University Mohamed Khider of Biskra
Faculty of Architecture and Urban Planning
Department of Earth and Universe Sciences

Domain: Architecture, Urbanism, and City Professions
Field: Urban Technical Management
Specialisation: City Management
Réf. Number: ……

MASTER THESIS

Submitted and defended by:
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On: 02/06/2025

TYPOLOGY OF DEGRADATION IN INDIVIDUAL HOUSINGS IN URBAN AREAS AND OPTIMAL INTERVENTION MEASURES "CASE STUDY OF THE CITY OF BISKRA "

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The academic year: 2024/2025

Acknowledgements

Thank you, O God, for granting me life and then the ability to accomplish the noble task of learning and the love of knowledge.

I extend my sincere gratitude to my thesis supervisor, Pr **Bouzaid Meh Lahcen**, for his assistance, advice, support, and trust.

I want to express my sincere gratitude to the committee members who agreed to evaluate this work.

I would like to express my gratitude to Mrs **MSELLEM Houda** for supervising my thesis.

I would also like to express my deep gratitude to Mrs **ARAMI Soumia** for chairing my examination committee.

And with deep pride and honour, I extend my thanks to all the professors of the Department of Earth and Universe Sciences in Biskra for what they have provided in terms of knowledge and understanding, and for their continuous support, which has contributed to my scientific and intellectual formation.

I would also like to thank all the teachers who supported me throughout my academic journey, and everyone who helped me with a word or deed, and provided me with the support and encouragement to complete this work. You are the source of my inspiration and true support.

Thank you.

Dedicated

To the spirit of my dear father, *who always supported and encouraged me from afar.*

To my dear mother, *the source of my endless love and tenderness. Your strength and kindness They shaped the person I am today. May God grant you health, happiness, and a long life.*

To the memory of my dear grandfather, *may paradise be your eternal abode.*

To my brother and sister, Marwa. *You have shared with me many precious moments and happy memories. May God bless you.*

To my beloved nephews, Daniel and Nizar, *I love you.*

To my dear family, *for your love and continuous support.*

To my friends, *your understanding and support have always given me strength.*

Abstract

Housing, like any other installation, is subject to all kinds of deterioration and degradation. This study aims to examine and analyse the phenomenon of individual housing degradation in the urban context of the city of Biskra, by identifying the types of degradation and their causes, and proposing appropriate urban interventions through rehabilitation and urban renewal methods. The study was based on a descriptive-analytical approach, combining a theoretical treatment based on specialised literature and a field analysis based on data extracted from a questionnaire aimed at a sample of degraded houses within the urban fabric. The results showed that the degradation of housing is the result of the interaction of several factors, including design errors, material failures, building ageing, a hostile environment, misuse, and lack of maintenance.

Keywords: housing degradation – typology of degradation – individual housing – Biskra – rehabilitation – urban renewal.

Résumé

L’habitat, comme toute autre installation, sont soumis à toutes sortes de détérioration et de dégradation. Cette étude vise à examiner et analyser le phénomène de dégradation des logements individuels dans le contexte urbain de la ville de Biskra, en identifiant les types de dégradation et leurs causes, et en proposant des interventions urbaines appropriées à travers la réhabilitation et les méthodes de renouvellement urbain. L'étude s'est basée sur une approche descriptive-analytique, combinant un traitement théorique basé sur la littérature spécialisée et une analyse de terrain basée sur des données extraites d'un questionnaire destiné à un échantillon de maisons dégradées au sein du tissu urbain. Les résultats ont montré que la dégradation des logements est le résultat de l'interaction de plusieurs facteurs, y compris des erreurs de conception, des défaillances des matériaux, le vieillissement des bâtiments, un environnement hostile, une mauvaise utilisation et un manque d'entretien.

Mots-clés : dégradation du l’habitat – typologie de la dégradation – l’habitat individuel – Biskra – réhabilitation – renouvellement urbain.

الملخص

المساكن، مثل أي منشأة أخرى، تتعرض لجميع أنواع التدهور والتلف، تهدف هذه الدراسة إلى فحص وتحليل ظاهرة تدهور المساكن الفردية في السياق الحضري لمدينة بسكرة، من خلال تحديد أنماط التدهور وأسبابها، واقتراح تدخلات حضرية مناسبة من خلال إعادة التأهيل وطرق التجديد الحضري. استندت الدراسة إلى منهج وصفي-تحليلي، يجمع بين معالجة نظرية مستندة إلى الأدبيات المتخصصة وتحليل ميداني قائم على بيانات مستخرجة من استبيان موجه لعينة من المنازل المتدهورة ضمن النسيج الحضري. أظهرت النتائج أن تدهور المساكن ناتج عن تفاعل عدة عوامل، بما في ذلك أخطاء التصميم، وفشل المواد، وشيخوخة المباني، وبيئة معادية، وسوء الاستخدام، ونقص الصيانة.

الكلمات المفتاحية: تدهور السكن – أنماط التدهور – السكن الفردي – بسكرة – إعادة التأهيل – التجديد الحضري.

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OECD: Organization for Economic Co-operation and Development.

WMO: World Meteorological Organization.

UNISDR: United Nations International Strategy for Disaster Reduction.

UNDRR: United Nations Office for Disaster Risk Reduction.

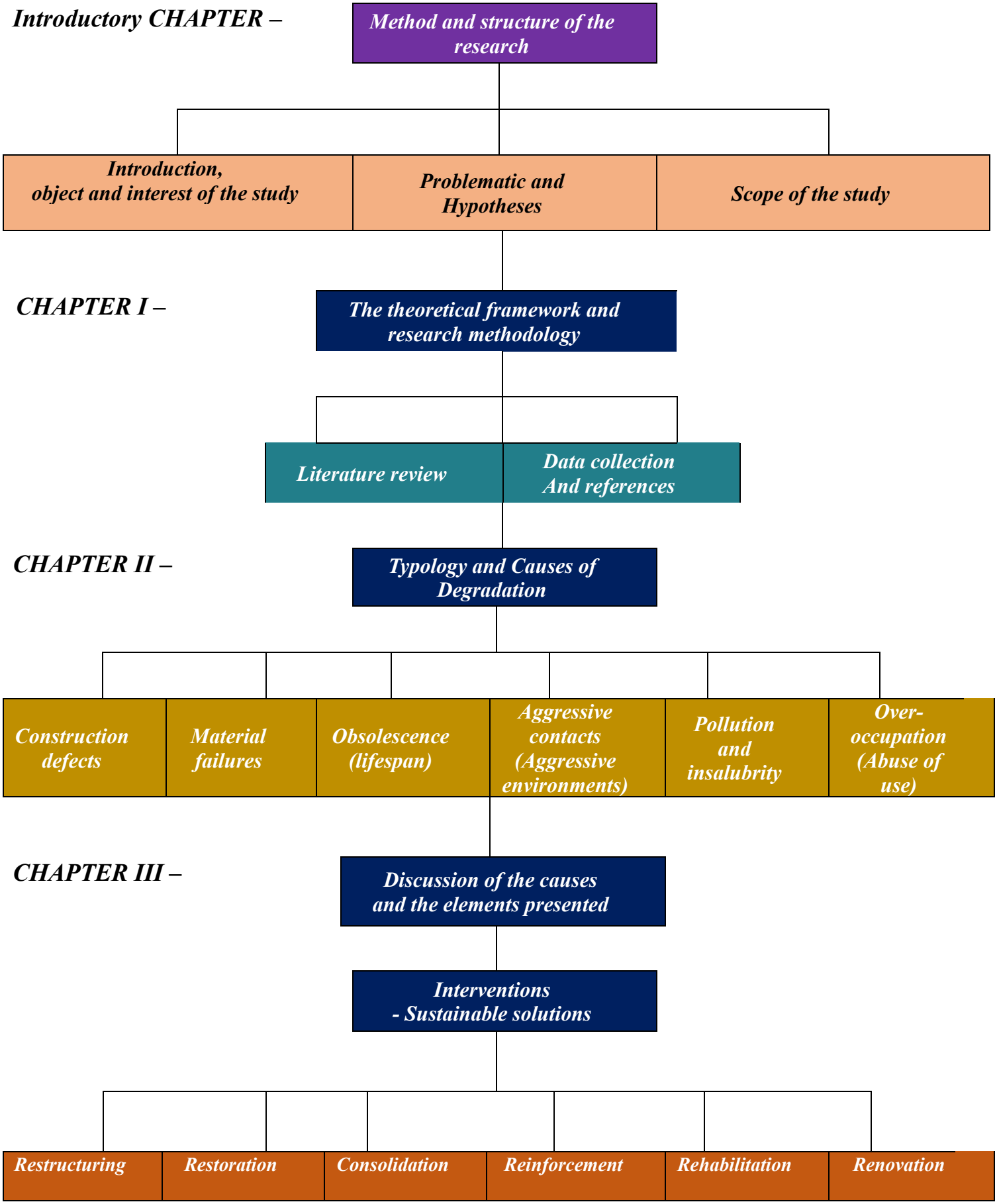
UNEP: United Nations Environment Program**.**

WHO: World Health Organization.

ISO: International Organization for Standardization.

ASPE: American Society of Plumbing Engineers.

IEEE: Institute of Electrical and Electronics Engineers.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Introductory CHAPTER _

Method and Structure of the Research

Introductory Chapte

Research Structure

In the introductory chapter, the research structure is clarified based on the problem statement, the selection of the case study, and the research questions, and the research objective is finally explained.

General Introduction

Single homes are a fundamental component of the urban fabric in cities, playing an important role in providing a stable living environment for residents. However, these homes face significant challenges that lead to their gradual degradation, especially in urban areas experiencing haphazard expansion and rapid demographic growth. These challenges are manifested in urban, environmental, economic, and social factors that negatively impact the sustainability of the urban fabric and reduce urban quality of life.

There are several reasons behind the degradation of housing, as a United Nations study indicated that "more than 1.6 billion people live in inadequate housing." Poverty, low levels of education, lack of financial resources, and inadequate urban planning are considered the main factors.

In the city of Biskra, which is undergoing rapid urban transformations, the degradation of individual housing appears as a direct result of several factors, including the age of the buildings, poor maintenance, construction defects, the use of low-quality materials, and overuse of the housing. This situation necessitates investigating the degradation patterns of these houses and identifying their main causes, aiming to propose measures to mitigate their negative impacts and improve the urban environment.

This study aims to diagnose and analyze the patterns of degradation of individual houses in the city of Biskra by identifying the factors influencing this degradation. The study relies on a field analytical approach that considers the technical, economic, and social dimensions. It also seeks to propose innovative measures to mitigate the degradation of individual houses and improve their quality.

2. Problematic

The urban fabric[1], with its structural composition, is a formation of complex elements that can generally be referred to as "human works" for various uses, but it is subject to diverse internal rules and factors as much as it is diverse. First, in its distribution across space, its density, proximity, quality, and so on. Second, in its occasional exposure to risks that may affect

[1] According to the Urban Design book, "The urban fabric is the spatial arrangement of architectural and urban elements in the city, and it includes the coordination between buildings, streets, public facilities, and open spaces, reflecting the cultural, social, and economic characteristics of the city."

It's overall architectural form, its function within the urban component, its durability, and so on. Thus, we are talking here about an area exposed to the possibility of multiple risks, some expected and others unexpected, which naturally qualifies it to be an area of sensitivity and fragility.

The fragility of the urban fabric[2] is subjective, whether material (structural), situational, or individual, and the relationship between the two depends on the level of awareness and knowledge of these characteristics. Everything is susceptible to influence depending on the adopted perspective - thus it is a universal concept - but it is relative to a specific case.

The issue at hand lies in the connection between the urban area and the vulnerabilities in the city of Biskra. This will enable us to discover some of the most overlooked aspects of urban environmental indicators under the influence of disruptive elements, including various types of pollution and their direct and indirect effects on housing structures, as well as construction errors, material failures, housing ageing, excessive use, lack of integration, lack of cohesion, and others, which sometimes lead to profound changes and/or modifications in the area.

As a result of the aforementioned issues affecting the urban fabric, we deduce the existence of technical solutions that include some practical urban interventions. From this, the central question arises as follows:

- What are the main patterns of deterioration affecting individual houses in the city of Biskra?

3. Hypotheses

A- Urban research indicates that the degradation of individual housing is directly linked to climatic and environmental changes, such as the presence of the residential building in a highly saline or high-humidity aggressive environment. Additionally, excessive use and chaotic handling of the housing negatively affect its condition, causing noticeable distortions on both the exterior and interior levels of the individual housing.

B- It has been found that the lack of material resources and social conditions such as poverty inevitably lead to the inability of families in the city of Biskra to regularly maintain their homes and thus the absence of maintenance and periodic upkeep of the housing, which leads to the accelerated ageing of these homes and the increased degradation of their condition.

[2] By "vulnerability," we mean the condition that individual houses suffer from due to their ageing, the poor quality of construction materials, and the lack of regular maintenance.

C- Unregulated, random, and chaotic construction using building materials that do not meet safety standards, and building in non-urbanisable areas in the city of Biskra leads to the concentration of urban problems and the weakening of infrastructure.

3.1. Discussion of hypotheses

Climatic factors, such as humidity, and environmental issues like pollution play a significant role in the degradation of housing. Furthermore, excessive use and careless handling of homes exacerbate these issues, resulting in visible distortions in the facades.

Families face considerable challenges due to limited financial resources and unsatisfactory social conditions, making it difficult to allocate the necessary funds for maintenance and repairs to their homes.

Unregulated construction often fails to meet urban planning requirements, leading to problems such as congestion, inadequate public services, and a lack of basic facilities. The use of substandard building materials further accelerates the degradation of structures, increasing the risk of accidents. Therefore, effective intervention is essential to regulate construction and enhance infrastructure.

4. Presentation of the study area

4.1. Geographical location

The study area of Biskra is located in the northeastern corner of the Algerian Sahara, 400 kilometres from the capital, and at an altitude of 120 meters above sea level. This area includes the Chott Melghir region in the southeast and southwest to the beginning of the Great Eastern Erg, covering a total area of approximately 21,671 square kilometres. It is characterised by its location on the northern edge of what is known as the African Shield, within a defined geographical range between

- Longitudes 4° 55' 12" and 6° 46' 12" East,
- Latitude lines 34° 16' 48" and 35° 23' 24" North.

4.2. Administrative framework

Biskra was classified as a province under the regional administrative division in 1974, and its borders were modified after the new administrative division in 2021. The province of Biskra currently includes twelve (12) districts and thirty-three (33) municipalities.

The province is bordered by:

• To the north, the state of Batna,

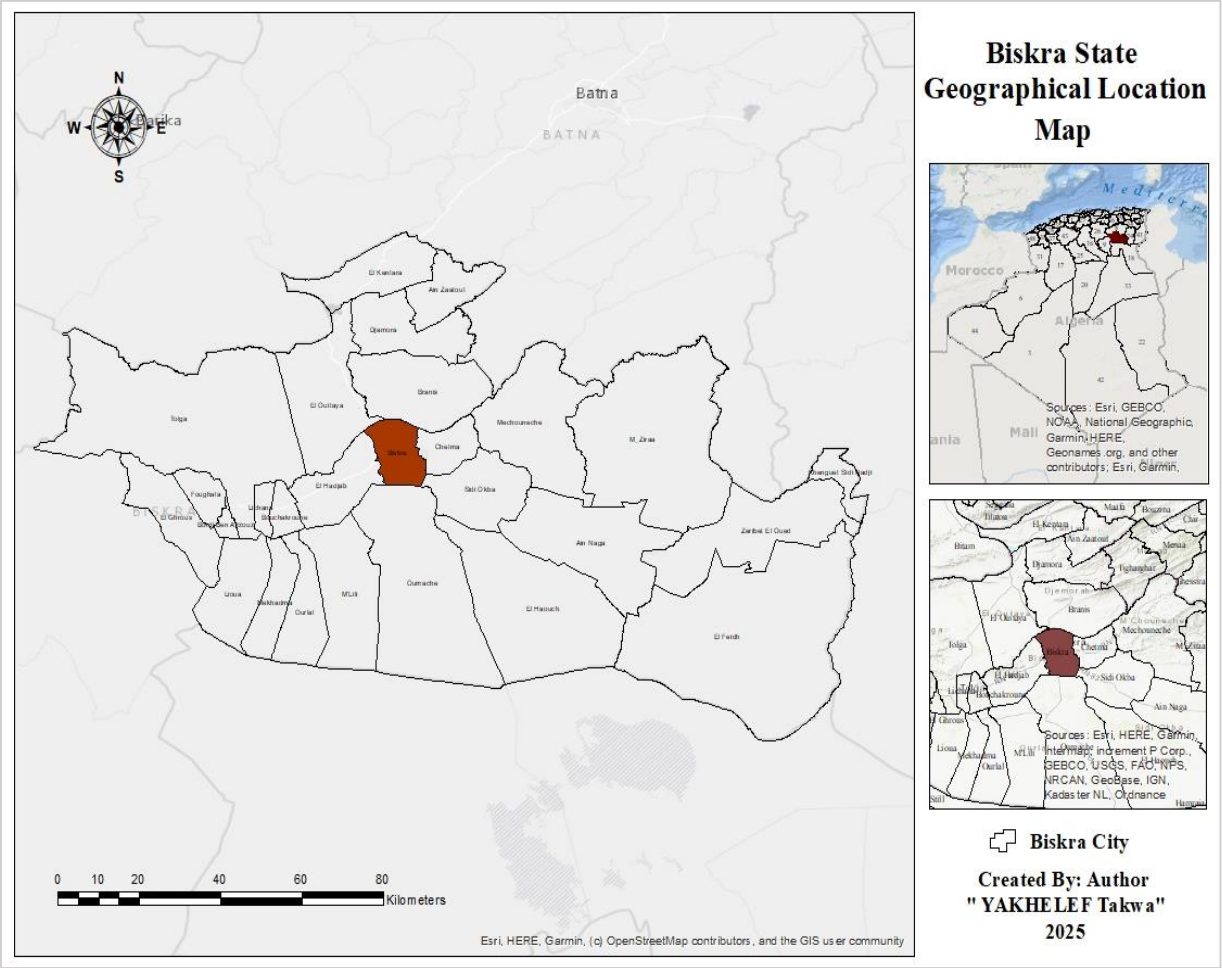
• To the south, the provinces of El Oued and Ouargla,

• From the east, the state of Tebessa,

• The province of M'sila from the west.

The state of Biskra is also known as the "Gateway to the Desert" due to its importance as a link connecting the northern provinces of the country with southern Algeria.

Map1 - Biskra State Location



Source : The Author, 2025

4.3. Climate data

- Temperature

Biskra is known for its continental climate, where the weather is hot in the summer, with temperatures sometimes reaching 40 degrees Celsius. In contrast, temperatures drop in the winter, ranging between 5 and 15 degrees Celsius. Accordingly, the average annual temperature is estimated to be around 20.9 degrees Celsius.

- Humidity

In meteorology (WMO), humidity refers to the amount of water vapour in the air. The city of Biskra is characterised by a dry continental climate, where relative humidity levels are often low, especially during the summer months, increasing the sensation of heat. Conversely, the region may experience an increase in humidity during the winter, but it remains within moderate levels.

- Rainfall percentage

Due to the semi-arid continental climate prevailing in the city of Biskra, this affects the amounts of rainfall the city receives, where we find:

• Annual rainfall average: The average rainfall in Biskra ranges between 120 and 150 mm/year.

• Seasonal distribution: Rainfall is mainly concentrated in the autumn and winter seasons, where the amounts of rain are greater, while summer is dry.

- The winds

The city of Biskra is affected by wind characteristics due to its geographical features and semi-arid continental climate. Among the most prominent wind patterns in the city are:

• The prevailing winds: Generally, the northeastern and eastern winds blow, carrying influences from the nearby desert regions.

• Southern winds: Winds may also blow from the south, which are hot winds that lead to a rise in temperatures.

5. Stages of the development of the city of Biskra

The city of Biskra consists of four main types of urban neighbourhoods that were formed during three different historical eras. The layout and urban fabric of these neighbourhoods are

similar to many cities in the Middle East, Europe, and Asia. However, what makes Biskra distinctive is the clear diversity in the urban fabric among these four neighbourhoods.

Many civilisations throughout history have contributed to shaping the oldest neighbourhoods of Biskra, including the Roman, Arab, Turkish, and French civilisations.

Type One: Old Biskra, the neighbourhoods influenced by the Turkish era (1541-1844). Since Old Biskra was formed from seven villages known as Mssid, Bab Dreb, Bab El Fath, Qadashah, Ras El Qarya, Mjanish, and El Qora (Farhi, 2002), each village consists of residential groups based on a regular linear layout along the streets that follow the "sakia" (irrigation channels in palm groves) and some dead-end streets.

Type Two: The second type of neighbourhood is a product of the French colonial era (1844-1962). What is called the "colonial city" or "station district" is located north of the palm oasis (Farhi, 2002). It is characterised by its chequerboard design, unlike the old town of Biskra.

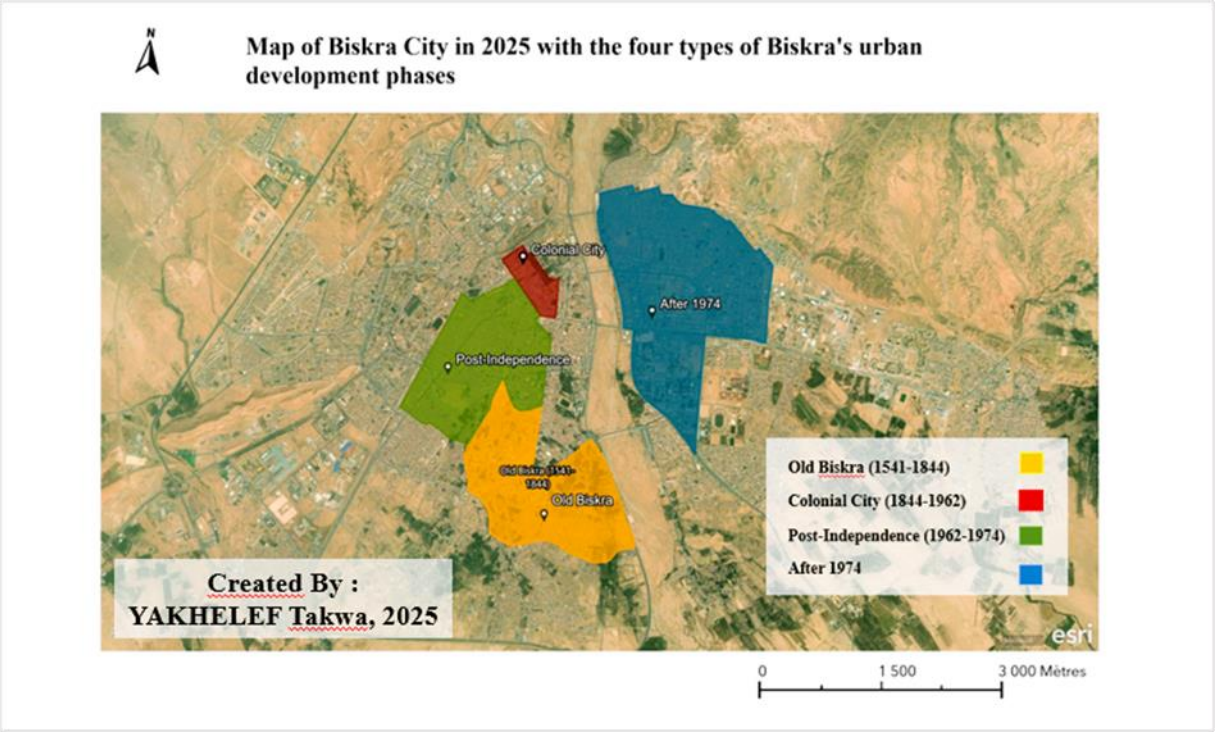
The third type: the post-independence era, witnessed the emergence of a new type of urban neighbourhood, where this modern pattern of urbanisation[3] took shape between 1962 and 1974. These new neighbourhoods were unplanned and were built haphazardly, lacking any organised urban plan. These neighbourhoods contributed to accelerating the urbanisation process and allowed for the connection between "Old Biskra" and the "colonial city".

Type Four: After 1974, another type of neighbourhood was built in a planned manner, where the first urban planning[4] tools were applied in Biskra (Walid-Mahfoud Djenaihi, 2021). These tools were not only used to correct the chaotic pattern of urban growth but also to meet housing needs through the use of planning laws such as building permits, subdivision permits, etc.

[3] The OECD defines urbanisation as an increase in population density and expansion due to social and economic changes.

[4] According to the Arabic Dictionary of Urban Planning Concept 2020,
Urban planning is the process of organising land use and developing urban areas to achieve sustainability and efficiency in the distribution of services and infrastructure.

Map2 - Biskra city map with the four types of urban development stages.



Source: ArcGIS Earth, adapted by the author,2025.

6. The objective of the study

Our study aims to address the issue of degradation patterns in individual housing in the urban areas of Biskra and understand the reasons contributing to this phenomenon. The main objective of this study is to identify the potential causes of degradation in individual housing in the city of Biskra. In this study, I will initially provide a comprehensive understanding of the basic concepts and principles related to our research topic, which is the degradation patterns in individual housing. In the second step, I will conduct an urban analysis in the specified area of Biskra to highlight and monitor the condition of individual housing, identify the reasons contributing to its degradation, and analyse them. This study will provide an in-depth understanding that the age or antiquity of a dwelling is not the only factor determining its potential for degradation; other patterns will also be identified. Based on the analysis results obtained, interventions will be made on these dwellings through appropriate practical urban intervention processes for the state of this degradation. In my thesis, I will also seek to find solutions to combat this problem by leveraging practical urbanisation processes that contribute to laying the foundations of urban planning, which achieves the well-being of residents and enhances their quality of life.

7. Thesis structure

According to our research methodology, this thesis begins with a general introduction presenting the main research problem, highlighting the issue that the research seeks to address. Furthermore, the basic hypotheses from which the research started will be discussed within the framework of studying the problem. This chapter also includes a comprehensive definition of the field of study, aiming to provide a cognitive context that helps in understanding the dimensions of the topic and analysing its aspects accurately .

Chapter One

In this chapter, we addressed the theoretical and methodological framework of the study, where we defined the basic concepts related to the deterioration of individual housing, its types, and urban causes to build a conceptual background for starting this research work effectively. We also mentioned urban planning tools as a means to address this deterioration, along with a brief overview of the most important previous studies on the subject. At the end of the chapter, we presented the adopted scientific methodology, data collection methods, sampling, and analysis techniques .

Chapter Two

We dedicated this chapter to analysing the manifestations and causes of the deterioration of individual houses in the city of Biskra, based on field studies and direct inspections. The cases of deterioration were classified according to their severity and pattern, and linked to the factors leading to them, whether technical, urban, or resulting from weak urban intervention. We supported the analysis with data collected through surveys and observations .

Chapter Three

In this chapter, we focused on studying urban interventions as solutions to address housing deterioration, where we reviewed various possible treatments such as restoration, rehabilitation, and urban renewal. We proposed a set of urban recommendations that take into account the specificities of the deteriorated neighbourhoods in the city of Biskra and contribute to improving the quality of the urban space.

CHAPTER I –The Theoretical Framework and Research Methodology

Methodology

In the first chapter, the literature was reviewed, and the methodology of this thesis was outlined.

Introduction

This chapter aims to provide a comprehensive theoretical framework that addresses the concepts of urban decay and methods to combat this phenomenon through various urban interventions. We began by presenting the concept of urban decay, as well as discussing the concept of housing, its types, and the terms related to risks. We also touched upon defining the patterns of decay and their impacts on the urban fabric.

We continued analysing the concepts of deterioration patterns, highlighting the most prominent phenomena and urban structures that reflect this deterioration. Additionally, we discussed various urban interventions used to combat deterioration, such as the concepts of renewal, restoration, urban rehabilitation, restructuring, and urban reinforcement and support, all aimed at improving living conditions and enhancing the urban functions of deteriorated areas.

We also reviewed the scientific methodology adopted in preparing the study, with a detailed explanation of the data collection methods and sources used, in addition to the sampling techniques we relied on to ensure the reliability and validity of the results. This chapter aims to establish a strong theoretical and methodological foundation to support the field study and achieve its objectives, and to provide a solid academic background that helps in understanding the phenomenon and finding solutions to address it.

I Literature review

1. Terms and concepts

Housing

According to the Ministry of Housing and Urban Planning, an independent building permanently or temporarily fixed on land or water, made of any building material, consisting of one or more floors, with a roof used for habitation, having one or more entrances leading from a public or private road to all or most of its components, and containing within itself the connection between the built field and the surrounding area.

Individual housing

Single housing is a type of accommodation that usually consists of a single residential unit designated for one family, characterized by its privacy and independence from other residential units (Oxford University Press, 2025).

It is a form of housing known as an independent residential unit designated for the accommodation of a single family or individual. This type of housing is characterised by its unique architectural design and integrates into the urban or rural fabric.

Collective housing

Collective housing is a type of housing where residents share certain facilities and spaces, while having private residential units (American Institute of Architects, 2010).

Collective housing is a type of housing that brings together a group of individuals or families in closely situated residential units within a single building or residential complex.

Risk

The Hyogo[5] Framework for Action in the context of disaster risk reduction and sustainable development (UNISDR) states that risk is defined as the probability resulting from the interaction of a set of threats with vulnerable elements, which is determined by a set of specific threat characteristics and the degree of vulnerability of the population or infrastructure. This means (risk probability = threat * vulnerability).

[5] (HFA - Hyogo Framework for Action) The Hyogo Framework for Action is a global agreement adopted at the United Nations World Conference on Disaster Reduction in 2005, which was held in the Japanese city of Hyogo.

Vulnerability

Urban fragility is described by the manifestations that reflect deterioration or susceptibility to it within the built environment of the city, at the level of a specific building or neighbourhood. According to UNDRR, "vulnerability is the degree to which a system is susceptible to, or unable to cope with, adverse effects of a hazard."

Stakes

The stakes involved are people, property, and the environment threatened by one or more hazards (aléas) that are likely to suffer harm or damage. The most important issue is, of course, human life. What is at stake are the structures, the population, and the environment directly or indirectly affected by the hazard (aléa). Therefore, they are the targets affected by the hazard. The stakes can be defined in terms of the number of people threatened by a natural phenomenon and the number of people affected (Jalizi, 2002).

2. Terms related to degradation patterns

2.1. Degradation

Degradation is a process that refers to a decline in quality, condition, or performance due to various influences and factors that affect it over time or because of external factors that may be natural or human-made, leading to a loss of efficiency or quality. Degradation is often associated with physical properties, such as buildings or materials, but it can also include the decline of the environment, natural resources, the economy, and mental health.

2.2. Housing degradation

A state of physical degradation in which the dwelling degrades or collapses due to multiple factors such as neglect, lack of maintenance, poor environmental conditions, ageing buildings, the use of substandard building materials, or even ecological impacts like humidity or pollution. Degradation occurs when homes lose their ability to provide a healthy and safe living environment, leading to negative effects on the residents' health and quality of life.

3. Typology of housing degradation

Housing degradation is defined as the condition in which homes are subjected to disturbances or a decline in their quality, leading to weakened infrastructure, an increase in urban distortions, and a lack of health and environmental standards in housing, which affects the quality of life for residents (UN-Habitat, 2014-2015).

Typology of housing degradation refers to different categories classified based on the types of problems and challenges faced by residential buildings. These patterns reflect the performance of the housing and illustrate how they degrade over time due to multiple factors, whether structural, functional, aesthetic, environmental, or social.

These typologies reflect how the degradation of housing can vary in nature and severity. Housing degradation can be classified into several typologies, each of which can result from multiple factors.

3.1. Construction defects

According to (Watt, 1999), a defect is a term used to describe a failure or shortcoming in the function, performance, organisation, or user requirements of a building. These defects, in addition to structural errors (foundations, columns, beams, etc.), occur as a result of mistakes in planning, design, construction, and use.

(Alomari, 2022) classified the defects into eight categories according to their causes, such as poor performance, cracking bodies, corrosion, separation, improper installation, surface appearance, and water issues. The defects present in building facades affect the structural integrity of the buildings and lead to the degradation of their exterior appearance. (A. Abass, 2024), A building defect occurs when the building loses its ability to perform its function. A building defect can be classified as a material defect (Bamira, 2020), and examples of a material defect include failure of strength and performance due to the building's inability to perform its function as expected within the acceptable limits set by the standard rules (Jamaluddin, 2017).

The construction defects lie in the degradation of materials, water leakage problems, mould appearance, degradation of finishes, cracks in ceilings and walls, the risk of building collapse, and so on. In this perspective, we evaluate the defective construction works in the residential area, where we find some of the main direct factors affecting the defective construction, including the use of poor-quality building materials, poor manufacturing, inadequate supervision, inappropriate design, design and execution defects, in addition to defects in building materials, lack of maintenance, incomplete work, and poor soil classification. As for the indirect factors or triggering causes that led to (or may lead to) the occurrence of the error, they include weather conditions, environmental factors, improper placement of trees, and neglect by owners or residents.

3.2. Material failures

Material degradation in buildings refers to the loss of mechanical or physical properties of the materials used in construction due to exposure to various environmental factors, which leads to a reduction in the building's lifespan (A. Al-Amri, 2020). It is about the failure of materials during their period of use. Structural failure occurs when environmental factors lead to the degradation of construction materials, causing cracks or collapses that may affect the integrity of the structure (Mirza, 2019). Leading to the loss of the material's ability to perform its intended function. This failure includes a variety of phenomena, such as cracks, wear, deformation, and fracture, and is often the result of unfavourable operating conditions, inappropriate design, or manufacturing defects. Material failure can result from a complex interaction between mechanical, thermal, and environmental factors.

3.3 Obsolescence (lifespan)

Obsolescence refers to the process through which the quality and performance of buildings degrade over time, losing their ability to meet the needs of their occupants in terms of safety and comfort. This degradation results from multiple interactions, including environmental factors, usage, and maintenance. According to (Kaklauskas, 2018), building Obsolescence refers to the process that leads to the weakening or deterioration of materials and structure due to continuous use and exposure to environmental factors such as humidity and heat.

The degradation of housing components and structures is an expected result of the obsolescence process. However, several factors can influence this process, such as the quality of construction and materials, and environmental factors that affect the housing by exposing it to various climatic fluctuations like humidity, heat, wind, and rain. Additionally, continuous exposure to ultraviolet (UV) rays, which cause material wear or lack of maintenance, significantly impacts this process.

Building lifespan management is an essential part of building ageing, as it relates to how to maintain functions and performance through regular maintenance (Kheir, 2018).

3.4. Aggressive contacts (Aggressive environments)

"Aggressive communication" refers to behavioural or verbal interactions characterised by aggression, such as rudeness, violence, or insult. When this type of communication occurs frequently or continuously, it has direct negative effects on the residents, leading to neglect of maintenance, property destruction, and increased degradation of residential buildings. Conflicts

or tensions resulting from these interactions can cause neglect of maintenance, breaking or damaging property, and reduced attention to the building's safety, exposing it to greater risks of psychological and physical degradation. In contexts where conflict and aggression are prevalent, the level of safety and security declines, leading to the degradation of the residence's physical condition, reducing its quality, and increasing repair and maintenance costs (Schmid, 2011).

The aggressive environment further deteriorates the housing quality, as residents do not adhere to necessary maintenance or repairs. Additionally, buildings are used as venues for expressing tension and violence, exacerbating the structural decline and deterioration of the buildings, worsening the housing crisis, and causing them to lose their functional and security value (Williams, 2018).

The hostile environment contains factors or activities that negatively affect people or the immediate surroundings of the residence. Hostile environments refer to human or environmental activities that lead to the degradation of housing quality, whether through pollution, noise, chemical effects, or industrial activities.

3.5. Pollution and insalubrity

According to the definition by the UNEP, pollution is the direct or indirect introduction of any substance or energy into the environment that results in adverse effects on human health or living organisms, or affects the legitimate uses of environmental resources.

The WHO defines lack of health as "the presence of environmental conditions that negatively affect human health, such as continuous exposure to pollutants, poor indoor air quality, and inadequate sanitation and clean water infrastructure."

"Pollution and unsanitary conditions" in the context of housing refer to the state in which a dwelling becomes contaminated due to the spread of environmental pollutants such as dust, unpleasant odours, chemicals, or waste, making it unsafe for habitation. The degradation of the quality of life in homes associated with pollutants and poor hygiene significantly contributes to the structural decline of buildings. Neglecting cleanliness leads to the accumulation of waste, material damage, and an increased likelihood of surface and infrastructure erosion of the dwelling. This accelerates the degradation processes of both stable and unsustainable homes (Zhang, 2019).

Pollution and lack of health are two phenomena that lead to the degradation of housing. Pollution refers to the introduction of pollutants into the environment, threatening the quality

of life, while lack of health pertains to unfavourable environmental or physical conditions that negatively impact public health, including air pollution, lack of clean water, poor sanitation, inadequate ventilation, or humidity, which increases the spread of diseases. These two factors combine to create a hostile environment that adversely affects housing.

3.6. Over-occupation (Abuse of use)

"Overcrowding" or "misuse" of housing means exceeding the capacity of the place by the number of residents or inappropriate use of designated spaces, causing significant stress on the structural integrity, lack of necessary maintenance, and deterioration of the overall condition of the facility. Overcrowding is one of the main reasons for the accelerated deterioration of buildings, as it leads to damage to infrastructure, reduced building lifespan, and wear and tear of structural elements due to excessive use, as well as insufficient space for comfort and cleanliness, which exacerbates the physical deterioration of housing and affects the quality of life for residents. Misuse, such as overloading the number of residents or not adhering to usage standards, is one of the factors that lead to the deterioration of residential buildings and reduce their ability to sustainably meet the needs of residents (Liu, 2020).

The term overcrowding or over-occupancy refers to the presence of a large number of people in a space or in small housing units that exceed the capacity of that space. This phenomenon is a result of population density, where increasing pressure on infrastructure leads to the degradation of essential facilities such as water, sanitation, and health services, which in turn leads to the degradation of living conditions and the misuse of resources.

Overcrowding is an event resulting from the inability to provide adequate housing for all individuals, leading to an excessive concentration of people in unsuitable living spaces, which seriously threatens the quality of life and health of the population.

4. Urban Intervention Operations

4.1. Maintenance and Repair (Maintenance et L’entretien)

Maintenance is a set of procedures to keep buildings and facilities operating correctly, including any necessary repairs and improvements. According to (Au-Yong, 2014), building maintenance is a combination of technical and administrative procedures. To ensure that the building elements are at an acceptable level to perform their required functions.

Maintenance relies on specific strategies to ensure the long-term operation of facilities, reduce the risk of deterioration, and ensure the sustainability of functional performance. The

ISO has defined "maintenance as a combination of all technical and administrative actions aimed at preserving an item or restoring it to a state in which it can perform its required function." Periodic maintenance is considered if it is scheduled quarterly, annually, or monthly.

4.2. Urban renovation

Urban renewal is the process of developing and redesigning old or deteriorated urban areas to improve the urban environment, infrastructure, and quality of life for residents. It often involves renovating buildings, improving planning, and updating facilities and services (Lacour, 2004).

Urban renewal is the process of rehabilitating and developing deteriorated or old urban areas to improve the quality of life for residents and achieve a balance between economic, social, and environmental aspects. This includes improving infrastructure, updating buildings, creating new public spaces, and rehabilitating old neighbourhoods in a way that ensures the sustainability of urban growth.

4.3. Urban restoration

The elements intended to replace the missing parts must blend harmoniously with the whole, while distinguishing themselves from the original parts, so that the restoration does not distort the artistic and historical document (Larousse, 1983).

In urban planning and architecture, the term restoration refers to returning a building or even a neighbourhood to its original state. This policy, common in architecture, is less common in urban planning and is reserved for a few cases of high heritage value.

Urban restoration is a set of interventions aimed at restoring, repairing, and maintaining deteriorated urban areas or historical heritage landmarks while preserving their original character, whether urban, cultural, or architectural.

4.4. Restructuring

Urban restructuring is a planning and implementation process carried out on the urban fabric to improve the functions of cities and residential areas, address existing problems such as infrastructure deterioration and lack of services, develop residential areas, reorganise neighbourhoods, improve public facilities, and tackle urban challenges such as slums or urban decay.

4.5. Rehabilitation

Rehabilitation is the process aimed at reusing old buildings or urban sites while preserving cultural and architectural values, to meet the needs of contemporary society (MERLIN, 1988).

Urban rehabilitation is a process that includes a set of integrated interventions to repair and renew urban areas suffering from urban decay or informality, through improving infrastructure, developing public spaces, and enhancing the social and economic services for residents.

4.6. Reinforcement

The reinforcement process is a set of engineering and planning interventions aimed at enhancing and strengthening the durability and stability of structures or underground foundations to withstand the pressures of environmental changes or potential risks. This process is applied to increase the structure's capacity to bear temporary and permanent loads, improving its functional performance, and reducing the risk of structural failure.

4.7. Consolidation

It is an engineering process that involves strengthening and improving the properties of soil or the base materials used in the construction of structures by removing water from the soil's pore spaces, resulting in increased density and reduced soil volume. This process is considered essential in construction projects, as it helps enhance the soil's ability to support applied loads and reduces the risks of settlement or cracking.

4.8. Reconstrucción

In the context of urban planning or urban architecture, reconstruction refers to the process of rebuilding or renovating damaged and ageing structures and infrastructure to improve them and restore them to their original condition, sometimes with a focus on enhancing efficiency and sustainability. This process may be a response to destruction caused by natural disasters, conflicts, or ageing infrastructure.

II. Method of investigation and data collection, and references

1. Research methodology

This research aims to conduct a descriptive and analytical study simultaneously within the same context. Therefore, the scope of our investigations is defined, and our methods are those generally used in studies related to problems, both direct and indirect, somewhat known

in the built environment. Our investigation begins with an exercise in direct observation and a survey based on a sample previously drawn using the scientifically recognised random number method .

The study presented in this research was primarily conducted within the urban fabric of the city of Biskra, with a sample from the city's neighbourhoods. This study aims to cover the deterioration of individual residences in the urban area, while the Biskra area was specifically studied to examine the main patterns of deterioration and attempt to address this degradation .

In the city of Biskra, three noteworthy phenomena have emerged. The first is the blank and dilapidated facades of the houses, especially the old ones. The second is the appearance of cracks and the spread of mould and moisture on the exterior walls. The third is the erosion and degradation of the structural integrity of the houses.

2. Study area and target population

The city of Biskra represents an urban model that combines old, medium, and modern neighbourhoods. The choice of this area was intentional due to the lack of studies on this subject in the region. I also chose this topic because of the seriousness of the problem in the study area. Biskra was selected due to the diversity of building styles and the varying levels of deterioration of individual houses, which allows for a precise analysis of the patterns causing the deterioration phenomenon .

The target population in this study consists of residents living in individual houses within the neighbourhoods of the city of Biskra, with its various architectural styles (old, medium, and modern) .

The methodology relies on identifying the causes that contribute to the deterioration of the urban structure, with a focus on the relationship between the age of the residence and the various causes of deterioration, using field analysis tools and statistical data to reach objective and accurate results.

3. Sampling technique

The study will be conducted on a database consisting of 15 neighbourhoods within the centre of Biskra city, with a sample of 95 vulnerable housing units varying in age (old neighbourhoods, moderately old neighbourhoods, and relatively new neighbourhoods), structure, layout, location, and other factors. The study aims to analyse the patterns, types, and forms of urban decay and then identify the main causes of the vulnerability of the urban fabric

in the centre of Biskra, whether related to the housing condition, construction errors, failure of construction materials, or exposure to hostile factors within the urban environment .

The sample was selected according to the random sampling method in this study. Since it is difficult to manage and distribute the questionnaire and conduct interviews with all the residents of the study area .

This means that the study will be conducted on a sample consisting, as previously mentioned, of approximately 95 households taken from the total number of households in the city of Biskra, which is estimated to be around 23,892, representing a ratio of 1/250 (Table 01).

Table 1-The Sample and the Survey Base - Biskra Centre, 2025

Zone	Population	Nb Habitat	Sample	TOL Moy
Zone 01	8294	1839	7	4.5
Zone 02	8757	1718	7	5.1
Zone 03	7955	1414	6	5.6
Zone 04	8384	1519	6	3
Zone 05	8159	1521	6	5.4
Zone 06	7617	1356	6	5.6
Zone 07	8222	1561	6	5.2
Zone 08	8763	1535	6	5.3
Zone 09	8692	1566	6	5.5
Zone 10	8107	1749	7	4.6
Zone 11	8541	1768	7	4.8
Zone 12	8532	1611	6	6
Zone 13	8655	1644	7	5.2
Zone 14	9816	1607	6	6.1
Zone 15	8306	1444	6	5.7
Total	126755	23 892	95	5.2

Source: The Author, our survey, Biskra 2025.

4. Methods of data collection

As for data collection, based on the results of the social survey of housing occupants, a questionnaire will be developed, tested, and evaluated using a pilot questionnaire before the field survey. After data analysis, this tool will provide us with preliminary information that cannot always be used directly. For this reason, it will be necessary to process (adjust) the data collected in this manner using mathematically known indicators before any analysis or commentary on the research topic .

Our study also relies on primary data supported by images obtained and captured through the field survey of the study area.

5. Data source

There are two main sources of data: the primary source and the secondary source .

In order to obtain reliable and accurate data, I will use both primary and secondary data. Primary data will be collected, as mentioned earlier, through the preparation of a questionnaire, interviews, and discussions with the population, as well as by taking photographs of the study area. As for secondary data, it will be collected through documents, reports, books, magazines, electronic media (the internet), and administrative institutions .

Various research papers, journals, scientific articles, books, and other secondary sources are the main data sources I used in my study.

6. Scientific Analysis Methods

The analysis takes a descriptive and analytical approach, employing quantitative data to draw scientific conclusions based on statistical and field foundations. The data was classified based on the architectural characteristics of the residences, the quality of construction materials, the age of the building, and the usage pattern, with geographical distribution and frequency ratio analysis used to determine potential causal relationships between architectural characteristics and the level of residential degradation. I will use Arc Earth and ArcGIS 10.3 from the Geographic Information System software, and AutoCAD .

The analysis method in this study relies entirely on observation during the field survey as well as the photos taken of individual houses during the survey, in addition to the information extracted from the survey data collected using the questionnaire, and the discussion of deterioration patterns in the concerned neighbourhoods and the exploration of various defects and errors present in the residences. They will first be analysed through the photos taken during the field survey, summarised, and presented. The questionnaires collected from the field survey of 95 samples will also be analysed quantitatively and presented in tabular form. The data collected through observations and discussions with residents during the field outing will also be analysed qualitatively to complement the quantitative analysis. Based on these results, I will intervene in the deteriorated housing through urban planning processes and address this degradation.

Summary

This chapter addresses the literature review related to the concept of urban decay, which has been defined as a pattern of deterioration affecting the urban fabric. It manifests through the phenomenon of building decay, infrastructure deterioration, and the decline of essential services. Patterns of decay have been classified based on design errors, material failures, housing obsolescence, and misuse, in addition to the hostile environment affecting building deterioration.

The concept of housing and its types, as well as the concept of risks, were reviewed due to the relationship between risk and building deterioration. Attention was given to urban interventions adopted to address deterioration, including explanations of the concepts of renewal, restoration, rehabilitation, restructuring, and urban reinforcement and support.

As for the methodology, the scientific foundations and procedures adopted for data collection from secondary and primary sources have been clarified, using various sampling techniques to ensure the reliability of the results, which will support the field study consisting of case analysis and evaluation of intervention programs.

In conclusion, this chapter highlights the importance of understanding theoretical concepts and scientific methodology in studying the phenomenon and determining the conceptual and practical framework that is relied upon to propose optimal solutions for addressing urban deterioration.

CHAPTER II – Typology and Causes of Degradation

Chapter 2

Data Analysis

This chapter aims to analyse patterns of urban decay in housing through a scientific methodology based on field data analysis.

Introduction

This chapter aims to analyse the patterns of urban decay in housing and identify the main causes contributing to their deterioration through a scientific methodology based on field data analysis. The focus was on classifying the causes of decay according to scientific principles, which included construction errors, material failures, and building ageing, in addition to hostile environmental factors that negatively affect the sustainability of housing. We also discussed misuse, particularly its connection to population pressure and housing conditions, such as overcrowding individuals in small spaces, which accelerates the rate of deterioration.

We relied on multiple analytical tools, foremost among them the analysis of images captured during the field survey, to assess the physical condition of the houses and interpret the signs of deterioration. Additionally, we analysed data tables extracted from questionnaires distributed to a random sample, using a scientific method that ensures the reliability of the results. These quantitative and qualitative data were reviewed to identify the most influential factors on the deterioration of the houses, contributing to a deeper understanding of the phenomenon and paving the way for appropriate intervention solutions to address it.

I Neighbourhoods at risk of urban structural degradation and selected for study in the city of Biskra:

The study focuses on 14 neighbourhoods distributed within the city of Biskra, selected based on the characteristics of urban decay. The neighbourhoods include: El-Messid, El-Mosalla, Bou Saïd, Bab El-Darb, El-Bukhari, Bilal, Satr El-Moulouk, El-Dalia, El-Dalaa, Khabzi, Haret El-Wad (North-South), Jnan Ben Yacoub, and El-Mahatta neighbourhood.

As shown on the attached map (03), these neighbourhoods have been distributed in a way that ensures comprehensive representation of different areas. The study area includes neighbourhoods with various urban characteristics, ranging from old neighbourhoods facing cracking and fissuring problems, to others showing signs of obsolescence, and yet others experiencing gradual deterioration in building facades.

1 .The Ancient-style neighbourhoods

(Al-Massid neighbourhood - Bouaissid - Bab Al-Darb - Al-Mosalla)

It is located in the southern part of the city of Biskra, bordered to the north by the Chattouni neighbourhood, facing the Wadi Sidi Zarzour to the east, and bordered to the west by the Qadasha neighbourhood and the Turk Tower .

The old Masjid neighbourhood, also known as the Ancient-style neighbourhoods of Biskra, is considered one of the oldest neighbourhoods in the city of Biskra and one of the seven gates that have shaped the city since the Ottoman period. The word "Masjid" comes from the Turkish language and means "mosque ".

It was previously known as "the Zaouia" and is famous for its dense palm trees and olive trees. Architecturally, there is also the Bab Al-Darb neighbourhood, which was one of the seven old gates of the city of Biskra. The houses in the neighbourhoods, along with the Bouaissid neighbourhood, which is characterised by its vast palm oases and shares the same features as the Al-Massid and Bab Al-Darb neighbourhoods, were built in a traditional style using local materials such as clay, straw, and palm trunks. These methods are still in use today, but in modern and sustainable ways. The Al-Massid and Bouaissid neighbourhoods are distinguished by their narrow and winding streets, reflecting the traditional planning of Islamic cities. These neighbourhoods suffer from noticeable deterioration due to their age and the neglect of the residents in maintaining them.

The Musalla neighbourhood was established between 1957 and 1958, and the neighbourhood was expanded after independence in the early 1970s. It is bordered to the south by the Masjid neighbourhood, to the north by the Chatouni neighbourhood, to the east by Wadi Sidi Zarzor, and to the west by the Sidi Barakat neighbourhood. The architecture in the Musalla neighbourhood is relatively old due to its period of establishment, in addition to the residents' neglect in maintaining it and the use of various building materials. In some houses, the residents were inspired by the idea of building with local materials from the Masjid neighbourhood, while other houses were built using bricks or red bricks. Additionally, many of these houses are in a deteriorated condition today due to several reasons that will be addressed later.

2. Middle-aged neighbourhoods

(Al-Mahatta neighbourhood - Al-Dhala - Al-Dalia – Haret Al-Wad (N+S) - Bilal - Jnan Ben Yacoub)

These neighbourhoods are located in the centre of Biskra city and include the Station neighbourhood, the Dalla neighbourhood, the Dalia neighbourhood, the Wadi neighbourhood, Bilal, and Jnan Ben Yacoub. The city is bordered to the north by the old train station, to the east by Wadi Sidi Zarzor, to the south by the Musalla neighbourhood and the village head, and to the west by the railway separating the neighbouring neighbourhoods, such as the Mujahideen neighbourhood and the Independence neighbourhood .

These neighbourhoods developed significantly during the colonial period, with the first being the Station neighbourhood, characterised by a distinctive chequerboard layout created by the French in a strategic location north of the city, away from the old neighbourhoods (the Seven Gates of Biskra). This was followed by random and unorganised residential expansions, such as the Wadi Hara neighbourhood and Jnan Ben Yacoub, which did not follow the organised planning of the Station neighbourhood .

Today, some of these neighbourhoods suffer from noticeable deterioration, especially in the areas that were most affected, such as the northern Wadi neighbourhood, which is in a worse condition, while there are other neighbourhoods in a moderate state of decay and wear. We will later see the current condition of the housing in these neighbourhoods.

3. Newly Established Neighbourhoods

(Satr Al-Muluk Neighbourhood - Al-Bukhari - Khobzi)

The neighbourhoods are located in the city centre, bordered to the north by Zuqaq Ben Ramadan and the Al-Dhala neighbourhood, to the east by the Jnan Ben Yaqub neighbourhood, to the west by the Al-Izdihar neighbourhood, and to the south by the Al-Hawza neighbourhood. These neighbourhoods were established in the 1960s as part of the city's expansion. Residents moved from older neighbourhoods such as Al-Masid, Al-Bashash, and Al-Qadasha to be closer to the city centre and commercial activities. The neighbourhoods were built without prior planning, leading to their current deteriorated state, especially since they are a vital market centre. Today, these neighbourhoods are experiencing significant deterioration in their housing and continue to face ongoing decline in both individual housing and infrastructure. Residents suffer from weak and deteriorating urban conditions, in addition to infrastructure problems that require interventions for rehabilitation, which we will discuss later.

Map3 - The location of the study area for residential neighbourhoods in the city of Biskra

Map of Study Areas

Boundaries of the residential area

Residential neighbourhoods in Biskra

The regions

- The expansion of the city of Biskra
- El-Msjid+Boussid+El-Mossala
- El-Mahatta
- Haret-El-Oued+Bilal+Djnan-Ben-Yaakoub
- Star-Lmlouk+El-Boukhari
- Dalia+El-Mahatta+Khobzi
- Study neighbourhoods
- OUED.

Source: Pos Biskra,2025

Coordinate System: WGS 1984
Datum: UTM-Zone-31
Units: Degree

Created By : Author
"YAKHELEF Takwa"

0 0,175 0,35 0,7 1,05 1,4
Kilometers

II. Causes of the degradation

All building elements are subject to defects, and the causes and types of these defects have been extensively documented. Defects can arise due to design errors, omissions, negligence, lack of knowledge, inadequate procedures, or even human errors. Sources of defects include: errors in building design, defects resulting from the manufacturer, defective materials, improper use or installation of equipment, or contractors' non-compliance with specifications (Kofi Agyekum, 2016).

According to Manning, the origins of defects can be divided into design defects, material defects, construction defects, in addition to latent defects. While other classifications divided the origin of defects into natural phenomena, design and manufacturing errors, defective materials, procedural errors, lack of maintenance, and misuse of buildings (Kofi Agyekum, 2016).

Based on the above, the causes of defects in buildings can be summarised as: design errors, construction errors, material failures, building ageing, and neglect in maintenance.

Among the types of degradation that affect residences, there are two main types: the first does not pose a danger to the safety of the residence, such as pollution and noise, hostile environments (industrial workshops), and neglect in maintenance that leads to the deteriorated condition of residential facades. The second type, however, can lead to partial or total collapse of the residence, which may necessitate its removal, as is the case with residences affected by ageing, structural failure, or exposure to natural disasters, for example."

This led us to classify the level of deterioration in the neighbourhoods of Biskra into three types based on the criteria above and the field visits we conducted: - Deterioration affecting the entire building (severe) - Deterioration affecting the components of the building (moderate) - Deterioration affecting the building materials (mild).

1. Diagnosis method

The diagnosis is based on the field visits I conducted and the results of the social survey of the residents, where in 15 neighbourhoods we found about 95 samples of individual housing units in relatively varying states of deterioration. Among them are old, partially dilapidated houses likely built before 2000, more severely dilapidated houses built before the 1970s, and highly deteriorated houses built before independence.

Its maintenance condition is uneven:

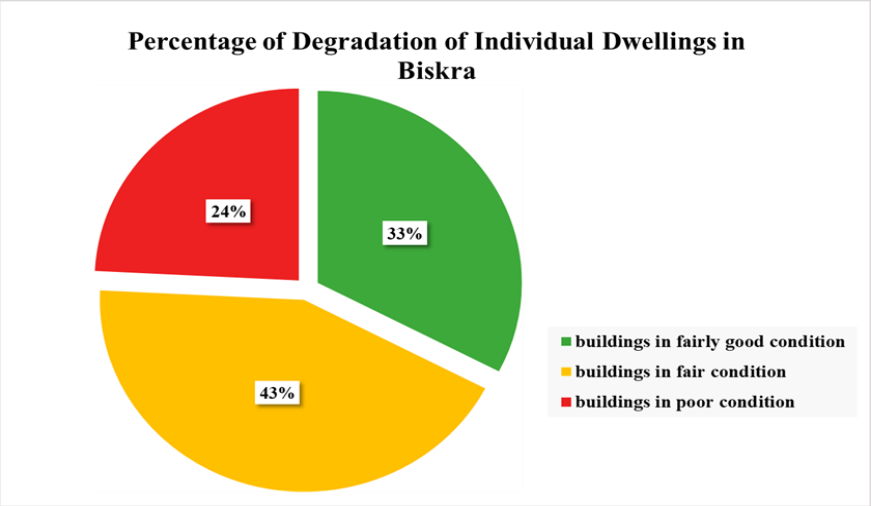
-31 buildings are in fairly good condition,

- 41 buildings in fair condition,

- And 23 buildings in poor condition.

This initial classification is only indicative and takes into account the appearance of the buildings, the condition of their structures, the external condition of the facades and coverings, and the condition of the drainage pipes and various networks.

Figure1 Relative circle illustrating the levels of deterioration of individual housing in Biskra.



Source: The Author,2025

-Two-thirds of the buildings are in average or poor condition.

The field survey and based on the technical observations of the housing, revealed the highly heterogeneous condition of individual residences in Biskra.

1.1. Classification criteria:

The classification takes into account the appearance of the houses, the condition of their structures, the external condition of the facades (paint and plaster), and the condition of the underground pipes and other networks.

Among the 15 neighbourhoods visited, the condition of the houses was assessed based on three levels:

• Somewhat good condition: These residences undergo a superficial analysis.

These residences are in fairly good condition, as they only require maintenance work on the facades or the house's sidewalks. The exterior appearance is satisfactory, and it may be subject to intervention to improve or paint the house's facade or partially renovate it.

• Medium condition: Subject to more detailed analysis,

These residences require at least partial restoration, rehabilitation, or network repairs. Several buildings have water networks with leaks or malfunctions in the water systems, which are likely to cause significant damage to the facades in the short term. The electrical systems also feature unauthorised and dangerous installations, and there are facade issues.

• Poor condition: These residences undergo a more in-depth analysis

These buildings undergo a more detailed diagnosis and require partial or complete renovation. They suffer from significant structural defects, visible faults in the facades and external walls, and issues with the facade paint (cracks, breaks, peeling plaster, water-damaged areas, or structural defects). These residences are in extremely poor condition and require extensive work. Living conditions are unsatisfactory or even dangerous, and some buildings are dilapidated.

The three levels of defining the housing condition allowed for the assessment of both the urgency and importance of the work that needs to be done.

2. Objective reasons:

The deterioration affecting individual homes can take several forms, which is why I classified them according to the cause of this deterioration to distinguish between them. The patterns of housing deterioration include six types of defects causing this degradation:

- Construction defects
- Material failures
- Obsolescence (lifespan)
- Aggressive contacts (Aggressive environments)
- Pollution and insalubrity
- Over-occupation (Abuse of use)

2.1. Analysis of construction defects and their impact on housing deterioration

Design flaws can be a major cause of building degradation over time. These flaws do not become apparent immediately upon completion of construction, but they lead to structural and functional problems in the long term, affecting the overall lifespan quality of the building. Moreover, execution defects can contribute to the emergence of errors and issues during the construction phases, starting from excavation and foundations to final finishes. In addition to design and execution defects, construction material flaws can lead to problems and deficiencies in the materials used in construction processes, which affect the quality and performance of the residences. Common defects include cracks and fissures, as well as chemical corrosion. These defects directly impact the safety and load-bearing capacity of the residence, increasing the risk of deterioration and collapse.

Figure2 Cracking and degradation of the exterior wall with the continuation of cracks to other parts of the house facade (Sitar Al-Muluk neighbourhood)

Figure3 Vertical crack at the level of the dividing column between the two residences (Bou Said neighbourhood)

Source: The Author, 2025

The two figures (2) and (3) show structural cracks extending along the outer column of the residence, indicating a flaw in the foundation design or its unsuitability for the existing ground type. Figure 3) reveals that these cracks and fissures continue to include other parts of

This has caused a concentration of pressure on the column and the outer wall, visible in the figure. This excessive pressure has led to the appearance of diagonal cracks and a potential structural flaw affecting the facade's integrity and its ability to bear loads.

2.2. Evaluation of material failure and its implications on structural condition

One of the main reasons leading to the appearance of defects in individual houses in Biskra and their degradation is the failure of the materials used, which manifests through cracks, deformations, and the peeling of paints from the walls, in addition to chemical corrosion at the structural level. By inspecting the houses in the city of Biskra, we noticed many examples of material failure, which are evident on the facades of the houses in the city.

Figure4 Shows the degradation of the concrete due to the corrosion of the reinforcement steel (Al-Masla neighbourhood)

Source: The Author, 2025

Figure 04 was taken from the Al-Masla neighbourhood, showing the collapse and breakage of concrete and the protrusion of steel on the first floor of a two-story residence. These issues are likely due to manufacturing defects or the use of poor-quality materials. Additionally, the photo shows the corrosion of steel materials due to the poorly installed gutter. Climatic conditions contributed to the interaction of moisture with the sun's heat, leading to the corrosion of the reinforcement steel. As rust developed, the bond between the steel and concrete was lost, causing noticeable peeling and breakage.

Figure 04 of a residence in the Al-Bukhari neighbourhood indicates a balcony on the verge of collapse, where the reinforcement bars are almost completely exposed. This is likely

Due to water leaks and stagnation resulting from household activities. It is also probable that the residence did not adhere to construction and safety standards during its construction.

Figure5 shows a balcony on the verge of collapse in the Jnan Ben Yacoub neighbourhood.

Source: The Author,2022

2.2.1. Analysis of statistical data on construction materials

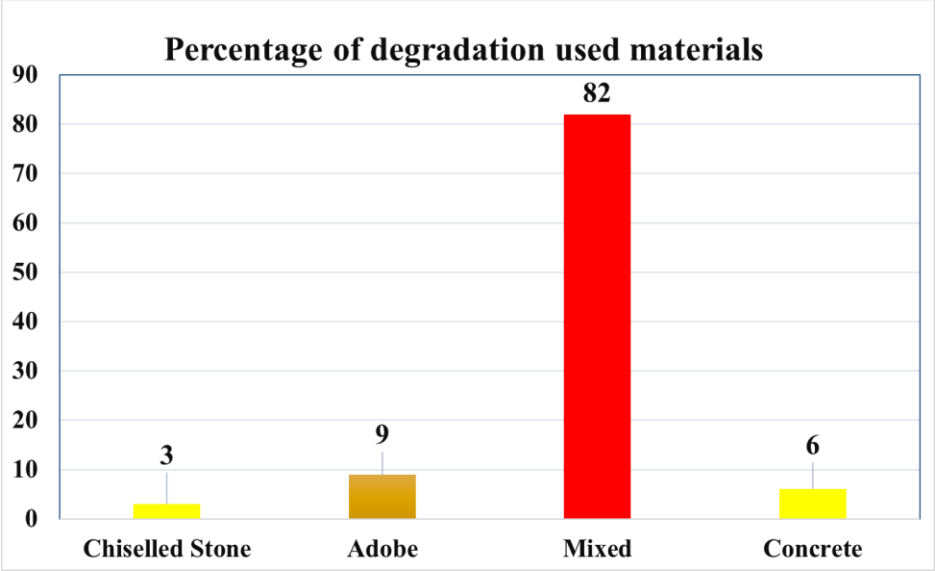
Table 2-Degradation of the habitat according to the construction materials used

Zone	Chiselled Stone	Adobe	Mixed	Concrete	Total	En %
Z - 01	211	107	857	322	1497	6
Z - 02	-	430	1070	210	1710	7
Z - 03	-	208	1068	215	1491	6
Z - 04	-	429	1074	107	1610	7
Z - 05	214	103	1063	194	1574	7
Z - 06	-	101	1281	105	1487	7
Z - 07	-	104	1504	-	1608	6
Z - 08	-	102	1279	103	1484	6
Z - 09	-	212	1498	-	1710	7
Z - 10	-	-	1718	-	1718	7
Z – 11	-	-	1502	108	1610	7
Z – 12	209	210	1061	102	1582	7
Z – 13	-	105	1716	-	1821	8
Z – 14	-	-	1496	-	1496	6
Z – 15	-	-	1494	-	1494	6
TOTAL	**634**	**2111**	**19681**	**1466**	**23892**	**-**
En %	**3**	**9**	**82**	**6**	**-**	**100**

Source: The Author, our survey, Biskra 2025.

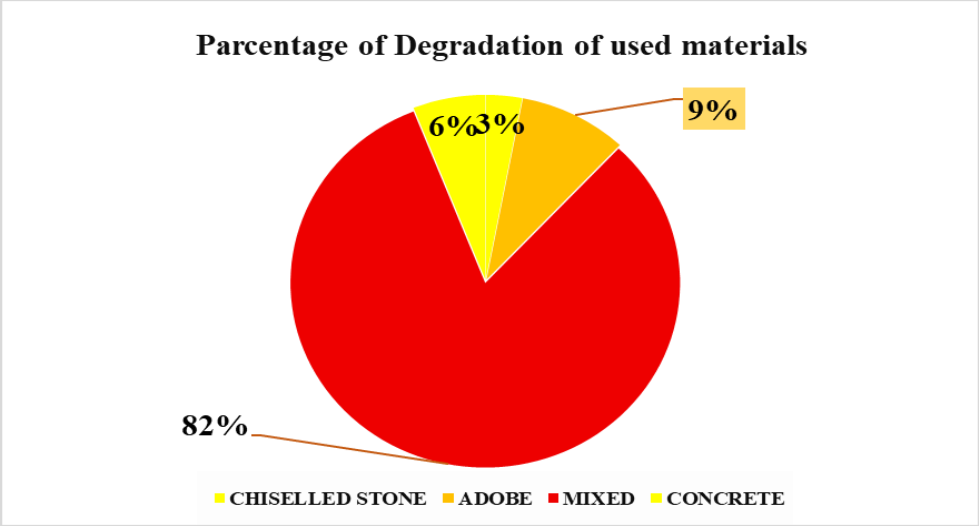
Mixed: Clay stone, sometimes reinforced with plant fibres.

Figure6 A chart showing the deterioration of houses according to the building materials used.



Source: The Author,2025

Figure7 The rate of degradation according to the building materials used.



Source: The Author;2025

According to the data provided in Table 02, the rate at which different types of construction materials deteriorate varies greatly and is primarily determined by their composition, physical and chemical characteristics, and the environmental conditions to which they are exposed .

With a deterioration rate of only 3%, natural stone, distinguished by its density and hardness, appears to be more resilient to environmental influences and can withstand wear and cracks over an extended period.

In contrast, Adobe, which is a clay material with a fragile nature and greater exposure to climatic factors, shows a deterioration rate of up to 9%, especially in areas with harsh climatic conditions such as humidity or thermal changes, indicating its relative fragility and susceptibility to damage at a relatively fast rate.

With 19,681 units across 15 neighbourhoods and an 82% percentage, mixed materials, which are made up of stone and plant fibers, suffer the most from deterioration. This could be the result of several things, such as poor component compatibility, mistakes made during the mixing process, or poor choice of additional materials, in addition to the influence of the site's environmental conditions. As a percentage of 6%, this includes a relative deterioration in the Béton material.

a) The qualitative and quantitative distribution of used materials and their correlation with degradation

Adobe: It is regarded as one of the most widely used materials, with 2,111 registered units, and is part of the natural heritage of desert construction, where its availability and ease of use are relied upon. However, the data show that the consumption of adobe bricks is not directly related to a decrease in deterioration levels, which could reflect their vulnerability to weather factors such as rain, humidity, and high temperatures, particularly given the limited restoration and maintenance operations.

Mixture materials: This category contains a large number of 19,681 units, indicating a general trend towards the use of a combination of materials, often to increase durability or due to economic constraints or the high cost of traditional materials. Data show that mixed materials account for 82% of all deterioration cases, implying that their use contributes significantly to higher deterioration rates.

Cement (Béton) : With 1,466 units, it represents a relatively modern material, with a noticeable increase in its use in modern constructions. The distribution shows that reliance on it is increasing in areas with high levels of deterioration, which raises the hypothesis that cement, despite its high resistance, if consumed indiscriminately, can lead to a decline in construction quality, especially if environmental considerations and soil characteristics are not taken into account.

Dressed stones (Pierres taillées) : It was the least used material, with 634 units, and its limited use is evident, especially in restoration and reinforcement operations. However, it is considered an old material with medium resistance, especially when used skilfully.

-The correlation between material quality and degradation

According to the findings, traditional natural materials such as adobe and dressed stones deteriorate at a lower rate than materials with mixed or concrete components .

Mixed materials and cement, despite their potential resistance under ideal conditions, appear in residences as a major contributor to building deterioration, possibly due to poor selection, weak resistance to environmental factors, or insufficient maintenance and continuous renovation processes.

b) Spatial analysis of the relationship between material type and deterioration

• High-deterioration areas (Z-12 and Z-13): Higher rates of deterioration are noted there, and this is unmistakably related to the increased use of cement and mixed materials. Since the type of material and the level of housing deterioration are directly correlated, this practically translates into higher deterioration rates. Due to their frequent locations in hot or humid climates, it may also be a sign of other factors like the buildings' age, poor maintenance, or the local climate.

• Areas with low deterioration (the remaining areas): Sustainability is higher in areas with less use or reliance on traditional materials like dressed stone and clay bricks, which lends credence to the theory that limited and natural materials, as long as they are environmentally acceptable, may be better able to withstand deterioration with less sustainability.

c) Used materials and their impact on the lifespan of housing

Based on the data, it can be assumed that mixed materials and cement are increasingly exposed to deterioration factors, especially in high-traffic areas, often due to poor material selection, maintenance conditions, or climatic factors such as humidity and temperature.

- Technical properties of construction materials: Traditional materials, such as clay bricks, can be environmentally resistant, but they require ongoing maintenance, whereas composite materials and cement are more resistant, albeit with a higher likelihood of deterioration due to environmental factors and a lack of maintenance.

The highest levels of deterioration are found in areas where high-performance or non-sustainable materials are used extensively, underscoring the significance of choosing materials according to lifespan, climate, and geography.

2.3. Analysis of the functional obsolescence of housing

Many houses in the city of Biskra have shown that the reason for their degradation is due to the age of the buildings and the poor quality of the construction materials used, making them more fragile and prone to cracking and breaking. Additionally, it has been determined that the design and construction did not contribute to enhancing the durability of the houses, due to the use of low-quality materials and designs unsuitable for local conditions. All these factors have contributed to accelerating the degradation process.

Figure 8The paint damage due to lack of maintenance is evident in the Haret Al-Wad neighbourhood.

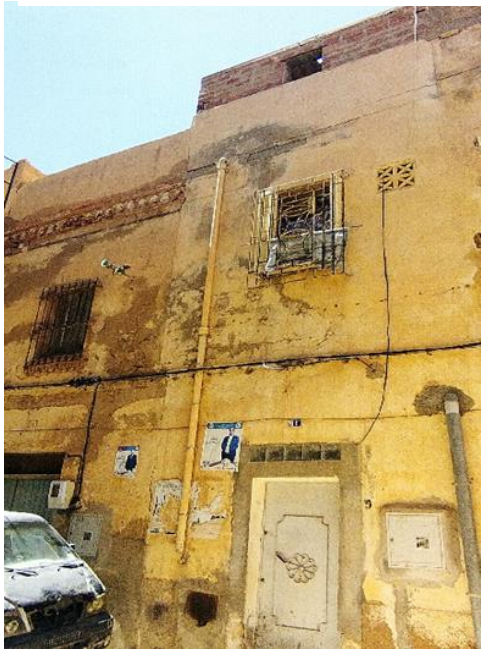


Figure 9The degradation of the facade due to the ageing of materials in the Al-Masjid neighbourhood is evident.

Source: The Author,2025

The two figures (08) and (09) show the condition of two houses in the neighbourhoods of Biskra. Figure 08 highlights the clear effect of humidity on the wall of one of the houses. Humidity has caused the paint to peel and the wall surface to change colour, exposing the inner layers in the lower part of the house, which were continuously exposed to sunlight, rain, and wind. This could be a possible reason for the facade's degradation. It is also possible that the damage is due to moisture penetrating through the walls of the house or rising from groundwater. Similarly, Figure 09 illustrates damage to the exterior façade of another house caused by harsh weather conditions, including rain, humidity, and direct sunlight. These factors have significantly affected the condition of the facade. The degradation in both houses is primarily due to neglect and the lack of necessary regular maintenance, which has exacerbated the problems and accelerated the deterioration process.

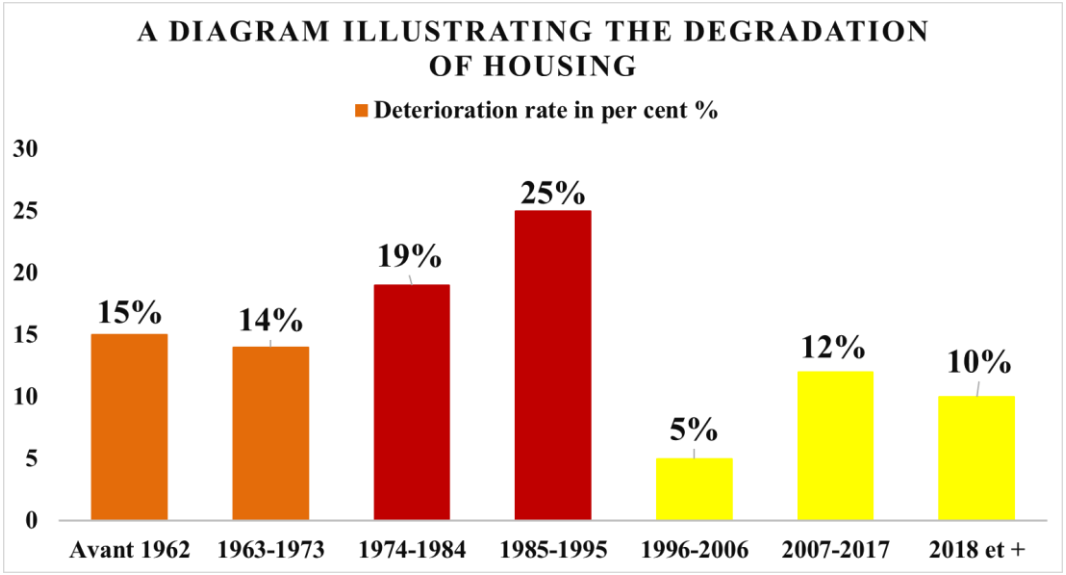
2.3.1. Analysis of statistical data on housing obsolescence

Table 3-Habitat degradation according to the construction period

Zone	Before 1962	1963 - 1973	1974 - 1984	1985 - 1995	1996 - 2006	2007 - 2017	2018 et+	Total	En %
Z – 01	113	105	434	1995	107	2017	209	**1403**	**6**
Z – 02	219	-	218	215	-	220	213	**1515**	**6**
Z – 03	-	190	-	430	-	435	622	**1676**	**7**
Z – 04	216	107	109	216	212	648	216	**1509**	**6**
Z – 05	110	225	436	214	217	435	-	**1425**	**6**
Z – 06	436	104	226	215	-	222	224	**1422**	**6**
Z – 07	218	214	224	-	108	432	-	**1305**	**5**
Z – 08	434	191	435	108	-	433	198	**1799**	**8**
Z – 09	220	322	110	107	107	434	104	**1723**	**7**
Z – 10	863	214	433	429	-	431	-	**1836**	**8**
Z – 11	436	428	647	108	-	218	-	**1619**	**7**
Z – 12	-	425	219	-	215	108	-	**1607**	**7**
Z – 13	434	426	431	213	108	535	211	**1938**	**8**
Z – 14	-	427	-	110	-	218	214	**1502**	**6**
Z – 15	-	-	647		-	646	104	**1613**	**7**
Total	**3699**	**3378**	**4569**	**6062**	**1074**	**2795**	**2315**	**23892**	**-**
En %	**15**	**14**	**19**	**25**	**5**	**12**	**10**	**-**	**100**

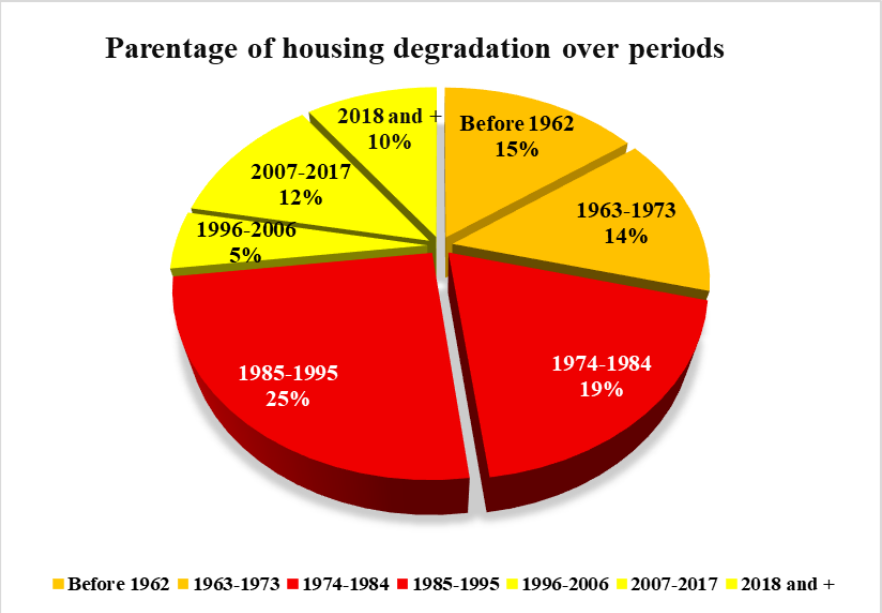
Source: The Author, our survey, Biskra 2025.

Figure 10 Habitat degradation according to the construction period.



Source: The Author,2025

Figure11 A relative circle illustrating the levels of housing deterioration over periods



Source: The Author;2025

Table 03 and the graphs represent the distribution of housing units in Biskra built during the period from 1962 to the present. These indicators illustrate the relationship between the age of the buildings, the construction period, and the rate of deterioration that individual houses have undergone. By reviewing the table data, the percentages determine the deterioration of individual houses over different periods for 15 areas.

The number of buildings in each area ranges from 110 to 863 units, with significant differences in distribution. The total number of buildings exceeds 23,892, with clear variations according to the construction period. The data has been divided into specific periods, including decadal periods (every 10 years) before 1962, between 1963-1973, then 1974-1984, 1985-1995, 1996-2006, 2007-2017, and the period after 2018 .

Focusing on construction periods: The largest number of buildings, especially in the recent periods of 1974-1984 and 1985-1995, represents about 19% and 25% of the total buildings for each period, indicating a boom in the construction market.

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2.4. Assessment of the impact of hostile environments on building degradation

Excessive humidity leads to mould growth on the exterior walls of homes, which we observed during our visits to the residences through the change in the colour of the facade paint. The paint in many homes has changed to brown, yellow, or even blackish hues, strong indicators of deterioration and high humidity. This is because mould grows rapidly on the paint in the presence of excessive humidity, resulting in this colour change.

Although Biskra is characterised by a hot desert climate, some neighbourhoods, such as the Station District, suffer from high humidity, possibly due to their proximity to the Jnan El Bailek Park, in addition to other factors related to the characteristics of the houses themselves. This increased growth of mould and fungi creates significant environmental problems in these residential areas.

Figure8 Horizontal cracking, mould appearance, and paint deterioration (SAlmahatta neighbourhood)

Figure13 Peeling wall, rusted drainage pipes, and paint damage (Dalia neighbourhood)

Source: The Author, 2025

Figures 12 and 13 of the station neighbourhood and the Dalia neighbourhood show the discoloration and damage to the wall paint, with colours leaning towards brown and yellow. The cause is likely, as shown in Figure 12, due to defects in the implementation of plumbing and sewage systems. This results in blockages in the gutters, leading to the leakage of surface and rainwater from the drainage pipes, in addition to the pipes rusting. All of this has contributed to the appearance of moisture along the pipe, leading to the erosion of the outer wall and the peeling of the paint. According to the American Society of Plumbing Engineers (ASPE), hydraulic design should include precise slopes to prevent water accumulation in the pipes.

As for Figure 13, it shows a noticeable degradation below the window, which has been observed in many residences in the neighbourhoods of Biskra. This damage is attributed to the residents' methods of use, where water is distributed to clean the windows, causing it to seep onto the facade of the house. Over time, this leads to the gradual decay and erosion of the wall.

Moreover, moisture can arise from uncontrolled water due to pipe, gutter, and drain leaks. This is evident in Figure 14, where water has seeped into the rafters and balconies, resulting in unsightly water stains. Over a long period of moisture penetration and ventilation, the excess moisture has promoted mould growth on the sides of the columns and gutters.

Figure9 This figure shows the leaking sewage pipe and the mould that has grown around it in the Al-Dhala neighbourhood.

Source: The Author, 2025

2.5. Analysing the impact of pollution and unhealthy conditions on the suitability of buildings

Figures 15 and 16 show the noticeable degradation in two types of buildings in the city of Biskra. In Figure 15, taken in the Bab al-Darb neighbourhood, we see mould marks on the facade of a building consisting of a ground floor and a first floor.

Figure10 A car repair workshop located beneath one of the houses in the Al-Bukhari neighbourhood.

Figure 16 Clear mould spots appearing on the exterior wall of a residence in the Bab Al-Darb neighbourhood.

Source: The Author, 2025

There are clear water leaks, indicating gradual decay or wet rot affecting the walls due to a clogged sewage gutter. Signs of moisture were also observed at the bottom of the exterior wall, likely caused by saline groundwater that led to the erosion of the exterior plaster. Additionally, the improper installation of drainage pipes contributed to the increased humidity levels and mould formation. As for Figure 16, it shows a car repair workshop in the Bukhari neighbourhood, where the workshop floor is entirely black due to the chemicals and industrial substances used in car maintenance. Furthermore, the air and noise pollution resulting from the equipment reduces the lifespan of the dwelling over time.

2.6. Review of cases of excessive use and hoarding within residences

The misuse of the dwelling accelerates its deterioration and leads to damage to structural elements and cracks, especially when the family is large and in a tight space. This excessive pressure increases the consumption of the dwelling's space and weakens the quality of the

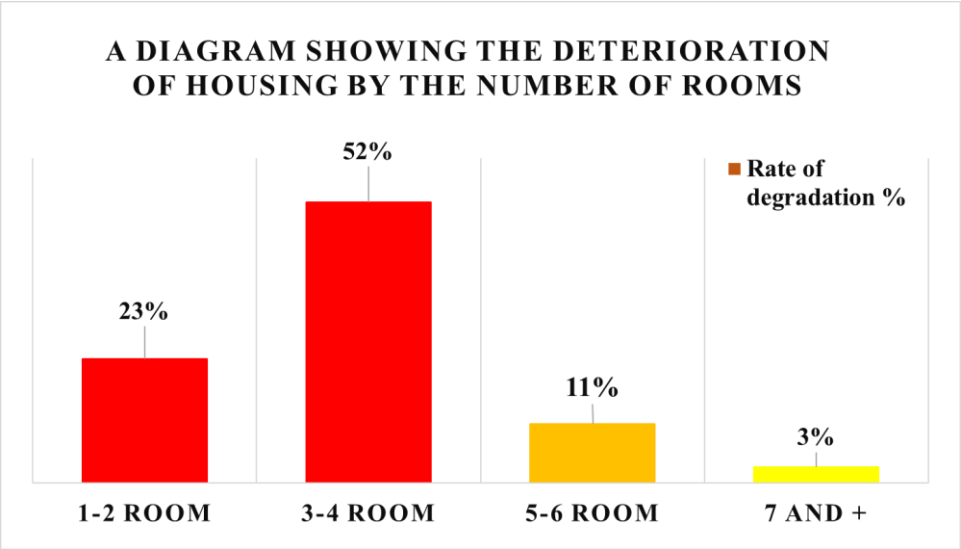
2.6.1. Analysis of statistical data on Over-occupation (Abuse of use)

Table 4– Deterioration of habitat according to the number of rooms

Zone	1_2	3_4	5_6	7 et +	Nb Habitat	NB Piéces	En %
Z - 01	430	859	394	-	1683	4500	**7.5**
Z - 02	215	1074	430	-	1719	4500	**7.5**
Z - 03	644	753	215	170	1782	3750	**6.3**
Z - 04	190	644	414	-	1248	4000	**6.6**
Z - 05	405	632	200	195	1432	3750	**6.3**
Z - 06	372	642	210	-	1224	3500	**6.0**
Z - 07	183	834	425	-	1442	3750	**6.3**
Z - 08	210	843	420	215	1688	3750	**6.3**
Z - 09	202	750	544	-	1496	4000	**6.6**
Z - 10	424	838	415	-	1677	4250	**7.1**
Z - 11	540	1280	207	-	2027	4250	**7.1**
Z - 12	630	640	203	-	1473	3750	**6.3**
Z - 13	422	827	403	181	1833	4500	**7.5**
Z - 14	418	852	193	-	1463	4000	**6.6**
Z - 15	209	1067	429	-	1705	3750	**6.3**
TOTAL	**5494**	**12535**	**5102**	**761**	**23892**	**-**	**-**
En %	**23**	**52**	**21**	**3**	**-**	**-**	**100**

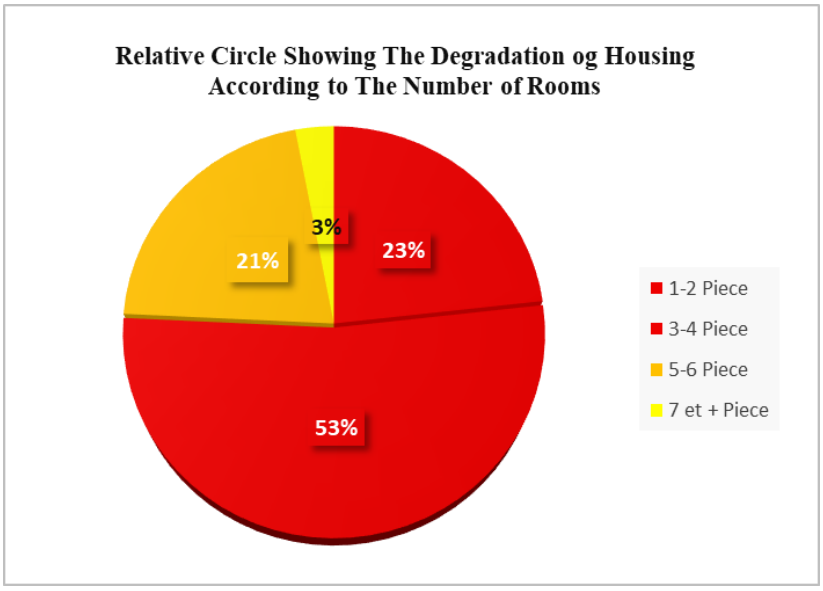
Source: The Author, our survey, Biskra 2025.

Figure11 A graph showing the rate of housing deterioration according to the number of rooms



Source: The Author, 2025

Figure 18 Relative circle showing the rate of housing degradation according to the number of rooms.



Source: The Author, 2025

-Analysis of housing deterioration based on the distribution of the number of rooms in individual housing units.

Table 04 aims to provide a systematic analysis of the phenomenon of housing deterioration, focusing on the relationship between the number of rooms in each dwelling and the deterioration rate, using statistical data obtained from field observations. This is represented

in a table that analyses the distribution of the number of rooms according to the study areas in Biskra, as illustrated by the graphs that provide a clear reading of Table .04

It cannot be considered that the deterioration of housing is solely dependent on the size of the rooms; rather, it is influenced by multiple factors, including the quality of construction, the lifespan, and maintenance practices. To explain the degree of the correlation between the number of rooms and the rate of deterioration, this analysis makes use of statistical data .

A statistical table comprising 15 areas (Z-01 to Z-15) is used for the analysis. It shows the numerical distribution of rooms in each area by category, including 1-2 rooms, 3-4 rooms, 5-6 rooms, and 7 rooms and above. The table also includes the total number of rooms in each area, as well as the total number of rooms in each of the mentioned categories, with the deterioration percentages determined based on the overall deterioration rates for each area .

I relied on a precise statistical analysis focusing on:

The distribution of rooms in different areas, the distribution of deterioration rates in areas with several rooms, the relationship between room size and deterioration rate, and identifying areas with higher levels of deterioration through percentage rates.

a) The general distribution of rooms across regions and categories : The total number of rooms in individual residences was distributed across 15 areas, with an average of approximately 4,500 rooms per area. In terms of category distribution, the 3-4 room category was the most deteriorated, representing 52% of the total rooms, followed by the 1-2 room category at about 23%, then the 5-6 room category at 21%, and finally the 7 rooms and above category at 3%. This distribution shows a significant concentration of small to medium-sized housing, which may reflect the overall state of the infrastructure, as small housing is more susceptible to wear and deterioration over time .

b) Distribution of deterioration and percentages: The analysis of degradation rates showed that the overall degradation rate across the regions falls between 6.0% and 7.5%.

The areas with the highest deterioration rates were Z-01, Z-11, and Z-13, with rates greater than 7%. For example, the Z-01 area deteriorated at 7.5%, while the Z-11 area deteriorated at 7.1%. The areas with the lowest deterioration rates were Z-06 and Z-12, with rates of about 6.0% and 6.3%, respectively. Regarding the areas with the lowest rates of deterioration, Z-06 and Z-12 had rates of roughly 6.0% and 6.3%, respectively.

This data shows that the presence of a high deterioration rate does not depend solely on the size of the housing or the distribution of rooms within it, but is also affected by additional factors such as the quality of construction, maintenance, and the lifespan of the buildings. It can be observed that some areas with a large number of small-roomed residences, such as Z-11, experience high deterioration rates, reflecting the characteristics of those areas in terms of the saturation of maintenance needs or poor living conditions.

C) The correlation between room size and deterioration rate: Analysis of room distribution by category revealed that areas with higher deterioration rates have more homes with small rooms (e.g., 1-2 rooms). For example, as explained earlier, Zone Z-11, which recorded the highest deterioration rate of 7.1%, has a high percentage of buildings with small rooms, reflecting that buildings with fewer rooms are often older and require continuous maintenance due to high resource usage, or they are of low construction quality .

Conversely, the areas that showed less deterioration, such as Z-06 and Z-12, often contain a higher percentage of larger buildings (5-6 rooms), indicating that these larger buildings may be relatively new or of higher quality, and are better maintained, making them less prone to deterioration .

Buildings with small rooms (1-2 rooms): Often older, more prone to deterioration, especially if they are of poor construction quality, suffer from misuse, or lack maintenance .

Buildings with large rooms (5-6 rooms or more): Usually newer or of improved construction quality, and they show lower deterioration rates, although this depends on other factors such as age and usage .

In addition to the size of the building, data shows that other factors play an important role in deterioration rates, such as misuse of the residence. If the number of individuals in a room increases, the use of facilities and resources also increases, and excessive use can lead to potential deterioration. The quality of construction, as older buildings with low quality are more susceptible, and areas with greater exposure to weather factors and humidity deteriorate faster .

-The category of 3-4 rooms is the most affected because most of the single-family homes in the study area contain rooms of type F3 and F4, even though the number of residents in the home equals or exceeds 6 individuals, which means the housing deteriorates faster due to frequent use or poor condition .

The relationship between building size and deterioration reveals that smaller buildings are more prone to deterioration, especially if the number of occupants is high. Additionally, the quality of construction is also affected by maintenance and age.

2.7. Maintenance deficiency

The lack of maintenance has been identified as one of the main factors contributing to the emergence of construction defects, which affects the structural safety and performance of the residence. When regular maintenance is neglected, defects such as material corrosion and structural deterioration begin to accumulate, increasing the likelihood of more significant problems occurring over a short period.

Figure12 Deformation in the installation of electrical equipment and the appearance of a horizontal crack in the external wall of the residence in the Khobzi neighbourhood.

Figure 20 Shows exposed electrical and gas wires and the degradation of the housing wall in the Al-Masid neighbourhood.

Source: The Author, 2025

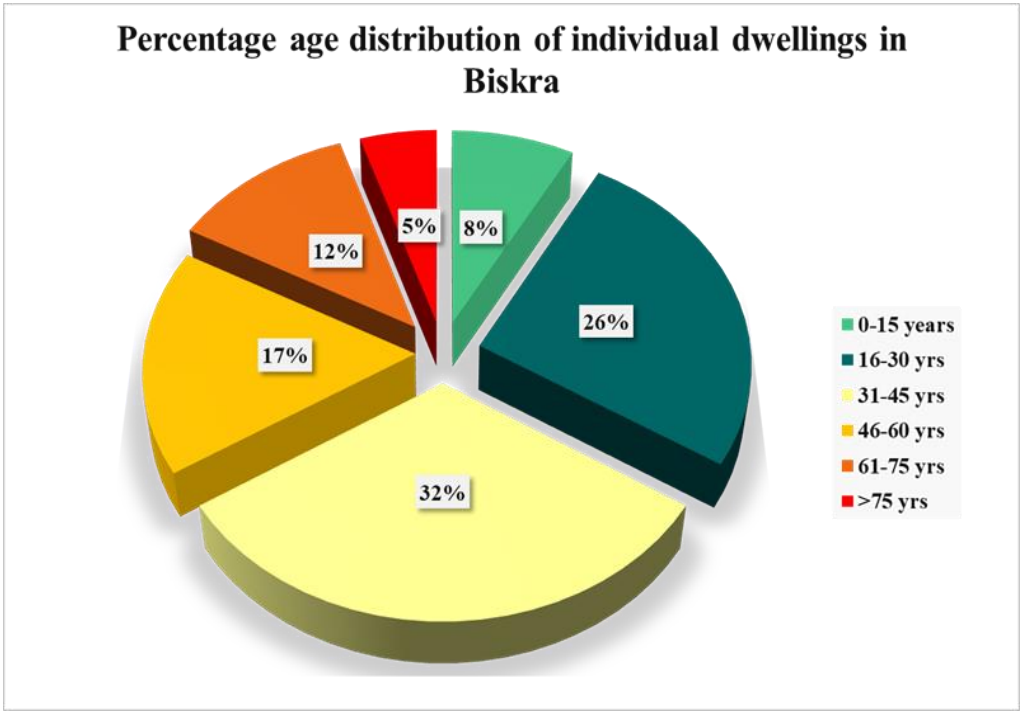
Several residences with electrical installation defects have been identified, as shown in the above photos. The existing potential for this hazard can lead to an electrical short circuit, exposing the residence to the risk of a fire outbreak. An IEEE report indicates that "failure to consider the distribution of electrical loads can lead to overheating and an increased likelihood of fires." The lack of maintenance, or rather the absence of it, leads to the deterioration of the residence and its inability to perform its function throughout its lifespan.

3. Presenting and analysing the results through pie charts

The relative distribution represents the ages of individual houses in Biskra, and it also illustrates the different ages of individual houses. Those less than 15 years old represent 8%. This percentage is an indicator of recent renovation or rebuilding rates, or the absence of recent housing expansions. Those aged between 16-30 years represent about 26%. This percentage represents the individual houses built in the 1990s and the early 2000s. Those aged between 31-45 years represent 32%. This age group constitutes the individual houses built between the 1980s and the early 1990s.

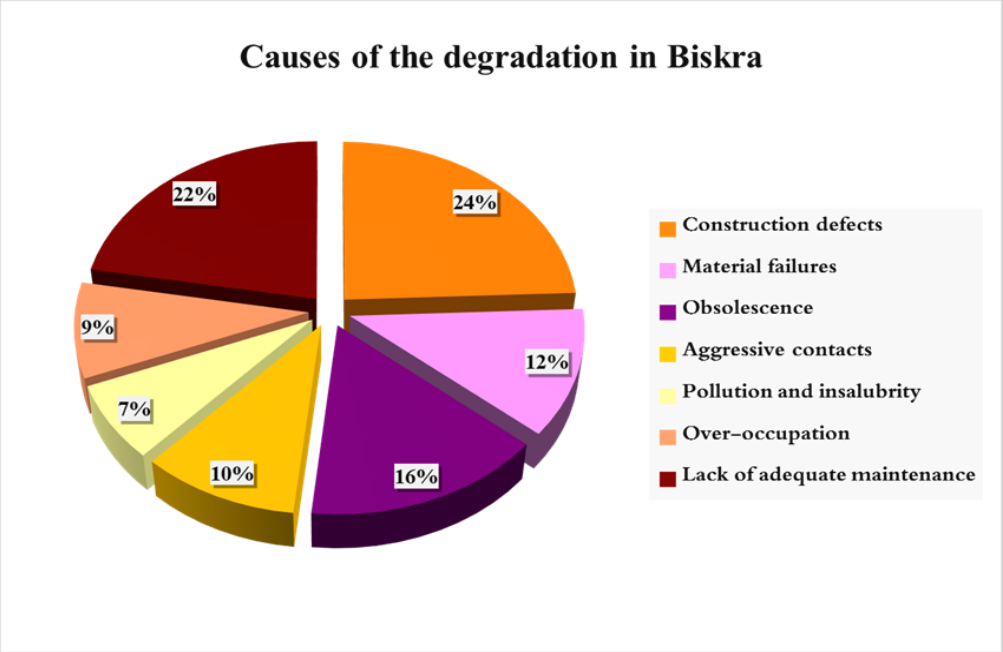
While the age group of 46-60 years also constitutes 17%, this group represents the individual houses built in the 1960s and 1970s. The age group of 61-75 years constitutes about 12% of the individual houses, which were built during the colonial period. Finally, those over 75 years old make up about 5%.

Figure13 The percentage distribution of the age of individual houses in Biskra



Source: The Author, 2025

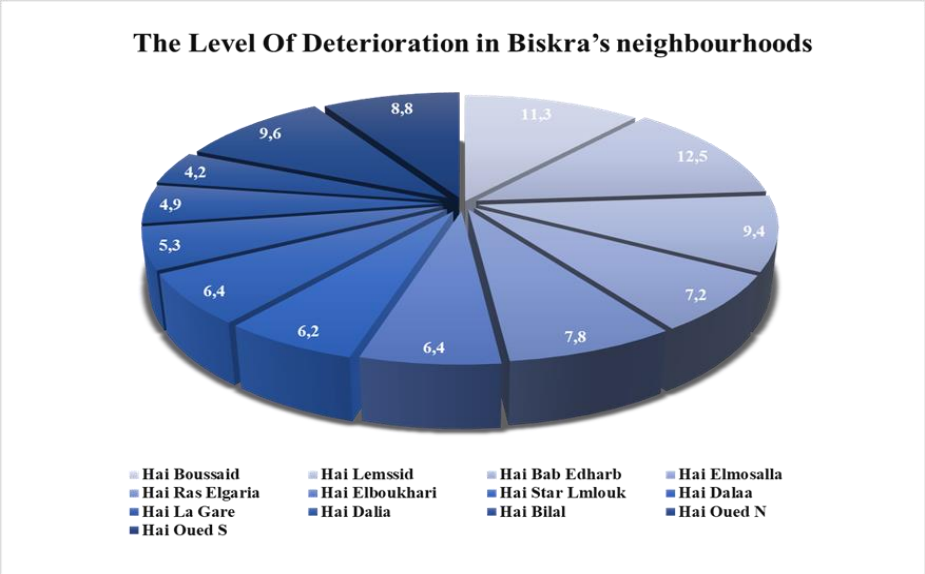
Figure 22 Percentage of Causes of Degradation in Biskra



Source: The Author, 2025

Figure 22 illustrates the percentages of the causes of deterioration in the city of Biskra. Through field studies and surveys, it becomes clear that most of the defects or errors present in individual residential buildings that led to degradation are the result of construction errors, inadequate design, the ageing of the dwelling, lack of sufficient maintenance, overuse, or aggressive contact in the individual residences of the city of Biskra. The survey revealed that 24% of the degradation rate was caused by construction errors, 16% by the ageing of the dwelling due to inadequate design, 12% by material failure and lack of sufficient maintenance, and 10% by inappropriate use or aggressive contact.

Figure14 The percentage of degradation in the neighbourhoods of Biskra



Source: The Author;2025

Graph 23 illustrates the distribution of degradation cases in the neighbourhoods of Biskra, where the levels of deterioration range from low to high. We observe that the neighbourhoods of El M'Sid, Bou Saïd, Bab El Dreb, and Ras El Qarya have the highest levels of deterioration. In contrast, the level of deterioration is moderate in the neighbourhoods of El Bukhari, Satr El Malouk, and Hara El Wadi. The third level of deterioration in the neighbourhoods of Biskra is found to be lower in the neighbourhoods of El Dalla, El Dalia, and Bilal.

The differences in the level of deterioration in these neighbourhoods can be attributed to their construction periods, but we do not consider this to be the main reason. For example, we might find a recently built house in the Dalla neighbourhood more dilapidated than an older house in the Masid neighbourhood. However, in general, we can consider that the older neighbourhoods of Biskra experience a higher level of deterioration due to their age and the local building materials used in their construction.

III. Results and Discussion

The field visit showed that some areas within the neighbourhoods of the city of Biskra suffer from age and degradation due to several factors. These factors include the use of local building materials in the ancient neighbourhoods, such as Al-Massid, Bou Said, Bab Al-Darb, Al-Masalla, and Haret Al-Wad, where these areas exhibit traditional construction methods made of clay, palm trunks, and straw. These residences are in a state of severe degradation and are close to extinction.

In contrast, other neighbourhoods such as Bukhari, Al-Mahatta, Khabzi, and Dalia, which date back to the colonial and post-independence periods, show moderate deterioration. This degradation is attributed to the lack of regular maintenance and the behaviour of residents who open commercial and industrial workshops, which causes pollution and creates hostile environments.

The neighbourhoods that can be considered relatively modern, such as Satr Al-Muluk and Bilal, are characterised by a lower level of deterioration, which is attributed to the use of poor-quality materials and poor design and planning.

The analysis showed that the ageing of the dwelling, wall cracks, appearance of reinforcement bars, corrosion of building materials, and electrical faults were classified as severe defects. On the other hand, paint peeling, gutter leaks, stains and discolouration of exterior walls, increased humidity on the dwelling's facade, uprooting of the dwelling's pavement tiles, mould growth, and improper use by residents were classified as less severe degradation and were rated as moderate severity.

Through the analysis of quantitative and qualitative data, we were able to determine that the sample consisting of 95 housing units in the urban fabric is entirely fragile and requires intervention and treatment through practical urban development and urban planning processes.

Summary

This chapter concluded that the deterioration of housing is caused by a complex and intertwined set of factors, including construction errors, material failures, and building ageing, in addition to the impact of hostile environments and misuse. An analysis of deterioration patterns, data, and graphs showed that deterioration occurs more rapidly in conditions where there is increased pressure on individual residences and infrastructure, reflecting the urgent need to implement intervention strategies aimed at improving design quality, using high-quality materials, and enhancing residential awareness by educating them on the importance of maintenance and regular upkeep.

The results also showed that relying on field image analysis and survey tables enhances the reliability of diagnosis and supports the construction of interpretative models that can be adopted in urban planning and management processes. The results call for the importance of early intervention and sustainable planning to address and slow down the signs of deterioration, to preserve the urban fabric, and achieve sustainable urban development.

CHAPTER III –

Interventions - Sustainable solutions-

Intervention Mechanisms

In this chapter, we aim to address the phenomenon of deteriorating individual housing.

Introduction

Urban interventions are A fundamental process that contributes to the revival and renewal of deteriorated urban fabrics, especially those suffering from old buildings and deteriorating infrastructure. These interventions gain significant importance in Biskra, where the deterioration of housing is one of the most prominent phenomena requiring sustainable solutions .

This chapter aims to review the proposed urban solutions to address the deterioration of individual housing by presenting practical processes that align with the requirements for improving urban conditions and contributing to the sustainability of deteriorating individual housing. The focus was on a proposed framework of urban interventions, the most notable of which include rehabilitation, restructuring, renewal, restoration, enhancement, and urban reinforcement, which were selected based on a prior assessment of the condition of the field residences. These operations also aim to create a modern urban environment capable of meeting the needs of the residents while preserving the urban and architectural character of the city .

The study relies on the use of the ArcGIS program to create maps that illustrate the proposed interventions according to the needs for intervention on deteriorated housing. An analytical approach was also relied upon, which includes combining different intervention processes and the possibility of their overlap within a practical framework to target a single dwelling, to integrate solutions to eliminate the phenomenon of deterioration. The approach is based on a flexible conception of interventions, where multiple operations can be combined within the same dwelling according to its nature and needs.

I am linking residential deterioration to the condition of the city's neighbourhoods.

The degrees of deterioration among the residences vary, with some areas showing severe decline in their infrastructure, while others suffer from less severe problems. For example, the old homes primarily face issues such as cracks, building debris, and near-total deterioration of the housing, like in the Al-Maseed and Bou Said neighbourhoods, reflecting an urgent need for rehabilitation and restoration. Meanwhile, some neighbourhoods with modern urbanisation face gradual deterioration in basic services, such as the appearance of humidity and mould on the facades of the residences due to sewage network leaks, which negatively impact the quality of life for the residents.

As demonstrated in the previous chapter, the causes of deterioration are numerous and include temporal factors related to the age of the buildings, environmental factors, poor urban planning, and a lack of continuous maintenance. Furthermore, some areas show signs of unregulated expansion, which has resulted in an overall deterioration of housing conditions .

As a result, the study addresses all individual residences in the concerned neighbourhoods, regardless of the degree of deterioration, to provide comprehensive solutions that align with the characteristics of each neighbourhood, with a focus on areas experiencing more severe degradation, aiming to improve living conditions, promote sustainable development, and preserve the urban heritage, within a framework that considers the social and environmental needs of the city.

II. Methods for addressing the deterioration of individual housing

After reviewing the literature in the first chapter on practical urbanisation processes, renewal and restoration, restructuring and rehabilitation, enhancement and reinforcement, which clearly defined the concepts, planning principles, practical guidelines, and urban preservation procedures, and which illustrated how urban interventions address the problem of housing degradation through various approaches.

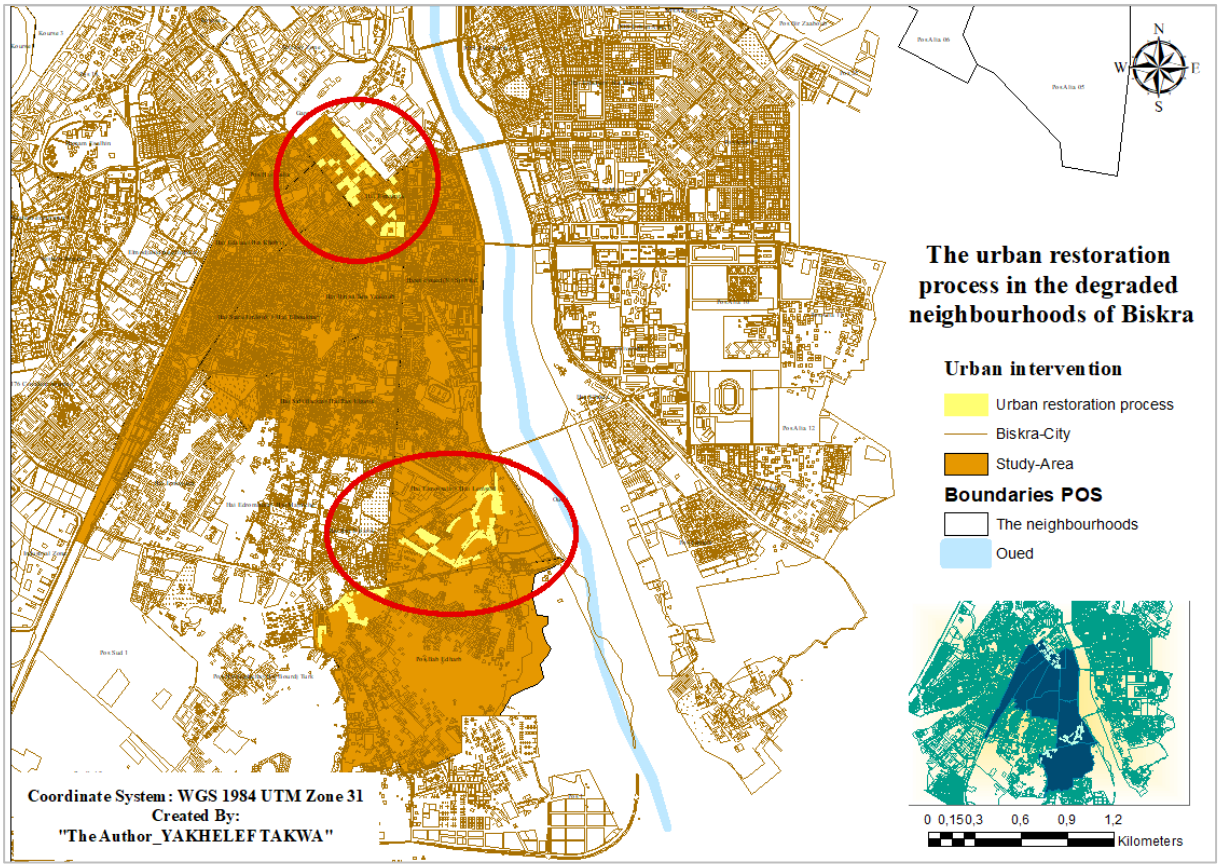
This study has identified the principles of urban interventions to address degradation:

1. The restoration process is one of the practical solutions for fragile housing

In the restoration process, any interventions must consider the original appearance, and most importantly, must not alter the inherent nature of the traditional dwelling. Interventions

that require the use of reinforced concrete should not be resorted to under any circumstances, as these practices directly contradict the construction style and concept of traditional houses in the Al-Masjid, Bou Said, and Al-Mahatta neighbourhoods. Furthermore, the original features of the buildings and the environment should not be significantly altered. Any limited intervention to restore the original shape or size of the traditional houses must be carefully examined and verified according to the formulated conservation principles. Potential treatments for degradation issues should be fully clarified based on the intervention procedures.

Map4 - A map showing the intervention of the restoration process on the deteriorated houses in the Al-Mahatta and Al-Masjid neighbourhoods



Source: The Author, 2025

Map (04) depicts the urban intervention in the Al-Mahatta, Al-Masjid, and Bou Said neighbourhoods during the restoration process, as the houses in these neighbourhoods represent tangible architectural heritage that reflects Biskra's unique design.

The chequerboard pattern of the Al-Mahatta neighbourhood indicates the presence of France in a previous era, while the organic fabric found in the Al-Masjid neighbourhood

represents an urban planning compatible with environmental factors. Therefore, the restoration process was chosen to preserve this architectural heritage .

The degradation must be addressed in a timely and limited manner for the affected and deteriorated houses. The intervention measures include cleaning the surfaces of the deteriorated houses, adding construction to the collapsed or unstable walls, introducing structural reinforcement elements, reinforcing and reapplying the existing plaster, and correcting and completing the mortar joints of the building. However, the following intervention measures and guidelines are completely incompatible with traditional houses and landscape features and must be prohibited, such as building new floors or raising existing buildings without structural reinforcement; building new external walls or other components using reinforced concrete or prefabricated components; building new columns or beam structures; replacing sloped roofs with flat roofs; changing the roof slope and its structural characteristics; and creating additional auxiliary spaces connected to the buildings.

Restoration and rehabilitation processes coexist in a home, with restoration addressing visible surface damages such as minor cracks, plaster peeling, or deterioration of outer layers, whereas rehabilitation is a quick and localised intervention that halts the progression of deterioration. Simultaneously, a building under restoration may require extensive rehabilitation of its structural elements, such as strengthening load-bearing walls or supporting roofs, to ensure long-term stability.

2. Restructuring to address structural designs

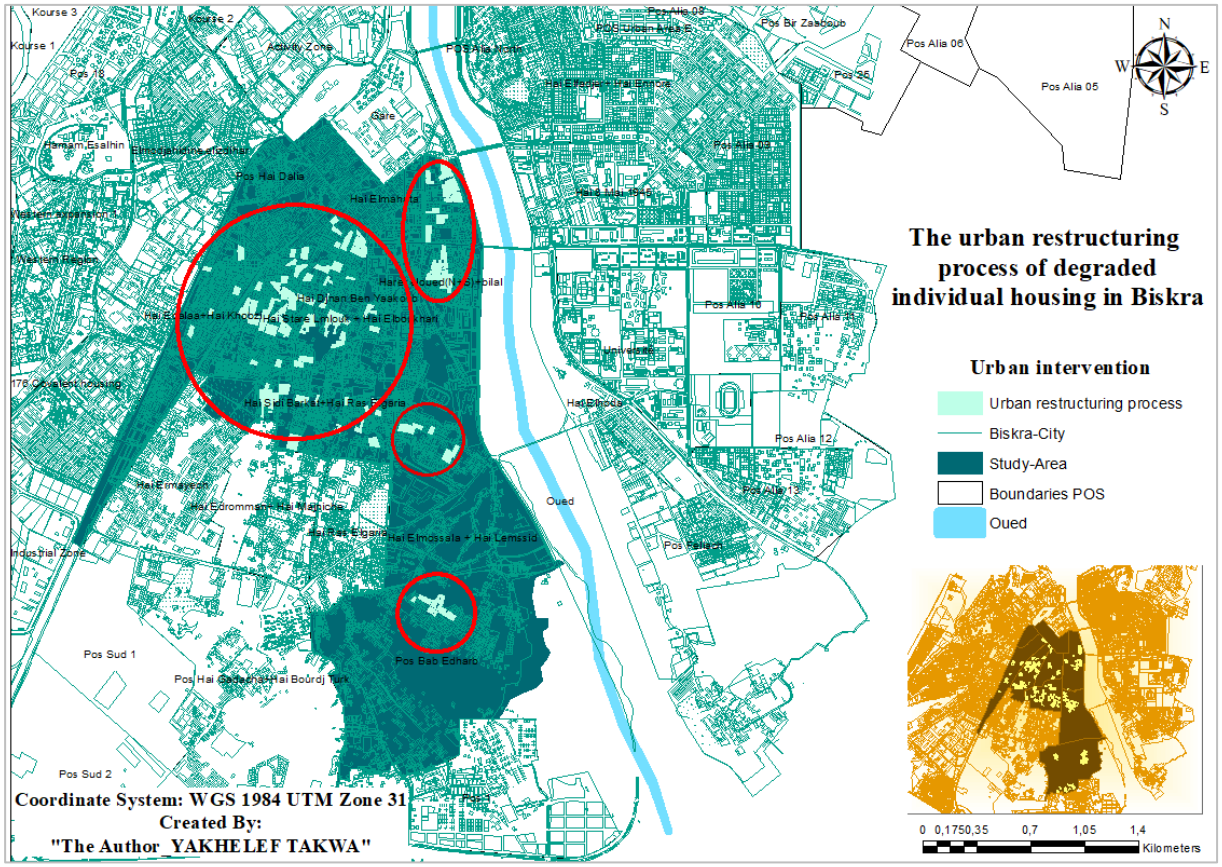
The process of restructuring is considered one of the most important intervention mechanisms for addressing the deep deterioration of individual housing, especially in cases where restoration or rehabilitation solutions are ineffective due to the complexity of the deterioration and its encompassing the entire urban structure, including the urban fabric. Restructuring intervention is called upon when field inspections reveal that the built fabric suffers from a comprehensive disruption that is impossible to overcome .

This process aims to radically reshape the urban space by reorganising the distribution of building blocks and urban functions, without affecting the cultural characteristics of the area .

In the study area of the city of Biskra, several houses have been identified as deteriorating, including both structural and urban infrastructure. These houses are located in the Boukhari neighbourhood, Bab Satr Al-Muluk neighbourhood, and the Northern Wadi Hara neighbourhood. Map (05) shows that these areas fall within the scope of structural intervention.

Field observations indicate a randomness in urban clusters, exacerbating the fragility of individual residences, which must be addressed through this process.

Map5 - A map showing the intervention of the restructuring process on the deteriorated housing in the city centre and the Harat Al-Wad neighbourhood



Source: The Author, 2025

The fabric has been diagnosed, and we have identified the random overlap of houses along the axes, in addition to the unplanned overlap between individual houses, resulting in unclear usage boundaries and a sharp variation in building heights within the fabric .

Through the technical principles of restructuring, the housing units will be redistributed according to an organised system based on the previous spatial analysis. The locations of the housing units will be adjusted to achieve harmony, random extensions will be eliminated, and the housing units will be reshaped to allow for functional integration. The restructuring process will redefine property boundaries and organise them within a new planning framework that allows for land use regulation and avoids encroachment or building overlap. The housing units will be controlled by adopting similar ratios for the units (height, density, coverage ratios).

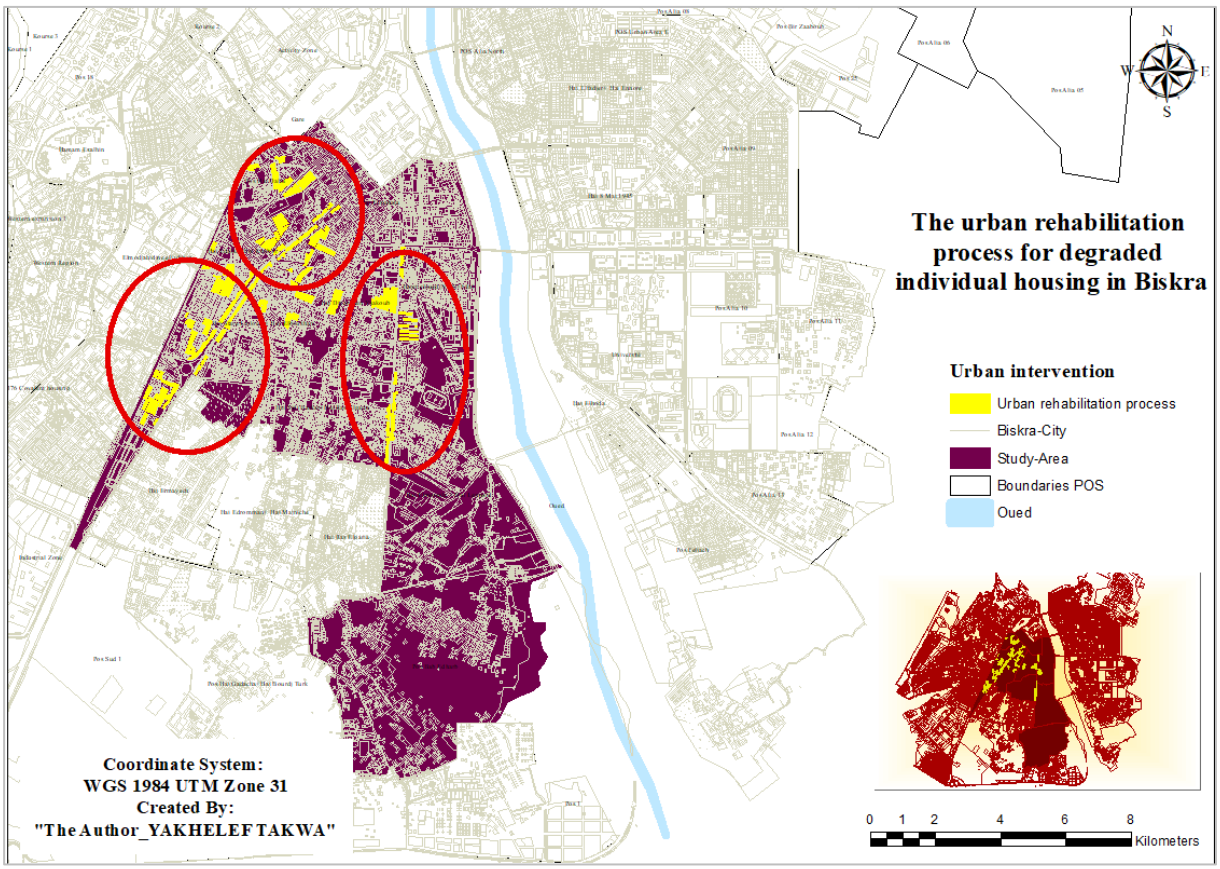
Buildings that deviate from the horizontal composition of the fabric or surpass the designated general height will not be allowed .

A more unified urban system with a distinct organisational and architectural identity is the result of this kind of intervention. Sharp distinctions between residences are removed, and new or reintegrated individual residences are absorbed within a homogeneous area while maintaining the existing spatial identity.

3. Rehabilitation is one of the radical solutions for maintaining deteriorating housing

The results of the spatial analysis of the housing degradation map in the city of Biskra showed a clear concentration of housing degradation cases within the urban fabric. The signs of deterioration included partial collapses in load-bearing walls, roof erosion, and noticeable deterioration in the openings' elements, in addition to inconsistent modifications made to some facades. Based on these observations, the most appropriate intervention in this context is rehabilitation, as it aims to restore the structural safety of the housing and stabilise its deteriorated elements without affecting its architectural identity.

Map6 - The map shows the rehabilitation process for deteriorated housing in the study area.



Source: The Author, 2025

Map (06) illustrates the rehabilitation process at the level of individual residences in the centre of Biskra city, focusing on the fact that the intervention will be on the residences facing the primary roads to improve and rehabilitate the building facades.

Three levels of intervention were established based on the severity of degradation :

-Level One, or basic rehabilitation, is designed for homes that have minor surface degradation, such as secondary wall cracks or peeling paint. This level includes repairing small cracks, addressing surface moisture, and repainting facades .

- Level Two, or intermediate rehabilitation, is for homes with documented secondary structural damage, such as non-load-bearing walls or ceilings. This includes restoring the openings to their original dimensions, using invisible components to strengthen the connections between walls and ceilings, and disassembling and reassembling deteriorated ceilings with original materials.

-Comprehensive rehabilitation (Level Three): This includes homes that suffer from extensive structural deterioration (partial collapses, foundation weaknesses, deformation in the shape of the house) .

These interventions require supporting the damaged foundations through internal backfilling, rebuilding the load-bearing walls using local bricks, reshaping the roof, and reinforcing the drainage system. These interventions are applied while respecting the overall architectural style of the area, in terms of opening ratios, building height, and architectural composition harmony.

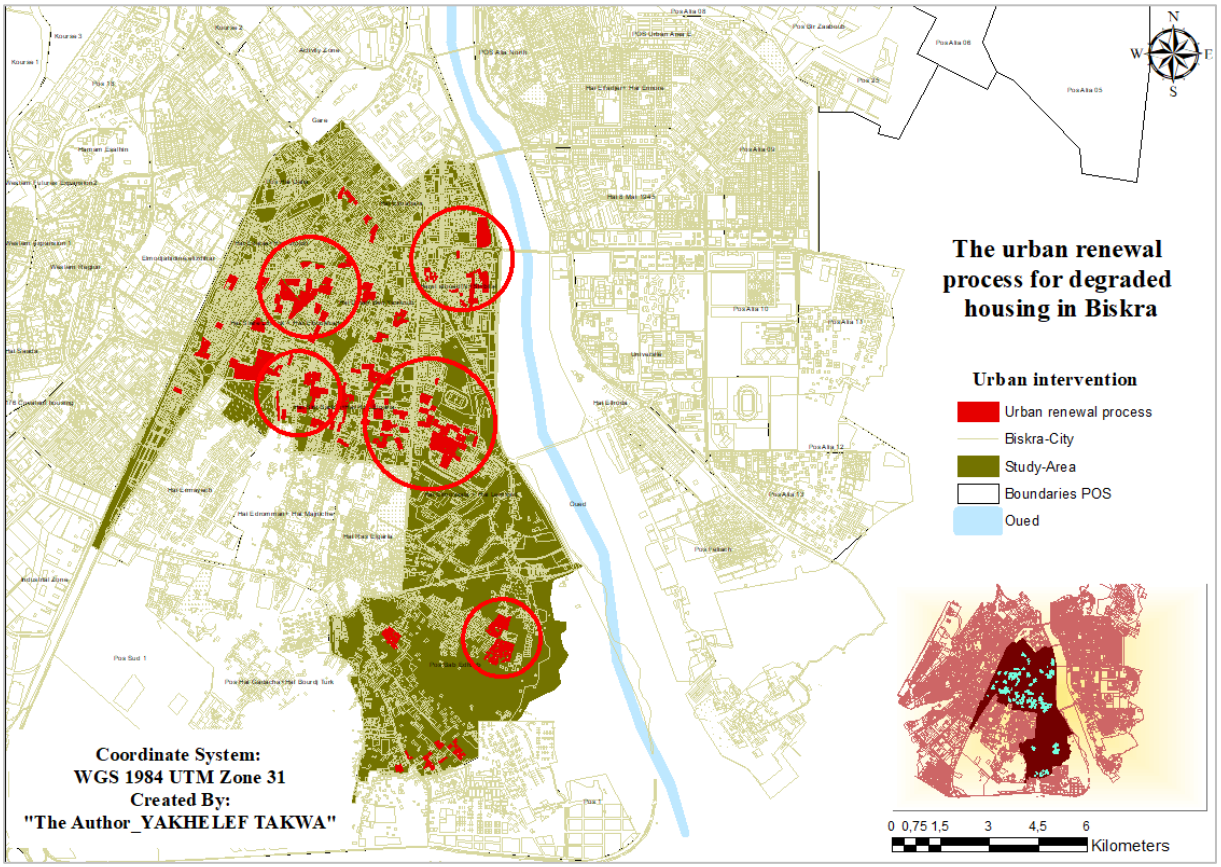
4. Urban renewal to improve the aspects of the deteriorating urban fabric

The intervention within the framework of urban renewal is based on a comprehensive urban reconstruction of deteriorated areas that cannot be addressed through partial interventions or simple structural repairs. This type of intervention is usually designated for fabrics that show partial or complete loss of their morphological value, due to the accumulation of random construction processes, repeated collapses, or visual and physical disconnection in the architectural composition .

Based on the results of the analysis and field survey, and through the map (07) illustrated below showing the distribution of deteriorated housing that generally requires partial renewal and, to a lesser extent, complete renewal, it becomes evident that individual houses are dilapidated in the urban fabric of the city of Biskra, especially in the Boukhari neighbourhood, Satr El-Melouk, and Haret El-Oued. These areas are characterised by the ageing of buildings,

the accumulation of random modifications, and weak infrastructure, making partial intervention insufficient in some cases. Urban renewal is proposed as a solution aimed at addressing architectural deterioration to reorganise the built environment. Urban renewal involves intervention at the level of individual housing and the urban fabric.

Map7 - The map illustrates the urban renewal process in the deteriorated housing areas of the study area.



Source: The Author, 2025

The urban renewal process includes the dismantling of collapsed individual houses. Through site analysis, the houses that have reached a stage of partial or complete collapse have been identified for renewal, as shown in map (07). These deteriorated houses are concentrated in the neighbourhoods of Al-Masalla, Al-Dhala, Jnan Ben Yacoub, and Al-Bukhari. Their condition does not allow for rehabilitation, so these houses are removed within a well-planned framework that prevents the creation of random voids within the urban fabric .

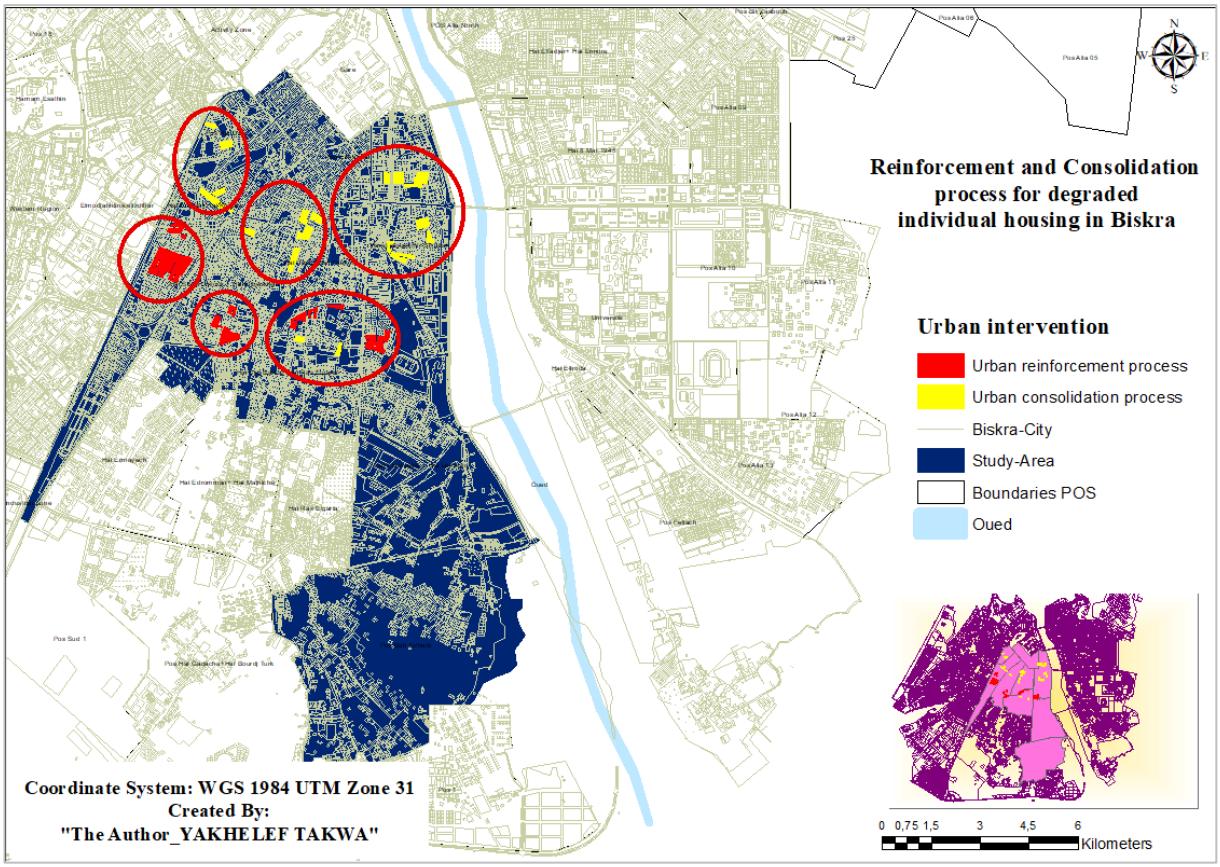
Reforming the houses according to global construction standards, the demolished houses are rebuilt using consistent materials and techniques, where the facade ratios, opening distribution, and building height are determined per the character of the intervened

neighbourhoods. The houses are treated through expansion, allowing for the opening of ventilation and internal lighting passages, without compromising the unity of the house. The reintegration of auxiliary urban elements, such as rainwater drainage points, and their integration into the roofing system, in addition to the incorporation of natural lighting and ventilation elements.

5. Reinforcement and Consolidation as a solution to the problem of deteriorating housing

Based on the analysis of deteriorating housing patterns in the intervention areas, some individual houses showed signs of localised deterioration without reaching a state of collapse. This necessitated the adoption of reinforcement and support interventions as a localised solution, which sometimes suffices instead of more extensive interventions. This intervention was applied to individual houses to halt imminent deterioration or an unstable structural condition.

Map8 - A map illustrating the urban intervention processes of reinforcement and consolidation on deteriorated housing



Source: The Author, 2025

Map (08) illustrates the deteriorated houses that will be intervened upon through the processes of reinforcement and support, as they are solutions to eliminate minor structural defects that do not require deep interventions such as rehabilitation or restructuring .

The site analysis of the study area revealed the nature of the structural defects, noting the presence of extensive cracks in the load-bearing walls due to weak connections between the building elements, partial settlement in the foundations caused by moisture or loss of connection with the columns, loosening in the structural corners due to climatic changes or soil movements, and the disintegration of plaster in the outer layers of the facade, which exposes the inner core to accelerated erosion .

A precise and localised technical intervention will be adopted to reinforce the dwelling and support the detached walls by re-aligning the building elements. Cracks will be treated by opening, cleaning, and then refilling them with mortar. The beams will be reinforced from below with parallel parts of the same length and measurement, without changing the ceiling level. The corners and facades will be connected at the intersection points between the walls, with a transverse connection using embedded and invisible metal elements. The cohesion in the corners will be enhanced using concrete fillers. The lower bases will be treated and the foundations supported by digging and refilling them with concrete, in addition to isolating the ground layer affected by moisture .

This intervention is localised and not comprehensive, as it did not involve any changes to the dwelling. The reinforcement and support process is aimed at maintaining the current state of individual homes. The impact of the intervention on the condition of the dwelling leads to immediate structural stability for homes that were at risk of partial collapse.

III. An analytical approach to the interplay of practical urbanisation processes in addressing deteriorated housing in Biskra

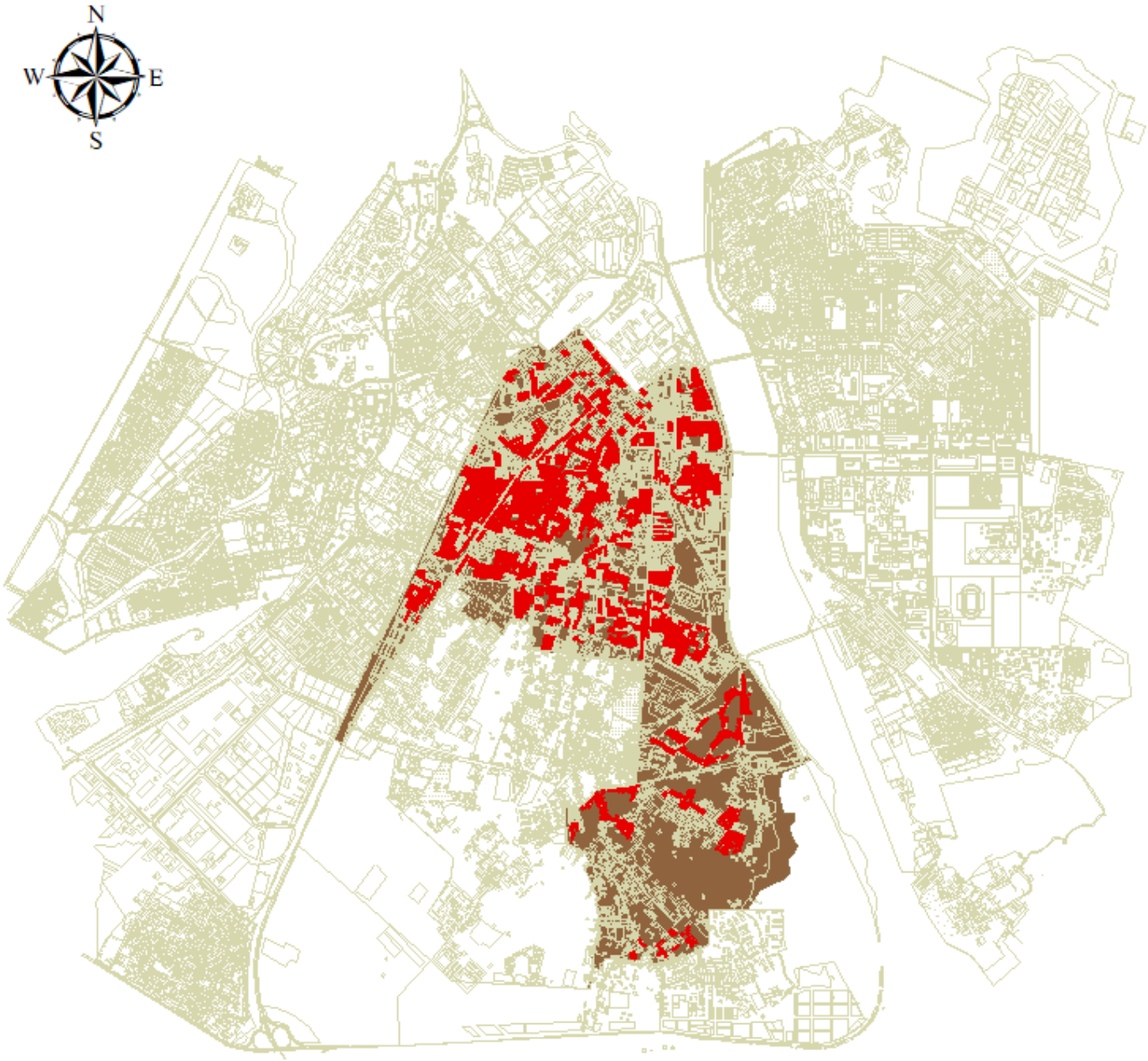
The study of urban interventions in addressing the deterioration of individual houses in the city of Biskra shows a variety of intervention mechanisms, where each process cannot be viewed in isolation, but rather several processes often overlap within the same housing unit, depending on the extent and depth of the deterioration in the dwelling. Each intervention carries its own technical and spatial specificity, but the success of addressing the deterioration depends on integrating these processes for the sustainability of the urban fabric .

Urban intervention processes in addressing deteriorated housing in the city of Biskra are characterised by overlap and integration, as addressing a specific deterioration case does not rely on a single process, but rather multiple processes can share the same housing unit or urban fabric.

The processes of urban renewal and reinforcement have overlapped in several residences, where renewal involves modifying facades and improving the infrastructure of the dwelling, while the dwelling needs to strengthen its foundations. The reinforcement process intervenes as a technical solution to support weak houses, allowing urban renewal to be completed without the risk of collapse or worsening damage. This overlap confirms that urban renewal is not just about beautification or reorganising spaces, but requires strong engineering support through reinforcement.

As for restructuring, it is often accompanied by rehabilitation and extension processes for renewal, because restructuring reorganises residential blocks and may change usage patterns and building areas. Therefore, this requires the restoration of old components that remain within the new structure, and structural rehabilitation of the preserved parts, in addition to updating their structure to meet new requirements. This integration clarifies that restructuring is a comprehensive process that incorporates various interventions at both technical and spatial levels. Consequently, it becomes clear from this overlap that urban interventions are not separate and limited actions, but rather an integrated and interconnected system that responds to the diversity of housing defects and the extent of deterioration in the urban fabric, ensuring that interventions proceed harmoniously, enhancing the sustainability of the results in addressing degradation.

Map9 - The map illustrates all types of urban interventions on deteriorated housing in the study



Urban interventions on degraded housing

Urban Intervention Operations

- Urban Restructuring
- Urban Rehabilitation
- Urban Restoration
- Urban Renewal
- Urban Reinforcement
- Urban Consolidation
- Biskra-City
- Study-Area

0 0,275 0,55 1,1 1,65 2,2

Kilometers

Coordinate System: WGS 1984 UTM Zone 31

Created By:The Author

"YAKHELEF TAKWA"

Through the implementation of programs for rehabilitation, restructuring, enhancement, restoration, fortification, and urban renewal, Map 09 shows the urban interventions to address urban decay in the city of Biskra. These interventions appear to be aimed at renewing the deteriorated urban fabric and achieving urban sustainability .

It can be said that these interventions work to enhance infrastructure elements and achieve a balance between economic, social, and ecological development within the urban area. Additionally, the focus on restoration, rehabilitation, and reconstruction processes reflects a trend towards improving urban functions and reducing social gaps by integrating marginalised areas into the overall urban fabric .

Using both qualitative and quantitative methods, these interventions provide tools to enhance the functional efficiency of the built environment, maintain the continuity of the urban fabric, promote a sustainable urban environment, and make the city a more attractive place to live. To address urban decay issues and achieve development, they can be considered an integrated urban response.

Summary

This chapter concluded that the deterioration treatments provided a clear description of the intervention procedures, material selection, operation execution, and recommendations.

It can also be confirmed that the proposed solutions for addressing the deterioration of individual housing primarily rely on urban and planning interventions that focus on restoration, renewal, restructuring, rehabilitation, and reinforcement processes.

Furthermore, the coordinated and flexible application of urban intervention processes effectively enhances the urban level of deteriorating housing, contributes to extending the lifespan of buildings, and improves their functionality.

The maps created using the ArcGIS program showed that accurately identifying the target areas facilitates the planning and implementation process and enhances the success of field intervention operations.

The comparative analysis of intervention processes and the impact of combining them on a single dwelling revealed that the overlap of procedures yields more positive results than applying a single process alone, especially in cases of severe and complex deterioration. The results highlight the importance of developing a comprehensive plan that integrates multiple urban strategies, with the adoption of a scientific methodology in selection and implementation, to ensure the improvement of living conditions and effectively address the phenomenon of deterioration.

Reference list

A. Abass, M. K. (2024, November). Exploring the patterns of deterioration: A case study of buildings in a residential estate in Nigeria. Proceedings. Covenant University, Ota, Ogun State, Nigeria.

A. Al-Amri, A. A.-H. (2020). Building materials deterioration: Causes and effects in residential buildings. International Journal of Architectural Heritage, 14(7), 932-943.

Alomari, O. (2022, March). Identification and categorization of building defects. Civil Eng. Arch, 10(2), 438-446.

American Institute of Architects. (2010). Guidelines for Residential Communities. Récupéré sur https://www.aia.org

Au-Yong, C. P. (2014). Prediction cost maintenance model of an office building based on condition-based maintenance. Eksploatacja i Niezawodnosc – Maintenance and Reliability, 16(2), 319-324.

Bamira, A. &. (2020). Structural defects in buildings and their classifications. Journal of Construction Engineering(15(3)), 45-58.

Farhi, A. (2002). De l'oasis à la ville saharienne. Revue méditerranée, 99(3.4), pp. 79-80.

Jalizi, J.-F. (2002). Natural hazards and land use planning: Approaching vulnerabilities (Doctoral dissertation). Bordeaux, France: Université Michel de Montaigne .

Jamaluddin, N. A.-M. (2017). Forensic building: Deterioration and defects in concrete structures. MATEC Web of Conferences. 103, p. 02016. EDP Sciences.

Kaklauskas, A. &. (2018). Building Maintenance Management. CRC Press.

Kheir, A. A. (2018). Building Lifespan and Performance. Wiley-Blackwell.

Kofi Agyekum, J. A. (2016, January). BUILT AND FORGOTTEN: UNVEILING THE DEFECTS ASSOCIATED WITH THE GHANA COCOA BOARD JUBILEE HOUSE IN GHANA. Journal of Building Performance Simulation, 24.

Lacour, F. (2004). Urban Renovation and Renewal. In: Throsby, D. (Ed.), Handbook of Urban Studies. London: Handbook of Urban Studies—Routledge.

Larousse, L. P. (1983). Le Petit Larousse illustré. Paris: Larousse.

Liu, H. &. (2020). Over-occupation and its effects on housing deterioration: An analytical review. International Journal of Housing Policy(20(3)), 345-360.

MERLIN, P. &. (1988). La réhabilitation, enjeux, pratiques et législations. Paris: Éditions du Moniteur.

Mirza, A. &. (2019). Structural failures due to material degradation in concrete buildings. Journal of Performance of Constructed Facilities, 33(5).

Oxford University Press, (. (2025, May 12). Single-family house - Oxford Learner's Dictionaries. Récupéré sur Oxford Learner's Dictionaries: https://www.oxfordlearnersdictionaries.com/definition/english/single-family-house

Schmid, H. (2011). Social conflicts and housing deterioration: The hidden costs of aggressive interactions. Journal of Urban Conflict Studies(7(3)), 231-245.

UN-Habitat, U. N. (2014-2015). State of the world's cities: Prosperity of cities. Nairobi, Kenya: UN-Habitat.

Walid-Mahfoud Djenaihi, N. Z. (2021, 10 4). Noise and Spatial Configuration in Biskra, Algeria—A Space Syntax Approach to Understand the Built Environment for Visually Impaired People. Sustainability, 13(11009), 5.

Watt, D. (1999). Building Pathology: Principles and Practice. Oxford, UK: Wiley-Blackwell.

Williams, P. &. (2018). Environmental stressors and housing quality deterioration. Housing Studies Journal(30(4)), 567-582.

Zhang, Y. &. (2019). Environmental pollution and housing deterioration: A review of health impacts. ournal of Environmental Health and Housing,(12(2)), 101-115.

Appendix

Questionnaire

Part I – Individual Values

1)

Number of individuals constituting the household	

Part II- Characteristics of the Habitat

1)

How many years have you been occupying the habitat?	

2) **The construction materials used**

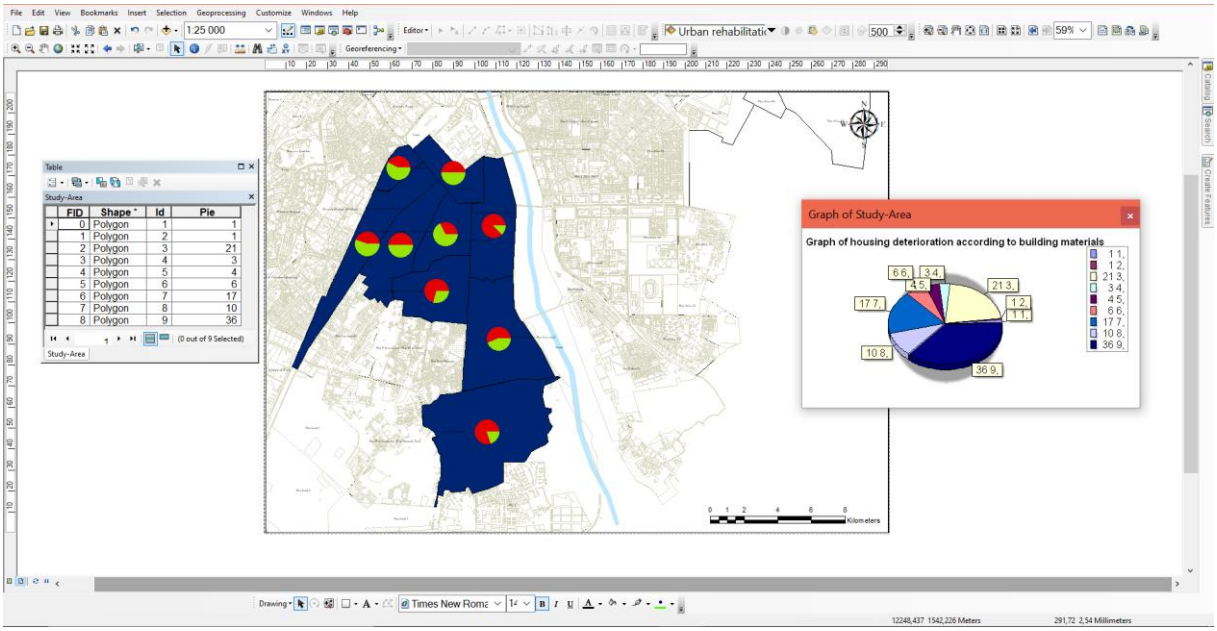
Concrete	Chiselled stone	Adobe	Mixed

Part III - Perception of Degradation

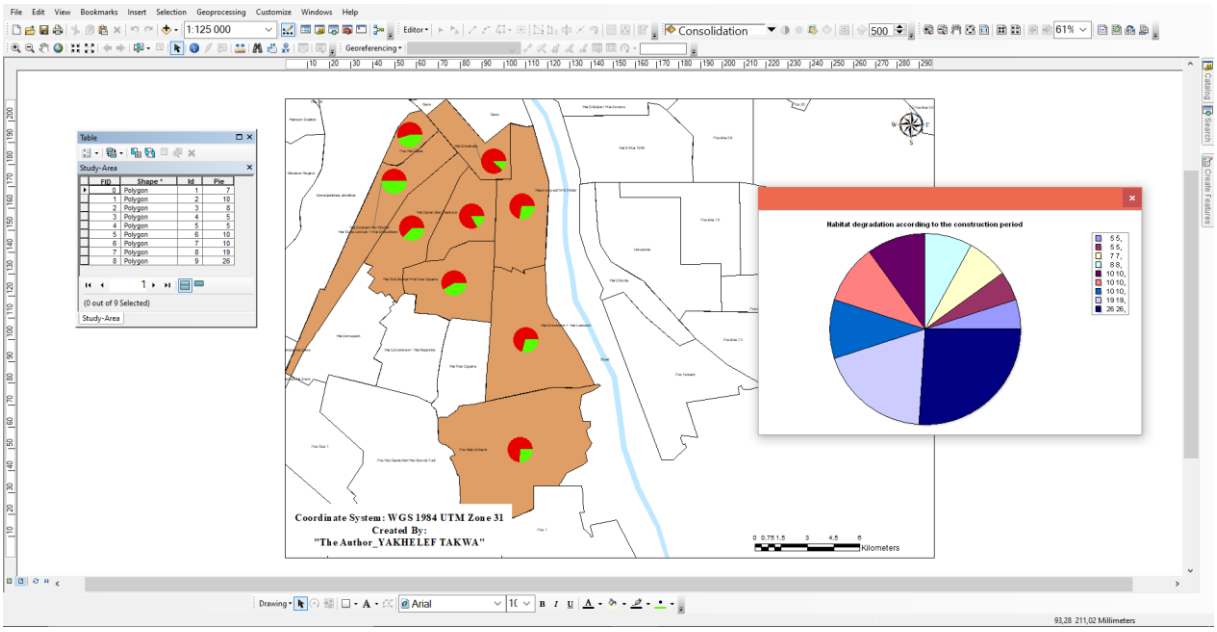
1) **The causes of external degradation of the habitat**

a) Construction defects	
b) Material failures	
c) Obsolescence (lifespan)	
d) Aggressive contacts (Aggressive environments)	
e) Pollution and insalubrity	
f) Over-occupation (Abuse of use)	

Appendix A - Housing deterioration rates by construction materials.



Appendix B - Housing deterioration rates by construction periods.



Appendix C – Attribute table of the neighborhood of Biskra