.

Another significant trend **is multifunctional flexibility and transformability** of spatial organization. Contemporary adaptive urban morphology increasingly requires buildings capable of responding to changing urban, social, and economic conditions. Therefore, flexible planning systems, modular structural grids, open floor layouts, and transformable spaces become essential principles of architectural design. Multifunctional spaces can adapt to different operational scenarios over time, allowing office zones, exhibition spaces, residential layouts, and public functions to transform according to future needs. Flexibility improves the long-term sustainability and operational viability of mixed-use high-rise complexes.

Adaptive urban morphology also increasingly emphasizes the integration of **landscape and public ecology into high-rise structures**. Vertical greenery, ecological podiums, roof parks, and green transitional environments create new forms of interaction between architecture and nature. Such systems improve environmental comfort, reduce overheating, enhance biodiversity, and contribute to the formation of healthier urban environments. The building is no longer perceived as an isolated technological object but instead becomes part of a broader ecological urban system.

Another contemporary trend is the **development of hybrid compositional systems**. Modern mixed-use high-rise complexes increasingly use clustered, terraced, stepped, and interconnected volumetric structures instead of isolated vertical towers. Such morphology improves visual permeability, daylight access, natural ventilation, and integration with the surrounding urban context. Hybrid systems also contribute to the creation of intermediate public spaces, sky terraces, and multifunctional social environments integrated into the vertical composition of the complex.

Thus, the contemporary trends in the formation of mixed-use high-rise complexes through adaptive urban morphologies demonstrate the transition from isolated high-rise structures toward multifunctional, environmentally integrated, flexible, and technologically adaptive urban systems. Contemporary architecture increasingly combines ecological strategies, mixed-use integration, public connectivity, smart technologies, and spatial flexibility in order to create resilient and sustainable high-rise environments capable of responding to future urban challenges.

Conclusion of the 1st section

1. As a result of the analysis, it was determined that contemporary mixed-use high-rise complexes are transforming into adaptive urban systems that combine residential, commercial, public, recreational, and office functions within integrated vertical environments.

2. The study revealed that the main trends in the formation of mixed-use high-rise complexes include ecological integration, multifunctionality, openness of public spaces, interactive technologies, adaptive facades, and flexible spatial-planning structures.

3. It was established that adaptive urban morphologies contribute to the creation of sustainable, technologically advanced, and human-oriented architectural environments capable of responding to changing social, environmental, and urban conditions.

SECTION 2. FACTORS AND FEATURES OF DESIGNING MIXED-USE HIGH-RISE COMPLEXES THROUGH ADAPTIVE URBAN MORPHOLOGIE

2.1. Analysis of factors that influence the formation of mixed-use high-rise complexes through adaptive urban morphologies

The transformation of contemporary cities, rapid urbanization, technological development, and the increasing complexity of social processes significantly influence the formation of mixed-use high-rise complexes. In modern architectural practice, the emphasis of design is gradually shifting toward the creation of adaptive urban environments focused on human needs, environmental sustainability, flexibility, and multifunctionality. Mixed-use high-rise complexes are no longer considered isolated architectural objects; instead, they function as integrated urban systems capable of adapting to changing social, environmental, economic, and technological conditions [1].

Adaptive urban morphology plays a significant role in the formation of contemporary mixed-use high-rise complexes. It is based on the ability of architectural and urban systems to transform according to changing urban requirements, climatic conditions, technological innovations, and the needs of users. The formation of such complexes is influenced by a large number of interconnected factors that can be conditionally divided into several major groups:

- natural and climatic factors;
- urban-planning and architectural factors;
- social and psychological factors;
- environmental and technological factors;
- economic factors.

Natural and climatic conditions have a significant influence on the spatial organization, volumetric composition, engineering systems, facade solutions, and environmental performance of mixed-use high-rise complexes (fig.2.1). Climatic conditions determine the orientation of buildings, facade systems, shading devices, natural ventilation strategies, and the use of ecological technologies [2].

Temperature-humidity conditions, solar radiation, wind direction, and seasonal climatic fluctuations are especially important in the design of adaptive high-rise complexes. In regions with hot climates, adaptive facade systems, double-skin facades, vertical greening, roof gardens, and kinetic shading devices are increasingly used to reduce overheating and improve environmental comfort.

One of the most notable examples is the Al Bahar Towers project in Abu Dhabi designed by Aedas. The towers use a responsive mashrabiya facade consisting of movable shading elements that automatically react to solar radiation. The adaptive facade system reduces solar heat gain and creates a comfortable indoor microclimate while simultaneously forming a dynamic architectural image.

Another example is the work of Ken Yeang, whose bioclimatic skyscrapers integrate vertical landscaping, sky courts, natural ventilation systems, and ecological engineering technologies into high-rise structures [4]. His projects demonstrate how climate-responsive architecture can become part of adaptive urban morphology.

Landscape and topographical conditions also influence the formation of mixed-use high-rise complexes. Contemporary projects increasingly integrate artificial landscapes, elevated public terraces, podium gardens, and water systems into vertically organized urban structures.

Urban-planning factors are among the most important components influencing the formation of mixed-use high-rise complexes. The location of the site, transportation accessibility, density of surrounding development, visual connections, infrastructure, and pedestrian networks significantly affect architectural and planning decisions [5].

Mixed-use high-rise complexes increasingly function as urban nodes connected to public transportation systems, metro stations, pedestrian routes, and public spaces. Transit-oriented development becomes one of the dominant directions in adaptive urban morphology (fig.2.1).

An important example is the Marina One complex in Singapore designed by Ingenhoven Architects [6]. The project integrates office towers, residential functions, retail areas, public spaces, and green landscapes into a unified urban structure connected

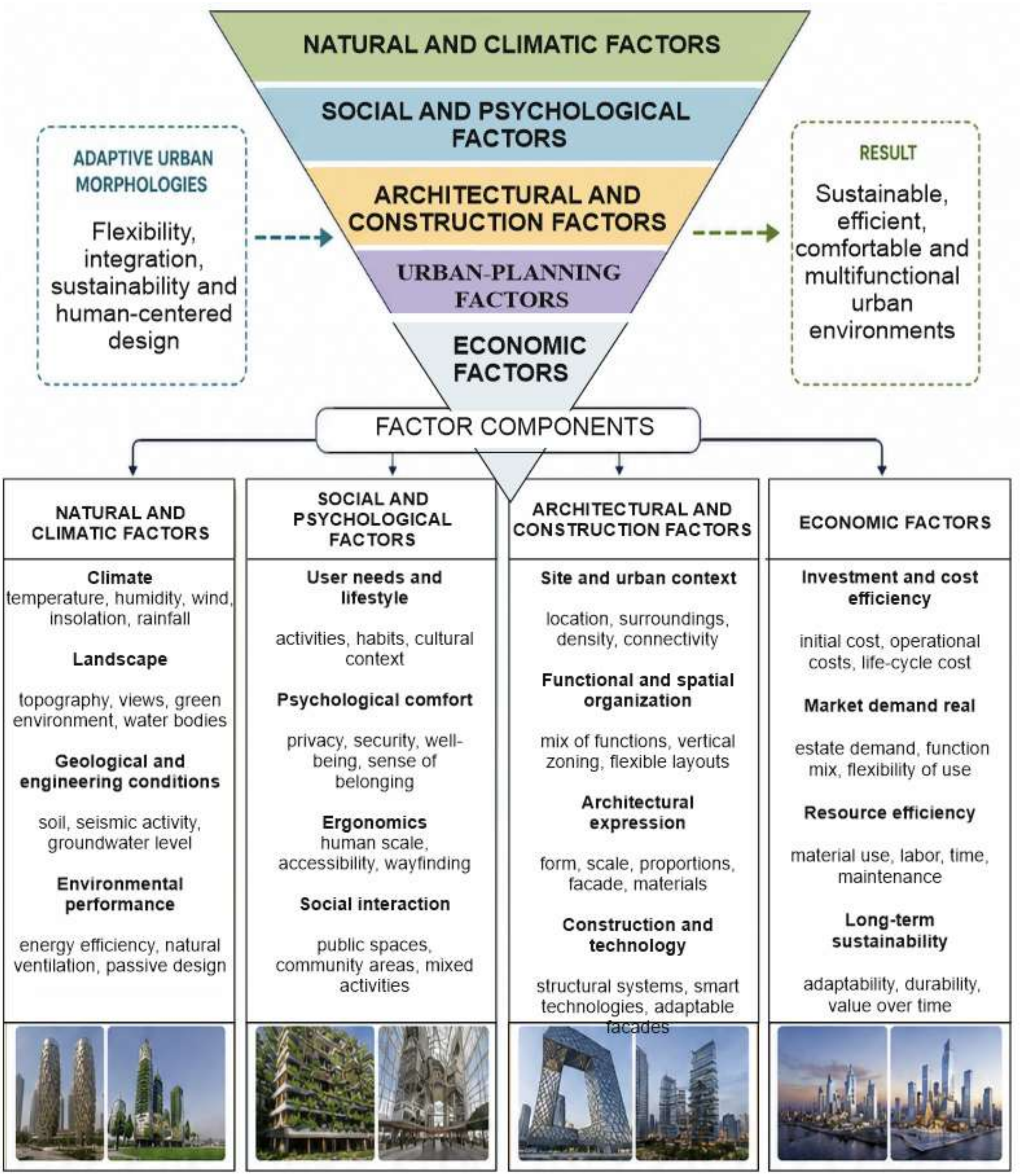


Figure 2.1. Factors

to transportation infrastructure. The central green atrium functions as a climatic and social core of the project.

Architectural and spatial factors include compositional structure, scale, proportions, visual perception, facade organization, and volumetric flexibility. In contemporary adaptive morphology, much attention is paid to creating expressive silhouettes, public podiums, multifunctional atriums, sky bridges, and open urban platforms.

The CCTV Headquarters in Beijing designed by OMA [7] demonstrates how architectural form can redefine urban relationships and create new models of multifunctional spatial organization. The continuous loop structure combines office, media, production, and public functions within a unified adaptive system.

Social and psychological factors are directly related to the creation of comfortable, human-oriented, and socially active architectural environments (fig.2.1). Contemporary mixed-use high-rise complexes increasingly focus on improving quality of life, social interaction, accessibility, and psychological comfort [8].

The “human factor” includes ergonomic, psychological, physiological, and socio-cultural characteristics of users. Modern adaptive urban morphology seeks to create spaces capable of supporting communication, recreation, work, privacy, and collective interaction within vertically organized environments.

Public spaces, sky terraces, atriums, co-working zones, recreational platforms, cultural functions, and green communal areas play an important role in forming social interaction within high-rise complexes.

One of the best examples is the Kampung Admiralty project in Singapore designed by WO. The project integrates housing, healthcare, retail, recreation, and public gardens into a vertically organized social environment focused on communication, accessibility, and community interaction.

The psychological perception of architectural space is also strongly connected with lighting, openness, natural materials, greenery, visual connectivity, and the flexibility of spatial organization. Open and adaptable environments contribute to improving emotional comfort and social engagement.

Environmental and technological factors have become dominant in contemporary adaptive architecture. Mixed-use high-rise complexes increasingly integrate renewable energy systems, intelligent engineering technologies, adaptive facades, water recycling systems, environmental monitoring, and smart building management systems (fig.2.1).

Adaptive technologies allow buildings to dynamically respond to climatic changes, occupancy levels, and environmental conditions. Intelligent facade systems, media structures, kinetic shading devices, and automated ventilation technologies significantly improve energy efficiency and environmental comfort.

An important example is the Media-TIC building in Barcelona designed by Cloud. The building integrates intelligent ETFE facade systems that regulate solar exposure and improve environmental performance while creating a technologically expressive architectural image.

Media architecture has also become an important component of adaptive urban morphology. Interactive facades, LED systems, and digital information surfaces increasingly influence the visual identity of contemporary mixed-use high-rise complexes.

The Yas Hotel Abu Dhabi designed by Asymptote Architecture demonstrates the integration of media technologies and adaptive architectural envelopes into urban space. Its dynamic LED shell transforms the appearance of the building and creates interactive visual communication with the city.

Economic factors significantly influence the scale, multifunctionality, technological complexity, and spatial organization of mixed-use high-rise complexes (fig.2.1). Rational use of financial, material, and labor resources is one of the key requirements in adaptive architectural design [13].

Mixed-use development allows developers to increase economic efficiency through the integration of multiple functions within one structure. Combining residential, commercial, office, hotel, and public functions creates continuous urban activity and improves the economic sustainability of projects.

Flexible and adaptive planning systems also increase the long-term viability of buildings by allowing transformation of spaces according to future needs and market conditions. Modular systems, transformable interiors, and multifunctional podiums improve operational flexibility and reduce future reconstruction costs.

The Hudson Yards development in New York designed by Kohn Pedersen Fox and other international studios demonstrates how large-scale mixed-use development can combine economic efficiency, transportation integration, public space, and adaptive urban morphology within a unified urban structure.

Therefore, the formation of mixed-use high-rise complexes through adaptive urban morphologies is influenced by a complex system of interconnected factors. Natural-climatic, urban-planning, social, environmental, technological, and economic factors collectively determine spatial organization, architectural image, environmental adaptability, and functional flexibility of contemporary high-rise architecture.

The analysis showed that adaptive urban morphology contributes to the creation of sustainable, multifunctional, technologically advanced, and human-oriented architectural environments capable of responding to contemporary urban challenges and future transformations.

2.2. Patterns of mixed-use high-rise complexes through adaptive urban morphologies

Today, there is a clear global tendency toward the development and popularization of mixed-use high-rise complexes as adaptive urban systems capable of integrating multiple functions within vertically organized environments. Contemporary cities increasingly require multifunctional architectural structures that combine residential, office, commercial, recreational, cultural, educational, and public functions in response to urban densification, technological progress, and changing human needs.

The integration of multiple functions within one architectural structure and their adaptation to changing environmental, social, and technological conditions represent one of the major advantages of mixed-use high-rise complexes compared to monofunctional buildings. Since their emergence, mixed-use high-rise complexes have undergone significant transformation depending on the historical period, urban context, environmental conditions, and patterns of urban development [1].

In order to analyze the regularities of forming mixed-use high-rise complexes through adaptive urban morphologies, it is necessary to identify several key positions according to which transformations can be monitored:

- the combination and hierarchy of functions;

- composition of spatial and functional blocks;
- diversity of mixed-use high-rise complex types;
- organization of vertical and horizontal urban processes;
- adaptability and flexibility of spatial structures;
- interaction between architecture and urban environment.

The analysis of contemporary practice made it possible to identify the following main functional blocks characteristic of mixed-use high-rise complexes (fig.2.2):

Residential blocks include apartments, serviced residences, hotels, co-living environments, temporary accommodation, and recreational living spaces integrated into vertically organized structures. Residential functions are often located in upper levels to ensure privacy, panoramic views, environmental comfort, and separation from highly active public zones.

Business and office areas include flexible workspaces, co-working environments, conference halls, meeting rooms, administration spaces, innovation hubs, and creative studios. Contemporary office spaces increasingly shift toward adaptive and open planning systems capable of responding to changing work patterns and digital communication technologies [2].

Communication zones play a crucial role in adaptive urban morphology. These include atriums, sky lobbies, public terraces, multifunctional halls, internal streets, bridges, observation decks, corridors, stair-elevator cores, recreational platforms, and social interaction zones.

In contemporary mixed-use high-rise complexes, atriums and public platforms increasingly function as internal urban spaces connecting different functional layers of the building. Vertical communication systems become important compositional and social elements of adaptive morphology.

Commercial functions include retail galleries, restaurants, cafes, entertainment centers, exhibition spaces, cultural platforms, and shopping areas integrated into podium structures or lower floors. These functions create active public interfaces and strengthen pedestrian interaction with the urban environment.

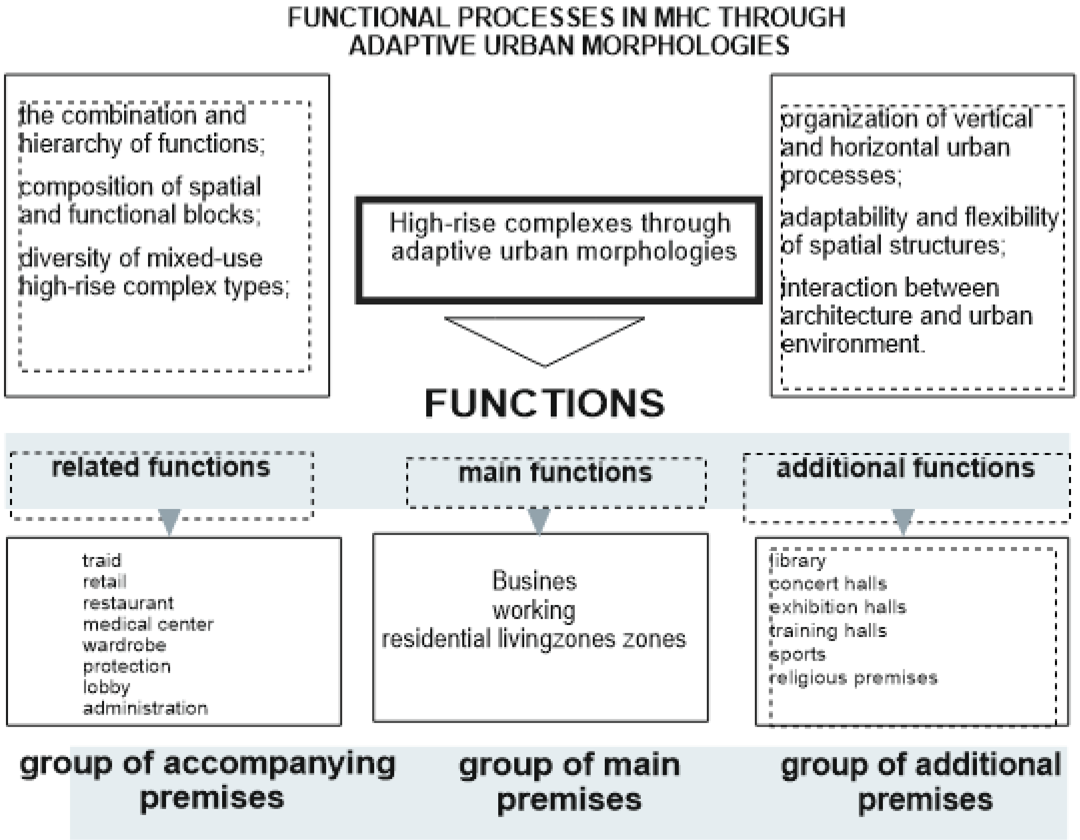


Figure 2.2. Functions

Mixed-use high-rise complexes increasingly integrate educational centers, healthcare facilities, sports complexes, wellness centers, children's facilities, libraries, cultural institutions, and public recreational spaces. Such integration transforms high-rise structures into multifunctional urban ecosystems [3].

Technical blocks include engineering systems, parking areas, logistics spaces, service zones, energy *systems*, and maintenance facilities. In adaptive urban morphology, infrastructure is increasingly integrated into architectural composition rather than hidden as secondary functional elements.

The percentage composition and spatial relationship between these functional blocks vary depending on the scale of the complex, urban situation, climatic conditions, transportation accessibility, and social requirements. Contemporary mixed-use high-rise complexes demonstrate high flexibility in combining different functions and adapting them to changing urban processes.

According to the dominant combination of functions, several main functional patterns of mixed-use high-rise complexes can be distinguished (fig.2.3):

- residential-business complexes;
- business-cultural complexes;
- business-educational complexes;
- residential-commercial complexes;
- hotel-entertainment complexes;
- transit-oriented multifunctional complexes;
- vertical mixed-use urban hubs.

One of the main tendencies in the development of mixed-use high-rise complexes is the increasing role of public infrastructure and open-access spaces. Contemporary adaptive urban morphologies increasingly integrate public terraces, elevated parks, sky gardens, open plazas, atriums, observation decks, and multifunctional recreational platforms into vertical structures [4].

Public spaces in mixed-use high-rise complexes can generally be divided into two main categories:

- open urban spaces: plazas, parks, roof gardens, pedestrian terraces, elevated courtyards;
- internal multifunctional public spaces: atriums, galleries, exhibition zones, restaurants, shopping areas, and cultural environments.

The spatial organization of mixed-use high-rise complexes increasingly reflects the principles of openness, flexibility, and social interaction. Contemporary high-rise environments no longer consist of isolated functions but instead operate as integrated adaptive systems with strong internal and external connectivity.

An important aspect of adaptive urban morphology is the differentiation between public and private spatial systems. In mixed-use high-rise complexes, public zones are usually concentrated in podiums and lower levels, while semi-private and private functions are distributed vertically according to their degree of accessibility and functional requirements [5].

The analysis of contemporary examples showed that several typological and compositional patterns form the basis of mixed-use high-rise complexes:

- dominant urban-planning position within the city structure;
- vertical functional zoning;
- integration of public and private environments;
- atrium and podium organizational schemes;
- compact, linear, or hybrid compositional systems;
- central communication cores;
- modularity and flexibility of planning structures;
- adaptability of functional systems;
- environmental integration and bioclimatic strategies;
- multifunctional public interfaces.

One of the best examples of adaptive mixed-use morphology is Marina One in Singapore designed by Ingenhoven Architects [6]. The project combines office towers, residential functions, retail spaces, public infrastructure, and ecological landscapes organized around a central green atrium functioning as an internal urban ecosystem.

Another important example is the CCTV Headquarters in Beijing designed by OMA. The project demonstrates a hybrid organizational structure in which media, office, public, and infrastructural functions are integrated into a continuous loop system that transforms traditional skyscraper typology.

The Kampung Admiralty project in Singapore designed by WOHA illustrates the pattern of vertically integrated public infrastructure combining housing, healthcare, retail, community spaces, and landscape systems within a compact urban environment.

The location of mixed-use high-rise complexes within the planning structure of the city significantly influences their morphology and architectural organization. Placement in the city center, middle zone, or periphery affects height limitations, density, transportation accessibility, and compositional significance (fig.2.3).

Complexes located in central business districts are characterized by:

- high building density;
- multifunctional vertical organization;

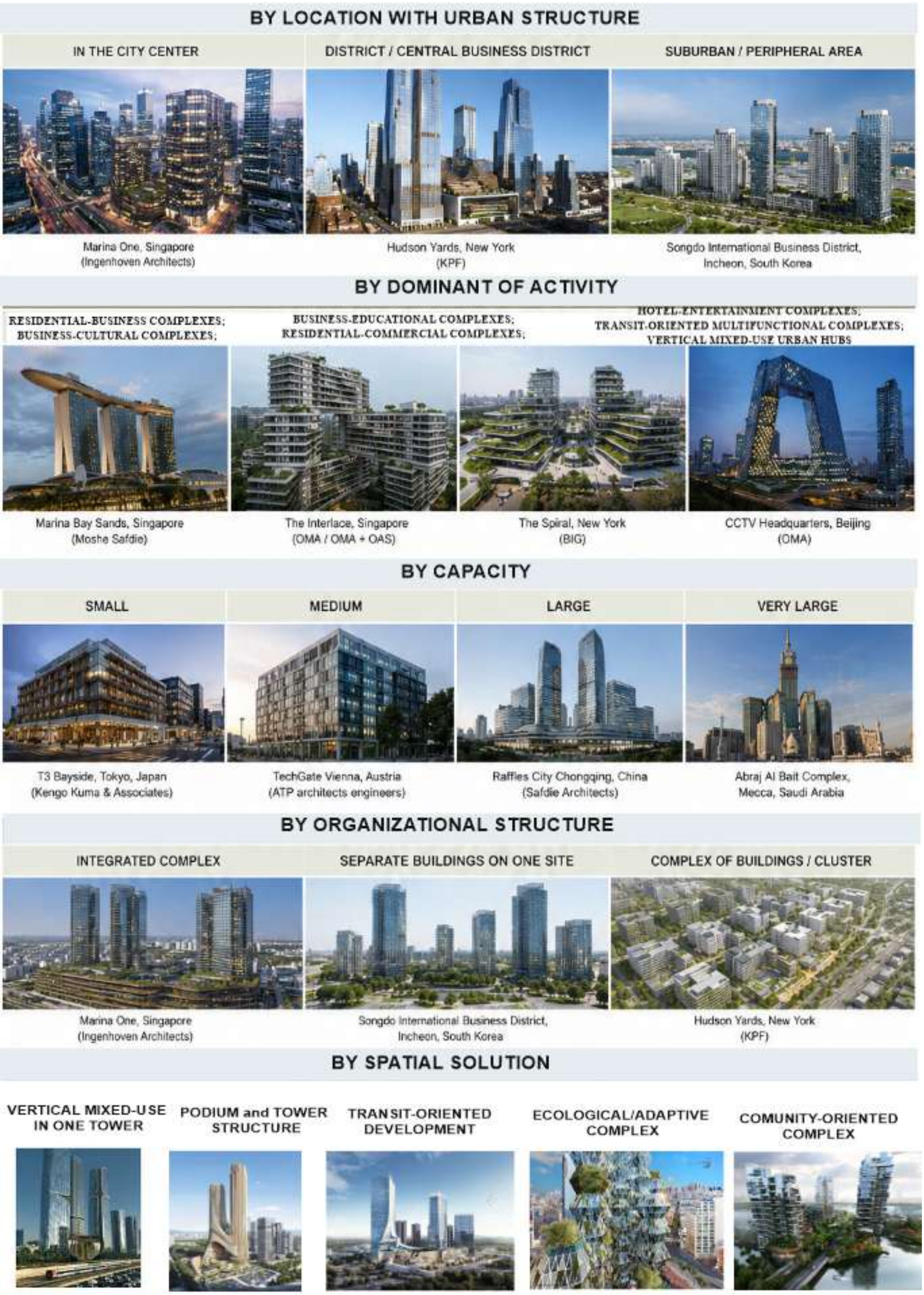


Figure 2.3. Typology

- integration with transportation systems;
- intensive public activity;
- dominant urban silhouette.

Peripheral mixed-use high-rise complexes increasingly function as autonomous urban fragments or "vertical cities" integrating housing, recreation, commerce, education, healthcare, and public infrastructure into self-sufficient adaptive environments (fig.2.3).

The planning and compositional schemes of mixed-use high-rise complexes largely depend on the organization of horizontal and vertical communication systems. Compact schemes with central communication cores are usually associated with open and flexible planning structures, while linear or hybrid systems allow corridor-based or combined planning organization.

The typology also presents a *classification of mixed-use high-rise complexes through adaptive urban morphologies*. It demonstrates how different compositional layouts, spatial organizations, and volumetric configurations influence the formation of contemporary multifunctional urban environments. The diagram systematizes mixed-use high-rise complexes according to their architectural composition, organization of open spaces, density, circulation systems, and adaptability to urban conditions.

The first compositional type shown in the scheme is the **Tower-enclosed layout**. In this configuration, high-rise towers are positioned along the perimeter of the site, creating an enclosed or semi-enclosed central public space. The towers form a strong urban boundary while simultaneously protecting the internal courtyard from excessive noise, wind, and dense surrounding development. Such schemes are often characteristic of complexes located in central business districts where high density and clear urban definition are required. The central open space usually functions as a public plaza, landscaped courtyard, or atrium-like urban environment. This pattern creates a strong dominant urban-planning position within the city structure and strengthens spatial orientation (fig.2.4).

An example of this pattern is *One Za'abeel* in Dubai, where vertically expressed towers frame a central urban zone and create a recognizable landmark composition. The scheme demonstrates how tower-enclosed systems combine density with the creation of protected public environments.

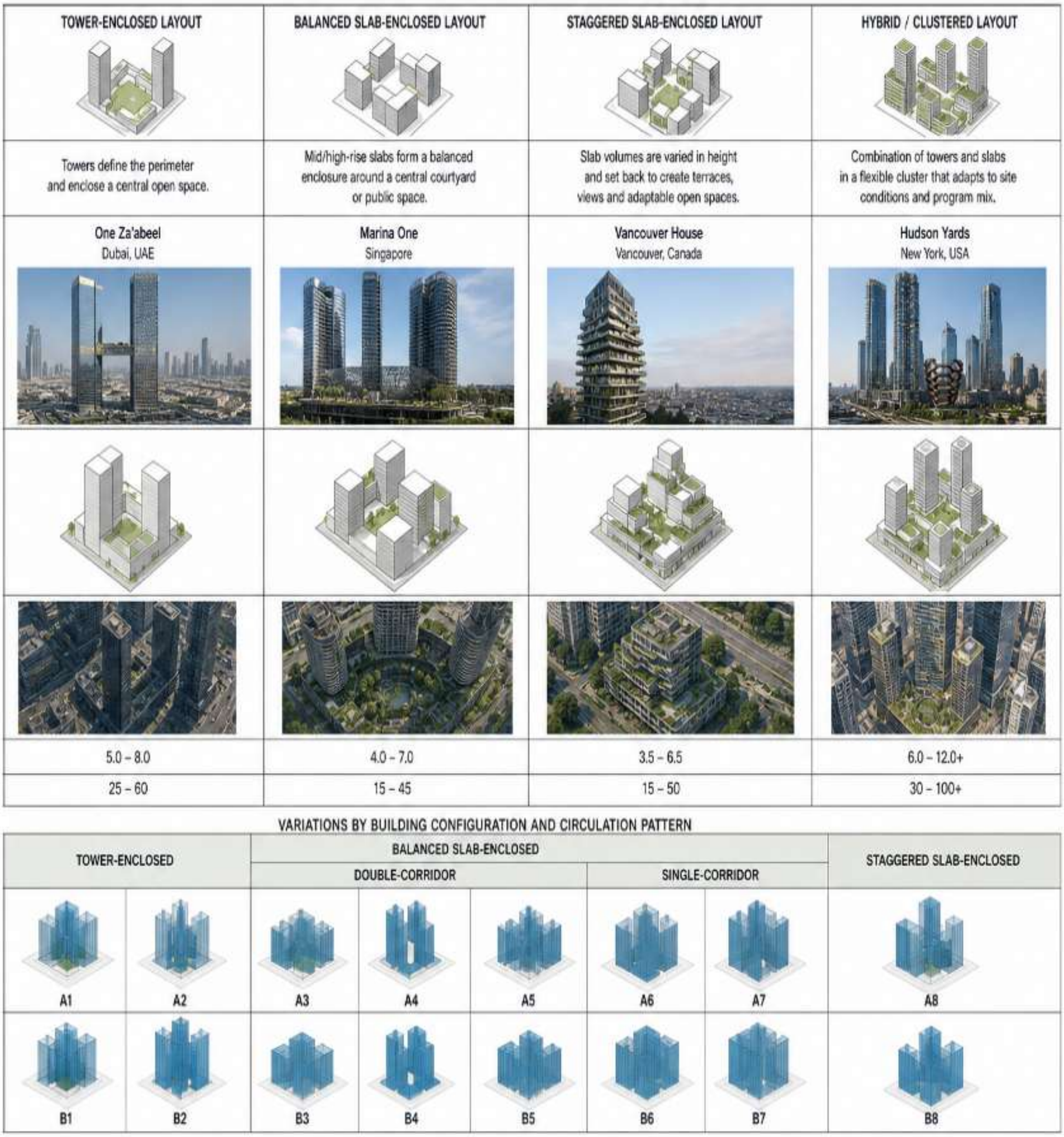


Figure 2.4. Typological patterns of formation of mix used high rise complexes through adaptive urban morphologies

The second type is the **balanced slab-enclosed layout**. In this system, mid-rise or high-rise slab buildings are arranged around a central courtyard or public open space. The composition is more horizontally balanced compared to tower-dominated systems and creates stronger visual continuity between buildings and open public areas. The balanced slab arrangement allows efficient natural lighting, ventilation, and social interaction between different functional blocks. Such compositions are often used in mixed-use residential-business complexes where environmental comfort and integration with the urban landscape are important.

An example presented in the scheme is *Marina One* in Singapore designed by Ingenhoven Architects. The complex integrates residential, office, retail, and public functions around a large central green atrium that functions as an internal urban ecosystem. The scheme illustrates how slab-enclosed structures contribute to environmental integration and bioclimatic strategies.

The third compositional type is the **staggered slab-enclosed layout**. In this configuration, slab volumes are arranged with different heights and setbacks, creating terraces, visual permeability, and adaptive open spaces. The staggered organization improves daylight penetration, natural ventilation, and panoramic views while reducing the visual heaviness of dense high-rise development. This type is often associated with adaptive urban morphology because it allows flexible responses to topography, climate, and urban context (fig.2.4).

The scheme uses *Vancouver House* in Canada as an example of this pattern. The project demonstrates how staggered and transformed building volumes create a dynamic architectural silhouette and strengthen the relationship between architecture and the surrounding cityscape.

The fourth type shown in the scheme is the **hybrid or clustered layout**. This configuration combines towers, slab buildings, podiums, bridges, and interconnected public spaces into a unified adaptive urban cluster. Hybrid systems are highly flexible and capable of accommodating complex multifunctional programs including housing, offices, commerce, recreation, culture, transportation, and public infrastructure. Such complexes often function as “vertical cities” within contemporary metropolitan environments.

An example is *Hudson Yards* in New York, where multiple towers and mixed-use structures are integrated into a large-scale adaptive urban system connected by public spaces, transport infrastructure, and pedestrian networks. This type demonstrates the highest level of multifunctionality and urban integration.

The scheme also includes a comparative analysis of the main spatial indicators of each compositional type. These include:

- Floor Area Ratio, which reflects urban density;
- approximate building height and number of floors;
- organization of open spaces;
- relationship between built volume and landscape systems.

The lower part of the scheme demonstrates variations of organizational structures according to building configuration and circulation systems. These are divided into:

- recessed compositions;
- regular alignment systems;
- double-corridor organizational patterns;
- single-corridor systems.

The recessed configurations create terraces, visual articulation, and environmental adaptability, while regular systems provide higher spatial efficiency and compact organization. Double-corridor systems improve circulation efficiency in large multifunctional structures, whereas single-corridor systems provide better natural lighting and environmental comfort.

The scheme also highlights several key elements characteristic of adaptive urban morphology:

- public open spaces and atriums;
- green terraces and roof gardens;
- primary pedestrian connections;
- vehicular access and parking systems;
- vertical communication cores.

Overall, the scheme demonstrates that contemporary mixed-use high-rise complexes are formed through a combination of adaptive compositional systems, multifunctional integration, environmental strategies, and flexible spatial organization. The typological patterns presented in the scheme illustrate how architecture responds to urban density, environmental conditions, transportation infrastructure, and changing social needs while creating sustainable and human-oriented urban environments.

Thus, the analysis of patterns of mixed-use high-rise complexes through adaptive urban morphologies revealed that contemporary high-rise architecture increasingly functions as an integrated adaptive urban ecosystem characterized by multifunctionality, flexibility, environmental responsiveness, social connectivity, and vertical urban integration.

2.3. Architectural features of designing mixed-use high-rise complexes through adaptive urban morphologies

The formation of mixed-use high-rise complexes through adaptive urban morphologies is closely connected with the structure of the urban environment, the density of development, climatic conditions, transportation systems, and the functional organization of the city. Contemporary high-rise architecture is increasingly transforming from isolated monofunctional towers into integrated urban systems capable of adapting to changing urban, environmental, and social conditions. In this context, adaptive urban morphology becomes an important principle for the formation of spatially flexible, environmentally integrated, and multifunctional architectural environments.

One of the main factors influencing the formation of mixed-use high-rise complexes is the type of urban morphology. In **compact urban morphologies** characterized by high-density development and limited land resources, architectural solutions are aimed at vertical intensification of functions and efficient land use (fig.2.5). In such conditions, mixed-use complexes are usually formed as compact podium-and-tower structures with active lower levels connected to public transportation and pedestrian systems. The organization of multi-level public spaces, atriums, roof terraces, and elevated pedestrian platforms allows compensation for the deficit of open urban spaces within dense city fabric. Compact morphology also requires clear vertical zoning of functions and efficient placement of communication cores.

Linear urban morphology, typical for waterfronts, transportation corridors, and elongated urban structures, generates different architectural principles (fig.2.5). In such conditions, mixed-use high-rise complexes are organized along visual and movement axes, which determines the use of linear, terraced, or stepped compositional systems. Orientation toward landscape and panoramic views becomes an important planning principle. Terraced forms improve natural lighting, visual permeability, and environmental comfort while simultaneously strengthening the relationship between architecture and the surrounding landscape. The elongated podium structure often functions as a continuous public corridor integrating commercial, recreational, and social functions.

Polycentric urban morphology significantly influences the formation of adaptive mixed-use high-rise complexes (fig.2.5). In such urban systems, architecture develops not around a single dominant center but through the formation of multiple multifunctional urban nodes connected by transportation and infrastructural systems. This creates conditions for clustered and hybrid compositions in which several towers, podiums, bridges, and public spaces are integrated into a unified adaptive structure. Such organization increases functional flexibility, strengthens public connectivity, and forms self-sufficient urban fragments capable of functioning independently within the larger city structure.

Special morphological principles are characteristic of **water-adjacent urban environments**. In waterfront conditions, mixed-use high-rise complexes are formed through stronger interaction with landscape and environmental systems (fig.2.5). Architectural composition increasingly uses terraced forms, lower podiums, open visual corridors, and permeable public edges connected with the waterfront. Water becomes not only an environmental element but also a regulator of microclimate and spatial organization. In such morphology, the integration of green-blue infrastructure, natural ventilation systems, and flood-resistant planning strategies becomes especially important.

The architectural-compositional organization of mixed-use high-rise complexes is based on the *interaction between vertical dominance and human-scale public environments*. One of the most widespread compositional approaches is the podium-and-tower system, where the podium contains public and commercial functions while the tower accommodates residential, office, or hotel spaces. Such organization creates a clear hierarchy between public, semi-public, and private zones while maintaining spatial unity of the complex. The podium also forms an active interface between the building and the city, strengthening pedestrian activity and public accessibility.

Another important compositional principle is the use of cluster and hybrid systems. Contemporary mixed-use complexes increasingly consist of several interconnected volumes with bridges, atriums, terraces, and shared public spaces. Such structures improve flexibility and allow adaptation to complex urban conditions. Hybrid morphology also reduces the visual scale of dense development and creates intermediate spatial levels between towers and surrounding urban fabric.

Stepped and terraced compositions are widely used in adaptive urban morphology because they improve environmental performance and spatial adaptability. The transformation of building massing allows optimization of daylight penetration, natural ventilation, and visual permeability while simultaneously integrating green terraces and public recreational platforms into the vertical structure. Such forms are especially effective in dense urban environments and warm climatic conditions.

The functional-planning structure of mixed-use high-rise complexes is based on the principle of vertical multifunctional zoning. Public functions such as retail, cultural spaces, entertainment, and transportation infrastructure are usually concentrated in lower levels due to their direct connection with urban flows. Semi-public functions including offices, co-working spaces, and educational environments occupy middle levels, while residential and hotel spaces are in upper floors where better environmental comfort and visual qualities can be achieved.

An important feature of adaptive urban morphology is the **integration of multifunctional public spaces** into the vertical structure of the complex. Atriums, sky lobbies, public terraces, and internal pedestrian routes increasingly function as internal urban spaces connecting different functions within the building. Such spaces strengthen social interaction, improve visual communication, and increase permeability of the architectural environment.

Flexibility and adaptability of planning structures are also key principles in the formation of mixed-use high-rise complexes. Contemporary urban conditions require buildings capable of transformation according to changing functional and economic

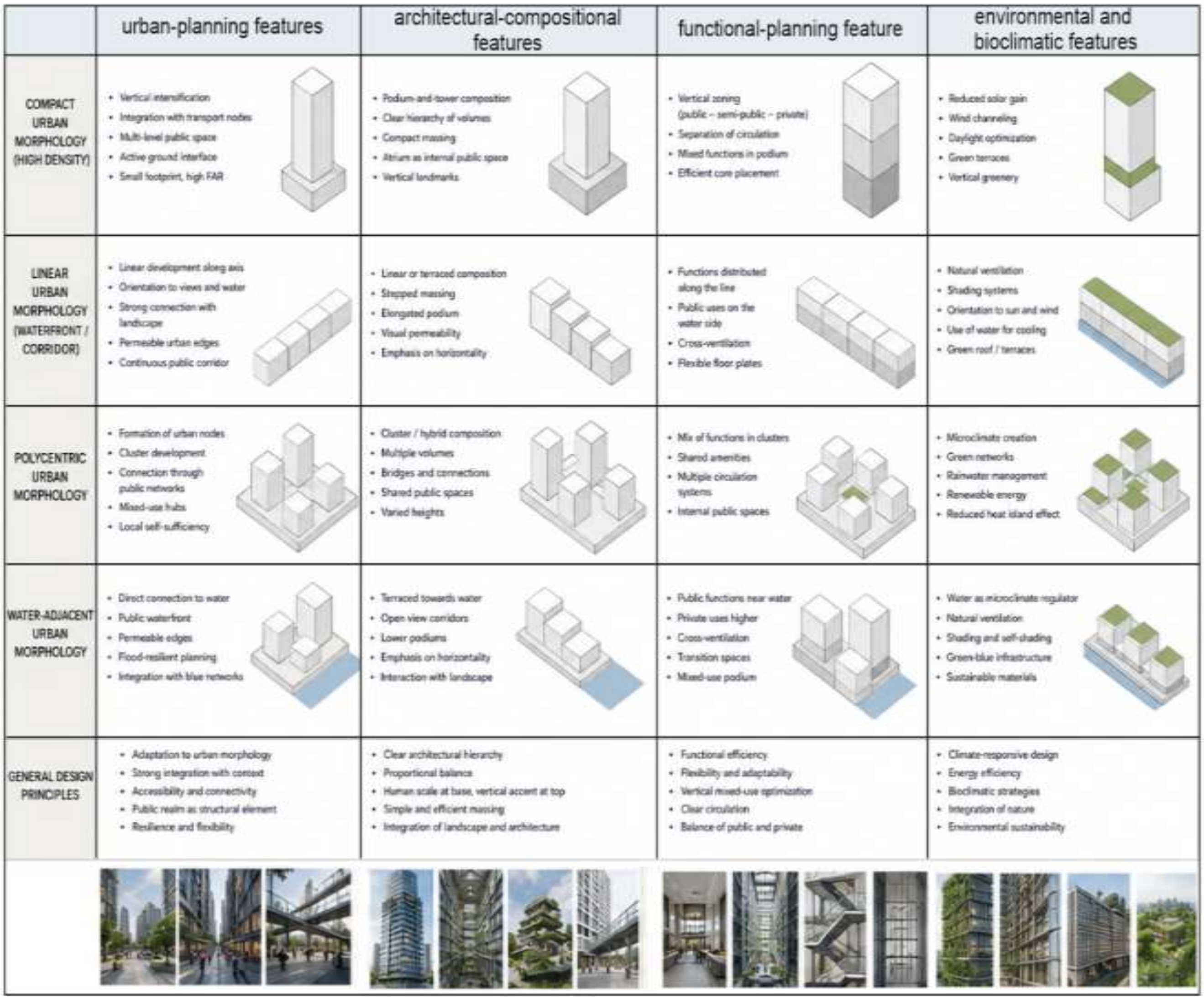


Figure 2.5. Architectural features of designing mixed-use high-rise complexes through adaptive urban morphologies

demands. Therefore, modular structural grids, open floor systems, flexible planning layouts, and multifunctional spaces become important components of adaptive morphology. Flexible systems increase the long-term viability of buildings and improve their ability to adapt to future transformations.

Environmental and bioclimatic integration is another important architectural feature of adaptive urban morphology. Contemporary mixed-use high-rise complexes increasingly incorporate natural ventilation systems, adaptive facades, solar protection devices, vertical greenery, roof gardens, and water-management strategies. Environmental adaptation influences not only engineering systems but also the volumetric and spatial organization of the building itself.

Green terraces, vertical landscaping, and ecological podiums improve microclimatic conditions and strengthen the integration between architecture and urban ecology. Adaptive facade systems and shading devices allow buildings to respond dynamically to climatic conditions and reduce energy consumption. Environmental strategies are therefore integrated directly into the architectural morphology of the complex rather than functioning as separate technological additions.

Thus, the formation of mixed-use high-rise complexes through adaptive urban morphologies is based on the interaction between urban-planning conditions, compositional organization, functional flexibility, and environmental adaptation. Contemporary mixed-use high-rise architecture increasingly develops as a flexible and integrated urban system capable of responding to different morphological structures of the city while simultaneously creating sustainable, multifunctional, and environmentally responsive urban environments.

Conclusions of second section

1. The analysis of contemporary trends showed that mixed-use high-rise complexes are transforming into adaptive urban systems that integrate residential, commercial, office, public, and recreational functions within flexible vertical environments. The formation of such complexes is increasingly based on principles of adaptive urban morphology, environmental integration, multifunctionality, and spatial flexibility.

2. The study of factors influencing the formation of mixed-use high-rise complexes revealed that urban morphology, climatic conditions, transportation infrastructure, density of development, and environmental requirements significantly affect their architectural and planning organization. Depending on compact, linear,

polycentric, or waterfront urban structures, different compositional, functional, and bioclimatic design approaches are formed.

3. The analysis of architectural features established that the design of mixed-use high-rise complexes through adaptive urban morphologies is based on the interaction of urban-planning, compositional, functional-planning, and environmental principles. Contemporary high-rise architecture increasingly develops as an integrated adaptive system characterized by vertical functional zoning, hybrid compositional structures, multifunctional public spaces, flexible planning systems, and environmentally responsive architectural solutions.

SECTION 3. RESEARCH APPROVAL: PROJECT OF MIXED-USE HIGH-RISE COMPLEX

3.1.Analysis of the design territory

The selected site for the design of the mixed-use high-rise complex through adaptive urban morphologies is located within the urban structure of Doha, Qatar, in the Al Hilal district. The territory occupies an advantageous urban-planning position due to its integration into the city transportation system, proximity to commercial and public infrastructure, and location within an actively developing multifunctional urban environment. The conducted analysis included the study of the location of the site within the city structure, district structure, functional zoning, transport and pedestrian connections, and spatial boundaries of the territory.

The analysis of the project site within the city structure demonstrates that the territory is located in the central-eastern part of Doha within a dynamically developing urban zone connected with major transportation corridors and multifunctional urban infrastructure. The site is situated between important urban districts and possesses convenient access to the central business areas of the city, Hamad International Airport, and coastal recreational territories (fig.3.1).

Figure 3.1.Analisys of territory

The surrounding urban structure includes residential, commercial, business, public, recreational, and transport zones. Residential development dominates the urban fabric surrounding the territory, while commercial and business functions are concentrated along major transportation corridors and central districts of Doha. Such multifunctional urban context creates favorable conditions for the formation of a mixed-use high-rise complex integrating residential, office, retail, hospitality, and public functions.

An important urban-planning characteristic of the site is its accessibility to major city infrastructure elements including (fig.3.1):

- Hamad International Airport;
- Doha central business district;
- shopping centers;
- cultural and sports facilities;
- public parks and recreational zones.

The site is also integrated into the city transport framework through major highways, main urban streets, and planned metro infrastructure. This increases the accessibility of the territory and supports the principles of adaptive urban morphology based on multifunctionality and urban connectivity.

The coastal location of Doha and the proximity of recreational and green zones positively influence the environmental conditions of the territory and create opportunities for implementing environmental and bioclimatic architectural strategies.

At the district level, the project site is located within the Al Hilal district, characterized by mixed urban development and active multifunctional infrastructure. The surrounding urban environment combines residential neighborhoods with commercial, public, educational, and service functions.

The site is positioned near important district-level objects including:

- hotels;
- shopping centers;
- healthcare facilities;
- sports infrastructure;

- public parks;
- cultural institutions.

One of the most important urban-planning advantages of the territory is its proximity to Al Muntazah Park, which creates favorable environmental conditions and strengthens the recreational potential of the future complex.

The district structure is characterized by a relatively regular street network formed by primary, secondary, and local streets. The site occupies a strategically visible position along Rawdat Al Khail Street, one of the important transportation corridors within the district. Such positioning increases visual accessibility and creates favorable conditions for the formation of a dominant mixed-use high-rise complex within the urban environment.

The surrounding development is predominantly medium-density residential morphology combined with local commercial and public functions. This creates a balanced urban context suitable for the integration of adaptive multifunctional architecture (fig.3.2).

The conducted functional analysis demonstrates that the project site is located within a multifunctional urban block characterized by a combination of residential, commercial, administrative, retail, service, and public functions.

Residential areas dominate in the urban fabric and form the spatial background of the territory. Commercial and business functions are concentrated primarily along the western and eastern edges of the site near the main transportation corridors. Administrative and office facilities are near the southern part of the territory, supporting the business and multifunctional character of the district.

Retail and service functions are in the surrounding block structure through shopping facilities, restaurants, cafes, and local services. Public and cultural facilities are also located within walking accessibility from the site, contributing to the formation of a socially active urban environment.

An important feature of functional organization is the presence of public spaces and landscaped elements integrated into the surrounding urban structure. Such

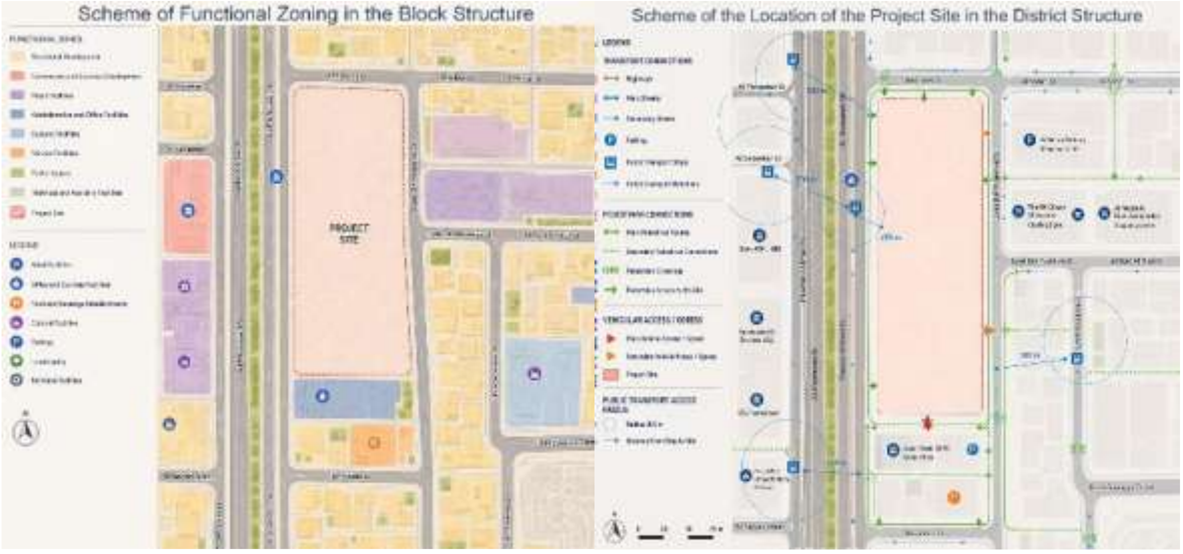


Figure 3.2. Functional and transport analysis of territory

organization supports the principles of adaptive urban morphology focused on environmental integration, pedestrian accessibility, and multifunctional urban activity.

The site itself possesses sufficient dimensions and regular geometry for the integration of multiple functions within a unified adaptive high-rise structure. The surrounding functional diversity creates favorable conditions for the development of:

- residential functions;
- office spaces;
- retail infrastructure;
- hospitality environments;
- public recreational areas;
- cultural and social functions.

The transport analysis revealed that the site possesses a high level of accessibility and strong integration into the district and city transportation network (fig.3.2).

The territory is directly connected with major transportation arteries including Rawdat Al Khail Street, D Ring Road, Al Rayyah Street, surrounding secondary urban streets. The street surrounding the site has a hierarchical organization that allows efficient distribution of vehicle and pedestrian movement. The presence of major and secondary roads creates opportunities for separating public, service, technical, and emergency access systems within the future complex.

One of the advantages of territory is the accessibility of public transportation infrastructure. Several public transport stops are located within walking distance of the site at approximately:150 m, 180 m, 220 m, 250 m and 280 m.

Such accessibility significantly improves connectivity with other districts of Doha and supports sustainable urban mobility principles.

Pedestrian infrastructure around the site is relatively well developed and includes main pedestrian routes, secondary pedestrian connections, controlled pedestrian crossings, direct pedestrian access to the territory.

The analysis also demonstrates that the site possesses the potential for organizing several independent vehicular access and egress points. This allows the future mixed-use high-rise complex to separate:

- residential access;
- public access;
- technical and service circulation;
- emergency transportation routes.

The geometry of the site additionally creates opportunities for organizing underground and multi-level parking systems integrated into the podium structure while preserving active pedestrian zones at ground level.

The project site possesses a regular elongated rectangular configuration, which creates favorable conditions for flexible architectural and planning organization. The geometry of the territory allows efficient placement of podium structures, tower volumes, public spaces, technical infrastructure, and landscaped zones.

The borders of the site are clearly defined by surrounding streets and urban blocks, simplifying functional zoning and circulation organization. The territory has high visual openness and strong accessibility from surrounding streets, which increases its urban significance and potential for creating a dominant architectural composition.

The spatial organization of the territory allows the implementation of adaptive urban morphology principles including:

- vertical multifunctional zoning;
- podium-and-tower systems;
- public terraces and plazas;
- green transitional spaces;
- integrated pedestrian environments;
- environmental and bioclimatic strategies.

The orientation of the site also creates favorable opportunities for natural lighting, solar control, and environmental adaptation. The dimensions of the territory allow the formation of hierarchical public, semi-public, and private spaces integrated into the multifunctional structure of the future complex.

Thus, the conducted analysis of the design territory demonstrates that the selected site possesses favorable urban-planning, functional, transportation, environmental, and spatial characteristics for the formation of a mixed-use high-rise complex through adaptive urban morphologies. The integration of multifunctional infrastructure, transport accessibility, environmental potential, and flexible spatial organization creates strong conditions for the development of an adaptive, sustainable, and multifunctional architectural environment within the urban structure of Doha.

3.2.The concept of mixed-use high-rise complex

The concept of the mixed-use high-rise complex through adaptive urban morphologies is based on the idea of creating an integrated vertical urban environment that combines residential, commercial, public, recreational, and environmental functions within a unified adaptive architectural system. The building is designed not only as an isolated high-rise structure, but as a multifunctional urban organism capable of interacting with the surrounding city morphology, climatic conditions, and modern social processes.

The main conceptual idea of the project is the formation of a dynamic adaptive tower that responds to the dense urban environment of Doha while simultaneously creating a human-oriented and environmentally integrated architectural space. The building acts as a vertical continuation of the urban structure, integrating public activity, landscape systems, and multifunctional spaces into one flexible spatial composition.

The volumetric-spatial solution of the complex is formed through an expressive asymmetrical composition emphasizing movement, transformation, and adaptability. The tower volume gradually changes along the height of the building through shifting terraces, recessed facade elements, and dynamic horizontal platforms integrated into the architectural composition. Such morphology creates a visual effect of fragmentation and movement while reducing the visual scale of the tower and strengthening its relationship with the human scale of the surrounding urban environment.

The composition of the building is based on the interaction between a compact vertical tower and an expanded multifunctional podium structure. The podium forms the public base of the complex and integrates commercial, recreational, and entrance functions connected with the pedestrian urban environment. Above the podium, the tower volume develops vertically through a system of transformed terraces and open landscape platforms that create transitional spaces between architecture and nature.

One of the main compositional features of the project is the integration of open terraces and landscaped sky platforms into the facade structure. These elements form intermediate recreational zones and create environmental breaks within the vertical morphology of the building. The terraces improve environmental comfort, provide shaded outdoor spaces, and strengthen visual interaction between interior spaces and the surrounding cityscape. Such organization reflects the principles of adaptive urban morphology and bioclimatic integration.

The facade solution of the complex is based on the combination of transparent glazing systems, dark metallic elements, perforated shading structures, and integrated greenery. The facade acts not only as an enclosing structure but also as an adaptive environmental system responding to climatic conditions and solar exposure.

Large glass surfaces emphasize the openness and multifunctionality of the complex while creating panoramic visual connections with the city. The reflective glazing visually reduces the massiveness of the tower and strengthens the perception of lightness and transparency. At the same time, the integration of dark horizontal facade elements and inclined shading systems creates depth, contrast, and dynamic articulation of the volume (fig 3.3).

Figure 3.3 Concept idea

An important element of the facade concept is the use of adaptive shading structures inspired by the principles of climatic responsiveness typical for Middle Eastern architecture. Horizontal louvers and perforated facade fragments reduce excessive solar radiation, improve thermal comfort, and create changing shadow patterns on the facade surface throughout the day. These elements also strengthen the dynamic visual character of the building and emphasize its technological and adaptive image.

The integration of vegetation into the facade composition forms another essential part of the architectural concept. Green terraces, planted balconies, and rooftop landscaping create vertical ecological systems integrated into the morphology of the tower. Vegetation softens the technological appearance of the building, improves microclimatic conditions, and strengthens the connection between architecture and nature within the dense urban environment.

The material solution of the complex reflects the concept of contemporary adaptive high-rise architecture. The main materials used in the project include:

- structural glass systems;
- aluminum and steel facade panels;
- perforated metal shading structures;
- natural stone and composite materials at podium levels;
- landscape and water elements are integrated into public spaces.

The combination of transparent and solid materials creates a balance between openness and protection while emphasizing the multifunctional character of the building. The dark metallic facade elements visually frame the transparent glazing systems and strengthen the sculptural quality of the architectural composition.

The lower podium levels are designed with larger horizontal elements and more massive facade articulation in order to create a strong visual connection with the urban scale of the pedestrian environment. The upper tower levels become lighter and more transparent, emphasizing the verticality and openness of the building silhouette within the city skyline.

The master plan of the mixed-use high-rise complex through adaptive urban morphologies is based on the principles of multifunctionality, environmental integration, pedestrian accessibility, and adaptive spatial organization. The conceptual idea of the territory development is aimed at creating an integrated urban environment where residential, public, recreational, and service functions are combined within a unified landscape and circulation system. The master plan forms not only the functional organization of the site, but also creates a comfortable and environmentally adaptive urban space connected with the surrounding district structure (fig 3.4).

The spatial organization of the territory is formed according to the principles of adaptive urban morphology, where the building becomes the compositional core of the site, while the surrounding open spaces create a system of public, semi-public, and recreational environments. The elongated geometry of the site allowed the organization of a clear functional structure with separated pedestrian and transport flows, landscaped public spaces, and service infrastructure integrated into the overall composition.

The designed building occupies the central part of the territory and forms the dominant architectural element of the site. Its placement creates visual openness from the surrounding streets and allows the formation of landscaped buffer zones around the perimeter of the complex. Such organization improves environmental comfort, visual perception, and pedestrian accessibility.

Figure 3.4 Masterplan

The main compositional idea of the master plan is based on the creation of a gradual transition from active public spaces to more private recreational environments. Publicly accessible functions are concentrated along the perimeter of the territory near the main pedestrian and transportation connections, while quieter recreational zones are organized deeper within the site. This creates a hierarchy of spaces corresponding to the multifunctional structure of the complex.

The territory is organized through a system of pedestrian plazas, landscaped areas, recreational courtyards, sports zones, and seating spaces integrated into a unified landscape framework. The main entrance plaza is located along the eastern side of the territory and functions as the primary public space connecting the building with surrounding pedestrian flows and urban infrastructure. This plaza creates a representative entrance zone and improves the visual accessibility of the complex from the district structure.

An important element of the concept is the integration of green infrastructure into the master plan organization. Landscaping is distributed throughout the site and forms environmental buffer zones between pedestrian areas, transport infrastructure, and the building itself. Trees and planted zones improve microclimatic conditions, provide shading, reduce overheating, and strengthen the environmental quality of the territory, which is especially important in the climatic conditions of Doha.

The recreational courtyard located in the central and southern part of the site creates a semi-private environment for residents and users of the complex. This zone includes seating areas, shaded pedestrian spaces, and landscape elements designed for rest, communication, and everyday recreational activity. The courtyard space acts as an internal urban oasis integrated into the dense multifunctional environment of the complex.

Special attention is paid to public recreational functions. The southern part of the territory contains children’s playgrounds and sports grounds integrated into landscaped public zones. Such organization supports the concept of multifunctional urban living and creates opportunities for social interaction and healthy outdoor activity.

The transport organization of the territory is based on the separation of pedestrian, service, and vehicular flows. Main vehicular access points are organized from the eastern and southern sides of the site, allowing convenient access to parking and technical infrastructure without disrupting pedestrian environments. Separate access to loading and unloading areas improves operational functionality and reduces conflicts between public and service circulation systems.

Parking areas are positioned along the northern and southern parts of the site to provide convenient accessibility while minimizing the visual impact of vehicles on public recreational spaces. The organization of transport infrastructure along the perimeter preserves the central part of the territory for landscaped pedestrian environments and public activity.

Pedestrian circulation forms one of the most important components of the master plan concept. Continuous pedestrian routes connect all functional zones of the site and integrate the complex into the surrounding urban fabric. Public transport stops located near the territory additionally improve pedestrian accessibility and support sustainable urban mobility principles.

The master plan also incorporates principles of environmental and bioclimatic adaptation. Large, landscaped zones, shaded pedestrian routes, permeable open spaces, and vegetation systems contribute to improving thermal comfort and reducing the effects of excessive solar radiation. The integration of natural elements into the spatial structure of the territory strengthens the relationship between architecture and the urban environment.

Thus, the concept of the master plan is based on the formation of an adaptive multifunctional urban environment integrating architecture, landscape, public activity, and environmental strategies within a unified spatial system. The master plan creates a balance between public accessibility, environmental comfort, recreational quality, and operational functionality, forming a sustainable and adaptive territory around the mixed-use high-rise complex.

3.3. Architectural planning and functional solution

The architectural planning and functional solution of the mixed-use high-rise complex through adaptive urban morphologies is based on the principles of vertical multifunctionality, adaptive spatial organization, environmental integration, and flexible interaction between public and private urban environments. The building is designed as an integrated vertical urban system in which different functions are combined within one architectural structure while maintaining clear functional zoning and effective circulation organization.

The volumetric-spatial composition of the complex is formed according to the adaptive morphology of the site and the surrounding urban structure. The irregular geometry of the building responds to the configuration of the territory, transportation corridors, pedestrian connections, and surrounding urban development. Such an approach allows the building to organically integrate into the district structure while simultaneously creating a dominant architectural element within the urban environment.

The planning structure of the complex is organized around a central communication core containing elevators, staircases, engineering systems, and vertical circulation elements. This solution creates efficient functional connectivity between all levels of the building while ensuring flexible organization of internal spaces and clear separation of public, residential, and service flows. The central core also strengthens the structural stability of the tower and improves evacuation and operational efficiency.

The functional organization of the complex follows the principle of vertical zoning, where functions gradually transform from highly public and active spaces at the lower levels toward more private residential environments at the upper floors. Such organization corresponds to the principles of adaptive urban morphology, where the building functions as a vertical continuation of the city structure.

The first (groundfloor) and second floors form the public-commercial podium of the complex. These levels are designed as active urban spaces directly connected with surrounding pedestrian routes and public infrastructure. The lower floors contain retail premises, shopping galleries, exhibition spaces, public halls, stores, service functions, children’s play areas, and supporting technical facilities. Large trading halls and open circulation zones create flexible public environments capable of adapting to different operational scenarios. The integration of commercial functions at the lower levels activates the street environment and strengthens the interaction between the building and the surrounding urban context (fig. 3.5).

An important feature of the podium structure is the organization of loading, storage, technical, and staff zones separated from public circulation systems. Such organization improves operational logistics and minimizes conflicts between service and visitor flows. The public podium therefore acts not only as a commercial environment but also as an adaptive urban platform integrated into the district structure.

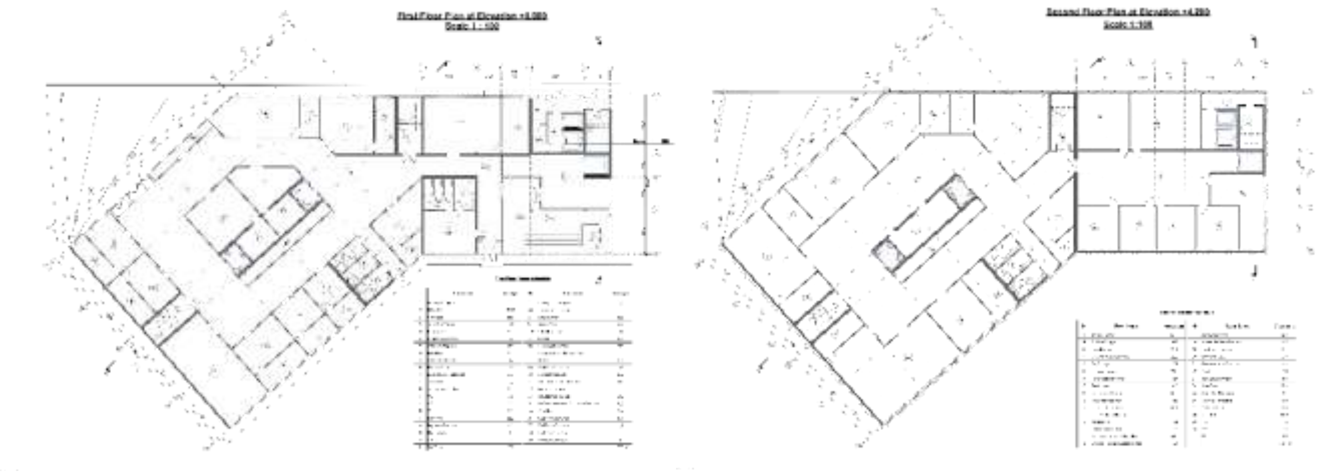


Figure 3.5 First (groundfloor) and second floor

The third floor forms the transitional recreational and wellness zone between the public podium and residential tower. This level includes café areas, spa functions, massage rooms, wellness spaces, relaxation zones, beauty facilities, and open recreational terraces. The integration of recreational functions into the intermediate level creates an environmental buffer between active commercial spaces and private residential environments. The open landscaped terraces and recreational zones improve environmental comfort, strengthen social interaction, and contribute to the formation of a mixed-use lifestyle-oriented environment (fig. 3.6).

Figure 3.6. third floor

The residential part of the complex begins from the fourth floor and is organized according to principles of adaptive and flexible housing typology. **Floors 4–7** contain one-room, two-room, and three-room apartments organized around the central communication core. The apartments include living rooms, kitchens, sanitary facilities, wardrobes, balconies, and loggias. The planning structure emphasizes efficient spatial organization, natural lighting, and panoramic visual connections with the city. Balconies and terraces improve environmental comfort and create transitional semi-open spaces integrated into the facade composition (fig. 3.7).

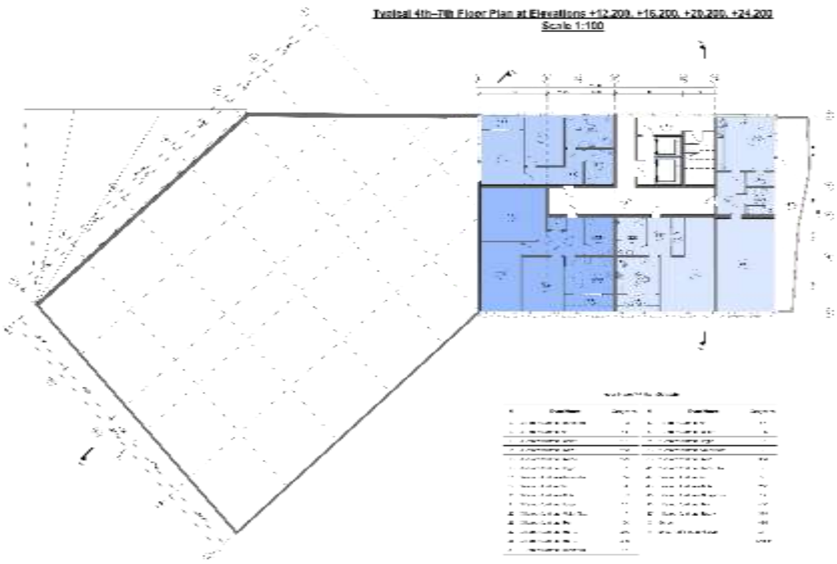


Figure 3.7. 4-7 floors

Floors 8–12 continue the residential function while gradually increasing the spatial comfort and privacy of the apartments. The layouts become less dense and include larger residential units with expanded balconies and improved orientation. Such organization corresponds to the principle of adaptive vertical zoning, where residential quality and environmental comfort increase with building height. The integration of panoramic terraces and open visual connections strengthens the relationship between the residential environment and the urban landscape of Doha (fig. 3.8).

The upper residential levels from the **13 to 16 floors** contain larger apartment typologies with improved spatial organization and more private living conditions. The reduction of density on the upper levels creates a calmer residential environment and emphasizes the hierarchical organization of vertical morphology. These floors include spacious living rooms, kitchens, private rooms, wardrobes, balconies, and circulation spaces integrated into a more exclusive residential structure (fig. 3.8).

Figure 3.8. 8-12 and 13-16 floors

The seventeenth floor forms the penthouse and exclusive panoramic recreational zone of the complex. The upper level contains a penthouse apartment with large living spaces, panoramic recreational areas, and private terraces. This level represents the culmination of the vertical residential hierarchy and strengthens the architectural expressiveness of the tower silhouette within the city structure (fig. 3.9).

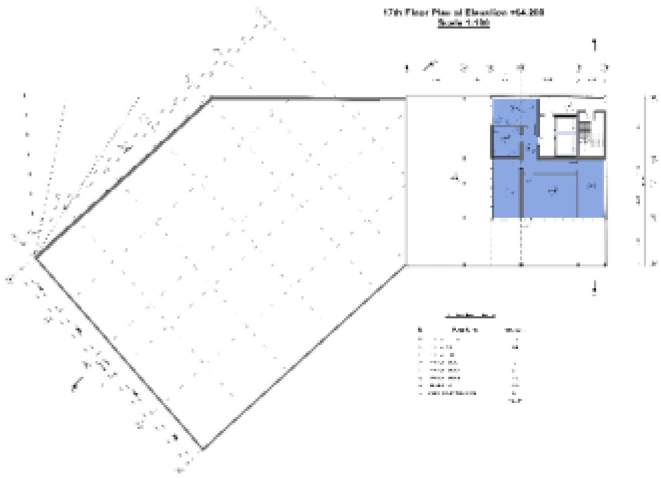


Figure 3.9. 17 floor

An important principle of the architectural planning solution is the integration of environmental and bioclimatic strategies into the spatial organization of the building. The irregular geometry of the volume, the use of terraces and recessed facade elements, the integration of open spaces, and the orientation of residential functions contribute to improving natural lighting, shading, and environmental comfort. Open terraces and landscaped intermediate spaces also reduce the visual scale of the building and strengthen its connection with the surrounding urban environment.

The multifunctional organization of the complex allows the building to operate continuously throughout the day and creates a dynamic urban environment integrating residential, commercial, recreational, and public functions within one adaptive vertical structure. The architectural planning solution therefore reflects the principles of adaptive urban morphology by creating a flexible, environmentally integrated, and multifunctional high-rise system capable of responding to contemporary urban, environmental, and social conditions.

Conclusion of 3 section

1. The conducted analysis of the design territory demonstrated that the selected site possesses favorable urban-planning, functional, transport, and environmental conditions for the formation of a mixed-use high-rise complex through adaptive urban morphologies. The territory is well integrated into the urban structure of Doha and connected with multifunctional infrastructure and public transportation systems.
2. The developed master plan concept is based on the principles of adaptive urban morphology, multifunctionality, environmental integration, and separation of pedestrian and transport flows. The organization of landscaped public spaces, recreational zones, and multifunctional infrastructure contributes to the creation of a comfortable and sustainable urban environment.
3. The architectural planning and volumetric-spatial solution of the complex reflects the principles of vertical multifunctionality, adaptive facade systems, environmental responsiveness, and flexible spatial organization. The integration of public, commercial, recreational, and residential functions within one adaptive high-rise structure forms a contemporary mixed-use urban system corresponding to modern architectural and environmental requirements.

SECTION 4. CALCULATION AND CONSTRUCTIONS

4.1 Location and climatic conditions of construction

The proposed project is a multifunctional high-rise complex located in Doha, Qatar, one of the most rapidly developing metropolitan areas in the Middle East. Doha is characterized by an extremely hot desert climate, high solar radiation, low annual precipitation, seasonal humidity, and frequent dust storms. These environmental conditions have a major influence on the architectural concept, structural system, and material selection for high-rise construction.

During the summer season, daytime temperatures usually range from +40°C to +48°C, and in extreme periods may exceed +50°C. Due to strong solar radiation, the surface temperature of exposed facade elements can become significantly higher. Winters are short and mild, with temperatures generally between +15°C and +25°C. Annual rainfall is very limited and occurs mainly during the winter months. Humidity from the Persian Gulf, combined with saline air, creates additional challenges for facade durability and maintenance.

One of the main design priorities is reducing solar heat gain and improving energy efficiency. Building orientation is selected to minimize direct solar exposure on the most critical facades. External shading systems, recessed glazing, ventilated facade elements, and reflective finishing materials are applied to protect interior spaces from overheating and reduce cooling loads.

The dense urban context of Doha also requires the integration of transport accessibility, public spaces, and pedestrian comfort. Covered entrances, shaded plazas, podium gardens, and landscape elements improve the local microclimate and create comfortable external spaces for residents, office workers, and visitors.

Wind loads are especially important for high-rise buildings due to the tower height and open urban conditions. Structural design must ensure lateral stability, vibration control, and resistance to thermal expansion caused by large temperature differences. Reinforced concrete combined with steel structural elements is commonly used because of its strength, fire resistance, and durability.

Foundation design must consider local soil conditions, groundwater levels, and possible aggressive saline effects near coastal zones. Deep bored pile foundations with reinforced concrete pile caps are generally preferred for tall buildings in Doha.

In summary, the climatic conditions of Doha require advanced climate-responsive and technically efficient design solutions. The main goal is to create a durable, safe, and energy-efficient multifunctional tower that provides comfort and supports intensive urban use under extreme desert conditions.

4.2 Architectural and structural solution

The architectural concept of the multifunctional high-rise complex is based on combining residential, office, hotel, retail, and public functions within a single vertical urban structure. This approach responds to the high density of modern Doha and allows efficient land use while creating a strong architectural identity suitable for a contemporary business district.

The complex consists of a high-rise tower connected to a multi-level podium. The podium contains commercial spaces, restaurants, conference halls, parking areas, and public service functions, while the tower includes offices, apartments, hotel rooms, and premium shared facilities. This zoning improves circulation efficiency and separates private and public functional areas.

The facade design is one of the most expressive architectural features of the project. Repetitive geometric shading modules create a dynamic three-dimensional envelope that gives the building a distinctive appearance while performing important environmental functions. The facade combines large glazed surfaces with deep shading elements to reduce solar radiation and improve thermal performance.

The main structural system is a monolithic reinforced concrete core combined with a reinforced concrete frame and local steel elements for long-span spaces. The central core contains elevators, staircases, technical shafts, and service rooms and acts as the primary lateral stability system resisting wind and seismic loads.

Reinforced concrete columns and beams form the main load-bearing frame and transfer loads from slabs to the foundation. Post-tensioned floor slabs may be used in office and commercial zones to provide larger spans and flexible layouts without excessive intermediate supports.

Additional shear walls and outrigger systems can be introduced at technical floors to improve lateral stiffness and reduce horizontal displacement under wind loads. This is especially important for tall buildings in Doha.

The foundation system is assumed to be deep bored reinforced concrete piles connected by a pile raft foundation. This ensures reliable support under high vertical loads and complex soil conditions.

The roof includes technical floors, mechanical equipment, and reflective insulated roofing to reduce overheating. High-performance glazing and advanced shading systems improve energy efficiency and indoor comfort.

Overall, the selected architectural and structural solution ensures stability, flexibility, durability, and long-term sustainability for a multifunctional tower in Doha..

4.3 Structural system

The multifunctional high-rise complex is designed using a combined structural system consisting of a monolithic reinforced concrete core (Fig. 1), reinforced concrete frame, and local steel structural elements for large-span areas. This system is highly suitable for tall buildings in Doha due to its strength, fire resistance, durability, and ability to resist strong wind loads and thermal stresses caused by the hot desert climate.

The central reinforced concrete core is the main structural element responsible for lateral stability. It contains elevators, staircases, service shafts, and technical rooms. The core resists horizontal forces such as wind loads and possible seismic actions while reducing building sway and improving overall stability.

Reinforced concrete columns and beams form the primary vertical load-bearing frame. Columns transfer loads from slabs and beams to the foundation system, while beams provide rigidity and connect the structural grid. This arrangement allows flexible internal planning for offices, apartments, hotel rooms, and commercial spaces.

Post-tensioned concrete slabs may be used in office and retail zones to achieve larger spans and reduce the number of internal supports. Additional shear walls and outrigger systems are introduced at technical floors to improve stiffness and reduce horizontal displacement of the tower.

Steel structural elements are applied in podium areas, entrance canopies, and long-span public spaces where lighter construction and larger open areas are required. External walls are non-load-bearing enclosure systems attached to the main frame.

This structural solution ensures safety, long-term durability, and efficient operation of the high-rise complex under difficult climatic and urban conditions.

4.4 Foundation

The foundation system of the multifunctional high-rise complex must support significant vertical loads and ensure stability under strong wind forces and local soil conditions of Doha. Due to the height of the building and the concentration of loads from the reinforced concrete core and columns, deep foundations are required.

A concrete pile foundation is a type of deep foundation consisting of long, slender, reinforced concrete columns driven or drilled deep into the ground. They transfer heavy structural loads through weak topsoil to stronger, deeper soil or rock layers. They are used to prevent settling in high-rise buildings, bridges, and in unstable soil condition

For this project, bored reinforced concrete piles (Fig 4.2) connected by pile raft foundation are considered the most suitable solution. The pile foundation transfers loads to deeper, stronger soil layers and reduces the risk of differential settlement. The pile raft also improves load distribution under the central core and heavily loaded column zones.

Pile caps and the raft slab are constructed using cast-in-place reinforced concrete with waterproofing protection against groundwater and possible saline effects common in coastal regions. Increased concrete cover protects reinforcement from corrosion.

Proper drainage and geotechnical control are essential to ensure long-term reliability and structural safety of the building foundation.

Figure 4.1. Reinforced concrete core

Figure 4.2. Pile installation process

4.5 Floors and slabs

The floor system of the high-rise complex is designed using reinforced concrete slabs supported by beams, columns, and the central core. This solution provides high strength, rigidity, fire resistance, and acoustic insulation, which are essential for mixed-use buildings containing offices, apartments, hotels, and commercial spaces.

Monolithic reinforced concrete slabs ensure uniform load distribution and contribute to the overall spatial stability of the structure. In office and retail areas, post-tensioned slabs are often used to achieve larger spans without excessive intermediate supports. This allows flexible interior layouts and improves functional efficiency.

The typical slab thickness depends on span length and operational loads and usually ranges from 220 to 300 mm. Areas with heavy equipment or technical floors may require increased slab thickness and additional reinforcement.

Concrete slabs also provide good thermal mass, which helps stabilize indoor temperatures and improve energy efficiency in Doha’s hot climate. Floor finishes vary according to function and may include stone, ceramic tiles, carpet systems, or raised technical floors in office zones.

The roof slab is also made of reinforced concrete and supports the flat roof system with insulation and waterproofing layers.

4.6 Stairs

The building includes reinforced concrete staircases designed for safe vertical circulation and emergency evacuation. Since the complex is a high-rise structure with mixed functions and high occupancy, stair design must meet strict fire safety and accessibility requirements.

The main staircases are located inside the reinforced concrete central core, which provides fire protection and structural stability. Emergency stairs are enclosed by fire-resistant walls and connected directly to evacuation routes and protected exit zones (Fig. 4.3).

The stairs are designed with comfortable riser height and sufficient tread width to ensure safe movement for residents, office workers, hotel guests, and visitors. Handrails are installed on both sides, and non-slip finishing materials are used to improve safety.

Monolithic reinforced concrete stairs provide high durability, fire resistance, and structural reliability during the entire service life of the building.

4.7 Roof

A flat insulated roof (Fig. 4.4.) is adopted for the multifunctional high-rise complex to support technical functions and improve thermal protection. The roof is constructed over a reinforced concrete slab and includes a vapor barrier, thermal insulation, waterproofing membrane, protective screed, and reflective finishing layer.

The flat roof accommodates mechanical equipment, ventilation systems, water tanks, and maintenance access zones required for building operation. In some technical areas, service platforms and screening elements may also be installed.

Due to the extremely hot climate of Doha, reflective waterproofing membranes and light-colored roof finishes are recommended to reduce solar heat gain and prevent overheating. Internal drainage systems ensure effective rainwater removal and protect the structure from moisture accumulation.

This roof solution provides durability, energy efficiency, and reliable long-term performance.

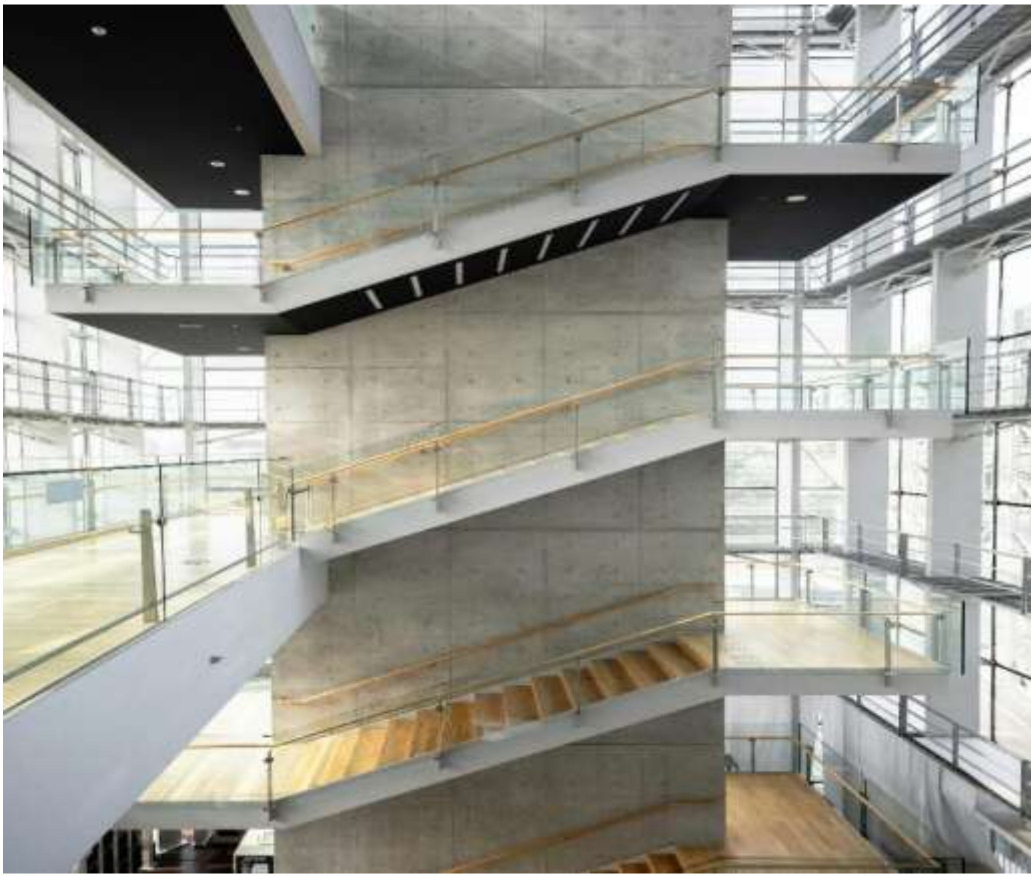


Figure 4.3. Reinforced concrete staircases for high-rise building

Figure 4.4. Flat roof installation process

Table 4.1 Total Design load

No.	Layer	ρ (kN/m³)	Height	G (kN/m²)	f	G × f (kN/m²)
Constant Loads						
1.1	Gravel	16	15 mm	0.24	1.1	0.26
1.2	Waterproofing membrane	12.0	2 mm	0.024	1.1	0.026
1.3	Leveling screed	20	20 mm	0.40	1.1	0.44
1.4	Thermal insulation	0.5	100 mm	0.05	1.2	0.06
1.5	Slope-forming cement-sand screed	20	20 mm	0.40	1.1	0.44
1.6	Vapor barrier	3.0	15 mm	0.045	1.1	0.049
1.7	Reinforced concrete slab	25	250 mm	6.25	1.1	6.87
Temporary Loads						
1.9	Operational load	–	–	1.50	1.2	1.80
2.0	Wind load	–	–	1.50	1.2	1.80
Total Design Load	11.48 kN/m²					

4.8 Analysis of the structural solution of the facade

The facade of the multifunctional high-rise complex is one of the most important architectural and engineering elements of the project. In Doha's extremely hot climate, where solar radiation and high temperatures create significant thermal stress, the facade must provide environmental protection, energy efficiency, and a strong visual identity.

The facade is designed as a non-load-bearing curtain wall system attached to the reinforced concrete structural frame. Its most distinctive feature is the external geometric shading screen composed of repetitive three-dimensional triangular modules. These projecting modules form a secondary facade layer that significantly reduces direct solar radiation on the glazed surfaces.

This system functions similarly to a contemporary interpretation of the traditional mashrabiya (Fig. 4.5), widely used in Middle Eastern architecture for climate adaptation. The external shading layer creates self-shading zones, reducing solar heat gain, lowering cooling demand, and improving indoor comfort. It also helps control glare while maintaining natural daylight and preserving external views.

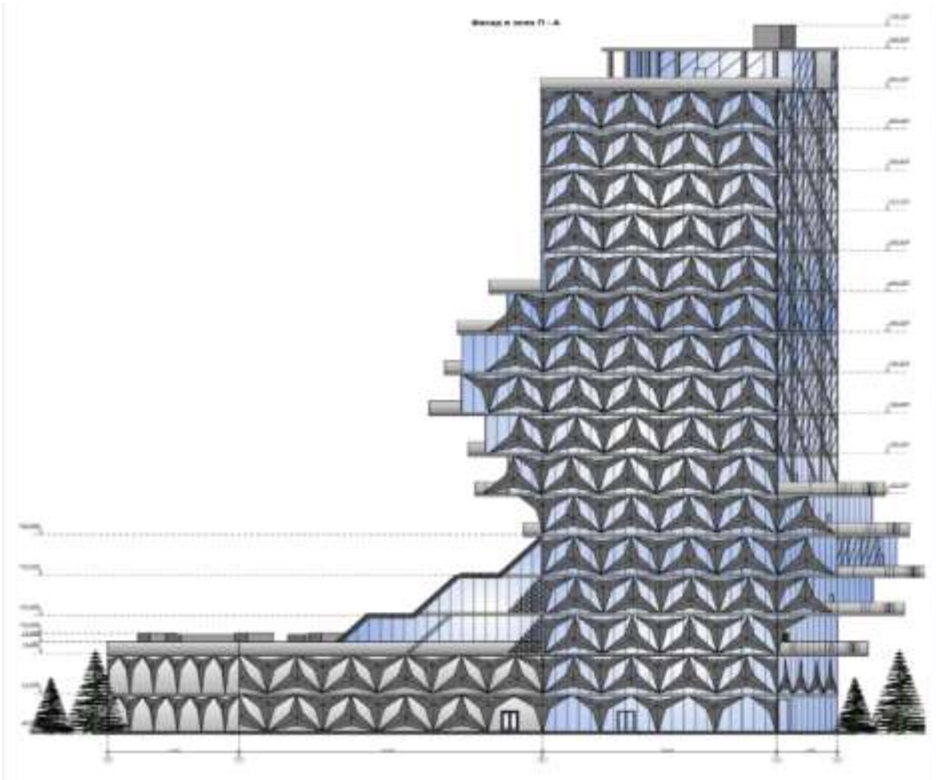


Figure 4.5. Facade visualization

Behind the shading system, high-performance double-glazed curtain wall panels provide thermal insulation, sound protection, and airtightness. Low-emissivity glass is recommended to minimize heat transfer while maintaining transparency. Ventilated facade cavities may also be introduced to improve heat dissipation and moisture control.

The podium facade is designed with a higher percentage of solid insulated wall panels, while the tower facade becomes lighter and more transparent. This creates both functional zoning and visual hierarchy within the composition.

The facade modules are supported by secondary steel framing connected to floor slabs and edge beams. Expansion joints are essential to accommodate thermal movement caused by large temperature differences between day and night.

Overall, the facade solution successfully combines structural reliability, climate adaptation, energy efficiency, and expressive architectural character, making it highly suitable for high-rise construction in Doha.

Conclusion to section 4

The proposed multifunctional high-rise complex in Doha represents a modern approach to urban development that combines architectural expression, structural reliability, and climate-responsive design within a single integrated project. The building is designed to accommodate residential, office, hotel, retail, and public functions, creating an efficient vertical urban environment that responds to the high density and rapid development of Qatar's capital city.

The climatic conditions of Doha have a major influence on the architectural and engineering solutions of the project. Extremely high summer temperatures, intense solar radiation, low annual precipitation, seasonal humidity, and strong winds require advanced design strategies focused on thermal protection, energy efficiency, and long-term durability. The use of external shading systems, high-performance glazing, reflective materials, and controlled facade openings significantly reduces solar heat gain and improves indoor comfort for users.

One of the most distinctive features of the project is its facade design. The three-dimensional geometric shading modules create not only a strong visual identity but also serve as an effective environmental protection system. Inspired by traditional Middle Eastern mashrabiya principles, the facade improves self-shading, reduces cooling demand, controls daylight, and enhances the overall sustainability of the building. This demonstrates how architectural aesthetics and engineering performance can be successfully combined.

The selected structural system, consisting of a reinforced concrete central core, reinforced concrete frame, and local steel elements, provides high strength, fire resistance, and stability under strong wind loads and thermal stresses. The central core ensures lateral stiffness, while columns, beams, slabs, and outrigger systems support flexible functional planning and reliable load transfer. Deep pile foundations with pile raft support guarantee stability under complex soil conditions and high vertical loads.

Flat insulated roofs with reflective waterproofing and technical service zones improve operational efficiency and protect the building from overheating. Reinforced concrete floors, slabs, and stair systems ensure fire safety, durability, and comfortable daily use for many occupants.

In conclusion, the proposed high-rise complex successfully integrates architectural quality, structural safety, climate adaptation, and urban functionality. It reflects contemporary principles of sustainable high-rise construction and provides an effective model for multifunctional development in extreme desert climates. The project demonstrates how modern engineering solutions can support both environment performance and strong architectural identity, making it highly suitable for the future development of Doha.

SECTION 5. OCCUPATIONAL HEALTH AND SAFETY

5.1. Regulation of occupational health and safety issues at the legislative level in the design of mixed-use high-rise complexes through adaptive urban morphologies

In the architectural design and operational planning of contemporary mixed-use high-rise complexes, ensuring occupational health and safety is one of the most important components of sustainable and adaptive urban development. Mixed-use high-rise complexes combine residential, office, commercial, recreational, hospitality, and public functions within a single vertically organized structure. Such multifunctionality significantly increases the complexity of circulation systems, engineering infrastructure, evacuation strategies, and operational processes. Therefore, occupational health and safety in these complexes requires an integrated architectural, engineering, and organizational approach based on international safety standards and national building regulations [27].

In the conditions of rapid urbanization and increasing development density in Qatar, the regulation of occupational health and safety has become especially important in the design and operation of high-rise multifunctional structures. The climatic conditions of Qatar, characterized by high temperatures, intensive solar radiation, dust exposure, and high energy consumption, create additional requirements for environmental comfort, construction safety, and engineering resilience. Adaptive urban morphology in this context becomes not only a spatial-planning principle but also a tool for improving environmental safety, reducing operational risks, and ensuring healthy working and living conditions [28].

The primary objective of occupational health and safety regulation in mixed-use high-rise complexes is the creation of safe, hygienic, ergonomic, and environmentally comfortable conditions for all categories of users, including residents, office employees, maintenance personnel, retail workers, technical staff, and visitors. This includes minimizing occupational risks, ensuring safe circulation and evacuation, improving environmental quality, reducing exposure to harmful climatic conditions, and supporting the efficient functioning of engineering systems.

In Qatar, occupational health and safety issues are regulated through a combination of national labor legislation, building codes, civil defense requirements, and environmental standards. The most important documents regulating safety in architectural and construction practice include:

- Qatar Construction Specifications (QCS) [29];
- Qatar National Building Code (QNBC) [30];
- Qatar Civil Defence requirements [31];
- Qatar Labour Law [32];
- GSAS (Global Sustainability Assessment System) standards [33];
- international standards such as ISO 45001 and NFPA regulations [34].

The Qatar Construction Specifications establish requirements for construction safety, fire protection, environmental comfort, structural reliability, engineering systems, and working conditions during construction and operation of buildings. These regulations are especially important for mixed-use high-rise complexes because of the complexity of their vertical organization and multifunctional operational systems [35].

One of the key aspects of occupational health and safety in adaptive high-rise morphology is the organization of circulation systems. Contemporary mixed-use high-rise complexes require clear separation between public, residential, service, and technical circulation routes. Independent evacuation systems, service elevators, emergency exits, and fire-resistant communication cores are necessary for ensuring operational safety and reducing conflicts between different functional flows.

Adaptive urban morphology also significantly influences the environmental safety of high-rise complexes. In hot climatic conditions such as Qatar, excessive solar radiation and overheating can negatively affect both users and technical systems. Therefore, architectural solutions increasingly integrate:

- adaptive shading systems;
- double-skin facades;
- recessed glazing;
- ventilated atriums;
- sky gardens and green terraces;

- climate-responsive facade envelopes [36].

These architectural approaches improve thermal comfort, reduce energy consumption, and create healthier environments for occupants and workers.

An important component of occupational safety regulation is the design of technical and operational spaces. Mechanical rooms, maintenance areas, waste management systems, loading zones, and engineering infrastructure must be safely integrated into the architectural structure of the building while minimizing exposure to noise, heat, vibration, and hazardous operational conditions. Service zones require appropriate ventilation, thermal insulation, ergonomic access, and fire-protection systems according to Qatari safety standards [37].

The design of mixed-use high-rise complexes also requires special attention to vertical evacuation systems and fire safety strategies. Due to the height and multifunctionality of such buildings, evacuation planning becomes significantly more complex than in traditional structures. Contemporary adaptive morphology increasingly incorporates:

- refuge floors;
- smoke-control systems;
- pressurized staircases;
- fire-resistant structural systems;
- compartmentalization of functional zones;
- intelligent evacuation guidance systems.

Environmental quality is another important component of occupational health and safety in adaptive high-rise complexes. Contemporary architectural design increasingly focuses on natural lighting, indoor air quality, acoustic comfort, and psychological well-being. Atriums, internal gardens, transitional shaded spaces, and natural ventilation systems improve environmental conditions while reducing dependence on mechanical systems .

Special attention is also paid to construction safety during the implementation phase of high-rise projects. Due to the complexity of vertical construction, high temperatures, and intensive use of heavy engineering systems, construction processes in

Qatar require strict safety management, worker protection systems, and climate-adaptive construction schedules. Temporary shading structures, cooling systems, regulated working hours, and hydration stations are important measures for protecting workers under extreme climatic conditions.

The integration of smart technologies into adaptive urban morphology also contributes to improving occupational safety. Intelligent monitoring systems, digital building management, environmental sensors, automated climate control, and emergency response technologies allow continuous control of operational conditions and improve the resilience of high-rise multifunctional environment.

Thus, occupational health and safety regulation in the design of mixed-use high-rise complexes through adaptive urban morphologies requires a comprehensive architectural and urban-planning approach integrating safety, environmental adaptation, technological resilience, and functional efficiency. In the context of Qatar, contemporary high-rise architecture must respond not only to urban density and multifunctionality but also to climatic challenges, environmental sustainability requirements, and advanced safety regulations. Adaptive urban morphology therefore becomes an important instrument for creating safe, resilient, and environmentally responsive high-rise environments capable of ensuring long-term operational efficiency and healthy conditions for all users.

5.2. Identification of potential hazards in relation to mixed-use high-rise complexes through adaptive urban morphologies

Contemporary mixed-use high-rise complexes represent highly complex architectural, engineering, and urban systems in which residential, office, commercial, recreational, hospitality, and public functions are integrated within a single vertically organized structure. Due to the multifunctional nature, high density of users, complex circulation systems, and intensive engineering infrastructure, such complexes are characterized by a wide range of potential hazards that may occur during both the construction and operational phases. The identification and assessment of these hazards are essential for ensuring occupational safety, environmental comfort, operational efficiency, and resilience of the architectural environment.

The thesis object – a mixed-use high-rise complex designed according to adaptive urban morphology principles – includes multiple functional zones such as residential units, office environments, public spaces, retail zones, restaurants, technical premises, parking areas, recreational facilities, vertical circulation systems, engineering infrastructure, and multifunctional podiums. Each of these spatial and functional components creates specific risks that require architectural, technological, and organizational solutions integrated into the design process.

Hazards during the construction phase

The construction of mixed-use high-rise complexes involves intensive engineering operations, large-scale vertical construction, and the simultaneous interaction of multiple technical systems. Due to the height and complexity of such structures, construction risks become significantly higher compared to traditional buildings.

Physical hazards are among the most critical risks during the construction phase. The use of cranes, scaffolding systems, temporary structures, heavy machinery, lifting equipment, and high-altitude operations creates risks of:

- falls from height;
- structural collapse;
- injuries caused by moving equipment;
- electrocution;
- falling construction materials.

In high-rise construction, vertical logistics and transportation systems also create additional safety challenges associated with crane operations, temporary elevators, and material transportation between floors.

Environmental hazards are especially significant in the climatic conditions of high-density urban environments and hot regions such as Qatar. Construction workers may be exposed to: excessive heat and solar radiation; dust pollution; noise and vibration; poor air quality; strong winds at upper construction levels.

Such conditions increase physical stress, fatigue, dehydration, and the risk of occupational injuries.

Chemical hazards. Construction processes involve the use of: adhesives; solvents; paints; insulation materials; concrete additives; cleaning chemicals.

Improper handling of these materials may cause respiratory diseases, skin irritation, toxic exposure, and environmental contamination.

Organizational and logistical hazards. Mixed-use high-rise construction requires coordination between numerous contractors, engineering teams, and technical specialists. Poor communication, lack of safety management, insufficient training, or incorrect sequencing of construction processes may increase the probability of accidents and operational failures.

Hazards during the operational phase. During operation, mixed-use high-rise complexes become dense multifunctional environments with continuous movement of residents, employees, visitors, maintenance personnel, and service systems. The interaction between different functions significantly increases operational complexity and requires integrated safety strategies.

Ergonomic hazards occur in office environments, maintenance zones, retail facilities, technical spaces, and service areas. Repetitive physical activities, poorly organized workplaces, inappropriate furniture dimensions, and uncomfortable maintenance conditions may cause:

- musculoskeletal disorders;
- physical fatigue;
- chronic stress;
- reduced operational efficiency.

Adaptive urban morphology therefore requires ergonomic integration into planning systems, technical areas, and service environments.

Slip, trip, and fall hazards. Public spaces, atriums, roof terraces, parking systems, retail galleries, restaurants, technical corridors, and recreational zones create risks of slipping, tripping, and falling, especially in: wet zones; maintenance spaces; areas with intensive pedestrian movement; transitional outdoor-indoor environments.

Improper flooring materials, insufficient drainage systems, and overcrowded circulation areas may significantly increase accident risks.

Fire hazards is one of the most important issues in mixed-use high-rise complexes due to: vertical density; multifunctionality; large number of occupants; complex evacuation systems.

Potential fire hazards include electrical system failures; overheating of engineering equipment; flammable finishing materials; kitchen and restaurant operations; technical infrastructure malfunctions.

Adaptive urban morphology requires integration of fire-resistant communication cores; refuge floors; smoke extraction systems; pressurized staircases; compartmentalized zoning systems; intelligent evacuation technologies.

Mechanical and engineering hazards. Mixed-use high-rise complexes contain highly complex engineering systems including elevators; escalators; HVAC systems; mechanical ventilation; automated facade systems; parking infrastructure; water supply systems.

Improper maintenance or malfunction of these systems may lead to operational failures, injuries, overheating, flooding, or interruption of building functions.

Environmental and climatic hazards. In adaptive high-rise morphology, environmental risks are strongly connected with climatic conditions and urban density. In regions with hot climates, excessive solar gain, overheating, and insufficient ventilation may negatively affect indoor environmental quality and user comfort.

Poor environmental design may result in:

- thermal discomfort;
- overheating of public spaces;
- insufficient daylight;
- poor indoor air quality;
- increased energy consumption.

Therefore, environmental adaptation through shading systems, natural ventilation, double-skin facades, green terraces, and climate-responsive envelopes becomes an important safety strategy.

Spatial and architectural hazards. The architectural organization of mixed-use high-rise complexes may also generate risks if spatial systems are not properly coordinated.

Insufficient functional zoning

Poor separation between public, private, technical, and service zones may create circulation conflicts; overcrowding; unauthorized access; security problems; operational inefficiency.

Adaptive morphology therefore requires clear hierarchical organization of functions and circulation systems.

Emergency evacuation deficiencies. Due to the vertical complexity of mixed-use high-rise complexes, evacuation planning becomes significantly more difficult than in traditional buildings. Risks may arise from: insufficient number of exits; overloaded evacuation routes; inadequate refuge spaces; poor emergency signage; long evacuation distances.

Vertical circulation risks. Elevators, escalators, sky bridges, and communication cores are critical components of adaptive urban morphology. Incorrect positioning or insufficient capacity of vertical transport systems may: slow evacuation; reduce operational efficiency; create congestion; increase emergency response time.

Psychological and environmental stress factors. Dense multifunctional environments may also create psychological pressure associated with: overcrowding; excessive noise; lack of privacy; insufficient rest zones; visual overload.

Adaptive urban morphology therefore increasingly integrates green spaces, transitional environments, natural lighting, and public recreational platforms to improve environmental comfort and reduce stress.

Thus, the identification of potential hazards in mixed-use high-rise complexes demonstrates the necessity of integrating safety, environmental adaptation, and functional organization into all stages of architectural design and operation. Adaptive urban morphology allows the creation of resilient, safe, and environmentally responsive high-rise environments capable of minimizing risks while supporting multifunctionality and sustainable urban development.

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

Contemporary mixed-use high-rise complexes through adaptive urban morphologies are characterized by multifunctionality, high density of users, vertical circulation systems, and complex engineering infrastructure. The integration of residential, office, commercial, recreational, and public functions within one structure significantly increases the number of potential hazards during both construction and operation phases. Therefore, the identification of risks and the development of preventive architectural and technical measures are important components of the design process.

The thesis object includes public podium spaces, office functions, residential zones, technical premises, parking systems, recreational terraces, vertical communication cores, and multifunctional public environments. Each functional zone creates specific risks that require integrated safety strategies.

Main potential risks of the thesis object

Fire and emergency situations. One of the most significant hazards in mixed-use high-rise complexes is fire risk caused by: electrical system failures; technical equipment overheating; restaurant and commercial functions; high density of occupants.

Due to the vertical organization of the complex, evacuation processes become more complicated and require protected staircases, refuge floors, smoke extraction systems, and fire-resistant communication cores.

Vertical circulation risks. Elevators, escalators, and stair systems are critical elements of adaptive high-rise morphology. Insufficient capacity or malfunction of vertical transport systems may create overcrowding, evacuation delays, and operational conflicts.

Slip, trip, and fall hazards. Public atriums, roof terraces, transitional zones, and commercial spaces may create risks associated with slippery surfaces, intensive pedestrian movement, and environmental exposure.

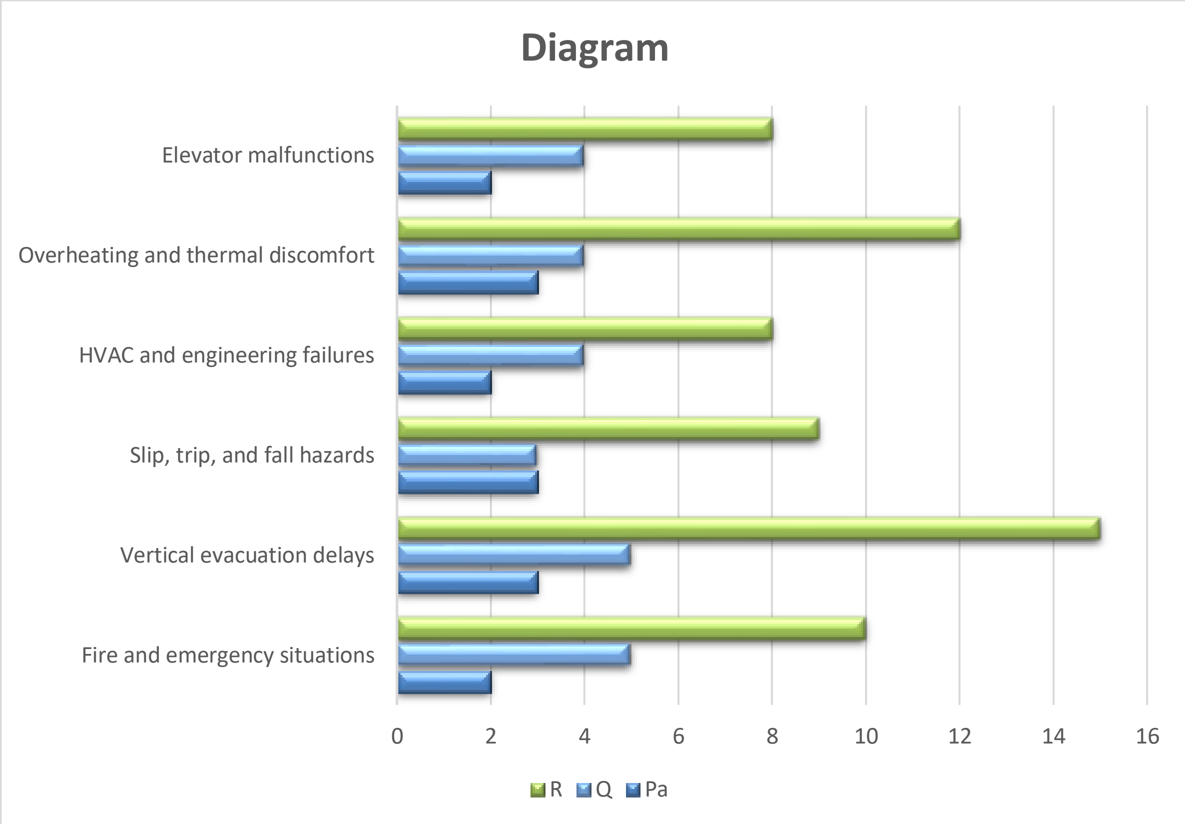
Environmental and climatic hazards. In hot climatic conditions such as Qatar, overheating, excessive solar radiation, and poor ventilation may negatively affect indoor environmental quality and operational comfort. Therefore, adaptive facade systems, shading devices, and natural ventilation strategies become important preventive measures.

Engineering and technical hazards. Mixed-use high-rise complexes contain complex engineering infrastructure including HVAC systems, elevators, automated facades, and water supply systems. Improper maintenance or technical failures may lead to operational disruptions and safety risks.

Table 1. Risk assessment of hazards in mixed-use high-rise complexes

Hazard	Pa	Q	R
Fire and emergency situations	2	5	10
Vertical evacuation delays	3	5	15
Slip, trip, and fall hazards	3	3	9
HVAC and engineering failures	2	4	8
Overheating and thermal discomfort	3	4	12
Elevator malfunctions	2	4	8

Diagram 1. Risk assessment diagram of mixed-use high-rise complexes.



5.4. Safety in emergency situations

Contemporary mixed-use high-rise complexes through adaptive urban morphologies are multifunctional architectural environments characterized by high density, vertical organization of space, complex engineering infrastructure, and intensive circulation systems. The integration of residential, office, commercial, recreational, and public functions within a single structure significantly increases the complexity of emergency management and evacuation processes. Therefore, ensuring safety in emergency situations becomes one of the key tasks in the architectural and engineering design of such complexes.

Emergency situations are defined as sudden events caused by natural, technological, environmental, or human-related factors that may threaten human life, disrupt building operation, damage infrastructure, or negatively affect environmental conditions. In mixed-use high-rise complexes, emergency situations may include:

- fire and smoke propagation;
- electrical failures;

- failures of engineering systems;
- flooding from technical infrastructure;
- elevator malfunctions;
- overheating and ventilation failures;
- structural emergencies;
- terrorist threats;
- medical emergencies.

The probability and consequences of emergency situations are significantly influenced by the architectural structure of adaptive high-rise complexes. One of the most important risk factors is the high density of occupants and the multifunctional nature of the building. Residential, office, retail, entertainment, and public functions generate different circulation flows and operational regimes, which complicates evacuation and emergency coordination.

Another important factor is the vertical organization of space. High-rise buildings require complex evacuation systems due to long evacuation distances, dependence on vertical circulation cores, and the possibility of rapid smoke propagation through atriums, shafts, and engineering systems. Adaptive urban morphology therefore requires the integration of protected staircases, refuge floors, smoke-control systems, and fire-resistant communication cores.

The complexity of engineering infrastructure also increases emergency risks. Contemporary mixed-use high-rise complexes depend on HVAC systems, elevators, automated facades, electrical systems, intelligent technologies, and mechanical infrastructure. Failures in these systems may cause overheating, smoke accumulation, flooding, power outages, or disruption of evacuation systems.

Climatic conditions are especially important in regions with hot environments such as Qatar. Excessive heat and high energy loads increase pressure on ventilation and cooling systems, which may create additional risks during emergency situations. Therefore, adaptive facade systems, natural ventilation strategies, shading devices, and climate-responsive architectural solutions become important elements of emergency safety.

One of the most critical emergency scenarios in mixed-use high-rise complexes is fire in multifunctional podium zones containing retail, restaurant, entertainment, and public functions. Such spaces are characterized by:

- high occupancy density;
- intensive pedestrian movement;
- technical and electrical equipment;
- kitchen and service infrastructure;
- direct connection with vertical circulation systems.

In the event of fire, emergency response begins with automatic fire detection and activation of alarm systems. Smoke extraction systems and fire suppression systems are activated automatically, while engineering systems serving the affected zone are isolated to prevent fire and smoke propagation.

Evacuation is carried out through protected staircases and fire-resistant communication cores. Elevators are automatically disabled except for emergency evacuation systems designed according to fire-safety regulations. Intelligent building management systems coordinate evacuation routes, emergency communication, and environmental monitoring in real time.

An important architectural principle of adaptive urban morphology is the compartmentalization of functions. Fire-resistant partitions, separated circulation systems, and refuge floors reduce the spread of fire and improve evacuation efficiency. Independent circulation systems for residents, office workers, technical staff, and public visitors also reduce operational conflicts during emergencies.

Adaptive urban morphology increasingly integrates intelligent safety technologies such as:

- smart fire detection systems;
- automated evacuation guidance;
- environmental monitoring sensors;
- digital emergency communication systems;
- intelligent smoke-control technologies.

Environmental and bioclimatic strategies also contribute to emergency safety. Natural smoke ventilation, ventilated atriums, double-skin facades, and open transitional spaces improve environmental resilience and reduce smoke accumulation during fire scenarios.

Thus, safety in emergency situations is one of the fundamental principles in the design of mixed-use high-rise complexes through adaptive urban morphologies. Contemporary adaptive architecture requires the integration of fire protection, environmental adaptation, intelligent technologies, protected evacuation systems, and multifunctional zoning into a unified architectural and engineering strategy. Such an approach contributes to the formation of resilient, safe, and sustainable high-rise environments capable of effectively responding to emergency situations.

Conclusions to section 5

Safety in emergency situations is one of the key components of designing mixed-use high-rise complexes through adaptive urban morphologies. The multifunctionality, vertical density, and complexity of engineering systems significantly increase the importance of integrated architectural and technical safety strategies.

The conducted analysis demonstrated that the most critical emergency risks in adaptive high-rise complexes are associated with fire safety, evacuation systems, engineering infrastructure, and environmental conditions. Therefore, contemporary architectural design must integrate preventive spatial organization, fire-resistant structures, intelligent monitoring technologies, and environmentally adaptive systems from the earliest design stages.

Adaptive urban morphology contributes to the formation of safer and more resilient high-rise environments through the integration of multifunctional zoning, protected circulation systems, environmental adaptation, and intelligent emergency management technologies. Such an approach allows contemporary mixed-use high-rise complexes to function as sustainable, secure, and operationally efficient urban systems capable of responding effectively to emergency situations.

GENERAL CONCLUSIONS

1. Theoretical approaches to the study of mixed-use high-rise complexes and adaptive urban morphologies were analyzed. It was established that contemporary high-rise architecture is developing according to the principles of multifunctionality, adaptability, environmental integration, and urban connectivity.

2. The practical experience of designing mixed-use high-rise complexes in contemporary architecture was analyzed. It was determined that modern architectural practice increasingly integrates residential, commercial, office, recreational, and public functions within unified adaptive vertical systems.

3. Current trends in the formation of mixed-use high-rise complexes were identified. The main trends include ecological integration, multifunctionality, flexible planning systems, smart technologies, public openness, and bioclimatic adaptation.

4. The main factors influencing the formation of mixed-use high-rise complexes within adaptive urban morphologies were determined. Natural-climatic, urban-planning, architectural, transport, environmental, and economic factors significantly affect the spatial and functional organization of contemporary high-rise environments.

5. Architectural and urban-planning methods for designing mixed-use high-rise complexes were identified. These include vertical functional zoning, podium-and-tower structures, adaptive facade systems, landscape integration, multifunctional public spaces, and environmentally responsive planning solutions.

6. An experimental project proposal for a mixed-use high-rise complex based on adaptive urban morphology principles was developed. The project demonstrates the integration of multifunctionality, environmental responsiveness, adaptive spatial organization, and sustainable urban design strategies within the urban structure of Doha.

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