O.M. Beketov National University of Urban Economy
in Kharkiv
(full name of university)

School of Architecture, Urban Planning and Design
(full name of institure or faculty)
department of Architecture of buildings and constructions
(full name of the department)

# Explanatory note

for the diploma project (work)

**Bachelor**
(educational scientific level)

on the topic of:

**«Assisted living center in Morocco (Marrakesh)»**

Completed by: student of the 4th year,
group **A 2021-5a**
branch of knowledge (specialty)
19 Architecture and construction
(code and name of branch of knowledge, specialty)
191 Architecture and Town Planning
(code and name of branch of knowledge, specialty)
EP Architecture
(code and name of branch of knowledge, specialty
Elhariri Imane
(last name and initials)
Supervisor PhD, assist. prof. Kononenko H.Y.
(last name and initials)
Reviewer PhD, senior lecturer Borysenko A.S.
(last name and initials)

Kharkiv – O.M. Beketov NUUE in Kharkiv – 2026

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

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

**Department** Architecture of buildings and constructions

Educational and scientific level **Bachelor**
Educational program **Architecture**
**(code and name)**
**Specialty** **191 Architecture and town planning**
**(code and name)**

**APPROVED**
**Head of ABaS department**
**Smirnova O.V.**

**December 2, 2025**

*T A S K*

**FOR THE STUDENT'S DIPLOMA PROJECT (WORK)**

**Elhariri Imane**
**(full name of the student)**

1. Topic of the project (work) Assisted living center in Morocco (Marrakesh)
supervisor(s) of the project (work): Kononenko H.Y., Associate Professor, PhD

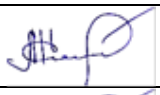
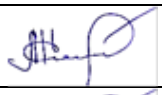
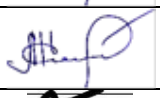
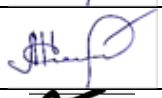
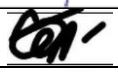
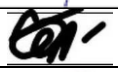
approved by order of higher educational institution № 165-03, issued on **December 2, 2025**
2. The deadline for student submission of the project (work) **February 25, 2026**

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

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

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

6. Consultants of chapters of the project (work)

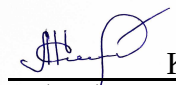
| Chapter | Прізвище, ініціали та посада консультанта | Підпис, дата | |
|---|---|---|---|
| | | завдання видав | завдання прийняв |
| 1-2 | Kononenko H.Y.., PhD, Assoc.Prof. of ABaS department |  |  |
| 3 | Kononenko H.Y.., PhD, Assoc.Prof. of ABaS department. Constructions section |  |  |
| 4 | Seryogina D.O., lecturer of the department of EaM |  |  |
| 5 | Viktoriia Malysheva. PhD, Occupational and Life Safety Department |  |  |

7. Date of issuance of the task **December 2, 2025**

## *CALENDAR PLAN*

| № | Name of stages of the diploma project (work) | Term of completion of stages of the project (work) | **Note** |
|---|---|---|---|
| 1 | Determining the topic of the diploma project, justifyingthe choice of the chosen object. Introduction | December 2025 | Done |
| 2 | Analysis of analogues of the selected design object. Information collection and analysis | December 2025 | Done |
| 3 | Urban planning analysis of the project area (analytical schemes, reference plan, master plan) | December 2025 | Done |
| 4 | Architectural and planning solution of the selected design object (graphic design of plans, facades, section) | January 2026 | Done |
| 5 | Volume-spatial solution of the selected design object (graphic design of perspective projections, 3-D models, perspective angles) | January 2026 | Done<br>Done |
| 6 | Development of an explanatory note (chapter 1) | January 2026 | Done |
| 7 | Development of an explanatory note (chapter 2) | January 2026 | Done |
| 8 | Completing the tasks of adjacent chapters of diploma projects (chapters 3-4) | January 2026 | Done<br>Done |
| 9 | Completion of the explanatory note (all chapters of the work) - check for plagiarism | February 2026 | Done |
| 9 | General exposition of graphic material | February 2026 | Done |
| 10 | Defense of the qualification work | February 2026 | Done |

**Student**  Elhariri Imane
( sign ) (last name and initials)

**Supervisor of the project (work)**  Kononenko H.Y.
( sign ) (last name and initials)

**CONTENT**

# INTRODUCTION

Contemporary demographic trends worldwide, particularly the growing proportion of elderly people in the population structure, necessitate a rethinking of approaches to the organization of social and healthcare infrastructure. Morocco is no exception. Despite traditionally strong family ties, the country is experiencing a gradual increase in the demand for specialized facilities providing care for older adults. In the context of urbanization, migration processes, and changing lifestyles, the creation of modern elderly care centers is becoming increasingly relevant.

The city of Marrakesh is one of the most significant cultural, tourist, and economic centers of the country, combining a rich historical heritage with dynamic development. The architectural environment of Marrakesh has been shaped by Islamic traditions, the climatic conditions of North Africa, and local construction technologies. Therefore, the design of a care center for the elderly in this city requires consideration not only of functional and medical requirements, but also of the cultural context, climatic characteristics, and principles of sustainable development.

The relevance of this bachelor's thesis lies in the need to create an architectural environment that ensures comfort, safety, social integration, and psychological support for elderly residents. A modern care center should function not merely as a medical and social institution, but as a полноценное living environment that promotes active longevity, preserves dignity, and supports social connections.

The aim of this work is to develop an architectural concept for an elderly care center in the city of Marrakesh, taking into account the climatic, cultural, and socio-economic characteristics of the region. To achieve this aim, the following objectives are set:

– to analyze the current state of the elderly care system in Morocco;

– to examine the urban planning conditions and natural-climatic characteristics of Marrakesh;

– to study international experience in designing similar facilities;

– to develop the functional and planning structure of the building;

– to create a volumetric and spatial solution based on the principles of

accessibility and energy efficiency.

The object of the research is an elderly care center as a type of public building with a social function. The subject of the research includes the architectural, planning, functional, and compositional features of forming such a center within the urban context of Marrakesh.

The practical significance of the work lies in the potential application of its results for the further design of social institutions in countries with similar climatic and cultural conditions. The proposed concept is aimed at creating a harmonious environment that combines the traditions of Moroccan architecture with contemporary requirements for the quality of life of elderly people.

# 1. CLASSIFICATION AND TYPOLOGICAL CHARACTERISTICS OF AN ELDERLY CARE CENTER

## 1.1. General Characteristics of the Design Object

An Elderly Care Center (ECC) is a specialized facility intended to provide accommodation and supportive care for older adults or individuals who have partially lost their independence. Its primary objective is to ensure that residents maintain a sense of autonomy while receiving assistance with essential daily activities such as bathing, dressing, medication management, and meal preparation. The design of such facilities aims to balance safety, comfort, and privacy by creating a non-institutional, home-like environment that promotes dignity, independence, and social engagement among residents [1].

Typologically, elderly care centers occupy an intermediate position between independent living facilities and nursing homes. They combine residential and healthcare components, resulting in a hybrid architectural typology that supports both private and communal living. These facilities can be classified within the broader category of residential healthcare buildings with semi-medical functionality. Spatial organization often follows a neighborhood or cluster model, where residents have access to shared amenities such as dining areas, gardens, and recreational spaces while maintaining private living units. This planning approach encourages social interaction

and community integration while preserving personal independence [2].

The target group of elderly care centers generally includes individuals aged 65 and older who are capable of relatively independent living but require some assistance with daily activities. These residents may have mild physical or cognitive limitations and benefit from supportive services within a socially active environment. The World Health Organization emphasizes that such settings are essential for promoting active ageing, social inclusion, and the overall well-being of older adults [3].

From an architectural perspective, elderly care centers prioritize accessibility, safety, and environmental comfort. Design features typically include barrier-free circulation, non-slip flooring, handrails, ramps, and wide corridors to accommodate mobility aids. Furthermore, natural lighting, clear wayfinding, and proximity to green spaces play a crucial role in reducing stress and supporting cognitive stimulation. The integration of biophilic and age-sensitive design principles contributes to both the physical and emotional well-being of residents, in accordance with human-environment interaction theories proposed in environmental gerontology [4].

Elderly care centers are subject to various design and regulatory standards governing safety, accessibility, and quality of care. Compliance with local building codes, healthcare regulations, and accessibility laws-such as the Americans with Disabilities Act (ADA, 1990) – is mandatory. In addition, professional organizations such as the American Institute of Architects (AIA) provide design guidelines specifically for residential healthcare facilities, ensuring that the built environment supports both operational efficiency and resident well-being [5].

In essence, the general characteristics of elderly care centers reflect a synthesis of healthcare-oriented, residential, and community-based design principles. They are intentionally conceived as adaptive, inclusive, and human-centered environments that respond to the evolving needs of an ageing population, bridging the gap between institutional care and independent living.

### 1.2. International Experience in Designing Facilities of the Selected Typology: Prototype Analysis

1.2.1. Senior Center of Guangxi / Atelier Alter Architects

The Senior Center of Guangxi in Guigang, China, designed by Atelier Alter Architects, is a contemporary elderly care complex that harmoniously integrates with the natural landscape [6].

Located on a sloped site, the building features terraced green roofs that function as pedestrian pathways and gardens, encouraging relaxation and physical activity. Open courtyards provide natural lighting, ventilation, and communal gathering spaces, while the flexible interior layout combines residential, medical, and recreational areas. The looped, barrier-free circulation system ensures safety and accessibility, creating a calm, home-like atmosphere that supports both independent and assisted living (pic. 1.1).


Picture 1.1. General view and master plan of the Senior Center of Guangxi in the city of Guigang

Main Functional and Spatial Use Components:

1. Rehabilitation Zone – therapy rooms and exercise halls with direct access to open terraces.

2. Residential Units – private rooms arranged around internal courtyards with

direct access to landscaped green areas.

3. Social Areas – a central courtyard and lounge spaces adaptable for group events and recreational activities.

4. Rooftop Garden – green roofs featuring walking paths and designated relaxation zones.

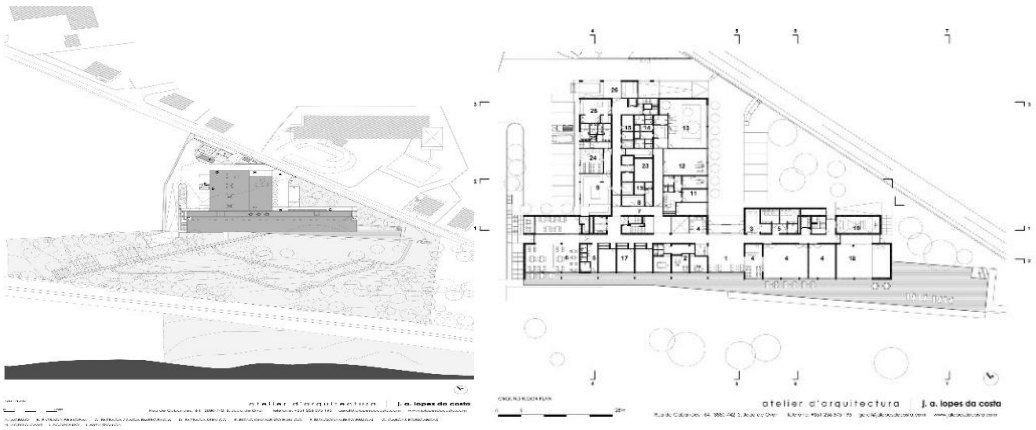
5. Medical Unit – easily accessible medical and nursing facilities located near the main entrance.

This project demonstrates how thoughtful architectural design can promote active ageing through accessibility, flexibility, and close interaction with nature.

### 1.2.2. Edifício Residencial para Adultos Maiores / Atelier d'Arquitectura JA Lopes da Costa

The Edifício Residencial para Adultos Maiores in Santo Tirso, Portugal, designed by Atelier d'Arquitectura JA Lopes da Costa, is an elderly care facility that harmoniously integrates into its sloped triangular site through a terraced T-shaped layout [7].

Combining residential, medical, and social functions, the building emphasizes comfort, accessibility, and a strong visual connection with the surrounding landscape. The south-facing façades open toward the valley to maximize natural light and views, while the north side ensures privacy and thermal efficiency. Interior spaces-including therapy rooms, living areas, and dining spaces-are organized to encourage mobility and interaction. Landscaped pathways and shaded outdoor areas further enhance residents' well-being and independence (pic. 1.2).



Picture 1.2. General view, floor plan, and master plan of the *Edifício Residencial para Adultos Maiores* building in Santo Tirso.

Functional and Spatial Characteristics:

1. Approximately 60 south-oriented rooms providing natural light, comfort, and privacy.

2. The ground floor includes common areas such as a living room, dining area, and activity rooms that encourage social interaction.

3. Health and rehabilitation facilities offering consultations, nursing care, physiotherapy, and a hydrotherapy pool.

4. Administrative and staff areas designed to ensure efficient operation.

5. Semi-basement service areas accommodating laundry, storage, and parking functions.

6. Landscaped gardens and pathways that promote relaxation and connection with nature.

7. Terraced outdoor platforms and shaded seating areas offering panoramic views and accessible movement between levels.

Sustainable design strategies, including optimal building orientation and natural ventilation, enhance energy efficiency and resident comfort.

1.2.3. Nursing Home in Utebo / Basilio Tobías

The Nursing Home in Utebo, designed by Basilio Tobías, is a residential facility with day-care services located next to Parque de las Fuentes in Utebo, Spain [8].

Its elongated form responds to the proportions of the site, integrating with both the urban and natural surroundings. Organized through longitudinal wings and

recessed volumes, the building separates residential, public, and service areas while ensuring accessibility and natural lighting. Social and therapeutic spaces on the ground floor open onto landscaped courtyards and shaded verandas, promoting interaction and outdoor activity.

The upper floors contain residential units with small lounge areas overlooking the park, creating a warm and home-like atmosphere. A ventilated façade with adjustable shutters improves energy efficiency and indoor comfort (pic. 1.3).

Picture 1.3. General view, floor plan, and master plan of the nursing home building in Utebo.

Functional and Spatial Characteristics:

1. Residential Spaces – Private and semi-private rooms located on the upper floors, overlooking the park, with small lounges for social interaction.

2. Social and Public Areas – Dining rooms on the ground floor, multifunctional halls, and recreational rooms connected to internal courtyards and verandas for communal use.

3. Healthcare and Care Facilities – Medical consultation rooms near the entrance

for easy access.

4. Administrative Areas – Offices and control points located near the entrance for efficient management.

5. Service Zones – Basement areas housing the kitchen, laundry, waste collection, and storage rooms, connected via service elevators.

6. Open Spaces – Landscaped gardens, protected walkways, and wooden verandas providing comfortable outdoor areas linked to the surrounding park.

### 1.3. Determining the Overall Functional Composition of an Elderly Care Center

The overall functional structure of an Elderly Care Center (ECC) integrates residential, medical, social, and operational areas within a single architectural system that supports independence and well-being. These facilities combine the qualities of a comfortable home with the operational efficiency of a healthcare environment, providing residents with privacy, autonomy, and access to supportive services as needed [9].

The residential zone forms the core of the center and mainly consists of private or semi-private rooms equipped with accessible bathrooms, small kitchenettes, and balconies. These units are often organized around small shared lounges or neighborhood clusters that encourage social interaction without compromising privacy. For example, the Senior Center of Guangxi by Atelier Alter Architects groups residential blocks around internal courtyards, enhancing daylighting, ventilation, and visual connection to nature. Barrier-free access, non-slip flooring, handrails, and emergency call systems are key elements that ensure resident safety and comfort.

The healthcare and rehabilitation area provides medical and therapeutic services in close proximity to residential zones. Typically, it includes care stations, consultation rooms, physiotherapy and hydrotherapy facilities, and spaces for occupational or cognitive therapy. In the *Edifício* Residencial para Adultos Maiores in Santo Tirso, Portugal, Atelier d'Arquitectura JA Lopes da Costa positioned therapy

and nursing rooms adjacent to residential wings, enabling efficient circulation and accessibility for residents with limited mobility. This close integration allows for continuous supervision and rapid response while maintaining the home-like atmosphere that distinguishes elderly care centers from hospitals.

The social and communal zone supports socialization, recreation, and cultural engagement, which are critical for cognitive and emotional health. It includes dining areas, multifunctional halls, lounges, libraries, and workshops. The Utebo nursing home by Basilio Tobías illustrates this concept by situating communal areas on the ground floor with direct access to landscaped internal courtyards and shaded verandas, extending indoor activities into the outdoor environment. This spatial continuity encourages movement, interaction, and participation in daily activities, fostering a sense of belonging and community.

The administrative and service zones ensure the center operates efficiently and include reception areas, administrative offices, staff rooms, and technical facilities such as kitchens, laundries, storage areas, and waste management rooms. These functions are typically located in separate or semi-basement sections to minimize noise and visual disruption. At the Utebo nursing home, administrative offices are near the entrance for effective management, while service areas such as kitchens, laundries, and waste rooms are located in the basement to allow uninterrupted operation without interfering with residential or communal spaces.

The open and environmental zones extend the residential and social spaces, providing therapeutic and recreational environments that promote active ageing. Gardens, walking paths, rooftop terraces, and sensory landscapes are designed to provide visual stimulation and opportunities for physical activity. The Senior Center of Guangxi incorporates terraced green roofs and courtyard gardens as part of its daily circulation system, demonstrating how contact with nature can serve as a key therapeutic element.

Functionally, all these zones are interconnected, forming an accessible and intuitive layout that minimizes walking distances and supports the autonomy of residents.

### 1.4. Classification and Typological Features of the Primary Function of an Elderly Care Center

The primary function of an Elderly Care Center (ECC) is **residential**, as the main purpose of such a facility is to provide accommodation that combines independent living with supportive care. This function shapes the spatial, operational, and social structure of the building. It requires a balance between privacy and shared communal areas, ensuring residents live comfortably while receiving assistance when needed. The residential aspect prioritizes accessibility, safety, and comfort through features such as barrier-free movement, wide corridors, and handrails, while maintaining a home-like, non-institutional atmosphere that supports emotional well-being.

Elderly care facilities can be classified according to the level of independence and the type of care provided. Main types include:

1. Independent living units – Allow residents to live autonomously while accessing additional services as needed.

2. Assisted living units – Residents receive partial help with daily activities such as dressing or bathing.

3. Specialized care units – For residents with memory impairments or mild cognitive disabilities, designed with secure layouts and visual orientation aids.

From a typological perspective, elderly care centers may take various forms: small group homes, apartment-style complexes, or cluster/neighborhood models. The Senior Center of Guangxi, designed by Atelier Alter Architects, illustrates a successful cluster model. Private residential units are arranged around internal courtyards, enhancing natural light, ventilation, and visual connection to the landscape. This configuration supports both independence and social interaction, creating a comfortable and calming environment for older residents.

Similarly, the Edifício Residencial para Adultos Maiores by Atelier d'Arquitectura JA Lopes da Costa demonstrates an effective residential function through its terraced T-shaped design, maximizing daylight and interaction with outdoor spaces. South-facing rooms ensure comfort and privacy, while shared lounges

and dining areas on the ground floor promote socialization. Integrating therapeutic and rehabilitation facilities within the same building reinforces the supportive nature of the residential environment.

In contemporary elderly housing design, the «neighborhood-cluster» model is often considered the most effective typology. It organizes residential units into small clusters or «micro-neighborhoods» connected by shared spaces such as lounges, dining rooms, and gardens. Each cluster operates semi-independently while remaining part of a larger community. This spatial arrangement enhances flexibility, fosters a sense of belonging, and easily adapts to varying levels of care needs. It also supports architectural goals of accessibility, comfort, and dignity—core values in residential environments for older adults.

### 1.5. Features and Typological Characteristics of Secondary Functions in an Elderly Care Center

Beyond the primary residential function, an Elderly Care Center includes secondary functions that enhance health, comfort, and social well-being. These typically comprise medical and rehabilitation facilities, communal and recreational spaces, administrative and service areas, and landscaped outdoor environments.

The medical and rehabilitation function provides consultation rooms, nursing care, therapy, and rehabilitation areas designed to be accessible and safe while maintaining a calm, non-institutional atmosphere.

Communal and recreational zones, including dining rooms, lounges, activity rooms, and multifunctional halls, encourage social interaction, participation in cultural or recreational programs, and community engagement. These spaces are usually centrally located or easily accessible and are flexible enough to accommodate groups of various sizes.

Administrative and service areas, such as reception, offices, staff rooms, kitchens, laundry, and storage facilities, are efficiently organized to support uninterrupted operation while remaining separated from private and communal spaces to preserve confidentiality and comfort.

Open and landscaped spaces, including gardens, walking paths, terraces, and relaxation areas, provide opportunities for physical activity, leisure, and interaction with nature, designed to be fully accessible and safe for residents.

Together, these secondary functions create an integrated support system that complements the residential core and addresses both the physical and social needs of the facility [9].

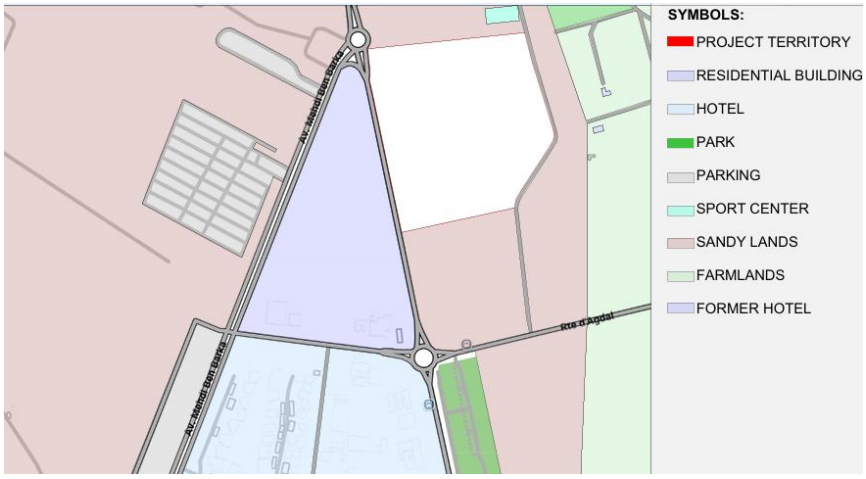
## 2. ARCHITECTURAL-PLANNING AND VOLUMETRIC-SPATIAL SOLUTION

### 2.1. Urban Analysis of the Project Site

The design object is an Elderly Care Center located in Marrakech, Morocco, on a site of approximately 40,000 m². At this stage of the project, the functional layout of the site is defined at the level of overall site organization and spatial planning, without specifying detailed internal functions or floor areas. The organization of the territory depends on the physical characteristics of the site, its climatic conditions, and the functional structure of the surrounding area, as identified in the site analysis.

The site is situated at an elevation of approximately 482 meters above sea level and features a gentle slope. These topographical conditions facilitate clear and rational site organization, providing gradual spatial transitions and improving accessibility across the site. The slope also supports natural surface drainage and reduces the need for extensive earthworks, which is especially important for projects intended for elderly residents.

According to the site analysis scheme, the surrounding area includes a variety of existing functions such as road infrastructure, pedestrian streets, parking zones, green spaces, parks, sandy lands, agricultural plots, former hotel facilities, and public transport nodes. These elements are not part of the Elderly Care Center project itself but reflect the existing territorial context in which the site is located. Their presence helps define the character of the site and influences planning decisions related to orientation, buffering, and the relationship between built and open spaces within the project boundaries (pic. 2.1).

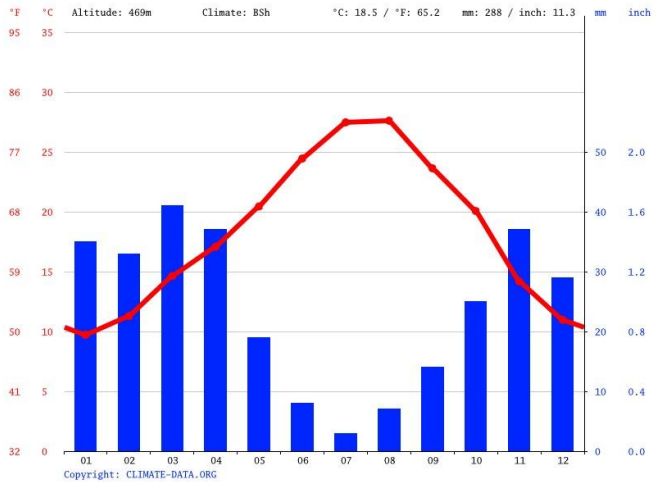



Picture 2.1. Functional Analysis Diagram of the Project Site

Thus, the functional organization of the project site is based on a clear distinction between the project area and its surrounding environment. While the built-up zones within the site are reserved exclusively for the senior care center, the open spaces are arranged to ensure spatial cohesion, environmental comfort, and visual continuity, without replicating or encroaching on adjacent functions. This approach allows the project to remain autonomous while appropriately responding to the existing land-use pattern identified in the site analysis.

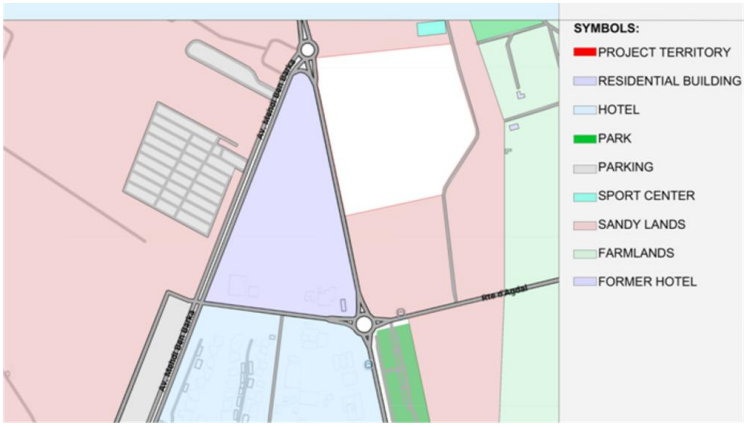
The size of the site permits a low-density spatial layout, which is suitable for senior care facilities and supports a calm and controlled spatial environment. At this stage, the functional composition emphasizes flexibility and adaptability, ensuring that future design development can occur without conflict with surrounding land uses or regulatory constraints.

Climatic conditions are a key factor influencing the organization of the site. Marrakech has a hot semi-arid climate (BSh) with an average annual temperature of approximately 18.5°C. Summers are long and hot, with temperatures often exceeding 35°C, while winters are mild. Annual precipitation is limited, averaging around 280–300 mm, mostly falling during the cooler months. These climatic characteristics highlight the importance of site organization that maintains thermal comfort at the ground level, achieved through a balance between built and open spaces and by incorporating strategies to mitigate environmental impacts (pic. 2.2).




Picture 2.2. Climate of Marrakech: Weather in Marrakech and Monthly Temperatures

The functional composition of the site for the elderly care center is determined based on general planning principles that take into account the site area, elevation, slope, climate, and surrounding functional context. Existing functions identified in the site analysis serve as contextual elements rather than components of the project itself, ensuring a clear distinction between analysis and design while providing a coherent foundation for subsequent stages of development (pic. 2.3).




Picture 2.3. Sceme of functional analysis of the design

The project site borders an existing network of active roads, providing direct and unobstructed access to the plot. The primary vehicular access is via the main road along the western edge of the site, connected to surrounding roads through roundabouts that regulate traffic flow and enhance safety at intersections.

Traffic circulation around the site is organized to allow smooth entry and exit while maintaining low speeds near pedestrian zones. The road network ensures

uninterrupted access for private vehicles, service vehicles, and emergency access without disrupting pedestrian movement. Inactive roads, as shown in the diagram, serve as secondary connections and reduce unnecessary through-traffic near the site.

Two bus stops are located near the project site along the main active roads, within walking distance from the site entrances. These public transport stops provide direct connections to the surrounding urban infrastructure and ensure convenient and accessible access for residents, staff, and visitors using public transportation.

Pedestrian streets form a continuous and clear network connecting the site to the surrounding road infrastructure and the nearest bus stops. Pedestrian movement is organized along clearly defined sidewalks and pedestrian streets running parallel to the main roads and leading directly to the project site.

Pedestrian routes are designed to be direct, safe, and easily navigable, minimizing crossings with vehicular traffic. Where pedestrian streets intersect with roads, crossings are clearly marked and located near roundabouts to enhance visibility and reduce vehicle speeds. The pedestrian network provides comfortable access from public transport stops to the site without abrupt level changes or obstacles (pic. 2.4).


Picture 2.4. Functional layout of the site and vehicular and pedestrian circulation diagram

All pedestrian routes providing access to the facility are designed according to universal accessibility principles. Continuous, step-free pathways connect bus stops and adjacent sidewalks to the project site. Crosswalks feature curb ramps to ensure smooth transitions for wheelchair users and people with limited mobility.

The pedestrian streets are wide enough and have stable, non-slip surfaces suitable for mobility aids. Slopes are kept within permissible limits, and where there are level

changes, ramps are provided, ensuring safe and independent access to the site from the surrounding road network.

### 2.2. Master Plan and Site Landscaping

The master plan for the elderly care center in Marrakech, Morocco, has been developed in compliance with current Moroccan building codes and standards, taking into account local climatic conditions and site topography. The irregular shape of the plot requires careful spatial organization to ensure comfort, safety, and the efficient functioning of all center facilities.

The primary goal of the project is to create a modern and comfortable environment for living, recreation, and medical care for elderly residents. The planning considers not only functional requirements but also aesthetic and ecological aspects of site landscaping.

The site layout ensures that each functional zone of the center is optimally located, providing convenient circulation for both residents and staff. Thoughtfully designed pedestrian pathways and access roads maximize the efficient use of the plot.

The spatial organization follows contemporary standards for ergonomics, accessibility for people with disabilities, and psychological comfort. Special attention is given to natural lighting, ventilation, and zoning to create a calm and cozy environment.

Engineering solutions are implemented to ensure uninterrupted operation of medical and support services. These include reliable systems for electricity, water supply, and drainage, as well as fire safety measures.

The modern infrastructure allows for the integration of innovative technologies for medical care, rehabilitation, and social interaction, supporting a holistic approach to elderly care.

The project features clear functional zoning, ensuring efficient use of the site while creating a comfortable environment for residents and visitors.

The building area includes the main center with all primary and auxiliary facilities: residential rooms, medical offices, rehabilitation halls, kitchen, and

administrative spaces. The layout ensures easy orientation on the site and quick access to all key facilities.

The site also provides open areas for relaxation, walking, and physical activity for residents. Key elements include:

– pedestrian pathways along the building and through green spaces;

– small architectural elements such as benches, trash bins, and gazebos to create comfortable outdoor resting areas;

– street lighting system for safe movement in the evening and at night;

– landscaping with lawns, flower beds, decorative shrubs, coniferous and deciduous trees, forming a cozy and pleasant microclimate;

– designated areas for physical exercise and recreational activities adapted for elderly residents.

The surrounding grounds include auxiliary facilities to enhance comfort and safety:

– outdoor sports area;

– guest parking for 50 vehicles, with specially allocated spaces for people with disabilities;

– access roads and pathways designed to provide convenient and safe entry to the center (pic. 2.5)

Picture 2.5 Master plan

For the reliable operation of the center, a comprehensive set of engineering solutions has been provided, including:

– connection to the city's water supply and sewage networks;

– installation of a local wastewater treatment system and stormwater collection;

– backup power supply, including a diesel generator for critical systems and solar panels for renewable energy;

– autonomous water and electricity systems to ensure uninterrupted operation in emergency situations.

This approach ensures the safe operation of the center under all conditions, including extreme climatic factors typical of the Marrakech region.

Thus, the master plan and site development provide a comprehensive approach to creating a modern, comfortable, and safe environment for living and elderly care in the city of Marrakech.

### 2.3. Volumetric and Planning Solution

In the process of designing a care center for the elderly in the city of Marrakech, various layout options for residential spaces are considered, taking into account the functional needs of the facility and the characteristics of the urban environment. For this project, a corridor-based floor plan has been selected, which allows for the most efficient organization of residents' rooms and ensures convenient internal circulation.

The chosen architectural and structural solutions comply with modern Moroccan norms and standards regarding:

– natural lighting of interior spaces;

– fire safety and emergency evacuation access;

– accessibility for people with limited mobility;

– acoustic comfort and the creation of a calm environment;

– comprehensive engineering systems, including heating, ventilation, water supply, and electricity.

This approach ensures a safe and comfortable stay for the residents of the center and creates conditions for the effective work of staff, in line with contemporary

requirements for elderly care.

The building has a complex geometric form. This shape allows for efficient use of the site and optimization of the internal space. The maximum dimensions of the structure along the outer axes are 85,0 × 56,0 m.

The total height of the building to the upper level is 10,3 m, which complies with the urban planning restrictions of the area and allows the facility to be harmoniously integrated into the surrounding development without disrupting the cityscape silhouette (pic. 2.5).

Picture 2.6. General view of the elderly care center building

The designed building has three above-ground floors. The height of the first floor is set at 4,0 m due to its public and functionally intensive purpose. The upper floors have a height of 3,0 m.

Each floor has a different area, with each successive floor being smaller in relation to the one below.

The first floor of the elderly care center plays a key role in organizing the reception of residents and visitors, coordinating staff work, and ensuring the functioning of administrative, medical, and service units. The spatial layout of the floor is designed according to principles of comfort, safety, and easy navigation. The plan provides a logical distribution of visitor, resident, and staff flows, creating a clear and accessible circulation system.

The public-administrative section of the first floor combines an entrance vestibule, a spacious lobby, a reception area, and a waiting zone. This area forms the

first impression of the facility and provides convenient access to all main rooms. The reception performs registration, information support, and access control functions, ensuring efficient communication with the administration. Nearby are offices for management and staff, archival and service rooms, as well as a conference hall and meeting rooms, which support effective facility management.

The medical and rehabilitation block on the first floor is organized to provide comprehensive care for residents. It includes primary examination rooms, procedure rooms, doctors' offices, rooms for psychologists and social workers, nurse stations, and storage for medications. To support residents' physical well-being, there are therapeutic exercise halls, physical rehabilitation rooms, a gym, and spaces for yoga and breathing exercises. A SPA area with hydrotherapy elements complements the wellness system and contributes to physical and emotional recovery.

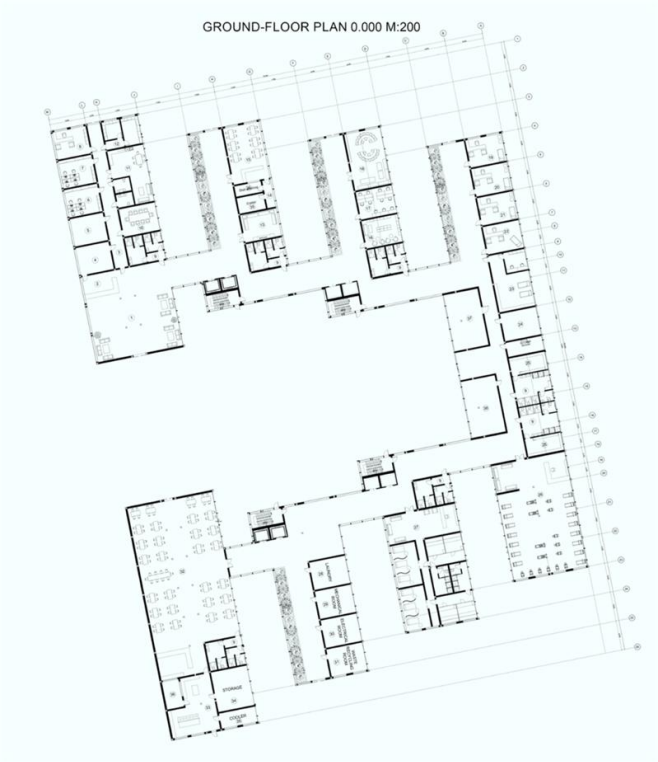
Social and recreational spaces encourage active interaction and cultural development among residents. The first floor includes a common recreation area with a media space, a library and reading room, a multifunctional room for clubs and workshops, rooms for family meetings, and a dayroom. This layout supports socialization, the organization of educational and recreational activities, and the creation of a comfortable environment for communication.

The dining area and dayroom are connected to the kitchen block, storage rooms, refrigeration chambers, and washing areas, ensuring the rational organization of meals in accordance with residents' dietary needs. Laundry, utility, and technical rooms, along with the electrical room and waste sorting area, guarantee proper sanitation and uninterrupted operation of engineering systems.

An important component is the arrangement of outdoor spaces. The internal landscaped courtyard, with shaded areas and covered galleries, provides conditions for safe walks and outdoor relaxation in any weather. The space is designed to receive adequate natural light, which positively affects the psychophysiological state of the residents.

All functional zones are integrated into a system of horizontal and vertical circulation with stairs and elevators. The layout follows principles of accessibility,

ergonomics, and sanitary standards, taking into account the climate conditions of Marrakech. As a result, the first floor creates a holistic, safe, and modern environment that combines living, medical care, recreation, and social activity for the elderly (pic. 2.8).




Picture 2.8. Plan at 0,000

On the upper floors of the elderly care center, there are residential rooms for the residents with equipped bathrooms, doctors' offices for medical staff, and procedure rooms for daily medical treatments. The floor layouts are designed with consideration for the comfort, privacy, and safety of the elderly, while also ensuring the efficient work of the medical staff (pic. 2.9).

Picture 2.9. Plan at +4,000 and +7,000

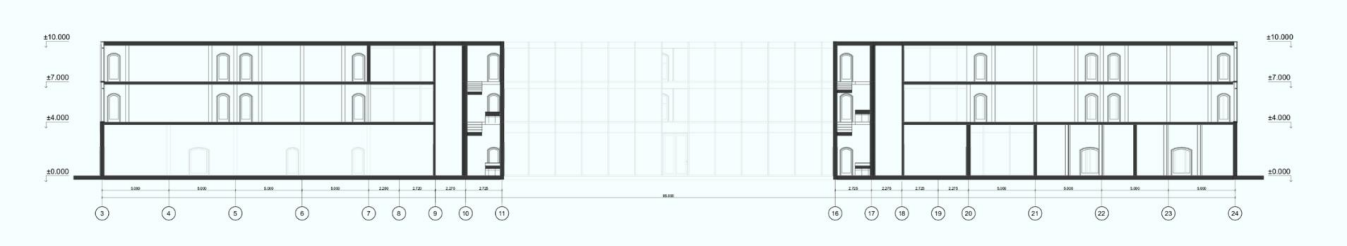
Vertical circulation between floors is organized using double-flight stairwells and elevator cores. Four separate stairwells lead to the second floor, ensuring an even distribution of resident and staff traffic, as well as quick access to service rooms and residential areas.

The center’s elevator system consists of eight passenger-cargo elevators with a load capacity of 1,000 kg. This allows for efficient transportation of residents, staff, medical equipment, and luggage, ensuring uninterrupted operation of the facility and user comfort.

In the event of an emergency, such as a fire, the evacuation of residents and staff is carried out via the stairwells. All doors along evacuation routes open in the direction of exit, in compliance with current fire safety regulations, ensuring fast and safe evacuation. Access to the roof is provided through the stairwells, allowing the rooftop to be used as an additional space for recreation and outdoor events.

The building roof is flat with a slope of i = 0.03 and is partially accessible. It is planned to accommodate a terrace bar and a sunbathing area, giving residents the opportunity to spend time outdoors and in the sun under safe conditions. Lightweight fabric canopies are provided for protection against sun and weather, which do not disrupt the architectural composition of the building and harmoniously integrate into the overall design of the center.

Thus, the organization of the upper floors and roof combines functionality, safety, and comfort, meeting modern standards of elderly care while taking into account the climate of Marrakech and the needs of the residents. The layout ensures efficient movement within the building, safe evacuation in emergencies, and the possibility of creating additional spaces for outdoor recreation and social activity (pic. 2.10).




Picture 2.10. Sections

## 3. ARCHITECTURAL AND STRUCTURAL SOLUTION

The building of the elderly care center in Marrakech is designed taking into account the climatic and cultural characteristics of the region. The structural system of the facility is a hybrid: a monolithic reinforced concrete frame is combined with load-bearing walls made of local materials, providing reliability and durability. The frame consists of columns, slabs, and rigid diaphragms, which together ensure the spatial stability of the building.

The structural scheme features a beamless frame with flat slabs without capitals, allowing flexible organization of interior spaces according to the needs of residents and medical staff. Foundations under the columns are designed as reinforced concrete pier footings, while foundation beams are laid under the walls. Monolithic slabs provide reliable horizontal rigidity, and their combination with vertical load-bearing elements and rigid diaphragms guarantees the stability of the entire structure.

The exterior walls are self-supporting, three-layered: the main material is aerated concrete blocks insulated with extruded polystyrene, providing high thermal insulation suitable for the Moroccan climate. Stairwells are constructed from solid bricks with a thickness of 380 mm, meeting fire-resistance standards and ensuring safety in emergencies. Slabs and stair flights are made of monolithic reinforced concrete, while lintels above windows and doors are prefabricated beam elements.

Partitions in residential and administrative spaces are made of 100 mm thick gypsum boards, with moisture-resistant gypsum board used in wet areas.

Vertical circulation is provided by double-flight stairwells and elevator cores. For efficient movement of residents, staff, and luggage, the center is equipped with eight passenger-cargo elevators with a capacity of 1,000 kg. In emergencies, such as fire, evacuation is carried out via stairwells, with all doors along evacuation routes opening in the direction of exit, in accordance with fire safety requirements.

The building roof is flat with a slight slope of i = 0.03.

The drainage system is internal and includes rainwater inlets, downpipes, and risers that direct water to the city stormwater network.

Interior doors are made of solid wood and custom-fabricated, while exterior doors are double-leaf metal-plastic with glazing. Windows are PVC profiles with triple-glazed units that open inward, and partially include glass facade systems typical of contemporary Marrakech architecture, which optimize natural lighting and ensure energy efficiency.

Floor finishes are selected according to functional use: granite tiles in vestibules and entrance areas; linoleum on thermal insulation in corridors, halls, offices, and rooms; ceramic tiles in sanitary and procedure areas; impact-resistant polyurethane in gyms; and rough-surfaced, moisture- and disinfectant-resistant tiles in pool areas.

The facades are finished with high-quality materials, reflecting the architectural style of the building and local traditions. Interior finishes are adapted to the needs of elderly residents: ceramic tiles in sanitary and procedure areas, water-based paint in corridors and halls, decorative panels in the entrance lobby, and wallpaper in residential and administrative areas. Wooden and metal surfaces are coated with two layers of oil paint to enhance durability and aesthetics.

Around the building, a 1 m wide asphalt concrete pavement on a crushed stone base is provided, sloped at 0.03 away from the walls for rainwater drainage, in accordance with local climate conditions and ensuring the durability of the structures.

Thus, the architectural and structural solution of the elderly care center in Marrakech combines modern technologies, local construction materials, and regional

climatic features, ensuring the safety, comfort, and functionality of the building for residents and staff.

## 4. ECONOMIC SECTION OF THE ELDERLY CARE CENTER

### 4.1. Assessment of the Existing Conditions

4.1.1. Functional Zoning of the Site

Within the framework of the project «Elderly Care Center in Morocco (city of Marrakesh)», the territory is functionally structured in accordance with healthcare, residential, and service needs. The spatial organization of the site is aimed at ensuring safe movement, comfortable living conditions for elderly residents, and efficient operation of the facility.

| № | Territory Elements* | Area, m² | Share of Total, % | Specific Indicator, m²/person |
|---|---|---|---|---|
| 1 | Residential and medical-care zone, total | 9,000 | 36 | 18 |
| 1.1 | Building footprint | 6,500 | 26 | 13 |
| 1.2 | Internal driveways and pedestrian paths | 1,200 | 4.8 | 2,4 |
| 1.3 | Outdoor recreational courtyards | 800 | 3.2 | 1,6 |
| 1.4 | Therapeutic garden / green patios | 500 | 2 | 1 |
| 2 | Public and service infrastructure, total | 16,000 | 64 | 32 |
| 2.1 | Dining facilities and kitchen block | 1,200 | 4.8 | 2,4 |
| 2.2 | Medical and rehabilitation rooms | 3,800 | 15.2 | 7,6 |
| 2.3 | Administrative and reception area | 1,000 | 4 | 2 |
| 2.4 | Utility and technical premises | 2,000 | 8 | 4 |
| 2.5 | Parking areas (open and covered) | 6,500 | 26 | 13 |
| 2.6 | Auxiliary facilities | 1,500 | 6 | 3 |
| **Total** | | **25,000** | **100** | **50** |

*The composition of site elements may vary depending on the final architectural

concept.

The proposed zoning structure ensures logical separation between residential areas, medical support spaces, service zones, and landscaped outdoor environments. Special emphasis is placed on accessible pedestrian circulation and the integration of shaded green areas adapted to the climatic conditions of Marrakesh.

4.1.2. Technical and Economic Indicators (Design Proposal)

| № | Indicator | Units | Value |
|---|---|---|---|
| 1 | Total site area | hectares | 2,5 |
| 2 | Estimated capacity (residents and staff) | persons | 500 |
| 3 | Site occupancy density | persons/hectare | 200 |
| 4 | Building footprint | $m^2$ | 6,500 |
| 5 | Site coverage ratio | % | 26 |
| 6 | Landscaping ratio | % | 18 |
| 7 | Green space per person | $m^2$/person | 9 |
| 8 | Road and paved surfaces | % | 8 |
| 9 | Paved surface per person | $m^2$/person | 4 |
| 10 | Open parking area | $m^2$ | 1,200 |
| 11 | Parking capacity | spaces | 55 |

These indicators demonstrate a balanced distribution between built-up areas and landscaped zones, ensuring comfortable environmental conditions and compliance with planning standards for social-care facilities.

## 4.2. Technical and Economic Indicators of the Elderly Care Center

4.2.1. Planning Indicators for a Healthcare and Residential Public Building

| № | Indicator | Units | Value |
|---|---|---|---|
| 1 | Number of floors | units | 4 |
| 2 | Building capacity | persons | 500 |
| 3 | Total building volume | $m^3$ | 28,000 |

| | | | |
|---|---|---|---|
| | – above-ground volume | $m^3$ | 25,000 |
| | – underground/technical part | $m^3$ | 3,000 |
| 4 | Building footprint | $m^2$ | 6,500 |
| 5 | Gross floor area | $m^2$ | 13,500 |
| 6 | Usable residential and care area | $m^2$ | 10,500 |
| 7 | Total area per resident | $m^2$/person | 27 |
| 8 | Usable area per resident | $m^2$/person | 21 |
| 9 | Building volume per person | $m^3$/person | 56 |
| 10 | K1 = usable area / gross floor area | – | 0.78 |
| 11 | K2 = building volume / gross floor area | – | 2.07 |
| 12 | K3 = external wall perimeter / gross floor area | – | calculated individually |

The presented technical and economic indicators confirm the efficiency of the architectural concept and the rational use of land resources. The moderate building height, optimized spatial configuration, and adequate per capita area contribute to comfortable living conditions, operational effectiveness, and sustainable development of the Elderly Care Center in Marrakesh.

## 5. OCCUPATIONAL HEALTH AND SAFETY

### 5.1. Regulatory and Legal Framework for Ensuring Occupational Safety

The implementation of the project «Elderly Care Center in Morocco (city of Marrakesh)» requires strict compliance with occupational health and safety regulations at all stages – from the construction of the facility to its subsequent operation. Establishing safe working conditions is a fundamental factor in protecting the health of workers, contractors, and future staff members, as well as ensuring the safety of the center’s residents.

The legal regulation of occupational safety in Morocco is based on the provisions of the Labor Code of the Kingdom of Morocco, specialized occupational safety legislation, and applicable building, sanitary, and technical regulations that define the

requirements for the design and construction of public buildings. These documents establish standards for organizing construction activities, regulating the use of machinery and equipment, and preventing exposure to hazardous and harmful factors affecting workers.

During construction and installation works, the following measures are envisaged:

– proper organization of the construction site in accordance with safety requirements;

– regular inspection and monitoring of the technical condition of machinery, equipment, and tools;

– implementation of collective and personal protective systems;
– restriction of unauthorized access to active work zones.

The client and contracting organizations are responsible for conducting systematic safety briefings, providing training in safe working practices, and supplying employees with appropriate personal protective equipment according to the nature of their tasks. Particular attention is paid to monitoring compliance with established standards and promptly responding to potential risks.

The primary objectives of the occupational safety system are the prevention of workplace injuries, reduction of professional risks, and creation of a secure working environment.

After the completion of construction and commissioning of the facility, the occupational safety framework extends to ensuring appropriate working conditions for medical, administrative, and maintenance personnel. The design solutions incorporate:

– rational planning of workspaces in accordance with ergonomic principles;

– barrier-free access for individuals with limited mobility and persons with disabilities;

– compliance with fire safety requirements, including evacuation routes and smoke protection systems;

– adherence to regulatory standards for natural and artificial lighting, ventilation, indoor microclimate, and sanitary-hygienic conditions.

Thus, a comprehensive approach to occupational safety management within the

project of the Elderly Care Center in Marrakesh is an essential prerequisite for creating a safe, functional, and socially responsible environment tailored to the needs of both staff and residents.

### 5.2. Assessment of Working Conditions and Identification of Potential Hazards at the Design Facility

The evaluation of working conditions within the project «Elderly Care Center in Morocco (city of Marrakesh)» covers two principal stages: the construction phase and the subsequent operation of the facility as a social and healthcare institution. A comprehensive analysis makes it possible to identify potential hazards in advance and to implement appropriate preventive measures.

1. Construction Phase

During the construction process, specialists of various trades are involved, including builders, installers of engineering systems, electricians, crane and machinery operators, and roofing workers. Their activities are associated with a number of occupational risk factors, such as:

– significant physical strain during manual operations;

– exposure to noise and vibration from construction equipment;– dust formation in the working area;

– work at height (roof installation, elevator shafts);

– use of electrical tools and machinery;

– proximity to moving construction vehicles and heavy equipment.

These conditions may lead to falls, mechanical injuries, electric shock, or occupational respiratory and musculoskeletal disorders. To reduce risks, organizational and technical safety measures are implemented, including collective and personal protective equipment, regular safety briefings, monitoring compliance with technological procedures, and restricting unauthorized access to the construction site.

2. Operational Phase of the Center

After commissioning, the nature of work changes; however, specific risks remain

due to the characteristics of elderly care services. Staff activities include medical supervision, social support, daily assistance, and technical maintenance of the building.

Potential hazards at this stage include:

– emotional stress and psychological fatigue of employees;

– contact with residents who may have chronic or infectious diseases;

– insufficient lighting, improper ventilation, or excessive noise;

– static loads and prolonged work in fixed or uncomfortable positions.

Such factors may contribute to professional burnout, musculoskeletal disorders, or allergic reactions. Therefore, the project provides for an effective ventilation and air-conditioning system adapted to the climatic conditions of Marrakesh, adequate natural and artificial lighting, ergonomic workplace design, and strict adherence to sanitary and hygienic standards.

3. Safety of Residents and Visitors

Special attention is given to creating a safe environment for elderly individuals, including those with limited mobility. Potential risks include:

– architectural barriers;

– slippery or uneven flooring surfaces;

– poorly organized visual navigation;– insufficient lighting in corridors and stairways.

To minimize these risks, the project includes ramps and elevators, widened doorways, anti-slip floor coverings, contrast markings, handrails, emergency lighting systems, and alarm systems.

Table 5.1 Summary of Working Conditions During Operation of the Elderly Care Center (Marrakesh)

| № | Staff Category | Nature of Work | Potential Hazards | Preventive Measures |
|---|---|---|---|---|
| 1 | Medical staff | Health monitoring, direct contact with residents, indoor work | Infectious risks, stress, physical overload | Personal protective equipment (PPE), ventilation, shift rotation, psychological support |

| | | | | |
|---|---|---|---|---|
| 2 | Caregivers and social workers | Assisting mobility, hygiene procedures | Back injuries, emotional exhaustion | Training in safe lifting techniques, ergonomic equipment |
| 3 | Technical and maintenance staff | Cleaning, minor repairs, use of detergents | Chemical exposure, slips and falls | Safe cleaning agents, protective clothing, anti-slip flooring |
| 4 | Administrative personnel | Computer-based and documentation work | Eye strain, sedentary lifestyle effects | Ergonomic workstations, scheduled breaks |
| 5 | Kitchen staff | Food preparation, use of heat equipment | Burns, cuts, overheating | Compliance with hygiene standards, ventilation, safety training |

The conducted assessment of working conditions and potential hazards forms the basis for developing an effective occupational safety system. This approach ensures the creation of a secure, ergonomic, and socially oriented environment tailored to the needs of elderly residents while meeting modern safety standards and regulatory requirements.

### 5.3. Risk Assessment of Potential Hazards at the Design Facility

The analysis of potential hazard realization risks within the project «Elderly Care Center in Morocco (city of Marrakesh)» constitutes a fundamental stage in ensuring safe working conditions and the sustainable operation of the institution. Such an assessment makes it possible not only to identify possible threats but also to evaluate their likelihood and the severity of their impact on employees, residents, visitors, and the overall safety of the facility.

During the construction phase, the dominant risks are primarily technical in nature. These include falls from height, improper handling of construction machinery, electric shock, and partial collapse of structural elements. The probability of such incidents increases in cases of non-compliance with occupational safety standards, insufficient staff training, or inadequate supervision.

Risk mitigation at this stage involves strict adherence to occupational health and safety regulations, systematic inspection of machinery and equipment, continuous

monitoring of construction processes, and the use of both collective and personal protective equipment.

After the completion of construction and commissioning of the Center, the profile of hazards changes. The operational phase introduces different categories of risk, including:

– biological hazards, particularly the possibility of infection transmission to medical and caregiving staff through direct contact with elderly residents;

– physical factors, such as inadequate microclimate conditions, insufficient lighting, or poorly organized workspaces;

– psychological strain, including increased likelihood of emotional burnout among employees.

In addition, technical risks remain relevant, including improper operation of medical or electrical equipment and the potential for fire caused by electrical system malfunctions.

Preventive strategies include:

– implementation of sanitary and hygienic monitoring procedures;

– maintenance of high standards of cleanliness and controlled indoor environments;

– staff training in the correct use of personal protective equipment (PPE);

– scheduled maintenance of engineering systems;

– provision of supportive measures to reduce psychological stress among employees.

Special consideration must be given to the safety of elderly individuals with limited mobility. Key risk factors may involve:

– absence of ramps, handrails, or properly equipped elevators;

– limited accessibility of functional areas;

– insufficient informational signage and navigation systems;

– slippery surfaces or inadequate lighting.

Such deficiencies may result in increased injury rates, reduced effectiveness of care services, and violation of inclusive design principles.

Preventive solutions include:

– implementation of barrier-free architectural design;

– application of anti-slip flooring materials;

– integration of visual, tactile, and acoustic navigation systems;

– ergonomic spatial zoning to ensure safe circulation.

Continuous risk evaluation throughout all project stages enables early detection of hazards and timely implementation of corrective measures. This approach reduces accident probability, enhances safety for both staff and residents, ensures stable facility operation, and supports the creation of a secure and comfortable living environment.

Risk Assessment Methodology

For evaluating risks at the Elderly Care Center in Marrakesh, a risk matrix method can be applied. This approach is based on two primary parameters:

Probability of occurrence (P)

Severity of consequences (S)

Probability Scale (P):

1 – Rare

2 – Possible

3 – Likely

4 – Highly likely

Severity Scale (S):

1 – Minor (slight loss of working capacity)

2 – Moderate (temporary injury or illness)

3 – Serious (long-term treatment required)

4 – Critical (disability or fatality)

Table 5.2 – Risk Assessment Matrix

| P \ S | 1 (Minor) | 2 (Moderate) | 3 (Serious) | 4 (Critical) |
|---|---|---|---|---|
| 1 | Low | Low | Medium | Medium |
| 2 | Low | Medium | High | High |
| 3 | Medium | High | High | Critical |

| | | | | |
|---|---|---|---|---|
| 4 | Medium | High | Critical | Critical |

Table 5.3 – Example of Risk Evaluation

| № | Hazard | Probability (P) | Severity (S) | Risk Level |
|---|---|---|---|---|
| 1 | Fall from height during construction | 3 | 4 | Critical |
| 2 | Contact with infectious resident | 2 | 3 | High |
| 3 | Staff fatigue or burnout | 3 | 2 | High |
| 4 | Fire caused by electrical short circuit | 2 | 4 | High |
| 5 | Cut injury while working with kitchen equipment | 3 | 2 | High |
| 6 | Resident fall due to absence of handrails | 2 | 3 | High |
| 7 | Allergic reaction to cleaning agents | 2 | 2 | Medium |
| 8 | Prolonged computer work without ergonomic setup | 4 | 1 | Medium |

The analysis indicates the presence of critical and high-level risks that require immediate preventive action. Particular attention should be devoted to working at height during construction, infection control procedures, the psychological well-being of staff, and the physical safety of elderly residents.

## 5.4. Development of Organizational, Technical, and Architectural –Planning Measures to Improve Working Conditions at the Design Facility

The formulation of organizational and engineering measures aimed at enhancing working conditions within the project “Elderly Care Center in Morocco (city of Marrakesh)” represents an essential component of the occupational safety management system. These measures combine administrative solutions related to staff organization with technical and spatial strategies intended to increase safety, efficiency, and overall comfort.

At the organizational level, it is necessary to establish a clearly structured occupational safety framework, including the appointment of responsible persons and the implementation of internal monitoring procedures. A structured schedule of

regular safety briefings, professional training sessions, and competency assessments should be introduced. Particular emphasis must be placed on personnel directly involved in elderly care, medical support, food preparation, and maintenance activities. The introduction of flexible working schedules and psychological support programs is advisable to prevent emotional fatigue and professional burnout.

From a technical perspective, all functional areas of the Center — residential units, medical rooms, dining facilities, administrative offices, and service areas — should be equipped with modern, ergonomically designed, and certified equipment. Engineering systems such as ventilation, air conditioning, lighting, and acoustic insulation must comply with applicable standards and be adapted to the climatic characteristics of Marrakesh. Strategically located first-aid kits, emergency call buttons, and personal protective equipment storage areas should also be incorporated into the building layout.

The spatial organization of the Center should follow universal design principles to ensure safe circulation and efficient workflow for both staff and elderly residents, including those with reduced mobility. This involves the installation of ramps, handrails, tactile paving elements, automatic doors, and integrated visual and audio guidance systems.

Architectural and planning solutions play a decisive role in shaping a safe and functional environment. Rational space planning reduces unnecessary physical strain on personnel, optimizes internal logistics, and prevents the intersection of service, residential, and visitor flows.

A key planning strategy is functional zoning. Administrative offices, healthcare units, residential rooms, recreational spaces, and service areas should be logically arranged to minimize excessive movement and improve operational efficiency. For example, locating medical consultation rooms close to residential wings reduces staff workload and ensures faster response times.

Ergonomic design of workstations – including nurse stations, administrative offices, and staff rest areas – is equally important. Work surfaces, lighting levels, ventilation systems, and access to utilities must comply with ergonomic standards.

Access to natural daylight and effective sound insulation contributes positively to the psychological and physiological well-being of employees.

Creating a barrier-free environment is crucial not only for residents with limited mobility but also for caregivers assisting them. The building should include ramps with appropriate slopes, elevators with wide door openings, automatic door systems, vibration-reducing floor coverings, clearly visible signage, and tactile indicators.

Separate entrances for residents, staff, and service operations help streamline circulation, reduce infection risks, and enhance operational efficiency. Dedicated storage areas for personal protective equipment, cleaning supplies, medical waste, and technical materials should be properly isolated and controlled.

All organizational, technical, and architectural measures must be documented in the institution's regulatory framework and supported by continuous monitoring, performance evaluation, and periodic updates within the occupational safety management system. This integrated approach not only minimizes professional risks but also fosters favorable working conditions for all employees of the Elderly Care Center in Marrakesh.

### 5.5. Conclusions

The comprehensive implementation of occupational health and safety measures is a fundamental prerequisite for establishing safe and comfortable conditions for both staff and residents of the Elderly Care Center in Marrakesh.

Consideration of safety requirements at the design, construction, and operational stages significantly reduces the likelihood of occupational injuries, work-related illnesses, and emergency situations.

Organizational measures should include:

– development of an effective internal occupational safety control system;

– regular safety training and briefings for employees;

– clear allocation of safety responsibilities among staff members;

– systematic monitoring of working conditions to identify and eliminate potential hazards.

Technical measures must provide for:

– use of certified and safe equipment;

– maintenance of optimal indoor microclimate conditions, adequate lighting, and proper ventilation;

– establishment of ergonomic workplaces;– availability of personal protective equipment;

– installation of emergency response systems, including fire alarms, evacuation routes, and first-aid facilities.

Architectural and planning solutions should ensure:

– barrier-free accessibility for persons with disabilities and elderly residents;

– safe and intuitive navigation for all users;

– installation of ramps, handrails, tactile and visual markings;

– properly designed evacuation pathways in compliance with safety standards.

In conclusion, the integration of organizational, technical, and architectural–planning measures within the project of the Elderly Care Center in Marrakesh ensures compliance with occupational safety regulations and contributes to the creation of a secure, inclusive, and efficient environment tailored to the needs of both employees and elderly residents.

## REFERENCES


1. U.S. Department of Health and Human Services, «Definition of an Assisted Living Facility,» National Center for Assisted Living, 2023. URL: https://www.ahcancal.org/ncal/about/assistedliving/

2. Schwartz, B., & Brent, R., Aging, Autonomy, and Architecture: Advances in Assisted Living, Johns Hopkins University Press, 1998, pp. 21 – 24.

3. World Health Organization, World Report on Ageing and Health, Geneva: WHO Press, 2015, pp. 88 – 95.

4. Lawton, M. P., & Nahemow, L., «Ecology and the Aging Process», in C. Eisdorfer & M. P. Lawton (Eds.), The Psychology of Adult Development and Aging, Washington, DC: American Psychological Association, 1973, pp. 619 – 674.

5. American Institute of Architects (AIA), Guidelines for Design and Construction of Residential Health, Care, and Support Facilities, 2021, pp. 15 – 20.

6. ArchDaily, «Senior Center of Guangxi / Atelier Alter.» URL: https://www.archdaily.com/553442/senior-center-of-guangxi-atelier-alter/

7. ArchDaily. Edificio Residencial para Adultos Mayores / Atelier d'Arquitectura JA Lopes da Costa. URL: https://www.archdaily.cl/cl/02-345627/edificio-residencial-para-adultos-mayores-atelier-lopes-da-costa

8. ArchDaily. Допомога людям похилого віку в Утебо / Базиліо Тобіас. Доступно за адресою:https://www.archdaily.com/358856/assisted-living-for-the-elderly-in-utebo-basilio-tobias

9. World Health Organization, Active Ageing: A Policy Framework, Geneva: WHO, 2002. URL: https://iris.who.int/handle/10665/67215

10. World Health Organization, Global Age-friendly Cities: A Guide, Geneva: WHO, 2007. URL: https://www.who.int/publications/i/item/9789241547307

11. Neufert, E., & Neufert, P., Architects' Data, 4th Edition, 2012. Wiley. URL: https://www.wiley.com/en-us/Architects%27+Data%2C+4th+Edition-p-9781405192539

12. Passini, R., Pigot, H., Rainville, C., & Tétreault, M. H., «Wayfinding in Dementia», Environment and Behavior, 2000. URL:

https://journals.sagepub.com/doi/10.1177/00139160021972594

13. Ulrich, R. S., “Effects of Gardens on Health Outcomes,” 1999. URL: https://www.researchgate.net/publication/232564156_Healing_Gardens

14. Chaudhury, H., Hung, L., Badger, M., & Sepehri, A., «The Role of the Physical Environment in Dementia Care», The Gerontologist, 2018. URL: https://academic.oup.com/gerontologist/article/58/3/427/4091493

15. Kellert, S. R., Heerwagen, J., & Mador, M., Biophilic Design: The Theory, Science, and Practice of Bringing Buildings to Life, 2008. URL: https://www.wiley.com/en-us/Biophilic+Design%3A+The+Theory%2C+Science%2C+and+Practice+of+Bringing+Buildings+to+Life-p-9780470163344