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**DESIGNING STREET FURNITURE:
PRINCIPLES AND CRITERIAS TO PROVIDE ADEQUATE
APPROACHES TO ENHANCE THE QUALITY OF LIFE IN URBAN
SPACES**

Dissertation for the degree of
Doctor of Philosophy in Architectural Engineering

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Abstract

In the face of global warming and the global health crisis, how should we rethink our cities and streets to make them more pleasant, livable, and sustainable? Should we promote well-being? Should we prioritize the functional city? Should we develop a smart city? What if street furniture were the critical issue in transforming tomorrow's urban streets? Street furniture could not only help to refresh streets, neighborhoods, and cities but also promote sustainable mobility, increase the comfort of citizens in public spaces, and encourage community living.

Public spaces evolve, and change: and so does street furniture. Users' and residents' expectations are increasing in street furniture, which is becoming a challenge for cities and municipalities. Today, cities must provide the population with an increasingly pleasant experience in urban spaces but also make these spaces attractive and appealing. There is nothing like sunbathing in a public square with beautiful deckchairs, and nothing better than taking a break in a park by sitting on a comfortable and ergonomic public bench.

The primary role of street furniture is to meet the expectations of residents and users. In addition, urban development must also make it possible to embellish public space and make it more attractive. Comfort, solidity, resistance, ergonomics, design, and style are now an integral part of the design of public spaces.

It is no longer possible to manufacture street furniture because it must integrate perfectly into the landscape while meeting essential satisfaction criteria. Functional and innovative street furniture must also meet environmental protection standards, and using environmentally inert and fully recyclable materials is fundamental. To meet this challenge, street furniture must be designed with the most appropriate materials, adapted to local social and environmental conditions, and in accordance with safety regulations.

The Mediterranean Garden in Sidi Bou Said was chosen as an example of neglected street furniture. The research aims first to evaluate the current state of street furniture and its relation with its users. The investigation results from classified street furniture according to four main criteria: Technical design, social integration, participative approach, and ecological aspects integration while designing street furniture. As a result, the potential and the resolution of different problems and pathologies while designing will be considered for this study.

Based on the evaluation and the analysis applied in Sidi Bou Said to understand the user's needs, inventory approaches were developed to rethink designing street furniture in similar urban spaces. The diagnosis was established by selecting a festive and representative area that serves as a definition of a potential landmark based on its significant geographical situation and qualities. In the process of developing the image of the city, the inventory approaches highlight the significance of the selected research area, presenting a unique design proposition that sets the light on both the social and environmentally friendly design, and contributes to a better understanding of the importance of street furniture design in Sidi Bou Said and cities with similar Mediterranean atmosphere.

Keywords: Street furniture design, Social integration, Participative approach, Eco-design, Sustainable Design, Urban Development.

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General Introduction

The search for socializing, well-being, and relaxation pushed the ancient Man to imagine the concept of public space incorporating different urban furniture. The historical evolution of public space is closely related to the history and development of cities. Indeed, starting from the agora of ancient Greece, the Roman forum and the consular ways have gradually led to life-size architectural concepts. In human societies, especially urban ones, public space represents any place of passage and meeting for community use, such as streets, parks, and train stations. Today, the urban planning of towns and cities allows much more modern development of public spaces with a wide range of urban furniture as ingenious as the original.

Before discussing the definition of urban furniture, it is essential to understand what urban planning is. Urban planning is responsible for the development and organization of cities, an aspect intimately linked to the development of the inhabitants. The excessive growth of the world's population is pushing us to rethink urban planning through innovative ideas. This means putting in place all the urban furniture to realize optimal urbanism. Thus, urban furniture is translated by all objects, whether in public spaces or the urban environment. These include public lampposts, park benches, and waste garbage cans. This group of furniture that makes up street furniture can also be referred to as outdoor street furniture or street equipment.

The idea of this Ph.D. research, following the objectives of my master's thesis, had an interest in renovating neglected street furniture to create new functions and save the urban space from transforming it into an area of territorialization and marginalization. Street furniture is a subject that aroused my motivation, more precisely around designing with and for people according to four main aspects: Technical design, social integration, participative approach, and ecological aspects integration while designing street furniture.

PART 1. INTRODUCTION TO STREET FURNITURE PERSPECTIVES

INTRODUCTION

1. Background of the Research

Providing various services and functions to the public, street furniture is represented as one of the most important elements in urban public spaces; it contributes to enhancing the urban landscape. The arrangement of public spaces is an asset for urban designers to ensure users' better quality of life. It should be well inscribed in space and time to be complementary and not parachuted within the space. By definition, street furniture is all equipment installed for the benefit of users on public roads and in public outdoor spaces (LAROUSSE). The combination of the terms "street" and "furniture" makes it a bizarre mix. The term Furniture is directly associated with privacy concerns, while the street is public. In Latin, furniture derives from the word "mobile," which means something movable in French, whereas street furniture is unmovable and fixed to the floor. Furniture derives from the French verb "Fournir," which means "to provide," focusing on functions. It provides us comfort and similar purposes as regular street furniture at home, making urban spaces livable.

A policy of redevelopment leads to the creation of new designs of street furniture. To make a good choice, it was necessary to make clear choices, functional and aesthetic, ecological, ergonomic, and economical. Furniture essentially acts as a social reference point, making it a point of assembly and separation.

The image of the city highly depends on the well-designed street furniture. It plays "an important part in establishing the identity of the town center in the minds of visitors and residents" (Bakewell & Partners, 1999). Overall, street furniture reflects the quality of the urban environment and the city's economic, cultural, and technological development. Street furniture has a significant role as it has been emphasized in developed parts of the world (e.g., the United States, Europe, and Japan). It has been one of the main elements of "urban characteristics" and public art in Europe (e.g., Paris) since the 1960s (Yang, 2005).

In developing countries, in Tunisia, the government places significance only on construction development and urban planification. Street furniture is presented without adequate examination, particularly regarding the public's needs, and it represents unsatisfied functions and insufficient street furniture to satisfy the user's needs. Other than the basic needs, street

furniture is planned without adequate exploration of the space circumstances like the lack of ecological design aspects, positioning, coordination with the surroundings, and several limitations of street furniture design that require investigations.

Today, due to the world's rapid urbanization and globalization, global warming, and humanism, urban landscape design (including street furniture) faces unprecedented challenges and demands (Yang, 2005; Wang & Wang, 2006; Wei & Sung, 2005). To meet the diverse urban needs and maintain a balance between different aspects in the new era, various perspectives must be considered in the design of street furniture. In addition, many countries have developed urban forms and spatial patterns in the 21st century. To improve the environment, the method of "from point to line and area" is widely accepted and applied (Yang, 2005). Under this approach, street furniture is emphasized and regarded as the starting point for urban rehabilitation and renewal of environmental improvement. Urban planners and architects consider "Street furniture design an important part of urban renewal projects (Yang, 2005, p. 26).

2. Overall aim of the Research

This research aims to forecast the implications of suitable street furniture in urban public spaces by evaluating the impact of the street furniture lack on user behaviors. It helps to assess its interaction effect and analyze the importance of well-integrating street furniture in urban spaces to understand relationships within society and urban spaces better. What is the importance of combining the essential design criteria (aesthetic and functionality) with the principle of sustainability and eco-design criteria? How could the community be involved in the development of street furniture production quality?

3. Research Questions

To establish a new approach to registering street furniture into the public urban space with all that surrounds them and adopt new techniques regarding sustainable development in Tunisia through the diverse type of street furniture, this research aims the answer the following questions:

- ◆ What is the impact of the street furniture lack on its users? Moreover, how it affects the interaction space/user relationship?

- ◆ How could street furniture ensure social integration within public spaces? What would be the appropriate approach?
- ◆ What processes help to accomplish the combination between essential design criteria and environmental criteria?
- ◆ How could society take part in revalorizing the street furniture and thus their city?

4. Research Objectives

The research objectives are:

- ◆ To analyze the existing street furniture in its relation with urban spaces, then propose recommendations to recover the street furniture lack.
- ◆ To enhance the street furniture integration not only on the functional level but also on a more social level and formulate recommendations to increase a social interpretation of the space.
- ◆ To explore the necessary criteria to design sustainable street furniture to present its importance, helping to ameliorate the quality of living in Sidi Bou Said.
- ◆ To identify new techniques for improving social participation in street furniture implementation.

5. Contribution of the Research

Integrating street furniture in urban spaces became a new challenge for urban designers; this study will help them use new methods and techniques to combine essential criteria (functionality and aesthetic) with environmental aspects into their design.

The designated methodology to analyze the importance of integrating sustainable street furniture in Sidi Bou Said will help local and central government, urban designers, investors, and citizens understand that it is a multidisciplinary action and requires collaboration.

6. Conceptual Framework

To answer the research questions, based on the literature review, the research starts with identifying the key variables to develop an understanding of the contribution toward street furniture integration and its sustainable design development. The key variables, urban

landscape adaptation, social integration, essential design criteria, and sustainable design, resulted in collaborations between all stakeholders, adapting new design criteria, increasing social values, and enhancing live quality.

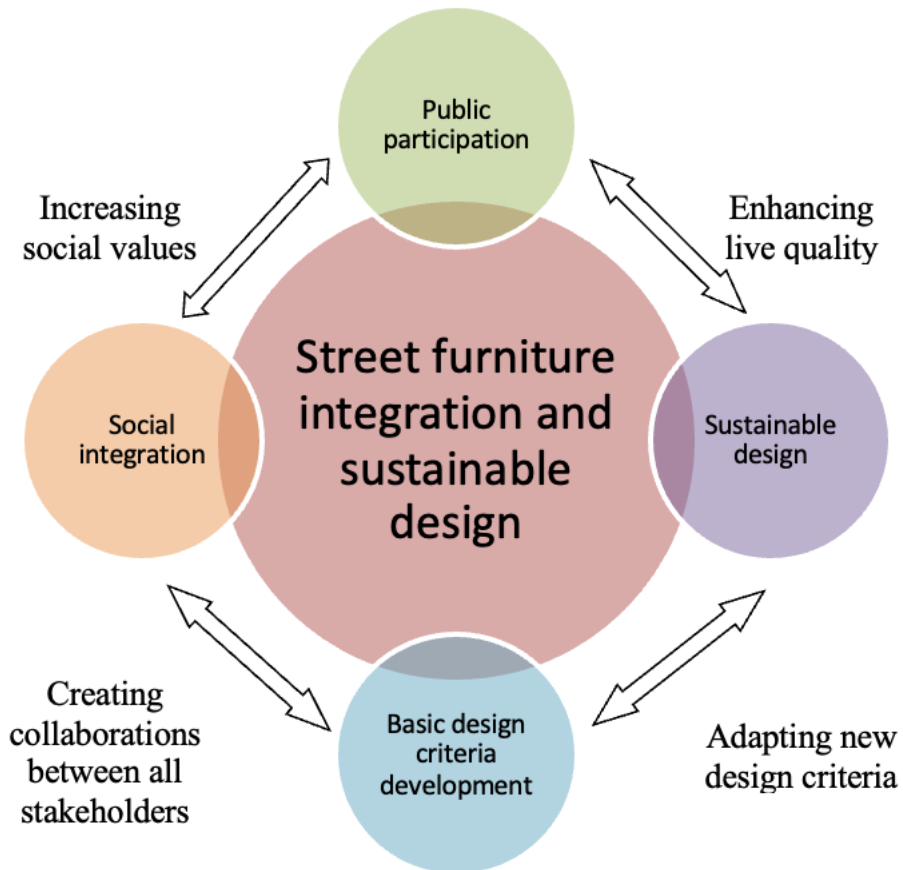


Figure1. Identified concept contribution and variables synergies (Author, 2023)

7. Methodology Overview

The research objective starts by identifying the current situation of urban furniture design and its characteristic in urban public spaces in Tunisia. The literature review researched both qualitative and quantitative methodologies. To answer the research questions, the chosen methods were:

Data collection: To collect and analyze information from scientific papers, books, urban plans, administrative documents, and others. In this research phase, different existing literature served to develop and formulate principles for precise future research steps.

Direct interviews: It seems necessary to organize with the municipal government representatives Sidi Bou Said, the Founders of the association, and activists in the social life activities about sustainability and other various organizations.

Questionnaires: A series of questions were addressed to the community of Sidi Bou Said to know the nature of the population and collect the necessary information about the community consciousness of their perceptions of the street urban furniture design and the importance of its integration to enhance the quality of their city.

The steps involved in organizing the survey ranged from the identification of objectives, the accuracy of the observation plan, the administration of the survey, the processing and analysis of the data, to finally arriving at the verification of the hypotheses and the exploitation of the survey according to the objectives of the research.

8. Thesis Structure

The first chapter introduces the research objectives based on the literature review and background knowledge (Theory and design of urban street furniture). It describes the benefits of well-integrating street furniture in urban public spaces. The second chapter focuses more on the urban structure of the research case study, Sidi Bou Said; it focuses on the city's analysis (historical background, the existing urban street furniture analysis, historical development plans, urban morphology, its functions accessibility, habitation examples, and climate chart). Also, it presents the investigation presentation of the survey corpus: the questionnaires and direct interviews with the community members to assess the urban street furniture applicability and to have general data about the participant, their knowledge about the importance of street furniture design, and its integration within urban spaces, also about the community participation in designing street furniture and the city development in general. The third chapter analyzes the research design principles, strategies, and methods concerning the first and second statements considering street urban furniture design and social integration). The fourth chapter investigates more methodologies and research design concerning the third and fourth statements which are related public participation, environmental, sustainable, and ecological aspects. The fifth chapter summarizes the scientific findings and the research results and highlights recommendations for integrating urban street furniture in public spaces.

LITERATURE REVIEW

This part is fundamental to this study. It provides an overview of related studies on the design of street furniture. It includes the general concepts of street furniture, definitions, history and development, function, essence and characteristics, classification and scope, and an overview of street furniture design principles. Through the review, analysis, and organization of related studies, this chapter seeks to accomplish the following objectives:

- ◆ A complete sorting and review of street furniture design studies.
- ◆ To provide a basic concept and knowledge of street furniture by helping to understand street furniture intensively from different perspectives.
- ◆ To find out the possible research direction for this study from the areas not covered in related studies.

1. History and development

The concept of “street furniture” was developed in Europe in the 1960s. Although the concept of street furniture was first defined in the 1960s, street furniture itself is not a modern invention. It came up with the foundation of the city. It can be found even in ancient Greek and Roman cities (e.g., Arenas, Plazas, and Podiums). Few studies have addressed the history of street furniture. Therefore, finding a detailed and complete history of street furniture is difficult. Wang and Wang (2006), Yang (2005), and Yu (2003) claim that it is difficult to discuss the history of street furniture for two reasons. First, the history of street furniture is closely related to the history of urban design (or landscape design). The history of urban design cannot be ignored when studying the history of street furniture. However, urban design always focuses on large scales and considerations such as architecture, planning, engineering (structures), horticulture, etc. Street furniture has become an accessory in urban design, and its history is not the mainstream of records and discussions. Second, although it is classified in various studies. Street furniture is an open and changing system with complicated elements and rapid development. This makes it difficult to define its scope and systematically and comprehensively study its history.

In ancient Rome, urban planning and street furniture developed into a complete system. Street furniture included raised water channels, sidewalks, street lights, flower beds, and a signage system. Later, the design of Roman cities took a different direction, reflecting Rome's

ambitions to expand and achieve world domination. Streets were neatly planned, and urban axes were emphasized. Street furniture like triumphal arches, fountains, ponds, and stelae was designed to become powerful landmarks of the city.

Paris has been considered the best representative of urban design since the 18th century. The geometric royal garden, radial street system, star-shaped plaza, and classical architecture with the coordination and arrangement of street furniture, including triumphal arches, street lights, monuments, and fountains, gave a sense of unity.

Street furniture evolved and significantly changed in the late 19th century. "The nineteenth century saw a flood of street furniture. The Industrial Revolution of the late 19th century changed the world. It led to rapid growth in urbanization and, thus, an increased need for urban design and street furniture. It also brought new technologies (e.g., machines) and new materials (e.g., metal, glass, and concrete) that were first used in street furniture design. Street furniture as part of the urban landscape and the various concepts of urban design changed significantly in terms of design, scale, quantity, etc. New types of street furniture were also inspired and created in this new era.

Since entering the second half of the 20th century, when urban design and street furniture had already developed to a certain extent under a functional and technological approach, urban design, including street furniture, was evaluated both intellectually and methodologically. Different schools of urban design developed. On the one hand, there are different requirements today due to new information based on industrial and technological developments. On the other hand, industry, technology, and urban landscape developments have seriously destroyed the natural environment, humanism, regionalism, etc. Street furniture needs a new development direction that coordinates the various needs and concerns.

Today, street furniture is still in the process of development and evolution. It is also gaining more and more public attention, developing and penetrating more areas. As mentioned earlier (Wang & Wang, 2006; Yang, 2005; Yu, 2003), it is evident that the history of street furniture coincides with the history of urban design. Street furniture is indeed a part of the urban landscape. Intensive research in urban landscape design is essential for a thorough study of street furniture design, including its history and evolution.

2. Classifications and perspectives

Numerous classifications of street furniture have been made by academics, professionals, and governments. The results from various perspectives, factors, and considerations on the needs, design, and implementation of street furniture show that street furniture is a broad topic that feeds into several different areas. To achieve a deeper understanding and better design and implementation of street furniture, a study of the different classifications of street furniture is essential. This can also help determine the scope of street furniture. The classifications of street furniture are listed in the following sections.

a. By the Types of Urban Landscape

This is a classification in the macro sense, emphasizing that street furniture is part of the urban landscape. Street furniture is therefore classified (along with other elements of the urban landscape, e.g., architecture and other urban facilities) according to the characteristics and nature of different urban landscapes and spaces. This classification can be defined by districts (residential zones, commercial zones, industrial zones, historical zones, cultural zones, administrative zones, tourist zones, green zones, Etc.), open spaces (squares, parks, gardens, playgrounds, Etc.), and paths (commercial/shopping pedestrian paths, living/residential pedestrian paths, green pedestrian paths)

b. By the Functions of Street Furniture

Another important method is classifying street furniture according to its functions and services. This method focuses on street furniture and shows the common characteristics of street furniture in different places. Taking France as an example, it can be seen that the country had an early and advanced development of street furniture. For example, in 1981, the Ministry of Construction classified various street furniture (1-7) according to their function in the document *Les Aménagements Extérieurs* (Outdoor Facilities Planning), and Carmona made additional classifications (8-9) in 1985. Street furniture was classified based on the examples given:

- ◆ Decoration: Gardens, planting, fountains, water views and sculptures.
- ◆ Information: City maps, clocks, billboards, bulletin boards and newsstands.
- ◆ Protection and demarcation: Railings, walls and bollards in stone and metal.
- ◆ Recreation and sanitation: Benches, drinking fountains, trash cans
- ◆ Parking: Parking and charging stations and facilities to separate private parking.
- ◆ Children's play equipment: seesaws, swings, and slides
- ◆ Engineering: Lightings, signs, electrical, communications, and postal and fire departments.
- ◆ Public transportation furniture: stations, crossings, and public transportation facilities.
- ◆ Public communications furniture: Private mailboxes, public mailboxes at the post office and on the street, and public telephone booths.

c. By the Types of Street Furniture

This classification is much more specific and appropriate for technical concerns and implementation. It is usually used in government documents and guidelines. In England, street furniture is classified into high mast lighting (steel from 18m to 46m high), Approved lighting columns (lighting columns of 8m to 15m high), Group A lighting poles (lighting columns of 8m to 12m height and extension bracket), Group B lighting (lighting columns of 5m to 6m height and with extension brackets), General lighting (lighting poles 4m high, including wall mounted lighting and floodlights), bollards and posts, litter bins, plantings, seating, shelters and kiosks, poster display units, guard rails parapets, and walls, footbridges, playground equipment, miscellany, paving, and signs (Design Council, 1983). It is noticeable that lighting is classified in particular detail. This shows that the technical concerns of lighting are emphasized at the administrative level because the lighting is important for the safety and order of a place, especially for traffic. In Germany, street furniture is divided into the floor covering, limits, lighting, facade, roof covering, disposition object, seating, vegetation, water, playing object, object, advertising, information, signposting, flag, showcase, sales stand, kiosk,

exhibition pavilion, table and chairs, waste bin, bicycle stand, clock, and letterbox (Wang & Wang, 2006).

d. Summary

The different types of classification reflect that street furniture is an open, complex, and extensive system. It has penetrated widely and deeply into the different urban landscape areas and provides a wide range of functions and services (Yu, 2003). Due to the different perspectives, each classification may attach importance to one area on the one hand and less importance to another. Classification by types of urban landscapes emphasizes the overall landscape design, but the details of each type of urban furniture may need to be addressed. Classification by street furniture function focuses on the systemic operation and management of street furniture, while it needs to consider its overall landscape and details sufficiently. Classification by type of street furniture emphasizes individual design and technical details. However, the relationship between the different types of street furniture and the overall landscape is ignored. Therefore, the study of the different classifications is important for the design of high-quality street furniture. The different focuses of the classifications complement each other and provide complete considerations and requirements for street furniture design.

3. Citizenship education

Street furniture and humans influence one another. People create urban landscapes and street furniture to satisfy their needs; therefore, the construction and facilities are specifically designed for urban life. However, people should also protect and preserve the landscape and street furniture to generate harmony between the environment and humans, which in turn helps to maintain the quality of urban life (Siu, 2007b). Citizenship education plays an important role in improving citizens' quality of life and cultivating people with civil awareness who respect the urban environment and facilities (Figures 2. a-b). Based on the flexibility of street furniture, citizenship education can help to guide the public appropriately in using street furniture to avoid causing human harm or damage to street furniture, at the same time, achieve the highest purpose of being able to use street furniture in different ways. On the other hand, it is the responsibility of designers to consider the possibilities of artificial destruction and minimize them. For instance, designing street furniture with movable parts should be carefully considered as users easily damage it (Wang & Wang, 2006).



Figures 2. a-b. In China, although modern urban, construction and facilities are developed rapidly, citizenship education has failed to complement with the level of development.

In the figures, a large number of promotion stickers are placed on the pedestrian paths. It causes serious damage to the urban landscape, street furniture/facilities, and also destroys the visual pleasure ((a) Gaoliangquiao Road and (b) Kexueyuannan Road, Beijing, China).

4. Street Urban Furniture Design

Suitably positioning and designing furniture add pleasure to its users to enjoy using outdoor spaces. The main challenge for urban designers is to make people feel well-involved and welcomed. The indication of the quality of urban space depends on how the identity was created; an example that could be present in various cities: London red phone cabins have become representative of the city identity. In order to set up street furniture, defining the space is fundamental, whether it is a plaza, street park, outdoor space, or indoor space, to define primary questions about the potential users of the space, furniture purposes, frequentation period, and the functions that will serve to its users. Design conception is necessary for the installation while planning and considering the user's needs, whether conditions, architectural character or urban identity.

Structures, colors, components, and textures can affect precisely the human physical environment. Each element has its attributes while planning an urban space with which people could interact.

a. Functional and Technical concerns

To appropriate public space, it has to be tangible and must offer joy to its users by arranging street furniture that is accessible easily and functional and attract individuals to use it legitimately and frequently. A necessary factor to have functional street furniture must fit the human ergonomic. Details and technical requirements were listed for government design guidelines. For example, the Hong Kong Highways Department's Public Lighting Design Manual (2006) lists all the technical design details of the various types of lighting (e.g., high mast lighting, tunnel lighting, street lighting, various lighting for pedestrian walkways, and traffic intersections). Details include dimensions, distribution spacing, lamp or bulb selection and intensity, and installations for different lighting in different locations. The British Standards Institution (1998) has also listed various engineering design details for playground equipment, such as clear heights for all platforms and swings and keeping areas clear of unexpected obstacles.

b. Aesthetic concerns

Another important concern is aesthetics, such as street furniture's form, color, style, and material. It can enhance the design value and attractiveness of street furniture and decorate and beautify the environment.

◆ Form:

Material is always decided from the form, measurements, and function to ensure the service required to give. Example: Seating in Hamburg, Germany.

Vehicle streets, walking way, squares, gardens, and green ranges are enlightened by various types of lighting, color, texture, form, and materials that could influence how it is utilized. For example, the contrasts created after the visual mix between these elements change its initial form perception.

- ◆ Color:

As a significant portion of the perception arrangement, color is an important aesthetic element that characterizes the nature of the public space. Street furniture can be easily perceived if it is appropriable colored (solid chromatic, sharp colors). Bright/dark colors, standard colors. Example: colorful seating in Austria.

- ◆ Texture:

Street furniture is directly identified with texture and forms; for a vital arrangement, textures are directly related to aesthetical and technical design. It hides minor design faults and makes a noticeable commitment to the structure rather than visual and technical attributes. Example: Texture surface in Warsaw, Poland; Sidney, Australia.

- ◆ Materials:

Quality must be considered since the latest innovation directly influences street furniture in terms of materials qualities. Materials are chosen depending on their design's function and visual impact. Concerning sustainable design, street furniture requires ecological conditions to design by picking the suitable materials and arrangements that deal with the climatic variable (light, wind, dampness). Security for the furniture.

5. Social Integration and public participation

Under globalization, urbanization, and industrialization, the humanistic approach to design has gained importance and weight since the 1960s. Certain studies have advocated a set of principles for street furniture design to put people at the center of considerations. Street furniture is designed for people, not simply as part of the urban landscape, and it should interact with the public and help them interact with the environment. Unique street furniture should be designed in different locations to maintain localism/regionalism. In addition, a barrier-free environment should be created through street furniture and other facilities so that everyone can enjoy the urban environment and urban life regardless of their background. To achieve these goals and fully satisfy people's needs, public participation in the design of urban landscapes, including street furniture, is important (Wang & Wang, 2006; Yang, 2005).

The human-centered principle is the primary principle/core idea of urban landscape design and serves as the foundation for other principles. Urban landscapes are created to meet both the

physical and psychological needs of people. A desirable living environment should be able to satisfy various physical activities and also provide psychological attachment and recognition.

Various methods of urban design, especially postmodernism, based on the humanistic approach, place people at the centre of their considerations, e.g. Sitte's visual order (1889/1945), Howard's garden city (1904), Saarinen's organic order (1943), Lynch's environmental image (1960), Jacob's diversity of the city (1961), Kurokawa's symbiosis (1991, 2003/2004), Bacon's simultaneous movement systems (1974), Alexander's pattern language (1977), Rowe and Koetter's collage city (1978), and Norberg-Schulz's spirit of place (1980) (See also Gibberd, 1970; Lang, 2005).

According to Wei and Sung (2005), a human-centered urban landscape should be comfortable-visual/aesthetic and practical, so that people feel comfortable doing various activities; recognisable-sufficient signage, strong spatial structure, appropriate number and arrangement of landmarks, environmentally friendly surroundings, sense and context of culture; be selective a wide range of open places for different human activities; be interactive - people can participate in shaping the environment according to their needs, and be convenient - people can use different activities and reach different places easily.

In order to create an ideal living environment that can satisfy people's various physiological and psychological needs, public participation and opinion are key to the purpose of people-oriented design (Bacon, 1974; Jacob, 1961; Lynch, 1960). Wang (2001) described the development of public participation in urban planning. From ancient times to the present, in many cities, residents who were not designers shaped their living environments and communities according to their needs and values without the help of professionals. Team 10, along with others (Jacob, 1961; Rudofsky, 1964), first proposed public participation. They claimed this showed the wisdom and ability of residents to shape their places. Among other studies, Turner (1963) and Habrakeen (1965), for example, pointed out the importance of public participation, which can contribute significantly to environmental design to meet residents' needs and avoid certain problems.

Public participation refers to the idea that designers do not design for the public but design with the public. Communication is an essential part of the design process. Designers should learn and understand the needs and values of residents and the context and background of the place from the public, while residents should learn and understand the techniques and related

knowledge of designing an environment from the designers. Implementation is about "building a partnership between government, the private sector, and civil society, and opening up the planning process to allow dialogue among all stakeholders" (Ng & Chan, 2005, p. 33).

There are various levels and ways to develop public participation, such as public forums, special public working groups, public visits to the site of development, exhibitions, discussions of design concepts, and public interviews. All aim to improve communication with the public to understand residents' lifestyles, needs, and issues in order to develop the appropriate design. In addition, "dialogue helps create collective knowledge as different stakeholders can bring different types of knowledge (political, social, economic, environmental, and community) and perspectives to urban planning issues" (Ng & Chan, p. 33). Urban landscape design can draw on the sciences; urban designers should consider different perspectives, such as those of social sciences and history, when designing an environment (Wang, 2001).

6. Ecological urban design and sustainable aspects

Since the Industrial Revolution, the destruction of the natural environment became more and more serious due to the rapid development of human society, urbanisation and industrialization. It led to a series of problems such as degeneration of ecological system, various kinds of pollution, storage of natural resources, etc.

A new ethic has emerged in relation to urban design and development. The concept of ecological city and sustainable development has become popular since the 1980s. The idea of ecological city appeared in earlier eras, e.g., in the traditional Chinese living environment that encompasses human and nature (Xiong, 1999; Wei & Sung, 2005), in Howard's radiant city of 1904 (Howard, 1904/2000), in Wright's Broad-acre city of 1932 (Hong, 2002; Wei & Sung, 2005), and in Kurokawa's philosophy of symbiosis of 1960 (Kurokawa, 1991, 2003/2004; Schmal, et al., 2005). Since 1960, Kurokawa has argued for a paradigm shift from the "age of the machine principle" to the "age of the life principle" (Kurokawa, 1991, 2003/2004).

The concept of sustainable development is already an important part of urban development. Sustainable development aims to maintain harmony between the environment, society and the economy. Equity is essential for sustainable development. Resources should be distributed equitably and preserved for the next generation. Public participation can ensure that the needs,

interests, and opinions of different parties are considered to create an equitable and harmonious situation (Dong & Wang, 1999; Ng & Chan, 2005).

For urban landscapes, effective design and layout is important to maximize the reduction of waste and inequality. The ecological environment should be respected, protected, and integrated. Thus, urban development should take into account the natural environment: Geographic and ecological features and resource conservation (e.g., 3Rs - reduce, reuse, and recycle).

7. Summary: Research direction

In this chapter, a review of studies on street furniture was conducted. The review included the general concepts of street furniture, including definition, history and development, functions, classification, and scope, and an overview of street furniture design principles. The review provided basic knowledge of street furniture. It helped to identify the positions, contribution, and significance, as well as the different perspectives of street furniture in the urban landscape and design issues, etc.

By reviewing the principles of street furniture, which have been imperfectly carried out in various studies, it was possible to identify untapped areas:

- ◆ Principles and concerns are scattered throughout the various street furniture studies. There is a need for a comprehensive guide.
- ◆ Many studies have examined street furniture as a supporting function of the urban landscape. There is a need for a detailed contextual approach.
- ◆ Due to the scattering of principles and the lack of detailed explanations of some principles or even some specific studies on street furniture that discussed different principles at a deeper level, the relationship and mutual interaction between different principles were not mentioned. Related principles need to be identified.

PART 2. STUDY CASE PRESENTATION AND RESEARCH METHODOLOGY

SIDI BOUSAID AS A CASE STUDY

1. The site analyzes

At the beginning of the 20th century, Sidi Bou Said became the favorite place of artists and men of culture who were seduced by the village and its atmosphere. Artists, intellectuals, writers, architects, plastic artists, filmmakers, etc., choose it as their home. An eminent personality was strongly linked to the destiny of the village; Baron Rodolphe d'Erlanger, a British banker of German origin, music lover, full of good taste, and painter, came for the first time to the village at the beginning of the century. Seized by the site's beauty, he resolved to reside there. Moreover, it was then that he built his palace, which he named "Nejma Ezzahra," of essentially oriental architecture. As a leading musicologist, he is the author of a treatise on Arabic music. It was at the origin of the beylical decree of August 6, 1915, safeguarding the village, and he pushed to introduce the white and blue of Sidi Bou Said. Due to its location on the seashore and its location on a forest site, the town of Sidi Bou Said is endowed with a specific natural landscape. The diversity of natural landscapes makes the city a place of relaxation and attractiveness.

a. Geographical situation

It is a village in the northern suburb of Tunis, 17 km from the capital. The town of Sidi Bou Said is located at the top of the promontory of "Cape Carthage." It is limited to the north and the east by the sea, to the south by Carthage, and to the west by the town of la Marsa.

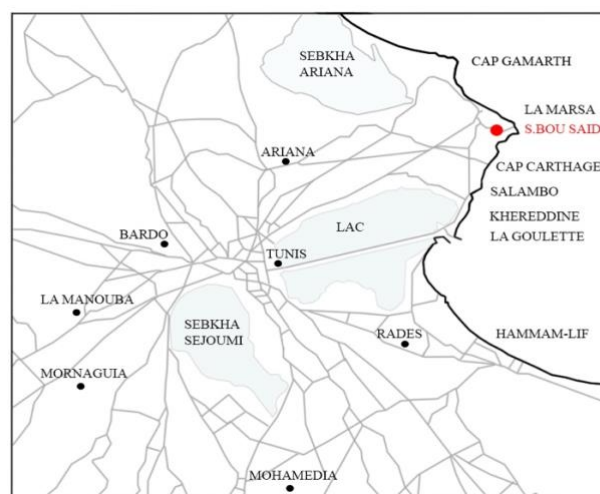


Figure 3. Geographical situation (Author 2023)

b. Mass plan

Sidi Bou Said is divided into two urban entities. The first one obeys the rules of the Arab-Islamic city (medina) organization, where each urban district represents a complex space governed by the family structure. The residences are thus very close to each other and form a compact mass surrounded by orchards and agricultural plots. Moreover, the second entity consists of a rather regular urban grid; the new district consists of the university area and isolated housing.



Figure 4. Mass of the frame in Sidi Bou Said (Author 2023)

c. Density plan

It consists of a university complex and isolated and grouped housing in the east of the city, separated by the TGM line on the multi-functional area or generally where we found commercial functions on the ground floors and housing on the upper floors. On the city's west side, we find the Medina and the tourist area, which is at the top of the hill with specific colors and a warm atmosphere.

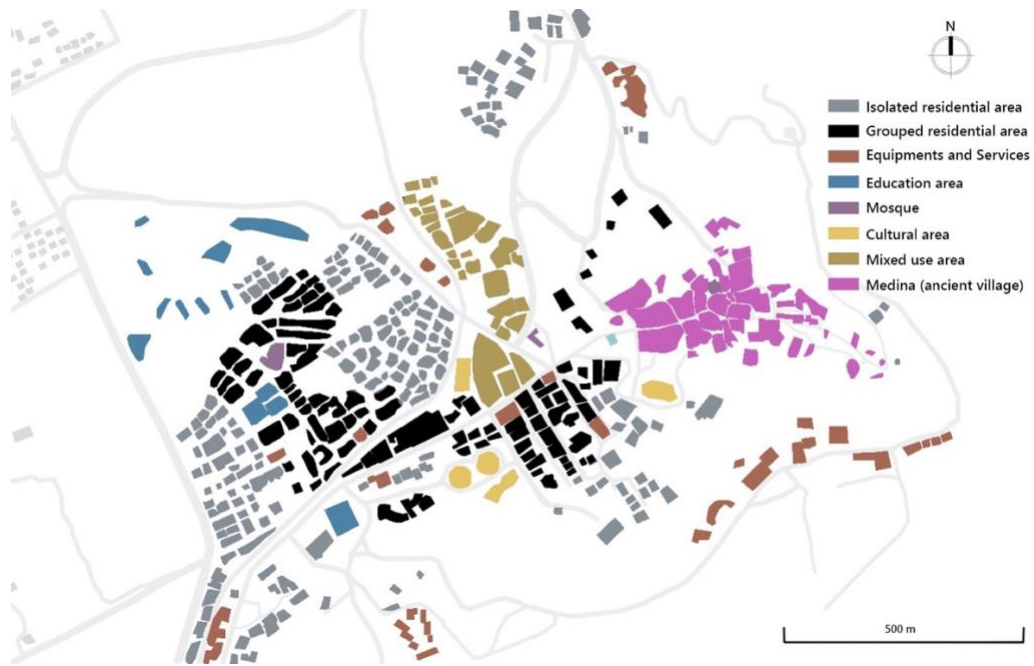


Figure 5. The density of Sidi Bou Said (Author 2023)

d. Accessibility

The area has an organic street pattern from the main roads surrounding the city, which is connected to La Marsa from the north and Carthage from the south. Sidi Bou Said is accessible by the TGM Train from the Capital and the various Buses 20 and 52.

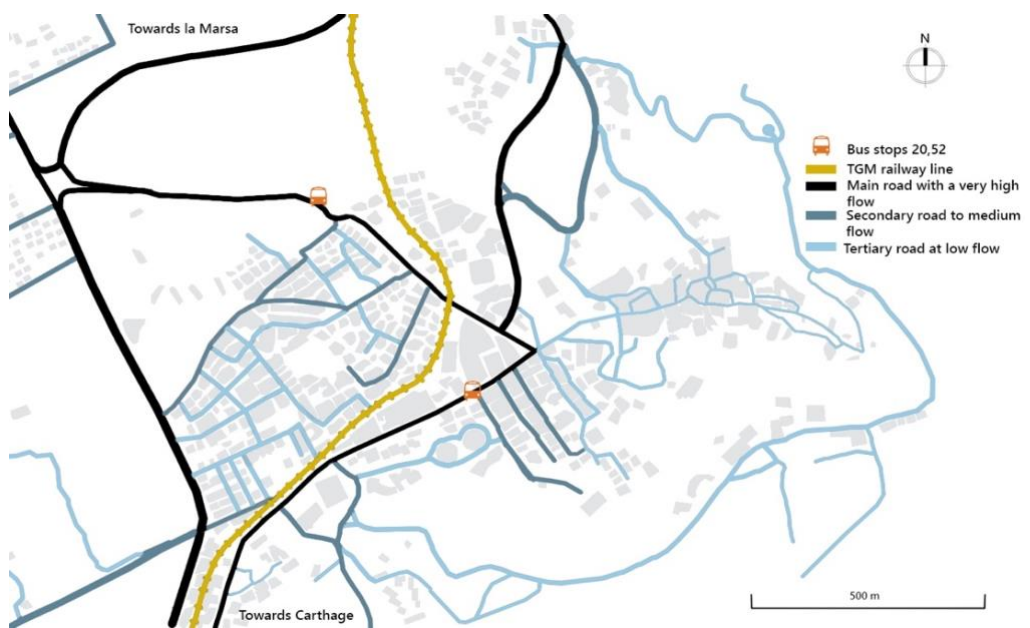


Figure 6. The accessibility to the city (Author 2023)

e. Topography

Sidi Bou Said is implanted on a hill that overhangs the great bay of Tunis at 129 m of altitude.

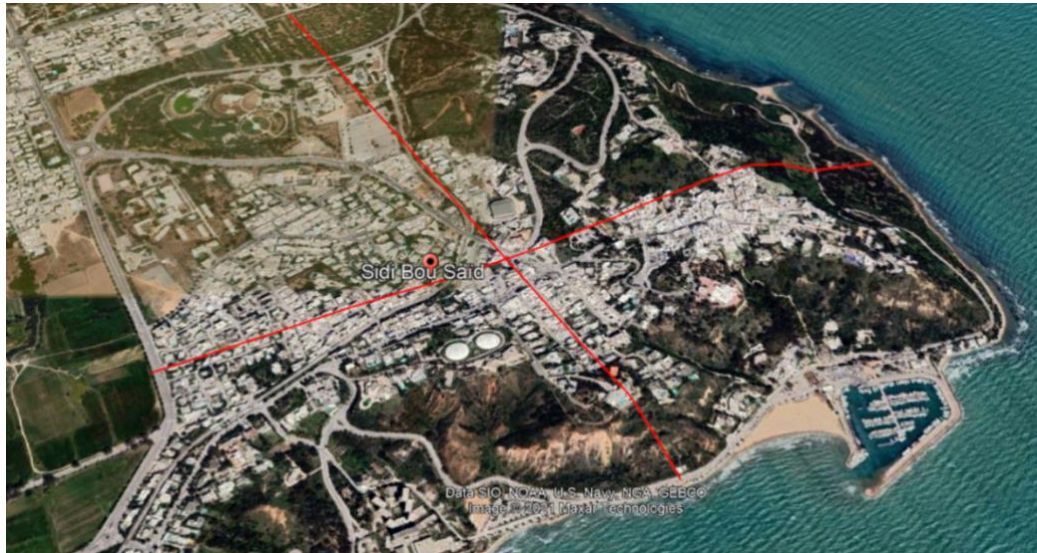


Figure 7. An overview on the topography of the city (Author 2023)

f. Example of habitations

The full/empty ratio increases as one move away from coffee in a coherent way. This ratio varies depending on the situation and the functionality of the space.

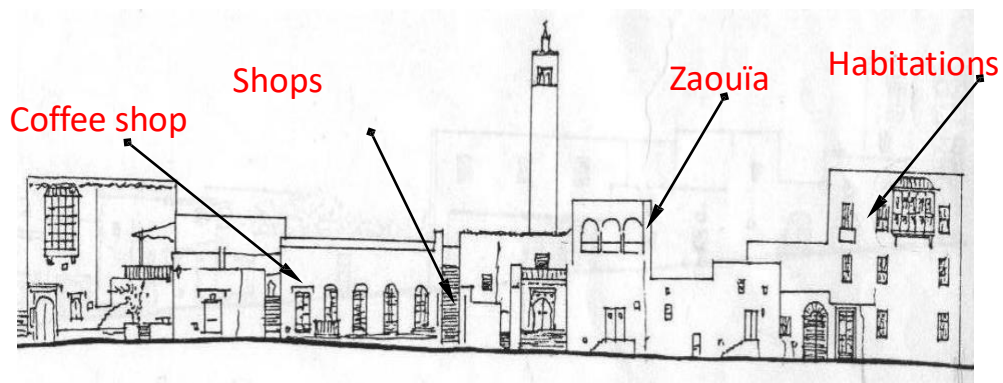


Figure 8. An overview of a landscape (Author 2023)

g. The site climate

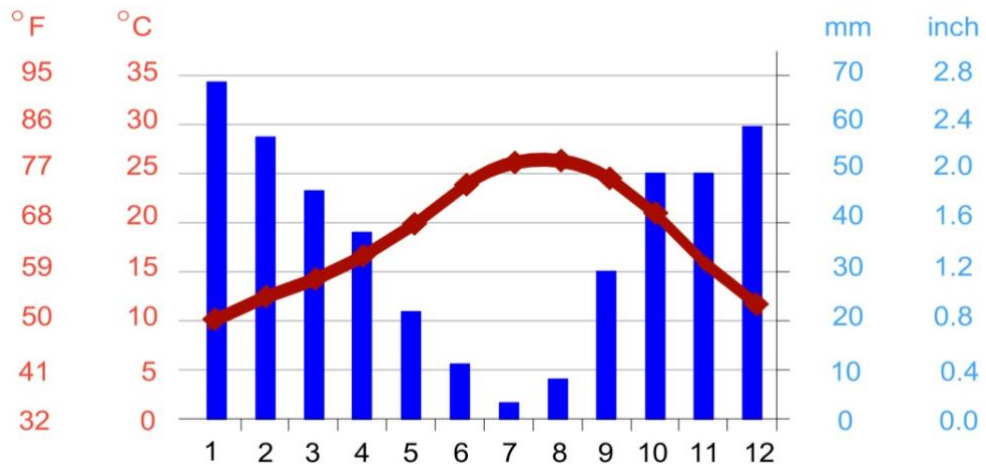


Figure 9. Climate chart of Sidi Bou Said (Author 2023)

Rainfall varies from the driest to the wettest of the months by 65 mm. Between lowest and highest temperature of the year, the difference is 16.0°C.

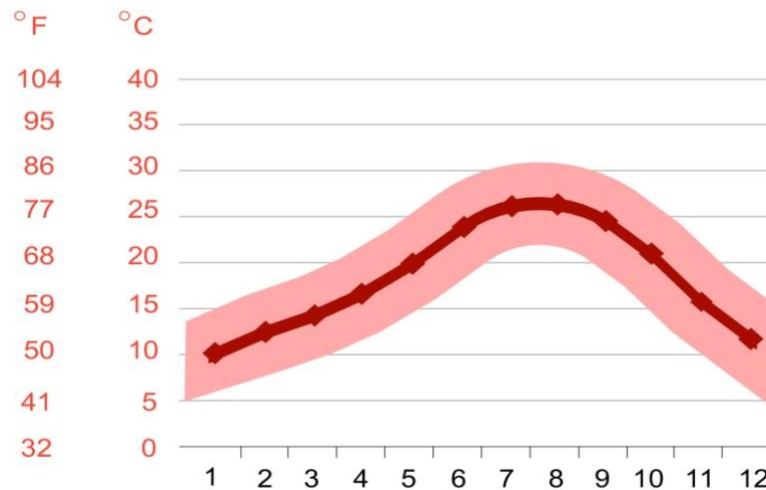


Figure 10. Sidi Bou Said temperature curve (Author 2023)

In August, the average temperature is 26.3°C. August is the warmest month of the year. In January, the average temperature is 10.3°C. January is therefore the coldest month of the year.

h. Historical development

The spatial hierarchy of the medina makes the central location, the mosque. Thus, the centrality of the city is religious: everything is ordered around the religious landmark which is the Zaouia of the saint. (Santelli 1956).



Figure 11. An illustration of the historical development of the city (Author 2023)

i. Urban morphology

Sidi Bousaid, in its global morphology, presents itself as an open-air pedestrian space with a total area of 217 hectares. Facing east, it welcomes the first light of day. It is wide open to the urban landscape on one side and a natural landscape on the other. Sidi Bou Said is a famous tourist attraction in Tunisia, and its positioning next to the Mediterranean Sea gives the city a cool atmosphere. The walls and staircases of the age-old buildings are of marble white, while the doors, window frames, shutters, and moucharabiehs are of blue color. Baron Rodolphe d'Erlanger, who was a French painter and a musicologist, introduced the blue and white theme. We chose to study this outside living space which are frequented by an infinity of users which include a social, cultural, commercial, artistic diversity. It is a small city with a population of around 6,000 (INS, 2014). Sidi Bou Said is an important touristic pole; it is one of the sites the most visited of the mediterranean sea and welcomes up to 100 000 visitors during the weekends of the summer months. It is at Sidi Bou Said that we meet the traditional model. The secondary residences are very close to each other and form a dense solid fabric reminiscent of the medina.

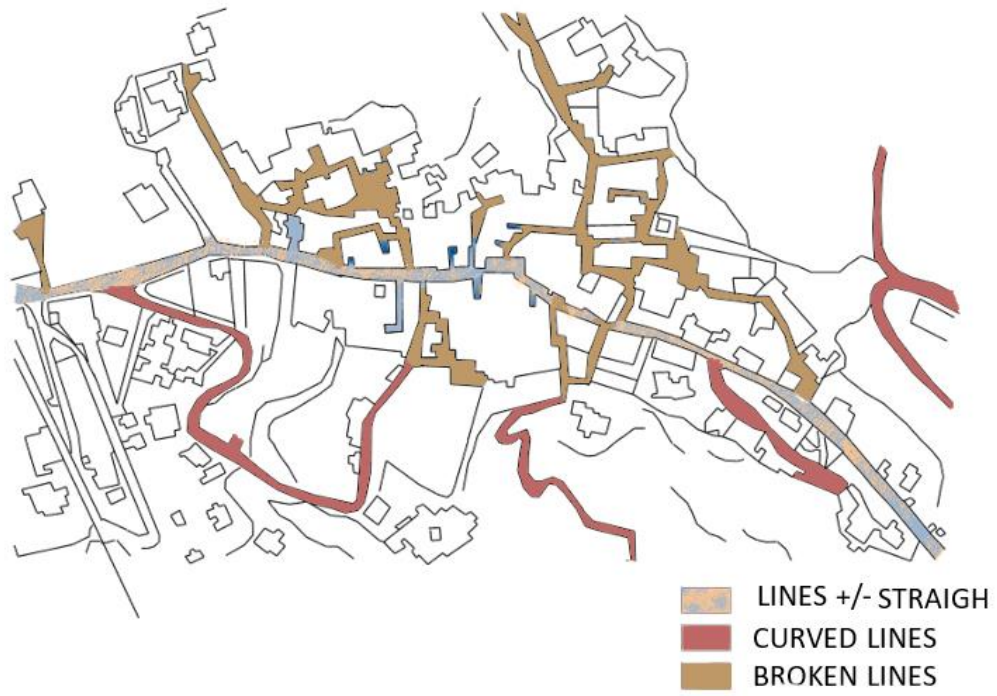


Figure 12. Street morphology of Sidi Bou Said (Author 2023)

j. The space functions

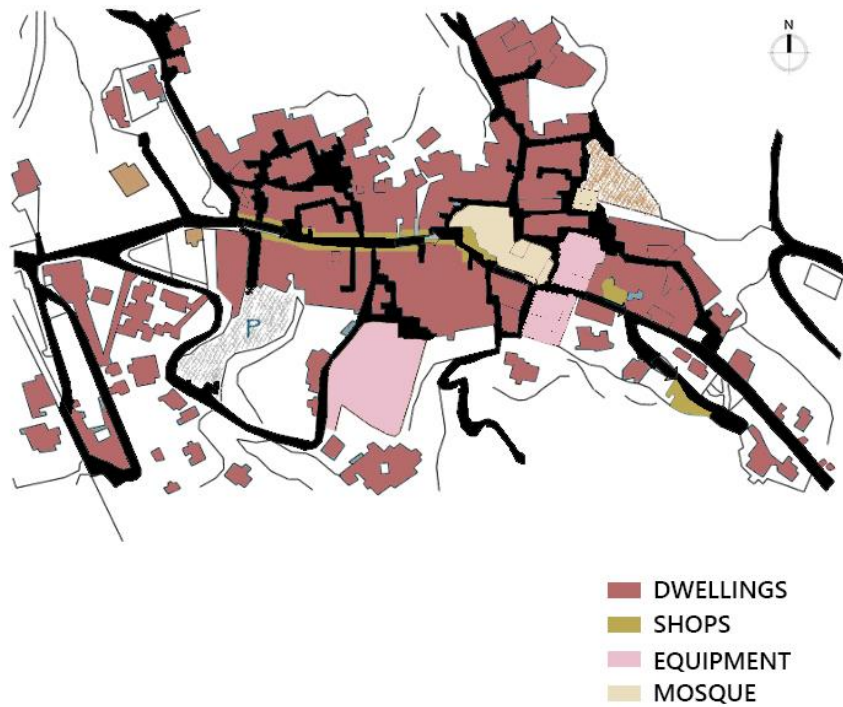


Figure 13. An illustration of the repartition of the space functions (Author 2023)

k. Texture and colors

A harmony between the colors with the predominance of the color blue and green, each color presents the specificity of the object: the trees, the built vehicles, the sky. Each object has a texture that shows the difference between the objects and can be expressed by different types of texture. The whiteness of the walls and the blue of the doors reflect the image of the city of Sidi Bou Said. The landscaped setting of the city of Sidi Bou Said is very rich; it is marked by the presence of the aquatic element and the harbor landscape. Orthogonal alignment ensures visual breakthroughs. The alignment of trees at avenues has ensured opportunities and openings on the sea and harbor.

l. Shadow and light

Our site is specific because of the implantation of vegetation almost on the boulevards to keep the shade in front of the buildings and to have a beautiful aspect of the facades, so in our course, we can see the presence of light by the sun rays and the shade by the trees.

m. Vegetation

In Sidi Bou Said we find two types of vegetation, planted in outer space and inside the houses, whose mass is offered to passers-by contact with the natural environment. The site also has green spaces open to the public. Pedestrians benefit on each sidewalk street on both sides of the road and are generally of sufficient width. A large number of trees on the site gives it an aspect of relaxation and relaxation since they play the role of a natural umbrella.

2. Existing street furniture in Sidi Bou Said

The Mediterranean Garden was selected for further analysis considering some characteristics: tourist, cultural, and social group diversity and geographical situation (at the entrance of the most visited part in Sidi Bou Said). Street furniture was degraded to the point of eliminating several features in the last years, which led to disuse and a lack of activities in public spaces.

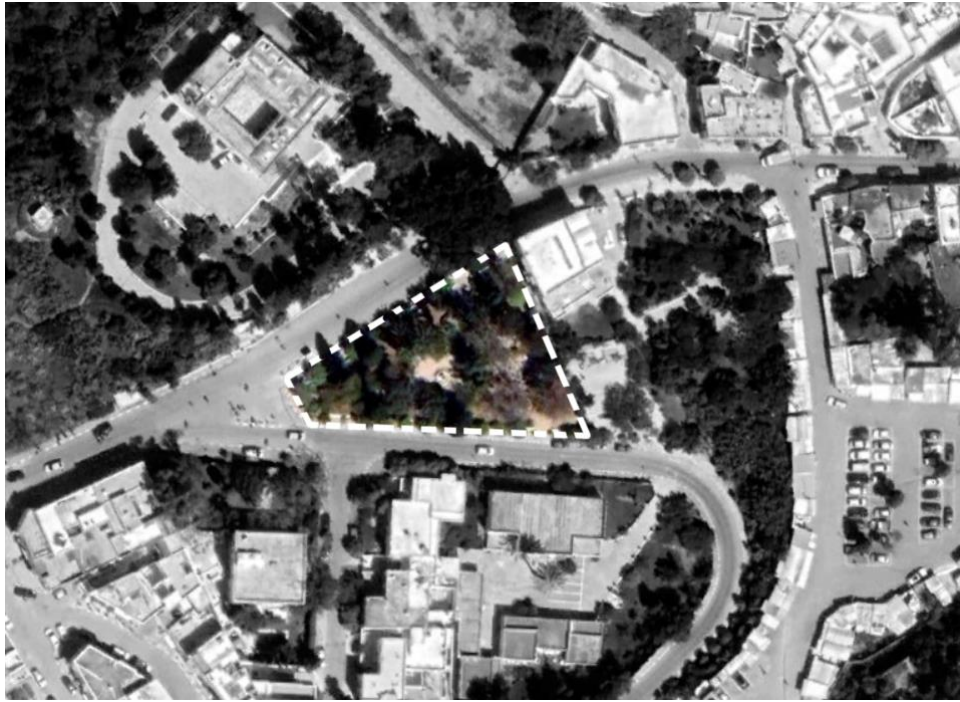


Figure 14. The Mediterranean Garden: Zoom on the plot

Urban street furniture is considered a microelement of city construction and important part of its ecological aspect that cannot be ignored. Creating an outdoor environmental space became primordial for the city's comfort. Based on the literature review, while the public space is famous and frequented by an infinity of users, street furniture should be gradually recognized. The municipal government in Tunisia has been working on overall large-scale urban planning while small-scale planning is not considered, and urban street furniture has been ignored. The disordered situation of street furniture leads to a series of problems related to the lack of ecological design aspects and environmental consciousness. Based on the social orientations and development design innovation, energy conservation, and economic enhancement, eco-design improves the promotion of sustainable city construction and space harmonization with street furniture. This part explores the possibilities of analyzing the actual situation of street furniture, just like mentioned in *Figs15 and 16*, first in its relation with the space and second in its incompatibility with the surrounding environment.



Figure 15. Incompatibility of street furniture with the surroundings in terms of design, appearance and implementation (Author, 2023)



Figure 16. The different sort of furniture is no maintained and do not merge with the surrounding environment (Author, 2023)

INVESTIGATION PRESENTATION OF THE SURVEY CORPUS

Sidi Bou Said was chosen as it receives a high number of visitors during the weekends and summer months; it has a population of 5911 inhabitants. The city hosts international cultural and artistic events, which helps promote the city's image to investors. According to the Sidi

Bou Said municipality, the city has different street furniture, which refers to all fixed or mobile objects or devices installed in public spaces to serve the community.

In this part, the context and methods chosen will be presented to give an overview of the participants and the results found; the questionnaire contained open-ended questions and closed questions with multiple choices (Linkert scale questions, matrix questions, dichotomous questions). Responders were asked to provide only one answer.

The questionnaire was created to obtain informations about: The community (habitants and space frequenters) knowledge on the importance of street furniture design and city development, street furniture integration within the public space, and community participation in drafting street furniture design and urban planification.

The questionnaire aimed to examine and prove the following hypothesis:

- ◆ The community of Sidi Bou Said is not satisfied with the street furniture design.
- ◆ Institutions have failed to provide an adequate approach to enhancing street furniture quality and its integration into the city's daily life.
- ◆ Community is not involved in drafting the street furniture conception and in the city development process.

The questionnaire contains five parts; the first part introduces general data about Sidi Bou Said community, the second part contains data on their knowledge about street furniture design, the third part includes data about how they rate the street furniture integration into Sidi Bou Said city, the fourth part is more about the involvement of the community in the revalorization of the street furniture, and the fifth part is about the importance of promoting the city image. Data analyses are done with SPSS software.

1. Analysis of participant's general data

The questionnaire was not restricted to a particular age group; the survey belonged to participant's age divided into six groups: under 18 years old, from 18 to 24 years old, from 25 to 34 years old, from 35 to 44 years old, from 45 to 54 years old and over 55.

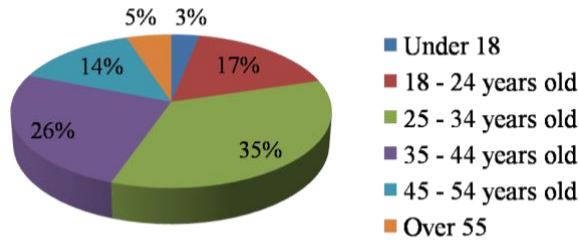


Figure 17. Age of all participants

The educational level of participants is divided as follows: 2.5% of responders have finished the elementary school, 10.8% the secondary school, 50.2% are graduated, 30.5% of them are with postgraduate level (Msc/PhD) and 5.7% graduated from other types of studies. (Figure 18) Participant gender was randomly chosen; it gave an equal representative for both genders (Figure 19).

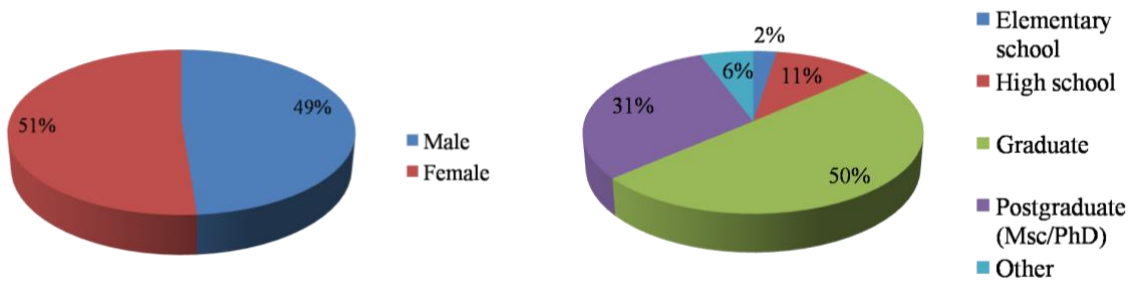


Figure 18. Gender

Figure 19. Educational level

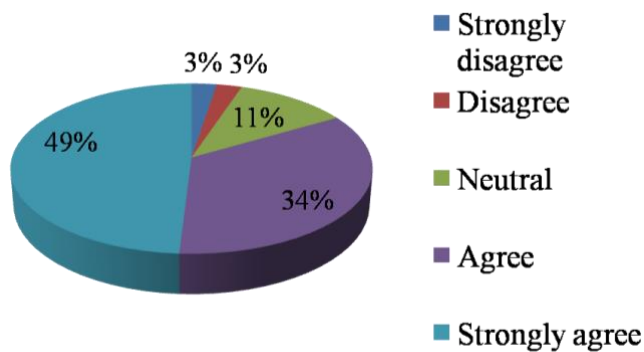


Figure 20. Employment status

Table 1 illustrates the connection between the questionnaire participants and Sidi Bou Said, it is found that 88.5% are related with different ways to the space (live and work there), while 11.5% do not.

Table 1. Do you live, study or work in Sidi Bou Said?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	139	88.5	88.5	88.5
	No	18	11.5	11.5	100.0
	Total	157	100.0	100.0	

Table 2 shows the intensity of regularity in attending the community council of the city; only 26 of 157 were interested to take part of the community council team, while 131 do not. That proves the lack of interest to attend the council.

Table 2. Do you regularly attend your community council?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	26	16.6	16.6	16.6
	No	131	83.4	83.4	100.0
	Total	157	100.0	100.0	

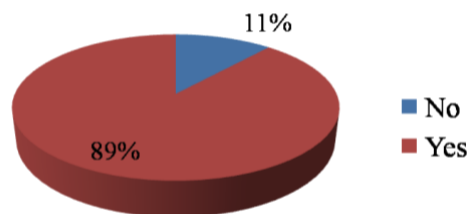


Figure 21. Do you live, study or work in Sidi Bou Said?

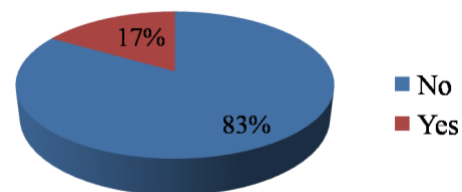


Figure 22. Do you regularly attend your community council?

It is presented in table 3 a cross tabulation between the educational level of the responders and their regularity attending the community council. The results give a clear idea that the level of education of the responders has no relation with the fact of attending and participating in the council activities or not.

Table 3. Educational level * Do you regularly attend your community council?		
Cross-tabulation		
	Do you regularly attend your community council	Total

		Yes	No	
Educational level	Elementary school	0	4	4
	High school	2	15	17
	Graduate	12	67	79
	Postgraduate (Msc/ PhD)	8	40	48
	Other	4	5	9
Total		26	131	157

2. Analysis of street furniture design knowledge data

As concerns the participants interest in recovering street furniture lacks, 88.5% of them showed a great motivation to recover street furniture in Sidi Bou Said, and only 11.5% of them were not interested in the subject. (Table 4)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	139	88.5	88.5	88.5
	No	18	11.5	11.5	100.0
	Total	157	100.0	100.0	

Most of the questionnaire participants are conscious regarding the importance of design in urban street furniture as they represent around 74.6%. This percentage is divided between average, above average and high. As a result, this shows a high awareness of the community about the importance of design in urban street furniture. (Table 5)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	24	15.3	15.3	15.3
	Below average	16	10.2	10.2	25.5
	Average	37	23.6	23.6	49.0
	Above average	70	44.6	44.6	93.6
	High	10	6.4	6.4	100.0
	Total	157	100.0	100.0	

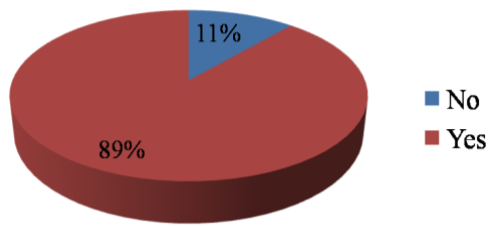


Figure 23. Do you have a general interest in recovering street furniture lacks?

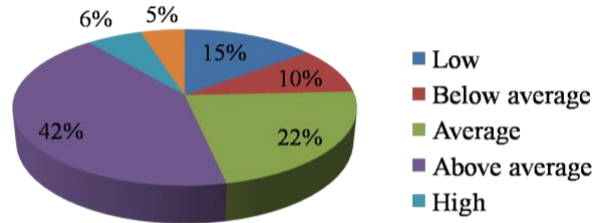


Figure 24. How much do you know about the importance of design in urban street furniture?

A cross-tabulation was necessary in this stage of research between the educational levels and how much is it important to design in urban street furniture. As results, the table shows a variety of answers, 117 of them from different levels are aware about the subject while 40 are not. This confirms that the level of education is not important to be aware of the importance of designing street furniture.

		How much do you know about the importance of design in urban street furniture?					Total
		Low	Below average	Average	Above average	High	
Educational level	Elementary school	1	0	2	1	0	4
	High school	1	2	5	8	1	17
	Graduate	17	10	14	34	4	79
	Postgraduate (Msc/ PhD)	5	3	13	23	4	48
	Other	0	1	3	4	1	9
Total		24	16	37	70	10	157

Answering the question about how well-designed street furniture can improve the sustainable development of the city, the answers were as follow; around 32% highly confirmed that it extremely helps to improve the sustainable development of the city, 48% consider it as above average, 16% Average, 2% Below average and 2% think that designing street furniture do not (Figure 25).

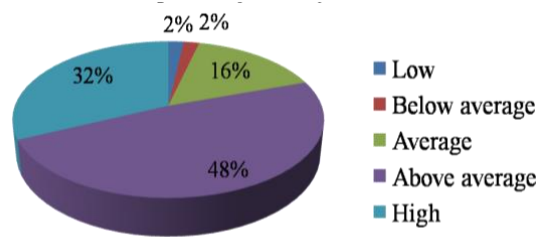


Figure 25. How much do you think having well designed street furniture can improve the sustainable development of the city?

Regarding how the participants think about the institutions management in providing an adequate approach to enhance the live quality and the city development, about 72% of the participants rated it with low and below average (Figure 26). As far as their satisfaction is highly concerned, about 70% are dissatisfied with the street furniture design in Sid Bou Said (Figure 27).

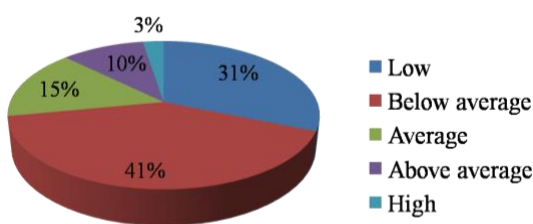


Figure 26. How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development?

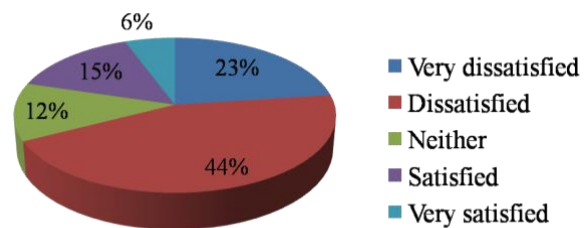


Figure 27. How satisfied are you with the street furniture design in Sidi Bou Said

To answer the question “what is the main reason for the degradation of the street furniture in Sidi Bou Said?” The analyse has been divided into three cross-tabulations in order to know the participants opinions about the responsibility regarding the degradation of the street furniture in Sidi Bou Said. According to some interviews made, the main responsible reasons cited are: Social practices with 55%, lack of awareness with 68% and inadequate approach of institutions with 70%. Table 7a shows that 51 of them disagree that the social practices are the responsible of this degradation, while 20 gave a neutral opinion and 86 agreed. The results shows a diversity in the answers which means that regardless the educational level, the participant answers are various and different.

Table 7a. Educational level * Social practices / the degradation of the street furniture in Sidi Bou Said? Cross-tabulation							
		Social practices responsibility regarding the degradation of the street furniture in Sidi Bou Said					
		Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total
Educational level	Elementary school	2	1	0	1	0	4
	High school	2	5	1	4	5	17
	Graduate	10	18	11	23	17	79
	Postgraduate (Msc/ PhD)	1	6	8	18	15	48
	Other	1	5	0	3	0	9
Total		16	35	20	49	37	157

Table 7b shows a cross-tabulation between the participant's lack of awareness responsibility of the degradation of the street furniture in Sidi Bou Said and their level of education. 30 of them disagree that lack of awareness be could responsible of this degradation, while 20 gave a neutral opinion and 107 agreed.

Table 7b. Educational level * Lack of awareness / the degradation of the street furniture in Sidi Bou Said? Cross-tabulation							
		Lack of awareness responsibility regarding the degradation of the street furniture in Sidi Bou Said					
		Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total
Educational level	Elementary school	2	1	0	1	0	4
	High school	1	3	4	4	5	17
	Graduate	8	7	14	25	25	79
	Postgraduate (Msc/ PhD)	1	1	2	13	31	48
	Other	1	5	0	1	2	9
Total		13	17	20	44	63	157

Regarding the inadequate approach of institutions, 27 of the participants disagreed on the fact that Inadequate approach of institutions could be the reason of the degradation of the street furniture in Sid Bou Said, while 20 of them have chosen to be neutral and 110 of the participants consider that institutions did not well manage to put an adequate approach to enhance the street furniture quality design.

Table 7c. Educational level * Inadequate approach of institutions / the degradation of the street furniture in Sidi Bou Said? Cross-tabulation							
		Inadequate approach of institutions responsibility regarding the degradation of the street furniture in Sidi Bou Said					
		Strongly Disagree	Disagree	Neither	Agree	Strongly Agree	Total
Educational level	Elementary school	2	1	0	1	0	4
	High school	2	2	3	4	6	17
	Graduate	6	10	13	20	30	79
	Postgraduate (Msc/ PhD)	0	0	2	12	34	48
	Other	0	4	2	1	2	9
Total		10	17	20	38	72	157

3. Analysis of street furniture integration data

In this part of research, the participants were asked to rate the street furniture integration and adaptation into its environment, if they are satisfied with the street furniture comfort, accessibility and design, and what they think about the harmony between the different types of street furniture of Sidi Bou Said. Based on the results, and for all questions, most participants show dissatisfaction with these claims and rate it with bad with around 65% while only 20% affirm that they are satisfied with street furniture in Sidi Bou Said.

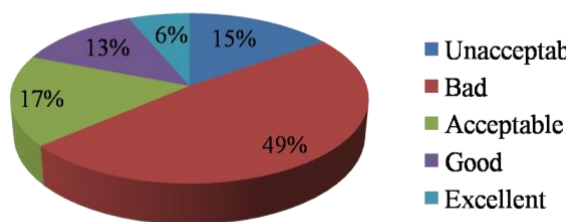


Figure 28. How do you rate the integration of street furniture into Sidi Bou Said's daily life ?

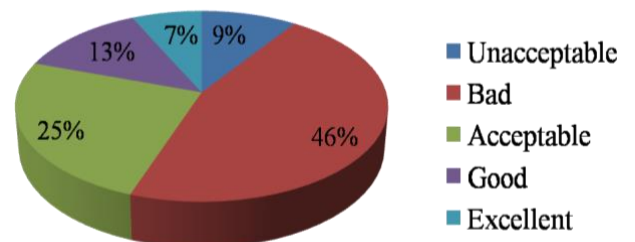


Figure 30. How do you rate the adaptation within the urban landscape?

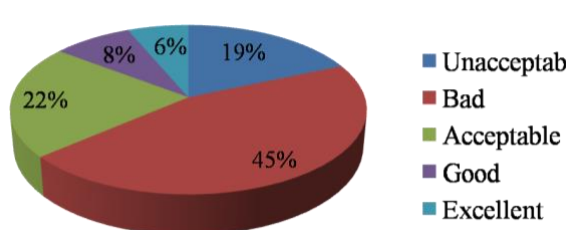


Figure 29. How do you rate the street furniture comfort?

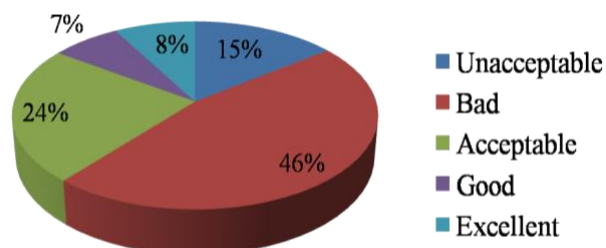


Figure 31. How do you rate the street furniture accessibility?

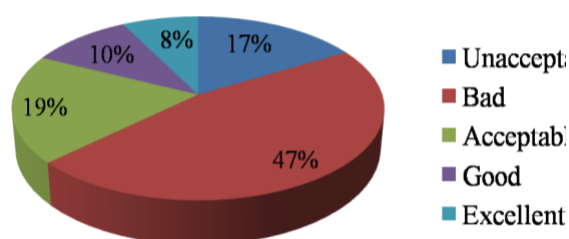


Figure 32. How do you rate the street furniture design?

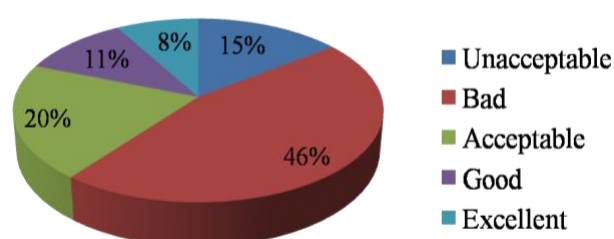


Figure 33. How do you rate the harmony between the different types of street furniture?

4. Analysis of the community participation in designing street furniture data

In this part of research, data about the involvement of community in designing street furniture were collected, 88% of participants have never been involved in drafting street furniture conception (Figure 34). 95% of participants have never participated in public presentations and discussions regarding street furniture implementation which are organized by institutions (Figure 35). When they were asked why, the answers were as following, “Never heard of any; I didn’t know such events existed; Never had the thought to think about drafting such a thing (which seems interesting)”.

Table 8. Have you ever been involved in drafting street furniture conception?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	12.1	12.1	12.1
	No	138	87.9	87.9	100.0
	Total	157	100.0	100.0	

Table 9. Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	5.1	5.1	5.1

	No	149	94.9	94.9	100.0
	Total	157	100.0	100.0	

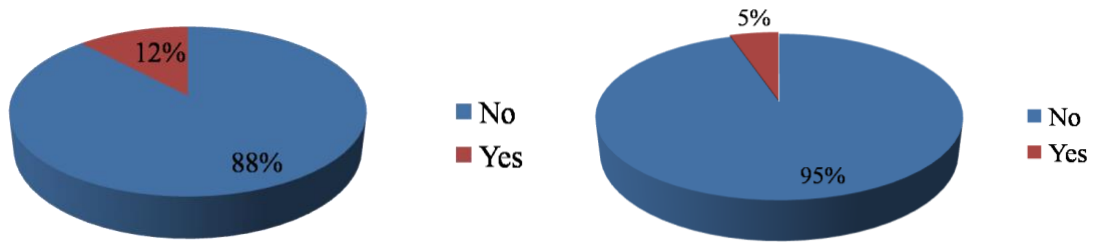


Figure 34. Have you ever been involved in drafting street furniture conception?

Figure 35. Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions?

Concerning the participants knowledge about the existence of a community council where they can discuss the revalorization of street furniture in Sidi Bou Said, around 70% of participants don't even know about its existence, while 20% answered with no and 10% with yes.

Table 10. Is there a community council where you can discuss the revalorization of street furniture concerning your city?					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	17	10.8	10.8	10.8
	No	31	19.7	19.7	30.6
	I don't know	109	69.4	69.4	100.0
	Total	157	100.0	100.0	

5. Analysis of the city development concepts data

This part is conceived to understand the participant's points of view about the impact of the revalorization of street furniture on the development of the city. They agree with a percentage of around 85% that revalorizing street furniture is important in promoting the city image (Figure 36) and about 82% think that street furniture design plays a significant role in the culture of the city (Figure 37). Most participants, about 83% agree that street furniture is an important element of the character and the identity of a certain area (Figure, 38), and about 81% think that it is important to take into consideration the small-scale planning (street furniture implementation) (Figure 39). About 87% of participants agree that urban landscape plays an important key to attract more tourists (Figure 40) and about 89% think that tourism development will definitely help in the economic growth (Figure 41).

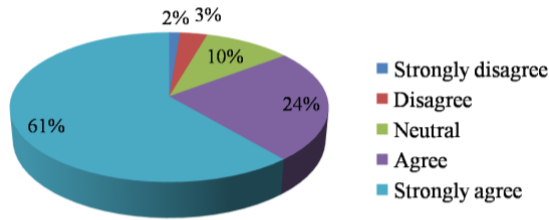


Figure 36. Revalorizing street furniture is important in promoting the city image

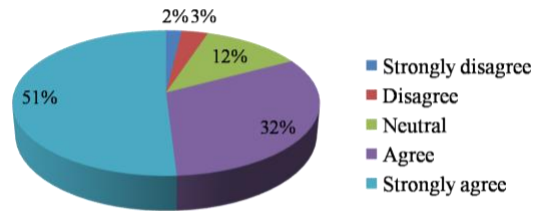


Figure 37. Street furniture design plays a significant role in the culture of the city

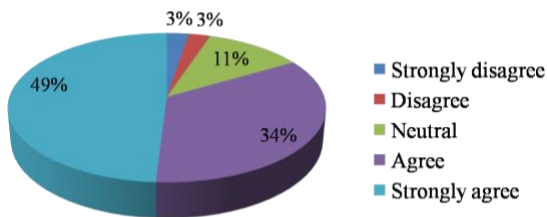


Figure 38. Street furniture is an important element of the character and the identity of a certain area

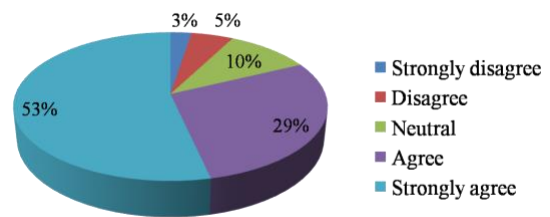


Figure 39. It is important to take into consideration the small-scale planning (street furniture implementation)

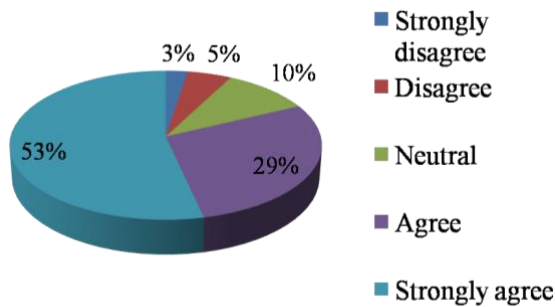


Figure 40. Urban landscape should attract more tourists

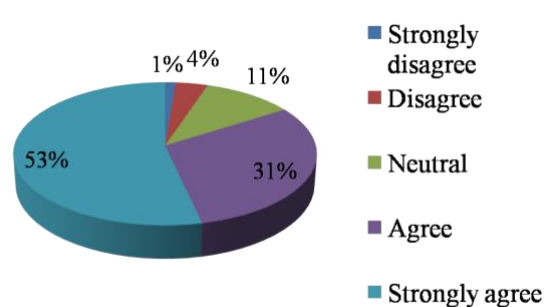


Figure 41. Tourism development will help in the economic growth

As far as institutions have an important role in the city development, about 85% of participants think that it is essential to have a better integration of street furniture into the city's daily life (Figure 42) and institutions investment should play a key role in the revalorization of street furniture ecological design aspects in Sidi Bou Said (Figure 43). They also think that Institutions should involve the community when drafting street furniture design and its implementation with a percentage of 83% (Figure 44). In order the protect the street furniture

from any form of aggression and damage, about 86% of them agree to come up with new information regarding how the community can take care of street furniture (Figure 45).

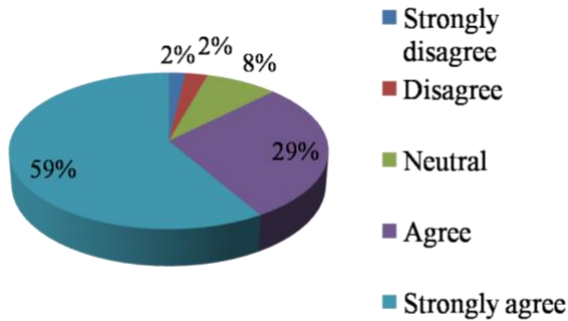


Figure 42. *It is essential to have a better integration of street furniture into the city's daily life*

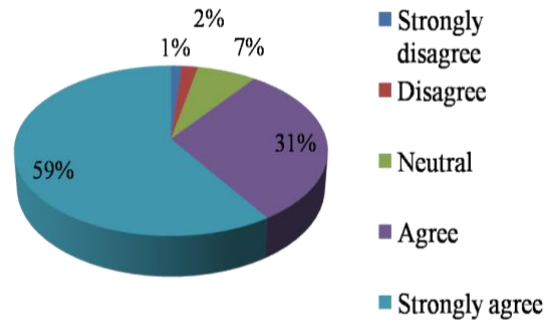


Figure 43. *Institutions investment should play a key role in the revalorization of street furniture ecological design aspects*

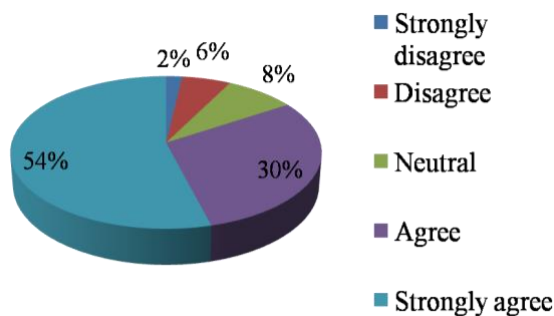


Figure 44. *Institutions should involve the community when drafting street furniture design and its implementation*

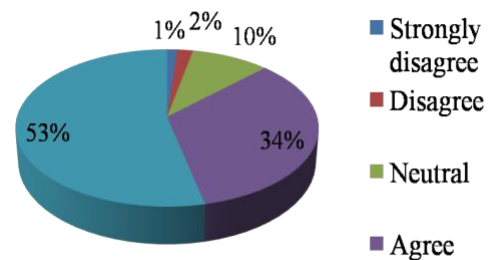


Figure 45. *It is important to come up with new information regarding how the community can take care of street furniture*

MAIN FINDINGS FROM THE OBSERVATION AND INTERVIEWS

Different international studies published and documented by local and international authors, were reclaiming about how much it is important to satisfy the different needs of users in urban spaces. Beside its functional importance, street furniture was represented as an essential element to hence the quality urban environment and urban life in general. To achieve this, a comprehensive study of street furniture was required.

1. Main findings from observation

Within the Mediterranean garden, there is not enough street furniture to create social comfort in the space and create a relation to the identity and culture of the unique city of Sidi Bou Said, just like mentioned in Figure 46, which could be used by the community and promote the city image for the tourists.

Benches, as the most important element that links people to each other, do not exist in the Mediterranean garden; their presence is related to issues of public space for sociability and accessibility. This research will focus more on designing benches by giving the choice to stay longer, with links to wellbeing and inclusion, supporting resilience and human connections at the local level and the importance of good landscape design for supporting this. In the vast majority of outdoor public places, comfortable benches, longer benches, and simply more of them are highly recommended.



Figures 46. Lack of street furniture in terms of design and social comfort (Author, 2023)

2. Main findings from interviews

According to several analysis from the questionnaire above, interviews (Formal and informal ones) with the community of Sidi Bou Said were a better way to understand the society and municipality management. According to informal interviews, features were identified by the landowners and the community explaining how it is important to work on street furniture degradation. Street furniture condition was rated as below average in most case to not say all. An interviewee affirmed “street furniture in Sidi Bou Said is considered as one of the most popular ones in whole Tunisia as it is touristic by excellence, but the degradation of its quality is going down year after year and the quality degradation of benches is incredible” (Interviewee1, 2021). Another interviewee reclaimed that “there are missing aspects of maintenance of the existing street furniture and no relevant intervention to enhance it”. (Interviewee2, 2021).

The degradation of street furniture is quite large and diverse, including all aspects of design criteria, social integration, and sustainable and ecological directions. The restoration and conservation aspects are not even implemented by the representatives of the institutions mainly and the community as well. Benches quality and design was the most element that annoyed the interviewees.

Institutions have failed to develop any sustainable or ecological criteria in Sidi Bou Said, this is the result of not implementing any new strategies and development policies that would integrate street furniture into the actual daily life of the city that it would be beneficial for the city and by consequence to the community.

The involvement of the community of Sidi Bou Said needs has never been taken into consideration, there was no planification in the past years and not for the future. “Only placement, replacement and repairs of missing, destroyed, or damaged street furniture (not in all cases)”. (Interviewee 3, 2021).

The exclusion of experts as urban designers has a huge effect on the conception development that meet the needs of citizens and the world change as well. Street furniture has never been a priority in the development strategies of the state and municipality. “The lack of understanding the importance of integrating sustainable and ecological approaches into street furniture is incredible”. (Interviewee 4, 2021).

**PART 3. SOCIAL INTEGRATION AND STREET URBAN
FURNITURE DESIGN**

INTRODUCTION

“To be able to sit down is the expression of a friendly city” This quote by Jean-Paul Alain, sociologist – urban planner, questions the easy-to-live city daily and the development of public spaces as spaces of life and sharing. Appeared with the city, the public bench, with other furniture, is part of the landscape of our streets and squares; the bench is invested with a special symbolic charge, affecting both the urbanity, the social relations, and the image of the city. The public bench maintains a privileged relationship with the city—an object of paradox, furniture questions the citizen and the elected.

In the twentieth century, the annexation of public space by the automobile gradually made public spaces lose their coherence, simplicity, and harmony. The reconquest of the public space was started in the 90s by the major metropolises following Barcelona, Lyon, Paris, Strasbourg, and Nantes. They want to witness a certain sweetness of life. The evolution of lifestyles combined with expectations in terms of living environment poses the role of the bench in the composition and conviviality of public spaces acutely. The bench has multiple uses and responds to social and identity dimensions, open to many issues that affect the quality of life daily. The changing needs and expectations that development must meet requirements that, in a rare and coveted urban space, the conditions for the choice and implementation of the public bench be laid down in a global and multidisciplinary approach to development. Thus the bench is a constituent of the public space and an object in itself. It is of all these problems that the guide proposes to address.

INVESTIGATION AND STATEMENT ANALYSIS OF THE SURVEY CORPUS

In order to validate the following statements:

Statement n°1: The community of Sidi Bou Said is not satisfied with the street furniture design.

Statement n°2: Institutions have failed to provide an adequate approach to enhance the street furniture quality and its integration into the city.

Matrix questions were necessary to analyze data in which the participants were asked about their opinion about how institutions have managed to provide an adequate approach to enhance

the live quality and the city development and how satisfied are they with the street furniture design in Sidi Bou Said.

Table 11. Case summary			
		How satisfied are you with the street furniture design in Sidi Bou Said	How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development
N	Valid	157	157
	Missing	0	0

Table 12. Descriptive statistics	
How satisfied are you with the street furniture design in Sidi Bou Said?	
Mean	2.3567
Std. Deviation	1.15477
How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development?	
Mean	2.1210
Std. Deviation	1.04606

The participants were asked, in table 13, about their satisfaction with the street furniture design in Sidi Bou Said. 22.9% are very dissatisfied, 44.6% are dissatisfied, 12.1% choose to neutral, 14.7% are satisfied and 5.7% are very satisfied. Table 14 shows the participants opinions about the institutions management in order to enhance the life quality and the city development. 72% of participants rated it with low and below average, 24% with average and 12.7% with above average and high.

Table 13. How satisfied are you with the street furniture design in Sidi Bou Said? - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Very dissatisfied	36	22.9	22.9	22.9
	Dissatisfied	70	44.6	44.6	67.5
	Neither	19	12.1	12.1	79.6
	Satisfied	23	14.6	14.6	94.3
	Very satisfied	9	5.7	5.7	100.0
	Total	157	100.0	100.0	

Table 14. How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development? - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	49	31.2	31.2	31.2

Below average	64	40.8	40.8	72.0
Average	24	15.3	15.3	87.3
Above average	16	10.2	10.2	97.5
High	4	2.5	2.5	100.0
Total	157	100.0	100.0	

Table 15 present a correlation between “How satisfied are you with the street furniture design in Sidi Bou Said” and “How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development” that is positive of .654** and with a significance level .000. It means that there is a statically significant linkage between the two variables. Based on this correlation, it can be confirmed that institutions have failed to provide an adequate approach to enhance the live quality and the city development and the community is not satisfied with the street furniture design.

Table 15. Variable Correlations			
		How satisfied are you with the street furniture design in Sidi Bou Said	How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development
How satisfied are you with the street furniture design in Sidi Bou Said	Pearson Correlation	1	.654**
	Sig. (2-tailed)		.000
	N	157	157
How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development	Pearson Correlation	.654**	1
	Sig. (2-tailed)	.000	
	N	157	157
**. Correlation is significant at the 0.01 level (2-tailed).			

METHODOLOGY AND RESEARCH DESIGN: CONCEPTS, THEORIES AND INTERPRETATIONS

1. Location

a. Importance of location

The bench is an element of the urban landscape: it must be integrated into the site. The choice of location thus becomes essential. There are many reasons to install a bench, so users can choose to install it:

- Where it is beneficial (along the pedestrian path)
- Where it invites users to stop (feeling of well-being)
- Where users want to go according to the place's attraction (landscape, shops, facilities)
- Where users want to go according to the atmosphere (lively place, pleasant and peaceful place)

b. Location: sensory dimension/ views/ relationship to car traffic

It is essential to consider the sensory dimension in the choice of locations. We will thus seek the following:

- The unobstructed view and intimacy: it is also necessary to favor the location in front of a pleasant and unobstructed view in places where one lingers (the riverbank; remarkable urban or natural landscape)
- Proximity to water: river, fountain for water noise, freshness
- The proximity of plants for intimacy, shade, perfume, cutting oneself off from a noisy environment.

The location allows living the animation to capture the atmosphere of the place. A facility near the children's games allows watching them play and monitoring them. Some locations are much less favorable, and the benches will not be used or little: avoid placing them in front of a parking lot or along major roads of high traffic. In addition, it will be necessary to favor an orientation allowing a perspective offered to the sight. Consider installing benches regularly to facilitate travel, considering the topography: "Some seniors do not go out because there are no benches on their journeys."

c. Conditions: sun or shade, under trees, night light

Particular conditions are inherent in the chosen location. It is possible to install benches facing the sun or, on the contrary, to the shade. Planning street furniture under trees presents several constraints: risk of soiling birds, sap, or fruit flow that could lead to less developed bench use. Therefore, it will be necessary to propose both conditions to users and provide for regular maintenance to maintain a good level of cleanliness.

Regarding the relationship between public benches and lighting, the uses can vary depending on whether the benches are unlit (to be hidden) or, on the contrary, lit (security). Again, it will be necessary to adapt the lighting conditions to the desired uses within the environment, taking into account the impacts on the neighborhood. It is also necessary to distinguish between evening and night lighting and ensure the user is not dazzled by the lighting.

d. Urban/natural environment

Benches do not respond to the same logic depending on whether one is in an urban or natural space. Benches will be installed in squares in urban spaces, wide streets, and boulevards near schools and public places. In natural spaces, they will be implanted on walks, riverbanks, or natural areas.

2. Implementation

The target implementation criteria are:

a. Structuring of space (composition, the orientation of flows, soil wedging, axiality with other elements)

The bench, like other urban furniture and vegetation, the bench will delimit spaces to organize circulations. The path drawn must be natural, fluid, unobstructed, and easily readable, even for the visually paired or visually impaired. The location must take into account traffic flows.

b. Sensory criteria (orientation, views, noise, wind, flow)

The location facing a view

- If the trail or sidewalk is heavily used, encourage pedestrians to pass behind the bench

- On a bicycle circuit, provide bike racks outside the pedestrian path for cyclists who wish to pose on the benches.

c. Promoting conviviality and encounter (vis-à-vis, proximity, intimacy)

Maintain a comfortable pedestrian path and reserve side spaces for strollers and armchairs.

Perimeter clearance to ensure accessibility for all orientations according to view, according to noise (limit traffic noise).

Sheltered from wind and rain for waiting for places (passenger shelter)

Distributed in a user-friendly way to allow exchanges.

Reasonable distance between benches on regular pedestrian routes, depending on route type and slope.

Provide baskets nearby (but at a sufficient distance to avoid inconvenience). Ensure accessibility for everyone: ergonomics and soil treatment (stable and not slippery).

3. Ergonomics/ Comfort

Comfort is an important parameter defined by the possibility of a durable seat. The use of the bench requires appropriation by the user. The ergonomics of the bench refers to the adaptation to the more efficient use that integrates not only the concept of comfort (seat, material) but also other dimensions, in particular, the intuitive perception of the use that contributes to the definition of the bench.

The bench must be comfortable; it must not attack the body. The individual must feel well during the sitting moment and be usable by all.

Comfort according to the template:

- Seat depth and height (often too deep and too high)
- Armrests (supports to get up more quickly)
- Cradle tilt
- Material (contact), the width of slats sufficient to ensure comfort

- Clearance under the bench to place the feet into the bench, respecting the detectability volume with the blind cane.

4. Materials/ Sustainability

In terms of bench design, attention should be paid to the quality of the materials suitable for outdoor use and for use as a seat, as well as the cross-section of the parts, which must be in a standard that is easy to produce or obtain for repairability. The quality of the assemblies is important; they must be able to be ventilated and not cause water retention that accelerates wood decay. The spacing between slats must be sufficient to avoid stuck waste.

- Concrete or cast iron or steel + wood: many designs, wide and a plethora of quality and very uneven ergonomics.

- Concrete: high resistance that does not prevent degradation over time (concrete is more porous than natural stone), generally offers surfaces conducive to tags. Cumbersome to implementation and displacement.

- Natural stone: suitable for specific places, rather uncomfortable in cold and heavy periods

- Metallic: generally, steel allows a design with light shapes or transparency is a factor of integration by making the perception of the furniture discreet. The contact surface, usually in the mesh, is very openwork, limiting thermal discomfort's effects and preventing water from stagnating.

Materials with a high conductivity that restore the cold in winter and heat in the sun are uncomfortable and to be avoided.

The benches are used and graded by skateboarders. Vigilance over the length of the benches, the design can limit the diversion of use, and built-in anti-skate devices exist to avoid this degradation. The «removable» benches allow you to change only the defective part and not the whole bench each time.

5. Harmonization of street furniture

The implementation of furniture ranges has many advantages in maintenance and management: impact on costs due to economies of scale, possibility to store parts allowing replacement. It would also allow better reactivity regarding maintenance.

On a metropolitan scale, it seems essential to put coherent ranges of furniture adapted to different environments and uses for harmonization of furniture. It would facilitate maintenance while allowing project managers sufficient flexibility to propose a coherent and sensitive response.

It seems important at first to differentiate ranges for urban and natural environments. Different ranges are to be set up according to the categories of uses of the benches: furniture related to mobility for specific uses and adjustment furniture for prolonged uses.

Specific ranges can be implemented on large projects with specific creations. Like the cleanliness baskets or bike supports, It would be desirable to undertake a process of optimization so that the community can have types of furniture for the whole of the metropolitan territory that would respond quickly to the solicitation.

6. Accessibility

As a part of the environment, street furniture should be consistent in its style and appearance, spatial structure, and meaning and merge with the surrounding environment, which includes architecture, open spaces, and grounds. Ideally, all the elements of a place or street are planned and designed simultaneously, and unfortunately, street furniture is often distributed following the establishment of other elements. Exhaustive investigation and research into the background of a place (including its history, culture, design style, and the lifestyle and behavior of its residents) are required in designing street furniture that complements its surroundings.

Criteria for street furniture arrangement on public and private roads

The pedestrian path must be: As short and direct as possible

- Wide enough to accommodate wheelchairs for persons with disabilities
- Clear of any obstacles (billboards, poles, bollards, benches, Etc.)
- On a flat, non-removable floor with a regular surface
- With urban proximity and delimitation furniture (pole, bollard, Etc.) that can be identified

visually and detectable by the canes of visually impaired persons

- With a noticeable color, contrasting with the surrounding area (pavement, parking)

a. Qualities of floor coverings and pathways

The surface of the paths must be identifiable by floor revetment colors contrasting with the surroundings (pavement, parking). The floors and floor revetment of the pathways must be flat, stable, not movable, slippery, and not present obstacles or hazards to wheels, rods, or pedestrians.

The floor covering must not show any surface rise or accident (hollow or rough) at a height, depth, or width exceeding 2 cm.

The riser should not exceed 2 cm in height with a 4 cm rounded edge or chamfered edge. The riser is a protruding part on a uniform horizontal or sloping ground. It constitutes an obstacle for a person in a wheelchair or a danger for someone with a visual impairment, an elderly person, or someone who is distracted.

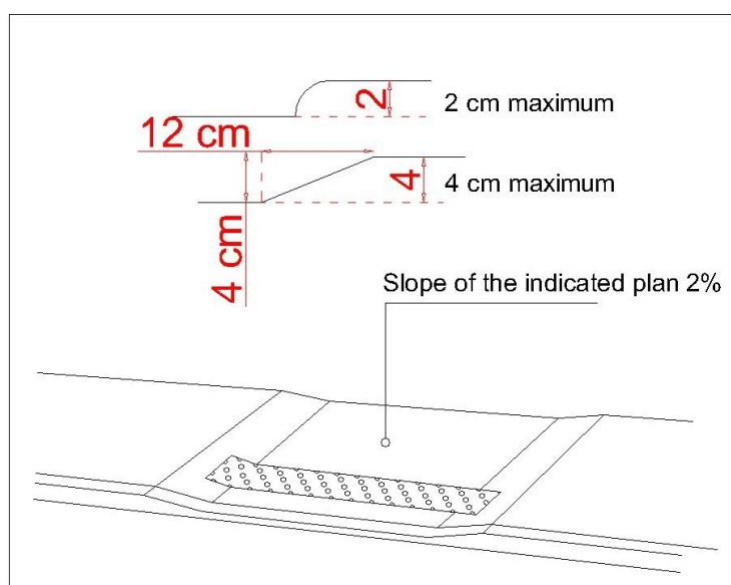


Figure 47. *Floor coverings and pathways*

b. Arrangement and limitation of sloping paths

The paths should be horizontal. If a slope is inevitable, it must be less than 5% (unless technically impossible). The path must be as low as possible and, in cases, 2% (risk of fall and deviation of trajectory).

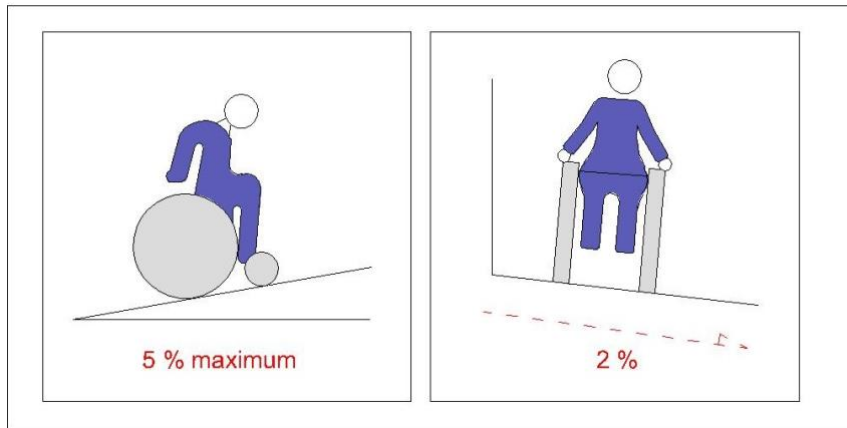


Figure 48. Arrangement and limitation of sloping paths

c. Special arrangements if slope is between 4% and 5%:

A rest stop shall be provided at the top and bottom of each incline and every 10 meters in continuous travel. The rest bearings are horizontal and provide a rectangular space of 1.20 m by 1.40 m, excluding any obstacles and are arranged at each fork in the path.

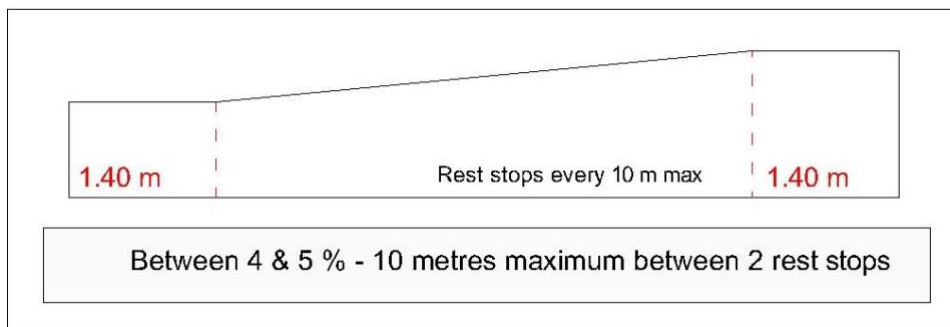


Figure 49. Special arrangements if slope is between 4% and 5%

d. In case of technical impossibility, a slope higher than 5% is tolerated

The number of the rest bearings increases in function of the slope. This slope can go up to 8% over a length of 2 m and up to 12% over a length of 0.50 m.

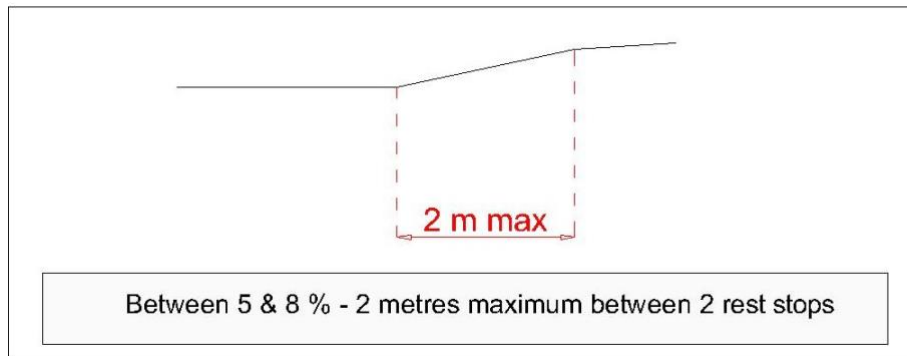


Figure 50. A slope higher than 5% is tolerated

e. Specific arrangements, in case of break in the level of the path

In case of break in the level of more than 0.40 m, the installation of a protective barrier is mandatory. As soon as there is a significant height difference, it is recommended to set up a 5 cm height minimum wheel flush edge to avoid falls and allow the spotting by the visually impaired.

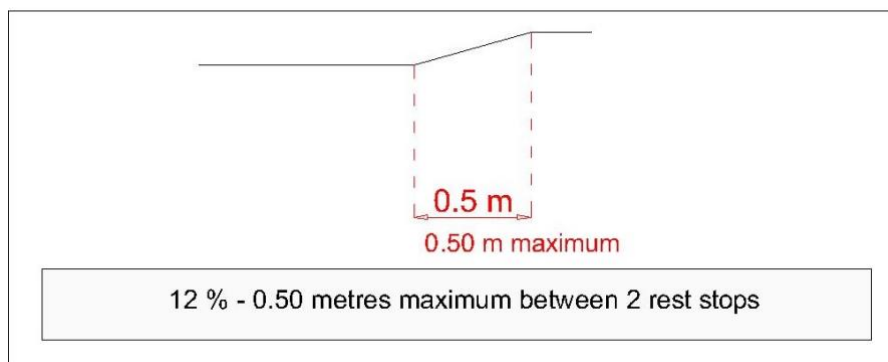
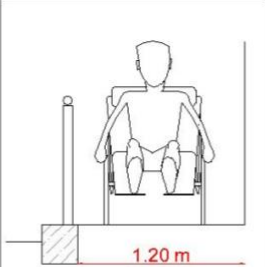
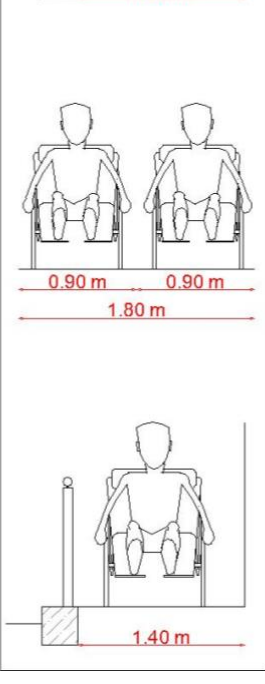


Figure 51. Specific arrangement in case of break in the level of the path

f. Recommended pedestrian path widths (Sidewalks)

<p>Width can be only 1.20 m: In the absence of walls or obstacles on both sides, such as a path lined with green spaces of the same level. REMINDER: Dimensions of a manual or electric wheelchair width: 0.75 m</p>	
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<p>Recommended width 1.80 m: Allowing 2 people in a wheelchair to cross each other without bothering.</p>	
<p>Width that can be reduced to 1.40 m: In the presence of an obstacle (street furniture) located on the sidewalk (alternating traffic).</p>	

7. Technical design measurement

a. *Street furniture as an undetectable suspended obstacle*

When the obstacle consists of an element overhanging the sweep, the cane passes underneath and the person has no indication of the object they are likely to hit.

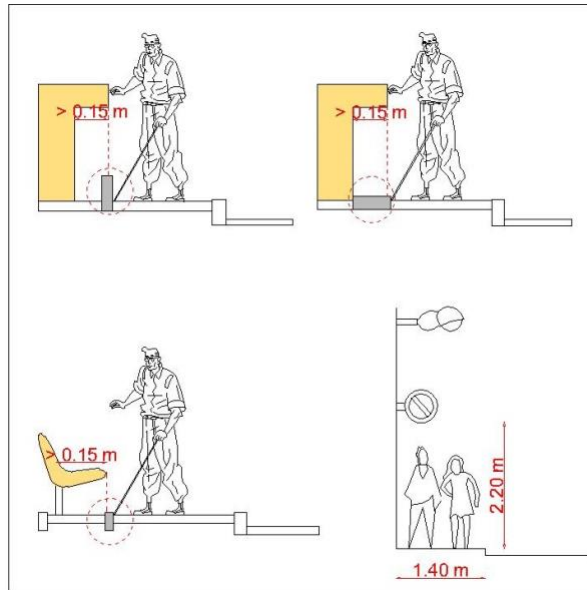


Figure 52. Measurements for undetectable suspended obstacle

b. Street public bench

Many people, especially the elderly or the handicapped, who move with a cane, have difficulty sitting and getting up when they use the benches. It is therefore necessary to ensure that the seat height is high enough to not be handicapping (more than 45 cm), and to choose benches equipped with armrests. It is strongly advised to reserve lateral locations for prams or wheelchairs either (0.80 x 1.30 m) outside the path.

c. Ischiatic support bench

It is advisable to develop the implementation of the ischiatic support that allows pedestrians to rest in a standing position (sitting upright 0.70 m

d. Interactive and service furniture

Free space of at least 1.30 m and 0.90 m must be available in front of this type of furniture (Parking meter, mailboxes...).

8. Street furniture implementation: Obstacle detection principles

a. Band path tactile landmark guidance and guidance assistance

To help the visually impaired to follow the path, it is recommended to install in the ground on the whole length, orientation aid strips having the following characteristics:

- **Visual Reference:** Color contrast to the path
- **Tactile landmark:** Through a hollow relief detectable by the blind cane

b. Physical detection of an obstacle by a blind cane

The furniture must not be an obstacle on the path space except technical necessity or security requirement. Street furniture must be identifiable and detectable by visually impaired persons and allow the normal passage of a wheelchair.

- Visually impaired persons using a cane during their travel have been previously trained in this obstacle detection technique.
- However, the reliability of this practice is highly dependent on the characteristics of urban furniture, which are more or less detectable depending on their shape, size or location.

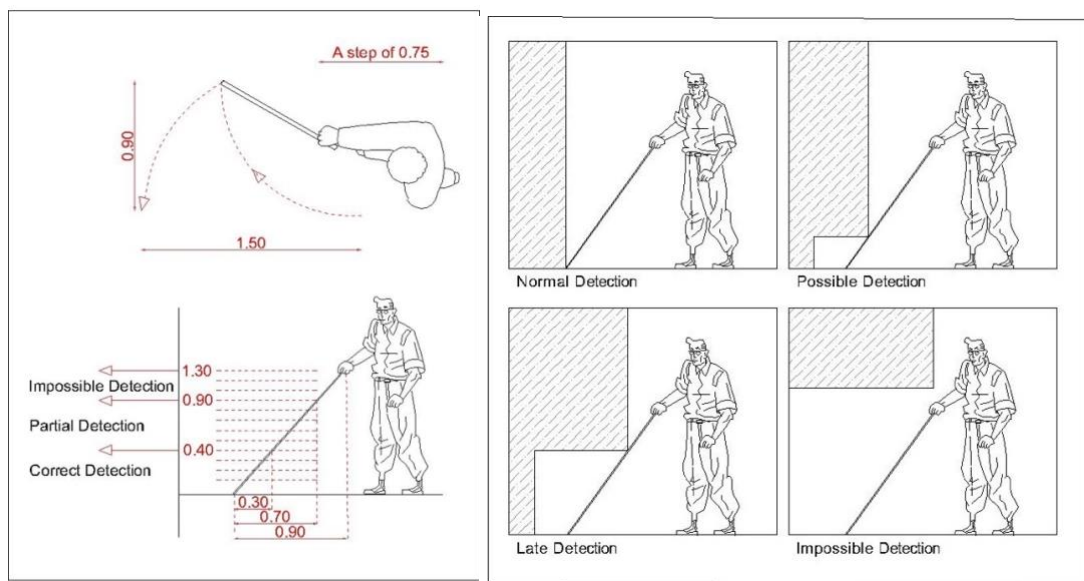


Figure 53. *Physical detection of an obstacle by a blind cane*

After technical studies and experiments, regulatory standards concerning the dimensions and forms of urban furniture were defined so that they are easily detectable, as shown on the previous figure.

c. Identification of obstacles by visual contrast of colors

Each color has its own light reflection index, calculated by a photometer. To be easily spotted, an obstacle must have a visual contrast of at least 70% either between two formed parts (top/bottom - middle/end) or with respect to its environment and background.

	White	Grey	Black	Brown	Pink	Purple	Green	Orange	Blue	Yellow	Red
Red	84									82	
Yellow		73	89	80		75	76		79		
Blue	82										
Orange				76							
Green	80										
Purple	79										
Pink				73							
Brown	84										
Black	91										
Grey	78										
White											

Do not use (> 70%)
 Compliant (< 70%)

Recommendation: Choose color combinations where visual contrast is $\geq 70\%$

Figure 54. Table of visual contrasts between two colors

Thanks to intelligent and inclusive street furniture, people with disabilities can access various facilities safely and adaptively. For example, a physical disability that requires the use of a wheelchair should be addressed by improving access to the various facilities and activities offered by the municipality. Street furniture must also be adapted to people with profound visual disabilities. In this case, guidance strips on the ground, special coatings, contrast effects, or even sound devices for bus and streetcar stops are essential to ensure the environment is perceptible. In both cases, street furniture forms, materials, dimensions, and functionality must be adapted to facilitate their use and detection so that no one feels excluded.

FIRST AND SECOND THESIS STATEMENTS

- *The community of Sidi Bou Said is not satisfied with the street furniture design.*

The street furniture design has a significant impact on the frequency of the Mediterranean garden, unlike the urban context which has not had an influence according to the site analyses. Street furniture allows people to enjoy their streets, alleys, parks, gardens, and other public spaces more comfortably. Street furniture contributes significantly to the quality of life that a

city or town offers to its inhabitants. But it is not the case after observing the results of the investigation.

- *Institutions have failed to provide an adequate approach to enhance the street furniture quality and its integration into the city.*

Street furniture must also take into account the different profiles of users in order to promote inclusiveness, well-being, and living together. An inclusive city must do its utmost to guarantee complete access to its services for people with disabilities. This applies to communication and information systems, play and leisure, access to roads, parking, and public transport, adapting lighting, rest areas, and access to related services.

**PART 4. PUBLIC PARTICIPATION AND ENVIRONMENTAL,
SUSTAINABLE AND ECOLOGICAL ASPECTS**

INTRODUCTION

Today's environmental challenges are prompting designers to rethink their way of designing. The preservation of resources, the prevention of pollution, the balance of the climate, and the fight against waste have become essential in the design and production phase. This part of the research has a purely scientific direction, which is leading to the use of the investigation results and the presentation of the methodology and research design concepts.

In this chapter, the selection of the statements is based the public participation and Environmental, sustainable and ecological aspects.

INVESTIGATION AND STATEMENT ANALYSIS OF THE SURVEY CORPUS

Statement n°3: The community is not involved in drafting the street furniture conception and into the city development process.

The third hypothesis to confirm is that the community is not involved in drafting the street furniture conception and into the city development process. For that, correlation method was used between the following variables: “Do you regularly attend your community council”,

“Have you ever been involved in drafting street furniture conception” and “Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions”.

Table 16. Descriptive statistics	
Do you regularly attend your community council?	
Mean	1.8344
Std. Deviation	.37292
Have you ever been involved in drafting street furniture conception?	
Mean	1.8790
Std. Deviation	.32719
Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions?	
Mean	1.9490
Std. Deviation	.22061

In table 17, 18, 19, the participants were asked if they regularly attend their community council, have ever been involved in drafting street furniture conception and have ever participated in public presentations and discussions regarding street furniture implementation which are

organized by institutions, the answers were in all questions with a percent of 83.4%, 87.9% and 94.9% for “No”.

Table 17. Do you regularly attend your community council? - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	26	16.6	16.6	16.6
	No	131	83.4	83.4	100.0
	Total	157	100.0	100.0	

Table 18. Have you ever been involved in drafting street furniture conception? - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	19	12.1	12.1	12.1
	No	138	87.9	87.9	100.0
	Total	157	100.0	100.0	

Table 19. Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions? - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	5.1	5.1	5.1
	No	149	94.9	94.9	100.0
	Total	157	100.0	100.0	

Table 20 presents a positive correlation of .360** between Do you regularly attend your community council and Have you ever been involved in drafting street furniture conception with a significance level of .000. In the second case, there is a positive correlation of .536** between Have you ever been involved in drafting street furniture conception and Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions with a significance level of .000. In the third case there is a positive correlation of .208** between Do you regularly attend your community council and Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions with a significance level of .000. It can be concluded that there is a statistically significant linkage between these three variables confirming the third hypothesis saying that the community is not involved in drafting the street furniture conception and into the city development process.

Table 20. Variables correlations

		Do you regularly attend your community council?	Have you ever been involved in drafting street furniture conception?	Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions?
Do you regularly attend your community council?	Pearson Correlation	1	.360**	.208**
	Sig. (2-tailed)		.000	.009
	N	157	157	157
Have you ever been involved in drafting street furniture conception?	Pearson Correlation	.360**	1	.536**
	Sig. (2-tailed)	.000		.000
	N	157	157	157
Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions?	Pearson Correlation	.208**	.536**	1
	Sig. (2-tailed)	.009	.000	
	N	157	157	157

** . Correlation is significant at the 0.01 level (2-tailed).

Statement n°4: Street furniture is not well integrated to fit sustainable and ecological development of the city.

In order to prove the fourth hypothesis, a correlation method was needed between the two variables: “Institution’s investment should play a key role in the revalorization of street furniture ecological design aspects” and “How much do you think having well designed street furniture can improve the sustainable development of the city?”

Table 21. Descriptive statistics	
Institutions investment should play a key role in the revalorization of street furniture ecological design aspects	
Mean	4.3121
Std. Deviation	.90478

Having well designed street furniture can improve the sustainable development of the city	
Mean	4.0637
Std. Deviation	.85246

Table 22 highlights general outcomes of the participants opinions about the institution's investments in the revalorization of street furniture ecological design aspects. 1.3% strongly disagree, 3.8% disagree, 10.8% choose to be neutral, 30,6% agree and 53,5% strongly agree. Table 23 shows the participants awareness about the idea of having well designed street furniture can improve the sustainable development of the city. 1.9% rate it with low, 1.9% with below average, 15.9% with average, 48.4% with above average and 31.8% with high.

Table 22. Institutions investment should play a key role in the revalorization of street furniture ecological design aspects - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	1.3	1.3	1.3
	Disagree	6	3.8	3.8	5.1
	Neutral	17	10.8	10.8	15.9
	Agree	48	30.6	30.6	46.5
	Strongly agree	84	53.5	53.5	100.0
	Total	157	100.0	100.0	
Table 23. Having well designed street furniture can improve the sustainable development of the city - Frequencies					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	1.9	1.9	1.9
	Below average	3	1.9	1.9	3.8
	Average	25	15.9	15.9	19.7
	Above average	76	48.4	48.4	68.2
	High	50	31.8	31.8	100.0
	Total	157	100.0	100.0	

A measurement of the correlation between the variables presented in table 22 and 23; Institution's investment should play a key role in the revalorization of street furniture ecological design aspects and having well designed street furniture can improve the sustainable development of the city. It is seen that there is a positive correlation of .464 and the significance level of .000. Based on this correlation, it can be concluded that there is a statistically significant linkage and that street furniture is not well integrated to fit sustainable and ecological development of the city.

Table 24. Variables correlations			
		Institutions investment should play a key role in the revalorization of street furniture ecological design aspects	Having well designed street furniture can improve the sustainable development of the city
Institutions investment should play a key role in the revalorization of street furniture ecological design aspects	Pearson Correlation	1	.464**
	Sig. (2-tailed)		.000
	Sum of Squares and Cross-products	127.707	55.879
	Covariance	.819	.358
	N	157	157
	Having well designed street furniture can improve the sustainable development of the city	Pearson Correlation	.464**
	Sig. (2-tailed)	.000	
	Sum of Squares and Cross-products	55.879	113.363
	Covariance	.358	.727
	N	157	157
**. Correlation is significant at the 0.01 level (2-tailed).			

METHODOLOGY AND RESEARCH DESIGN: CONCEPTS, THEORIES AND INTERPRETATIONS

1. Public participation

Public participation (also known as community participation or user participation in different contexts) cannot be ignored in street furniture design (Lin, 1992; Lu & Ma, 2001; Sanoff, 2000; Siu, 2007b; Yang, 2005). The target users of street furniture are the public, who best understand their needs. Therefore, communication and cooperation between the designers and the public are important aspects of the design process to create facilities that can fully satisfy the public's needs. Again, the residents of the place where street furniture is to be located can contribute significantly to creating the identity of street furniture because they are the most knowledgeable of their area, including its local history, culture, and tradition. (It is correlated to the principle

of “identity”). In addition, public aesthetics can be presented in street furniture and become public art through public participation (Figures 55. a-b-c).



Figures 55. a-b-c Examples of public participation: drawings of children, names and well-wishing of different individuals of the public are carved on the pavers. (Seattle centre park, Seattle. USA)



*Figure 56. CitiLite 2.0, a hybrid of urban street light and free public exercise equipment.
Generate power through human exercises and use it for public illumination at night*

1. Environmental, sustainable and ecological aspects

Sustainable development is already a significant consideration of today's urban development. Sustainable development aims to maintain the harmony of the environment, society, and economy. Equity is essential for sustainable development; every one of the same generation and different generations should be able to access resources and their interests equitably and evenly. The resources should be fairly distributed and preserved for the next generation. Public participation can ensure that different parties' needs, interests, and opinions are considered to create an equitable and harmonious situation.

a. Sustainability and street furniture

Effective design and arrangement are important for urban landscapes to maximize waste reduction and inequality. The ecological environment should be respected, protected, and

integrated. For example, urban development should be structured by considering the natural environment (geographical and ecological features, and diversification and stability of the ecologic system); resource-saving (3Rs—reduce, reuse and recycle); pollution reduction (control on transportation, industry, and material use); protection and preservation (natural environment— forest, wetlands, sea, river, rural areas; and historical heritage.); green space (greenbelt, planting, and parks) and blue space (river and waterscape); and citizenship education and promotion.

Street furniture can provide different levels of sustainability within the context of a local city (Allameh and Heidari,+2018). Fig. 57 presents the spectrum from a not sustainable design to eco-design and a more environmentally responsible design, which is proposed to be applied in the design process of street furniture. According to the proposed framework, a deeper level of sustainability is expected to be achieved if social and behavioral sustainability is accomplished through eco-design strategies.

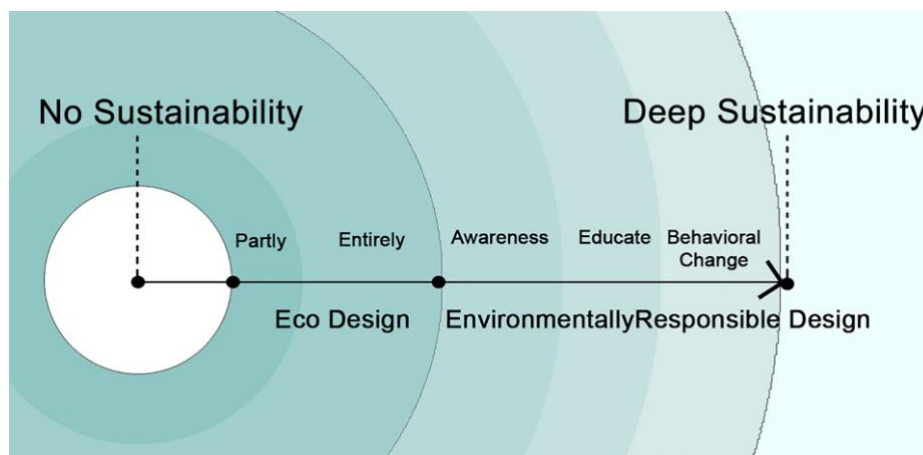


Figure 57. A move toward deep sustainability in design which includes coming out the white circle of "No sustainability" and moving toward eco design and environmentally responsible design

Considering environmental issues, designers' responsibilities have become more complex and important. Designers have crucial responsibilities to create environmentally friendly products and solutions for the earth. The traditional approach to environmental management has evolved from pollution control, the end-of-pipe approach, to preventive or cleaner production strategies. Some of the fundamental eco-design strategies are reported below:

- Design for Manufacturability
 - Enabling pollution prevention during manufacturing

- Design for less material or fewer different materials
- Design for safer materials and processes
- Design for Longevity
 - Provide life time period of usage
 - Improve flexibility and serviceability
 - Design parts/products so that components contain materials with reuse potential in other industries
- Design for Energy Efficiency
 - Reduced energy demand during use
 - Use renewable energy
 - Carbon Neutrality
 - Maximize use of recycled materials
- Design for Logistics
 - Use of local materials
 - Less transportation or arrange outsourcing to minimize transportation
- Design for Multi-functionality
 - Use one product for different purposes
 - Design for flexibility to enable changes for different functions, users, times and etc.
- Design for Recycling
 - Labeling of parts, especially plastics, for more accessible materials identification
 - Efficient choice of materials (e.g., thermoplastics easier to recycle than thermosets, use of natural, sustainable materials)
 - Design with less variety of materials
 - Use of materials that can be locally recycled
 - Design for greater materials recovery
 - Design for safer disposal of non-recyclables
 - Design for economical recycling, and arrange marketing incentives to promote recycling.

Recently, it has become clear that such interventions must be more radical and go beyond redesigning existing products to catalyze a transition toward a sustainable society. Design for Sustainability (DfS) goes beyond these eco-design strategies. DfS integrates social, economic,

environmental, and institutional aspects and offers opportunities to get involved in one's identity beyond consuming standardized mass products (Spangenberg, 2013). DfS suggests that a typical win-win situation is not only the eco-efficiency of production but also the eco-efficiency of consumption and sustainable consumption. A product is efficient if the abovementioned eco-design strategies are applied in its design process and if the use efficiency of this product can also be extremely low (most of the time, the product is not used). Hence, detecting possibilities for socio-cultural improvement rather than technical, like improving the use intensity, can lead to better results in eco-design and is a step forward to design for sustainability (Allameh & Heidari, 2018). Choosing a bicycle instead of a car in the Netherlands is one of the best successful examples of sustainable consumption instead of focusing on making that product eco-efficient. The need for sustainable behavior introduces a relatively new issue into the global debate on sustainable development. Sustainable behavior questions products and services and how needs and wants are defined and fulfilled (Vezzoli, 2003). This means that designers need to be aware of their new responsibilities and become competent to make specific contributions in the transition towards a sustainable society.

Accordingly, this research aims to explore the possibilities of promoting sustainable behaviors in the cities by developing new ideas for street furniture. The research discusses the implementation of street furniture, which drives the community towards deep sustainability. While the common examples of street furniture are functionally designed, ignoring the important roles that they can play in urban living, some emerging trends are applied in the literature in order to increase the benefits of street furniture for the city and the environment; the examples are as follows:

- ◆ Multifunctional ICT devices like a bus station, which acts as cloud device and include screens that display real-time information about bus movements and touch screens that provide access to interactive maps, local news, tourist information, and a USB charging port for mobile devices and advertising.
- ◆ Responsive Street Furniture, which adapts to the needs of individuals. The adaptations include brighter street lighting, audio information, different places to use, and more time to cross the road.
- ◆ Sustainable Technology like Energy Solar LED Street Lamps or roads with renewable energy use.

- ◆ Modular Street Furniture.
- ◆ Flexible or Pop-Up Hydraulic Power Units, Furniture (Hassanein, 2014).

b. Case study: Design experiment on sustainable street furniture

Geographic environment and climate also mold the identity of a place, its urban landscapes, and street furniture. For example, climate plays a role when choosing street furniture's color, materials, and design. If a place has high temperatures and constant sunshine, the color of the street furniture should not strongly reflect sunlight to provide visual comfort to its users. In addition, certain materials, like metal, should be avoided when producing street furniture for this type of climate because of their ability to absorb heat efficiently. Some examples follow:

Street furniture recycling design (Rotterdam, Holland)

"The New Raw," a research and design studio based in Rotterdam, has built its business on recycling plastic by transforming it into urban furniture. The team of 7 employees has designed urban parts (benches, chairs, pots, dog bowls, library, rocking horse, and bike rack) using a 3D printer using plastic materials, an innovative and environmentally friendly initiative called "Print your city." It is just enough for the citizens to bring their plastic waste, and the trick is done! This initiative is well thought out since they eliminate it to become eco-responsible actors actively involved in the recycling process. The significant disadvantage of plastic is that it usually causes heavy damage that is often irreversible and has dramatic consequences for ending up in the oceans. It is now reused for ecological purposes and to create geometric ergo-design objects. Today, more than 3,000 different designs have been designed since December 2018. Over time, The New Raw's goal is to recycle 4 tons of plastic waste. It should be easy for society to access it, given the significant number of people who use it. This technological advance allowed by the 3D printer bodes well for the future of our planet.



Figure 58. a-b 3D printer in serve of transforming plastic into urban street furniture

(Source: The New Raw)

Street furniture eco-design (France)

The idea is about multiplying the vegetation supports in the city into an ecological system. Apart from being problematic for the environment, the spreading of the urban spaces reduces the vegetation's surface area of the city. The reintroduction of vegetation on buildings, public spaces, or urban furniture is necessary to keep considerable human surroundings. The project of the vegetal bus shelter proposed here is an example of the numerous possible supports as vegetal surface areas in the city.

The bus or tramway shelter is emblematical urban furniture that reduces vehicles' place in the cities and limits greenhouse gas emissions. Here, it shelters the waiting and stopping while proposing a landscape environment. It salvages rainwater and becomes autonomous; also, low-consuming lights are used.

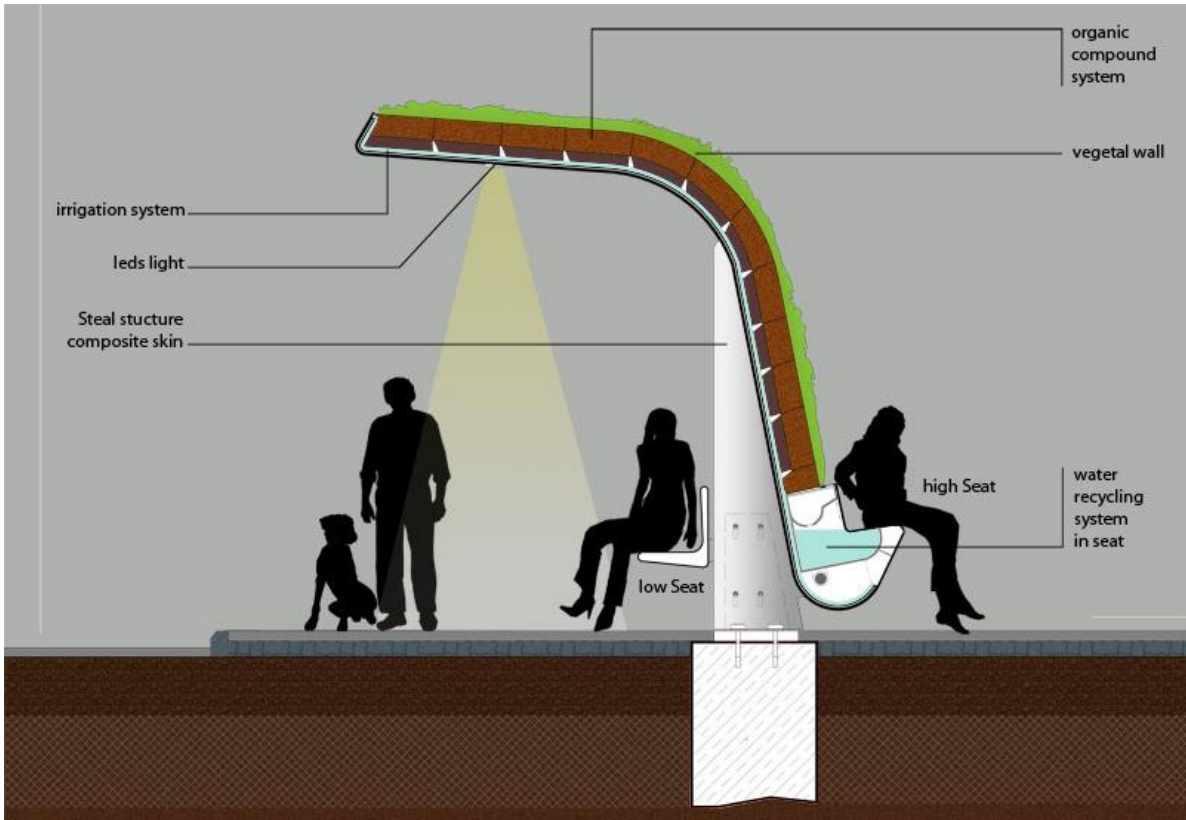


Figure 59. *Vegetal Bus-stop designed by Florent Prat (Source: Designboom)*

Street furniture green design (Waikiki, Honolulu, Hawaii)

The year-round climate favors luxuriant plant growth and different kinds of water sports in Hawaii, with its archipelagos in the Torrid Zone. In Waikiki, Honolulu, Hawaii, green and tropical plant-patterned street furniture reflects Hawaii’s identity, molded by its geographic location and climate.



Figures 60. a-b *Waikiki is full of “green” because of the luxuriant plant growth and large scale planned green areas. It is also a popular place for different kinds of water sports.*



Figures 61. a-b Green and tropical plant-patterned street furniture in Waikiki, Honolulu, Hawaii. The design of street furniture in this type of climate may provide shelter from the sun



Figures 62. a-b As a popular water sport place, in Waikiki, (h) sculpture with waterscape is designed about surfing, and (i) Information board in the shape of a surfboard. (Surfing is a popular water sport in Hawaii)

THE LEGAL FRAME OF SUSTAINABILITY AND STREET FURNITURE PROTECTION IN TUNISIA

In Tunisia, the fennec ‘Labib’ symbol of environmental protection in Tunisia became in the 1990s the mascot that mobilized young and old for the protection of the environment. It was everywhere in the landscape, and its effigy was visible at the entrances of all cities. After the

Revolution of 2011, this ecological symbol disappeared without any mascot replacing it. Worse, the environment suffers more and more attacks of general indifference. Several factors influenced Tunisia to embrace sustainable development. The major concerns of the agricultural land loss in Tunisia are: Erosion that threatens 76% of the nation's land area, degradation of range and forest lands due to overgrazing, and overcutting timber for fuel. In order to involve the sustainable living idea, Tunisia has implemented laws and legal texts. At the national level, the protection of the environment in Tunisia is ensured by a fairly large legal arsenal which reflects, on the one hand, an awareness of the problems related to the management of natural resources and, on the other, the commitment of the country to the rational and sustainable use of the heritage of future generations.

In Tunisian law, there is no environmental code that contains all the provisions relating to environmental law; however, several provisions are scattered in several legal texts, which concern totally or partially environmental matters. Institutions supporting sustainable development in Tunisia: Agence Nationale de Protection et de l'Environnement (ANPE), Agence de Protection et d'Aménagement du Littoral (APAL), Agence National du Patrimoine (ANP). The new Tunisian constitution of January 2014 incorporated a set of environmental principles:

1. *Prevention*: It is an impact assessment before the preparation of a plan or the realization of a work or activity. This forecast document contains four elements: the potential direct effects of a project on the environment, the indirect effects, the immediate consequences and the distant consequences. The impact assessment must be of dual interest: theoretical and other practical interest;
2. *Precaution*: This is a precautionary principle; it involves taking the necessary steps to avoid risks. It shall implement risk assessment procedures and adopt provisional measures to prevent damages;
3. *Reparation*: The principle (polluter pays) aims to impute the social cost of pollution to the polluter, thereby triggering a liability mechanism for ecological damage covering the effects of pollution not only on property and people but also on nature itself;
4. *Information and participation*: The best way to deal with environmental issues is to ensure the participation of all concerned citizens.

The new constitution clearly recognized the right to a healthy and balanced environment, a sustainable development goal that governs much of the constitutional provisions, a right to water, and the protection of heritage the fight against pollution and climate protection.

Concerning the legal frame and street furniture protection in Tunisia. The following examples show penalties in case of rules breaking. The Violation Administrative Line Amount in dinars:

- ◆ Dumping of construction, dust or left-over plants, trees, garden waste, and household waste on the State's public property of roads or the easement zones allocated to it. 1000 per operation.
- ◆ Posting or writing on bonds, directives, information, or directives under bridges, electrical poles, or installations and installations of the State's public property. 300 per operation.
- ◆ Smash an electric shaft. 2000 for each operation.
- ◆ Smash the lanterns of electric columns and damage road drawings or kilometer points and all other equipment belonging to the State or writing on roads. 400 per operation.
- ◆ Smash signs or vertical traffic signs 1000 for each operation.
- ◆ Break down safety slips. 100 per linear meter.

THIRD AND FOURTH STATEMENT

- *The community is not involved in drafting the street furniture conception and into the city development process.*
- *Street furniture is not well integrated to fit sustainable and ecological development of the city.*

Under the condition that the importance of street furniture is highlighted, one should be sufficiently knowledgeable in designing street furniture. Today, some may only consider or even neglect the function of street furniture; some may consider it an individual item and ignore its relationship with others (i.e., different types of street furniture, surrounding environment, and time). Even if both function and unity principles are satisfied, some street furniture lacks representing the meanings and characteristics of its locations and users. All of these show that

street furniture design is misinterpreted. Street furniture design is a complicated task, and it requires a complete understanding of the nature of street furniture and its design principles (as this study has suggested).

To design quality street furniture with comprehensive consideration, one needs to understand the nature, importance, and functions of street furniture in an urban environment and urban life and its design principles from different perspectives. To achieve this main principles, based on the people-oriented premise, sufficient and extensive research and public participation are key ways to create quality street furniture. This provides adequate sources of users' needs and behaviors, situations, and locations and ensures putting people first in designing an urban landscape.

PART 5: RESEARCH FINDINGS AND CONCLUSIONS

SUMMARY AND RESEARCH CONTRIBUTIONS

The discussion and examples showed that the principles in the model are equally important, and correlated to and interflow with one another. One principle's fulfillment can contribute to others' achievement and vice versa. This means that the design principles (and sub-principles) do not run individually but coordinate with others to provide different functions of street furniture. Some examples are as follows:

1. “Identity” of street furniture should be created coordinately with the principles of “unity.” The identity (appearance and style) of street furniture should be designed by reflecting (consistently with) the meanings and characteristics of the place. On the other hand, “unity” should not be applied rigidly to the entire place but allow room for identity expressed in different districts or streets.
2. “Quantity”, “accessibility” and “arrangement” should operate together to provide a convenient environment where the users can see, reach and use street furniture effortlessly when in need.
3. “Arrangement” of street furniture contributes to “accessibility” by placing street furniture appropriately so it can be easily recognized. It also contributes to “unity” by designing street furniture consistently or more straightforwardly to achieve “compatibility between different types of street furniture” and “compatibility between street furniture and the surrounding.”
4. “Aesthetics” of street furniture also includes the considerations of “sustainable development and green design” to have design merge with the development and become long-lasting, “unity” to have the design which is consistent with other street furniture, the surroundings and time, and “identity” to have a design which can reflect the meanings and characteristics of the places.
5. “Flexibility” of street furniture allows users to use street furniture in different ways. It concurrently cooperates with “citizenship education,” which leads the users to use street furniture appropriately without causing human injury or destruction to street furniture. The consideration of “flexibility” facilities street furniture to be designed compatibility with one another, surroundings, and time.

6. “Public participation” provides significant information and resources for the considerations of “function,” “unity,” and “identity” of street furniture. It facilitates street furniture to be designed for users’ physiological and psychological satisfaction.

The proposed design idea will be established to provide a reference for street furniture design, which will help to enhance the quality of street furniture and, hence, the urban environment and urban life, as well as rectify and reinforce the concept of nature, importance, and principles of street furniture design. Also, through the design and discussions, it intends to direct all parties (including policymakers/governments, designers, and the public/users) to re-understand street furniture design.

Street furniture in some places is considered a common accessory to the urban landscape to be apparently and causally designed and arranged. It is essential to understand that street furniture is an important element of the urban landscape and directly influences the urban environment and life, reflecting the economics, society, politics, culture, etc. of a city. The emphasis on street furniture, especially by the policymakers/governments (the party who owns and manages most of the street furniture), can help improve the city's quality in many aspects.

In order to achieve development in Sidi Bou Said city, the design of street furniture has to be linked to social integration and participation, ecological and sustainable criteria. Proposing approaches was mandatory to develop strategies that apply attractively, multifunctional, and sustainable street furniture that inhabitants and tourists like to use. These approaches are as follows:

- ◆ **Social Integration Approach** to link the street furniture design to the social aspects and needs. Street furniture seems to be the significant element that defines the city's social interaction.
- ◆ **Street furniture design Approach** focuses on the street furniture user's experience and the quality of service that can offer as the key value for combining functionality and aesthetics.
- ◆ **Participative Approach** serves to involve the community of Sidi Bou Said in taking their opinion regarding the street furniture conception and the city development process.

- ◆ **Sustainable and ecological Approach** to provide the design with environmentally friendly aspects that consider the overall ecological impact, including materials used while designing.

1. Social Integration and Street Furniture design Approaches

This part will discuss the requirements and criteria that should be considered while designing street furniture. At this point of research, it seemed necessary to develop a protocol to assess street furniture design considering and evaluating the following features:

- ◆ **Location and implementation rules:** Accessibility to all people with good circulation.
- ◆ **Comfort:** When it comes to comfort, urban furniture can encourage city dwellers and tourists to take their time to enjoy the present moment and the surrounding landscape;
- ◆ **Accessibility:** The urban furniture must be arranged in such a way as to promote the development of an obstacle-free route in outdoor public spaces;
- ◆ **Technical design measurement:** Analyzing the model's design and quality may lead users to create new activities in the space;
- ◆ **Harmonization and city image promotion:** Street furniture could advertise and affect the city image in terms of aesthetic/visual appreciation;
- ◆ **Design and city identity:** Urban furniture becomes a real issue for municipalities to create an identity;
- ◆ **Materials and sustainability:** Design for use of recycled materials with a minimum negative impact on the environment;

As a necessary factor to have functional street furniture, it must fit the human ergonomic. The proposed protocol presented in Tables 25 and 26 allows for identifying necessary features and characteristics to design each street furniture by giving it a specific profile.

Table 25. Proposed protocol for street furniture observation in terms of location and implementation rules, comfort, accessibility, and technical design measurement.

		Location and implementation rules		Comfort		Accessibility		Technical design measurement	
		yes	no	yes	no	yes	no	yes	no
STREET FURNITURE	Rest	x	-	x	-	x	-	x	-
	Information	-	x	-	x	-	x	-	x
	Street signage	x	-	x	-	x	-	x	-
	Stalls, Stands	-	x	-	x	-	x	-	x
	Parking	-	x	-	x	-	x	-	x
	Playing furniture	-	x	-	x	-	x	-	x
	Sanitation	-	x	-	x	-	x	-	x
	Lighting	x	-	x	-	x	-	x	-
	Furniture for people with limited mobility	-	x	-	x	-	x	-	x
	Landscaping	-	x	-	x	-	x	-	x
Protection	-	x	-	x	-	x	-	x	

Table 26. Proposed protocol for street furniture observation in terms of harmonization and city promotion, design and city identity, and materials and sustainability.

		Harmonization and city image promotion		Design and city Identity		Materials and sustainability	
		Yes	No	Yes	No	Yes	No
STREET FURNITURE	Rest	x	-	x	-	-	x
	Information	-	x	-	x	-	x
	Street signage	x	-	x	-	-	x
	Stalls, Stands	-	x	-	x	-	x
	Parking	-	x	-	x	-	x
	Playing furniture	-	x	-	x	-	x
	Sanitation	-	x	-	x	-	x
	Lighting	x	-	x	-	-	x
	Furniture for people with limited mobility	-	x	-	x	-	x

	Landscaping	x	-	-	x	-	x
	Protection	-	x	-	x	-	x

As a result, all street furniture types described from A to K were considered and evaluated in order to extract and identify any relationship with the features mentioned above:

- Street furniture types A, C, and H were the only ones in which all features considered could be found but with a distinct lack of maintenance.
- Street furniture types D, E, F, and I were not found in the Mediterranean garden.
- Street furniture types A, B, G, J, and K significantly lacked quality and maintenance.

The proposed protocol allows researchers to identify critical physical characteristics of each street furniture, thereby classifying its location and occupancy aspects. Through this protocol, the main aspects of each street furniture can be outlined, focusing on the user's comfort. It is a valuable tool for mapping multiple aspects of street furniture, but it can also be used to analyze public spaces. The data collected are easily obtained because the practical aspects are mainly quantitative. This study conducted questionnaires and interviews with street furniture users to complete the data collected. After analyzing the results, street furniture types A, C, and H were set as the street furniture to be studied in the next phase of this research to answer the above question; what requirements and standards should be considered when designing street furniture? This street furniture represents a fundamental aspect that allows research to be carried out and improved.

2. Participative, Sustainable and Ecological Approach

In 2015, the president of the special delegation of Sidi Bou Said city announced that the city would soon establish two innovative projects regarding environmental preservation. The realization of these projects will make Sidi Bou Said a 'Pilot city.' Indeed, the first project will stop the circulation of cars by providing residents and visitors with electric buses to move around the streets. However, car parks will be at the entrance of Sidi Bou Said to accommodate the other vehicles. The second project concerns renewable energy used for public lighting in Sidi Bou Said.

The most popular method of designing environmentally friendly street furniture in urban design comprises the 3Rs method (reuse, reduce, recycle) in the design process. The main objective

of the 3Rs method is to minimize pollution, lower costs and minimize the consumption of resources. It was announced that to design green street furniture, three different ways should be taken into consideration; using recyclable and durable materials, using natural resources, and minimizing resources of maintenance. One of the objectives of the municipal government of Sidi Bou Said is to place significance on urban environmental planning, which is more livable. Meanwhile, a space analysis should be done concerning the geographic environment, climate, and local construction materials.

a. Sustainable design criteria

In most cosmopolitan cities and developed countries, the urban treatment of the city goes through a survey, a work essentially based on the seizure of the citizen's needs as an indispensable phase for elaborating any strategy. Apart from the urban furniture found in the streets, benches, signs, garbage baskets, Etc., the supplies and sports and cultural equipment become indispensable in the renewal and attractiveness of the place, but also in the shaping of a new urban experience by taking into account the health of the inhabitants and thinking about their entertainment.

Here, in the case of Sidi Bou Said, many visitors perceive the place as a health trail, a place to take a good walk, practice sports, take a break and stop at some places. In this sense, we must read all the possible scenarios of the place.

As is a practice of creation turned towards the future and underpinned by an ameliorative intention. It is about putting itself at the service of improving living conditions and the quality of life. Design is an approach that allows space users to contribute to the improvement of their living environment by imagining innovative forms of use through its tools for a sustainable project.

In terms of people's physical needs and mental health, the ecological design method is applied in this research stage. The proposed design integrates local materials with modern design aesthetics to adapt to modern life. It carries a profound design conception mixing the historical background of Sidi Bou Said with natural resources. During the design conception procedure, it was mandatory to link ecological design with people's needs, environmental landscape, colors and materials used, and technology in serve. Therefore, an assortment of multiple conception designs should be considered according to ecological design aspects, flexible positioning, and coordination with the space and the users.

The idea consists of installing futuristic streetlights powered by photovoltaic panels; it allows consuming renewable and kinetic energy. Different from regular streetlights, they also include fitness equipment. When users train with these sports' equipment, a generator converts the resulting mechanical energy into electrical energy. The electrical energy obtained then recharges the battery of the lamp floor so that it can light the city's streets at night *Fig. 63*.

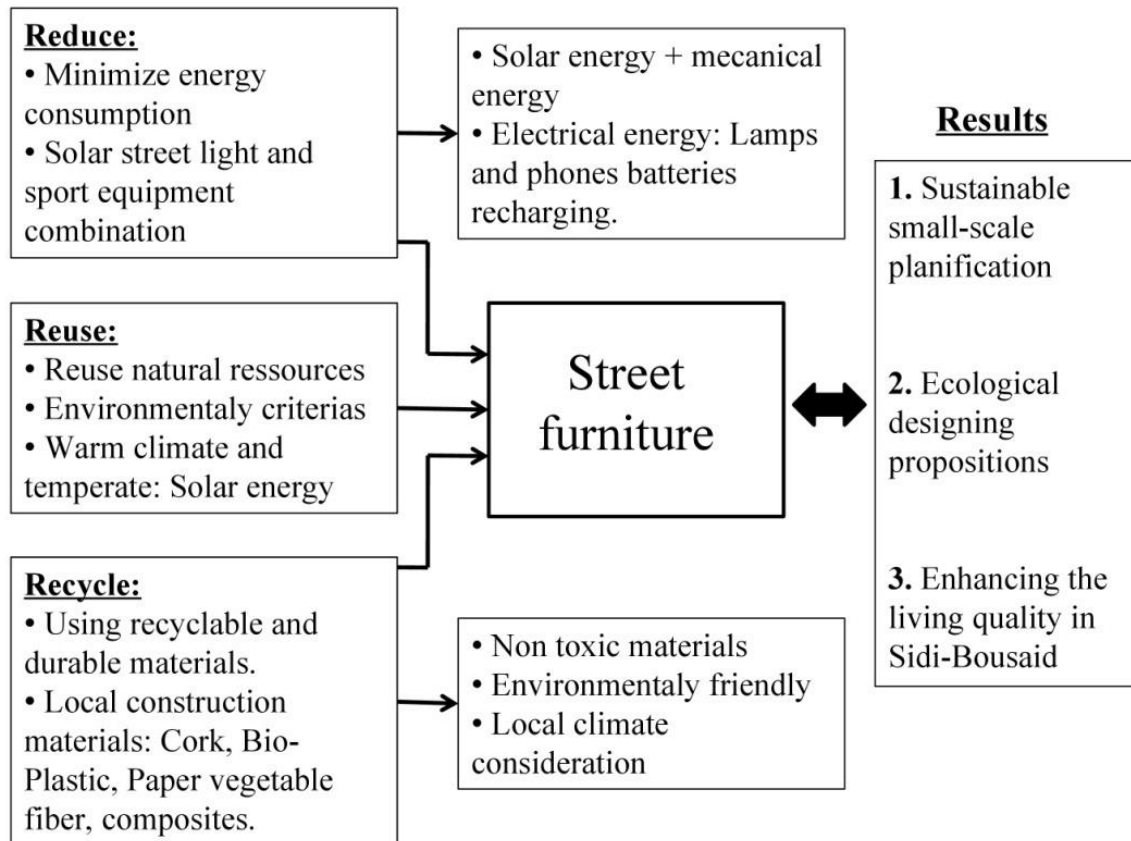


Figure 63. Structural model relating street furniture with eco-design conception

b. Local construction materials

As Sidi Bou Said is already known for its blue and white colors, which are the best colors representing the main colors for ecological design, including green, it makes people feel relaxed psychologically thinking of the natural space. Concerning the materials, the design choice is related to the risk factors control; non-toxic materials, environmentally friendly, and local climate considerations.

- *Cork*: Recycling of cork remains recovered in the factory during the manufacture of stoppers. This residual cork converses its natural properties: Ecological, durable, and insulating.
- *Bio-plastic*: The introduction of agro-sourced or agro-plastic plastic materials from renewable resources, such as corn, wheat, and sugar cane.
- *Paper and vegetable fiber material*: Papermaking is based on local materials like a palm leaves. Experimenting with paper pulp through new shapes and moldings.
- *Composites*: Mixing and creating alternative materials using agglomerated cork, natural fibers, and bio-plastic.

This waste is stored and then crushed separately before being mixed. The obtained chips are then heated in a machine to melt them. Large strips of plastic are then extracted to 100% of recycled material. It has significant advantages over other materials, including wood or steel. Composites are particularly suitable for street furniture design because they are heavy, solid, and robust.

RECOMMENDATIONS AND FUTURE RESEARCH

Perceived as a tourist destination that opens on the Mediterranean, "a city of the world" that welcomes so many visitors each year. Sidi Bou Said has enormous potential from the point of view of geographical location, climate, architecture, history, Etc., which makes it a world heritage for everyone that deserves to be maintained and highlighted. This research aims to propose urban furniture that meets both the needs of the architectural environment, its climate, and the daily needs of visitors to the space.

In this research, the aim of this study was to identify a new approach and methodology in designing and developing street furniture qualities. It will serve a contribution for the decision makers and designers and help them find a balance between street furniture design and city development.

It will also help institutions to understand that designing street furniture is a multidisciplinary task and requires the participation of institutions, designers, urban planners, citizens, etc.

The identified approaches and methodology for designing functional, sustainable, participative street furniture will serve as a basis guideline for drafting the city development for Sidi Bou Said and for each specific neighborhood and similar areas.

The proposed design recommendations based on the stated methodology followed by technical solutions will be suggested to the local municipality after accomplishing further study of street furniture. To realize a new ecological spirit in local culture and aesthetics in modern life through this design criteria. Not only Sidi Bou Said, but the proposed recommendations will be shaped as a landmark of ecological outdoor living space with the conformance of architectural character and urban identity in every similar city around the Mediterranean area.

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APPENDIX

Appendix 1. The questionnaire form addressed to the community in Sidi Bou Said (translated to English from original –)

Questionnaire for the community in Sidi Bou Said No. ___

This questionnaire is designed solely for research purposes. Your opinion is crucial as it will help to jointly evaluate the ___ and help to integrate it into the design of urban development plans and strategies. Please give only one answer. The questionnaire is anonymous. Thank you for the cooperation!

A- General information for residents

1. Age:
2. Gender: [1] female; [2] male
3. Educational level: [1] elementary school; [2] high school; [3] graduate; [4] postgraduate (Msc/ PhD)
4. Employment status
5. Do you live or work in Sidi Bou Said? [1] Yes; [2] No
6. Do you regularly attend your community council? [1] Yes; [2] No

B. Data on street furniture design knowledge

7. Do you have a general interest in recovering street furniture lacks? [1] Yes; [2] No
8. How much do you know about the importance of design in urban street furniture? [1] Not at all; [2] Very little; [3] Some; [4] About right; [5] Much
9. How much do you think having well designed street furniture can improve the social, economic and environmental development of the city? [1] Not at all; [2] Very little; [3] Some; [4] About right; [5] Much
10. How much do you think the institutions have managed to provide an adequate approach to enhance the live quality and the city development? [1] Not at all; [2] Very little; [3] Some; [4] About right; [5] Much
11. How satisfied are you with the street furniture design in Sidi Bou Said? [1] Very dissatisfied; [2] Somewhat dissatisfied; [3] Neither satisfied or dissatisfied; [4] Somewhat satisfied; [5] Very satisfied
12. What is the main reason for the degradation of the street furniture in Sidi Bou Said? [1] Social practices; [2] Lack of awareness; [3] Inadequate approach of institution.

C. Data on street furniture integration

13. Please give your opinion on the street furniture in Sidi Bou Said: [1] Strongly disagree; [2] Disagree; [3] Neutral; [4] Agree; [5] Strongly agree

How do you rate the integration of street furniture into Sidi Bou Said's daily life?	[1] [2] [3] [4] [5]
How do you rate the adaptation within the urban landscape?	[1] [2] [3] [4] [5]
How do you rate the street furniture comfort?	[1] [2] [3] [4] [5]
How do you rate the street furniture accessibility?	[1] [2] [3] [4] [5]
How do you rate the street furniture design?	[1] [2] [3] [4] [5]

How do you rate the harmony between the different types of street furniture?	[1] [2] [3] [4] [5]
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D. Data on community participation in designing street furniture

14. Have you ever been involved in drafting street furniture conception? [1] Yes; [2] No. If not, why?
15. Have you ever participated in public presentations and discussions regarding street furniture implementation which are organized by institutions? [1] Yes; [2] No. If not, why?
16. Is there a community council where you can discuss for the revalorization of street furniture concerning your city? [1] Yes; [2] No.

E. Data on city development concepts

17. Please give your opinion on the street furniture in Sidi Bou Said: [1] Strongly disagree; [2] Disagree; [3] Neutral; [4] Agree; [5] Strongly agree

Revalorize street furniture is important in promoting the city image	[1] [2] [3] [4] [5]
Street furniture design plays an important role in the culture of the city	[1] [2] [3] [4] [5]
Street furniture is an important element of the character and identity of the area	[1] [2] [3] [4] [5]
It is important to take into consideration the small-scale planning (street furniture implementation)	[1] [2] [3] [4] [5]
Urban landscape should attract more tourists	[1] [2] [3] [4] [5]
Tourism development will help in the economic growth	[1] [2] [3] [4] [5]
It is essential to have a better integration of street furniture into the city's daily life	[1] [2] [3] [4] [5]
Institutions investment should play a key role in the revalorization of street furniture ecological design aspects	[1] [2] [3] [4] [5]

Thank you for your time and the cooperation!